

Conference 7. The European electrical market

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**BIP Energy: Generation,
Storage and Management**



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- #03 Sustainability
- #04 Electrification
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Security of supply

#01

Context for Security of Supply

Our world has never witnessed an energy crisis of this depth and complexity.



Ukraine War



Post COVID



Crisis of globalization



COP 28



Security of supply



Logistics Issues



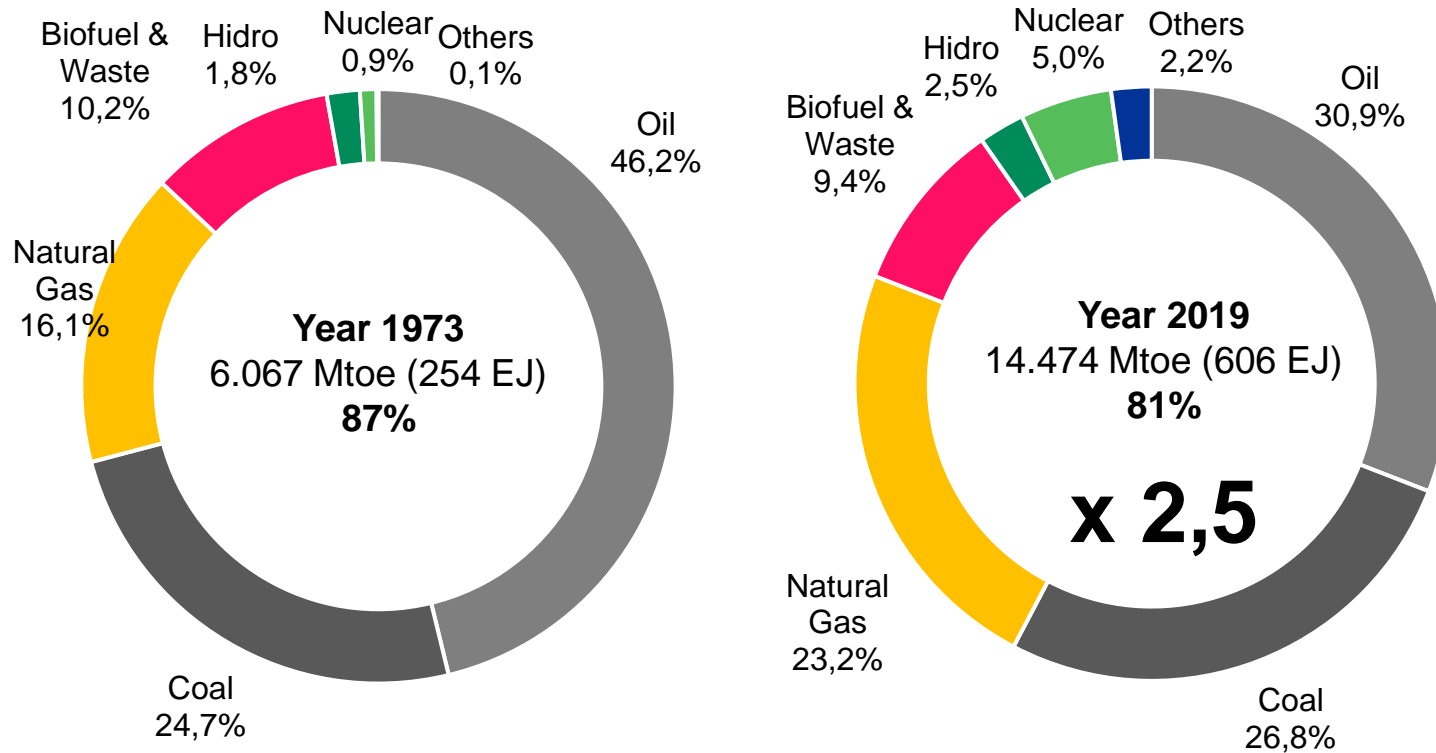
High energy costs



Inflation

Global Energy Supply

The world has hardly changed the MIX in the last 50 years, especially in fossil fuels, (Oil + Coal + Gas) = 87% vs 81%.



War

Fossil energy has played a key role in the development of countries during the previous century, (1st world power USA) and reason for armed conflicts.

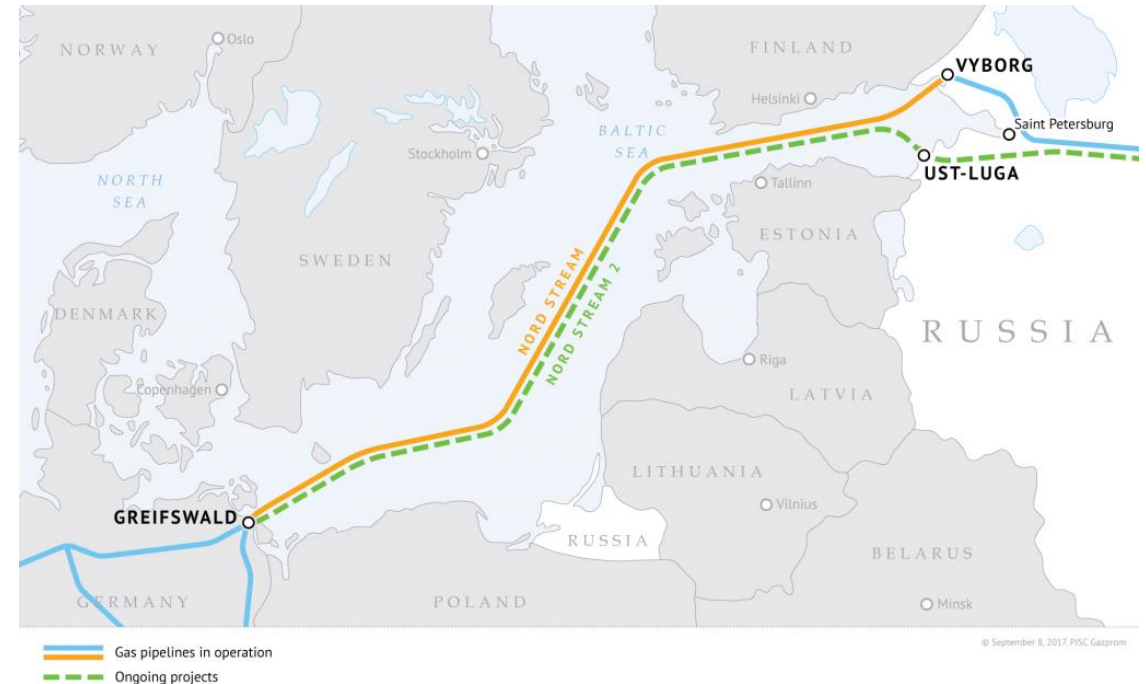
- In 1973, the Arab-Israeli Yom Kippur War resulted in the first oil crisis. There is a huge transfer of international power to the Middle East.
- The oil embargo on the West and the reduction of production by Arab oil-producing countries, in retaliation for their support for Israel, triggered a drastic rise in crude oil prices and a crisis in the industrialized economies after three decades of uninterrupted growth.
- Europe, dependent on oil that it could not produce and coming from environments with an unstable geopolitical situation, opens the way to nuclear energy at the moment and the supply of gas from Russia.



Nord Stream

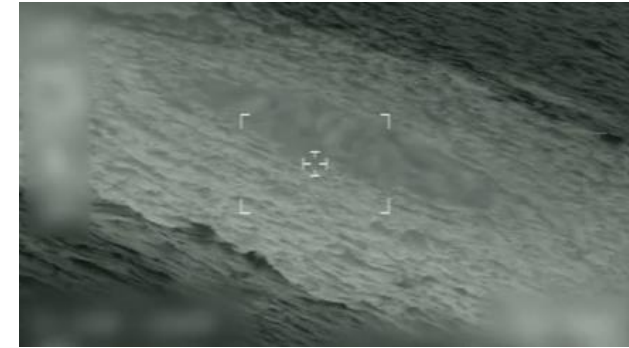
Nord Stream 1, which had been met with staunch opposition from the US and Ukraine, is in Europe's focus because of Russia's current influence in Europe.

- The North Stream (1 and 2 branches of about 1,200 km c.u.) would allow doubling (from 27,500 to 55,000 million m³/year) between Germany and Russia.
- The North Stream 2 completed in September 2021, its certification was paralyzed for not complying with European regulatory procedures and its construction company declared bankruptcy.
- Germany abandons nuclear energy after the Fukushima accident, betting on renewables with Energiewende.
- The German energy matrix, before the war in Ukraine, was highly dependent on Russia (33% oil, 55% gas and 45% coal).



Nord Stream

The sabotage of Nord Stream 1 and 2 ends the possibility of Russian gas reaching the EU and prices soar by 15%. TTF futures went from €183 to €210/MWh.

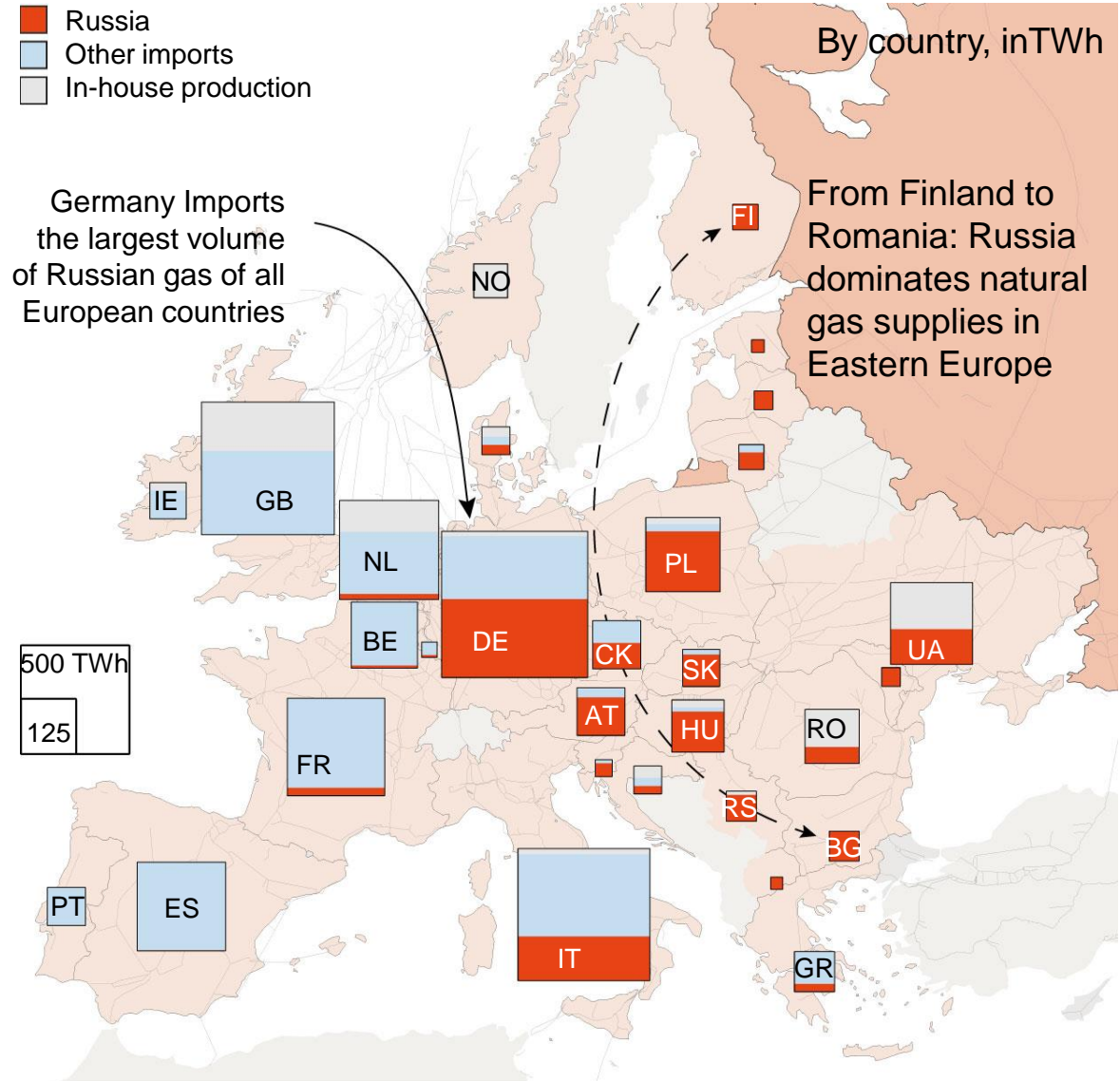


Security of supply in Europe

The current energy crisis may be a turning point towards a cleaner and more secure energy system.

Dependence on Russia has been particularly high in Eastern Europe and Germany in recent years. Germany has consumed the largest volume of Russian gas of any European country (55% gas, 33% oil, and 45% coal).

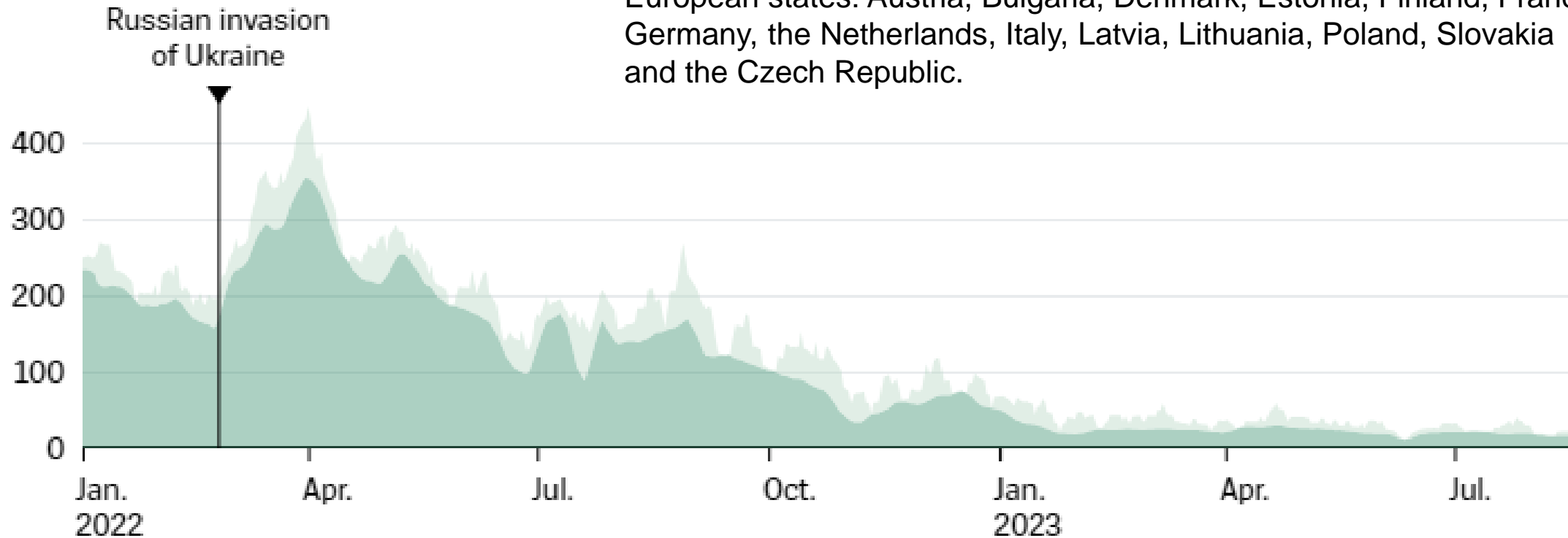
The need to replace Russian gas is pressing to secure supply, coupled with strong climate ambition, resulting in the increase in renewable energy capacity between 2022-2027 doubling compared to the previous five years.



Dependence on Russian gas from 40% to 5%

7-day average value in M€ of daily Russian gas exports to the EU

Pipeline LNG



Palestinian-Israeli conflict

On Saturday, October 7, 2023, there was a surprise attack by the Palestinian group.



Hamas' surprise attack on Israel on October 7 from the Gaza Strip is considered by many to be the worst the country has ever suffered.

Hamas is a Palestinian political and military organization, created in 1987 with the stated goal of liberating Palestine. It is considered a terrorist group by the U.S. and Israel.

On Friday the 13th, almost a week later, Israeli infantry made their first incursions into the Gaza Strip. "Operation Iron Sword"

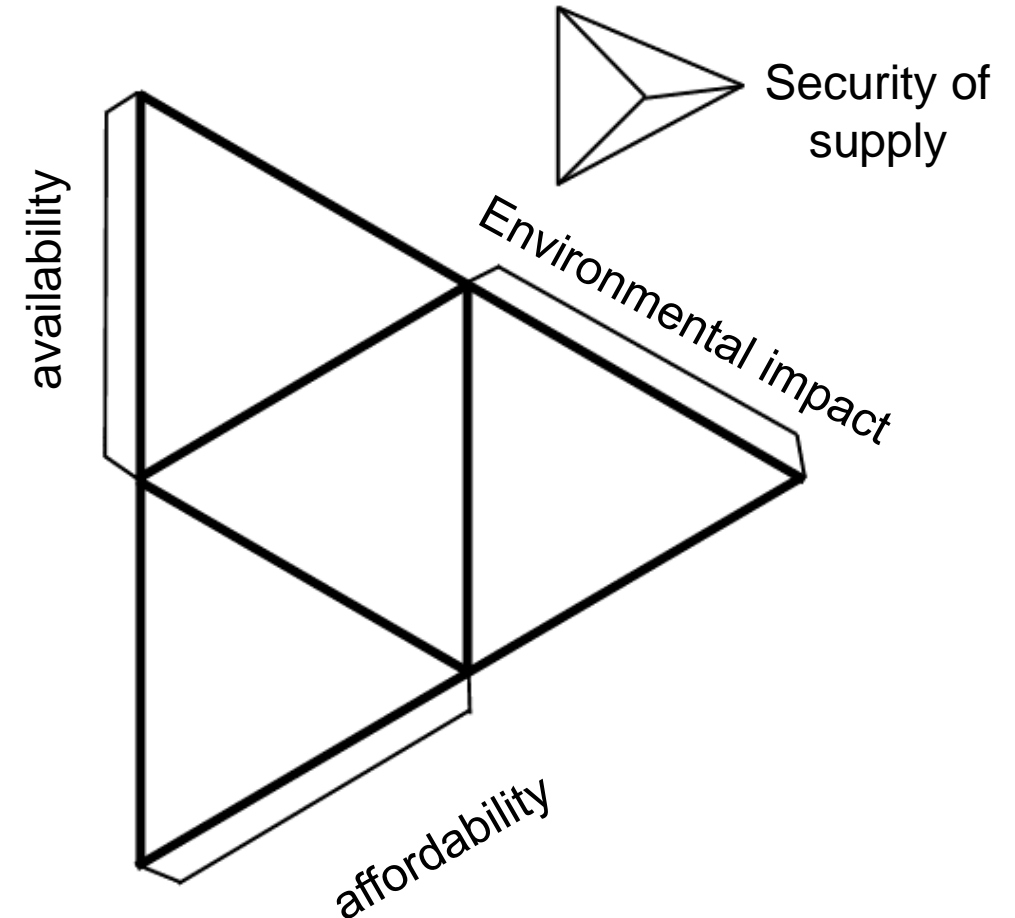
The "energy tetralemma"

With the invasion of Ukraine and Europe's energy dependence, they have brought the energy transition to a new dimension of energy independence.

In the current geopolitical context, rules also count and, in this case, the so-called "energy trilemma" is a good starting point.

It is a concept coined by the World Energy Council (WEC 2010) to measure the functioning of the energy systems of the largest countries.

It is a three-dimensional indicator that assesses three basic pillars of energy: its availability, equity and environmental impact.



Natural gas price on the Dutch TTF market

The price remained below €25/MWh between April 2017 and April 2021, bottoming out at €3/MWh in the early months of the pandemic.

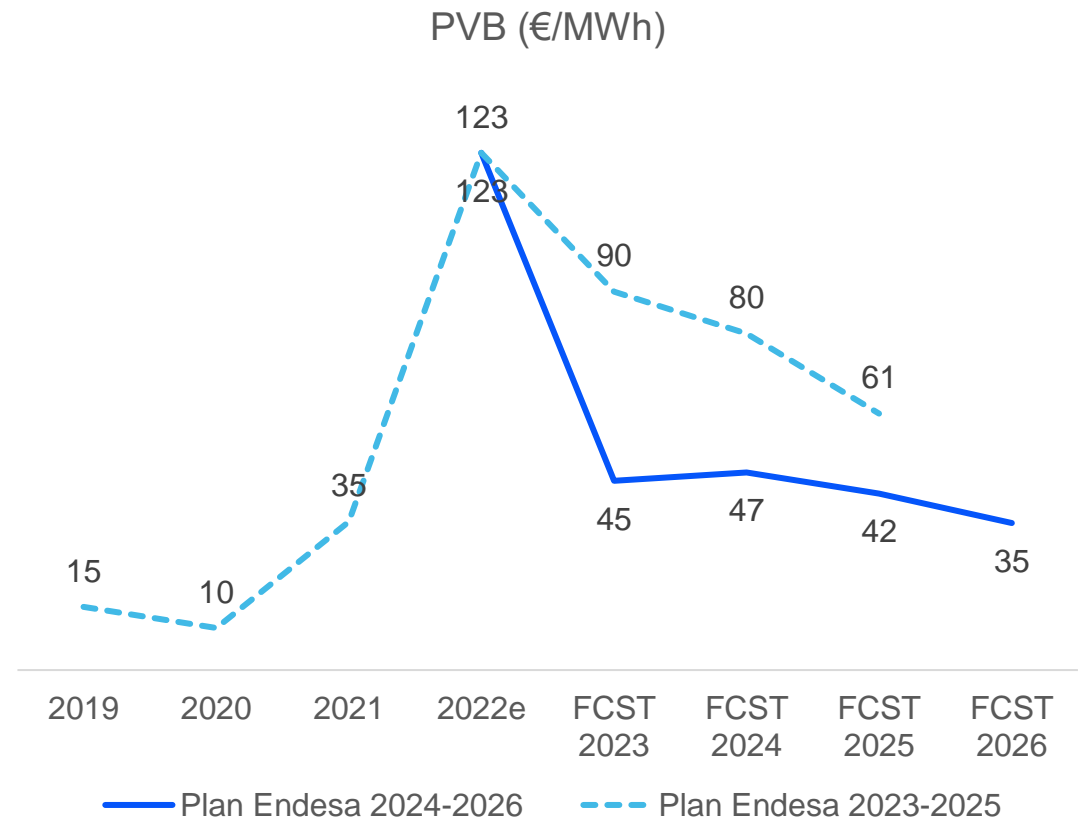
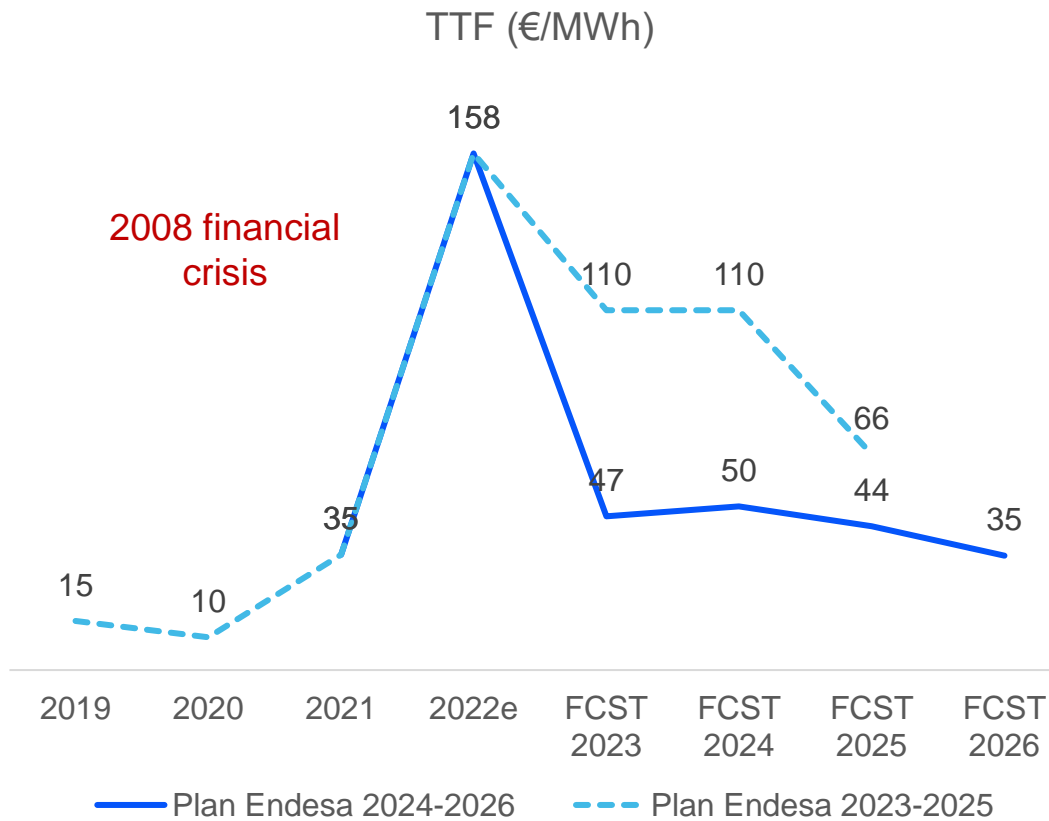
- A request has been made to remove the reference to the Dutch Title Transfer Facility (TTF).
- Different events have marked a continuous rise and highs: €137/MWh on 13/12/2021, €193/MWh on 28/2/2022 and the record of €339/MWh on 22/8/2022, with up to 14 times the price prior to this stage.
- European markets have recorded highs above €300/MWh, about 15 times above the historical average.



11/2023	2023	2024	2025	2026
TTF €/MWh	45	47	42	35

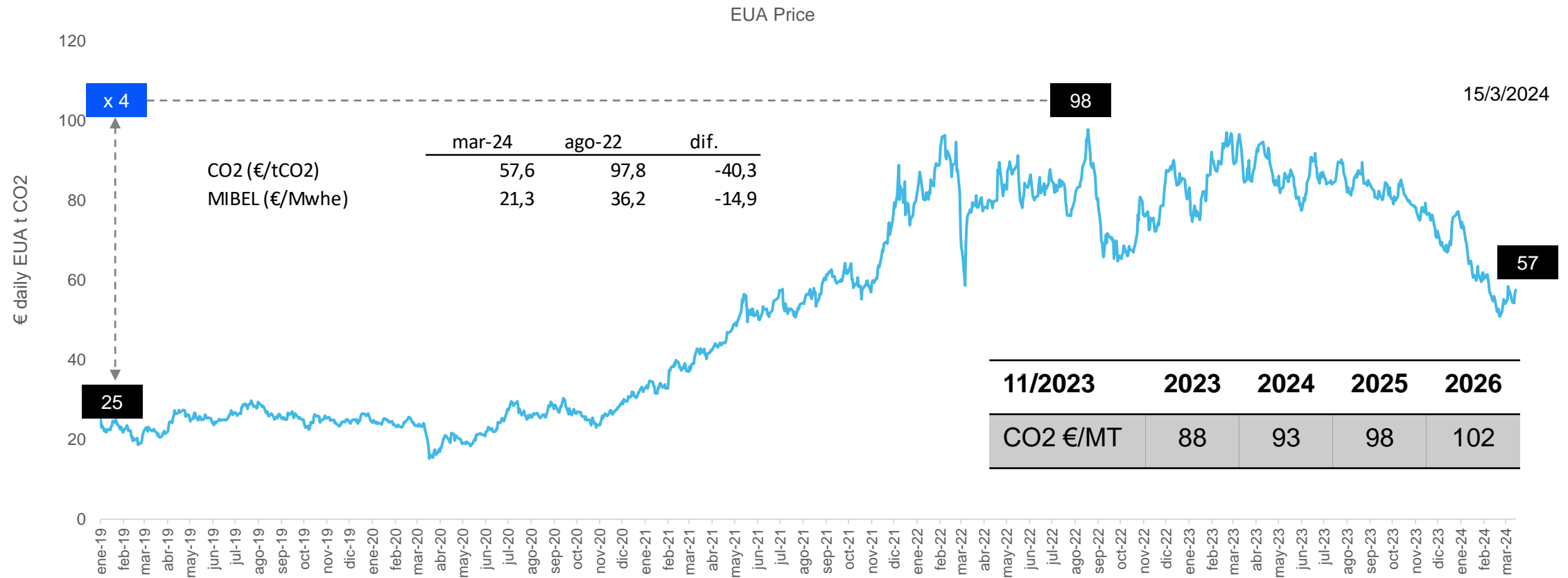
Impact on TTF & PVB prices

Prices in the Spanish Hub at its point of exchange, Virtual Balancing Point (PVB) in MIBGAS show an increase of 127% while in France (French PEG) it reaches 140%.



CO₂ European Emission Allowances

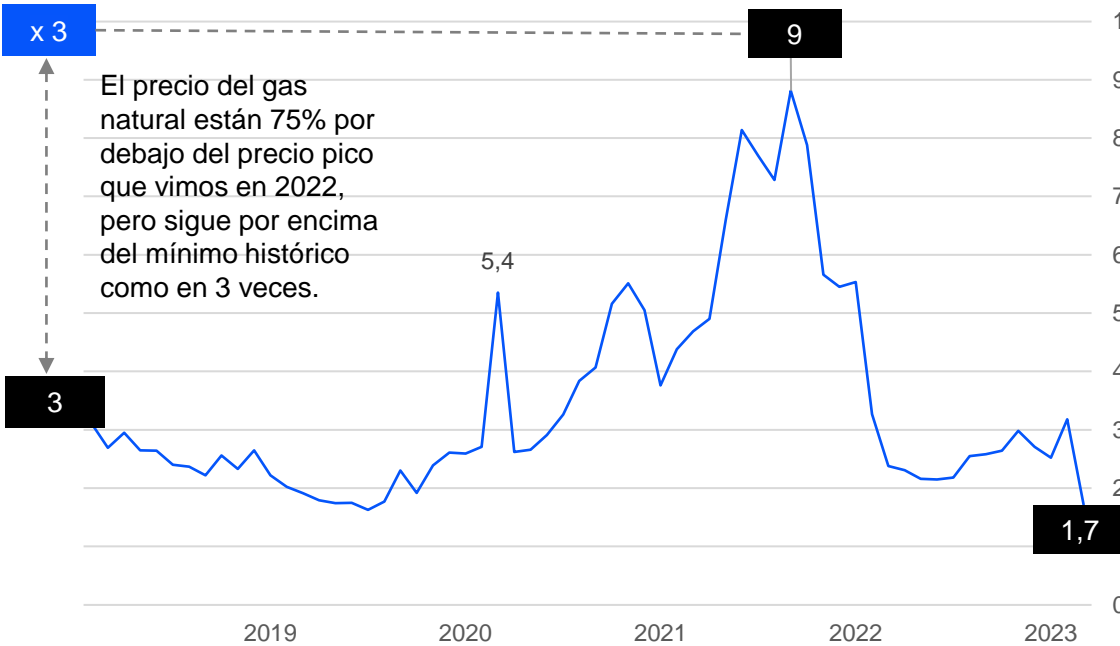
Since the European Parliament approved new measures to speed up compliance with the Paris agreement, the price of CO₂ has increased after years of minimum values.



Henry Hub y Brent

The Henry Hub in 2022 was below \$4/MMBTU and peaked at \$10 in the summer, since the fall it has gone from \$6 to \$3/MMBTU. Brent with a high of \$119/BBL (6/2022) is now still at high prices, compared to the low of \$21 (04/2020), .

Henry Hub (\$/MMBTU)



Brent (\$/BBL)

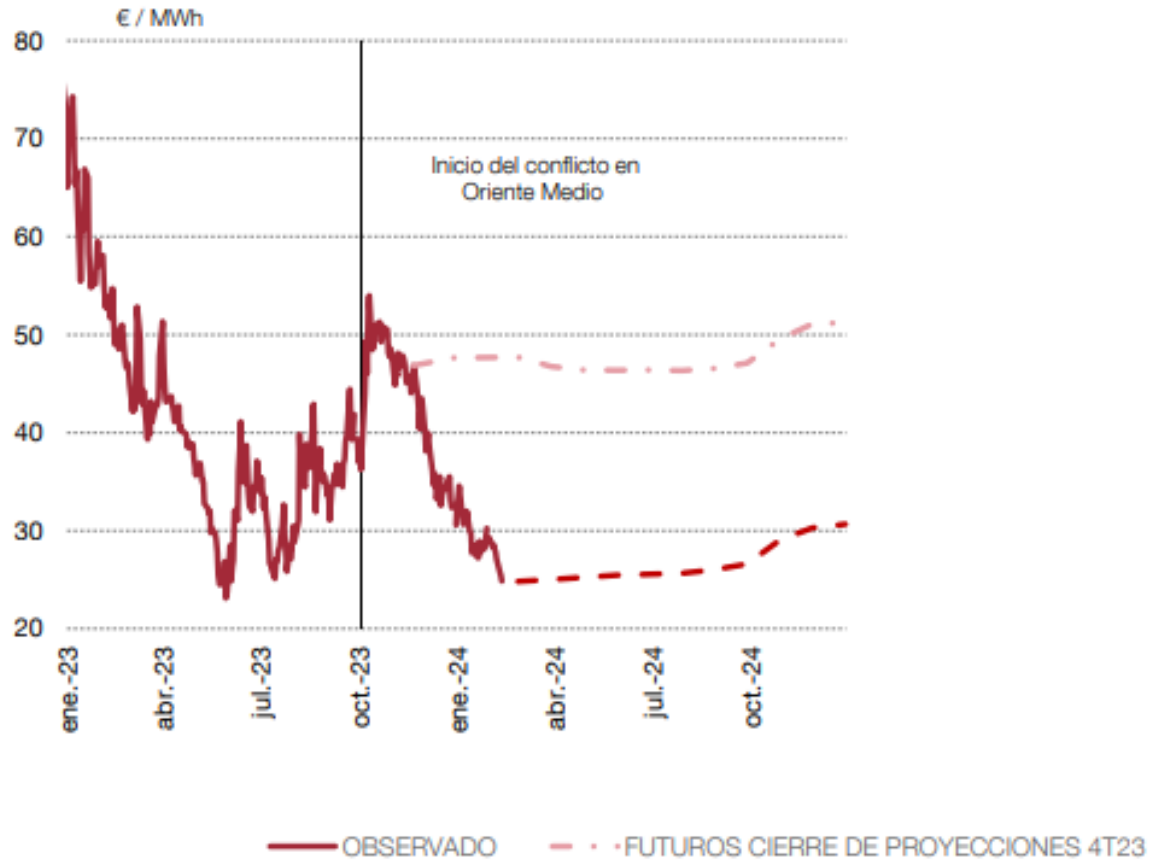


11/2023	2023	2024	2025	2026
HH \$/MMBTU	3,4	3,2	3,6	3,9

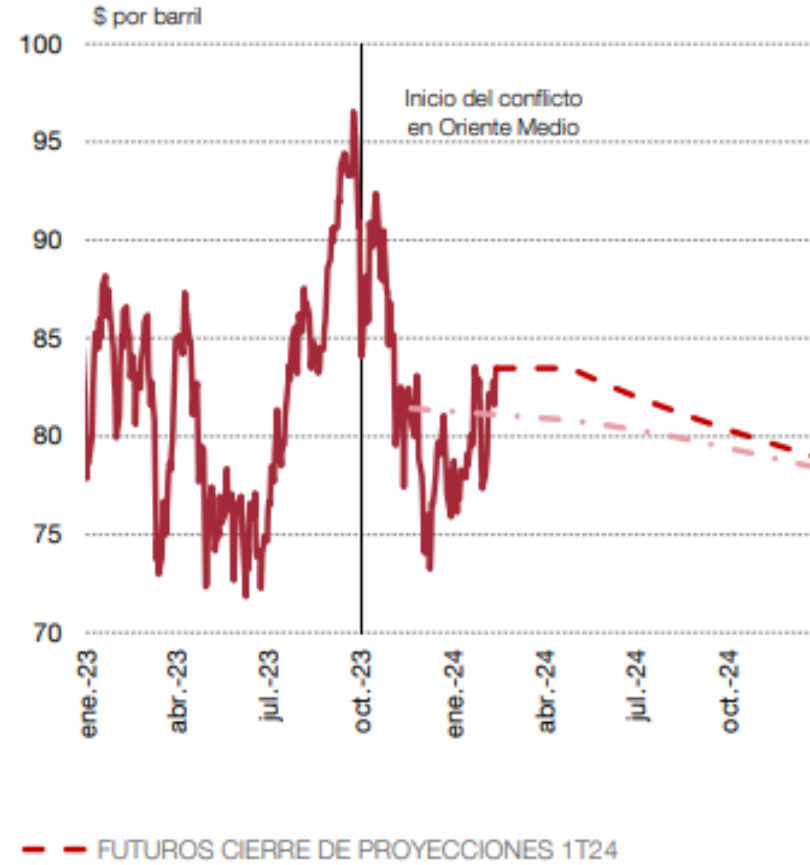
11/2023	2023	2024	2025	2026
BRENT \$/BBL	85	84	81	75

Previsión Bloomberg

PRECIO DEL GAS NATURAL (a)

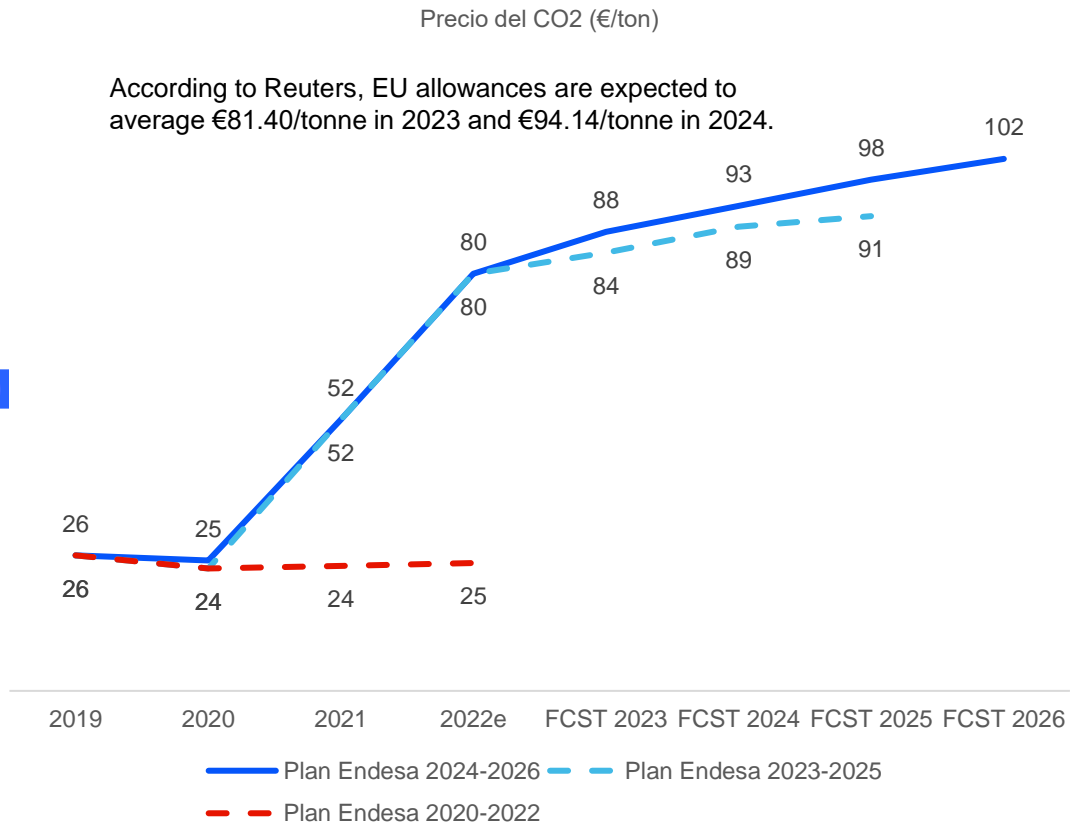
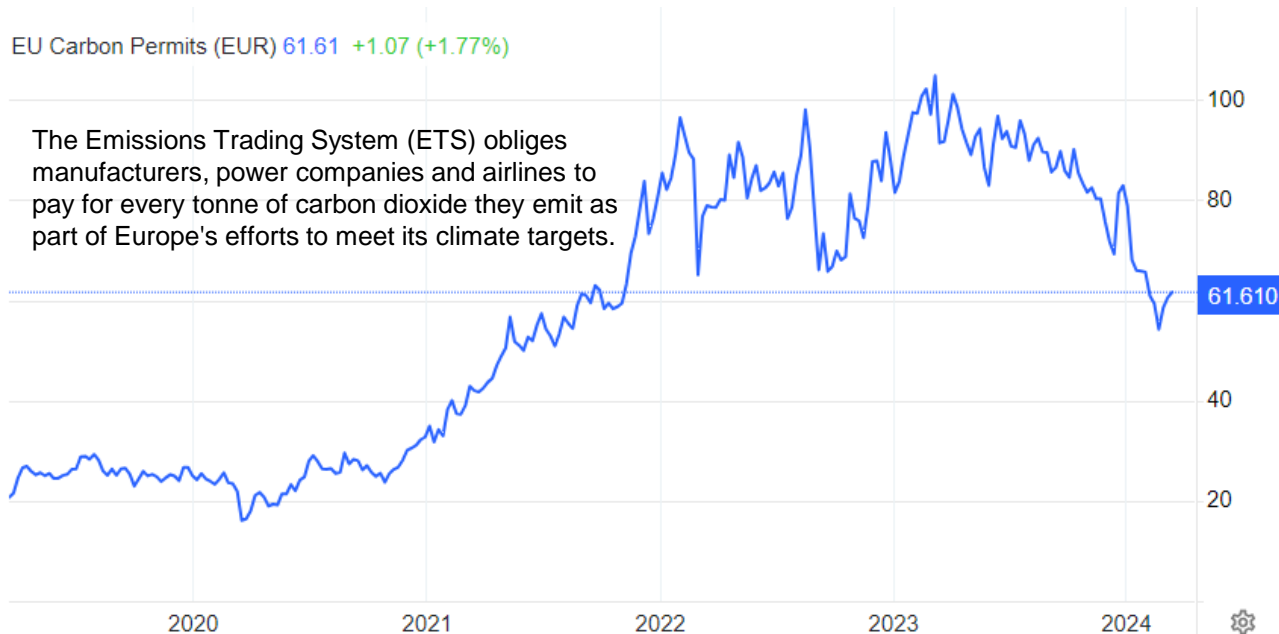


PRECIO DEL PETRÓLEO (a)



Impact on CO2 prices

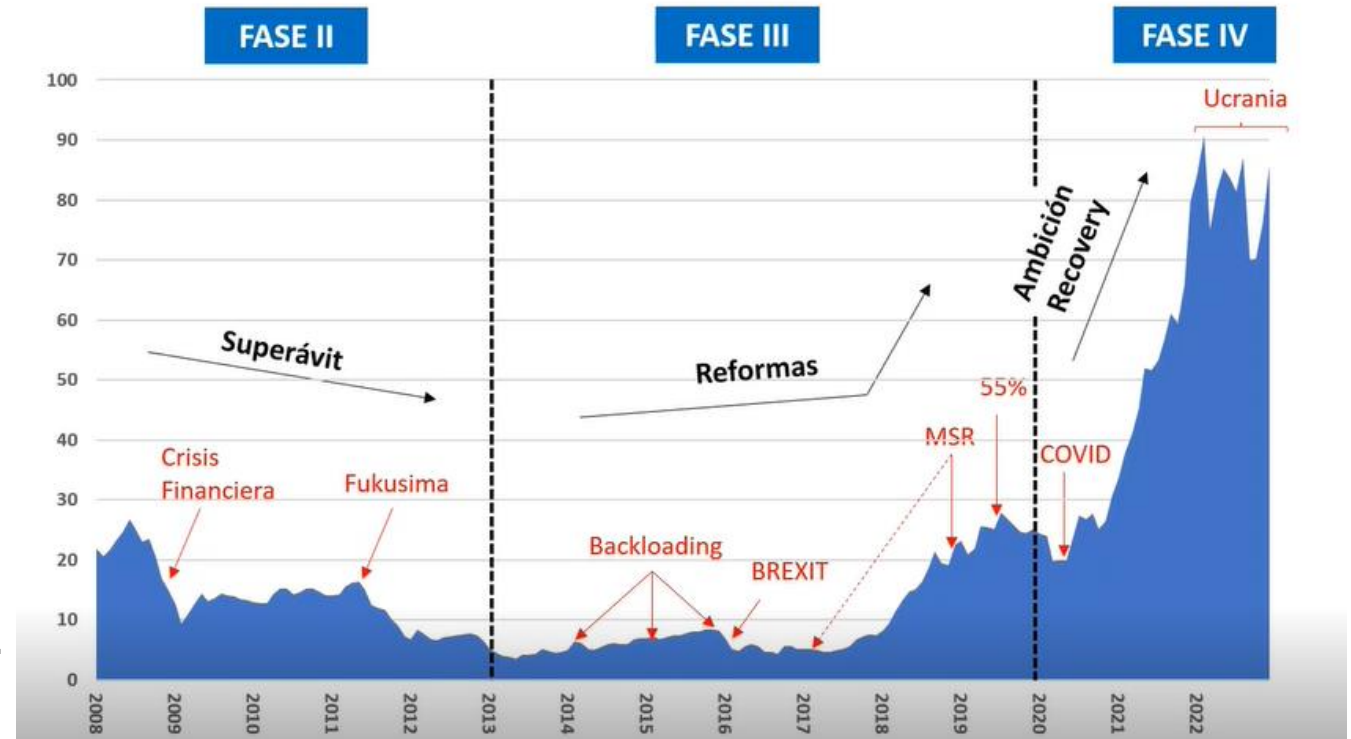
Carbon prices have reached record levels of €100/ton in February 2023. The warm winter helped ease the energy crisis, improving the prospects for increased activity and demand from industrial companies.



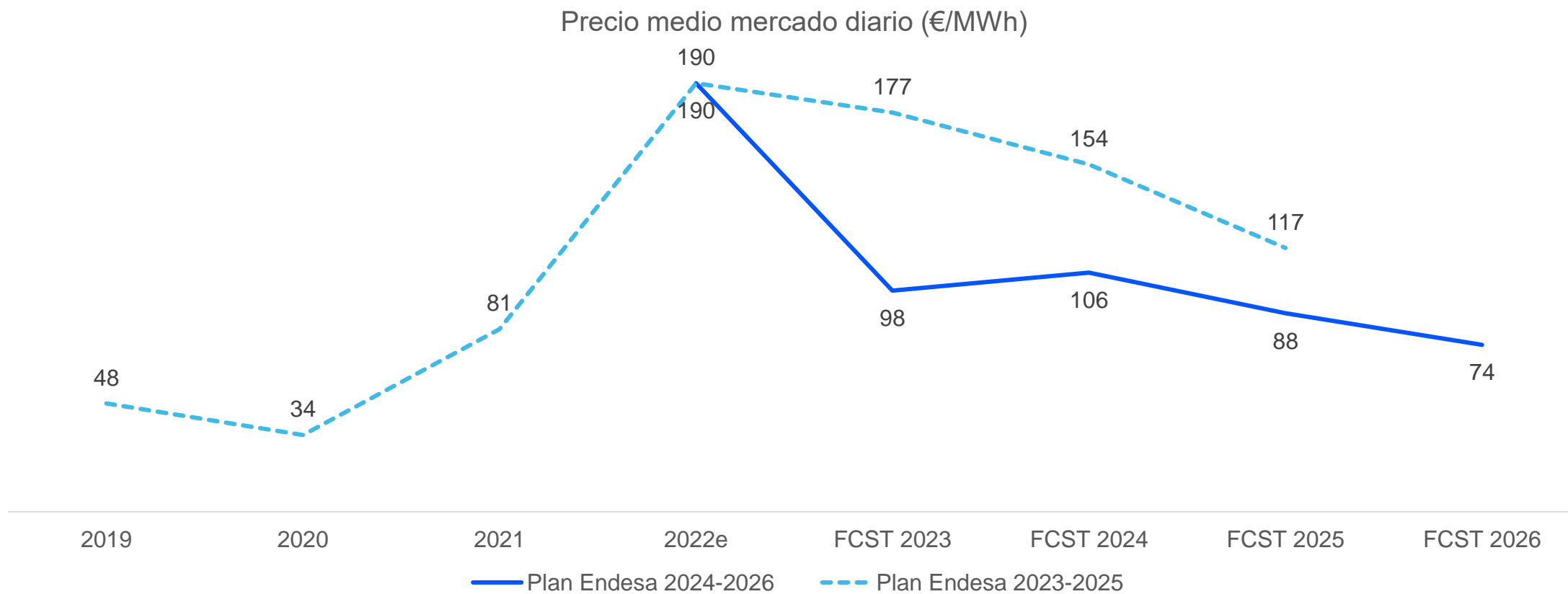
Phase IV emissions trading (ETS)

FIT for 55%: extra effort by all countries to reduce emissions by 55% by 2030 compared to 1990 (previously 40%).

- Forecast 102 €/ton in 2026
- End of gradual free allocations until 2034 for some sectors (cement, iron, H2, aluminium and fertilisers) by border imposed application.
- Obligation to draw up a decarbonisation plan in order to receive allocation.
- Alternative market ETS 2 small industry emissions (planned for 2027).

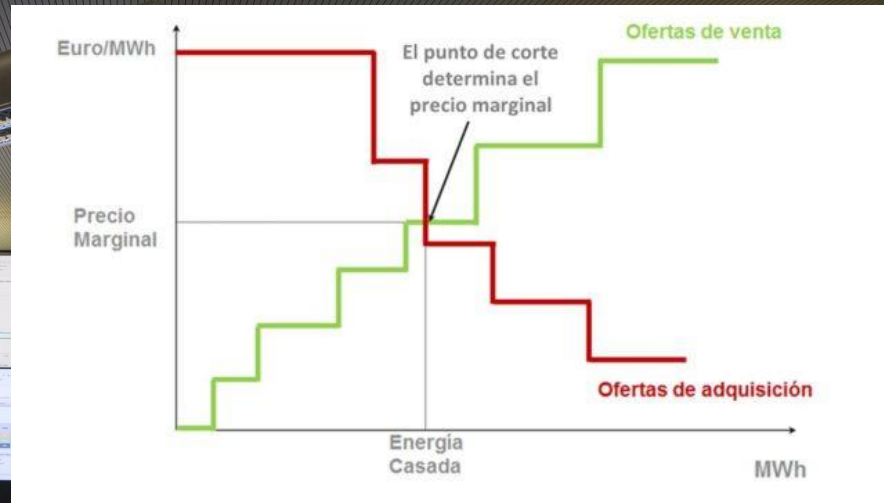
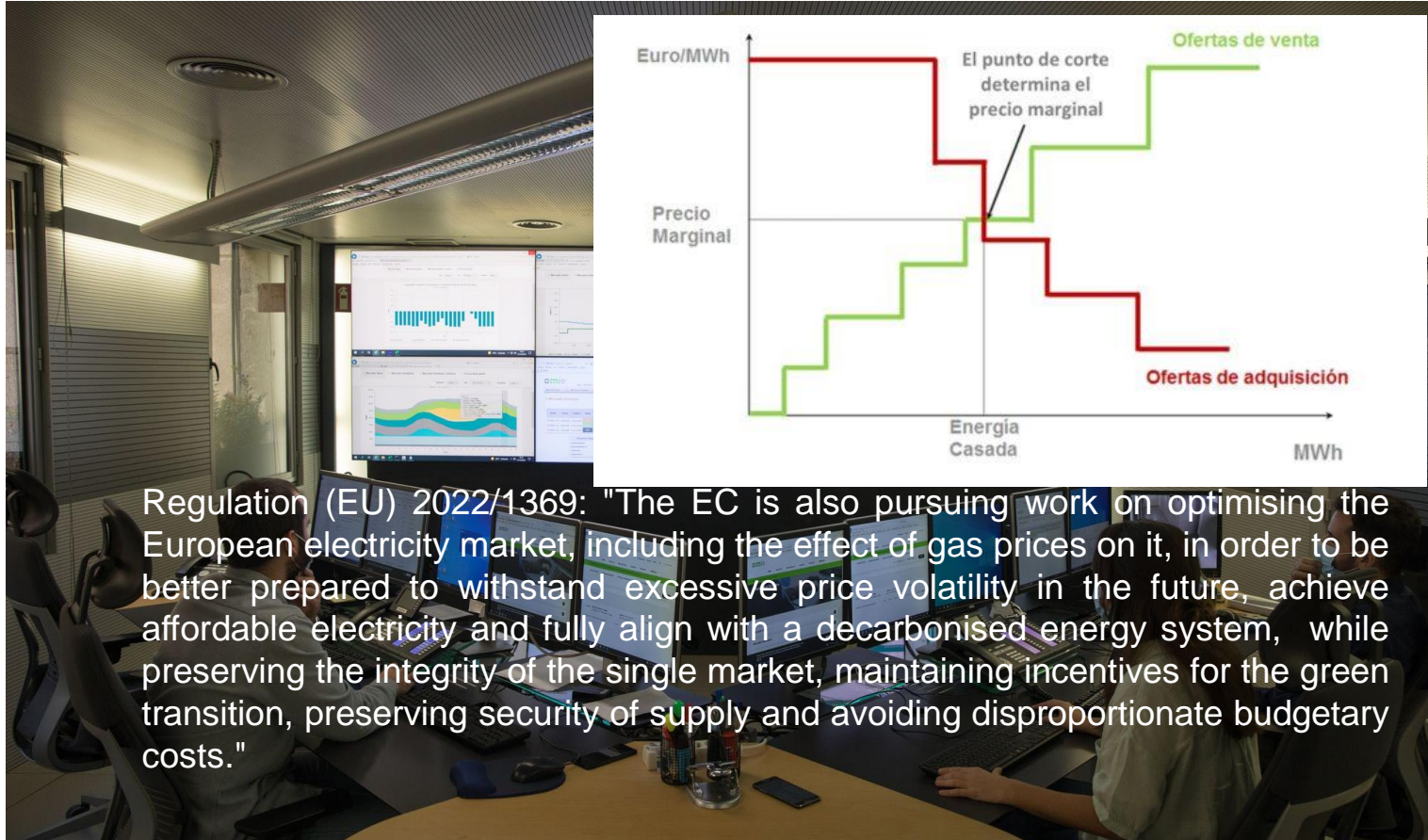


Impact on average daily price

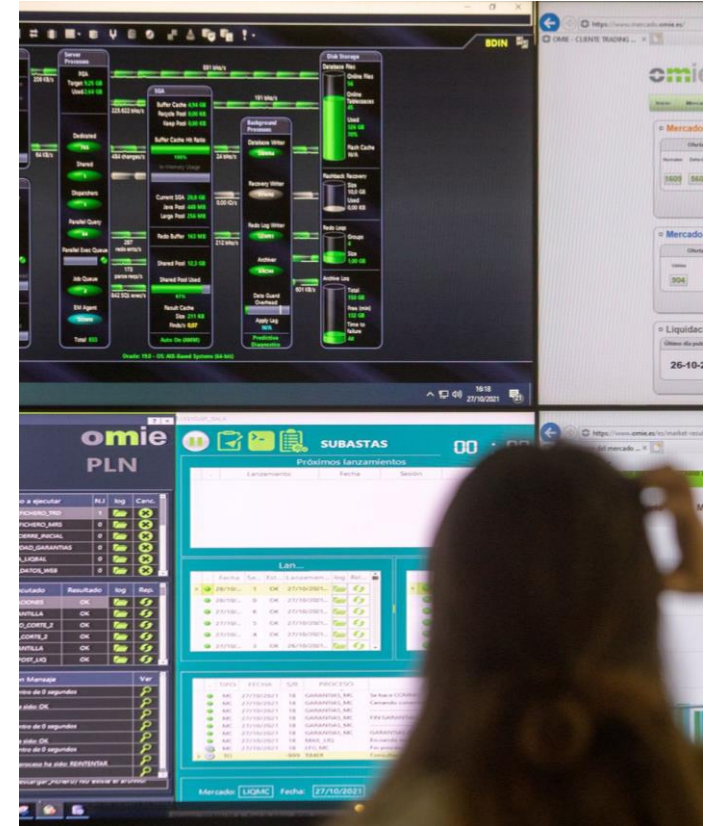


Euphemia

A debate is underway on the revision of the electricity market design. The electrification of the economy, the allocation of rents between consumers and producers in situations of stress and the massive deployment of renewable energies in the decade



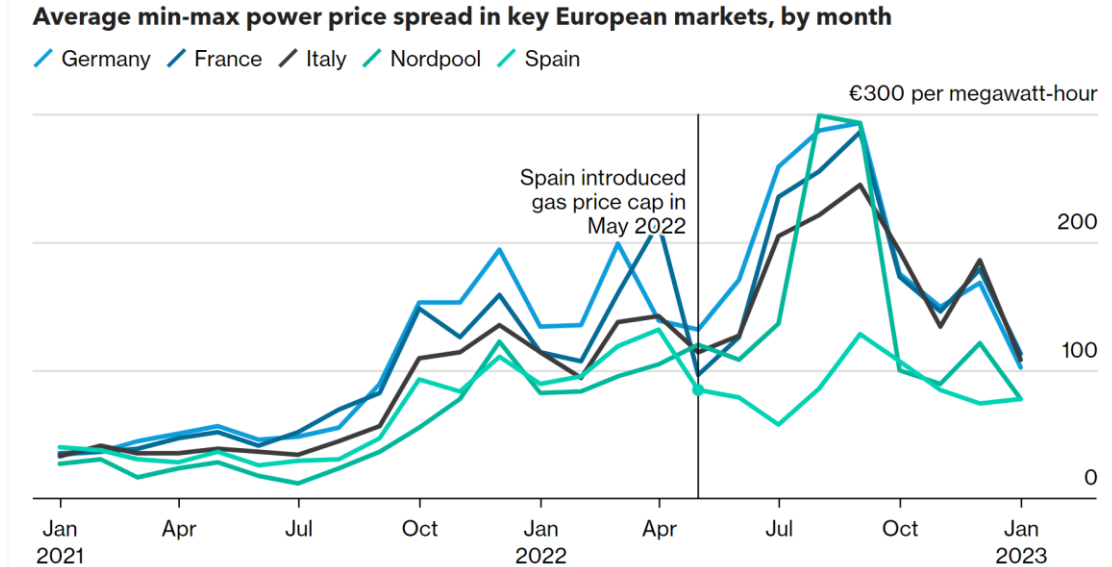
Regulation (EU) 2022/1369: "The EC is also pursuing work on optimising the European electricity market, including the effect of gas prices on it, in order to be better prepared to withstand excessive price volatility in the future, achieve affordable electricity and fully align with a decarbonised energy system, while preserving the integrity of the single market, maintaining incentives for the green transition, preserving security of supply and avoiding disproportionate budgetary costs."



Wholesale Gas Markets in Europe

Wholesale markets have reached record highs, with peaks above €300/MWh, 5 times more than a year ago and 15 times above the historical average.

- Prices have exceeded historical records, exceeding €300/MWh the price of the TTF (Title Transfer Facility, in the Netherlands) above that price reference of €30-50/MWh.
- In Spain and Portugal, an intervention is established that includes the introduction of a price cap. The joint purchase of natural gas is also discussed as a solution.



Climate change

#02

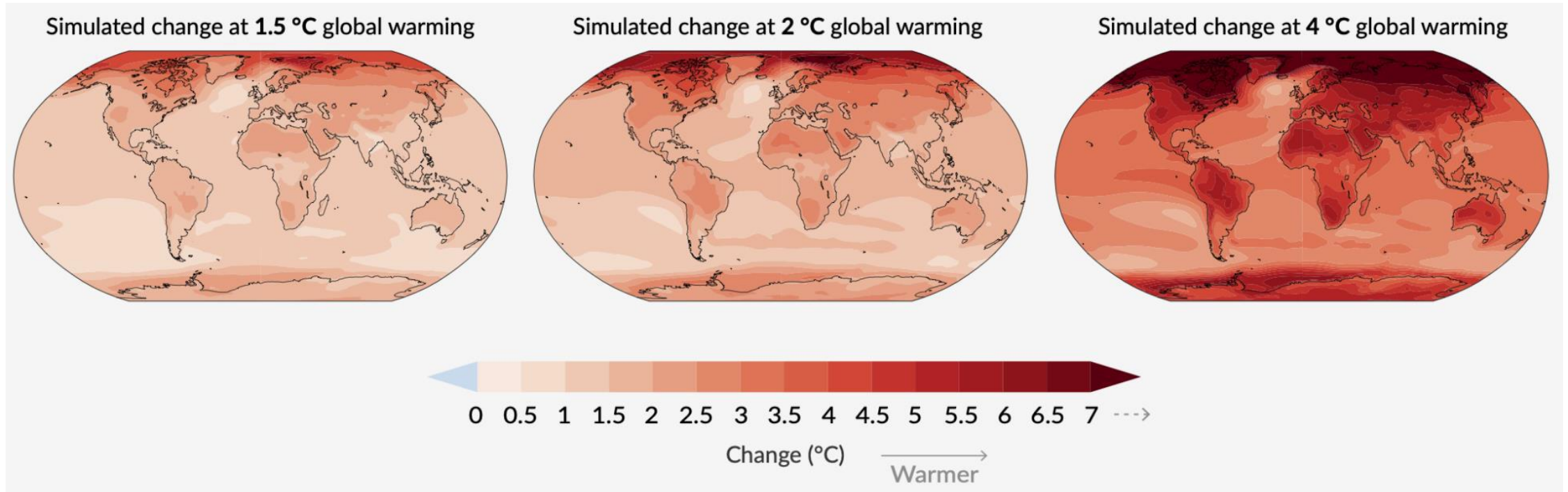
**Climate change
is the biggest
threat we have
ever faced.**

The Second Industrial Revolution occurred from 1870 onwards with the expansion of railroads and telegraph, the large-scale production of steel and iron, the use of power from steam, petroleum, and the beginnings of electrification.

The Industrial Revolution led to a new era of pollution, with waste materials being dumped into rivers, lakes, soil, oceans, and the atmosphere

The Scientific Evidence

Climate change is unequivocally a product of human action. The impacts of climate change are more accelerated, profound, and permanent than initially thought.

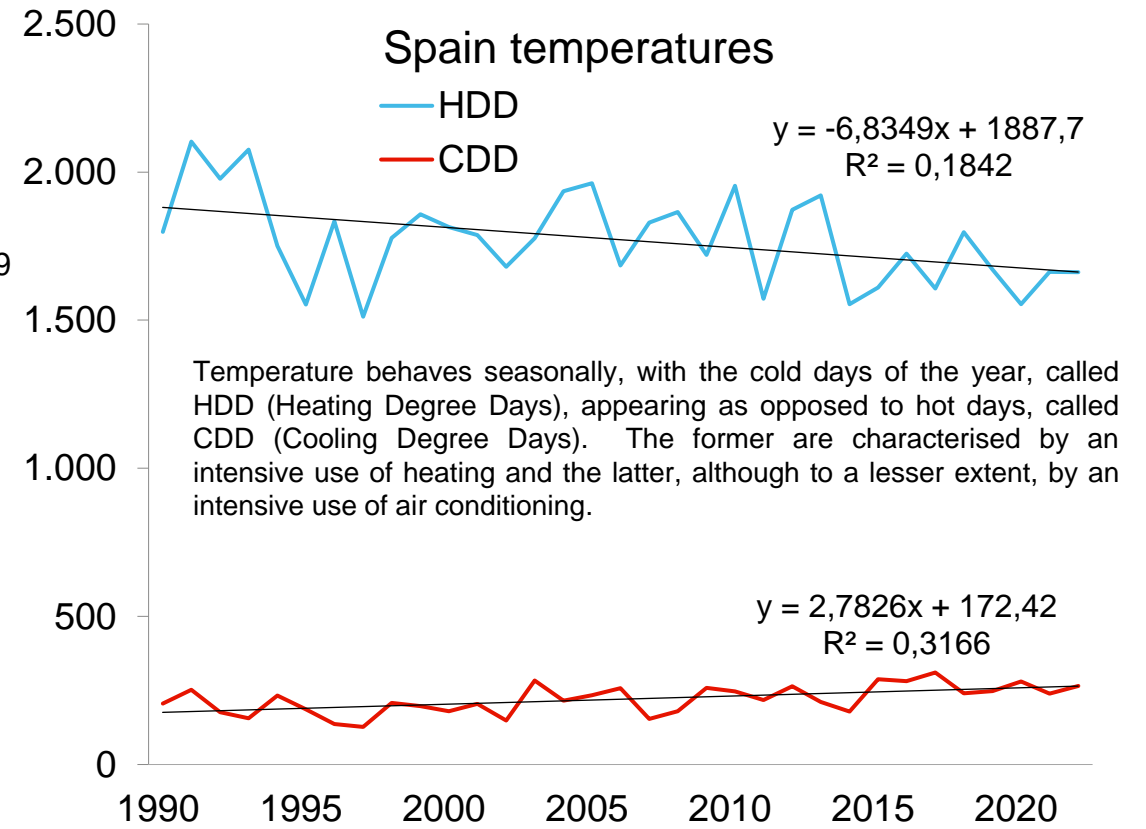
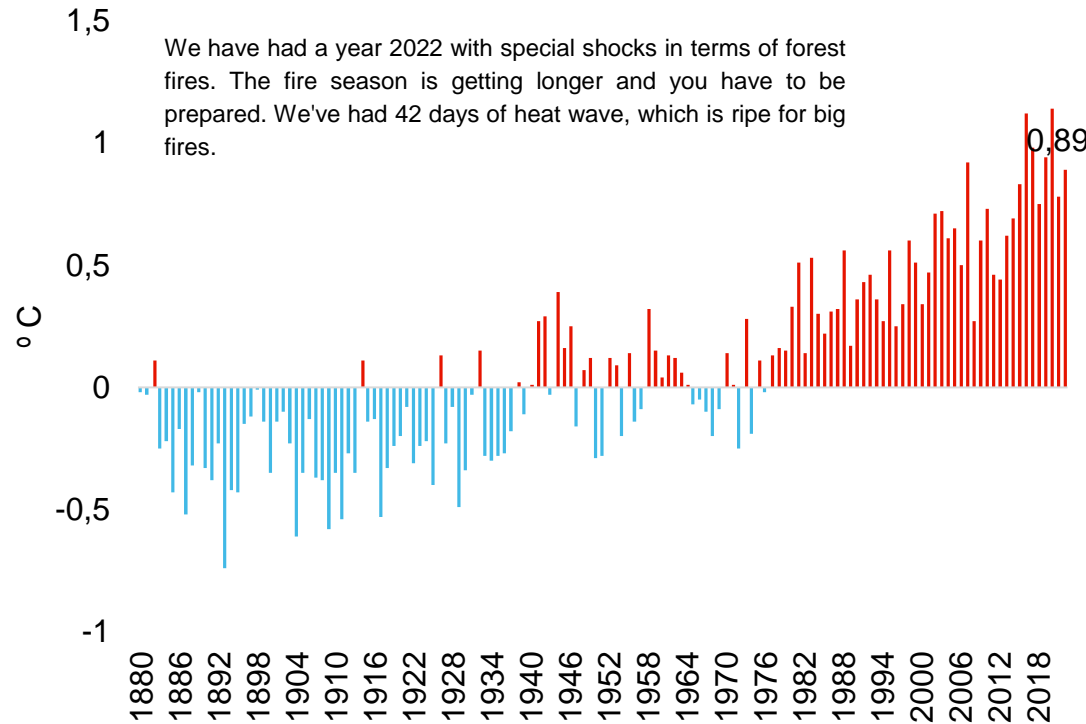


The IPCC Special Report on 1.5°C shows that drastic reductions are urgent, but achievable, and offer great benefits: avoided climate change, cleaner air, employment in the renewable energy sector, access to modern energy, etc.

Time Series of Temperature Anomalies

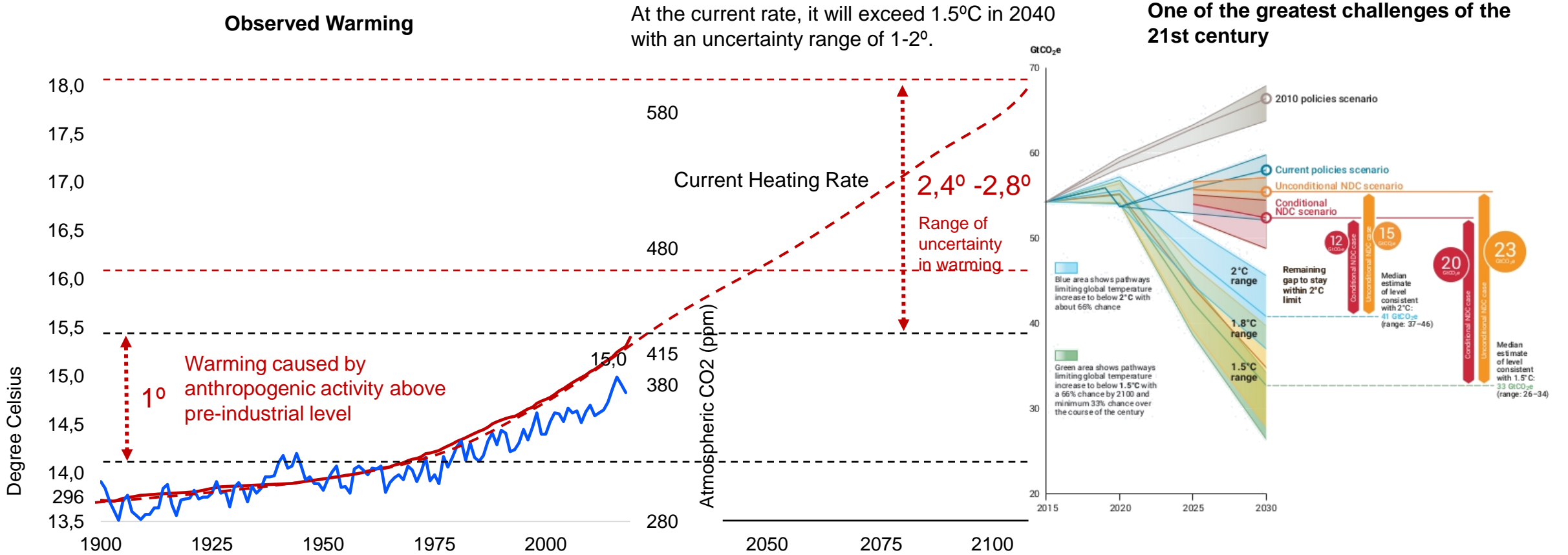
The global surface temperature was 0.89 °C above the 20th century average. The last few Januarys have been the warmest on record since 1880.

Global Land and Ocean Temperature Anomalies in January



Towards 2.5°C warming

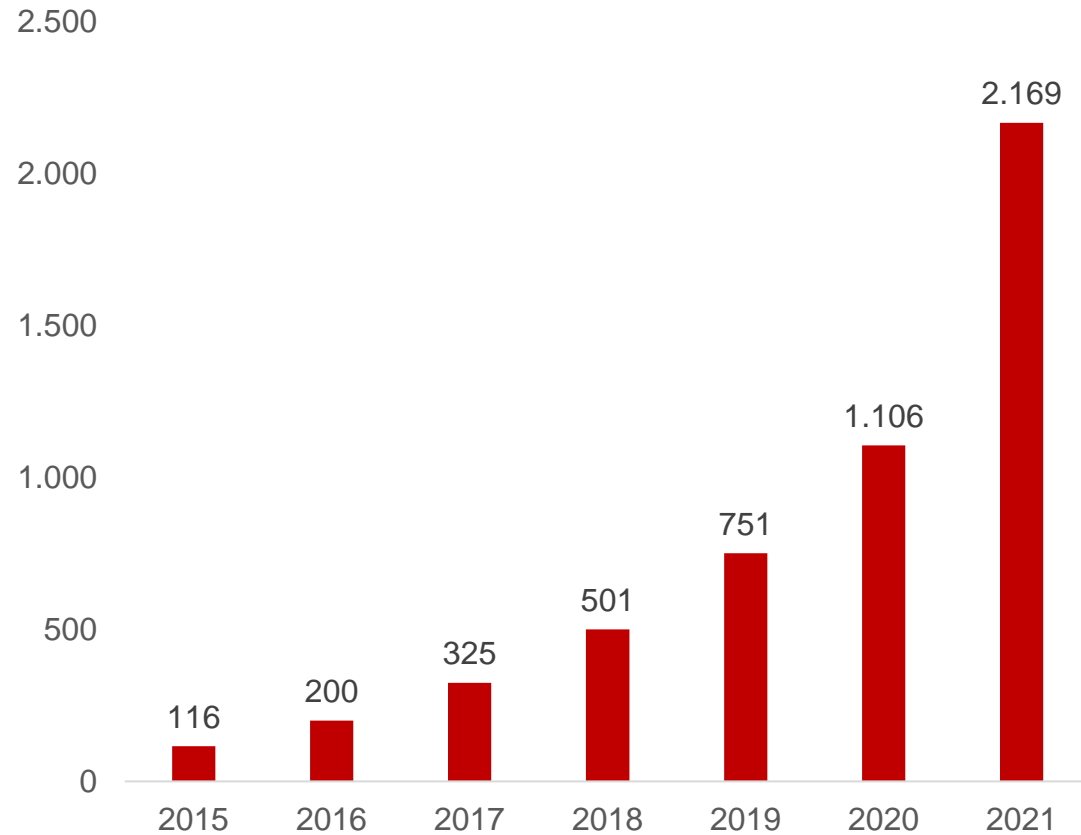
Long-term targets (2.4° with all commitments and 2.8° with current policies) are unlikely to be achieved. The concentration of greenhouse gases has been at levels unknown for 800,000 years.



The weight of emissions

92 countries responsible for 78% of global emissions now have a net-zero emissions commitment

Companies' commitments grow exponentially

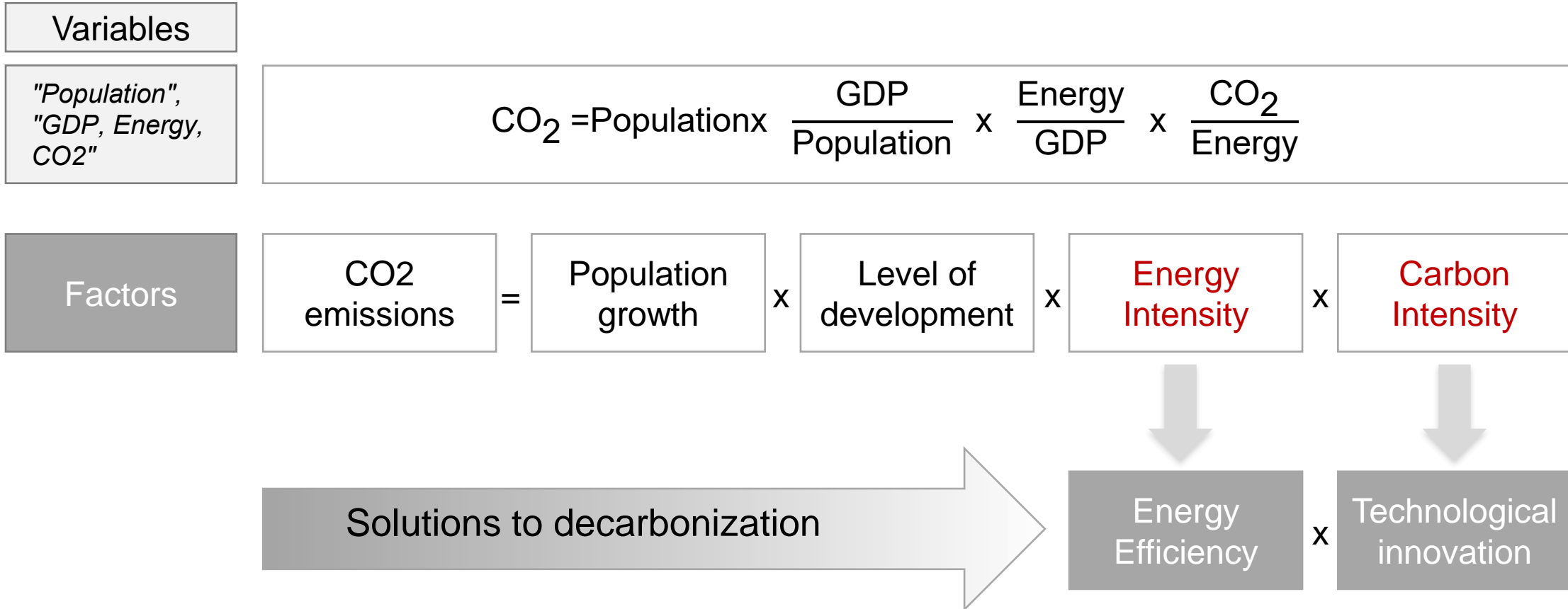


Countries with a significant weight



The Identity of Kaya (Yoichi Kaya, 1934)

With population and economic growth expected, strategies focus on improving energy efficiency and innovating towards low-carbon solutions.

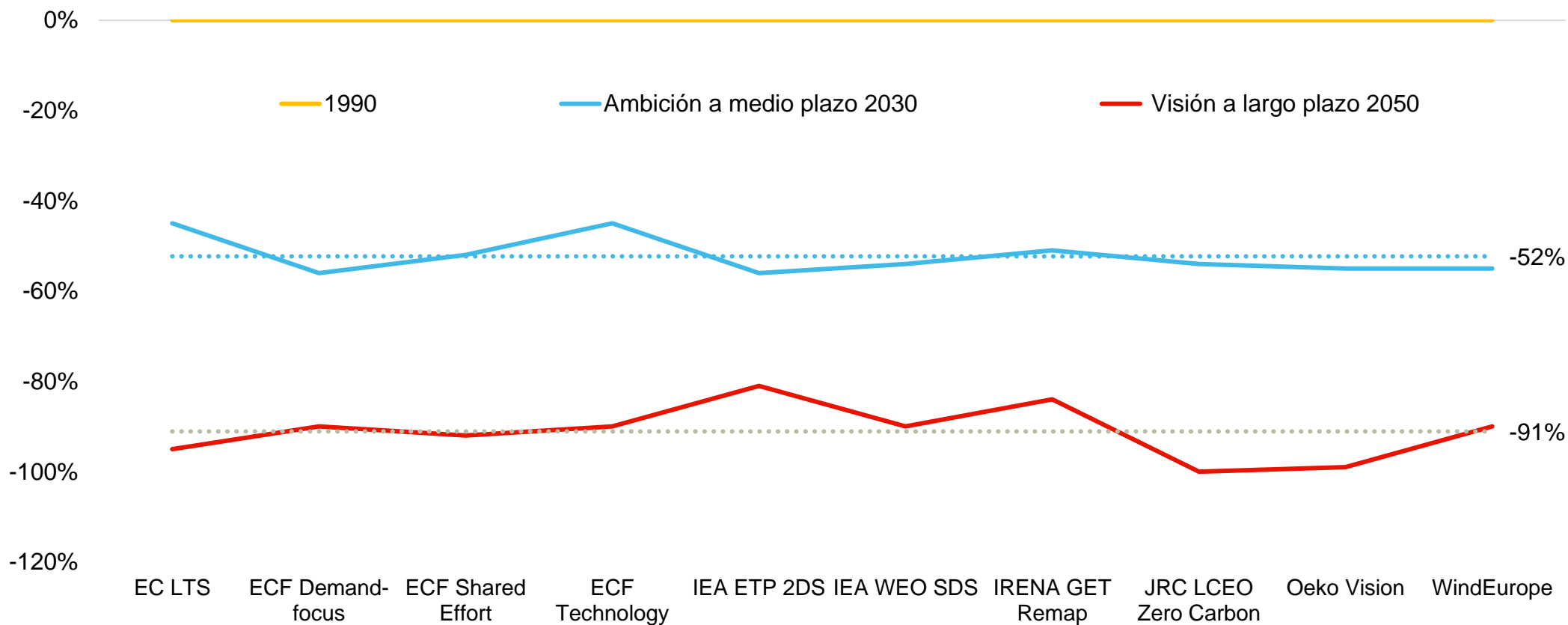


Decarbonization scenarios

Reduce emissions by 50% by this decade and by 90% by 2050.



Alternative scenarios (base 1990=1) to 2030 and 2050

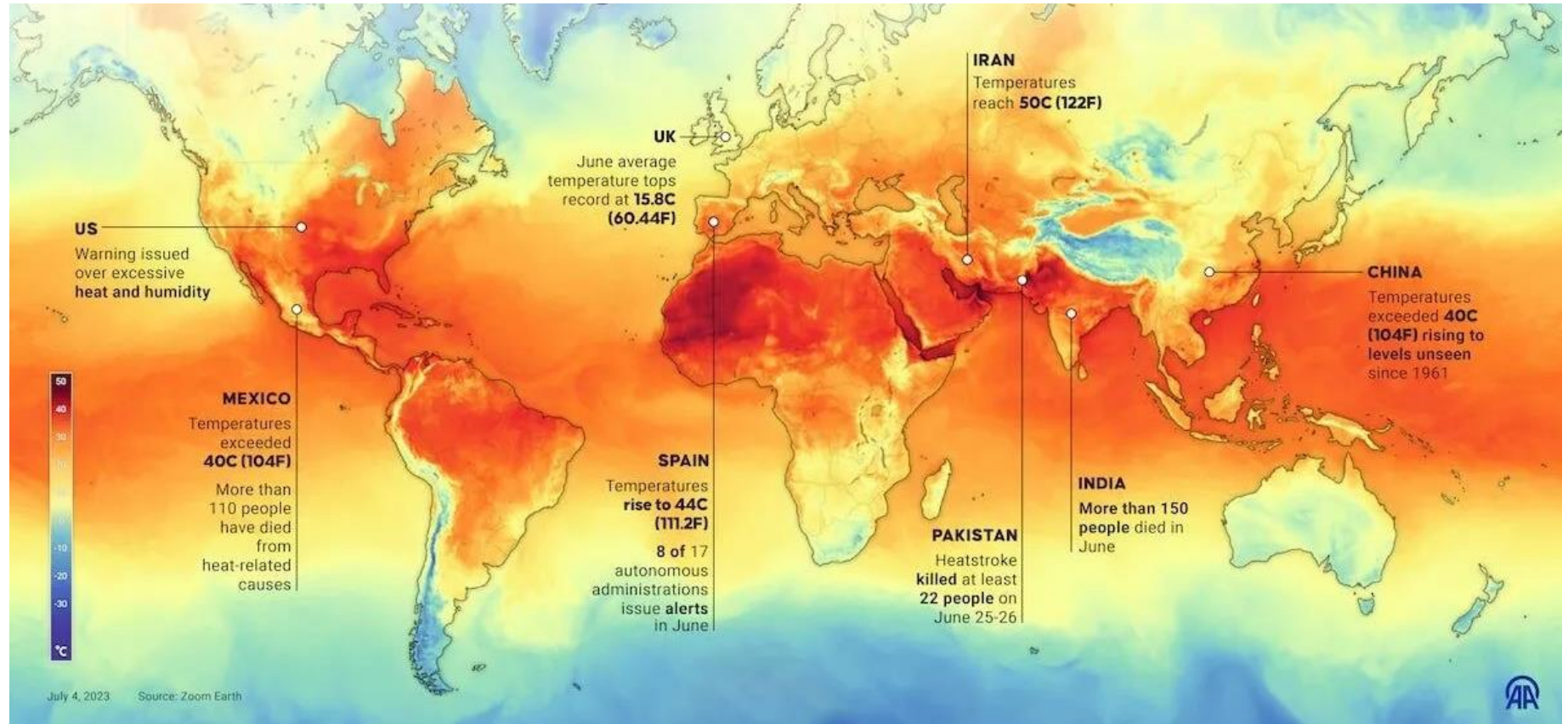


Fuente: JRC 2020, elaboración a partir de los escenarios citados

New temperature record 17.01 ° Celsius (3/7)

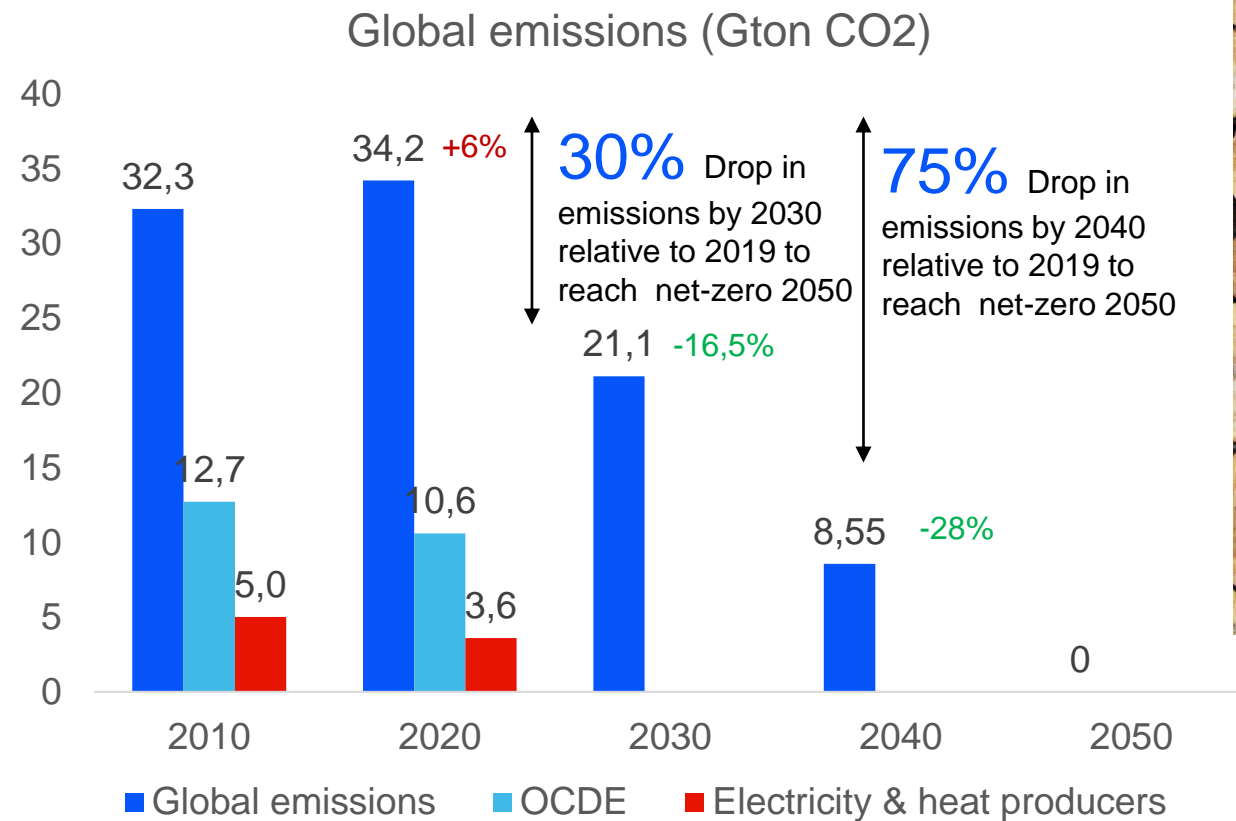
The average global temperature reached the highest value on record in the 19th century and since satellite tracking in the 1970s.

The high temperatures come after scientists predicted an "El Niño" event would occur, pushing the world to record the highest average temperatures.



Achieving Net Zero Emissions

Setting the path to CO₂ neutrality by 2050



Sustainability

#03

Our Planet and the Sun

Humans have been harnessing the sun's energy since the dawn of time.



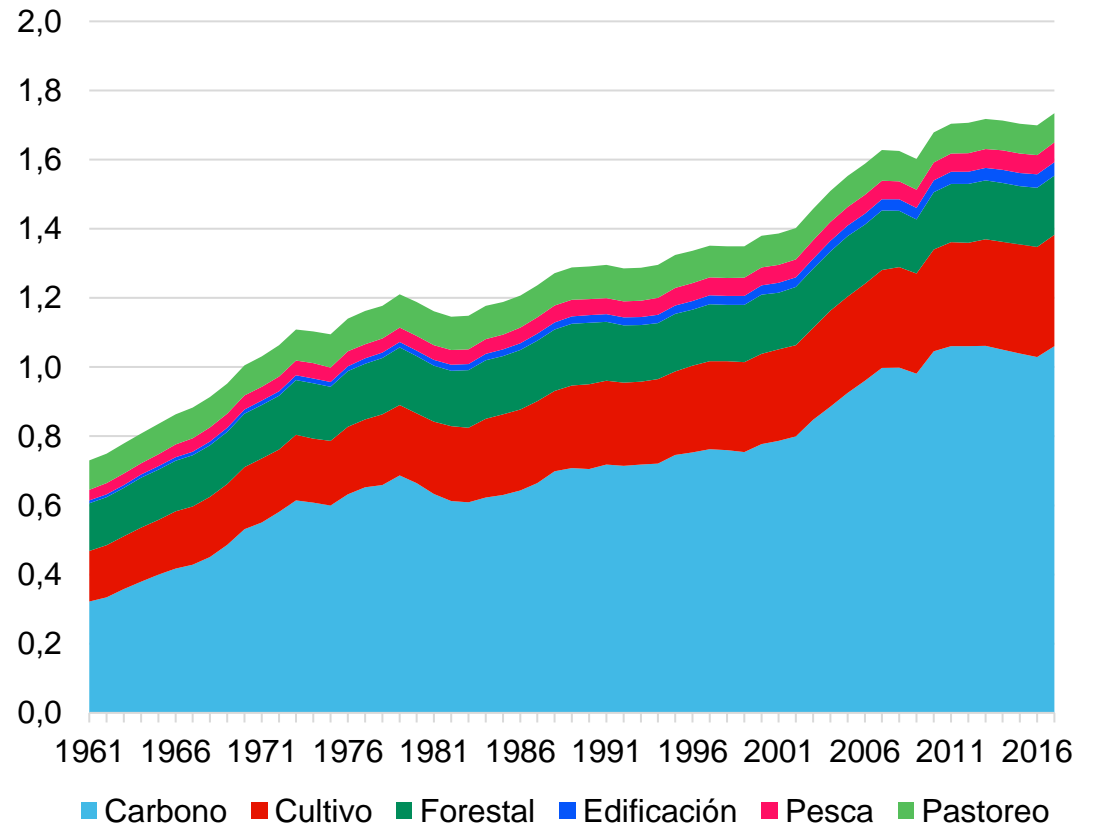
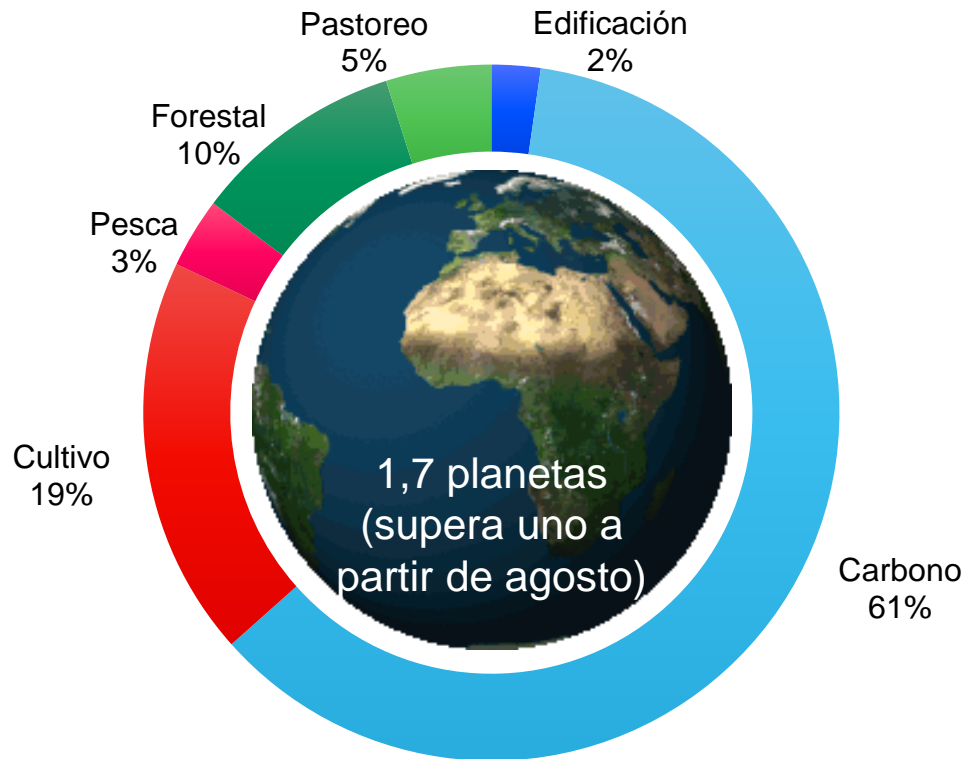
Our planet, Earth, is 149.6 million km from the Sun, optimal distance to allow liquid water to exist on the surface and carbon to allow life.

Albert Einstein suggested that light was composed of photons and demonstrated the photoelectric effect.

On April 24, 1954, Bell Labs announced the construction of the first solar panel, since solar cells reach more than 30% efficiency.

Ecological footprint

It is a biophysical indicator of sustainability that measures the total productive area needed to produce the resources consumed per average inhabitant, as well as the amount needed to absorb the resources it generates.



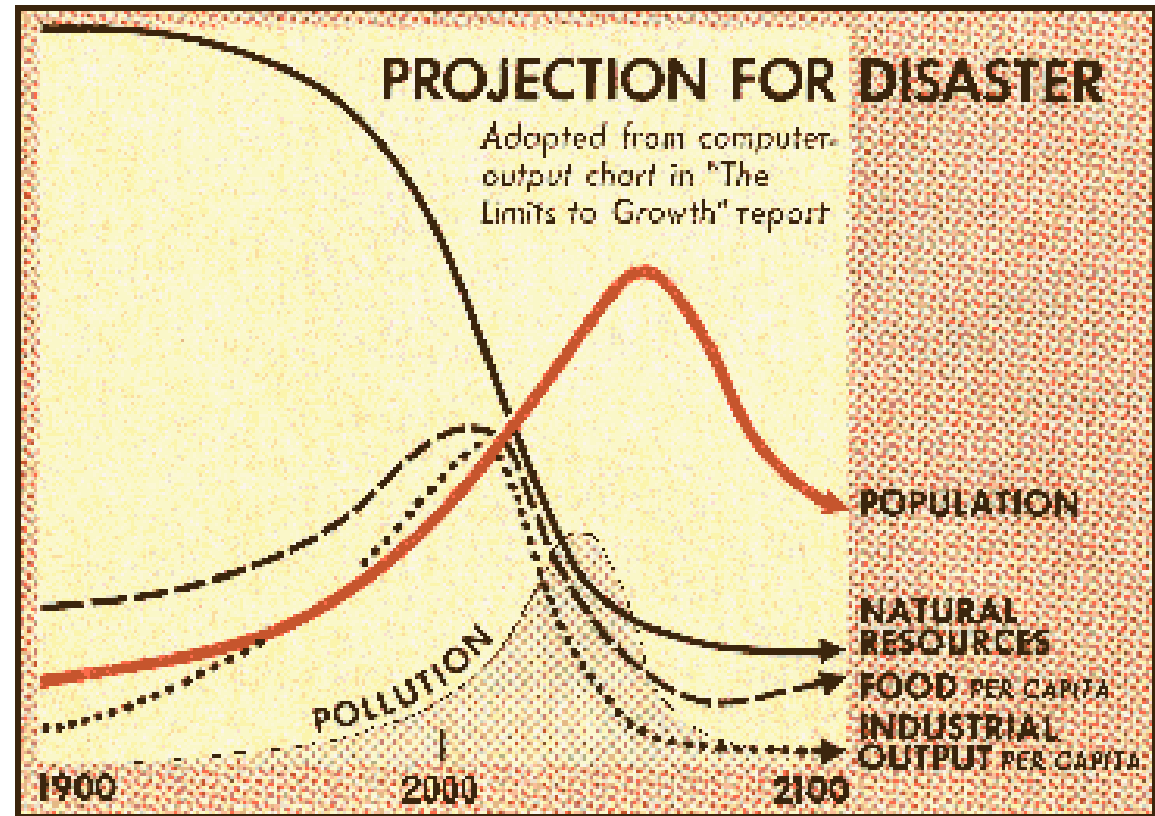
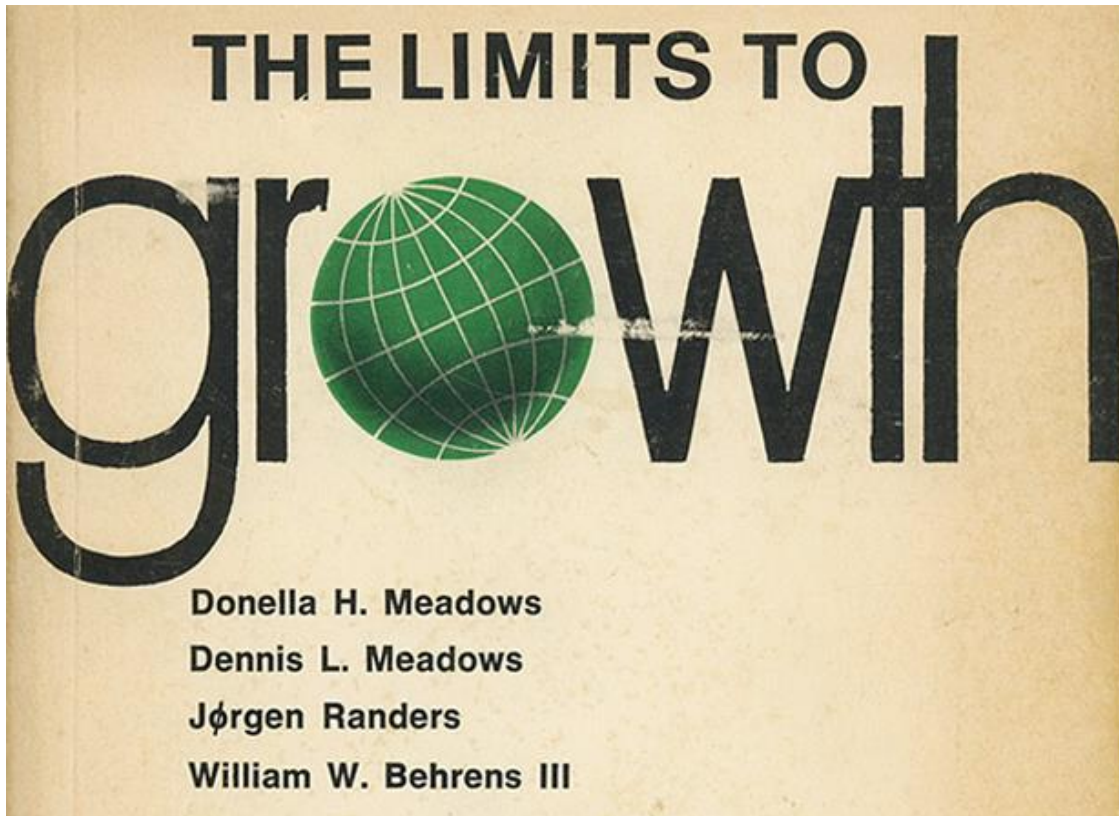
Choosing Between Growth and Sustainability

Can the economy fight climate change? Do we need a carbon tax? How can we provide the right incentives?

1. Companies are no longer just committed to return on investment, but to nature, society, and future generations.
2. All decisions must take into account environmental factors and sustainable development. The private sector is essential to address these challenges with new ideas to solve them.

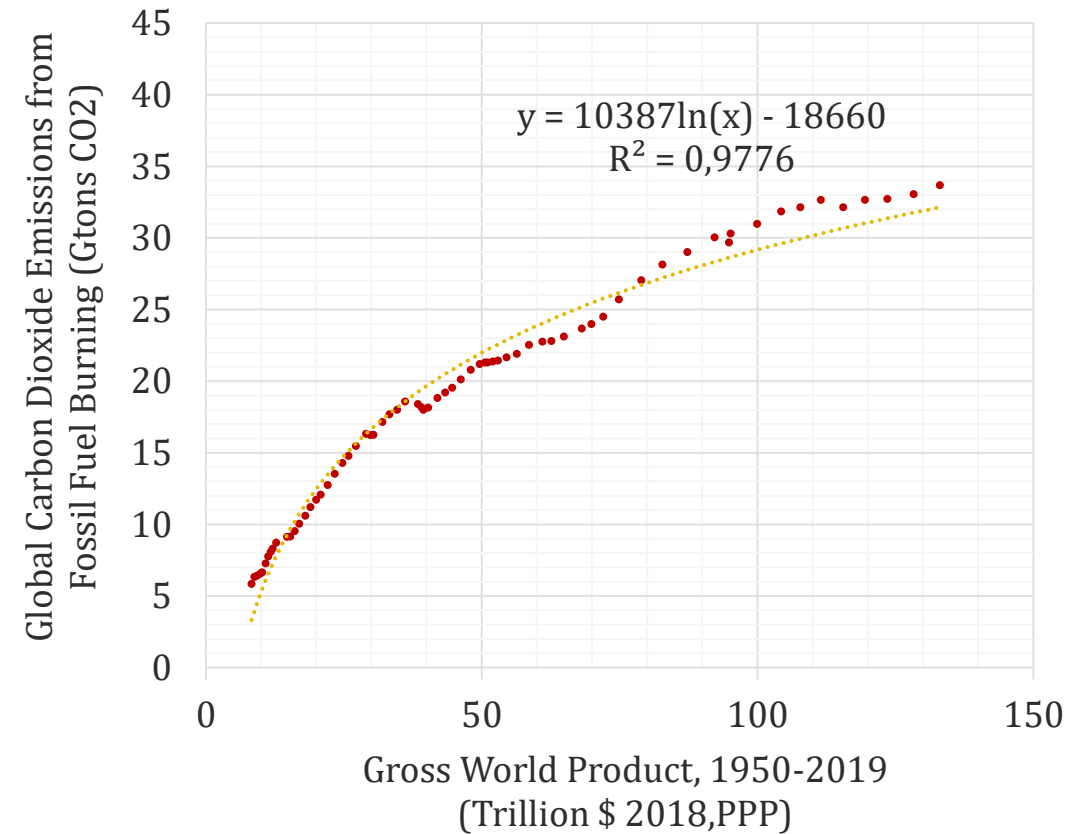
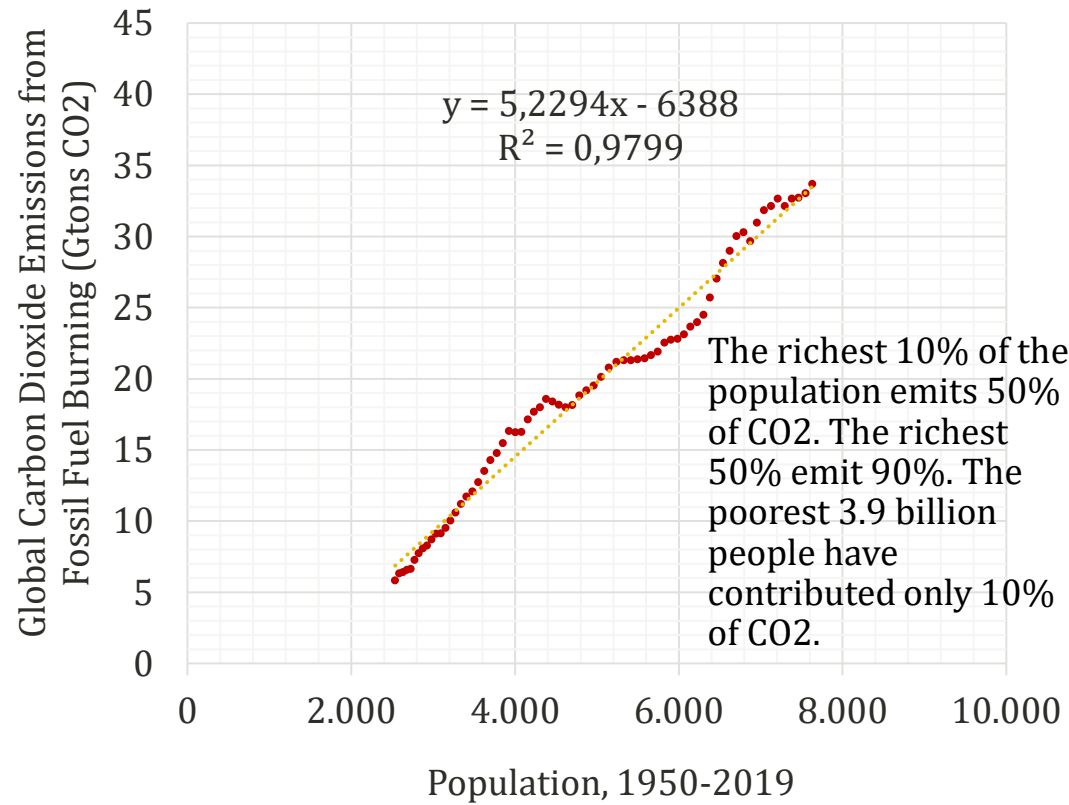


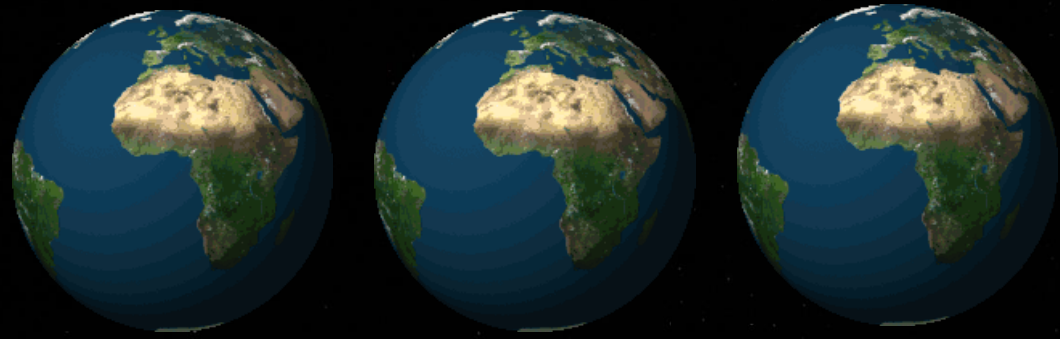
Is there a limit to growth?



CO2 emissions linked to growth

The world is moving towards unsustainable emissions from 33.5 to 44.5 gigatons of CO2 in a scenario of continuity for a population of 9,735 thousand. population by 2050.



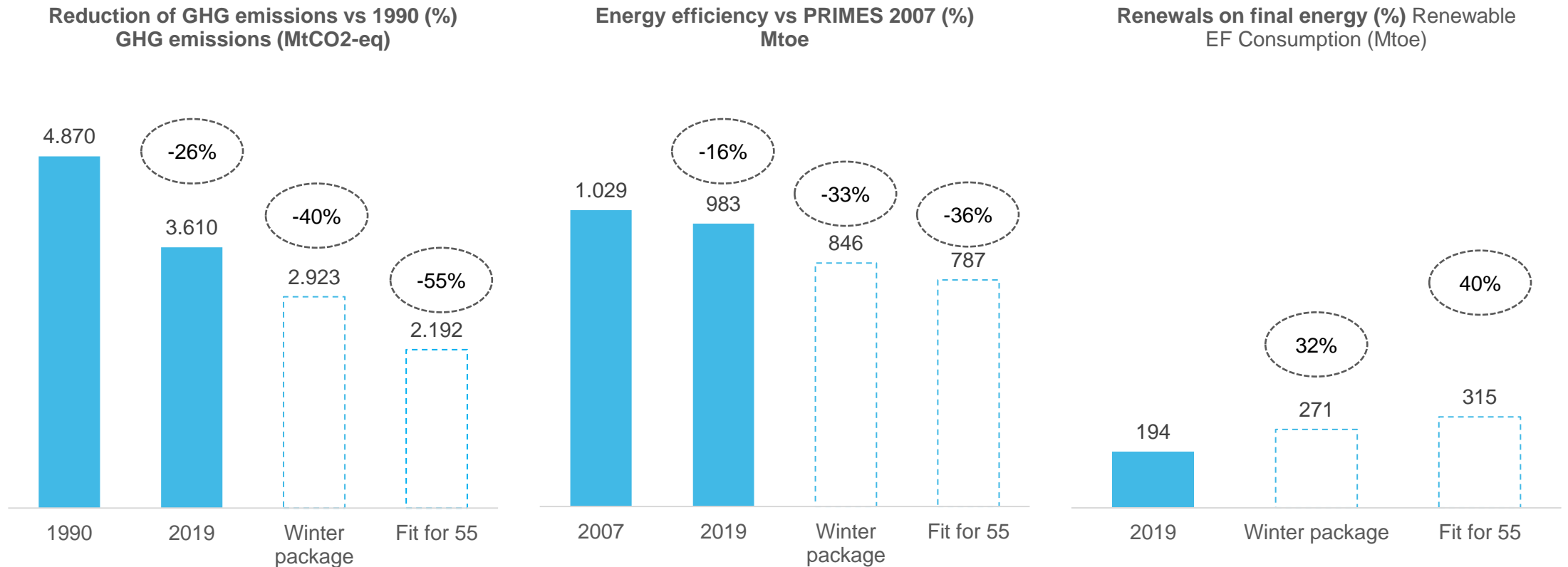


9,600 million inhabitants in 2050

In thirty years, it will take three planets like ours to provide the necessary resources while maintaining the current lifestyle.

Objectives of the EU Fit for 55 package

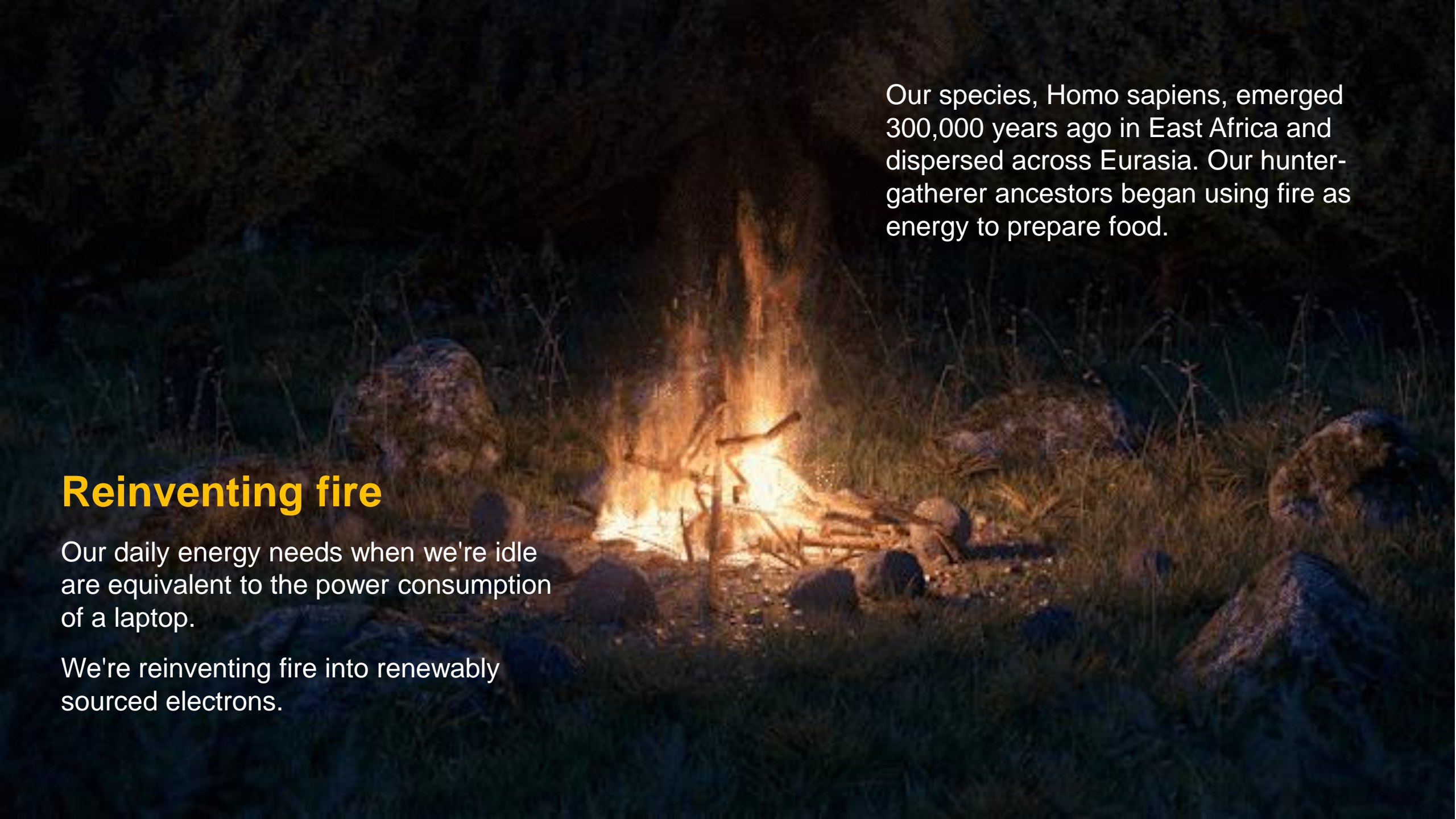
The EU, which promoted the 2015 Paris Agreement, has set the goal of reducing its emissions by 40% by 2030, expanding to 55% in the so-called winter package, and currently to 57% due to the war in Ukraine.



In this decade, we will need to multiply the rate of reduction of GHG emissions by 3 and the rate of demand reduction by 5.

Electrification

#04



Our species, Homo sapiens, emerged 300,000 years ago in East Africa and dispersed across Eurasia. Our hunter-gatherer ancestors began using fire as energy to prepare food.

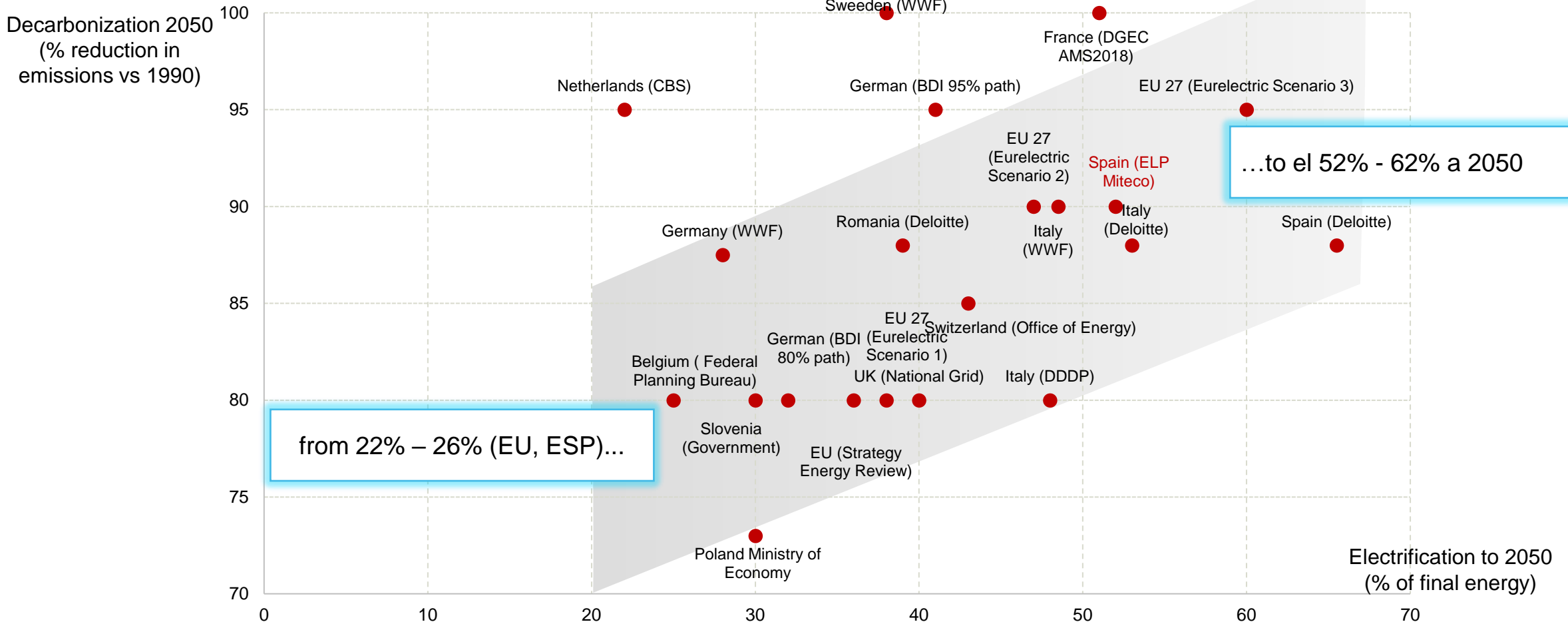
Reinventing fire

Our daily energy needs when we're idle are equivalent to the power consumption of a laptop.

We're reinventing fire into renewably sourced electrons.

Doubling electricity in final energy

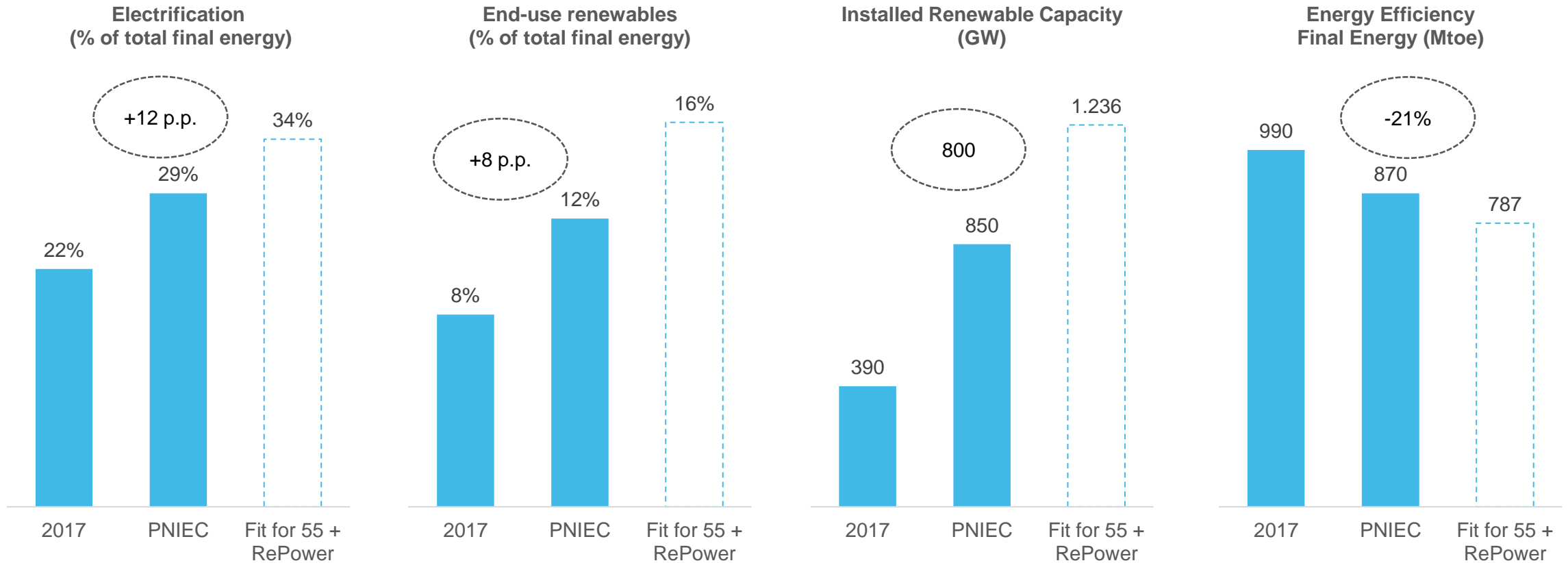
If we are to have any hope of achieving our climate and energy policy, we need to increase the weight of electrification as soon as possible.



Nota: ELP (MITECO) sector eléctrico 100% renovable antes de 2050, siendo la principal palanca de la descarbonización. Se duplicará la electrificación de los usos energéticos finales desde un 26% en 2020 a un 52% en 2050. PNIEC 2030: generación eléctrica renovable 74% en 2030, un 42% de contribución renovable sobre el consumo de energía final.

Fit for 55 y REPowerEU

The most important countries in Europe have proposed revisions to their NECPs with more ambitious decarbonisation targets, among which Spain stands out



En esta década necesitaremos multiplicar **x 3** el ritmo de reducción de **emisiones GEI** y **x 5** el de reducción de **demanda**.

NECP objectives (general)

Objectives of the Integrated National Energy and Climate Plan



Objetivo	PNIEC 2020	PNIEC 2023	DIF
Reducción emisiones GEI respecto a 1990	23%	32%	+8 p.b.
Reducción de emisiones GEI (Sectores ETS) vs 2005	-61%	-70%	-9 p.b.
Reducción de emisiones GEI (sectores difusos) vs 2005	-39,1%	-43%	-3,9 p.b.
Renovables en generación eléctrica	74%	81%	+7 p.b.
Número de vehículos eléctricos	5 millones	5,5 millones	+0,5 millones
Número de viviendas rehabilitadas	1,2 millones	1,38 millones	+0,18 millones
Potencia instalada renovable	113 GW (s/T 160 GW)	160 GW (s/T 214 GW)	+47 GW
Almacenamiento	6 GW	22 GW	+16 GW
% renovables sobre energía final	42%	48%	+6 p.b.
Eficiencia energética (reducción de energía primaria)	-39,5%	-42%	+2,5 p.b.
Eficiencia energética (reducción de energía final)	-41,7%	-44%	+2,3 p.b.
Dependencia energética	61%	51%	-10 p.b.

Objectives of the new Spanish Plan for 2030

107 policies and measures for the objectives, with the following notable objectives:

- 32% reduction in greenhouse gas emissions compared to 1990.
- Achieve 48% renewables in the final use of energy, with 81% renewable energy in electricity generation.
- 44% improvement in energy efficiency in terms of final energy.
- Estimated investments of around 294,000 million euros, distributed in: Renewable energy (40%), Energy networks (18%), Electrification of the economy (12%) & savings and efficiency (29%)
- Significant participation of the private sector, with 85% of the planned investment. A contribution of 11% of European funding is expected.

NECP objectives (by final sector)

Objectives of the Integrated National Energy and Climate Plan

Objetivo	PNIEC 2020	PNIEC 2023	DIF
Transporte			
Reducción intensidad de emisiones GEI transporte	-	16,6%	+16,6 p.b.
Renovables en sector transporte	15%	25%	+10 p.b.
% combinado gases renovables sintéticos, bios av. y biogás	2,1%	11%	+8,9 p.b.
Industria			
Incremento anual renovables en industria	1,1%	5,1%	+5 p.b.
% gases sintéticos renovables en industria	25%	74%	+49 p.b.
Climatización			
Renovables en edificios	-	73%	+73 p.b.
Aumento anual % de renovables en climatización	0,89% (2021-2025)	1,27% (2021-2025)	+0,38 p.b.
	1,19% (2026-2030)	2,07% (2026-2030)	+0,88 p.b.

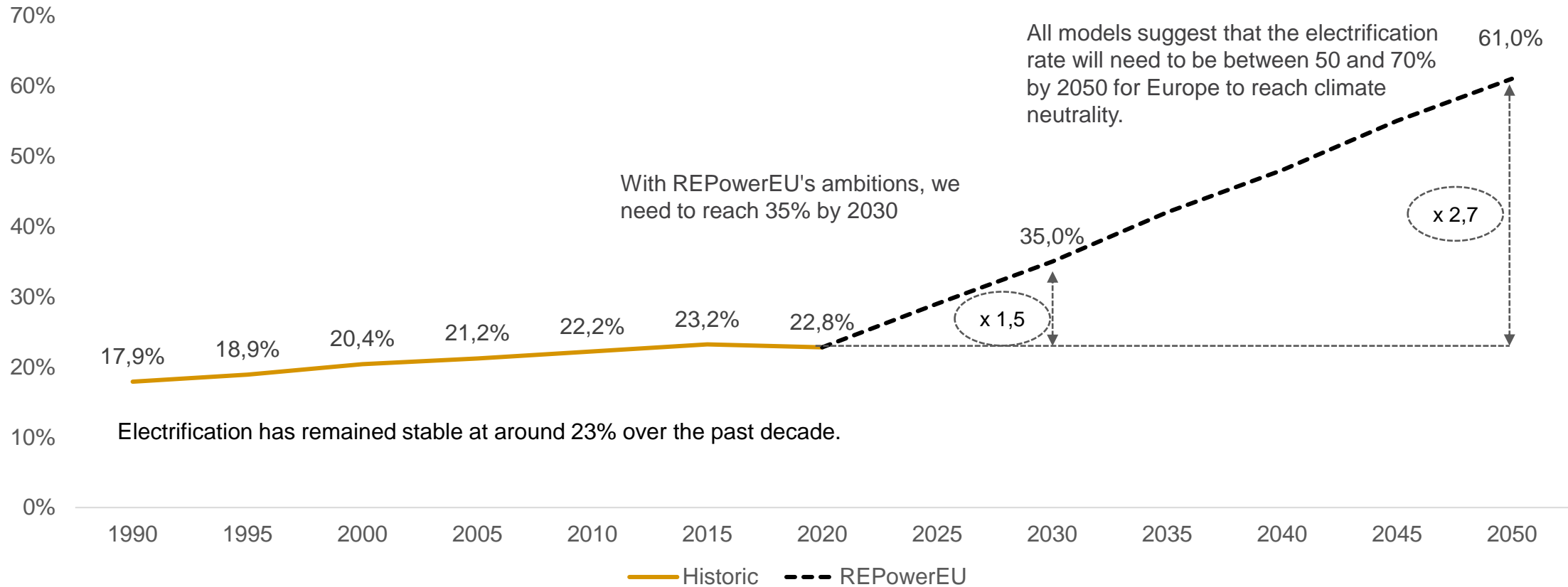
The role of electric power in the NECP

Objetivo	2019	2020	2025	2030
Eólica (terrestre y marítima)	25.583	26.754	42.144	62.044
Solar Fotovoltaica	8.306	11.004	56.737	76.387
Solar termoeléctrica	2.300	2.300	2.300	4.800
Hidráulica	14.006	14.011	14.261	14.511
Biogás	203	210	240	440
Otras renovables	0	0	25	80
Biomasa	413	609	1.009	1.409
Cogeneración	5.446	5.276	4.068	3.784
Residuos y otros	600	609	470	342
Renovable	56.857	60.773	121.254	163.797
Carbón	10.159	10.159	0	0
Ciclo combinado	26.612	26.612	26.612	26.612
Cogeneración	5.446	5.276	4.068	3.784
Fuel y fuel/gas	3.660	3.660	2.847	1.830
Nuclear	7.399	7.399	7.399	3.181
Térmica	47.830	47.830	36.858	31.623
Almacenamiento	6.413	6.413	8.828	18.543
Total	110.100	115.015	166.939	213.963

- Installed capacity 214 GW on the peninsula for a peak of 51 GW
- Promotion of renewable energies: solar PV (includes 19 GW of self-consumption) and wind (includes 3 GW offshore)
- Complete closure of coal, conservation of the combined cycle fleet and compliance with the nuclear closure schedule.
- Storage of 22 GW (considering thermoelectric).
- Forecast of the net export balance with France and Portugal of 51 TWh.
- Exchange capacity between Spain and France of 8 GW. Average price differential of €22.2/MWh.

Electrification trends in Europe

Electricity is 23% of the final energy consumed in Europe as of 2020. We are working to decarbonise electricity and replace fossil fuels.



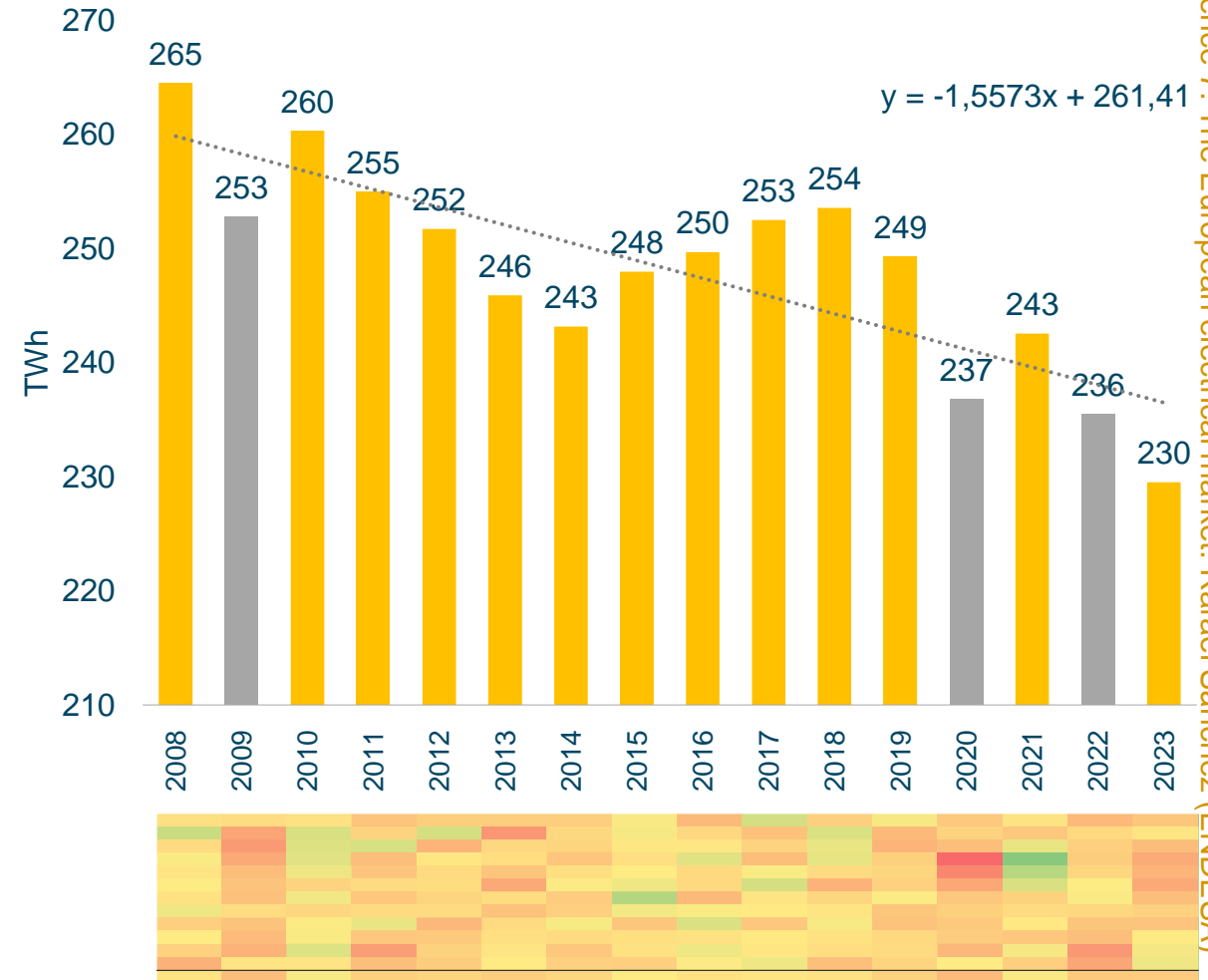
Electricity demand

Electricity demand continues to decline. In 2023 we continue with negative growth, of -2.3% at the peninsular level and similar -2.5% in the southern area.

From 2017 to 2019 it maintained a stable performance (between 253 and 249 TWh per year).

The effect of the COVID-19 pandemic and the measures associated with it led to a marked reduction in demand in 2020, with a reduction of -5% compared to 2019.

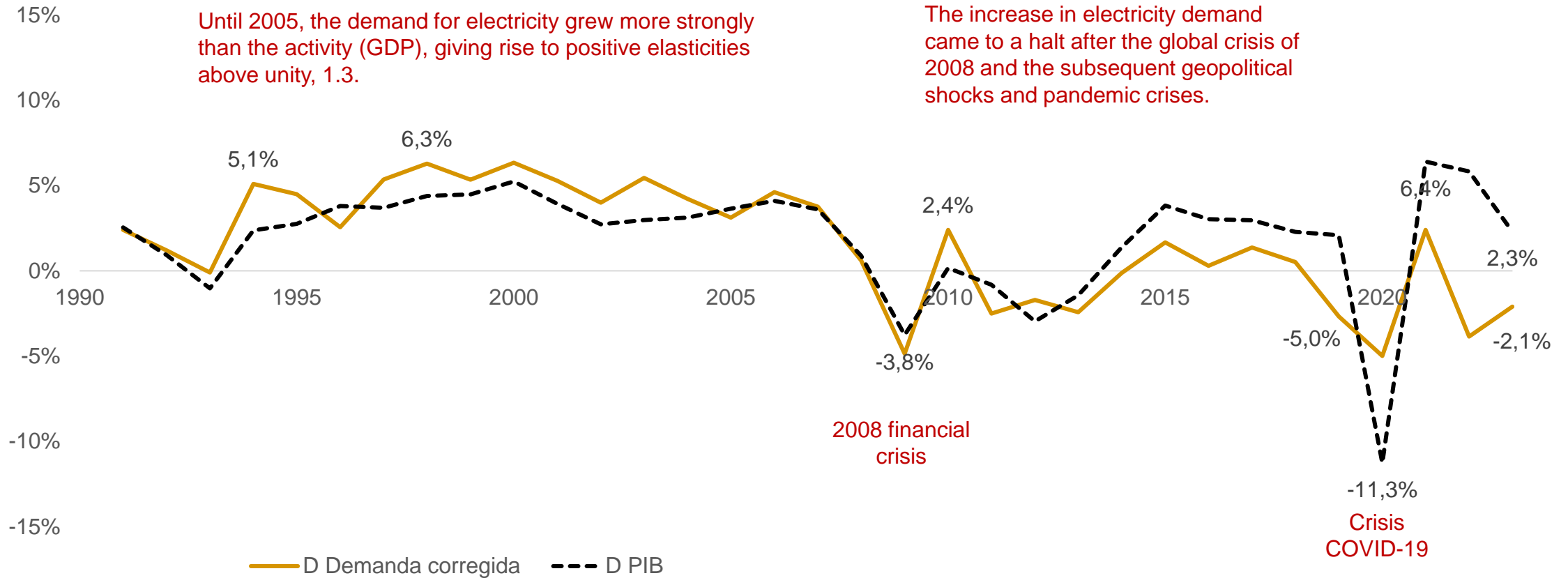
A partial recovery in demand began in 2021, but in 2022 it has fallen back to 2020 values due to the war.



Elasticity Peninsular Electricity Demand vs GDP

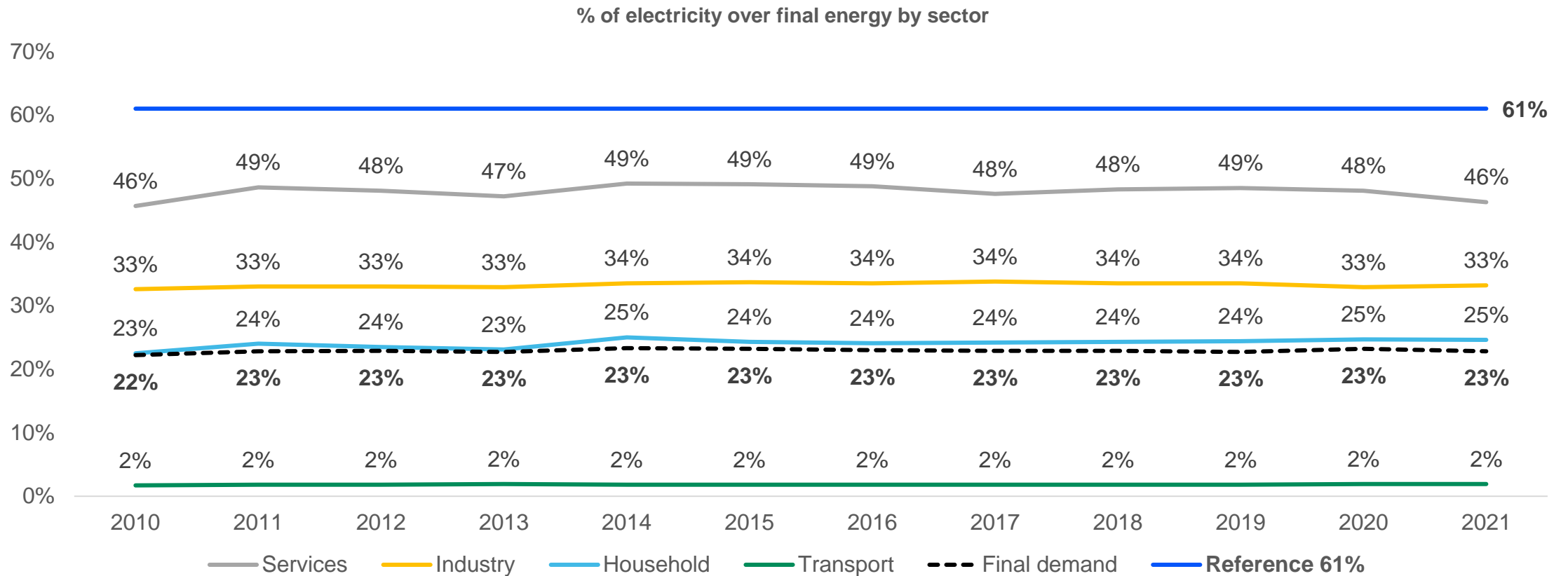
Energy and the economy have always been at a parallel pace in our country. Since the 2008 crisis, they have been decoupled, reducing their elasticity to <math><1</math> values.

Annual variation in mainland electricity demand and GDP



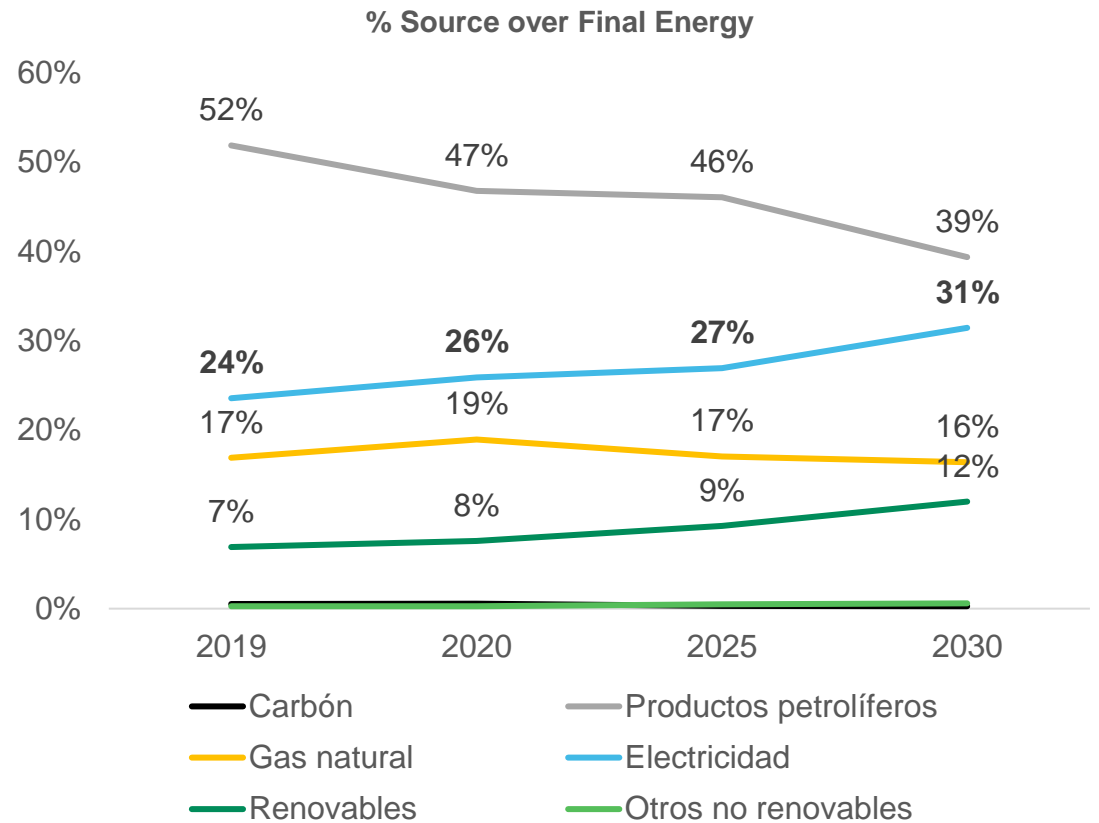
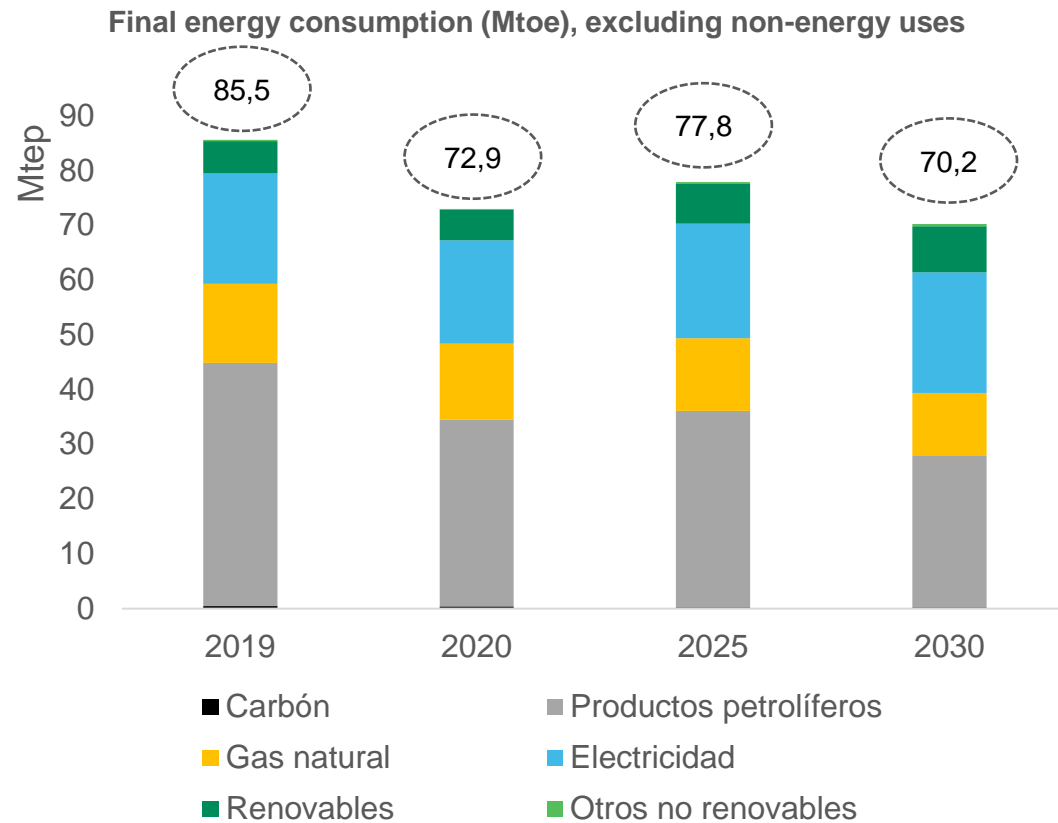
Electrification by sector

An almost flat trend common to all sectors and countries. The adoption of electric mobility and heat pumps are key, and must increase by 3 to 4 times to meet the objectives of the current decade.



Final Energy at PNIEC Spain

A binding final energy target that increases the improvement in energy efficiency by 44% by 2030, compared to 38% in Europe. This translates into a final energy consumption (excluding non-energy uses) of 70.2 Mtoe in that year.



Renewable Potential by Region

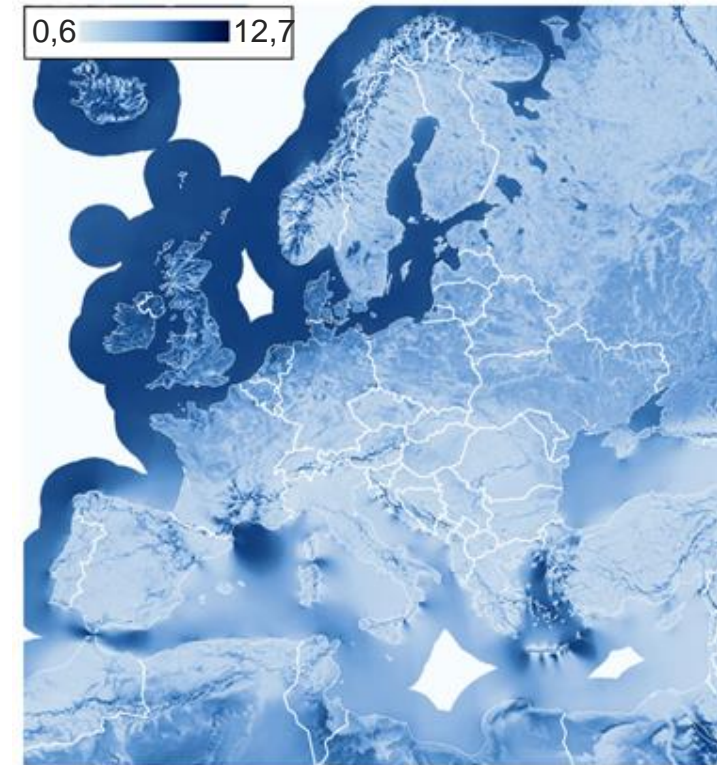
Spain has the differentiating factor of producing more competitive renewable energy, which gives it a key advantage to attract investment.

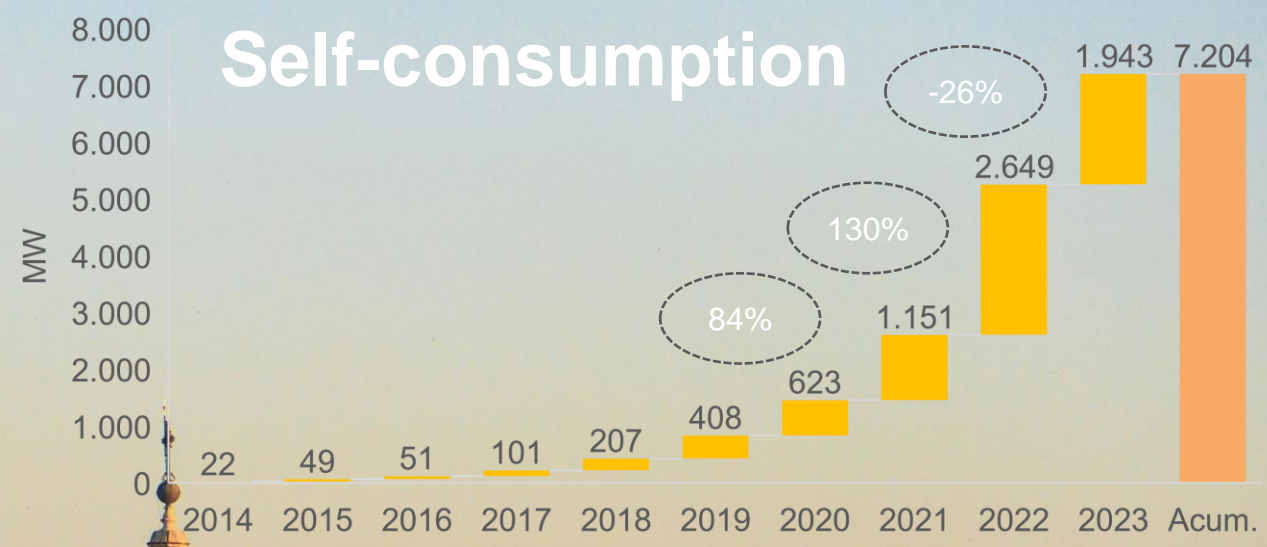
Solar irradiation,
kWh per square meter per day, 2023



Spain has a daily average of 4.6 kWh of sunlight per square meter, Morocco 5.6 kWh, twice what Germany can expect. It is essential that Spain knows how to take advantage of the opportunity today to start building the industry of the future

Wind speed, 100 m s/sea level.
Meters per second, 2023

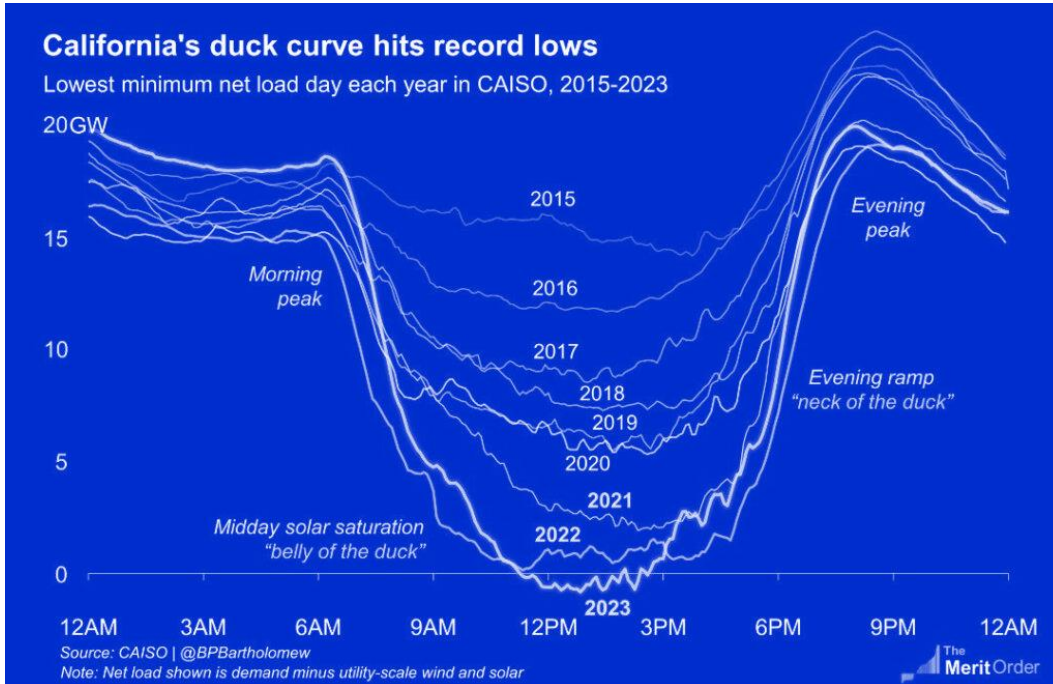




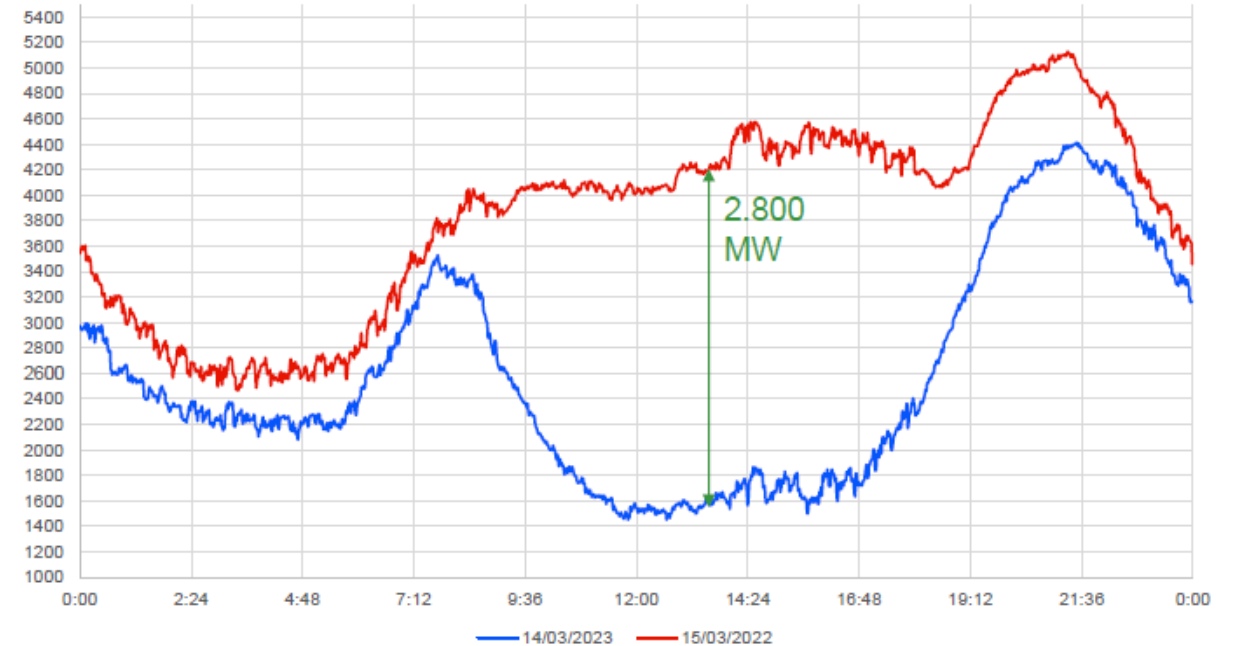
Demand is key to the energy transition

To avoid the duck curve, it is imperative to electrify demand and encourage the development of new industry.

California Duck Curve 2015-2023



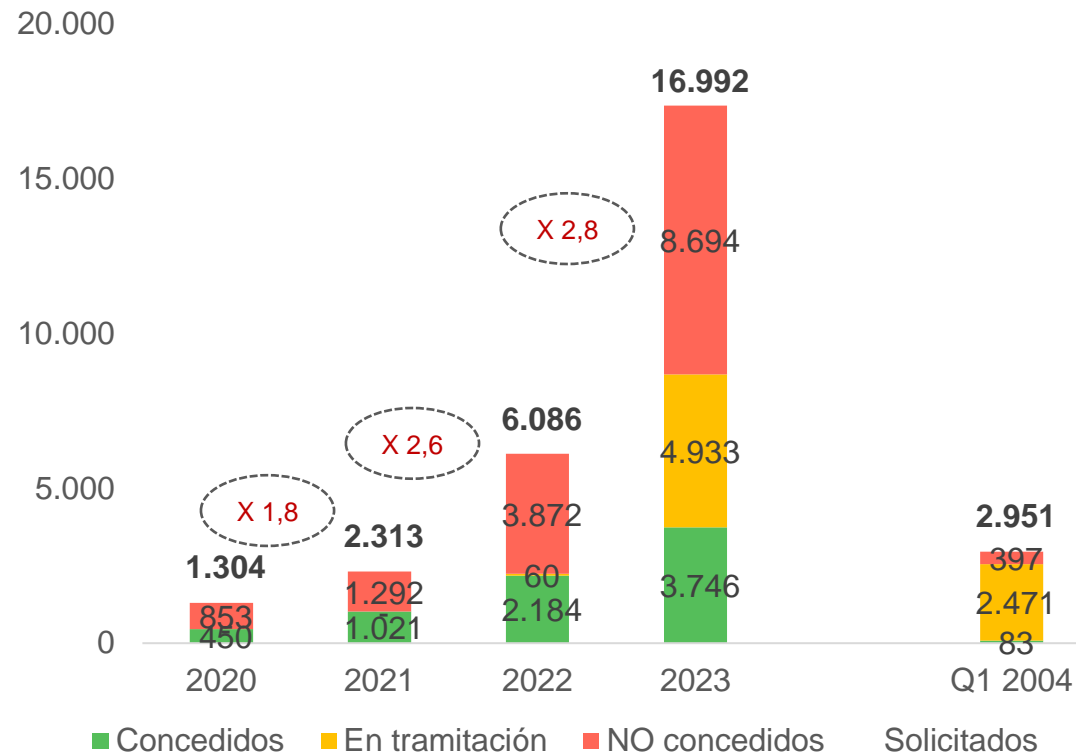
Andalusia Duck Curve 2022-2023



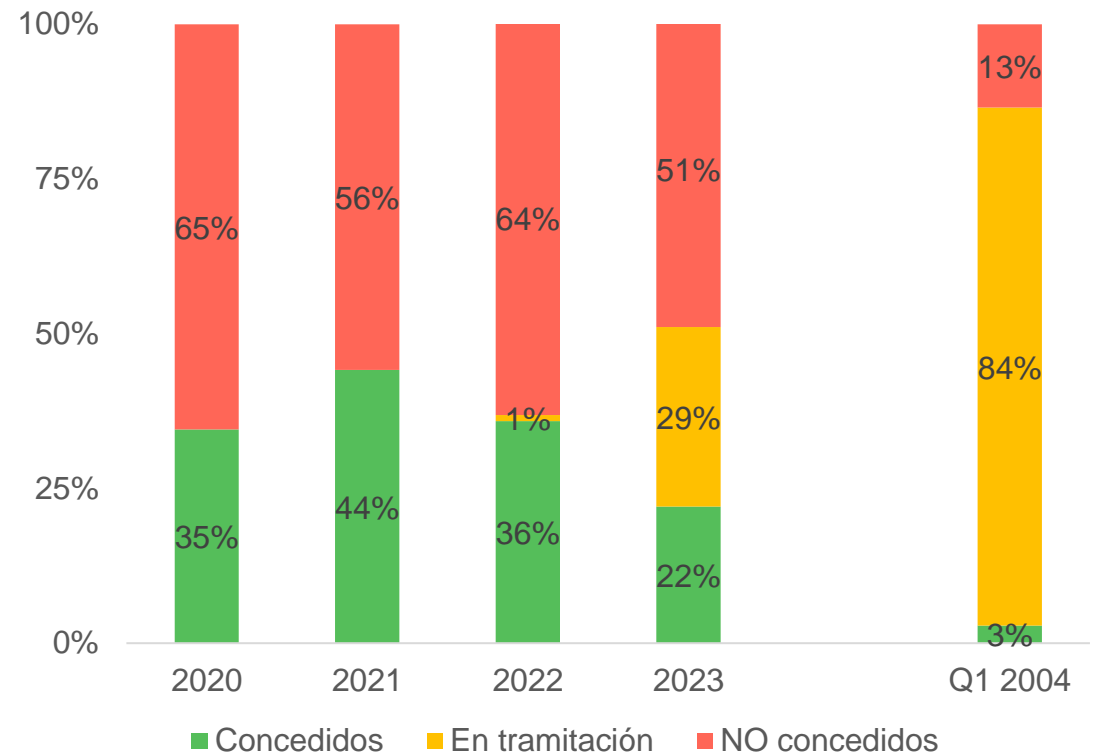
Access requests for 25 GW

Of this total, 51% have been rejected due to lack of capacity of the network infrastructures (TSO/DSO), 25% have been granted and an equivalent value is in process.

Process-Based Access Requests (MW)

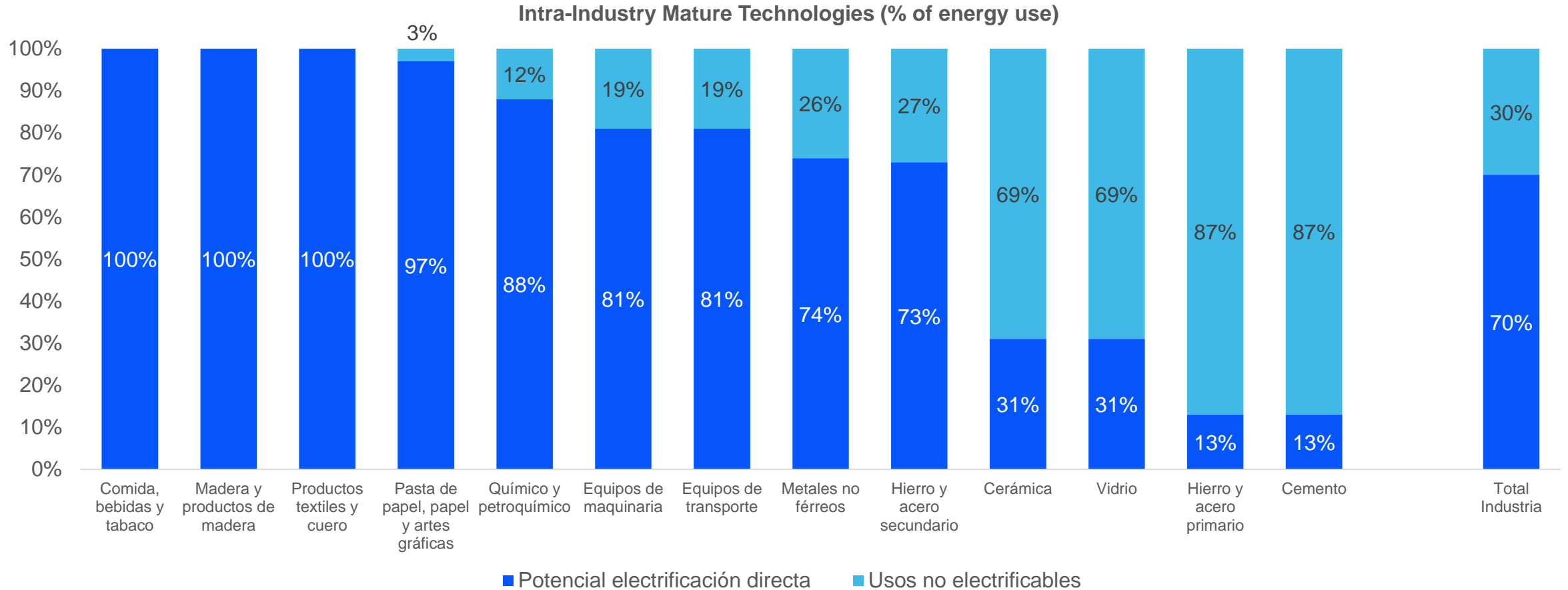


Access requests by process (%)



Electrification potential of Spanish industry

Industries with lower thermal needs (<math> < 400^{\circ}\text{C}</math>) have a greater technical potential for electrification with technologies already available.



Electrification Success Stories


+ *Heat pump*

+ *Electric Vehicle & Bus*

+ *Green Harbour*

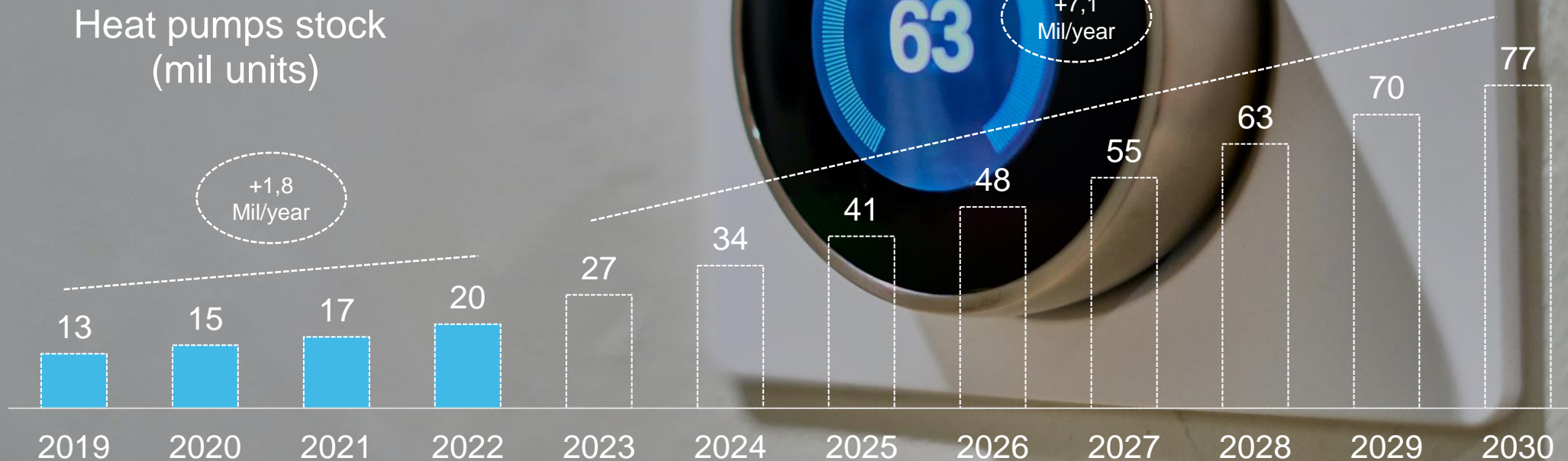
+ *Industry: 11 sectors (92% of Europe's emissions) can be electrified by 70-80% with existing technologies.*

+ *Indirect electrification*

A large, bold, white letter 'E' logo is positioned on the right side of the slide.

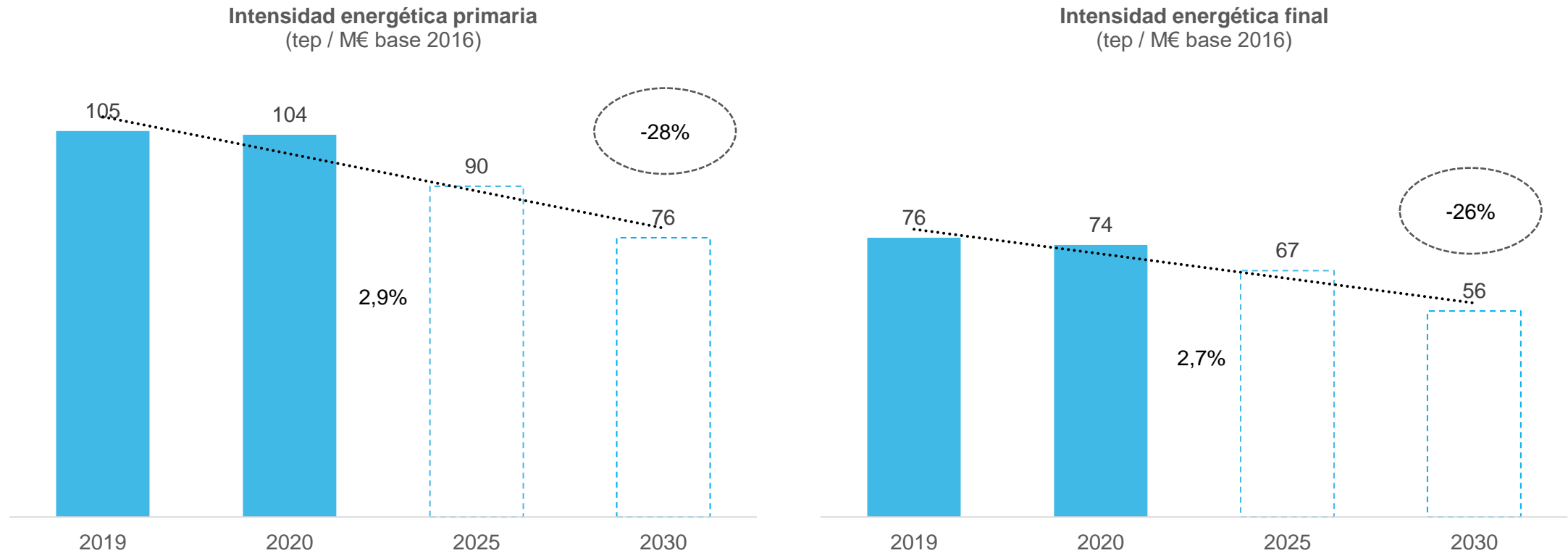
Heat pump

Spain's heat pump must increase by 4 times to meet the 2030 targets. In terms of impact on electricity demand, it is estimated that every additional 1 million heat pumps increases demand by 4 TWh (~0.4 Mtoe)



Energy intensities PNIEC Spain

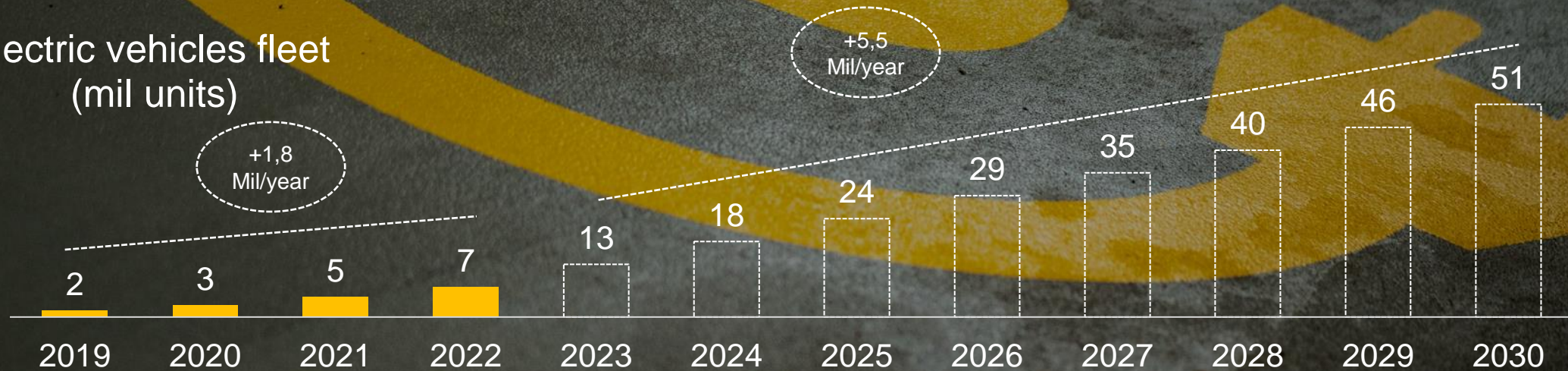
The reduction of 1.9% per year in primary energy consumption and 1.6% in final energy, compared to an average GDP of 1.1%, resulting in an improvement in primary energy intensity of 2.9% and final energy intensity of 2.7% per year until 2030.



Electric Vehicles

Electric vehicles must increase their sales rate by 3 times to meet the 2030 targets. In terms of impact on electricity demand, it is estimated that every additional 1 million EVs will account for 2 TWh (~0.2 Mtoe)

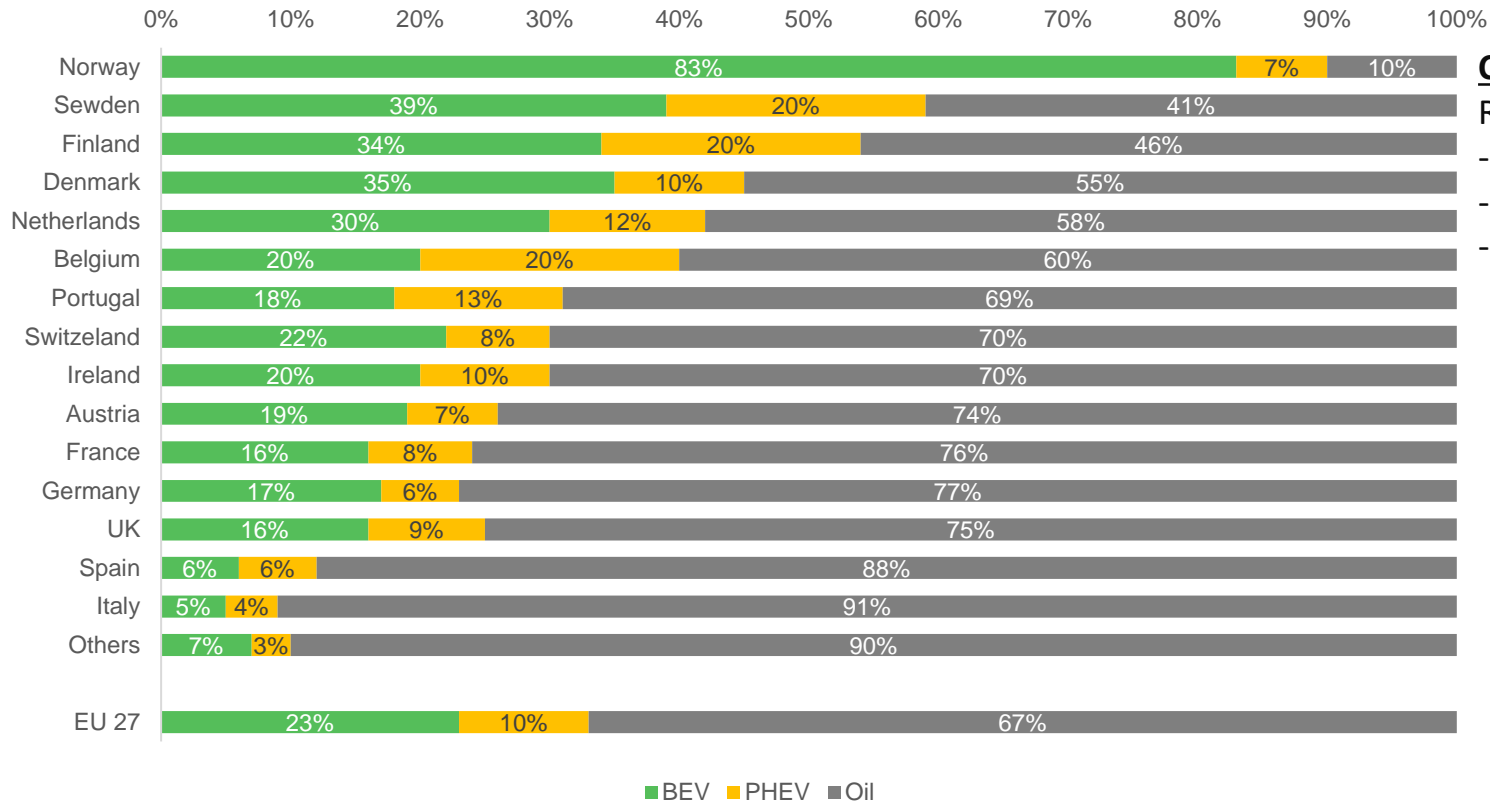
Electric vehicles fleet (mil units)



Electric Vehicle Sales in Europe

Electric vehicles sold in Q4 2023, 1,700 (22%), up 16% from Q3 2023 and 1,100.

2023 J-N % New EV sales in Europe by powertrain & Member State



Carga ultrarrápida y rápida

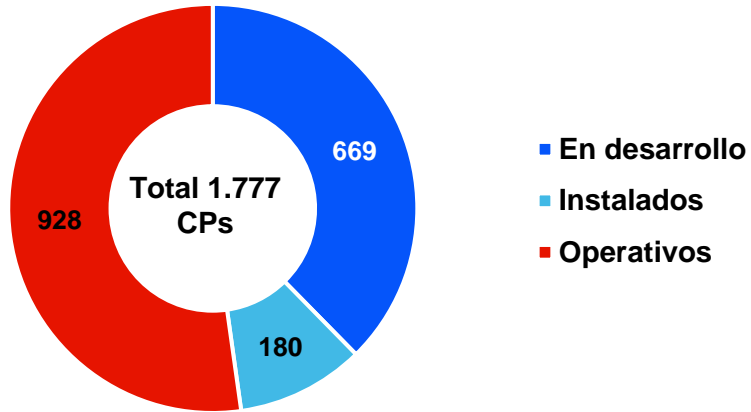
Recarga cuarto horaria para un consumo de 18 kWh/100km

- **Potencia del cargador:** 350 kW (en 15 mins 486 km)
- **Potencia del cargador:** 150 kW (en 15 mins 208 km)
- **Potencia del cargador:** 50 kW (en 15 mins 69 km)

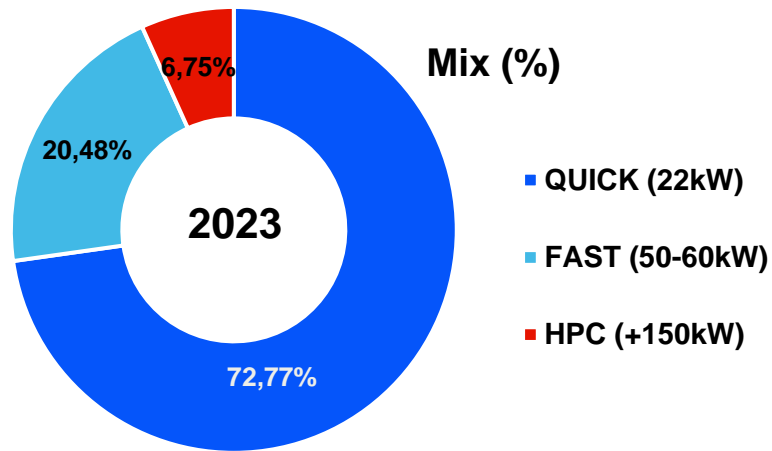


Deployment of charging network in Andalusia

Deployment Status



Mix (%)



	Operativos	Instalados	En Desarrollo	TOTAL
QUICK (22kWh)	593	83	323	999
FAST (50-60kWh)	257	56	178	491
HPC (+150kWh)	78	41	168	287
TOTAL	928	180	669	1.777

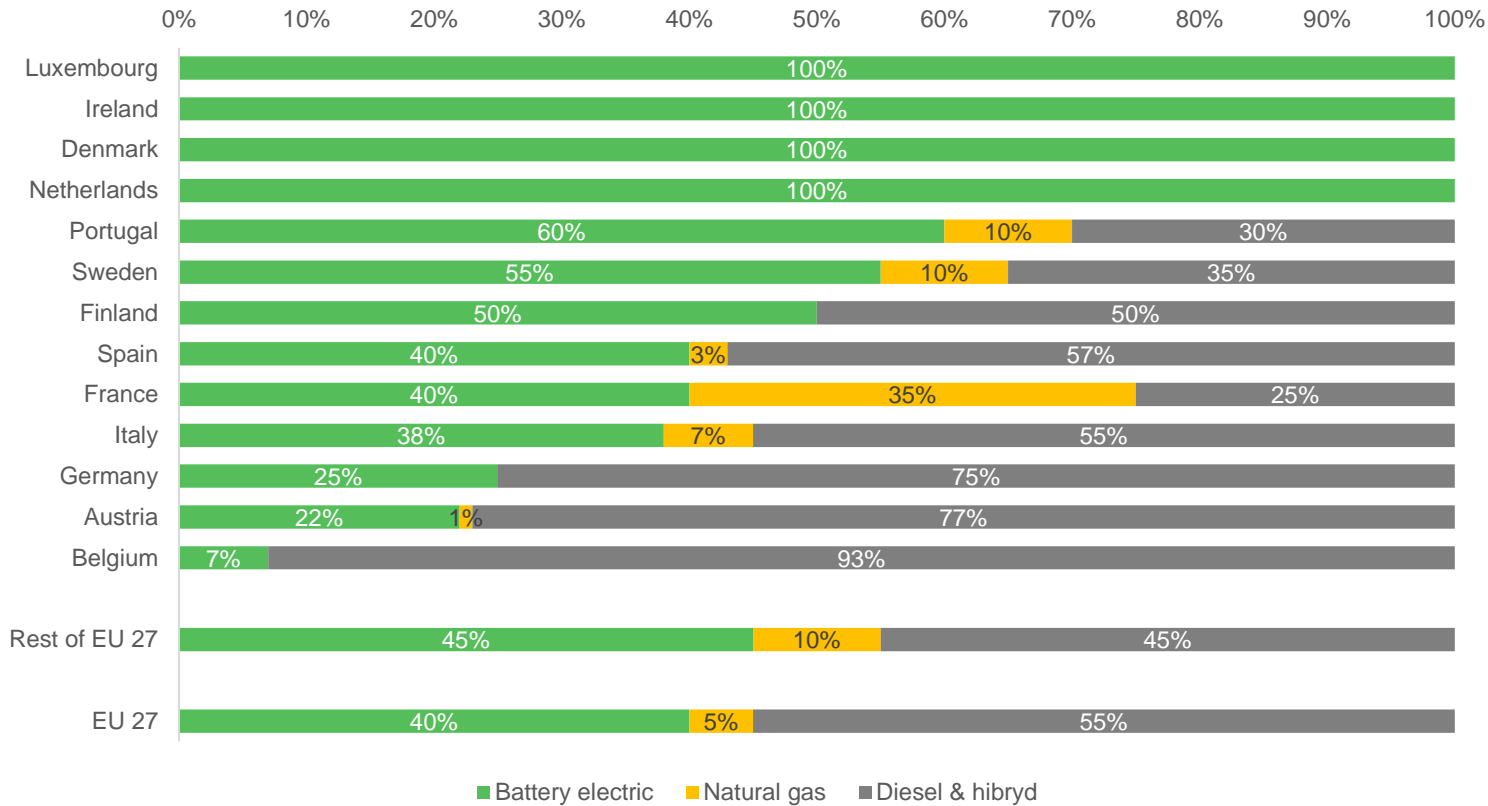


	QUICK (22kW)	FAST (50-60kW)	HPC (+150kW)	TOTAL
Almería	47	22	19	88
Jaén	23	30	35	88
Granada	93	69	25	187
Córdoba	120	64	35	219
Málaga	181	76	33	290
Sevilla	190	108	76	373
Cádiz	218	87	58	363
Huelva	127	35	6	169
TOTAL	999	491	287	1.777

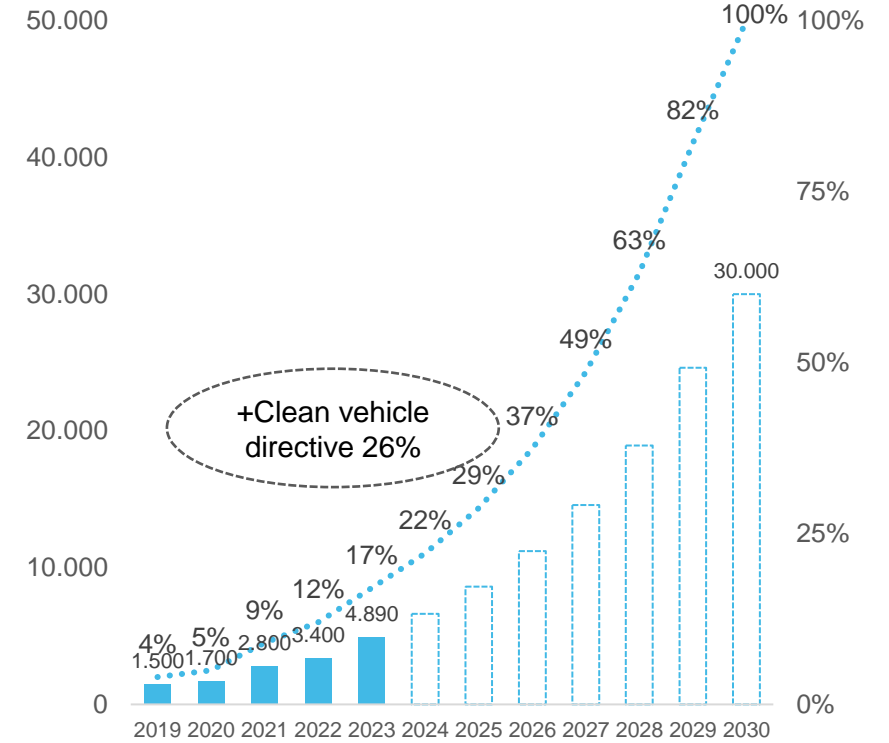
Sale of e-buses in Europe

Electric buses sold in Q4 2023, 1,700 22%, up 16% from Q3 2023 and 1,100.

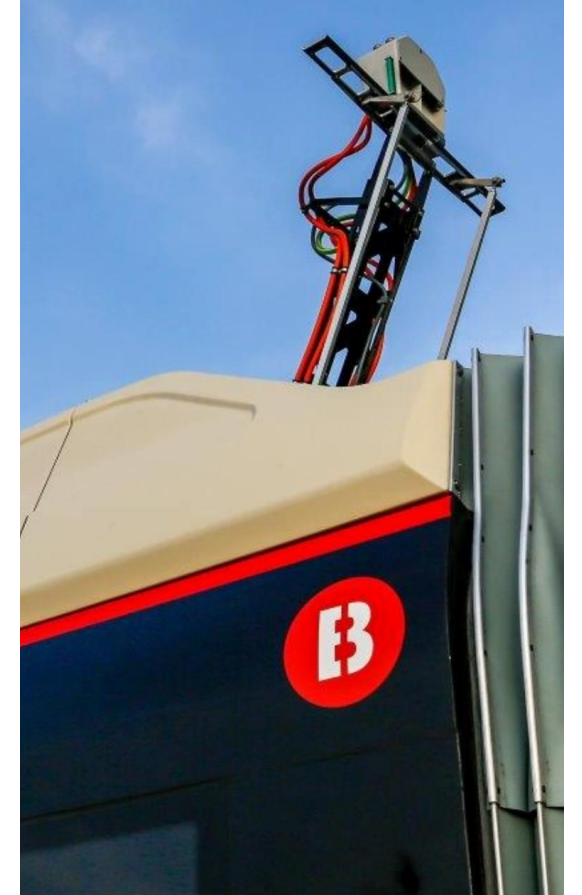
2023 Q4 % New City buses un Europe by powertrain & Member State



Zero – emisión buses sales (mil units)



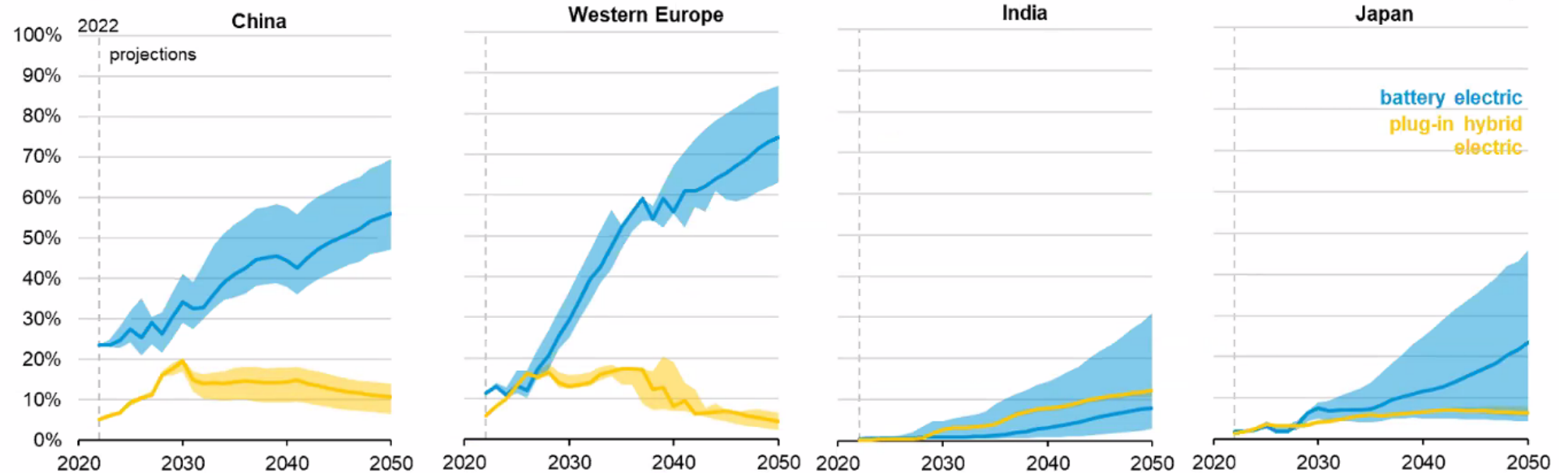
High power needs in urban environments



Global Electric Vehicle Forecast

The passenger car fleet grows from 1,400 million in 2022 to 2,000 million in 2050. A year in which BEVs will account for between 29% and 54% of vehicle sales. A peak in the global fleet of internal combustion vehicles is observed in all cases, which will occur between 2027 and 2033.

Electric share of light-duty vehicle sales percentage



Data source: U.S. Energy Information Administration, *International Energy Outlook 2023* (IEO2023)
 Note: Each line represents IEO2023 Reference case projections. Shaded regions represent maximum and minimum values for each projection year across the IEO2023 Reference case and side cases.





#eCity y #ePort

Sustainable Mining



Atalaya Mining 50MW without grid connection





ET & DT

Energy

Transition

Digital & AI

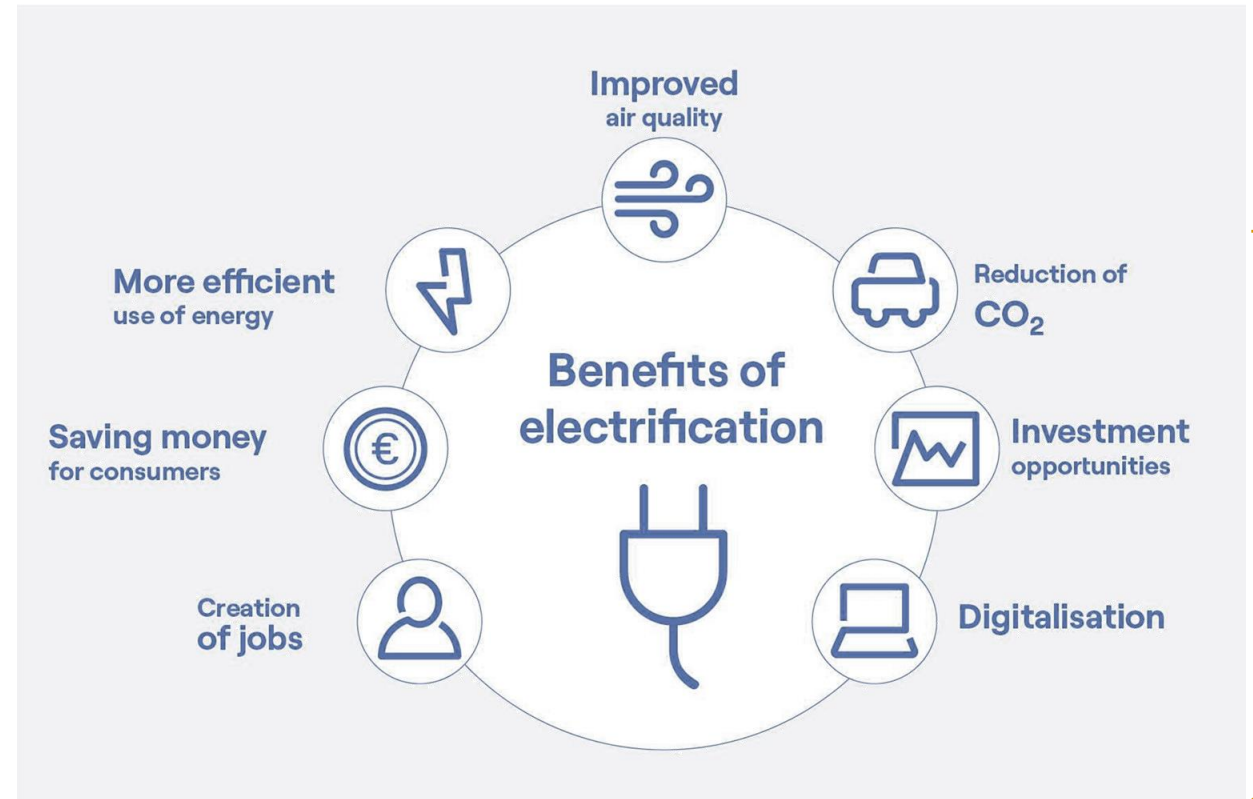
Transformation

Convergence of sectors

Electrification and its advantages

It emerges as the critical vector and unprecedented opportunity to foster a transition to clean energy and the decarbonization of energy uses

- A MIX based on renewable energy is the way to an affordable and reliable system.
- The way to increase the efficiency of energy uses and save money.
- It improves air quality in cities by reducing local pollutant emissions.
- It enables the digitalization of energy uses, the integration of smart technologies, and supports the development of products, services, and business models.
- Promote the circular economy and the creation of new green jobs.



An aerial photograph of a dense, lush green forest. The trees are tightly packed, creating a vibrant green canopy. The lighting is bright, highlighting the various shades of green. In the bottom right corner, the word "Gracias!" is written in a large, white, sans-serif font.

Gracias!