eurelectric

POWER BAROMETER

2024

ZEROING IN

Foreword

European Union is steadfast in its commitment to a sustainable future, with ambitious climate targets having been set for the coming decades. Aiming for net zero emissions by 2050, with an intermediate goal of 55% emissions reduction by 2030, the EU's path towards decarbonisation rests critically upon the adoption of clean energy and the development of a robust grid infrastructure.

Within this context, Power Barometer 2024 provides a comprehensive review of the progress that has been made over the past five years, and especially on the developments within this past year. Let's start with the good news. Encouragingly, there has been notable progress in reducing emissions, with the power sector emerging as a leading force in this transition. Last year, nearly two-thirds of the EU's electricity came from clean and renewable energy sources, with nuclear contributing 23% and renewables 45%. Year-to-date in 2024, this share has further increased to nearly three-quarters.

However, despite these positive trends, several challenges persist. The most pressing issue we have observed is the stagnation of electricity demand. Electrification has reached a plateau, and electricity demand growth has stagnated. Although this is partially due to an increase in electrical efficiency, the primary driver is the decline in industrial demand, driven by economic slowdown. Furthermore, the occurrence of negative prices in energy markets is creating a discouraging signal for future investments in renewables, potentially undermining the financial incentives necessary for continued progress. On the other side, the increasing occurrence of negative prices can also be seen as a business case for storage and flexibility resources. Additionally, grid development is something the EU must continue to focus on, along with the development of renewables; both must go hand in hand.

Thus, Power Barometer 2024 aims at providing a clear picture of where we stand today, the progress made, and the obstacles we must overcome to ensure a sustainable and secure energy future for Europe. We hope that Power Barometer 2024 will contribute to the EU energy landscape by effectively informing policymakers and other stakeholders about the energy transition, and on the critical challenge of stagnating electricity demand and electrification.

Kristian Ruby
Secretary General Eurelectric

About

Power Barometer is Eurelectric's annual flagship data report that offers an evidence-based analysis of the EU power sector's performance and its intersection with broader energy issues over the past year. It provides a comprehensive overview of key metrics and progress indicators in the areas of decarbonisation and electrification. By examining the shift towards renewable energy sources, the integration of electricity in various sectors like transportation and industry, and the advancements in grid development, Power Barometer presents a clear picture of the sector's evolution towards a more sustainable and efficient energy system.

Beyond the power sector, the report also addresses critical issues such as security of supply, international competition, and climate change, recognising the integral role of electrification in achieving decarbonisation goals. It delves into market developments and investment patterns, providing stakeholders with crucial insights for navigating today's rapidly changing landscape.

Eurelectric's Power Barometer does not adhere to a fixed list of indicators or metrics. Instead, it adapts its analysis to reflect the latest developments and trends in the energy landscape. This flexible approach ensures that the report remains relevant and provides timely insights into the evolving challenges and opportunities within the electricity sector and beyond.

As the sixth edition of Power Barometer, the 2024 report not only examines the events of 2023 and the ongoing year but also provides a comprehensive progress report of the past five years. This retrospective analysis comes at a critical time as the EU prepares to welcome a new European Commission and offers timely insights into the sector's advancements and challenges over the recent years.

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Analyst - Energy data & scenarios Eurelectric

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EU's green energy roller coaster: from Green Deal to Repower EU

Dec 2019

Green Deal

Net zero target & 2030
-55% GHG target

Mar 2020

Covid

Covid disrupted supply chains & investments

Feb 2022

Russian invasion of Ukraine

War in Ukraine was a wake-up call to get rid of fossil fuel dependence

May 2022

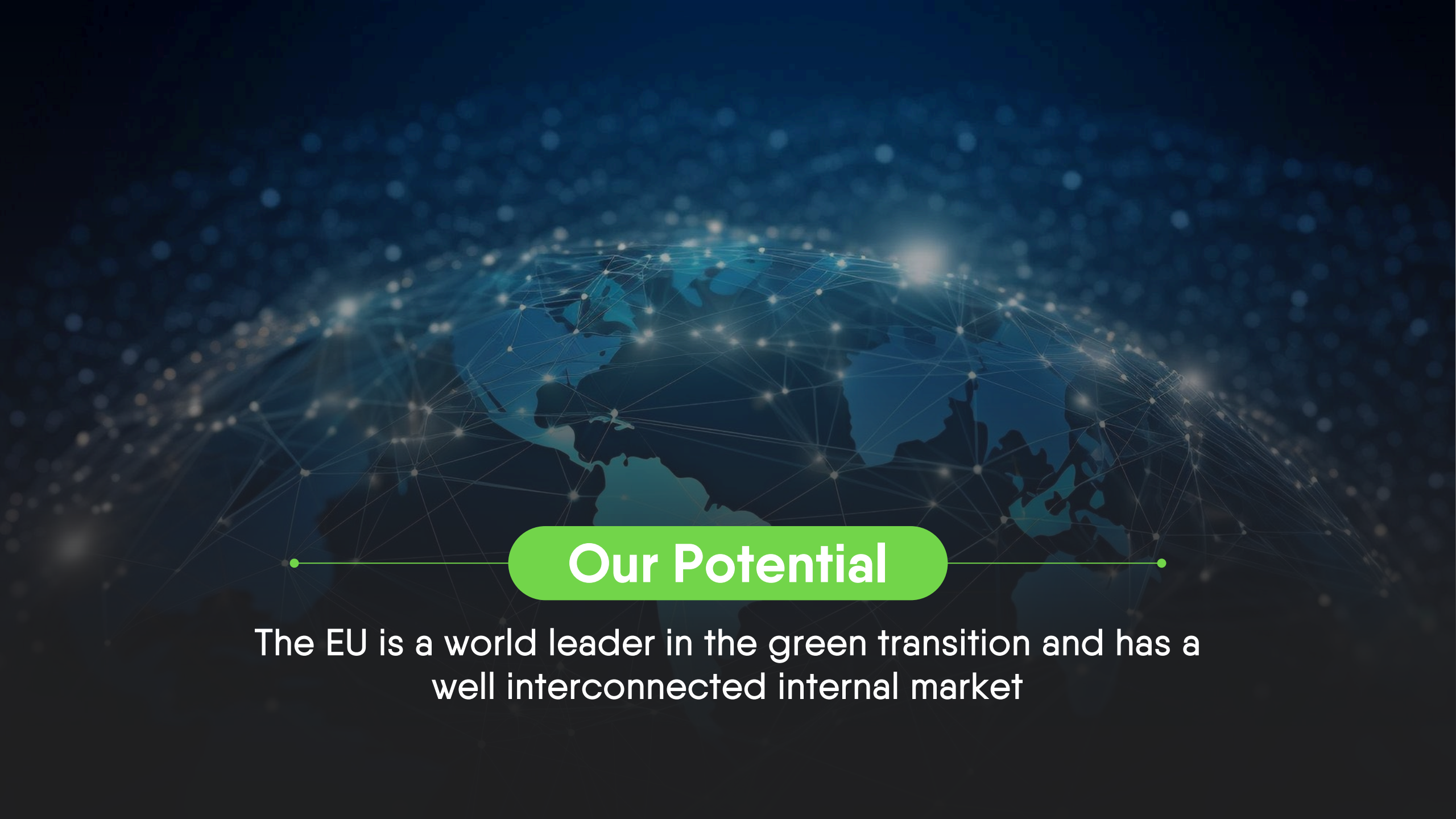
RePowerEU

EU reacts with more ambitious renewable targets and energy savings

2022-2023

RED III & 2040 targets

42.5 % RES & 2040 targets assessment



Our Potential

The EU is a world leader in the green transition and has a well interconnected internal market

Europe is a leader in the green transition

China is increasing its numbers

by taking advantage of its large population and material resources.

- **Leader** in newly-installed capacity and investment in renewables
- **60%** of global net-zero technology manufacturing
- **>50%** electric vehicles drive on Chinese roads

European Union is increasing its share

and strives to integrate the most renewables within its population

- **Highest** share of renewable electricity generation
- **Leader** in investment and deployment of heat pumps
- **Highest** use of electric vehicles per capita

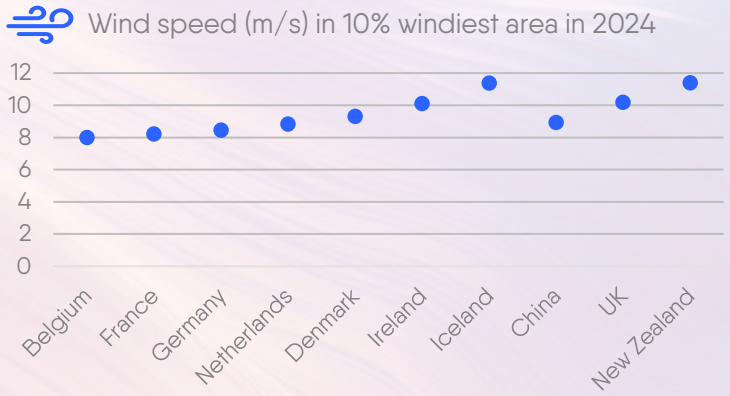
Source: Strategic perspective report "Competing in the new zero-carbon industrial era"

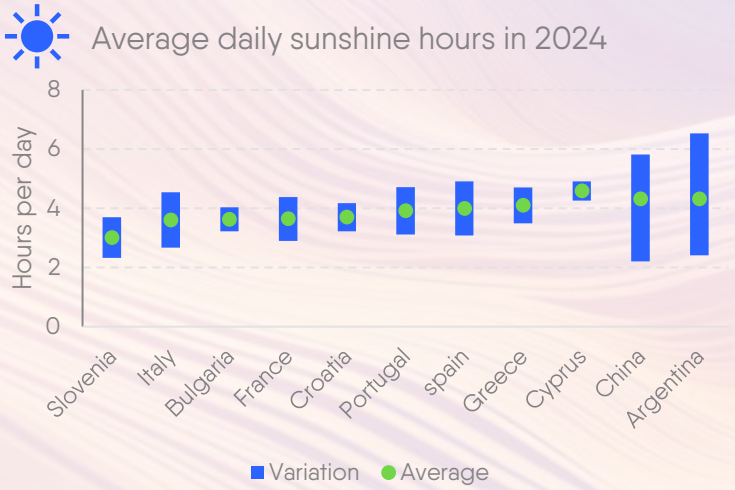
Using EUs natural strengths to decarbonise

EU has some of the best wind and solar resources

EU uses them to produce green electricity

Spread within EU Single Internal Electricity Market





220 GW → 490 TWh

Second largest wind power capacity and wind electricity production

263 GW → 237 TWh

Second largest solar power capacity and solar electricity production

420 interconnections

445 TWh of cross-border electricity flow

Highest electricity traded in power exchanges

Source: Eurelectric's Elda, ENTSO-E, global solar & wind atlas

Power Sector Progress Report

Power Sector Progress Report

Decarbonisation

The power sector is leading the EU’s decarbonisation

Power sector's emissions dropped by 50% between 2008-2023

The power sector's emissions & emissions intensity dropped significantly in 2023 compared to the previous year. Some of this will be permanent as more and more renewable capacity enters the grid. A portion of the drop can be attributed to the slowdown of industrial demand. 2024 is poised to see further emission reductions.

gCO_2/kWh

369	255	201	71	0
2000	2022	2023	2030	Around 2040

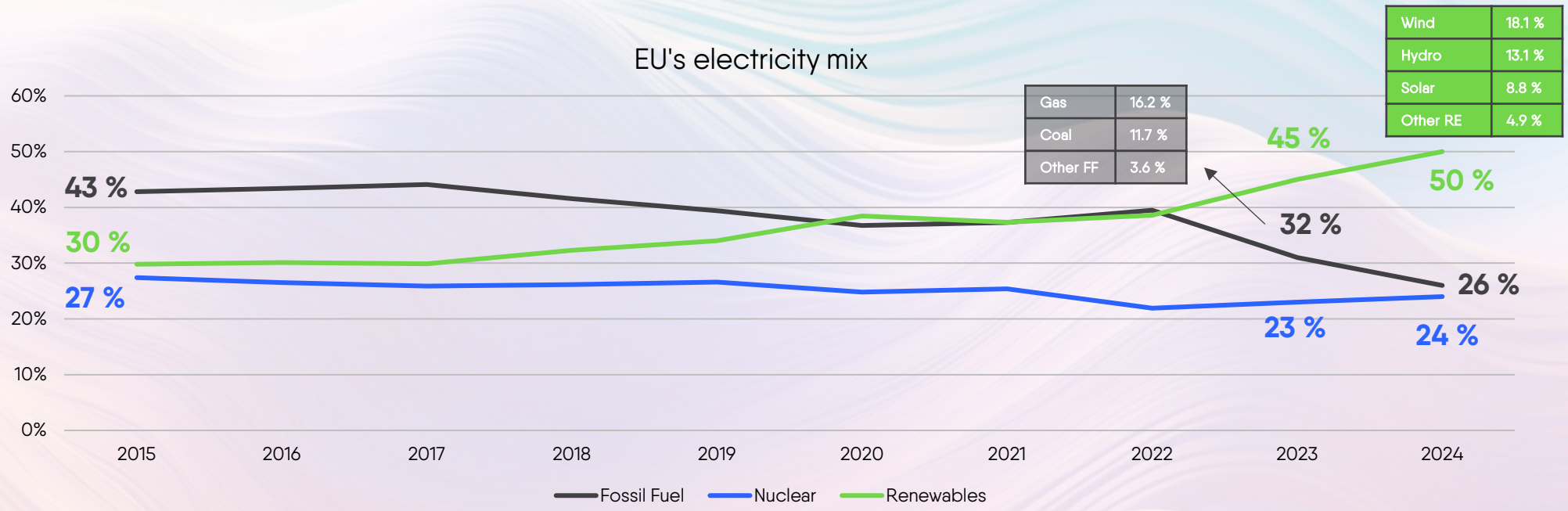
2024 is seeing a further drop in emissions compared to 2023

202	163
2023 Jan-Aug	2024 Jan-Aug

* Carbon neutral

Source: Eurelectric's Elda, ALLBNK scenario of EC's 2030 Climate Target Plan Impact Assessment (2030)

Rising share of clean electricity in the EU: 74% in 2024 YTD

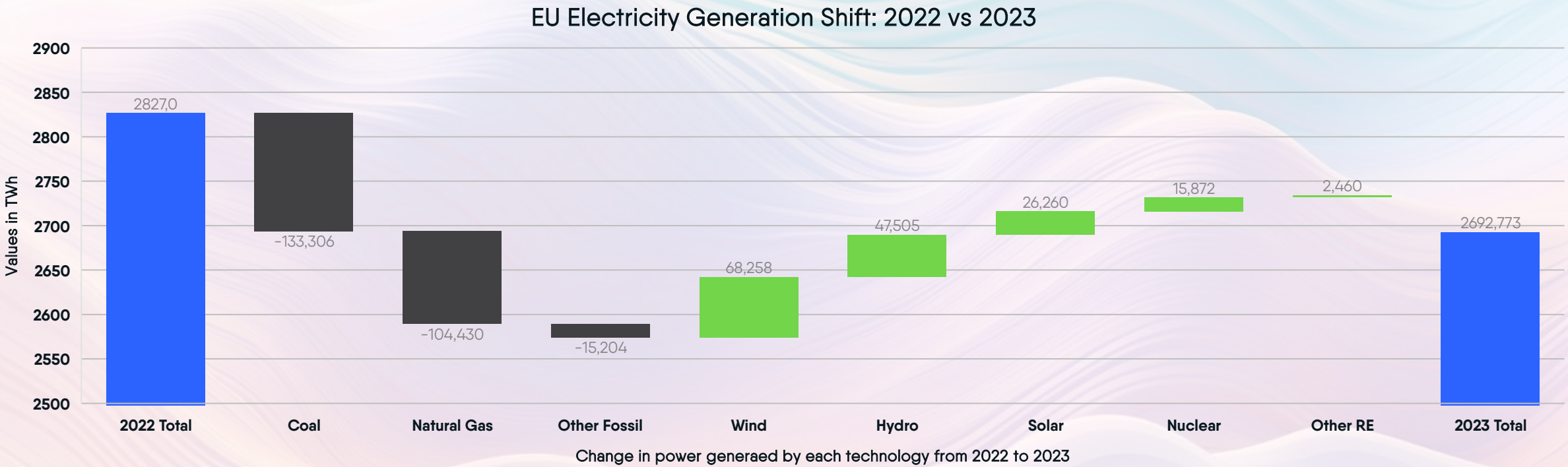


In 2023, renewables surged to a historic 45% share of the EU's electricity mix, led by wind energy at 18%. This marked the first time wind surpassed natural gas in power generation

In 2023, 68% of the EU's electricity in the EU came from renewable and nuclear sources. In 2024 YTD, this has increased to 74%, with 50% now coming from renewables

Source: Eurelectric's Elda, Eurostat for 2015

Clean power surges while fossil fuels decline to lowest share on record



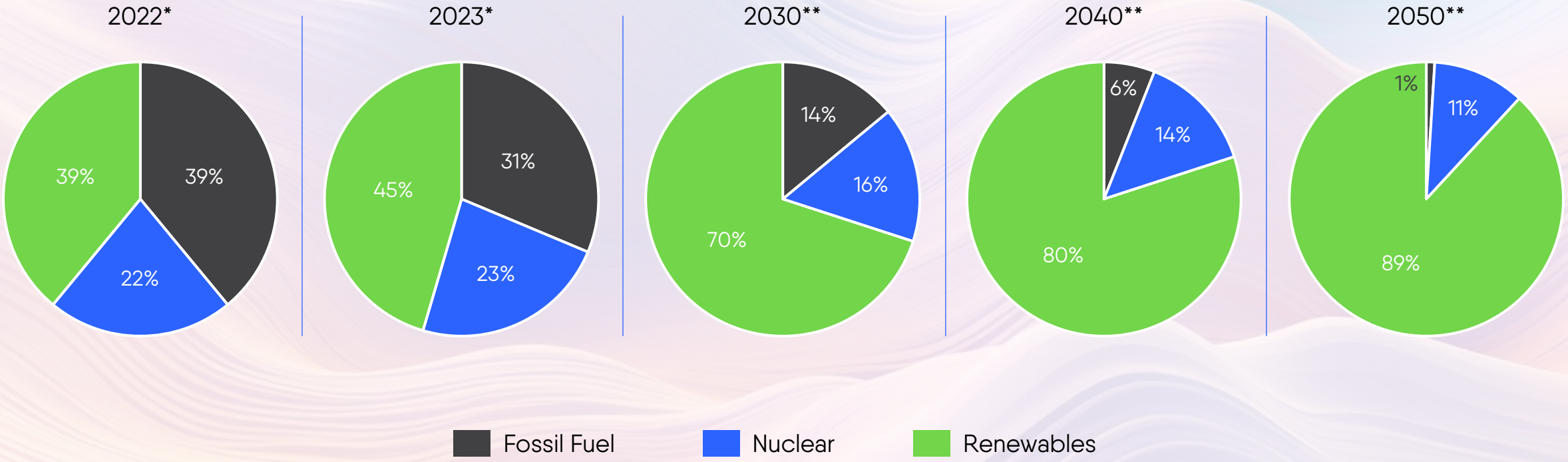
Electricity generation decreased overall due to reduced demand. Fossil fuel generation dropped by 393 TWh, while low-carbon power increased by 160 TWh, resulting in the lowest fossil fuel share on record

Reduced demand and additional installed renewables capacity contributed to this transition

Source: Eurelectric's Elda,

Expected 70% renewables by 2030

Electricity generation mix (%)



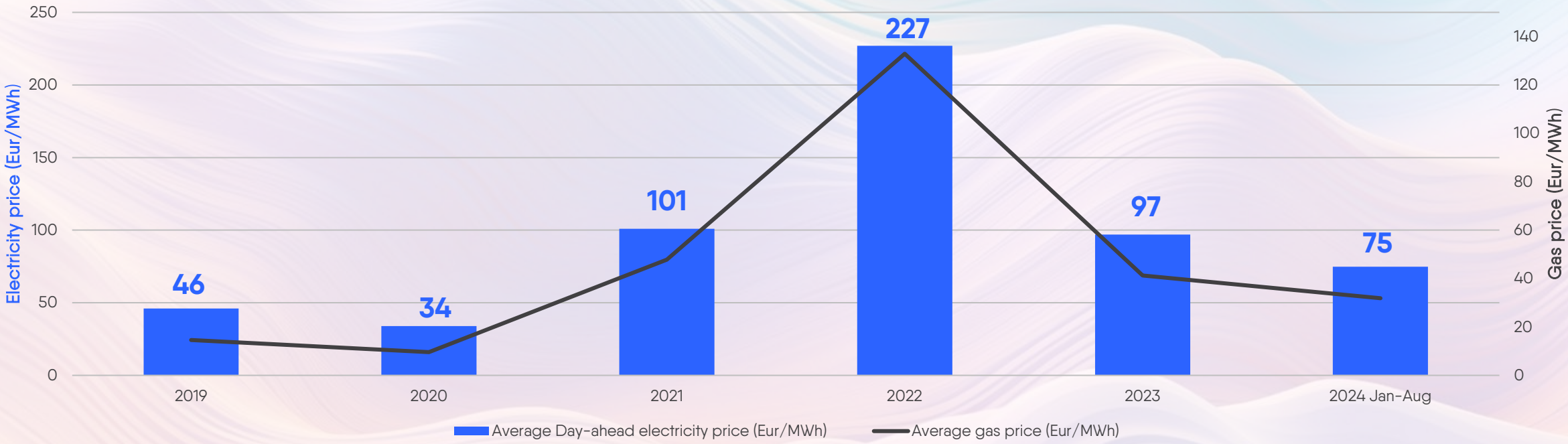
Source: *Elda for historic data, **Eurelectric decarb speedways for future projections

Power Sector Progress Report

Power Prices

Power prices have decreased and are now below pre-war levels

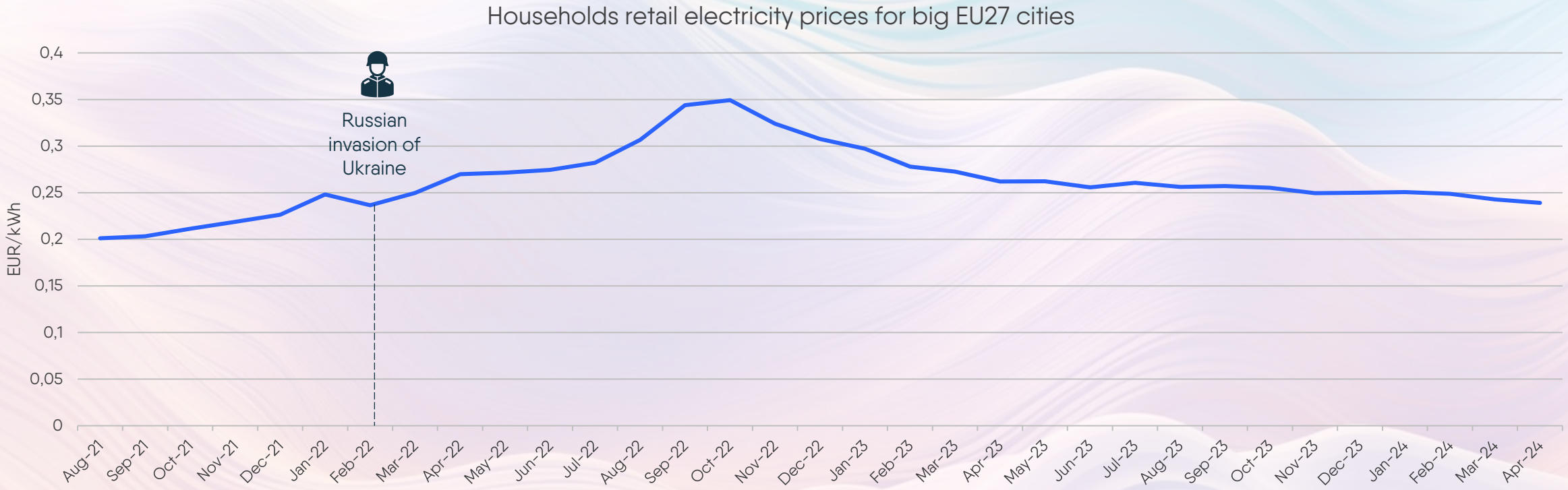
Volatile power prices: the need for more renewables & flexibility



Electricity prices tend to follow gas prices, which have shown volatility. The recent energy crisis underscores the urgent need for extensive adoption of renewables and greater system flexibility. Swift implementation of the electricity market reform, including long-term contracting and enhanced system flexibility, would better safeguard consumers from short-term price fluctuations.

Source: Eurelectric's Elda, ENTSO-E TP for electricity prices, investing.com for the gas prices

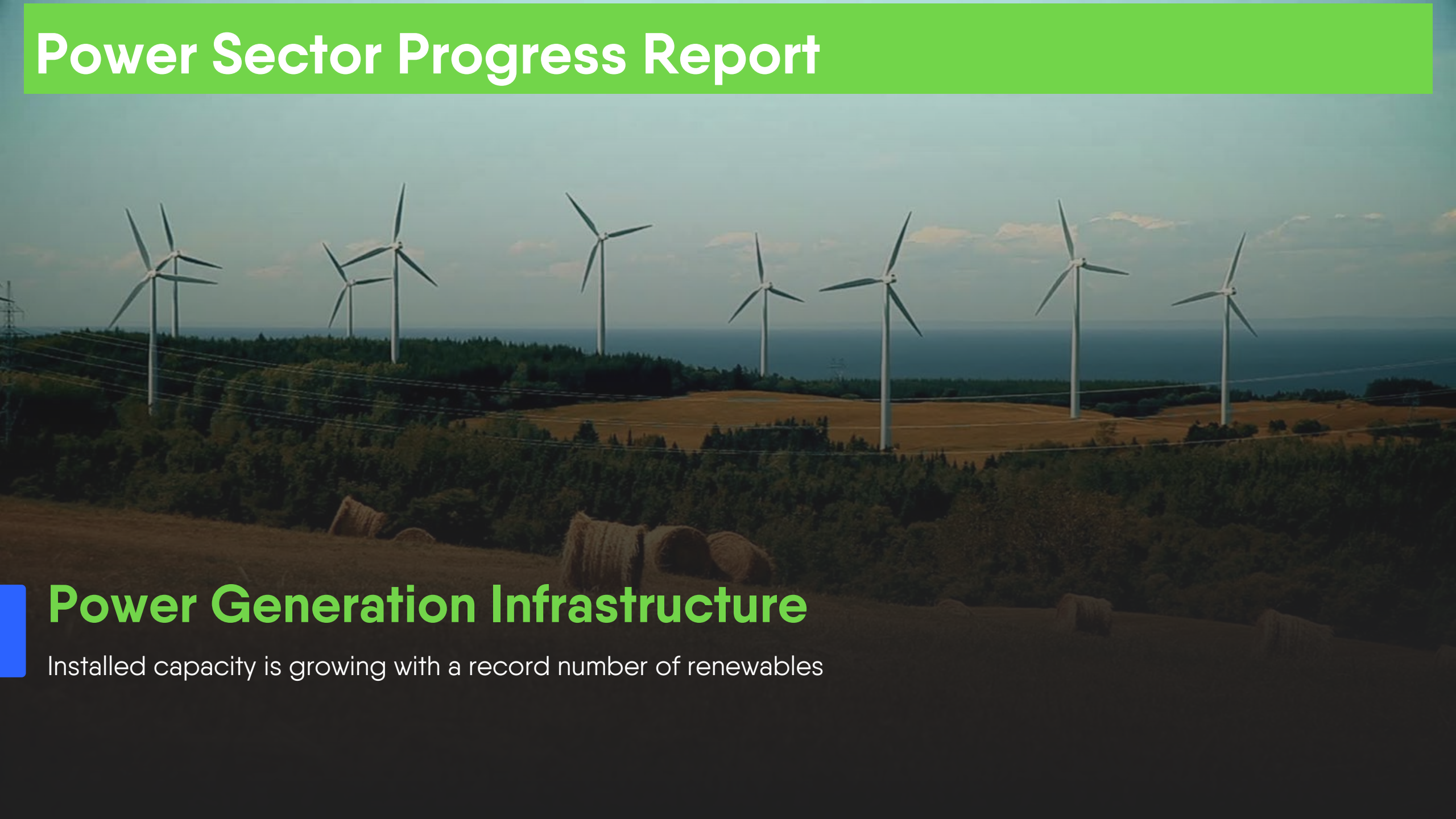
Retail electricity prices are returning to pre-invasion levels



Prices have peaked in 2022 and are now returning to their pre-war levels

Source: HEPI, Eurelectric

Power Sector Progress Report

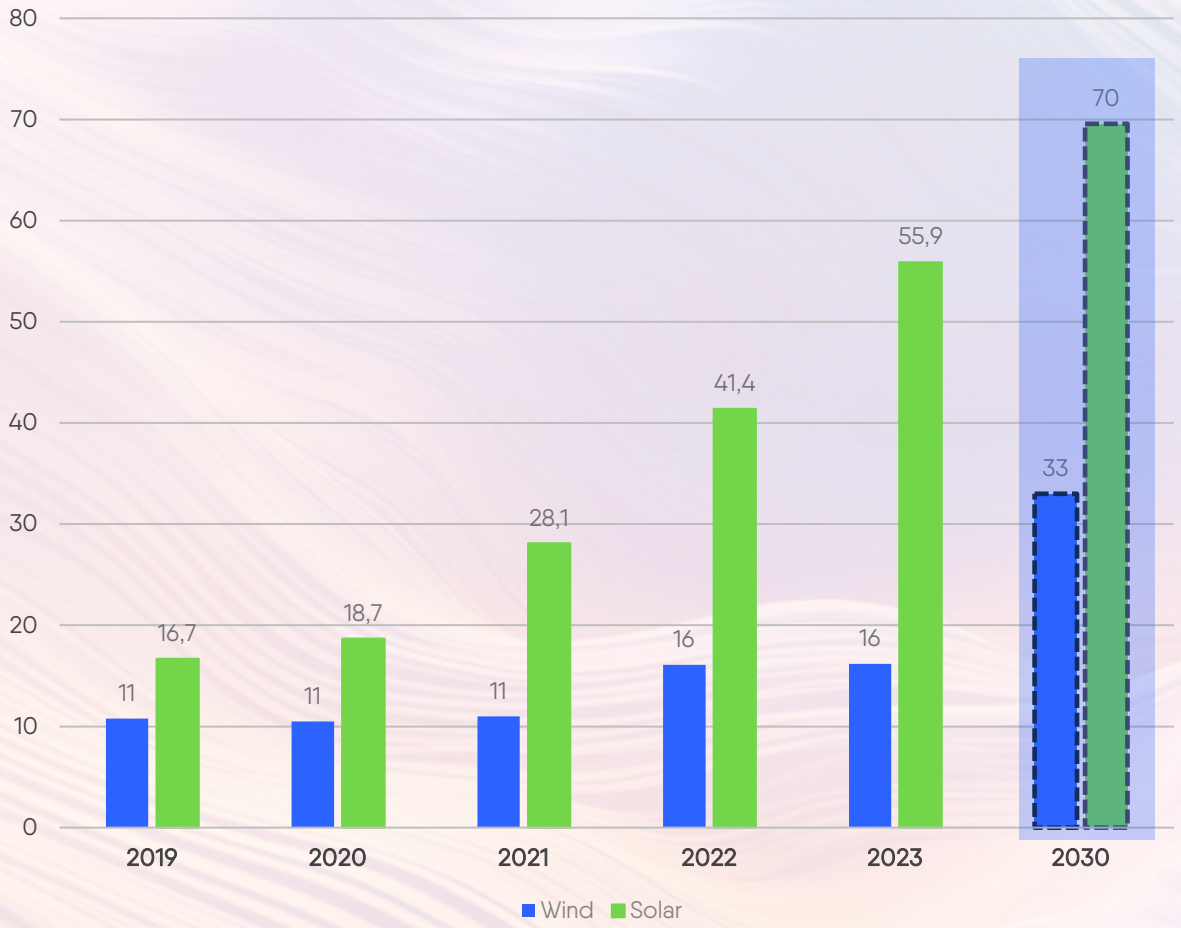


Power Generation Infrastructure

Installed capacity is growing with a record number of renewables

Solar PV installations surge while wind energy falls below targets

Annually installed wind and solar PV in the EU



Source: Wind Europe, Solar Power Europe, Eurelectric

Solar PV installation in 2023, +3.3X from 2019

56 GW of solar PV were installed in 2023 compared to 16.7 GW in 2019.

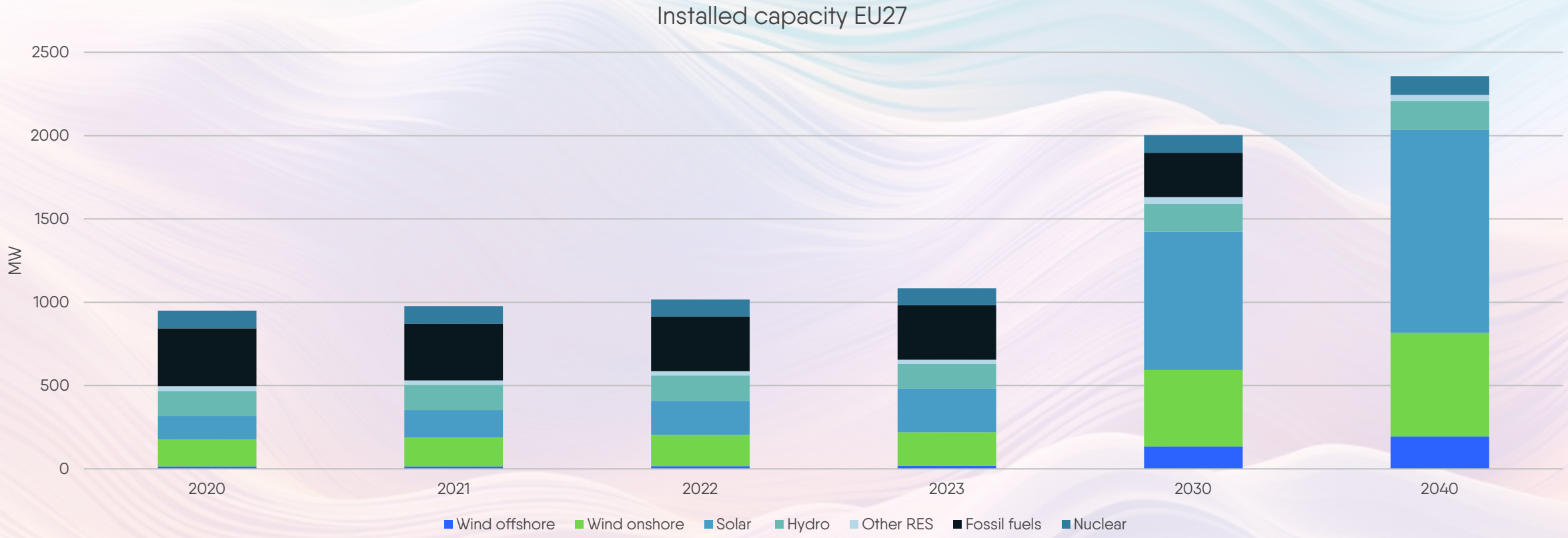
Wind installation in 2023, +1.5X from 2019

Wind installation grew in 2023, but this growth represented only half of what's needed to meet the 2030 target.

Bottlenecks

Permitting, grid infrastructure, supply chain constraints and challenging financing conditions remain bottlenecks for increasing renewables. Specifically, grid integration taking up to 8 years for solar and 10 years for wind are big challenges.

All technologies needed for the transition



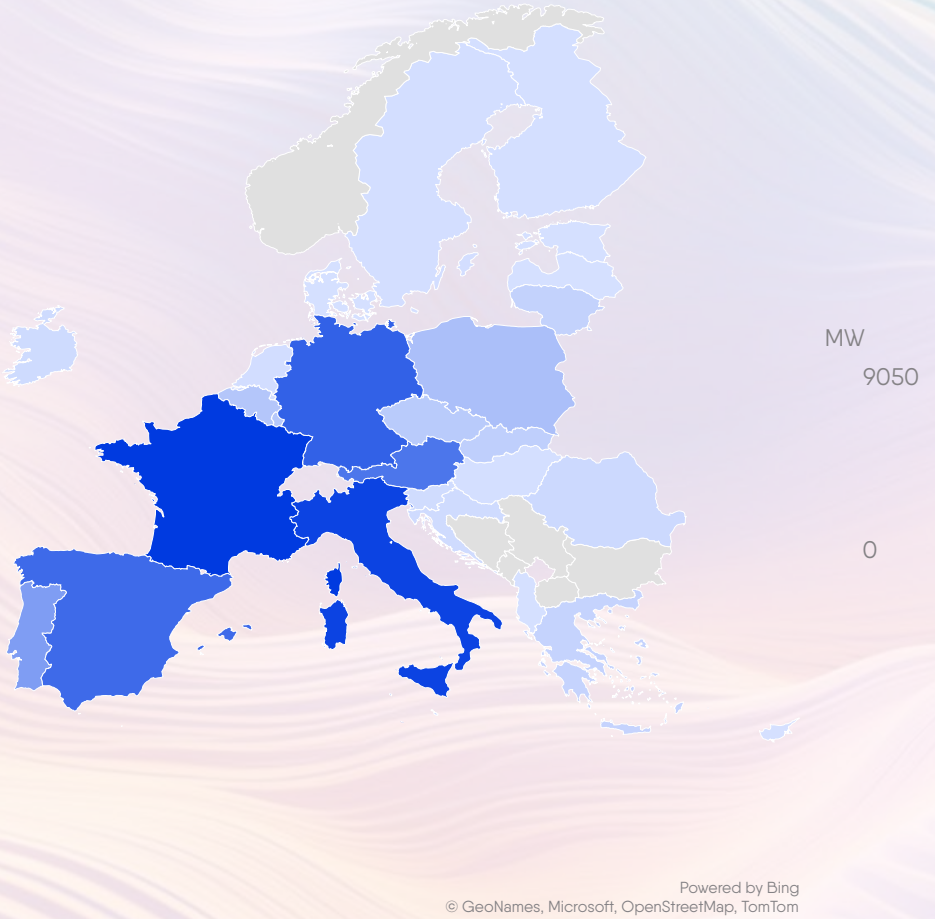
56 GW of solar PV and 16 GW of wind were installed in 2023. This represents a 300% and 150% growth in solar and wind installations respectively compared to 2019

Along with renewables, other clean, firm and flexible technologies are needed for the transition

Source: Eurelectric, Wind Europe, Solar Power Europe, ENTSO-E Transparency Platform, Enerdata

Storage of electricity is geographically concentrated and dominated by pumped hydro storage

Storage repartition in 2022



91%

Of storage is pumped-hydro storage

Targets

Storage capacity (GW)

2022	52 GW
2030	200 GW
2050	600 GW

Batteries development

4 GW
2022

X 29

117 GW
2030

Source: Eurostat, Enerdata, Statista

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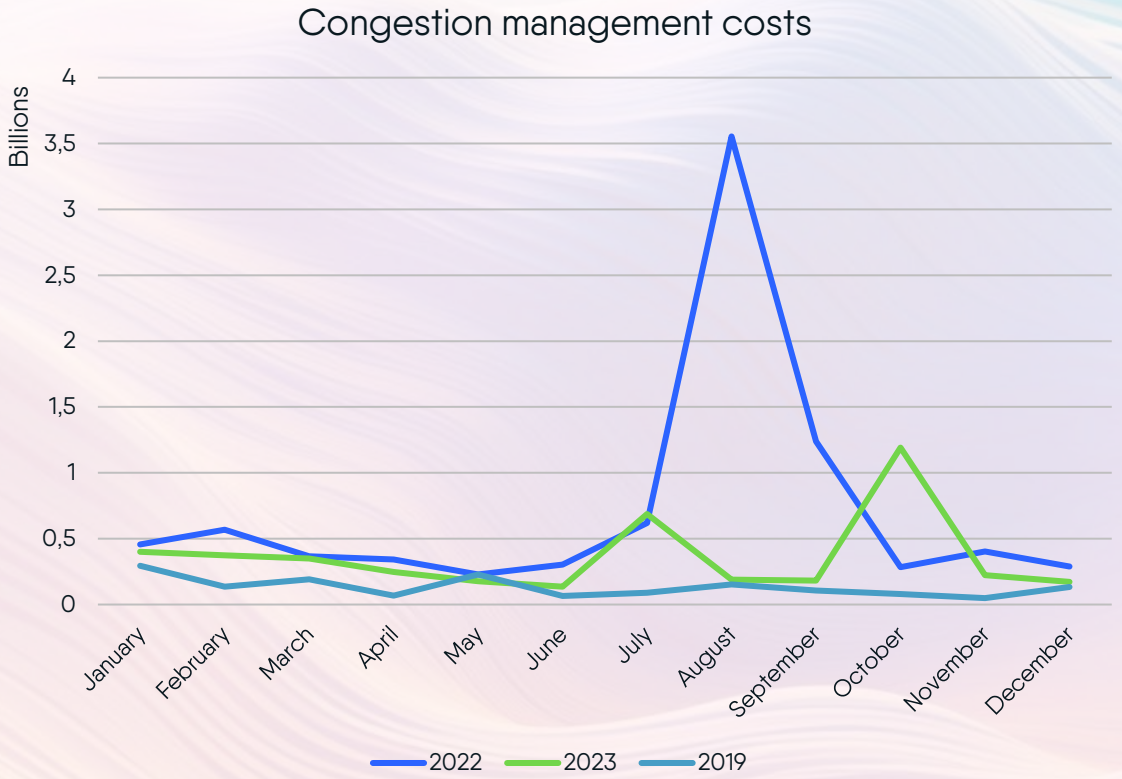
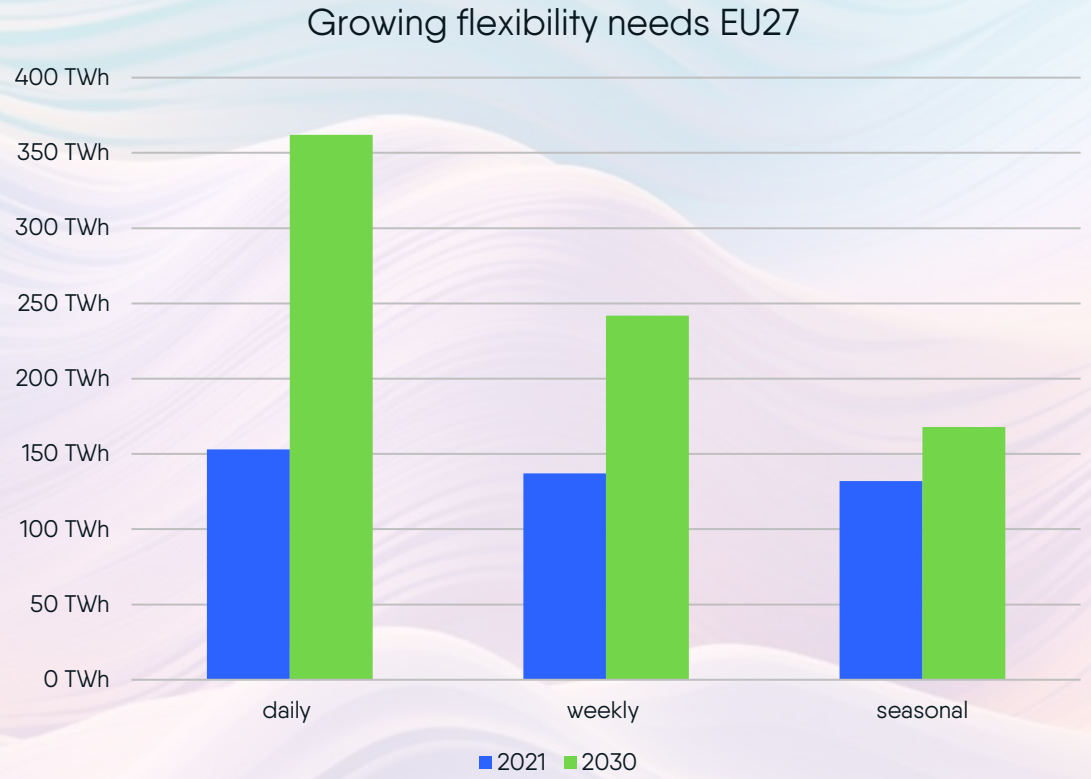
Flexibility becoming increasingly important





The cost of redispatch has increased since 2019 and is becoming more influenced by seasonal variations

Source: ENTSOE transparency platform, ACER

Increase in cost of capital represents a challenge

- Rising base rates have driven up the cost of debt in the last two years, creating a difficult environment for the renewables financing community to navigate
- In Europe, this has caused the levelised cost of electricity (LCOE) of offshore wind to rise in 2023
- Some offshore wind projects were paused to re-evaluate investment strategies

Source: ECB, Pexa Park

Mixed outcomes for Europe's wind energy development

>2X

Investment in wind energy

Despite tighter financing conditions, investments into Europe's wind energy more than doubled in 2023 compared to 2022, reaching a value of €48 billion; €30 billion of which went to offshore projects while the remaining €18 billion went to onshore projects.

+70 %

2023 vs. 2022: Permitted wind capacity in Germany & Spain

Germany and Spain permitted 7.5 GW and 3 GW respectively in 2023, 70% more than in 2022. Improvements were also visible in other markets such as France (+12 %), the UK (+10 %), Greece and Belgium.

3.3 GW

Undersubscribed onshore wind in Germany

In 2023, only 6.5 GW out of the 9.8 GW auctioned onshore wind capacity received bids in Germany. Spain held no auctions in 2023 after a 6% subscription in 2022. France and Italy saw oversubscription in 2023, unlike in 2022.

0 GW

Offshore wind in UK auctions

There were no offshore wind project bids during the UK's 5th CfD auction because auction parameters – especially strike prices- had not kept up with rising project costs- a problem that could jeopardize the 2030 offshore wind target.

Source: Wind Europe for investments, Bnetza for German auctions, DESNZ UK for UK data

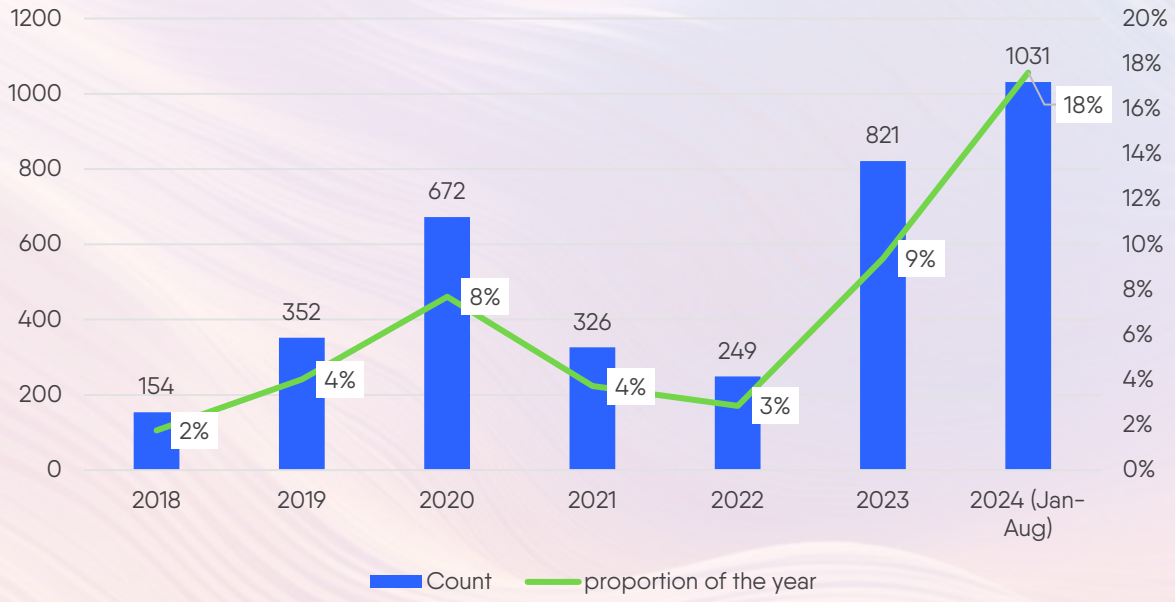
Power Sector Progress Report

Markets and Investments

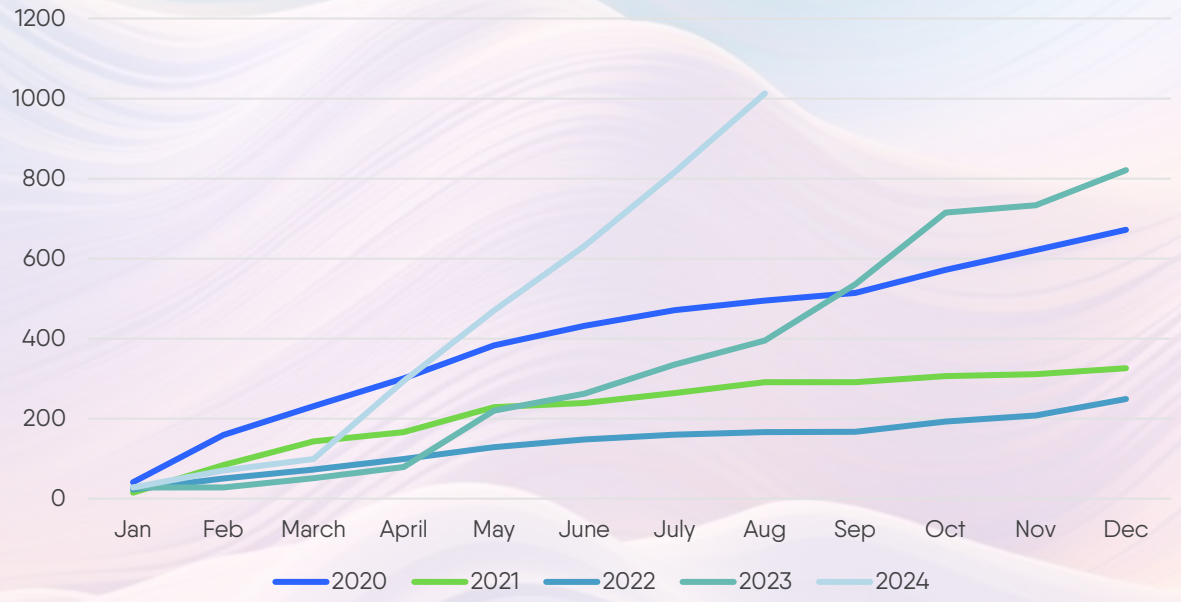
A mix of positive and concerning signals from the market

Negative prices on the rise: the need for flexibility

Number of hours where at least one EU27 country had a negative price



Evolution of negative price occurrences throughout the year in at least one bidding zone (BZ)

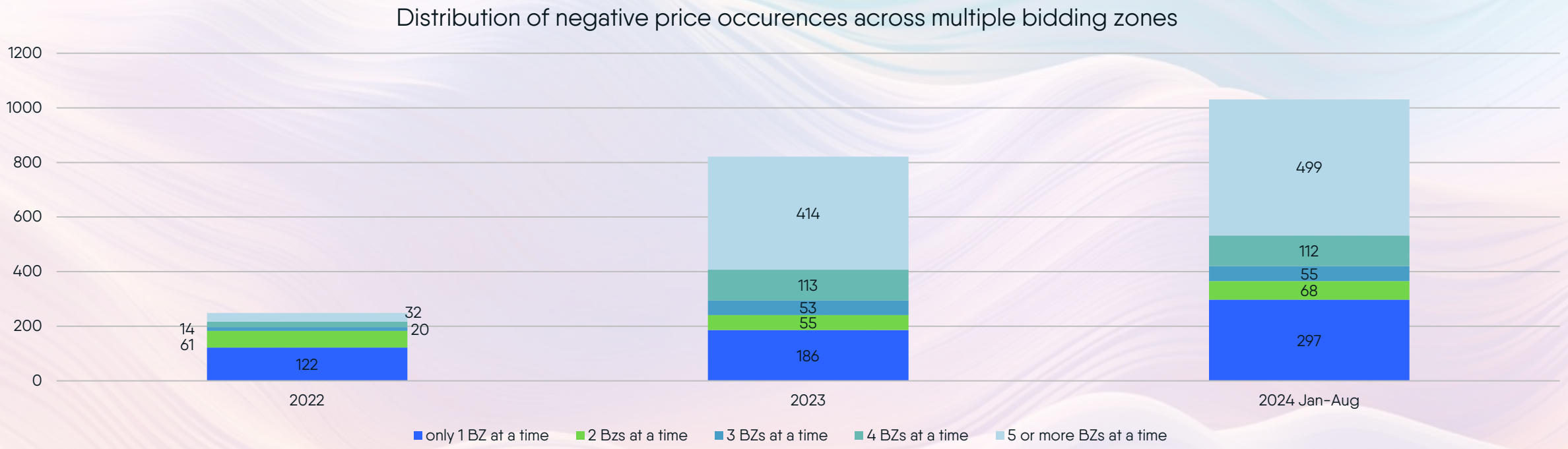


Number of hours with negative prices surged in 2023 & 2024 compared to previous years

While in 2023 there were negative prices during 9% of the total hours, from January to August 2024, this already increased to 18% as the EU recorded 1031 hours of negative prices in one or more of its BZs

Source: Eurelectric's Elda and calculations

Are negative prices occurring simultaneously in multiple bidding zones?

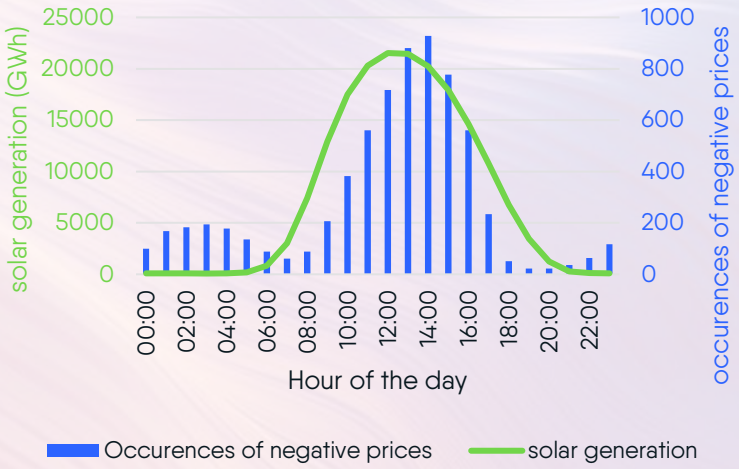


While in 2022 there were 249 hours with negative prices in at least one EU BZ, this rose to 821 hours for 2023. As of August 2024, the hours have already increased to 1031 hours. Zooming in on the 2024 data, there has been 499 hours where 5 or more BZs experienced negative prices simultaneously, whereas in 2023 the same took place for a total of 414 hours.

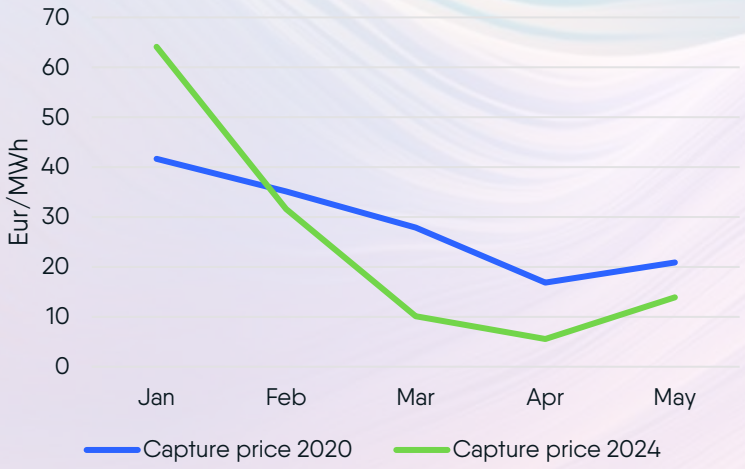
Source: Eurelectric's Elda and calculations

Solar driving negative prices in 2024

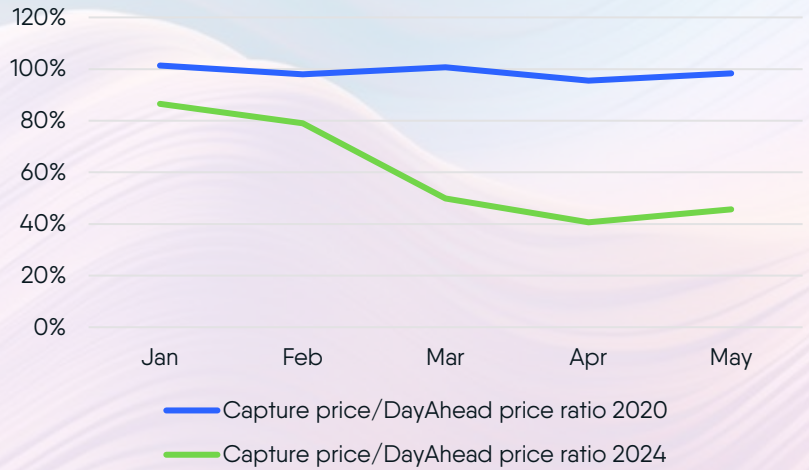
Occurence of negative prices vs solar generation in 2024 Jan-Aug



Capture price for solar in Spain in 2024 vs 2020



Capture rate for solar PV in Spain in 2024 vs 2020



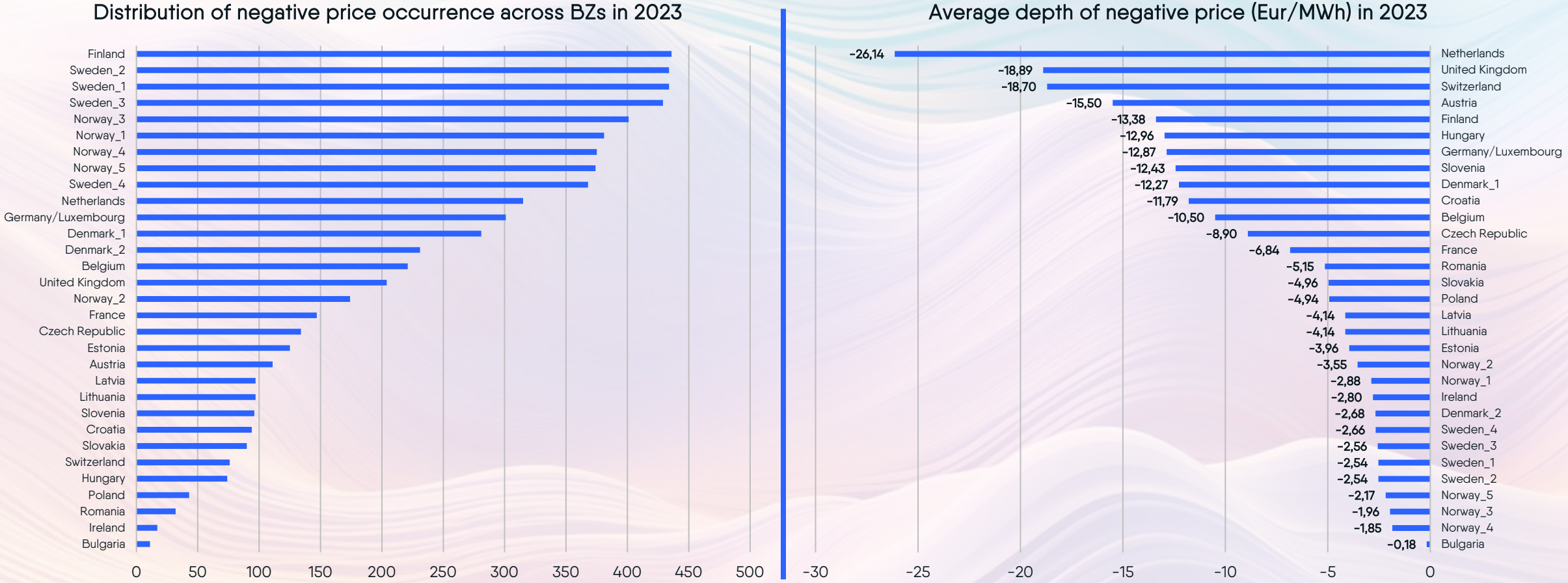
Most negative price hours occur at times of peak solar power generation

The capture rate for an asset measures how much of the average wholesale price an asset earns as revenue. In Spain, the capture rate for solar PV dropped to a low of 41% in April 2024. This indicates that solar PV was a major driver of negative prices.

This underscores the need for system flexibility, electrification and well-designed support schemes amidst increasing renewable energy integration.

Source: Eurelectric's Elda and calculations

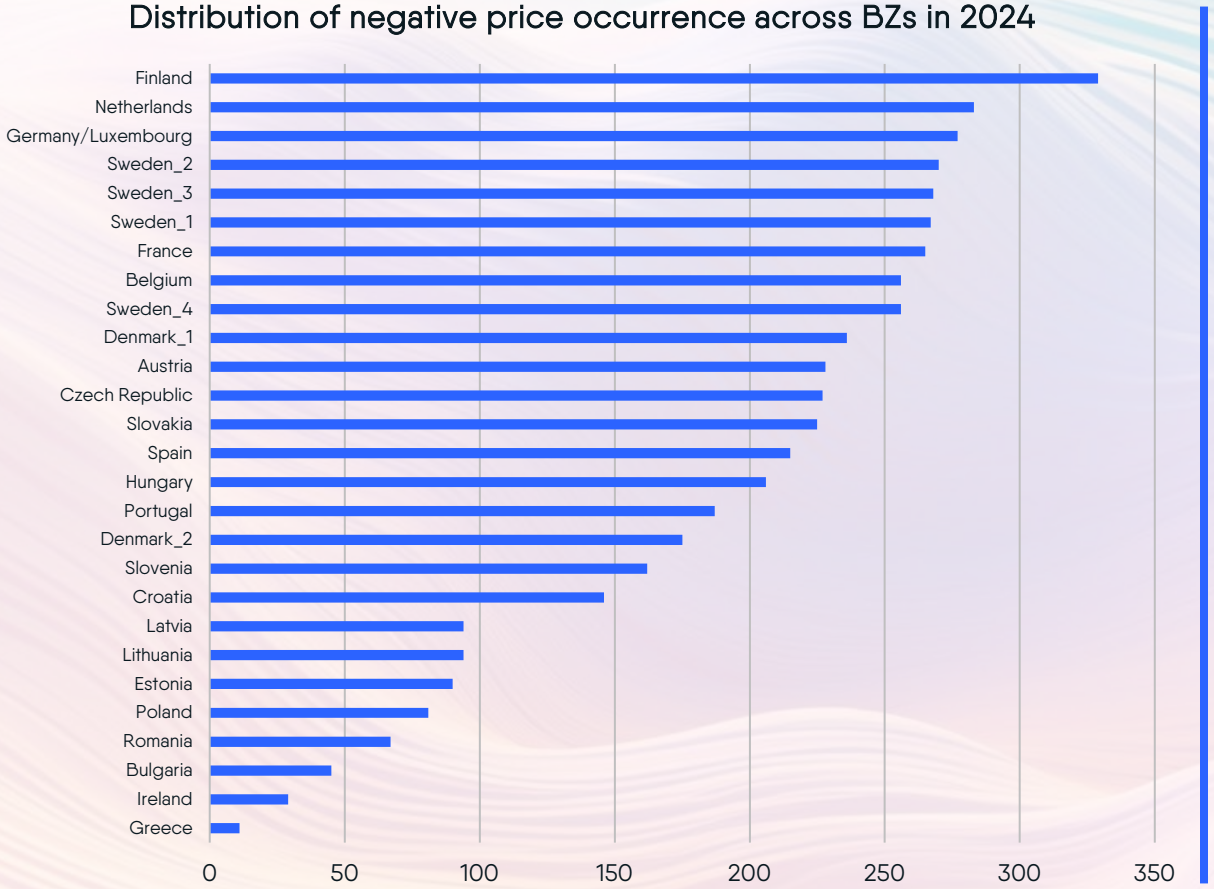
Occurrence of negative prices 2023: Member State perspective

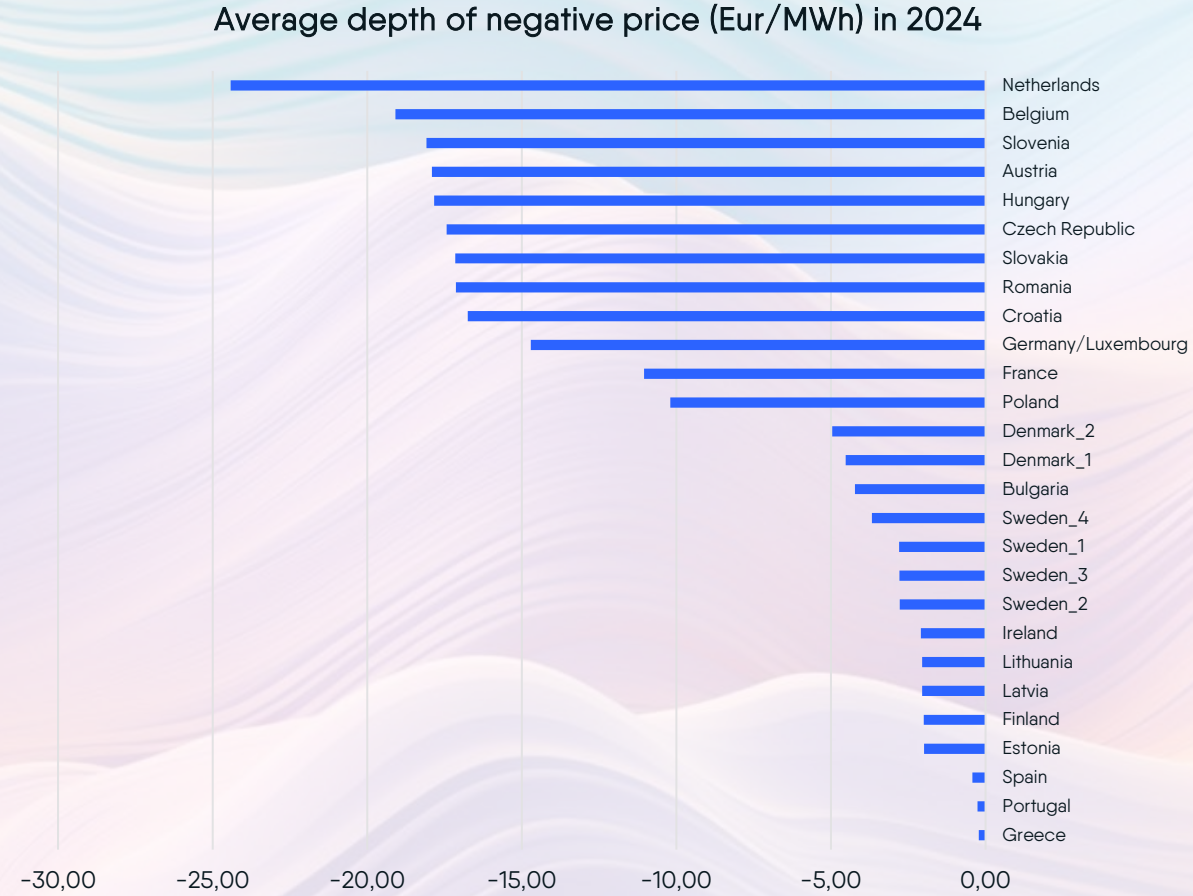


The arrival of new nuclear power plants, together with increased wind and solar generation, triggered more negative price occurrences in Finland. Meanwhile, Spain and Portugal saw negative prices for first time in 2024.

Source: Eurelectric's Elda

Occurrence of negative prices 2024: Member State perspective

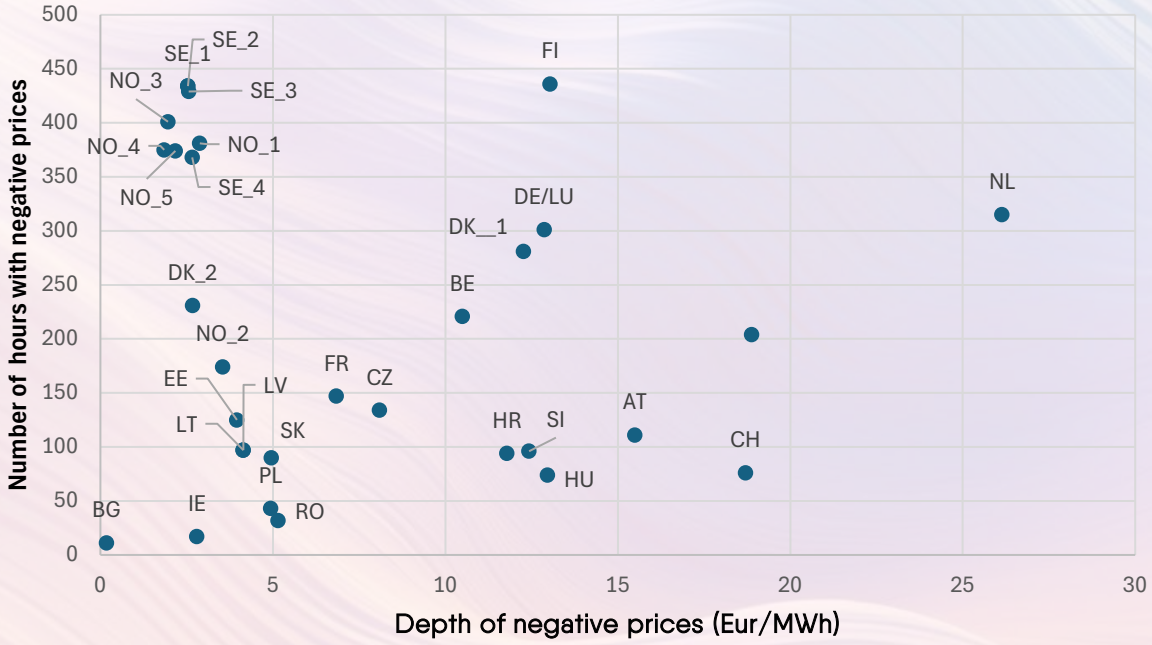




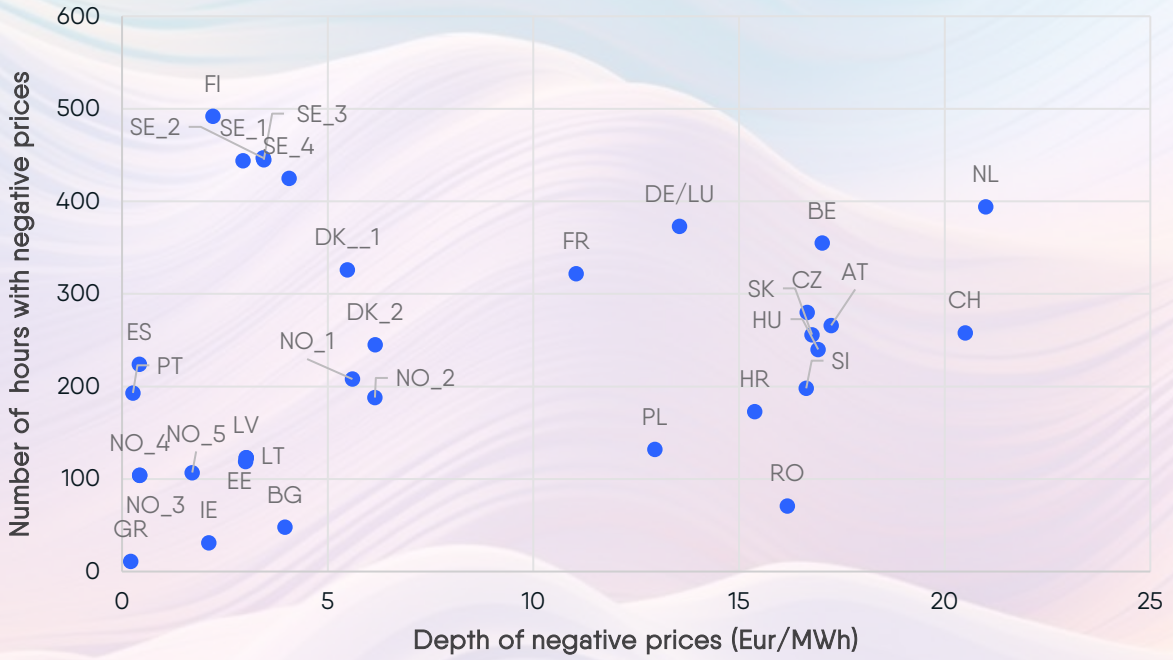
Source: Eurelectric's Elda

Occurrence & depth of negative prices – 2023 & 2024

Number of negative price hours & average depth of negative prices in European bidding zones in 2023



Number of negative price hours & average depth of negative prices in European bidding zones in 2024



Tip for reading the graph:

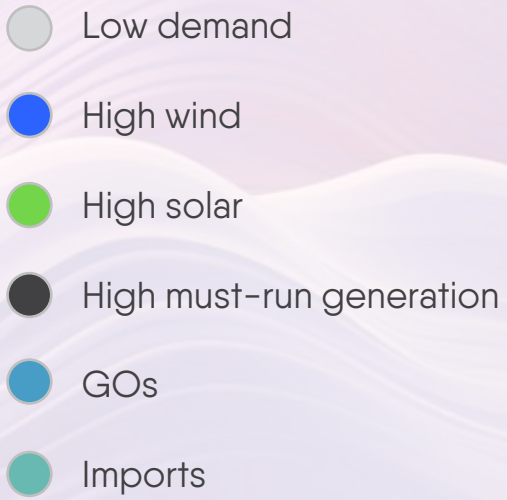
The farther right and higher a country appears, the more frequent and severe its negative prices.

In 2023 and 2024, the Netherlands saw frequent and deep negative electricity prices due to rising renewables, grid congestion, and insufficient flexible power sources. While the Nordic countries had more negative prices, their depth was lower than in Central Western Europe (CWE) and Southeastern Europe (SEE)

Source: Eurelectric's Elda

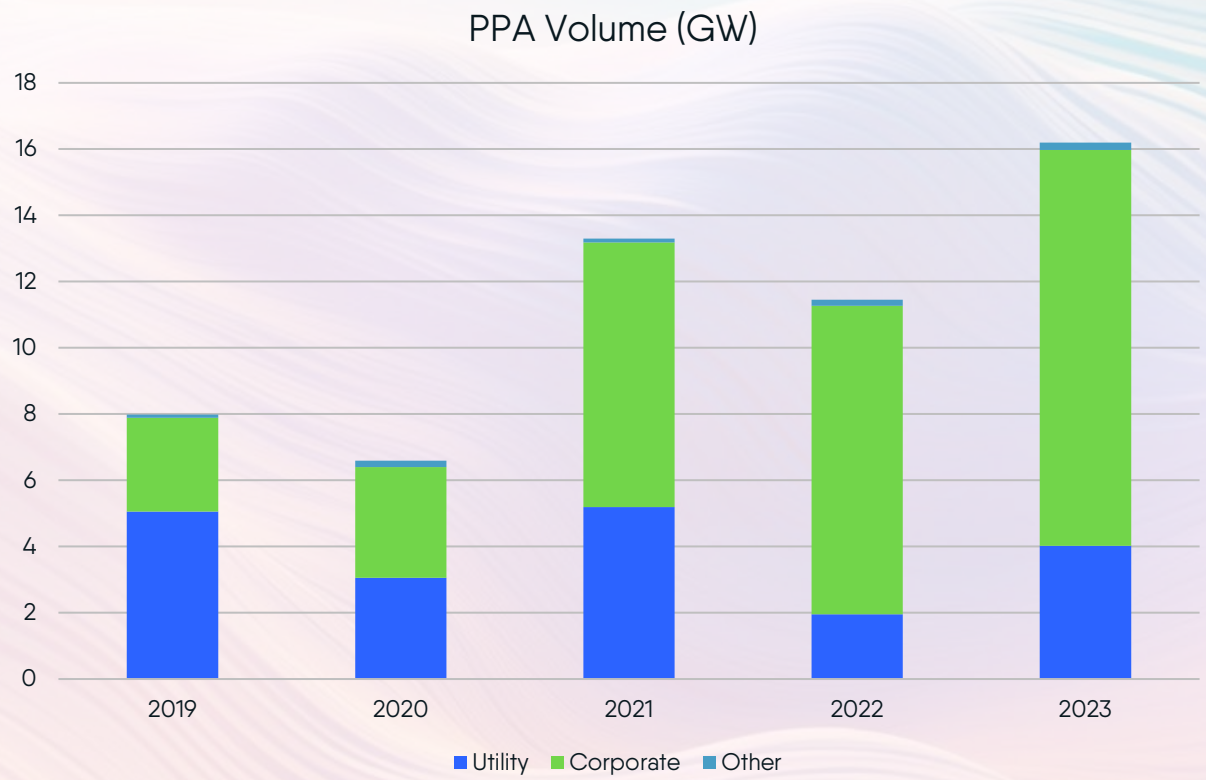
Various factors can cause negative prices

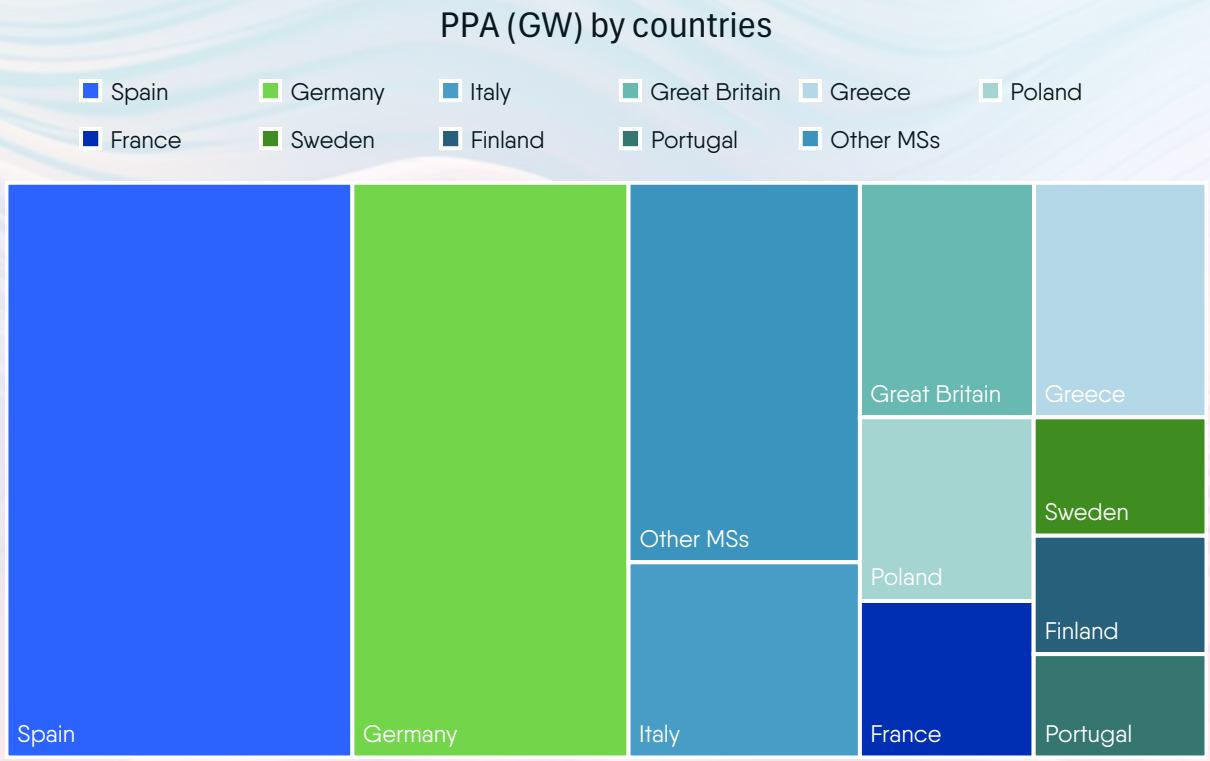
Country	Major driver of negative price
Netherlands (NL)	
Austria (AT)	
Germany (DE)	
Czech Republic (CZ)	
Hungary (HU)	
Great Britain (GB)	
Denmark (DK1)	
France (FR)	
Denmark (DK2)	
Finland (FI)	
Norway (NO2)	
Sweden (SE4)	
Sweden (SE1)	
Norway (NO4)	
Spain (ES)	
Portugal (PT)	
Greece (GR)	



Source: Eurelectric, Montel Analytics

41% increase in PPA volumes, concentrated in two countries





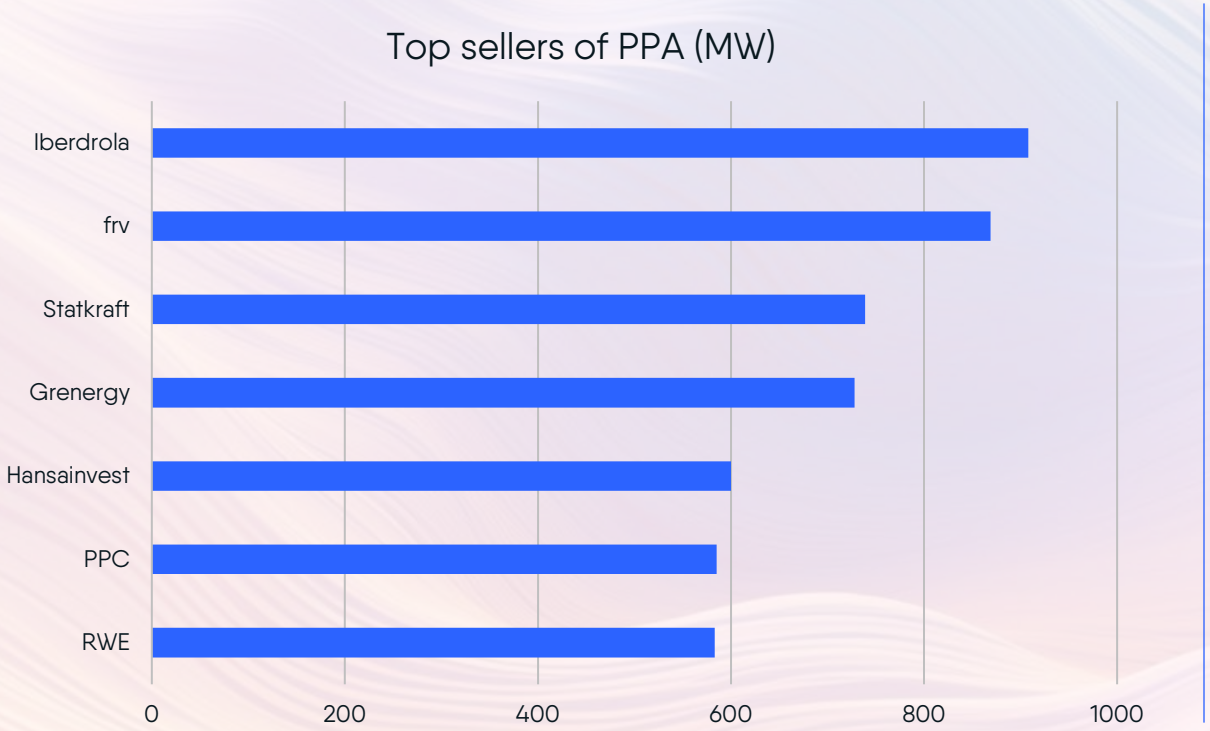
Number of PPAs surged in 2023 both in terms of volumes and deals

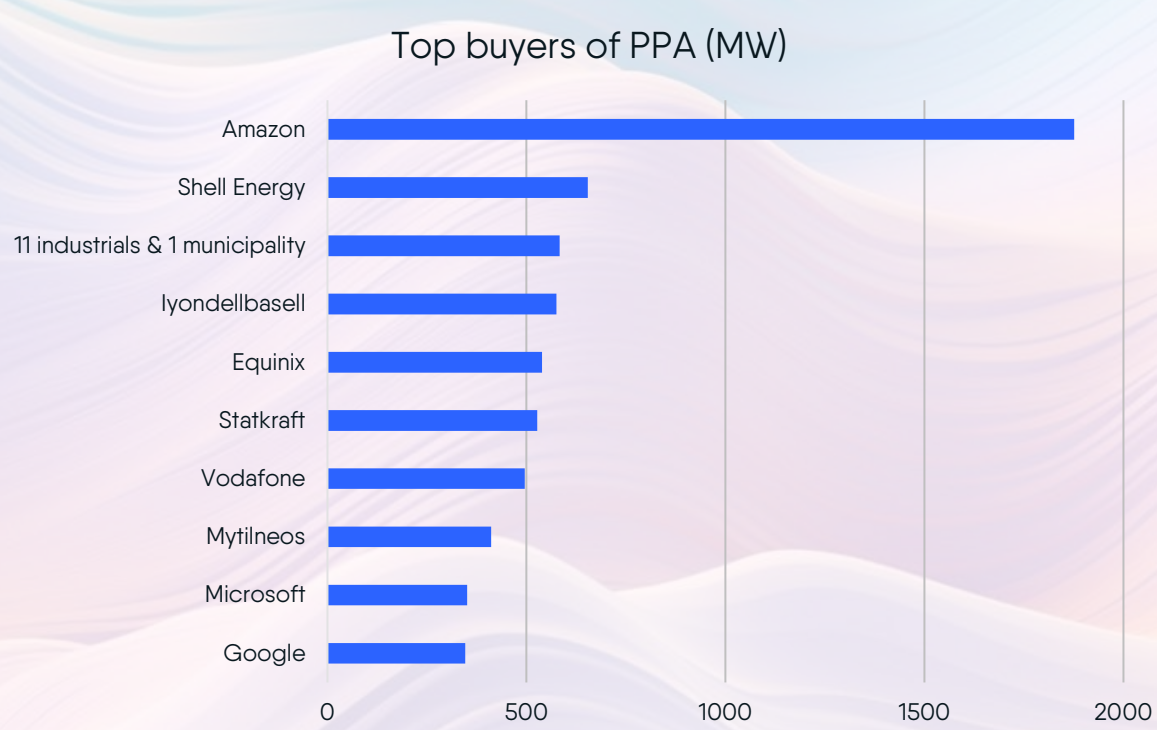
51% of PPAs are signed in Germany or Spain

Corporates led in signing PPAs. After a dip in 2022 due to price volatility, utilities are now surpassing previous levels, likely due to a more stable pricing environment in 2023

Source: Pexa Park

Top sellers & top buyers of PPAs in 2023



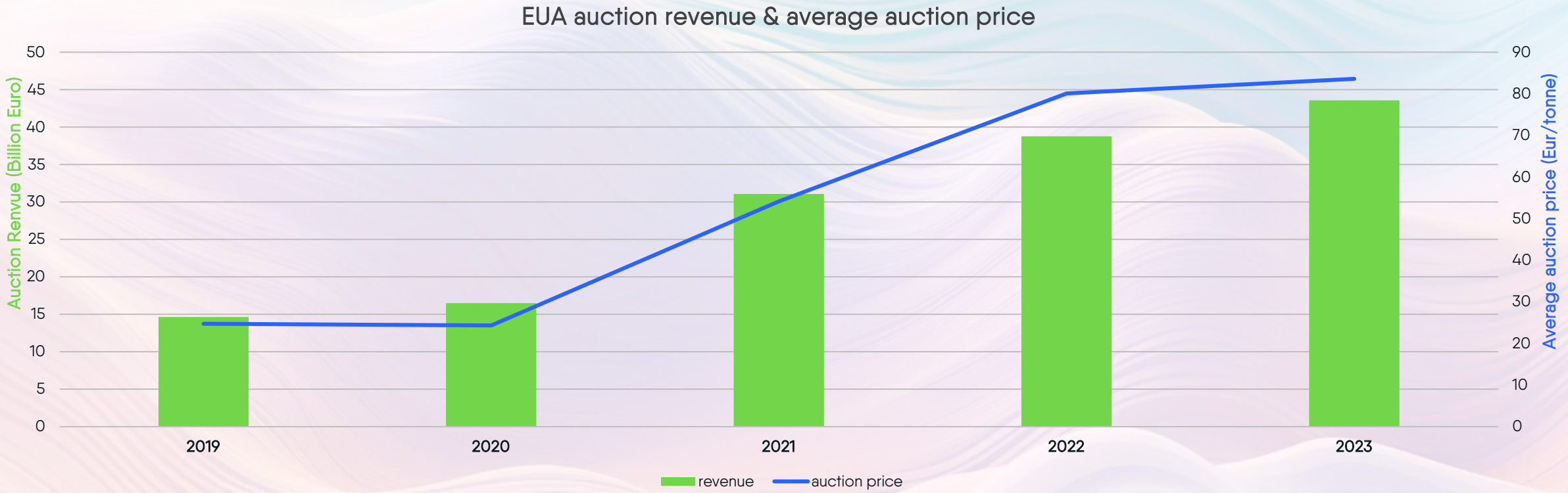


Source: PexaPark

IT Sector: the top PPA buyer in 2023

Source: PexaPark

ETS revenues grew from 14 billion to 38 billion in 4 years

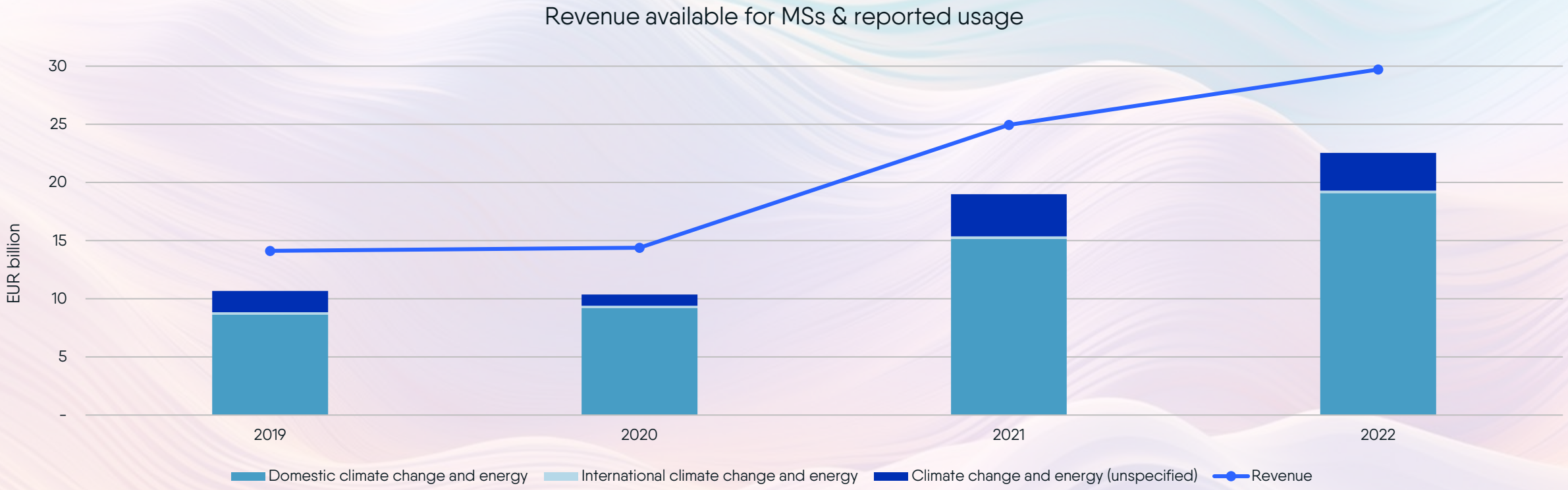


The price of carbon grew 3.4 times from 2019 to 2023; this helped boost ETS revenues from 14 billion euros in 2019 to 38 billion for 2022

Source: Eurelectric based on EEX

Revised Directive:

From 75% to 100% of ETS revenues allocated to climate & energy initiatives



100%

Under the Fit for 55 package, Member States (MS) now must allocate 100% of their ETS revenues to climate and energy purposes, up from the previous 50% requirement

On average, from 2019 to 2022, 75% of the revenues available to MS were spent on climate and energy purposes

Source: Eurelectric based on EEX

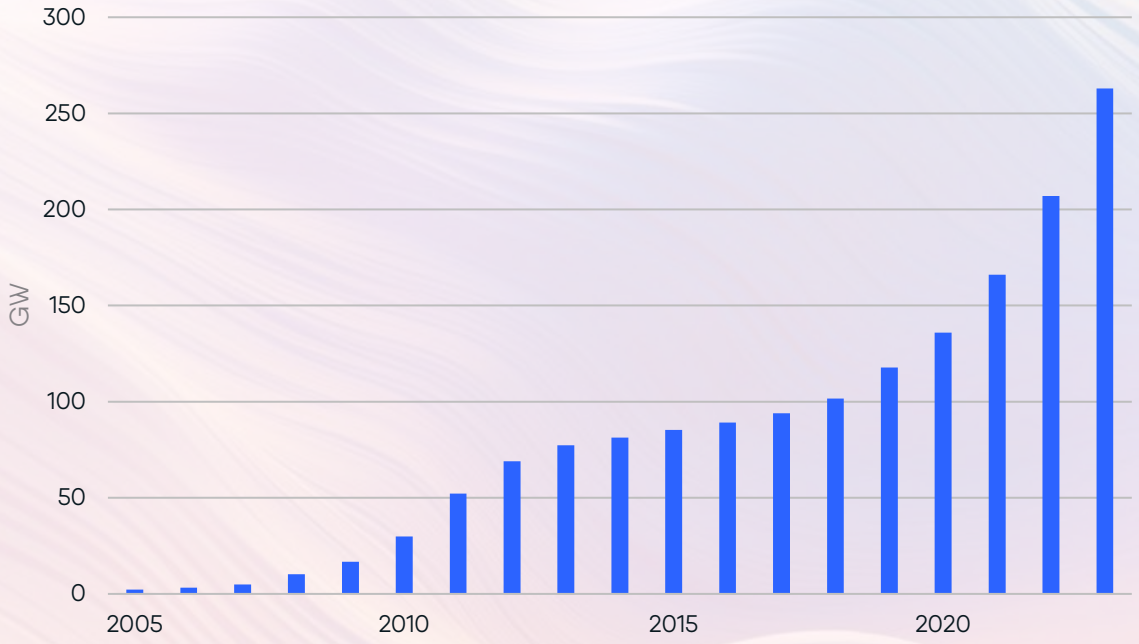
Power Sector Progress Report

Electricity Grids

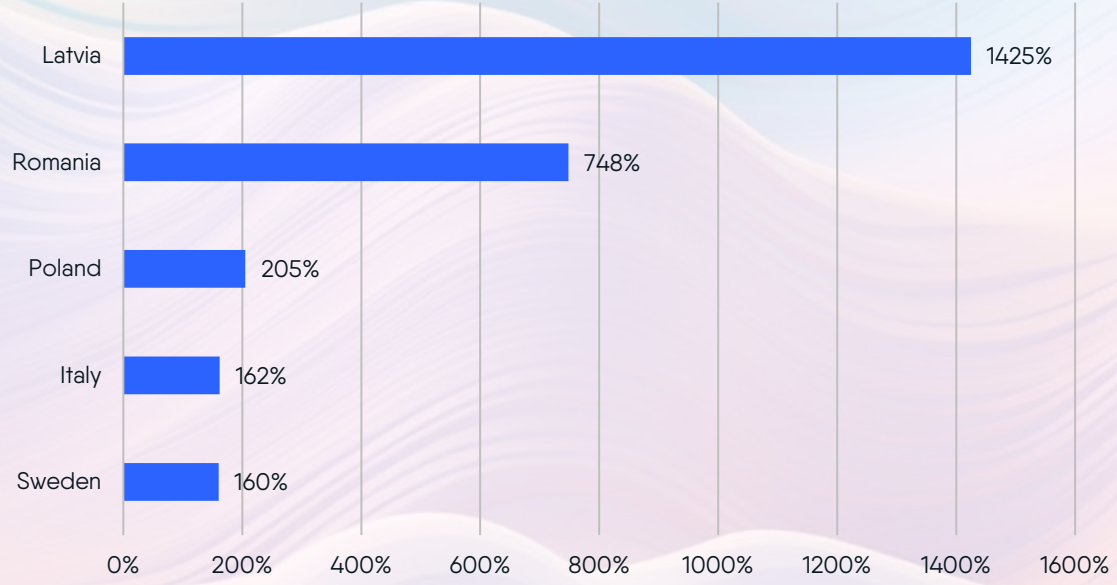
No transition without grids

Exponential growth in solar PV = surge in grid connection requests in the EU

Evolution of solar PV capacity in the EU



Increase in grid connection requests for solar PV in selected MSs (2021-22)

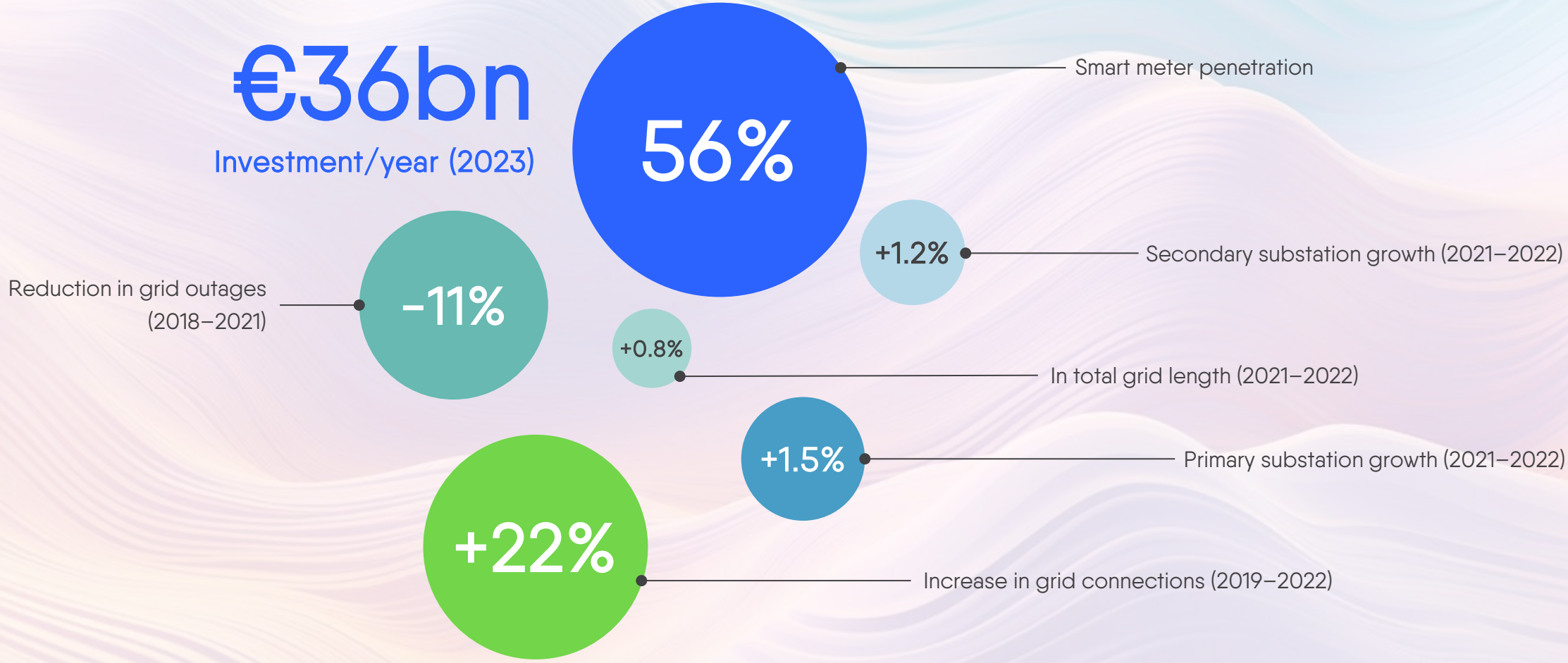


The exponential growth of renewables, and especially of solar, has significantly increased grid connection requests in the EU

Amount of connection requests to all European DSOs increased from double to triple previous amount

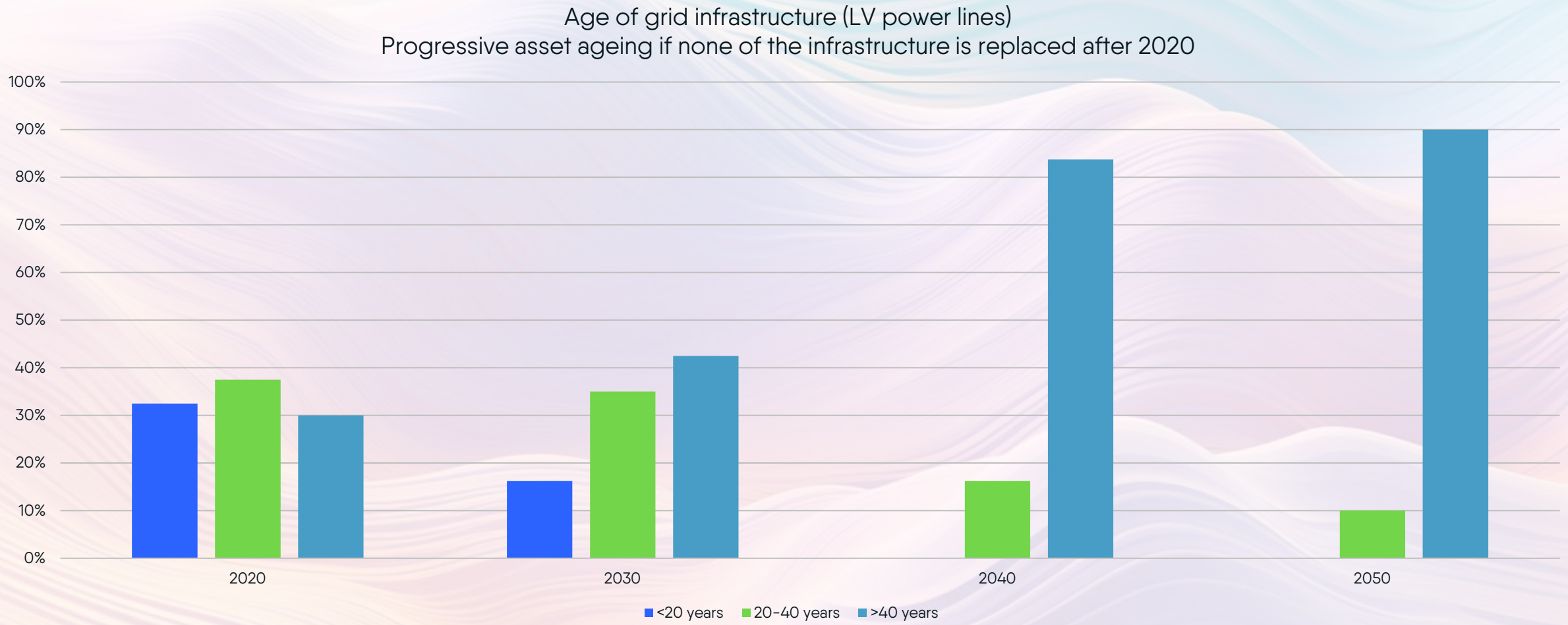
Source: Grid connection requests from EU DSO entity's Fit for 55 paper, solar PV capacity from Eurostat and Solar Power Europe.

The distribution grid has delivered so far – now we have to accelerate



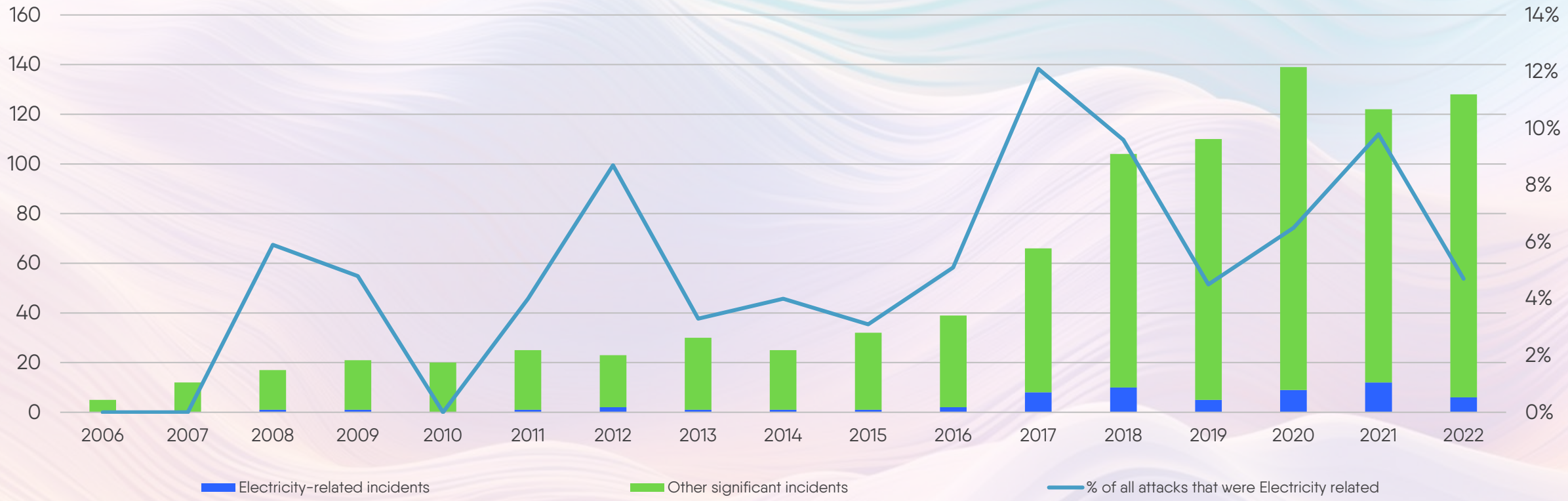
Source: Eurelectric Power Barometer 2023.

30% of today's grid is over 40 years old



Source: Eurelectric Grids4speed

Increasing cyber attacks

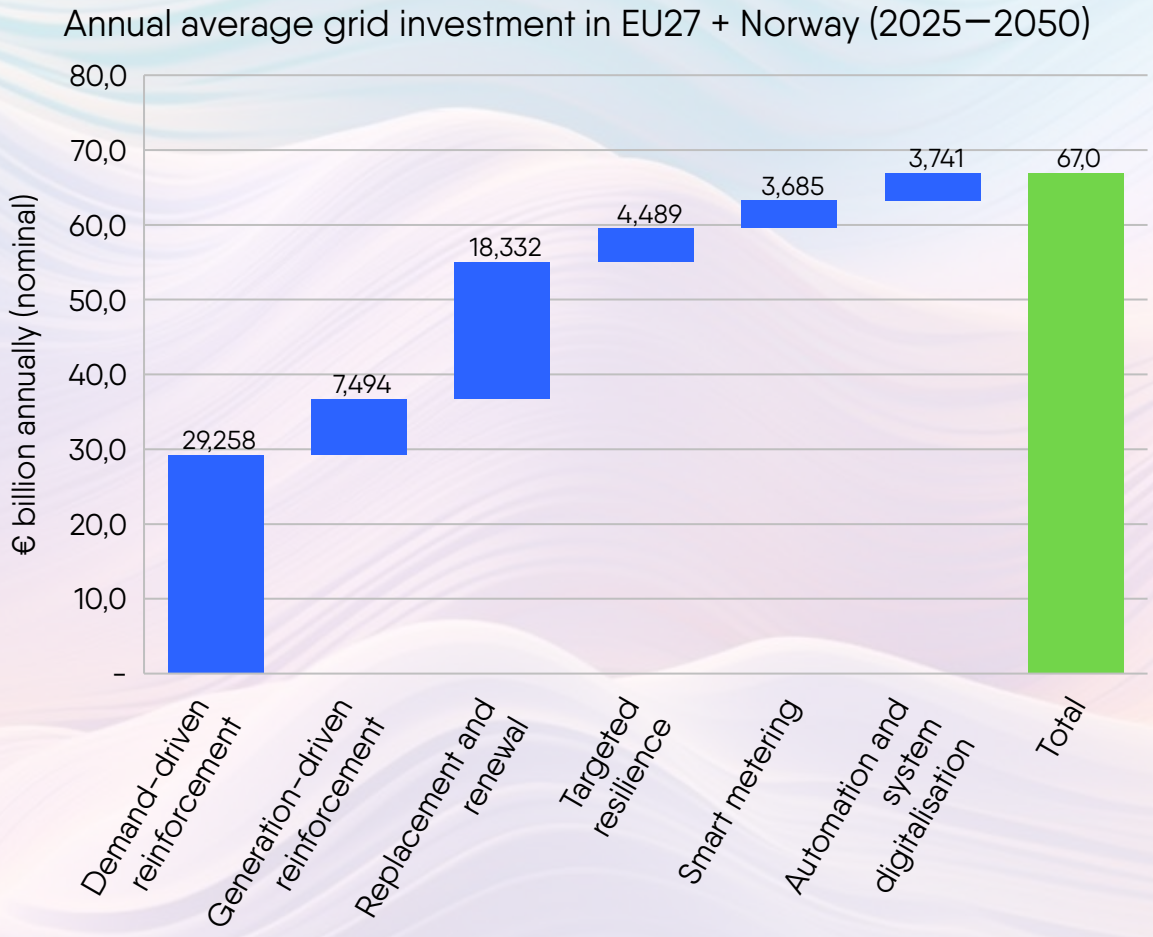


Increased cyber security attacks are leading to data and operational losses

Source: Eurelectric Grids4speed

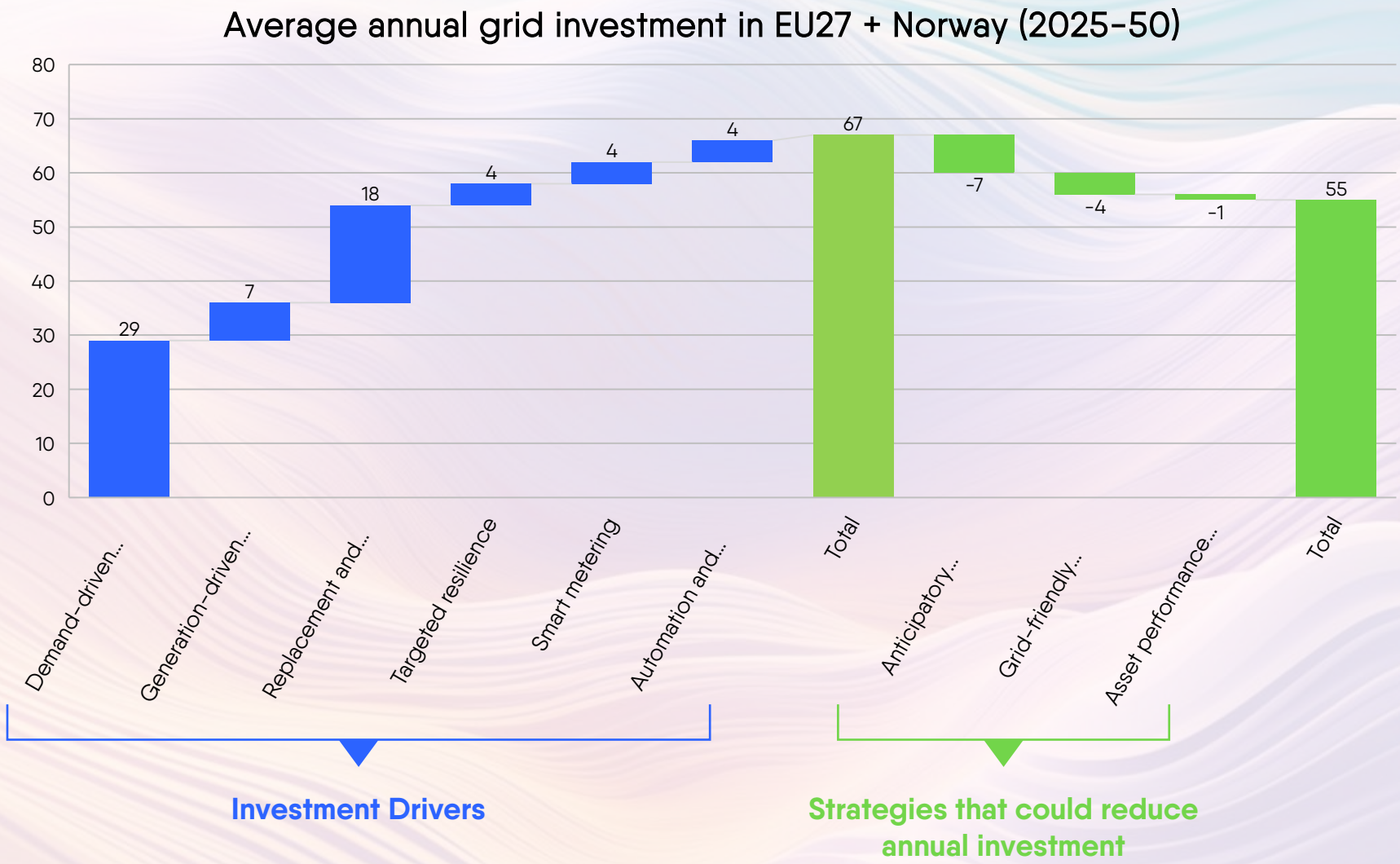
Grid investment needs to double from €36 billion to €67 billion annually

€67bn/ year	of investment required between 2025–50 in the EU27 + Norway*
43%	of this will be for demand-driven reinforcement
6	key investment categories that DSOs need to consider
€150	per capita per year to deliver the energy transition by 2050
~30%	of the total investments for the core power sector are needed for the grid



Source: Eurelectric Grids4speed, Eurelectric Decarbonisation Speedways, * 67 bn/year is 4 % of the total energy system investment projected in EC's 2040 impact assessment

Grid investment surge needed, but strategic investments could reduce by 18%



€67bn/year
of investment required between 2025–50 in the EU27 + Norway

€55bn/year
investment reduced by 18% if three key grid strategies are applied

Anticipatory investments
-10% off investments can be saved if anticipatory investment are made

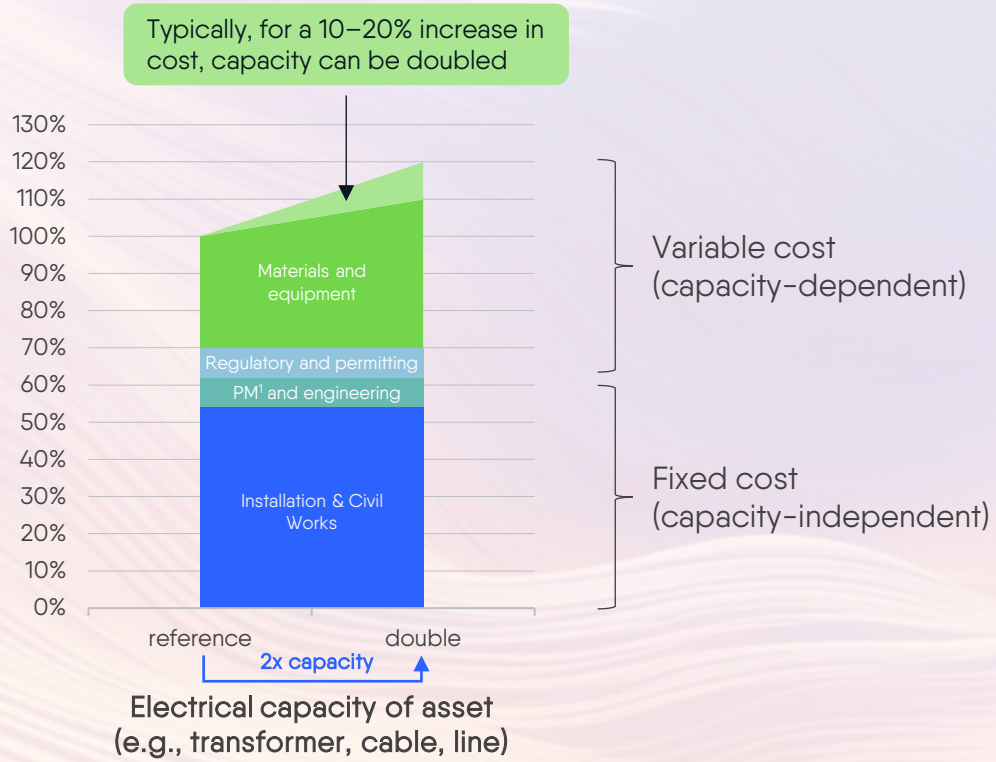
~30%
of total investments for the core power sector are needed for the grid

Source: Eurelectric Grids4speed

Anticipatory investments needed for distribution grid projects

Cost breakdown for a grid asset reinforcement project

Indicative representation of the cost breakdown for a grid overhead line and cable installation project (other grid assets have similar characteristics).



Source: EY analysis, and ACER and PWC (2023), Unit Investment Cost Indicators

1. PM is project management

Source: Eurelectric Grids4speed

Implication for distribution grid strategy

- Electricity grid projects are dominated by fixed costs for electrical installation and civil works, along with permitting, engineering and project management costs. Only material and equipment component costs are variable, as these are determined by the electrical size or capacity of the project.
- Typically, increasing the capacity of a grid project (e.g., line, cable or transformer installation) will only increase the cost of the project marginally, if within the same voltage level. For instance, doubling capacity may increase costs by around 10% to 20%, yet provide additional capacity for planned future projects, such as renewables integration, new housing developments or heat electrification.
- Where future strong loan growth is likely, it may be prudent to strategically size up capacity as an anticipatory investment during reinforcement or replacement projects. This will reduce the investment required in demand and generation-driven reinforcement as additional capacity is available.

Investment impacted in:

- Demand-driven reinforcement
- Generation-driven reinforcement

ECONOMY

Progress Report & Challenges

Economy: Progress Report & Challenges

EU Decarbonisation

EU is decarbonising its economy, but acceleration is needed

EU kicking its fossil fuel dependency but import bills still high

Gas imports

– 6%
Between 2019-2023

2019 : **205** million tons

2021 : **231** million tons

2023 : **192** million tons

Oil and petroleum imports

– 3%
Between 2019-2022

2019 : **479** million tons

2021 : **443** million tons

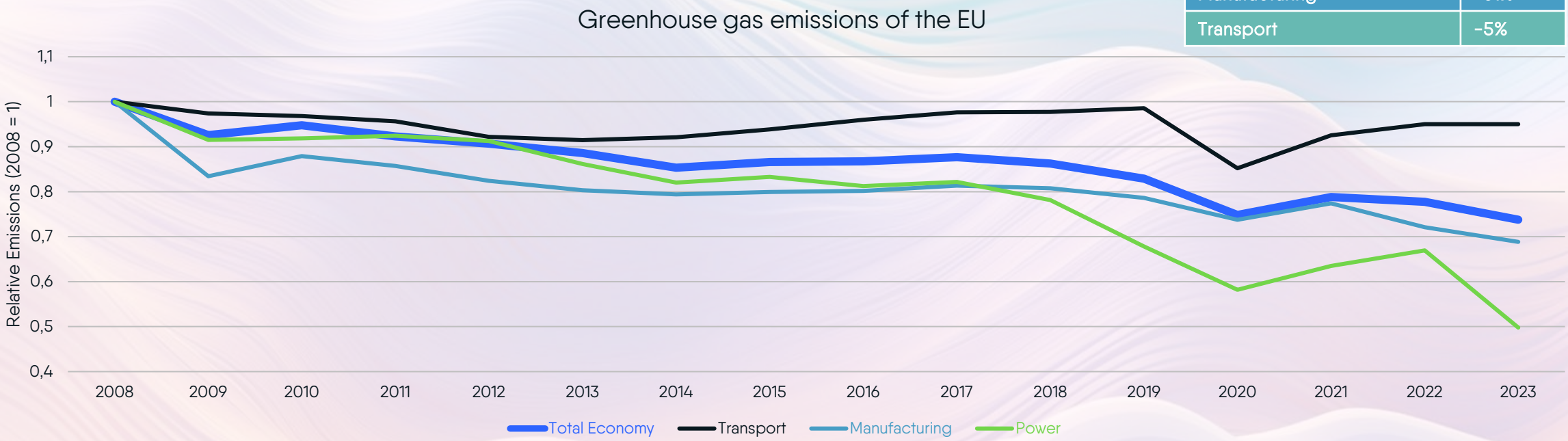
2022: **464** million tons

Despite decreased imports, the EU's energy import bill reached 451 billion euros (2.6% of GDP) in 2023, which remains 66% higher than 2019 levels

Source: Eurostat energy update March 2024

Power sector leading in emission reduction

Total economy (2008-2023)	-26%
Power sector	-50%
Manufacturing	-31%
Transport	-5%

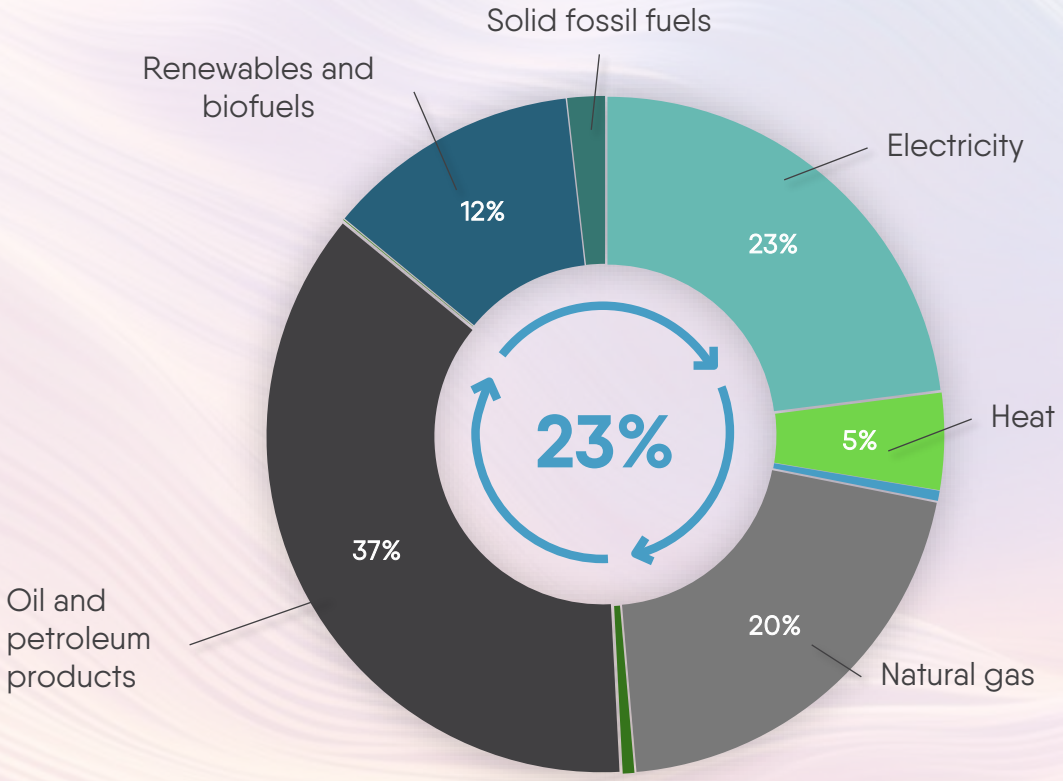


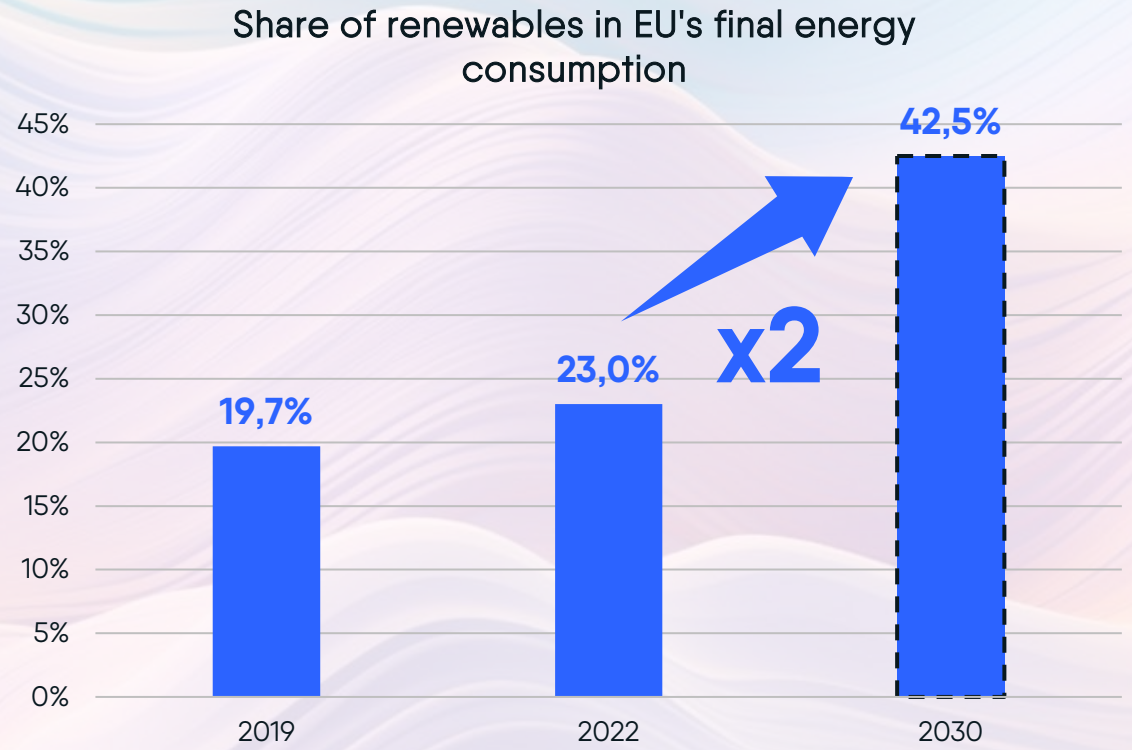
When compared to other sectors, emissions from electricity generation saw the largest relative decrease in greenhouse gas (GHG) emissions

With clean electricity growing, the power sector is becoming the low hanging fruit for decarbonising the EU's economy

Source: Eurostat for total & manufacturing, EEA for transport, Eurostat and EEA for power sector emissions until 2022, 2023 power sector from Eurelectric's Elda

Share of renewables in final energy consumption must double by 2030





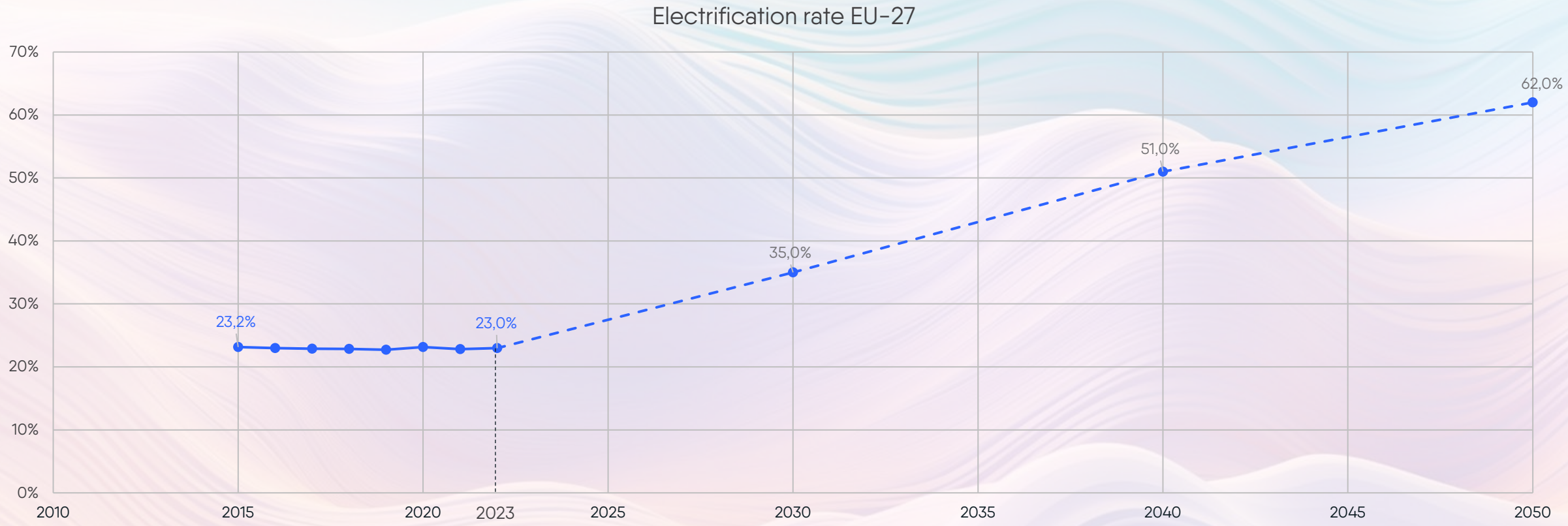
Source: Eurostat, Eurelectric, RepowerEU

Economy: Progress Report & Challenges

Electrification

Electrification is stagnating and needs a fix

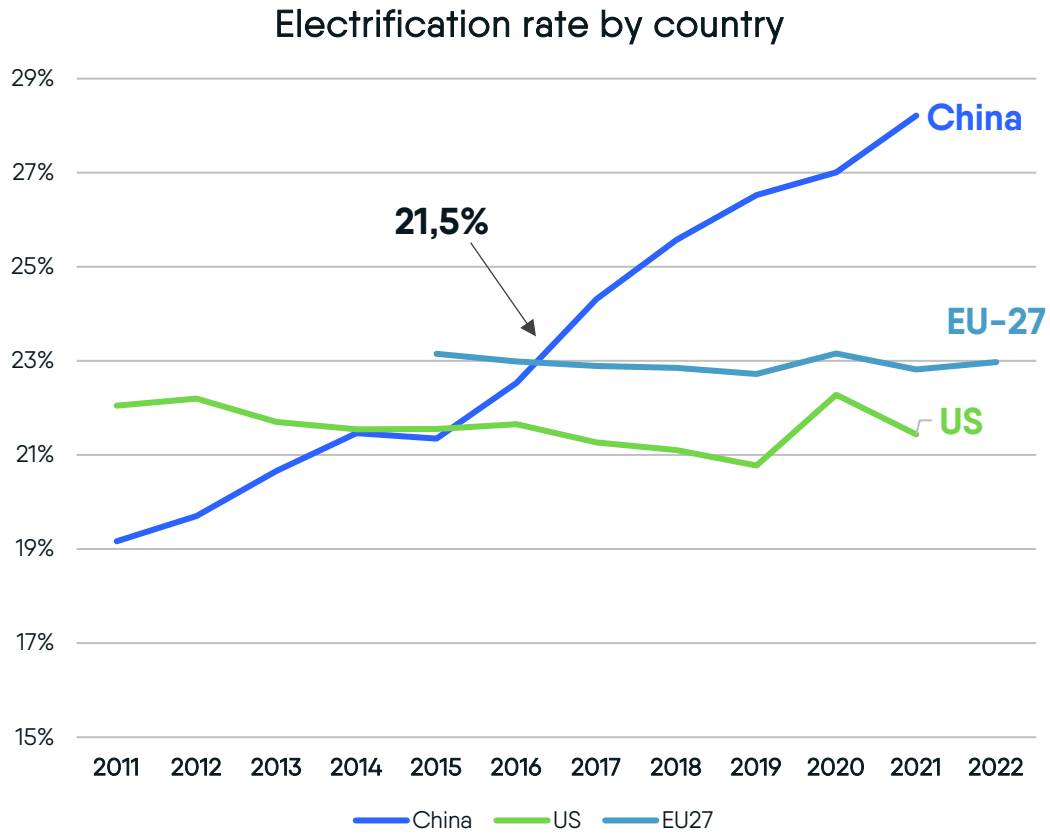
Electrification rates are stagnating

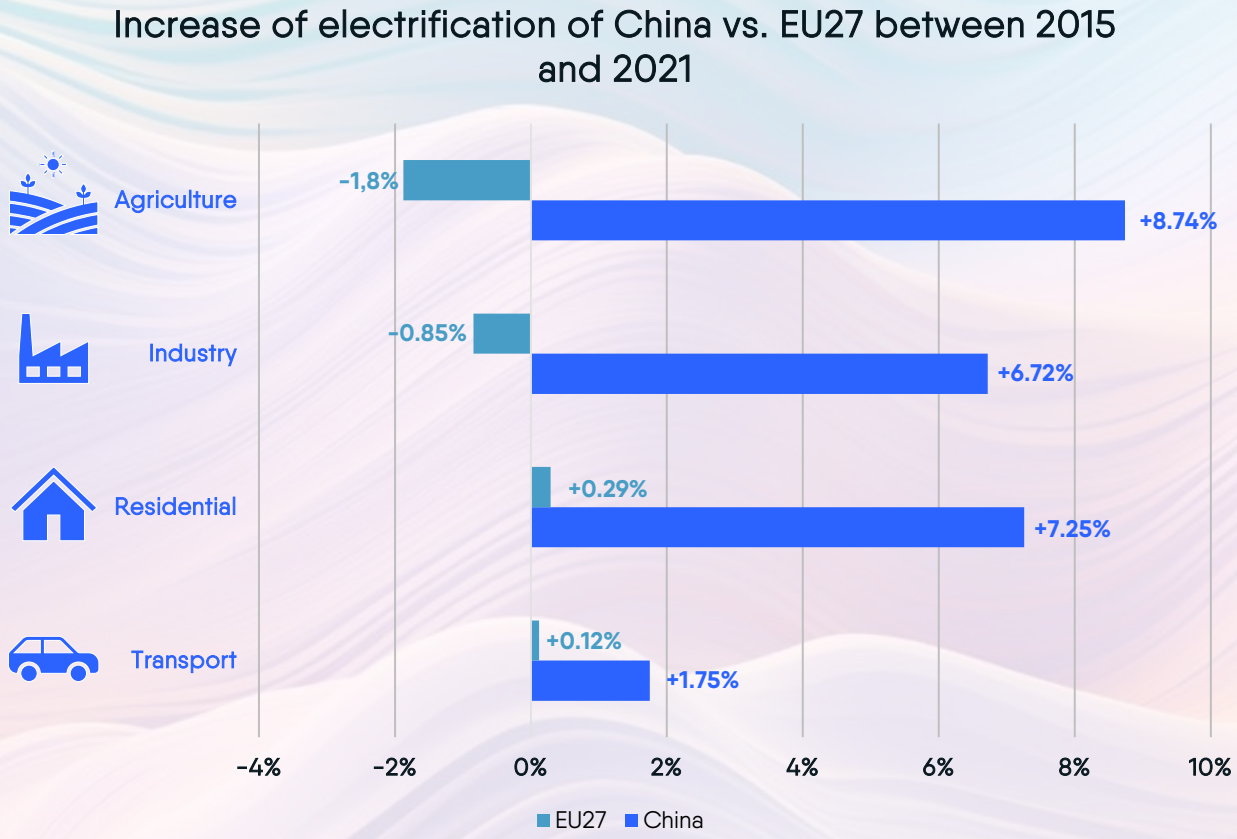


Despite the goals in place, the electrification rate is stagnating and is projected to fall well below the Commission's 2030 objectives, as outlined in the RepowerEU scenario

Source: Eurostat, Eurelectric, Comission's 2040 impact assessment

China is winning the electrification competition

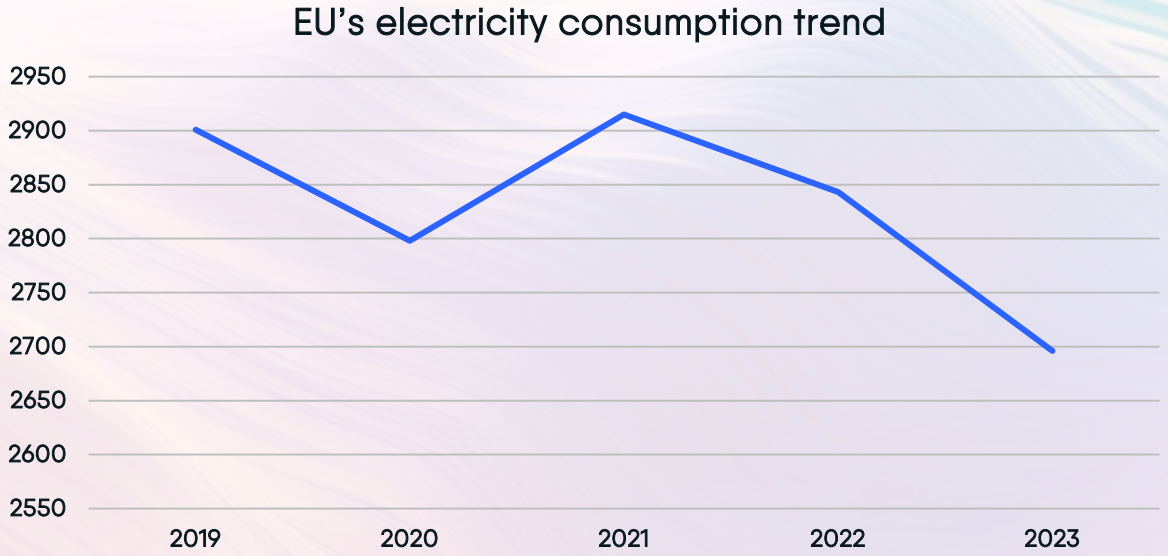




Since 2016, China is more electrified than the EU27 and has kept electrifying all sectors of their economy.

Source: IEA, Eurostat

Reduced electricity demand showing no recovery signs



> 50% Jan-March results indicates no recovery in industrial production

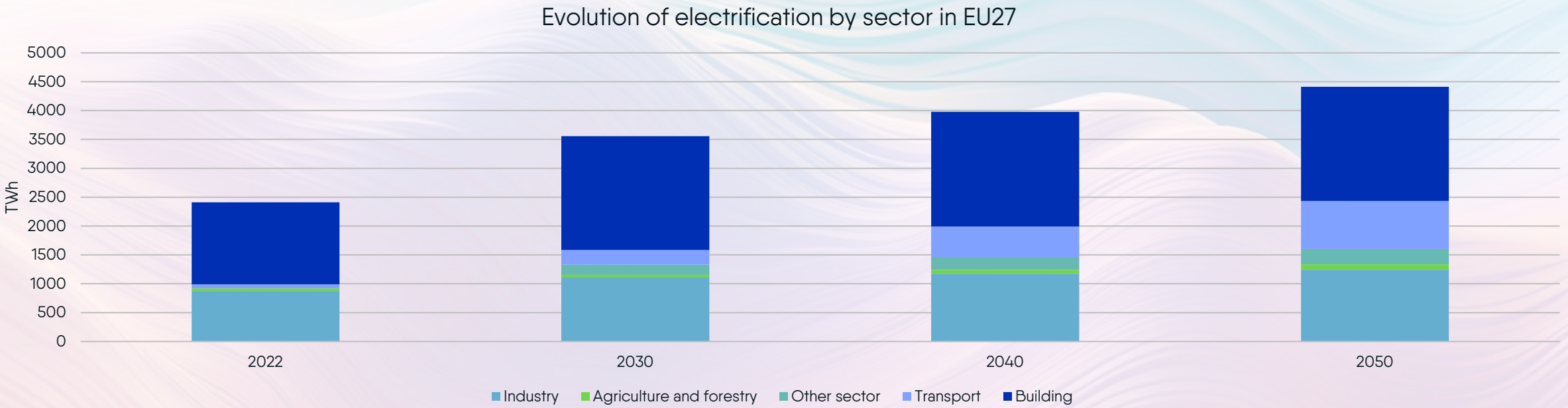
Demand has not yet recovered in 2024

-7.5% Jan-March results indicate no recovery in industrial production

Jan-March results indicates no recovery in industrial production

Source: Eurelectric's Elda, Eurostat, IEA

Electrification must accelerate across all sectors



TARGETS FOR 2030

Transport
X 13

Buildings
X 1.4

Industry
X 1.4

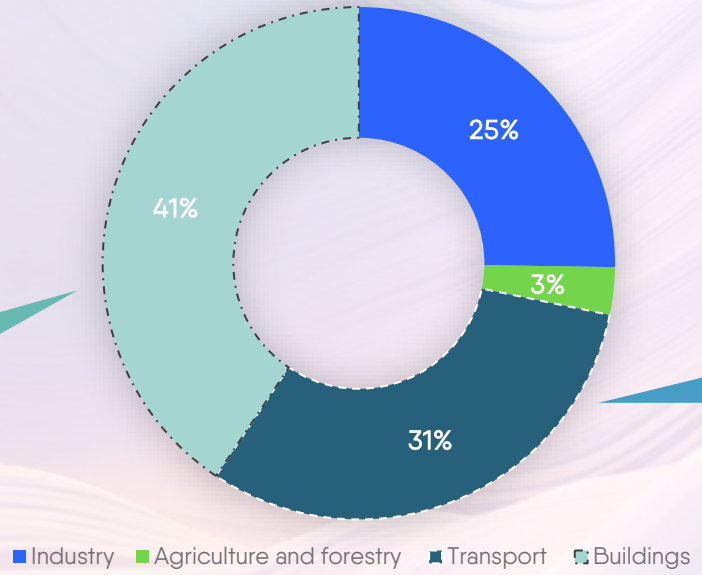
Source: Eurostat, Eurelectric

Transport and building decarbonisation needs to be prioritised

72 %

Of total energy is consumed by building and transport sectors

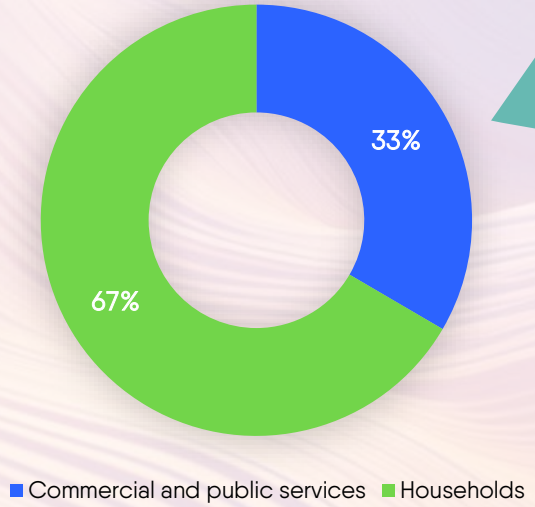
Final energy consumption by sector in 2022



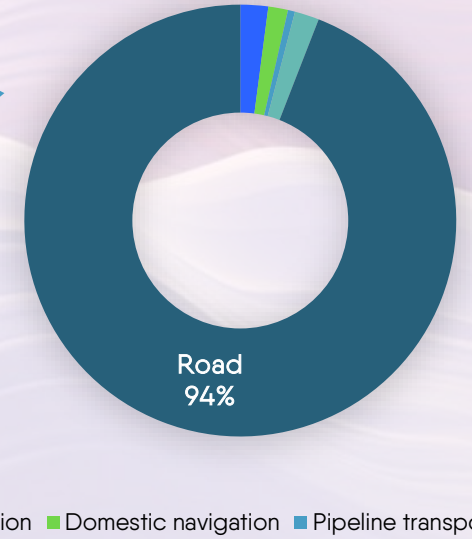
Which subsectors need to be prioritised for decarbonisation?

Households and roads are the biggest consumers

Building consumption in 2022



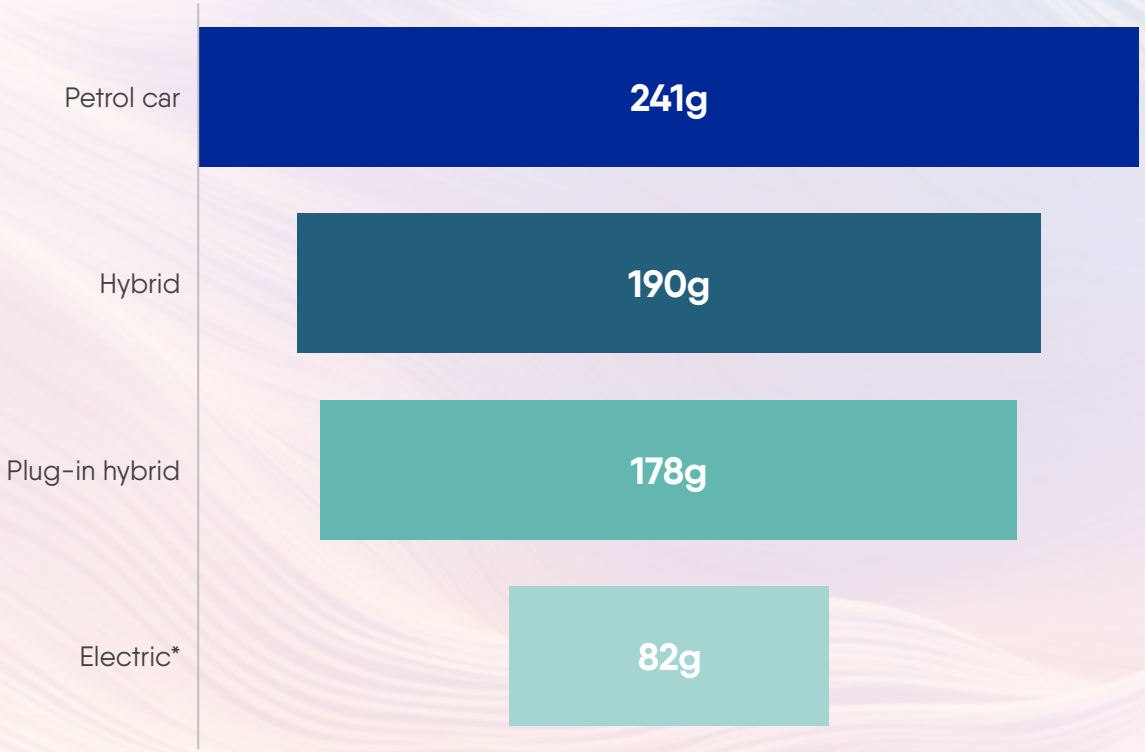
Transport consumption in 2022



Source: Eurostat, Eurelectric

EVs and heat pumps are key for decarbonisation

EU27 life cycle assessment comparison in gCO2eq per kilometer in 2022



2022 electricity grid carbon intensity of each country is defined based on a linear growth between 2020 data derived from EMBER and 2025 from ENTSO-E 'National Trends' scenarios. LCA comparison between medium-sized cars bought in 2022.

* : Battery produced in China in this case, EU27 for hybrid and Plug-in hybrid

Source: Transport & Environment, The Future of Heat Pumps, IEA

1,6 ton

Amount of CO2 emissions avoided by producing the battery in the EU27 versus China

is the approximate weight of an electric car

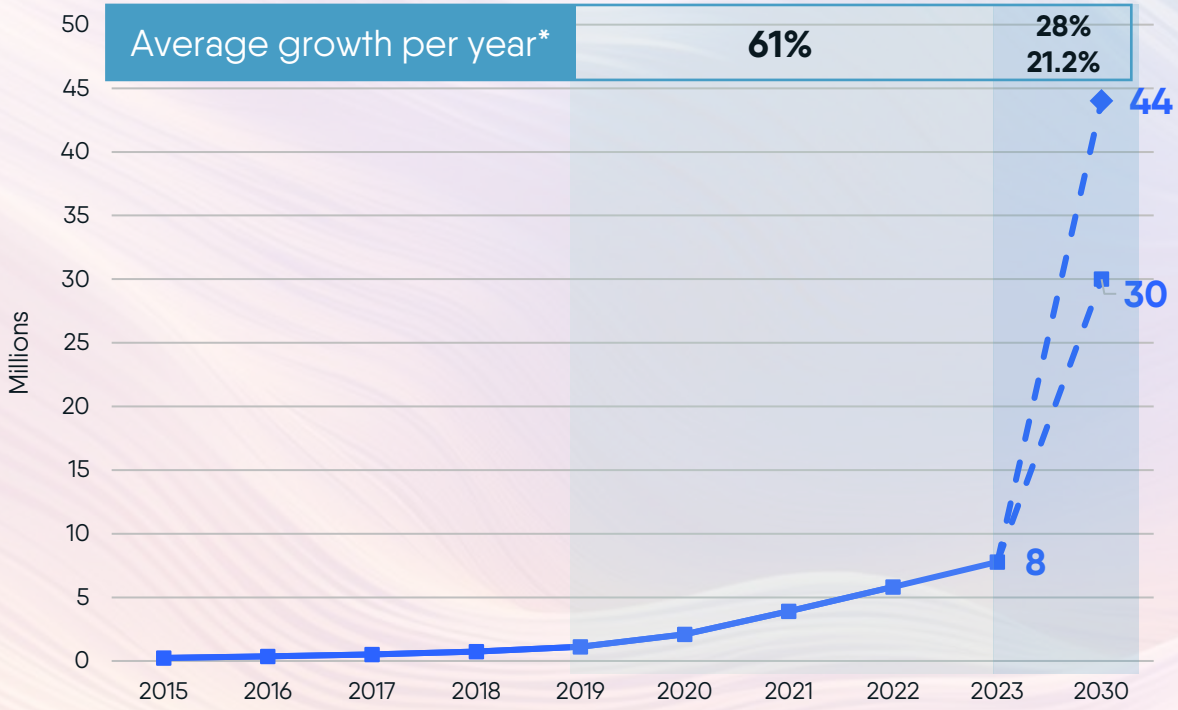
20-80%

is the range **of CO_2 savings by using heat pumps** instead of gas boilers globally in 2022, depending on the cleanliness of electricity

Transport electrification: catalyst is needed

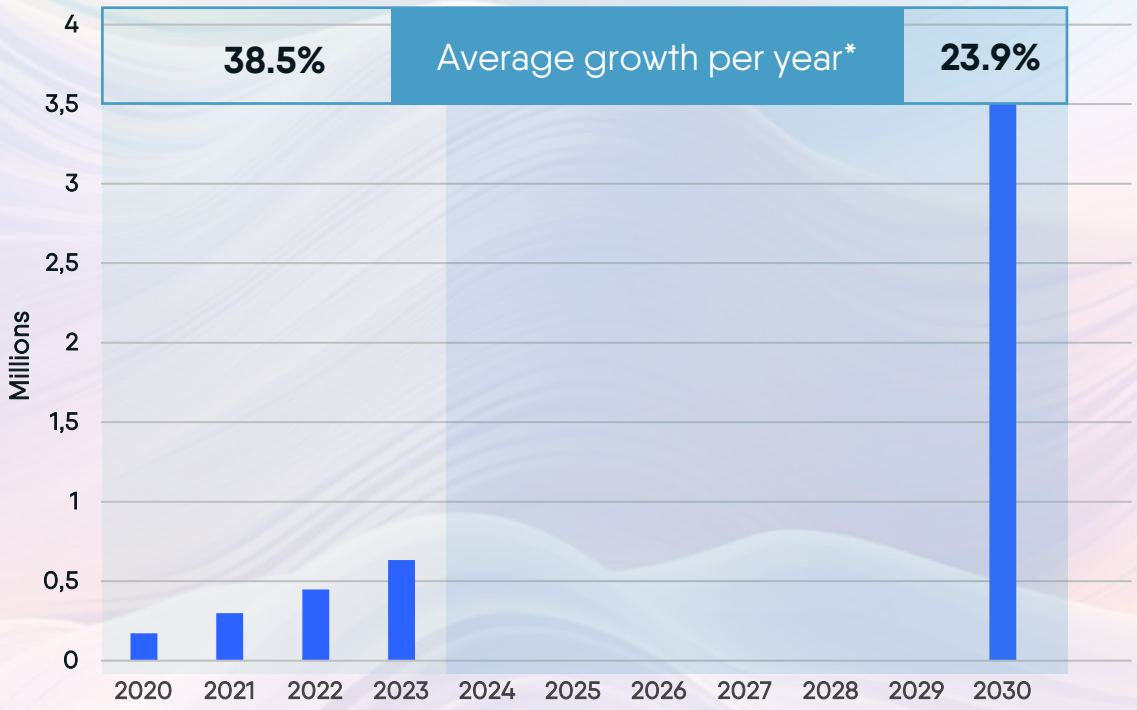
Electrification of transportation sector in 2022	1.96%

Evolution of the number of EVs



The total number of passenger car EVs currently stands at around 8 million. To meet the target of 30-44 million by 2030, an annual growth rate of 21-28% is required.

Number of EV public chargers



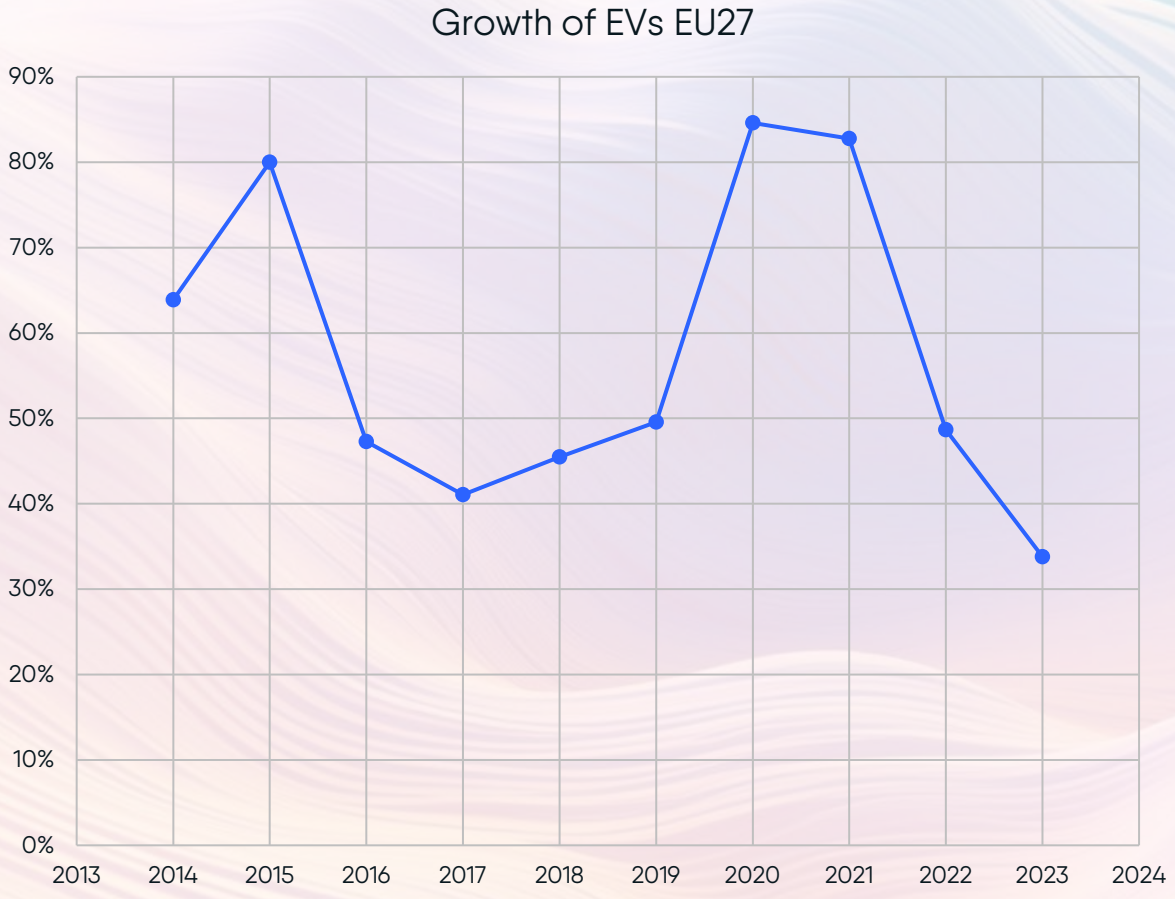
The total number of public charging stations currently stands at around 0.6 million. To meet the target of 3.5 million by 2030, an annual growth rate of 23.9% is required.

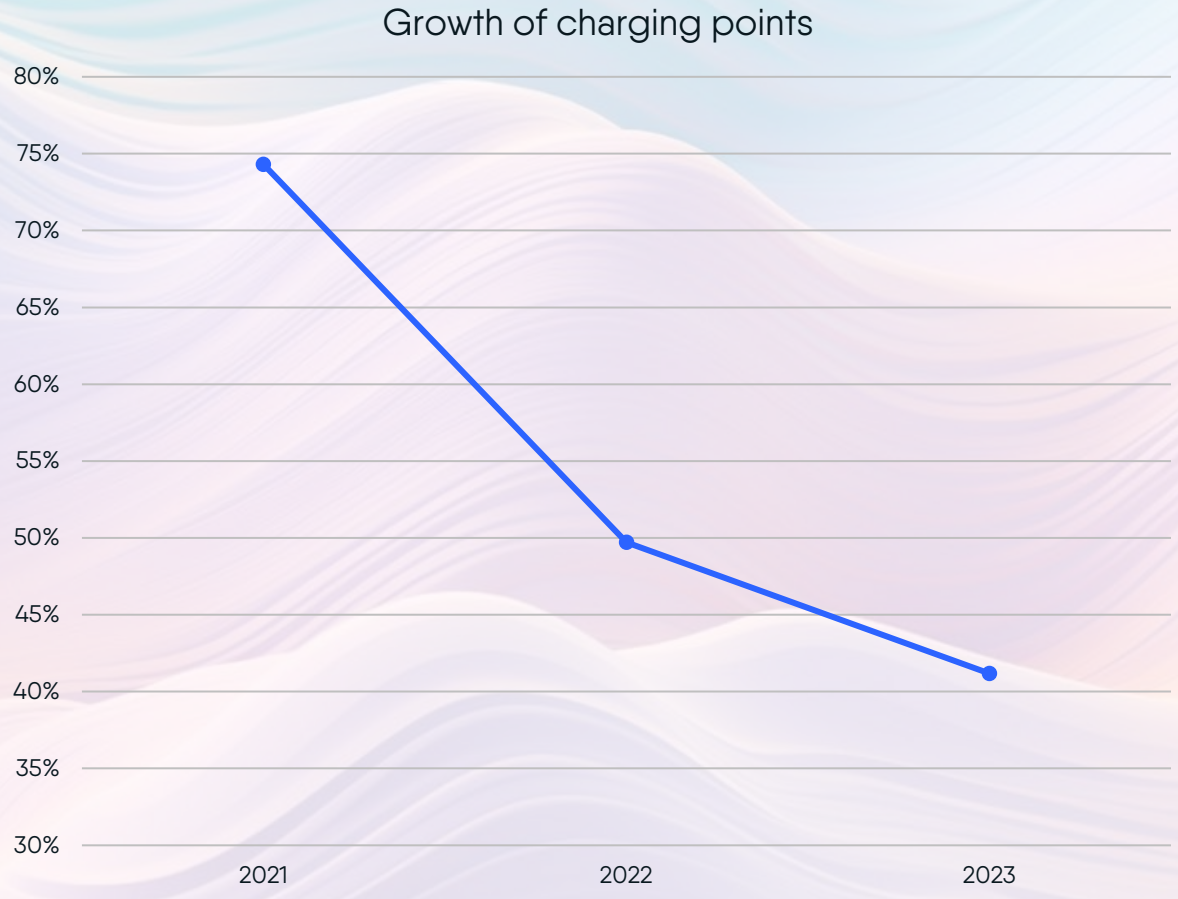
* Was calculated using CAGR formula CAGR (%) = (Ending Value ÷ Beginning Value) ^ (1 ÷ Number of Periods) – 1

Source: European alternate fuels observatory, EC's mobility strategy 2020 and IEA net zero for EV projections, AFIR for projected public chargers

Electrifying transport

Growth is moderating since 2021



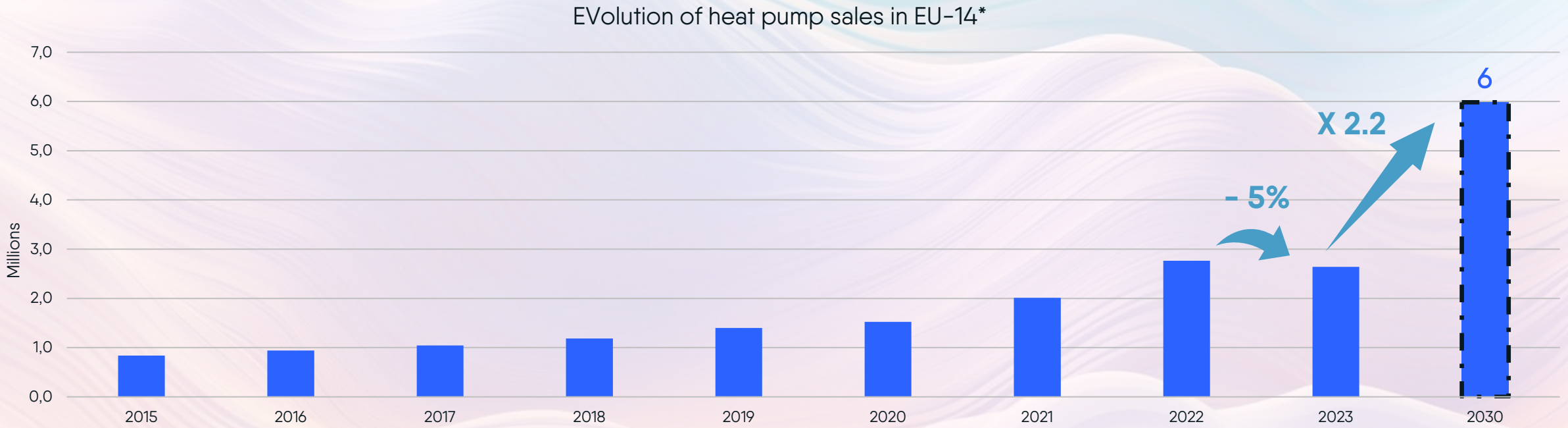


Source: Alternative fuel observatory

Electrifying buildings

heat pump sales suffered a dip in 2023, reversing the previous trend

Electrification of building sector in 2022	25%

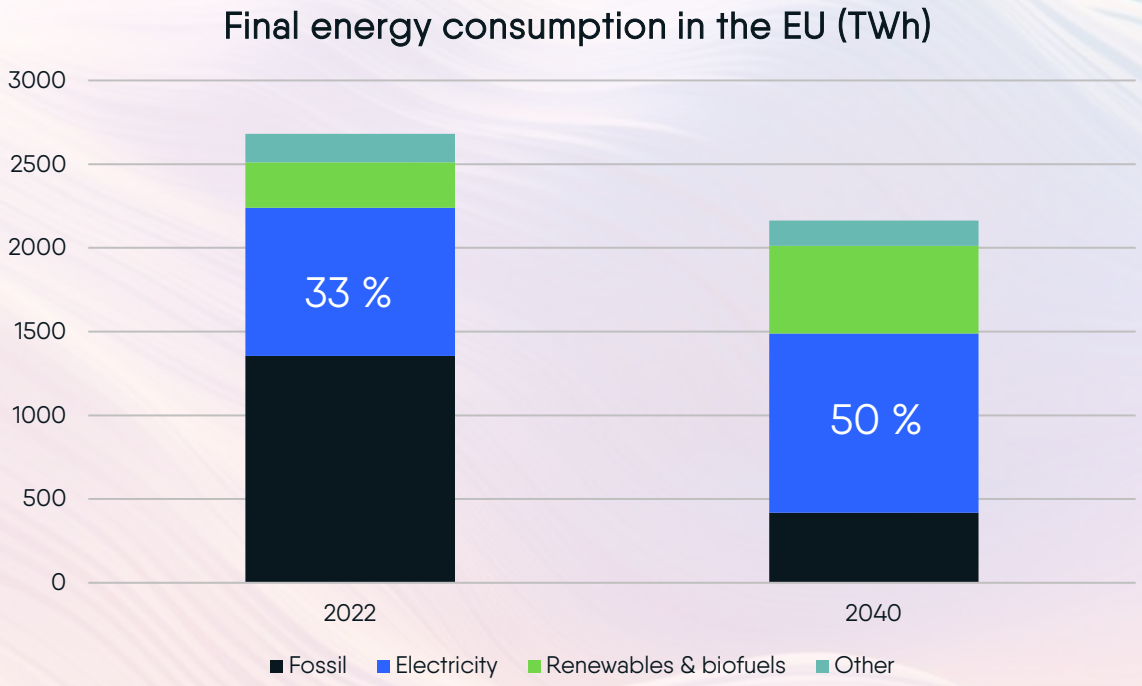


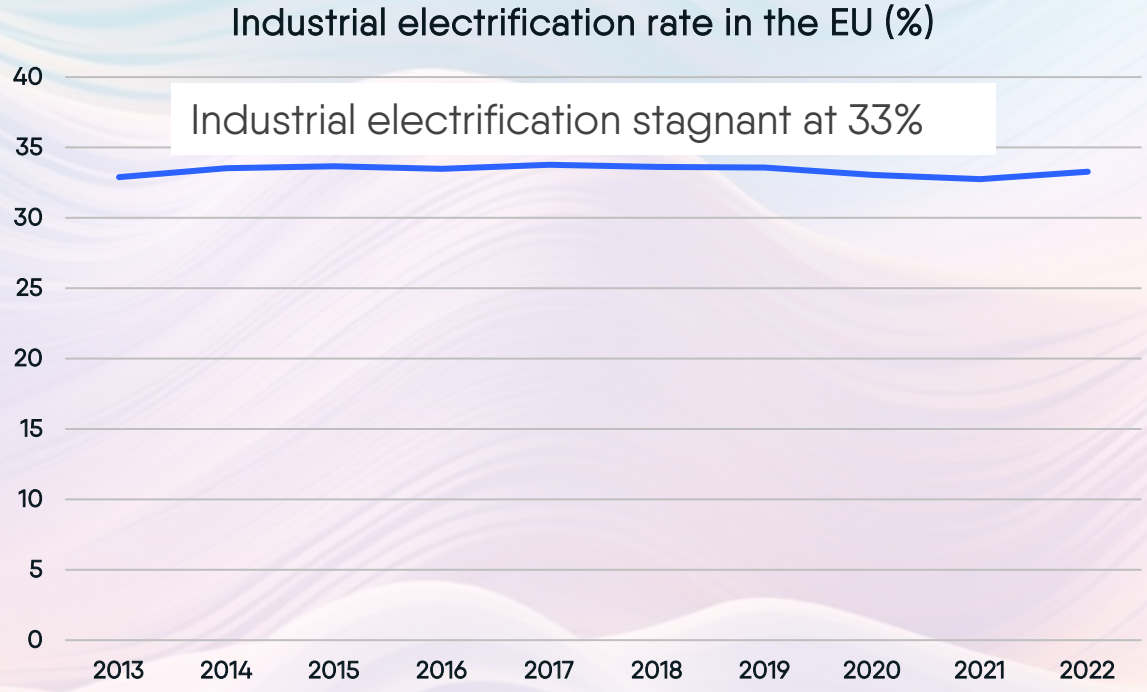
6 million	Number of annual heat pump installations required

58 million by 2030	Projection in the EC's 2040 targets impact assessment

Source: Historic data from EHPA statistics, 2030 prjojection is an estimation based on the EC projection of 58 million HP stock by 2030
*These 14 countries made up 90% of the European heat pump market in 2023

Electrifying industry
stagnation at 33%





50% electrification in industries projected by the commission by 2040

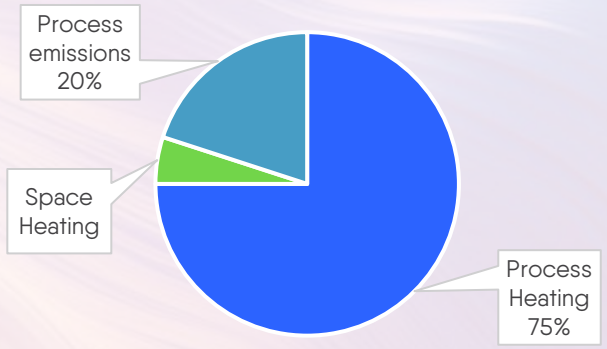
However, electrification has been stagnant at 33% in recent years

Source: Eurostat

Electrifying industry

Process heating dominates industrial emissions, of which only 4% is electrified

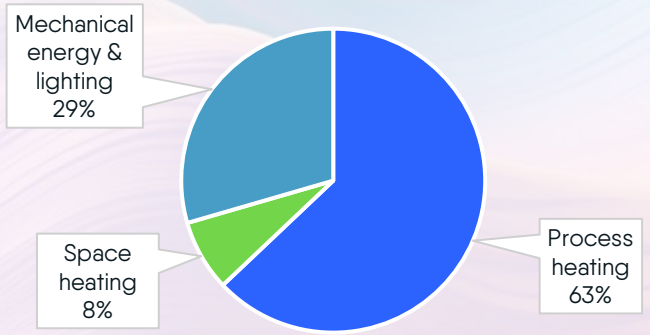
Structure of GHG emissions in the European industry sector



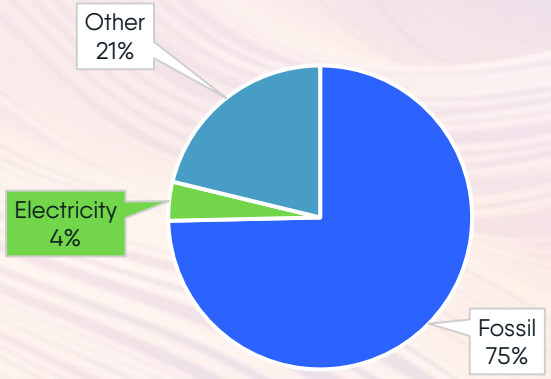
Process Heating

75%	of emissions
63%	of consumption

Composition of final energy consumption by end-use



Fuels used for process heating in the EU industries

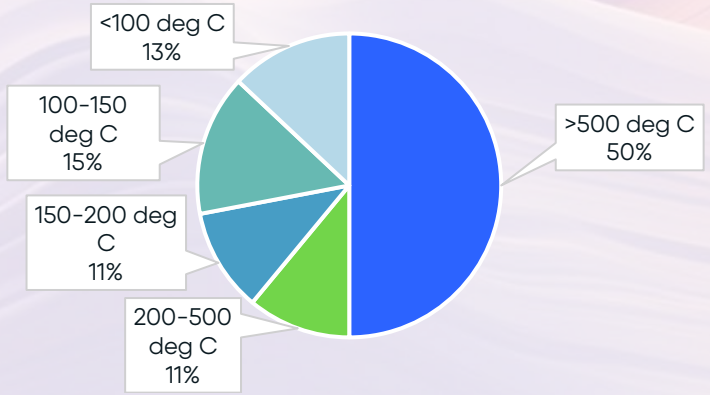


Source: Agora Industry

Process Heating

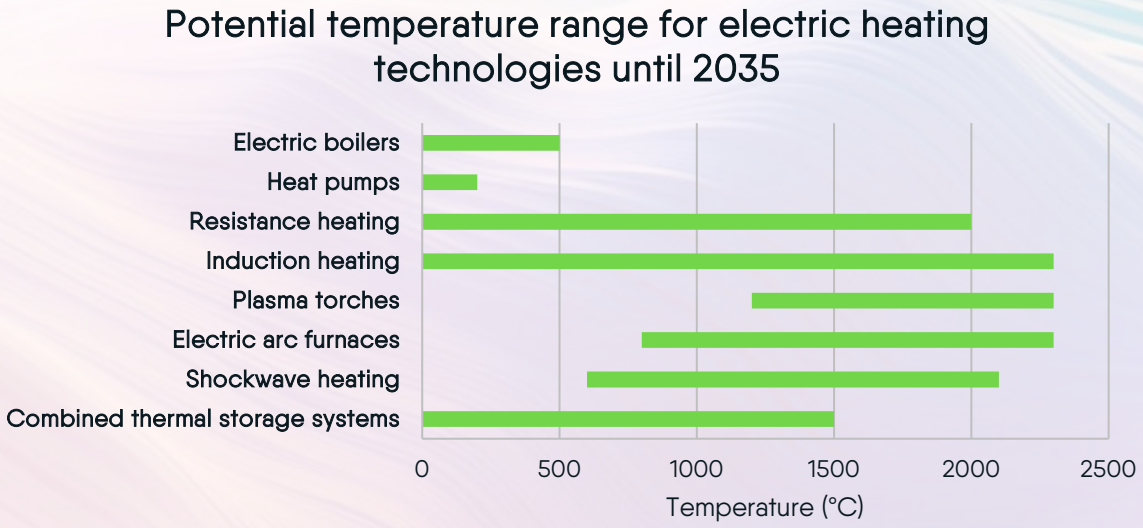
75%	fossil fuel
4%	only electricity
50%	>500 deg c

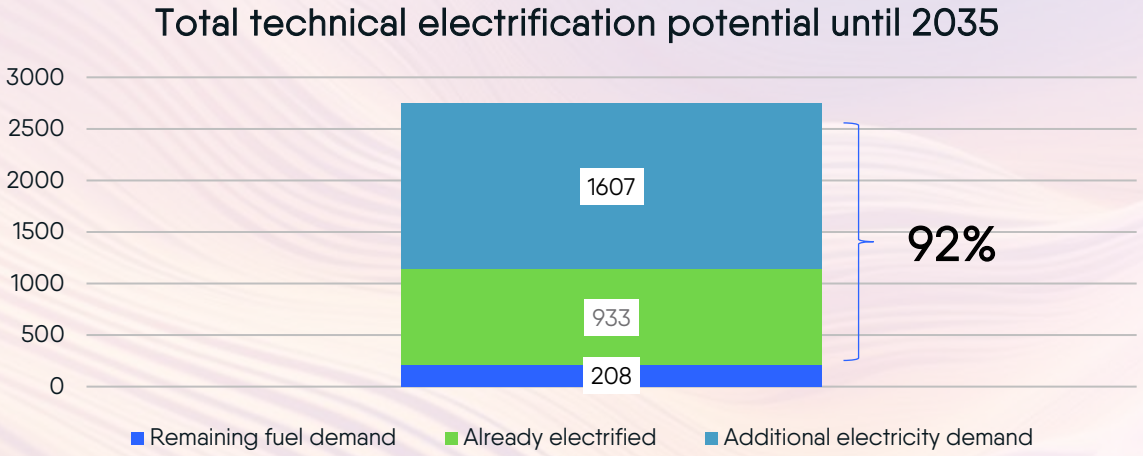
Temperature ranges of the total process heating demand



eurelectric

Electrifying industry: 92% technical electrification potential in industries





Source: Agora Industry

Broad range of technologies are available for electrifying process heating at various temperature ranges

92% of the final energy demand from industries can be electrified with current technology

Iron & Steel industry is the major outlier, where full electrification is technically not feasible with 200 TWh demand for a reducing agent

Three case studies for industry electrification

Iron & steel:
Steel rolling is used to shape raw steel into flat and long steel products, which are then turned into finished goods. Today, the fossil fuel demand for steel rolling in the EU is roughly 2.0 GJ/t, while the electricity demand is 0.4 GJ/t (Fleiter et al. 2023b).

Electric solution:
In July 2024, SSAB and Danieli have signed an Early Service Agreement for the Luleå mini-mill project in Sweden. Danieli will supply a highly-automated technology solution for the new mini-mill, consisting of two electric arc furnaces, secondary metallurgy, caster and strip mill. Quality hot-rolled coils will be produced through electric steelmaking and direct casting-rolling.

Chemical:
Steam cracking is used to produce ethylene and other high-value chemicals (HVCs). Naphtha or gaseous hydrocarbons are mixed with superheated steam and cracked at temperatures above 800°C with a process heat demand of 35.9 GJ/t (Fleiter et al. 2013).

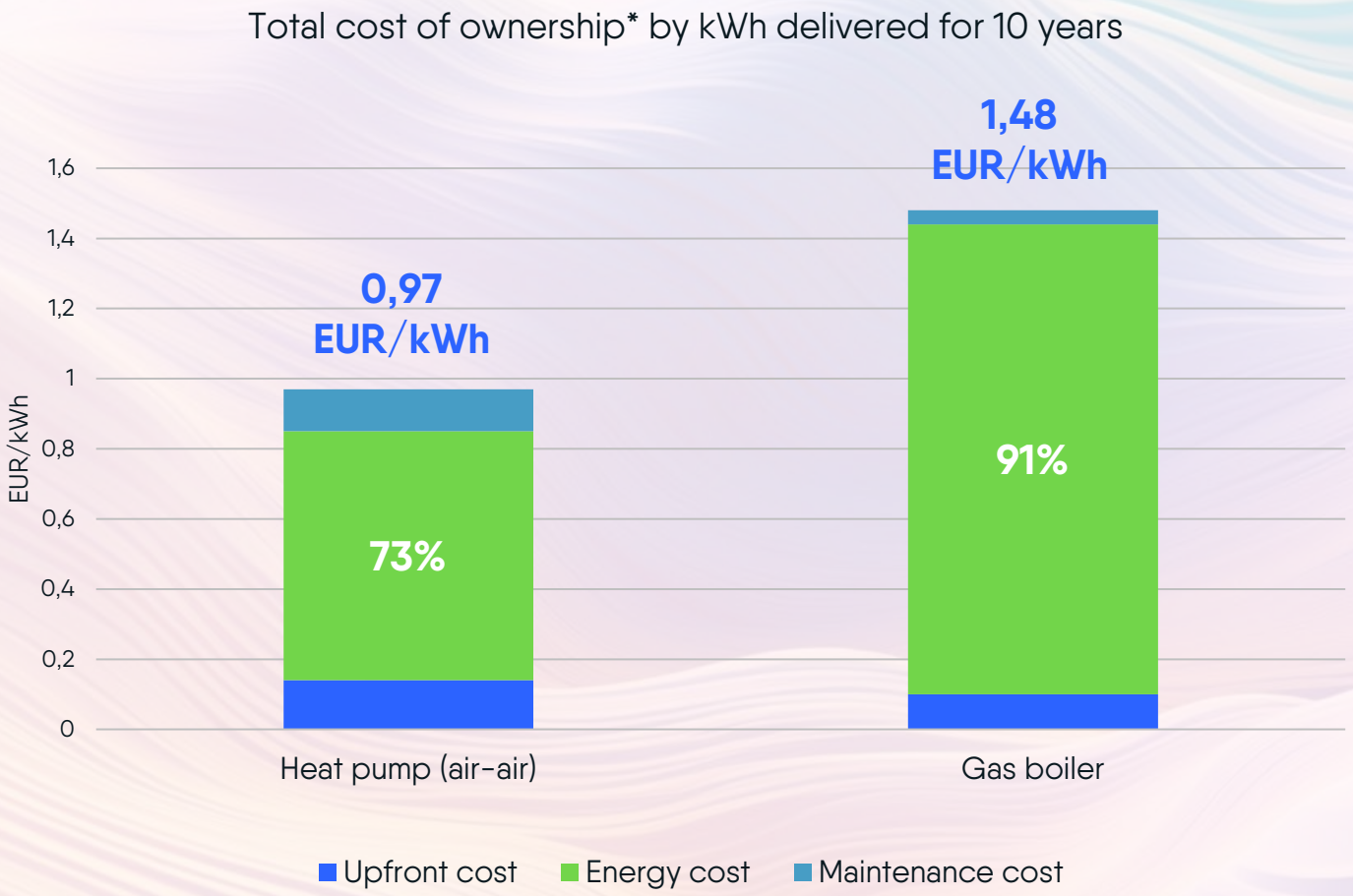
Electric solution:
In a major milestone for the sector, BASF, Sabic and Linde commissioned the world's first electric cracker demonstration project in Germany in April 2024. The electrified steam crackers employ resistance and shock-wave heating. With electrification, the efficiency of these steam crackers is expected to be as high as 95%, versus the 40% efficiency of today's fuel-based steam crackers (Jasi 2023).

Non-ferrous metals:
Non-ferrous metals processing includes aluminium melting, aluminium homogenising, aluminium heat treatment, copper melting and others. While electricity already accounts for a large proportion of the energy used by the non-ferrous metals sector, a large proportion, 36%, of the remaining fossil fuel use supplies temperatures below 500°C and could therefore be easily electrified.

Electric solution:
Even at high temperatures, induction and resistance heating offer efficient alternatives to fuel-based heating. As an example, in February 2024, major Romanian aluminium smelter Alro's Wrought Aluminum invested in an electric furnace for its production of primary aluminium.

Source: SSAB, Fleiter et al., Tercelli, World Steel, Linde Engineering, Jasi, SecoWarwick.

Heat pumps are cheaper than gas boilers in the long run



X 3

is the efficiency of a heat pump compared to a gas boiler

15 years

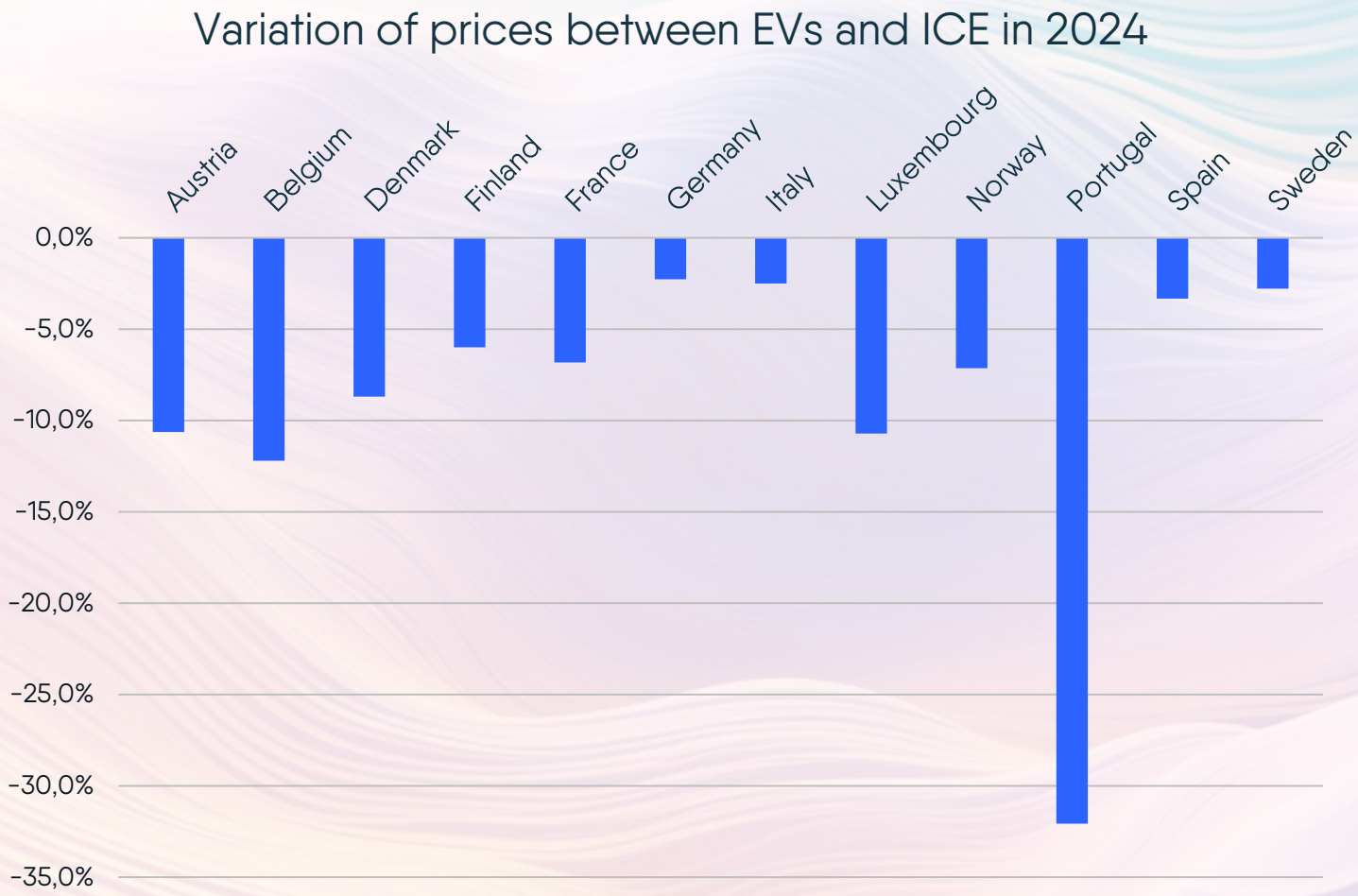
is the average heat pump payback price in the EU27 for 2022

1 year in Portugal

68 years in Croatia

Source: European climate association, EHPA, EEB study, *TCO : overall cost of a product or service over its entire life cycle

EV ownership costs lower than ICE vehicles



48 months study led on around 3 years-old's ICE and BEV

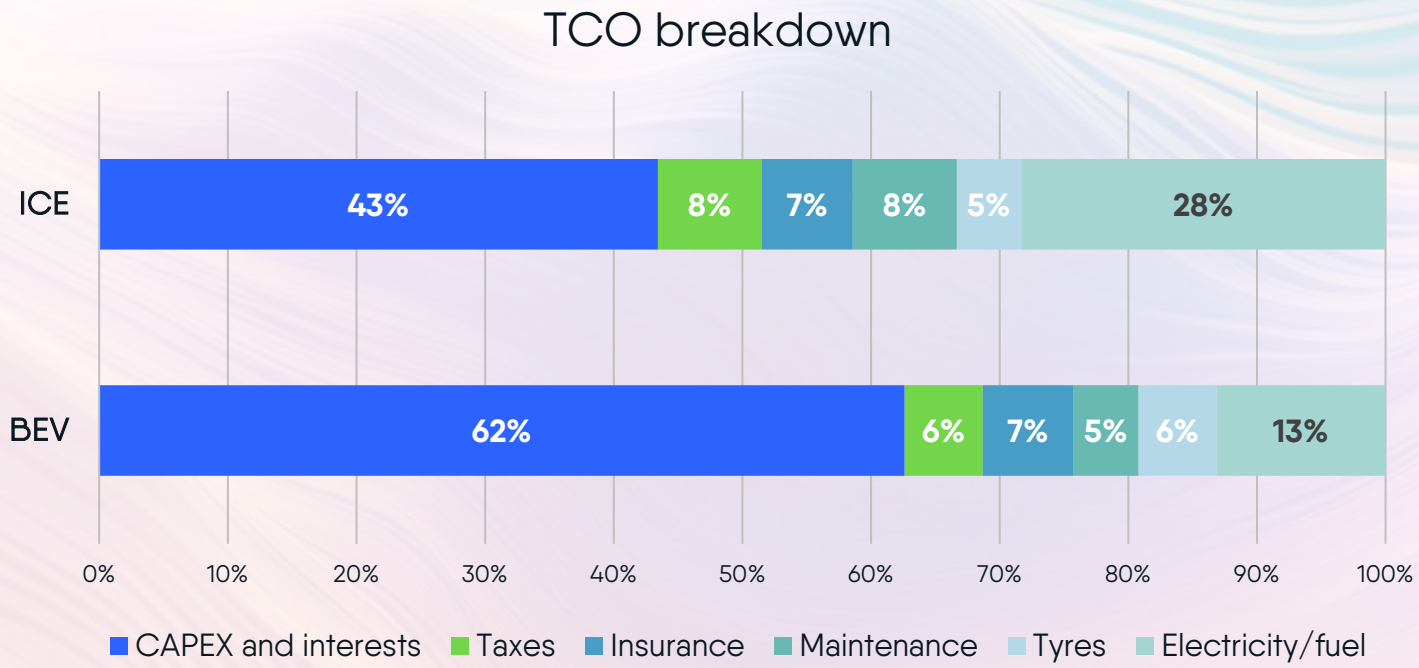
Source: Ayvens, Société Generale Group

Average TCO in these countries in 2024

0.41€/km

0.38€/km

EVs more resilient to energy prices fluctuations



Average TCO in these countries in 2024

0.41€/km

0.38€/km

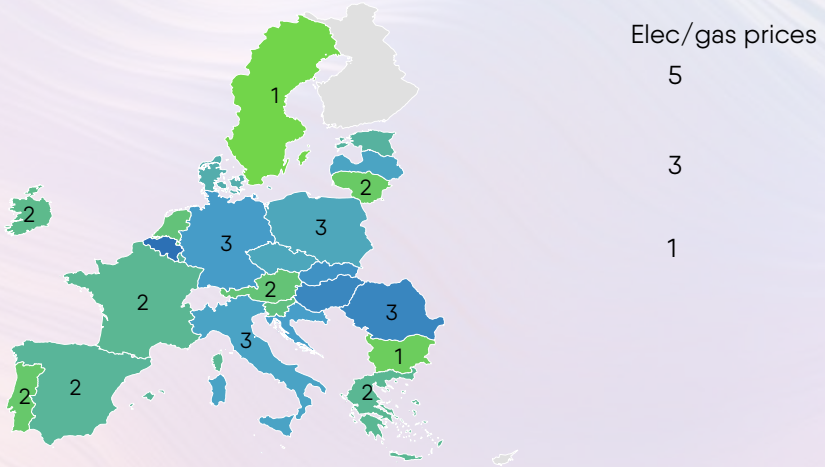
The share of electricity/fuel price is higher for ICE: EVs are more resilient to the fluctuation of energy prices

48 months study led on around 3 years-old's ICE and BEV

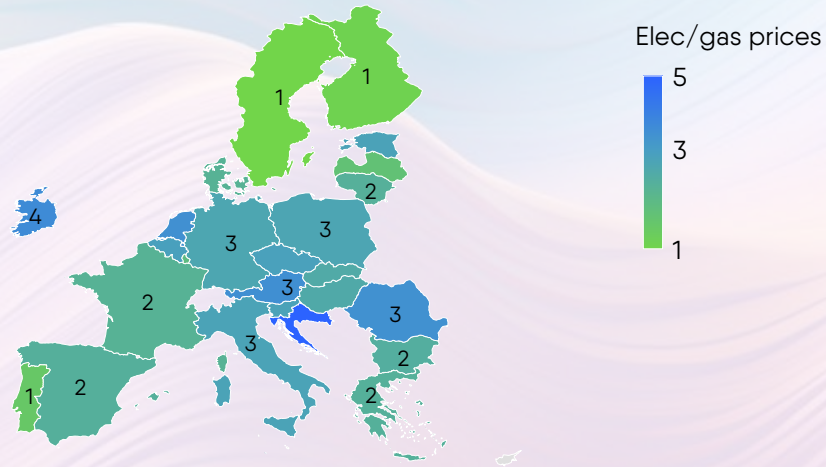
Source: Ayvens, Societe Generale Group

Electricity prices twice higher than gas in 2023, especially for industry

Electricity/gas retail prices ratio for household consumers in 2023



Electricity/gas retail prices ratio for industry in 2023

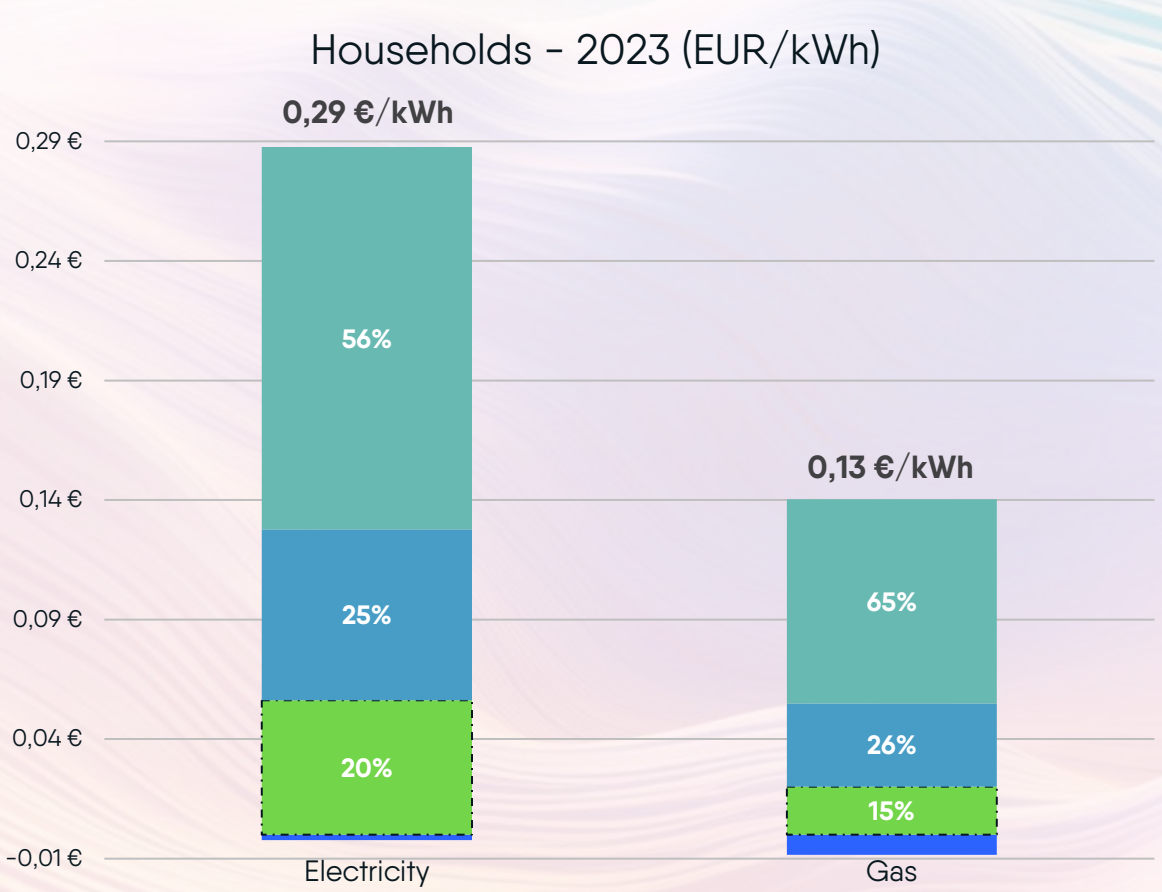


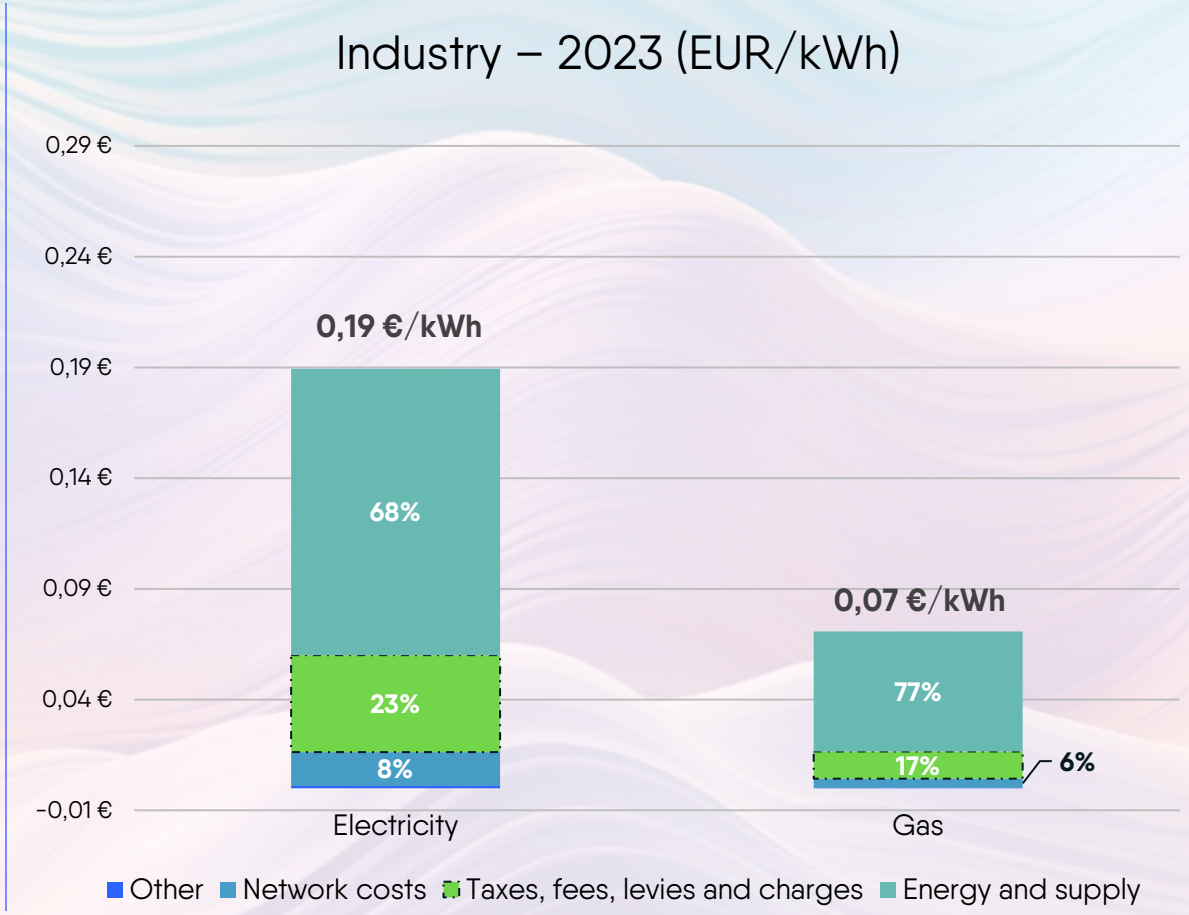
- When looking at the ratio of electricity to gas prices, on average, both household and industry electricity prices were twice as high as gas prices in the EU27 throughout 2023
- Overall, the difference between electricity and gas prices is greater for industry than for households
- On average, electricity is more efficient for producing heat than gas

Prices excluding VAT and other recoverable taxes

Source: Eurostat, Eurelectric

Taxes still contribute significantly to the price difference



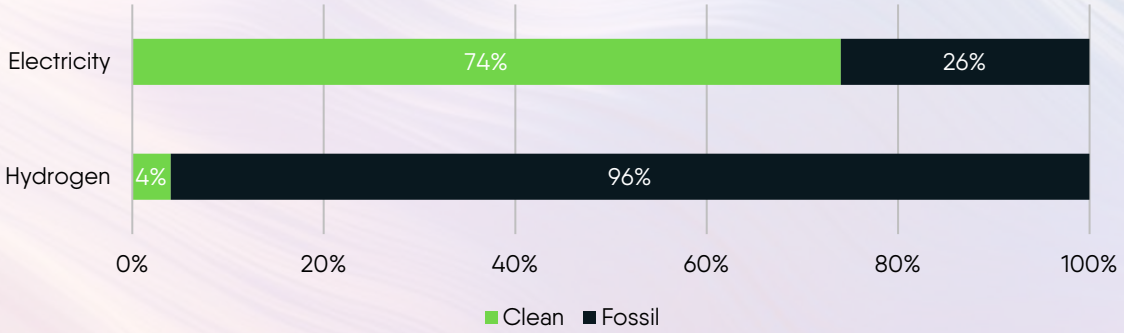


Electricity is taxed 1.4 times more than gas, resulting in higher prices

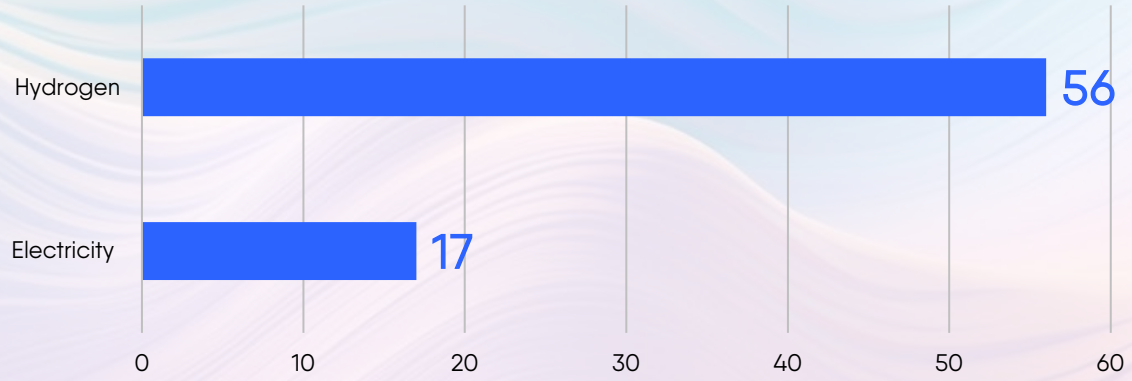
Source: Eurostat

Electrons are more efficient than molecules

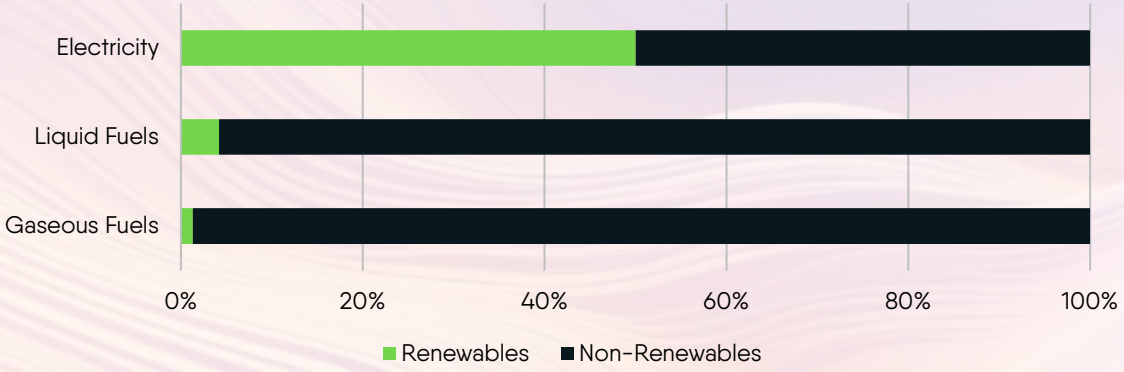
Current share of clean and fossil energy in H2 and electricity in the EU (%)



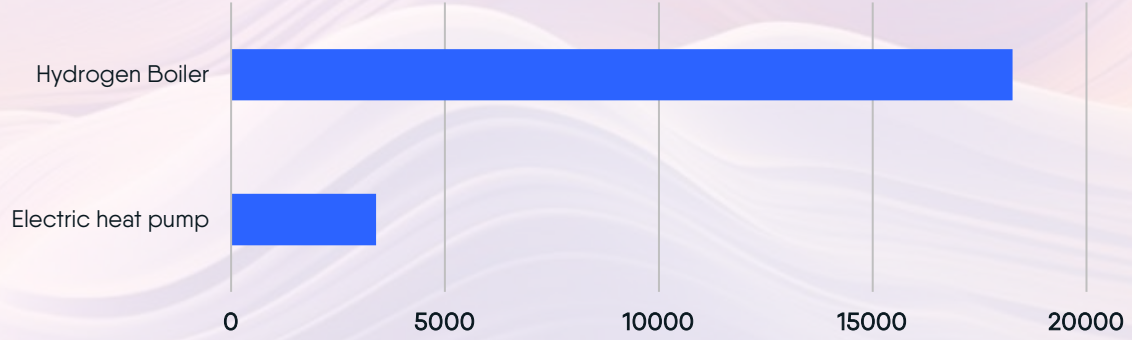
Electricity required to run an EV and FCEV for 100 km (kWh)



Share of renewables in today's major energy vectors (%)

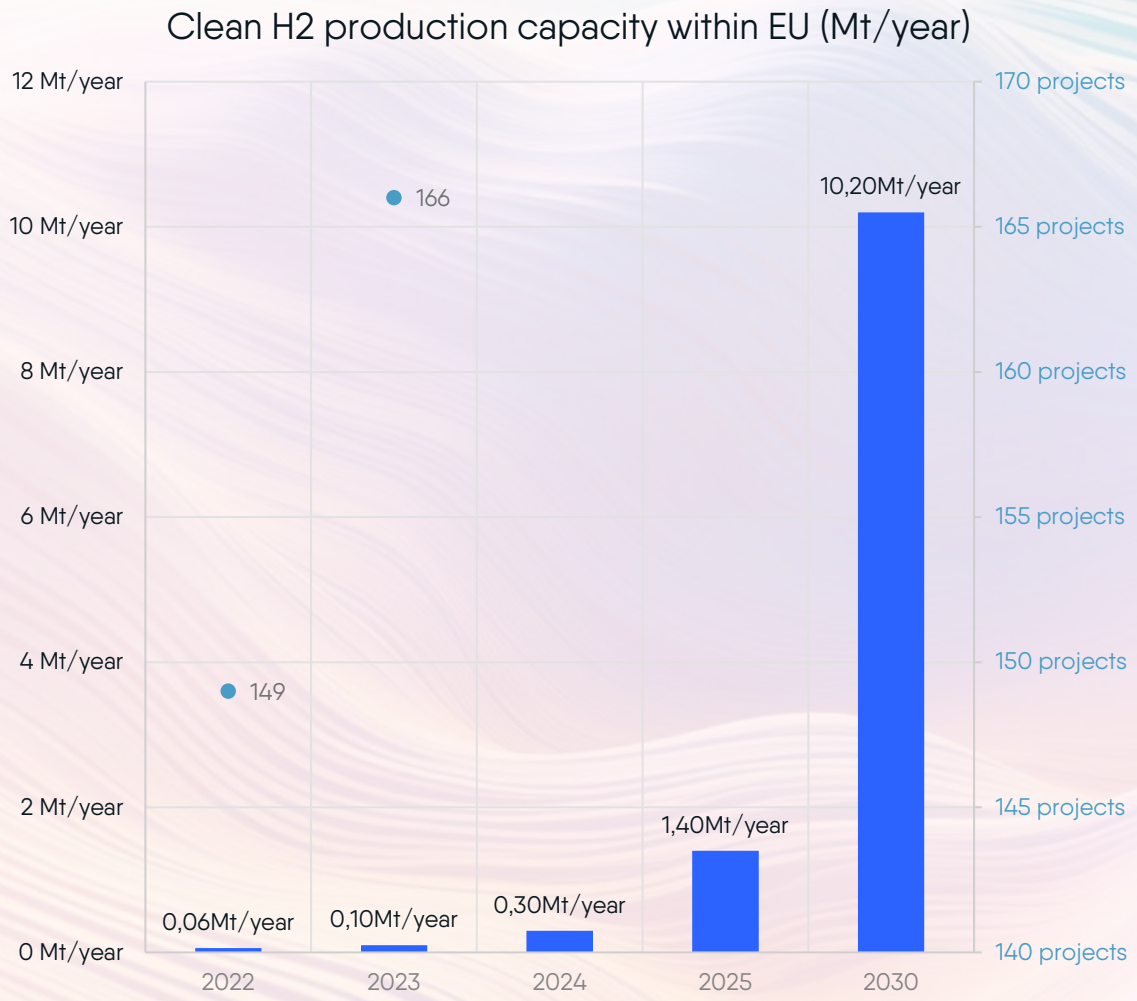


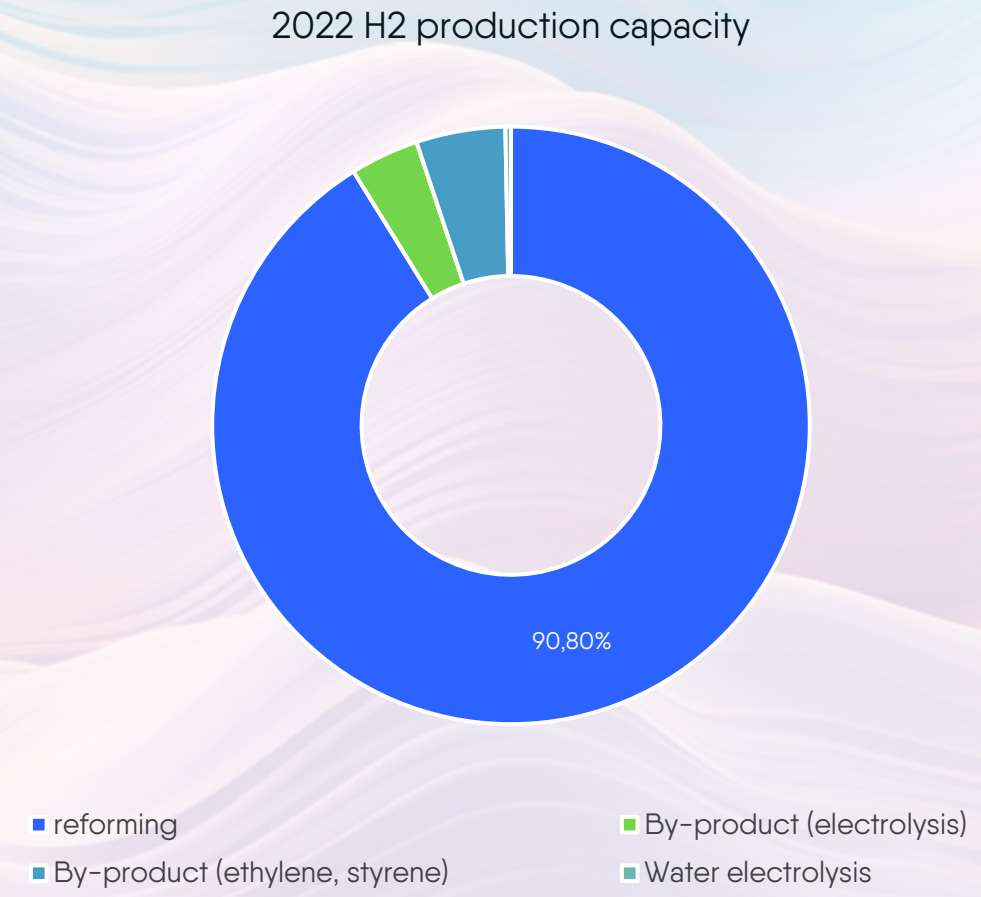
Electricity consumption required to space heat an average EU household (kWh)*



Source: Eurelectric calculations based on Eurostat,
For heating, average household consumption considered 11875 kWh, COP for heat pump assumed to be 3.5 and efficiency of hydrogen boiler starting from electricity to hydrogen to heat assumed to be 65 %. For FCEV vs EV comparison, the electricity is assumed to be grid electricity.

Indirect electrification: electrolyser capacity must grow

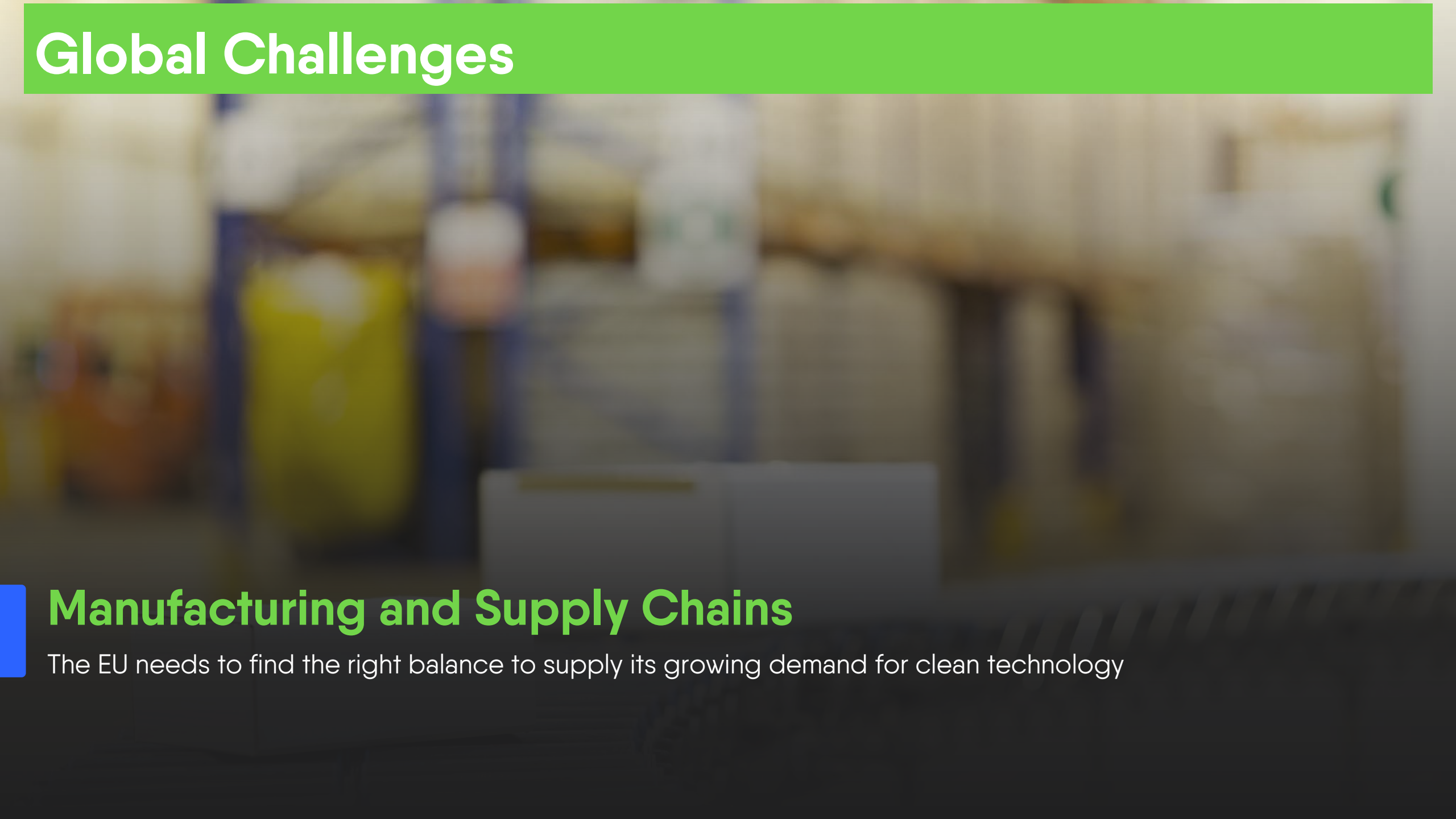




Source: Clean Hydrogen Europe 2023 report

GLOBAL CHALLENGES

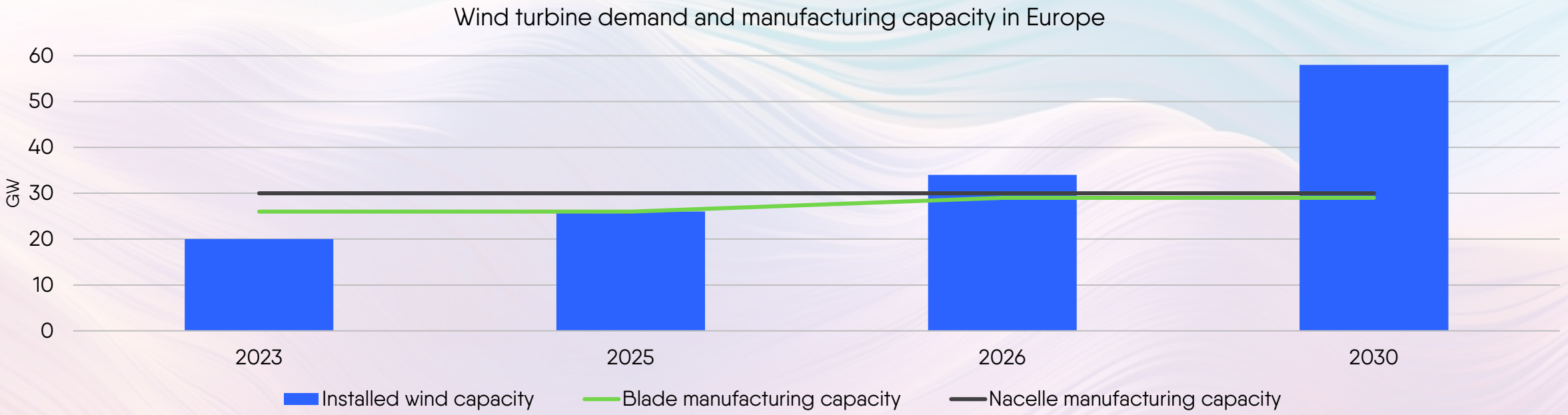
Global Challenges



Manufacturing and Supply Chains

The EU needs to find the right balance to supply its growing demand for clean technology

Risky supply chain for wind



Europe boasts one of the world's largest wind power component manufacturing capacities with a well interconnected supply chain

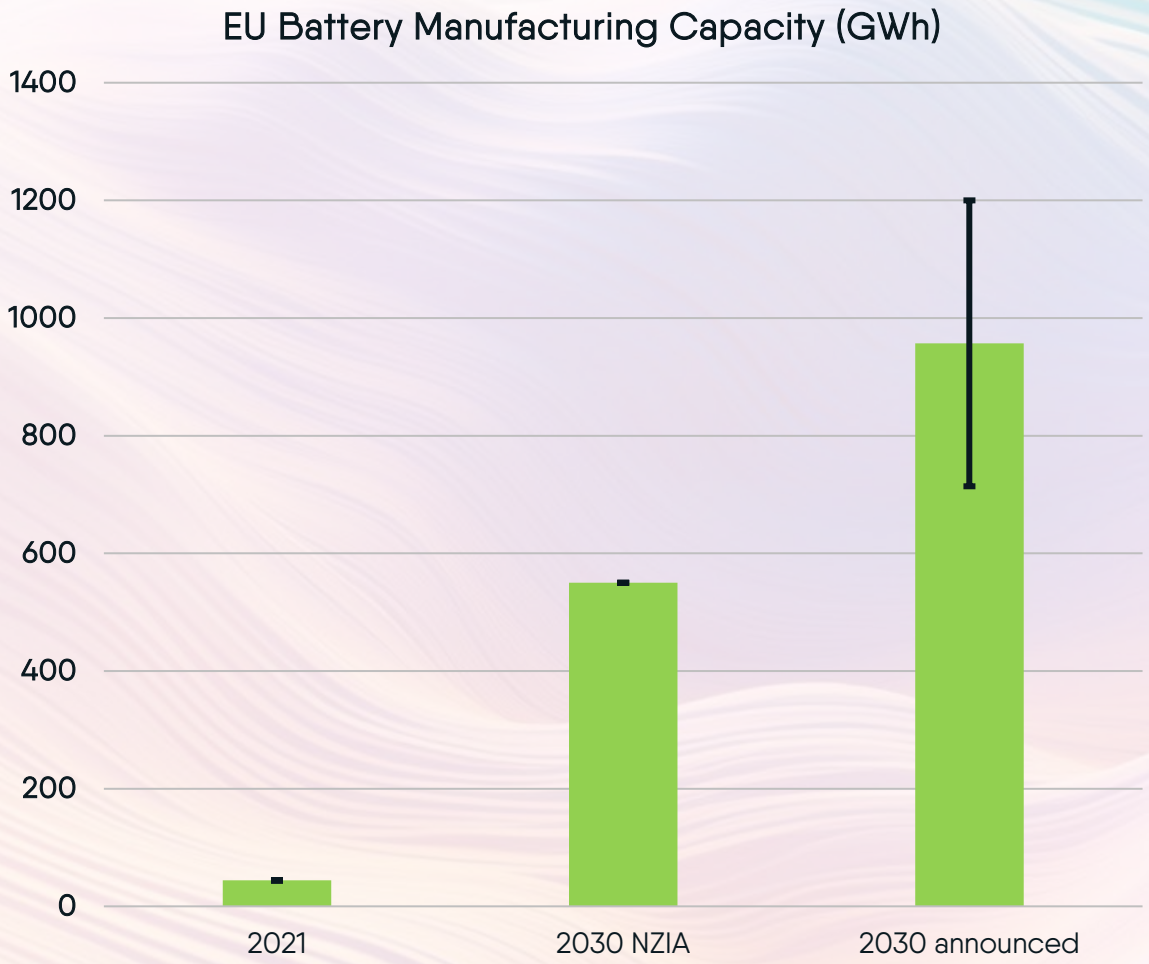
Demand is expected to outpace the turbine supply by 2026

Current European manufacturing capacity exceeds the annual wind turbine demand in Europe

Plans for expanding capacity are needed if the demand is to be met by European supply

Source: Wind Europe

EU battery manufacturing capacity must grow



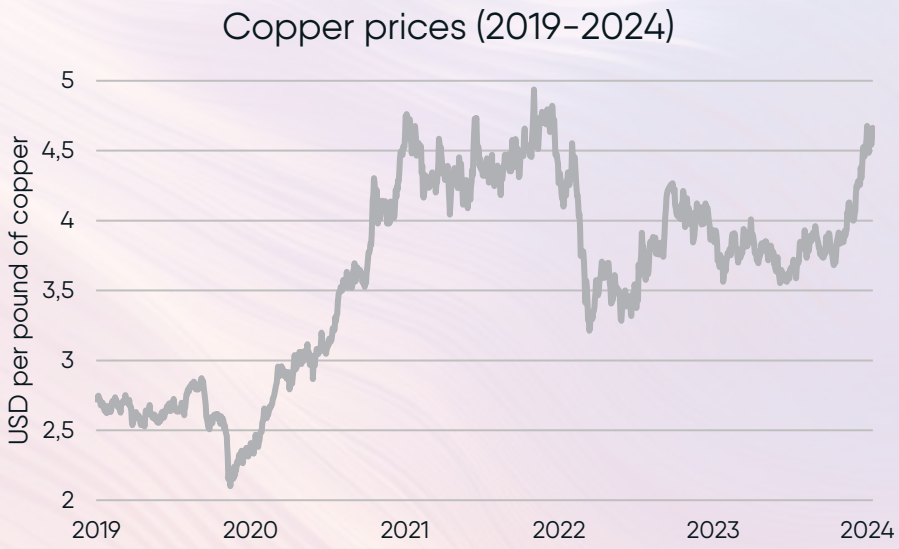
EU battery manufacturing met only 27% of the e-mobility sector's demand in 2021

92% of the final energy demand from industries can be electrified with current technology

Given announced projects, capacity will reach between 714-1200 GWh by 2030. However, several challenges remain, like attractive incentives in other economies and delays in said projects

Source: European court of auditors

Transformer shortage could cause grid bottleneck



Transformers use high quality copper. Copper prices have more than doubled in the past 5 years due to a high demand and stagnant supply. Copper represents around 14% of DSO investments.

Transformer Lead Time

2X

9-12 months

2 Years

Supply chain crisis still persists since covid. Currently, we have around 4.5 million transformers and by 2050 we will need around 9 million for the energy transition.

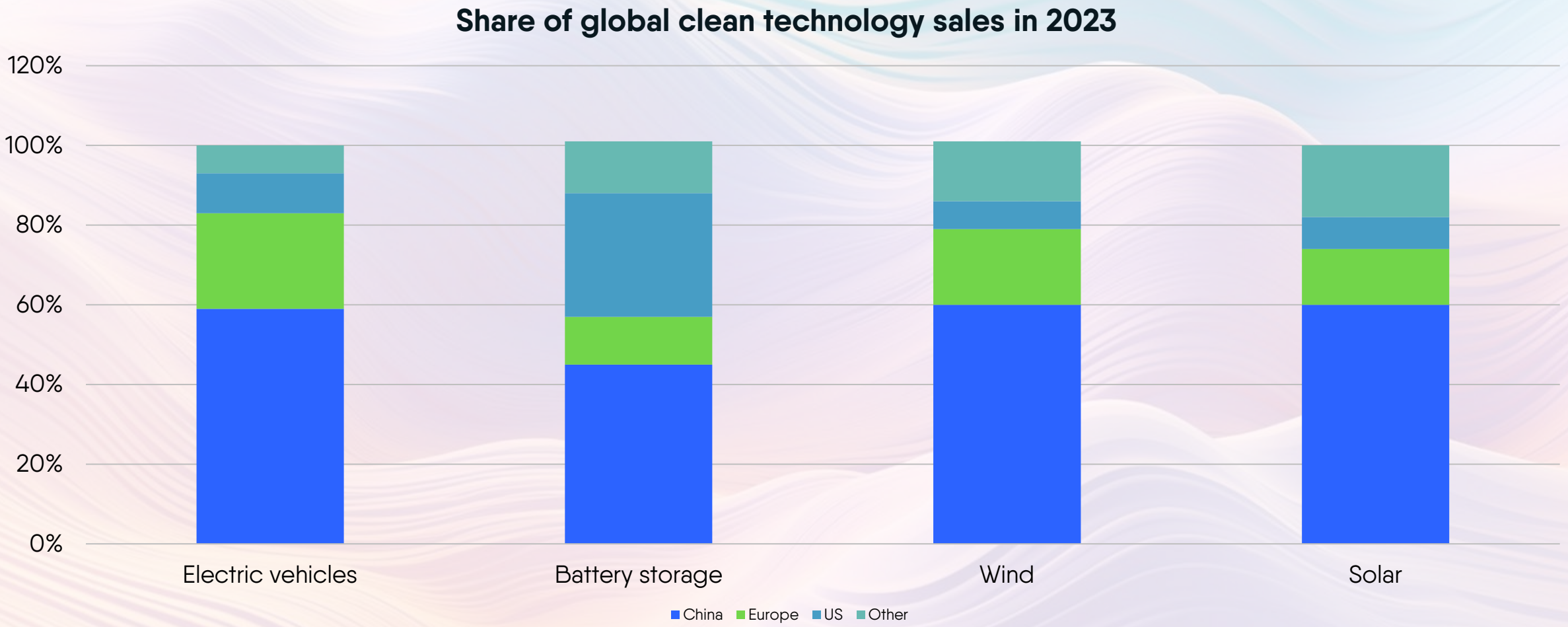
Transformer Price

+63%

The growing cost of copper, increasing demand and growing shortages have caused transformer prices to double when compared to pre-covid levels.

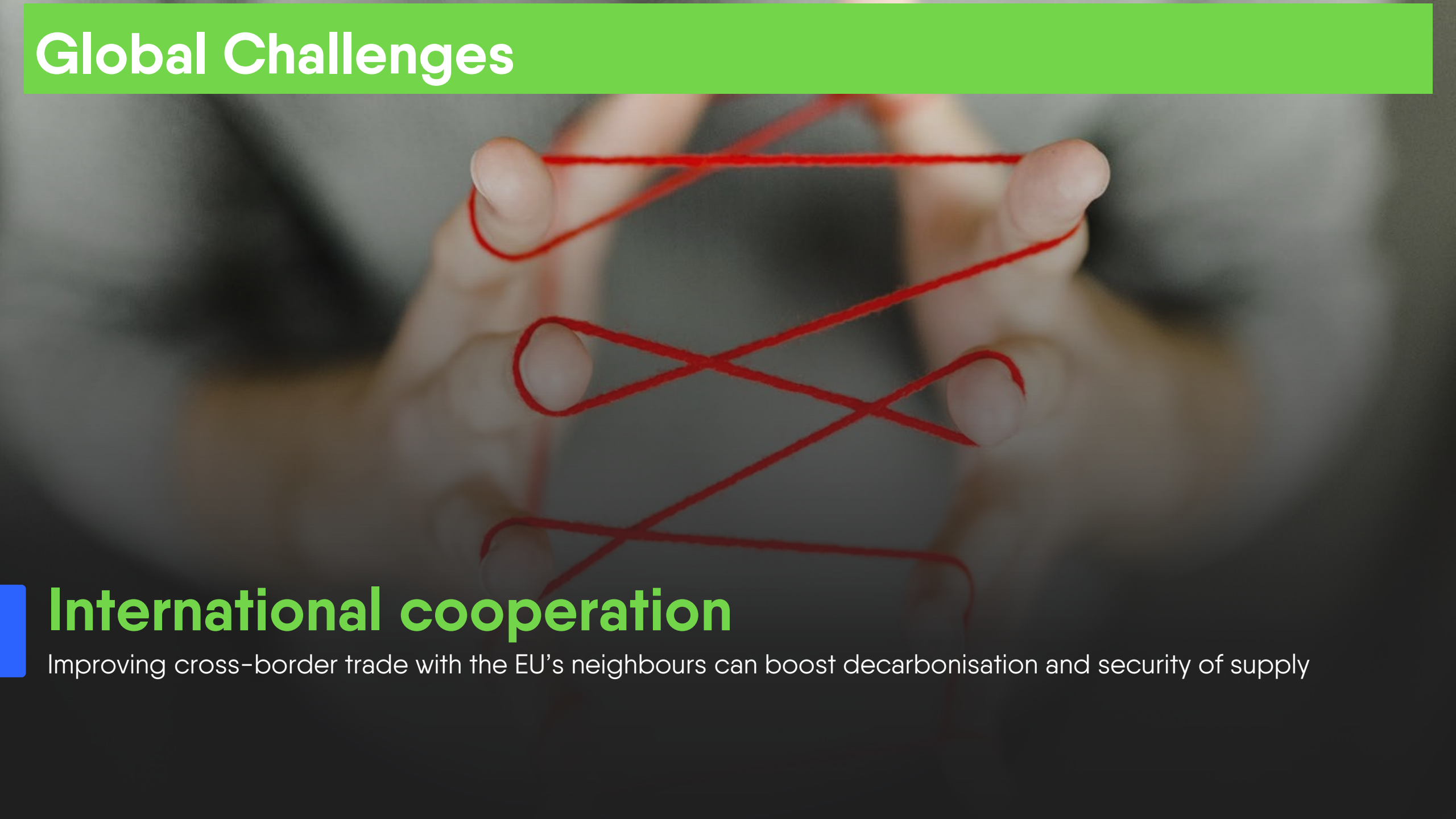
Source: Nasdaq for copper prices, Eurelectric, Euractiv

China is leading in global clean technology, but Europe can still catch-up



Source: BNEF

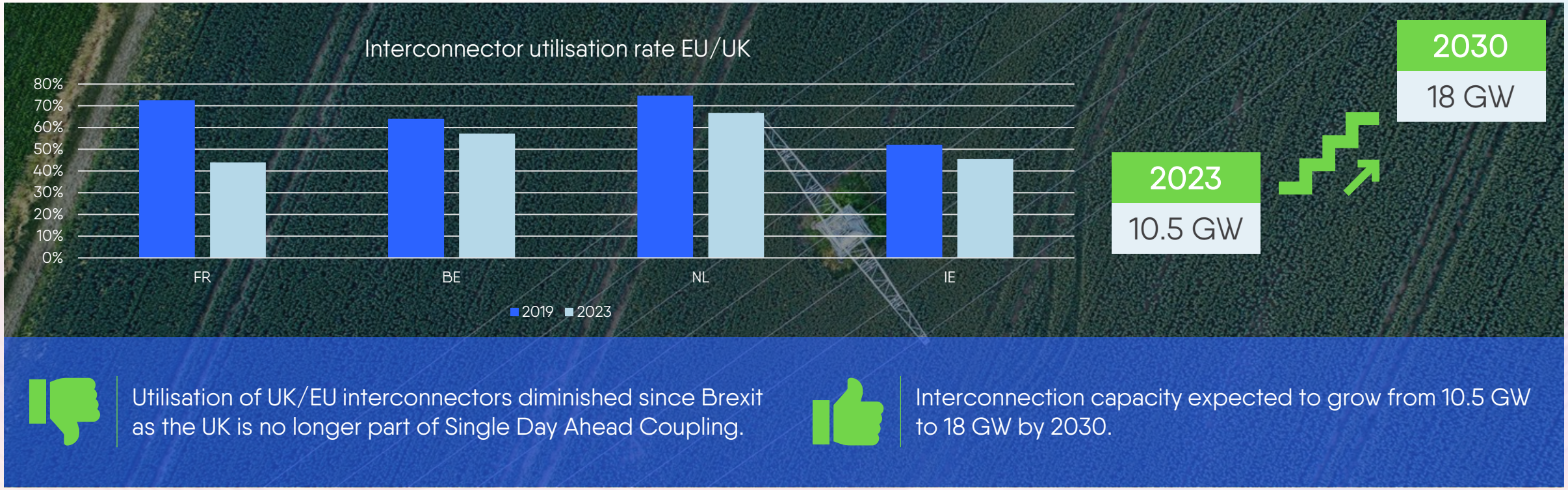
Global Challenges



International cooperation

Improving cross-border trade with the EU's neighbours can boost decarbonisation and security of supply

Unlocking North Sea wind: enhanced EU-UK trade needed



Utilisation of UK/EU interconnectors diminished since Brexit as the UK is no longer part of Single Day Ahead Coupling.

Interconnection capacity expected to grow from 10.5 GW to 18 GW by 2030.

Key insights

- Huge volume of offshore expected to be build around the British isles
- Improved EU-UK trade arrangements could help unleash the full renewable energy potential of the North Sea
- EU CBAM should not jeopardize the trade between the UK and the EU

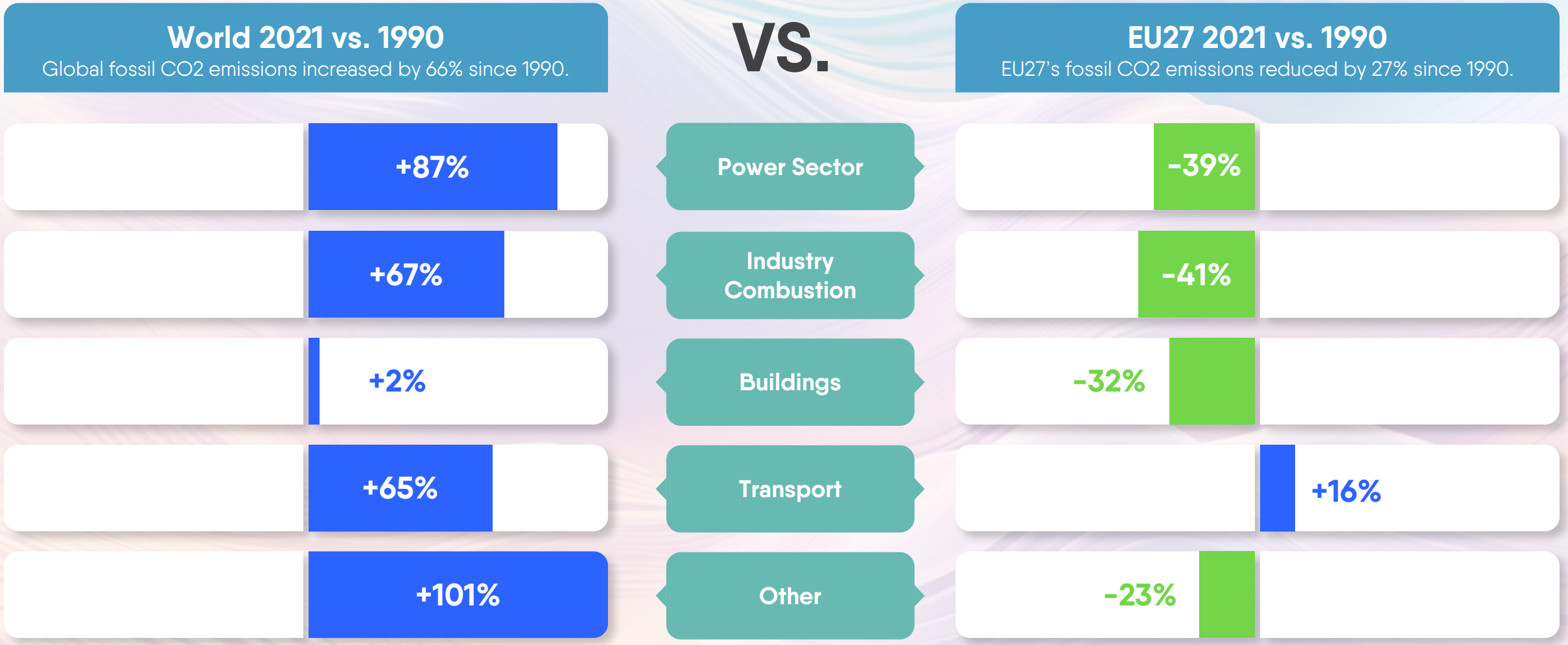
Source: Eurelectric's Elda, Energy UK, Gov.UK

Global Challenges

Climate Diplomacy

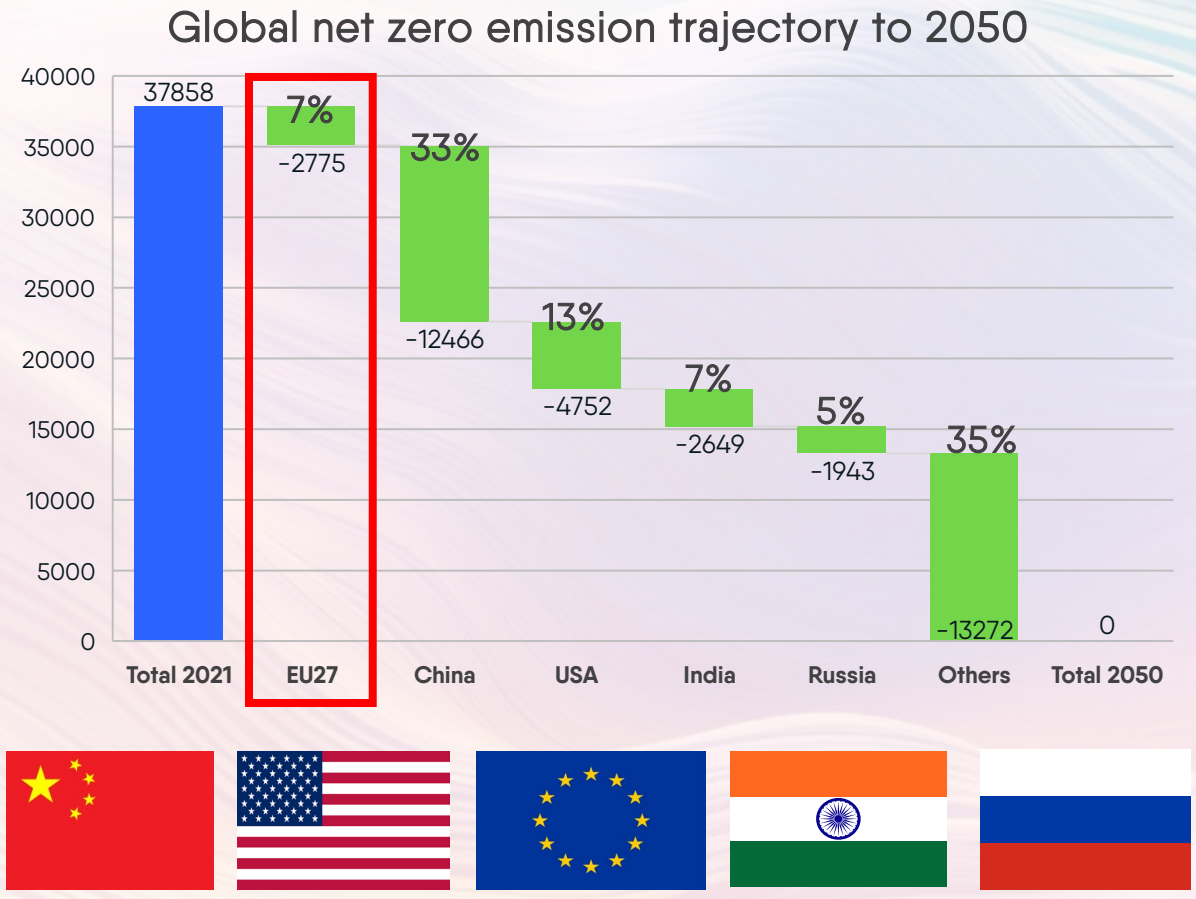
The whole world needs to contribute to decarbonisation

Emission reduction: World vs. EU27



Source: JRC

EU represents small fraction of total global emissions



65% of global emissions

Net Zero Target

2050	2060	2070

- Out of the top 5 emitters, the EU leads in the quest for achieving net zero
- US faces a potentially risky political situation that could jeopardize its path to net zero
- China and India, the growing emitters, continue to build coal power plants

Source: JRC, Climate Action Tracker

Policy Recommendations

Policy recommendations

The power sector has made significant strides towards decarbonisation over the past year, achieving a 50% reduction of emissions between 2008 and 2023. The market is functioning effectively and has strong fundamentals. Moving forward, our focus must shift to the following policy recommendations:

01

Ramping up electrification as quickly as possible. The slow down in electricity demand, and especially of industrial electricity demand, should be addressed by easing the economic barriers. An electrification action plan should be created to showcase the true value of electricity.

02

Stimulate growth in **flexible and storage technologies.** The role of flexibility in the energy system should be duly recognised. This flexibility can come from either the demand side, from generation assets, energy storage and/or electrolysers. An energy storage strategy is needed to stimulate storage investment.

03

Grid infrastructure development should be facilitated by modernising grid tariffs and ensuring access to EU funds. Forward-looking grid strategies such as anticipatory investments, optimal asset management and grid-friendly flexibility should be implemented.

04

Industrial competitiveness should be fostered through an industrial complement to the EU Green Deal, as well as competitively priced electricity and a swift implementation of the EMD.