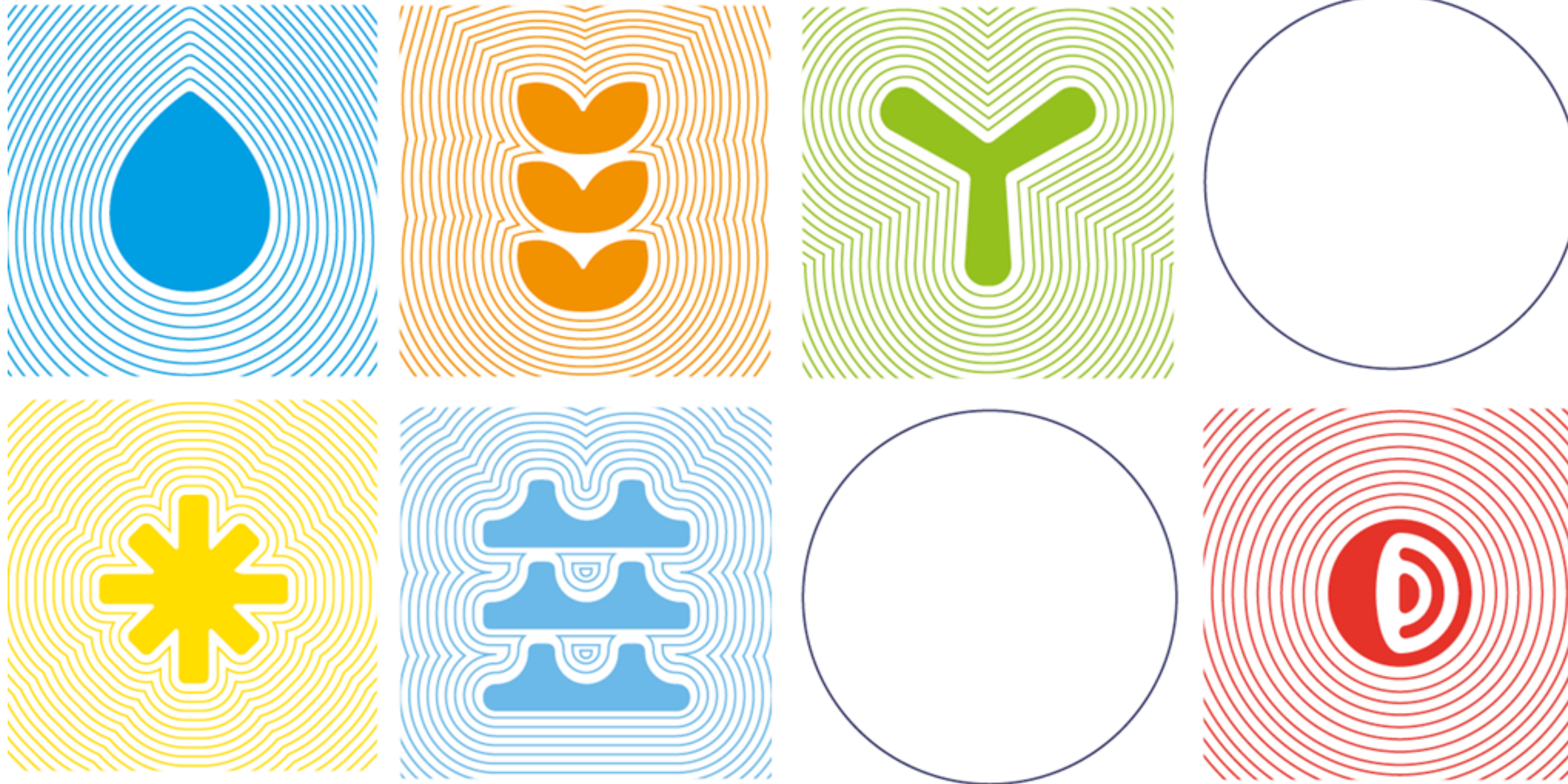


**Renewable Electricity Bulletin
December 2023**

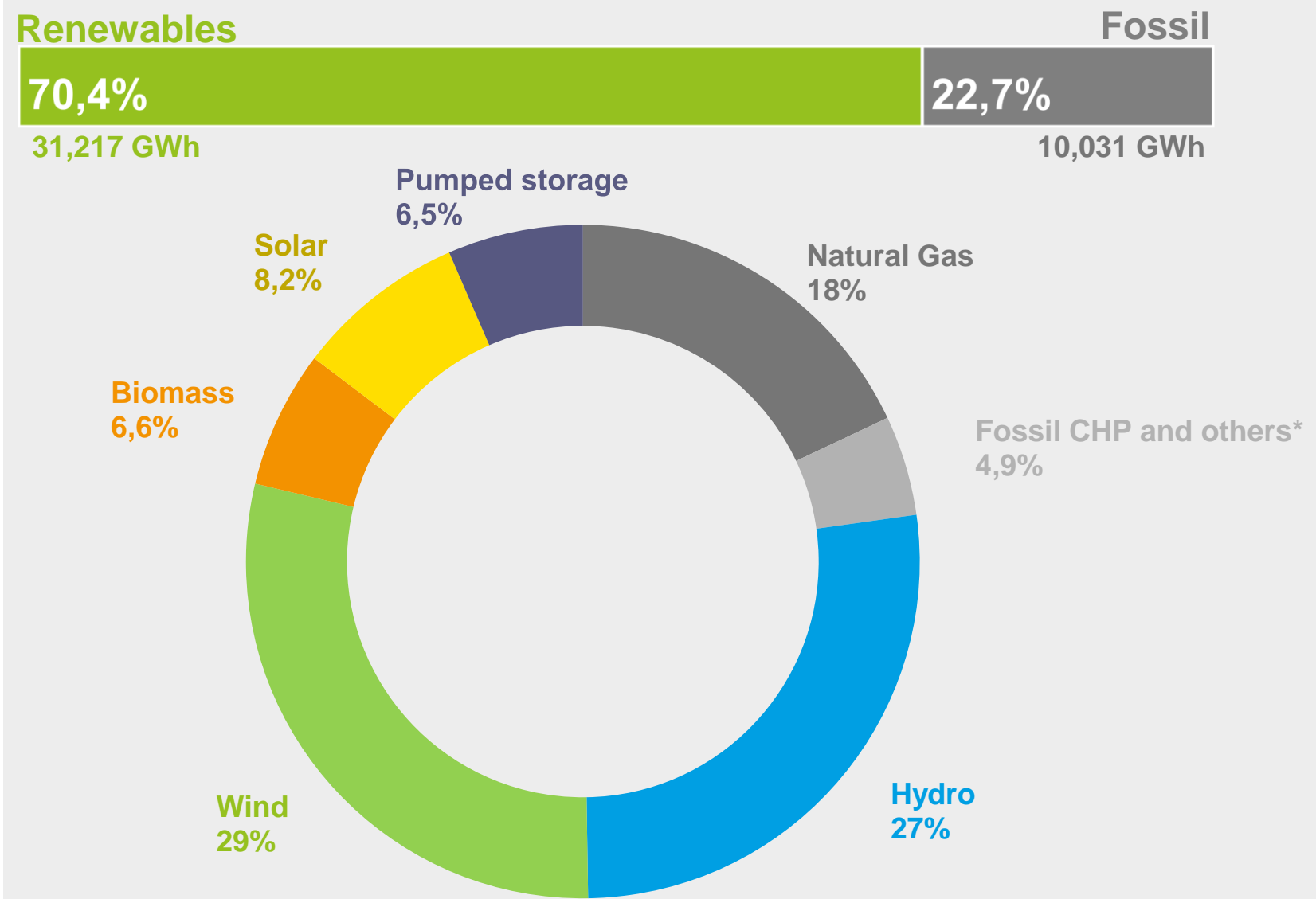


2023

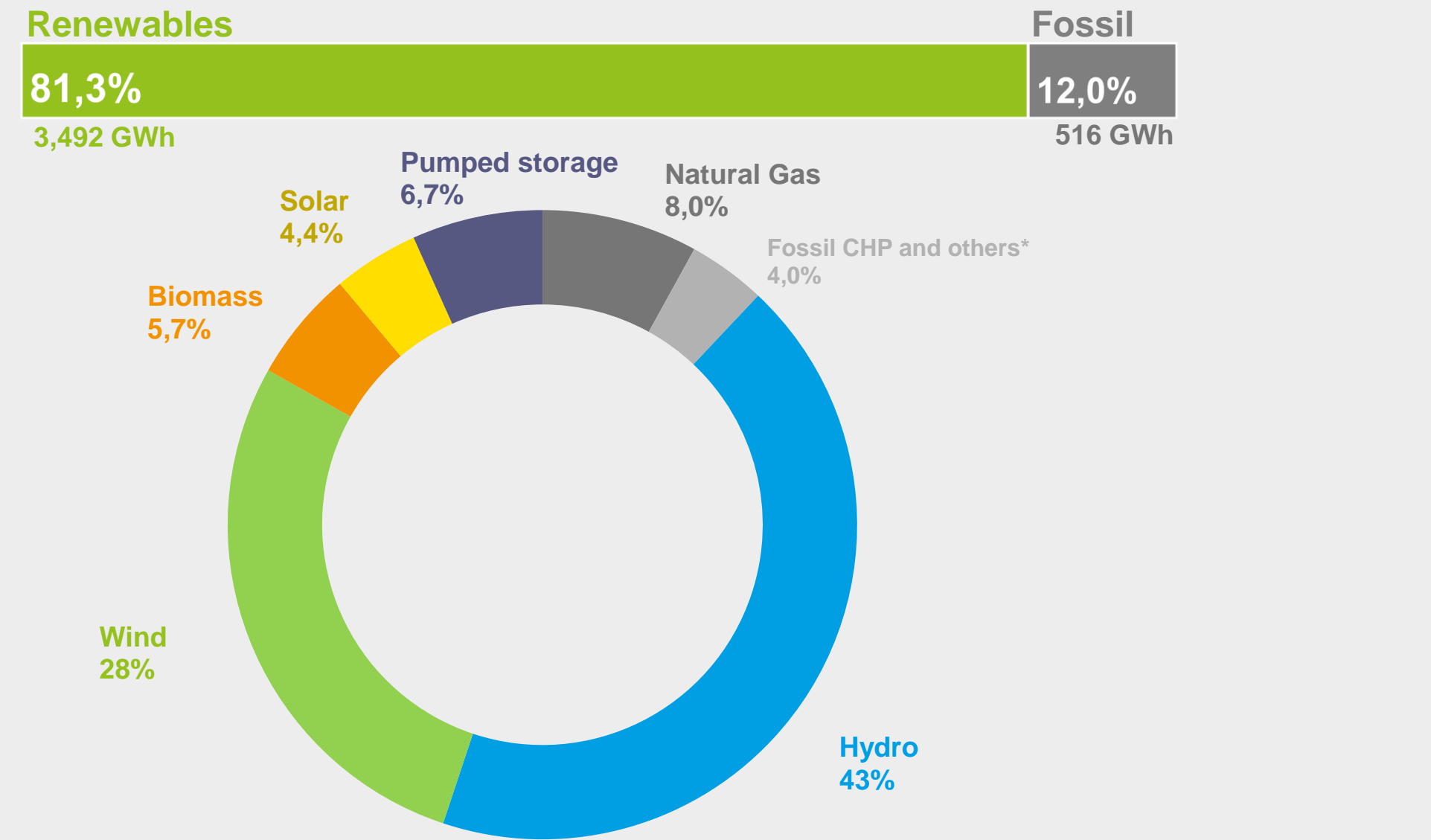
**PORTUGAL NEEDS
OUR ENERGY**

Executive Summary

Accumulated Generation (Jan-Dec)



Monthly Generation (Dec)



Electricity sector indicators (Jan-Dec)

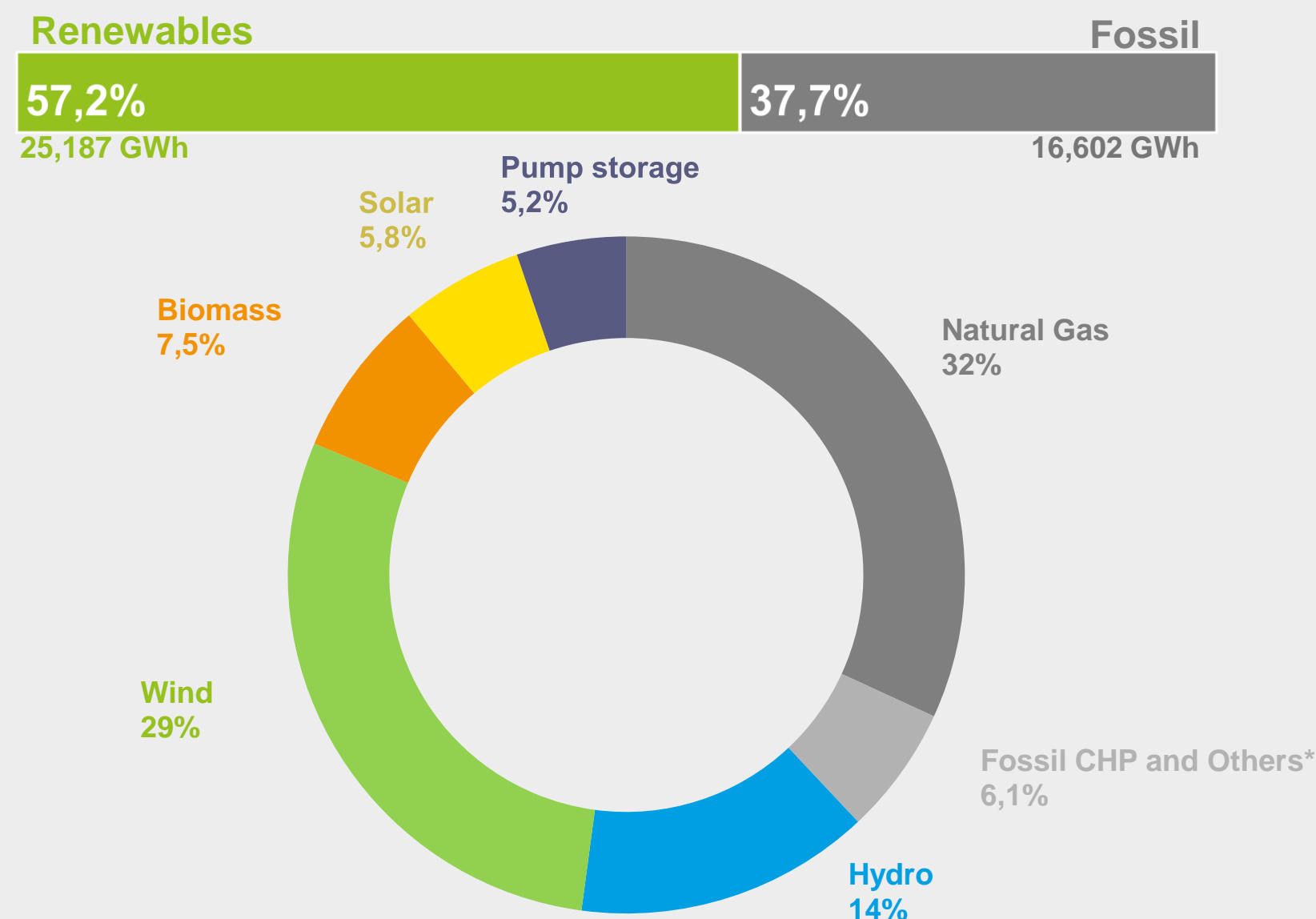
GWh 44,128 Generation ^a	tCO₂ €85.3 Price CO ₂	MWh €88.3 MIBEL Price PT	MtCO₂eq 3,6 CO ₂ Emissions	GWh 10.220 Import balance	gCO₂eq/kWh 82.2 CO ₂ specific emissions
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^aGeneration refers to the net power generation of the power plants, considering the production by pumping recently disclosed by REN. Pumping production is not accounted for in the percentage of production from renewable sources. Source: REN, Analysis APREN.

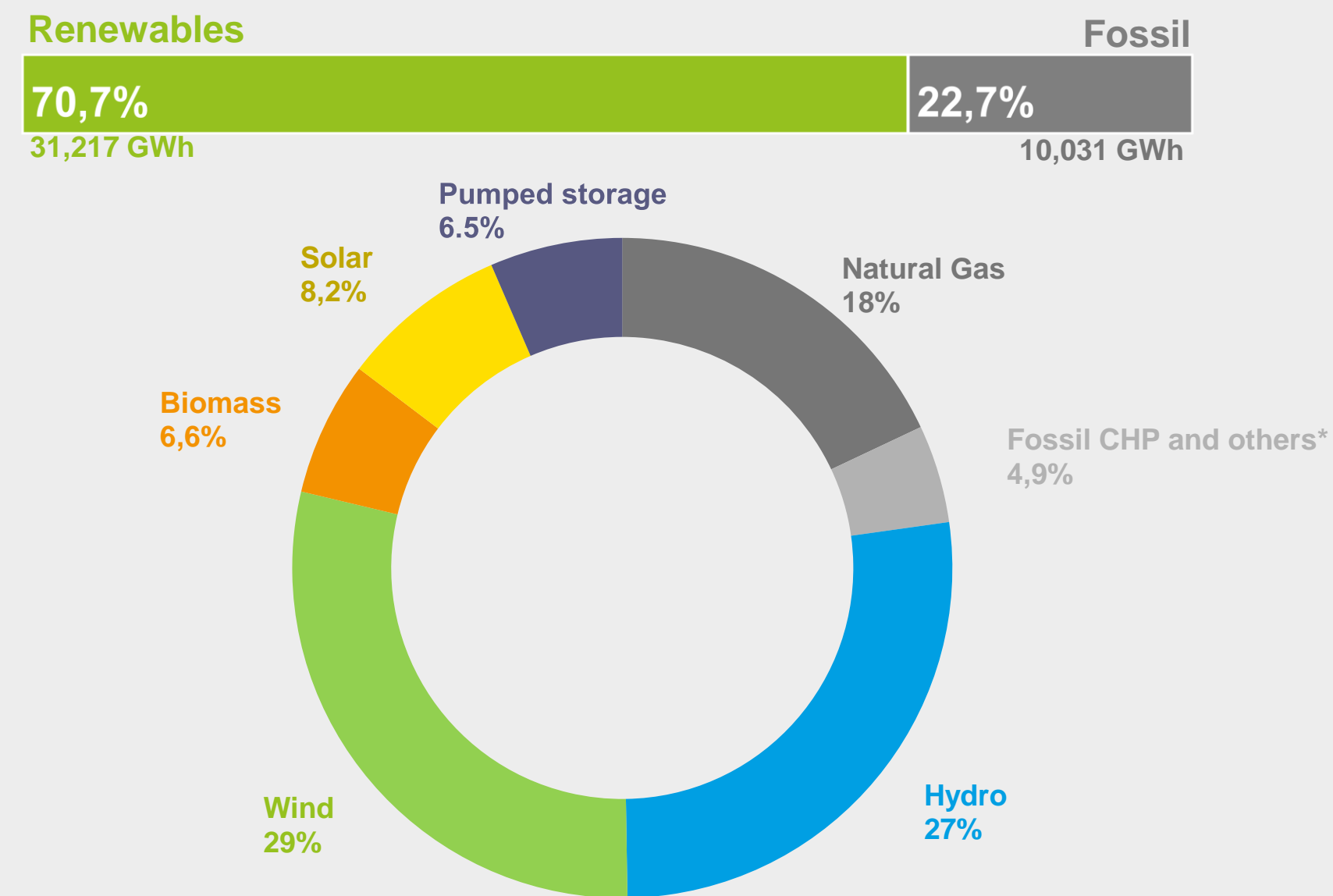
* Includes fuel oil, diesel, the non-biodegradable fraction of urban solid waste and other waste.

Executive Summary

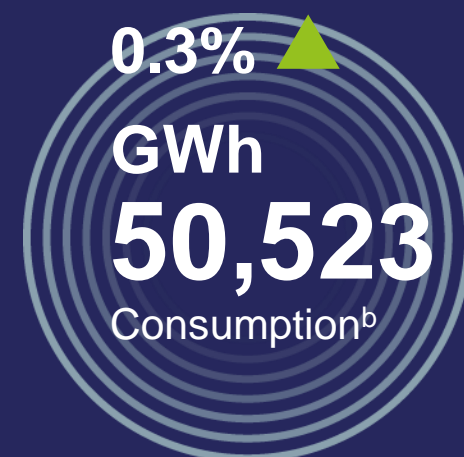
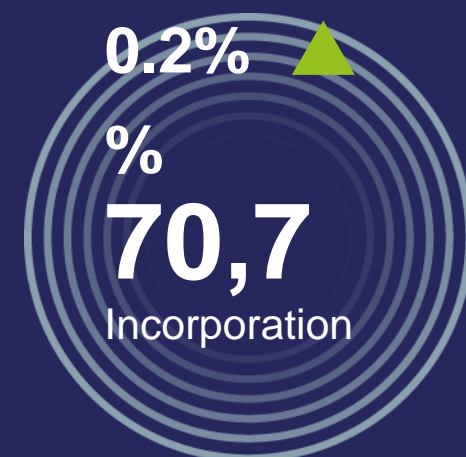
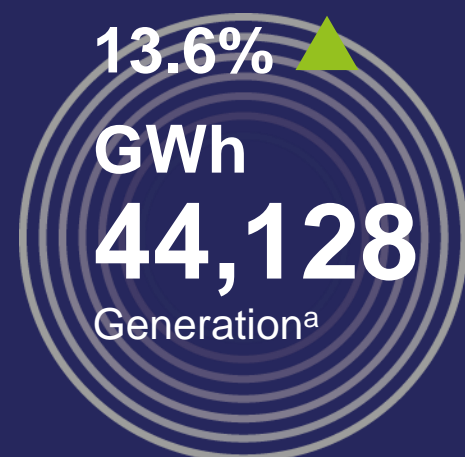
Accumulated December 2022 (Jan-Dec)



Accumulated December 2023 (Jan-Dec)



Main indicators In comparison to December 2022

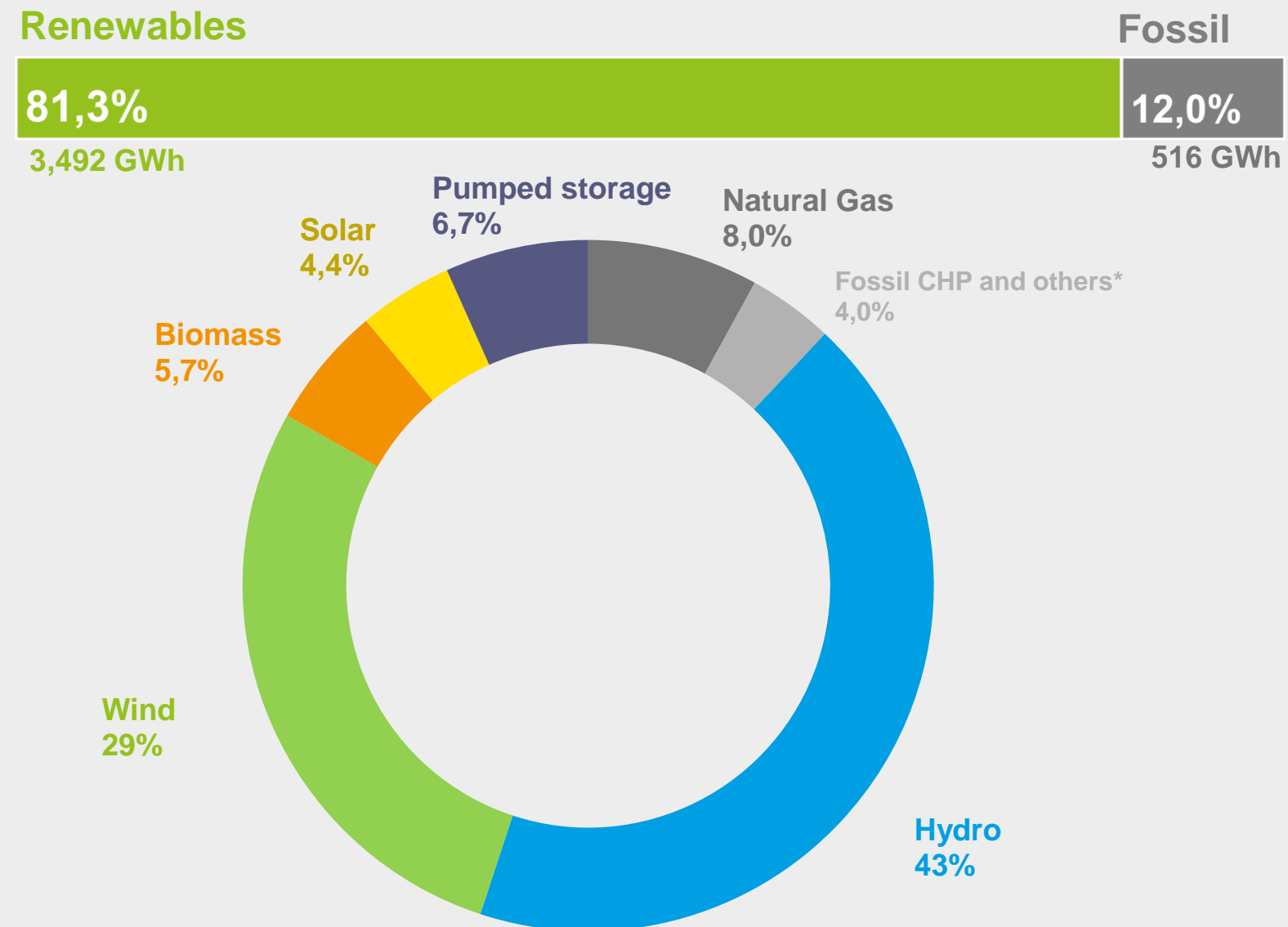


^a Generation refers to the net power generation of the power plants, considering the production by pumped storage recently disclosed by REN. Pumping production is not accounted for in the percentage of production from renewable sources. Source: REN, Analysis APREN

^b Consumption refers to the liquid generation of power of the plants, considering the import-export balance. Source: REN, Analysis APREN

* Includes fuel oil, diesel, the non-biodegradable fraction of urban solid waste and other waste.

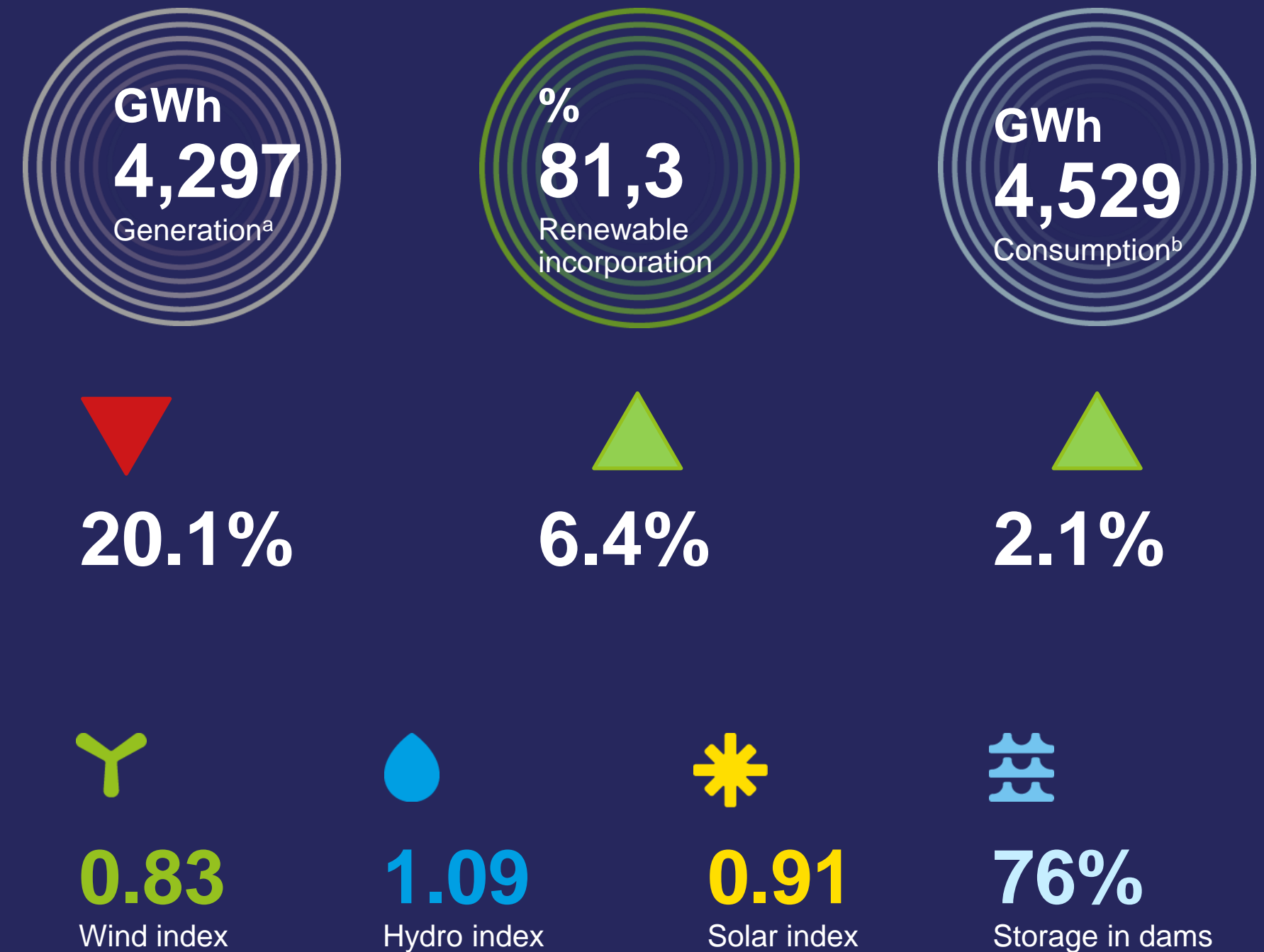
Monthly analysis in Portugal: December



Between December 1 and 31, 2023, renewable energy integration was 81.3%, totaling 4,297 GWh produced. The 6.4% increase compared to December 2022 is due to an across-the-board increase in renewable production, particularly hydro, which increased its production by 4%, but mainly due to the reduction in the incorporation of natural gas by 10%, with a decrease in production from 1,496 GWh to 1,209 GWh.

* Includes fuel oil, diesel, the non-biodegradable fraction of urban solid waste and other waste.

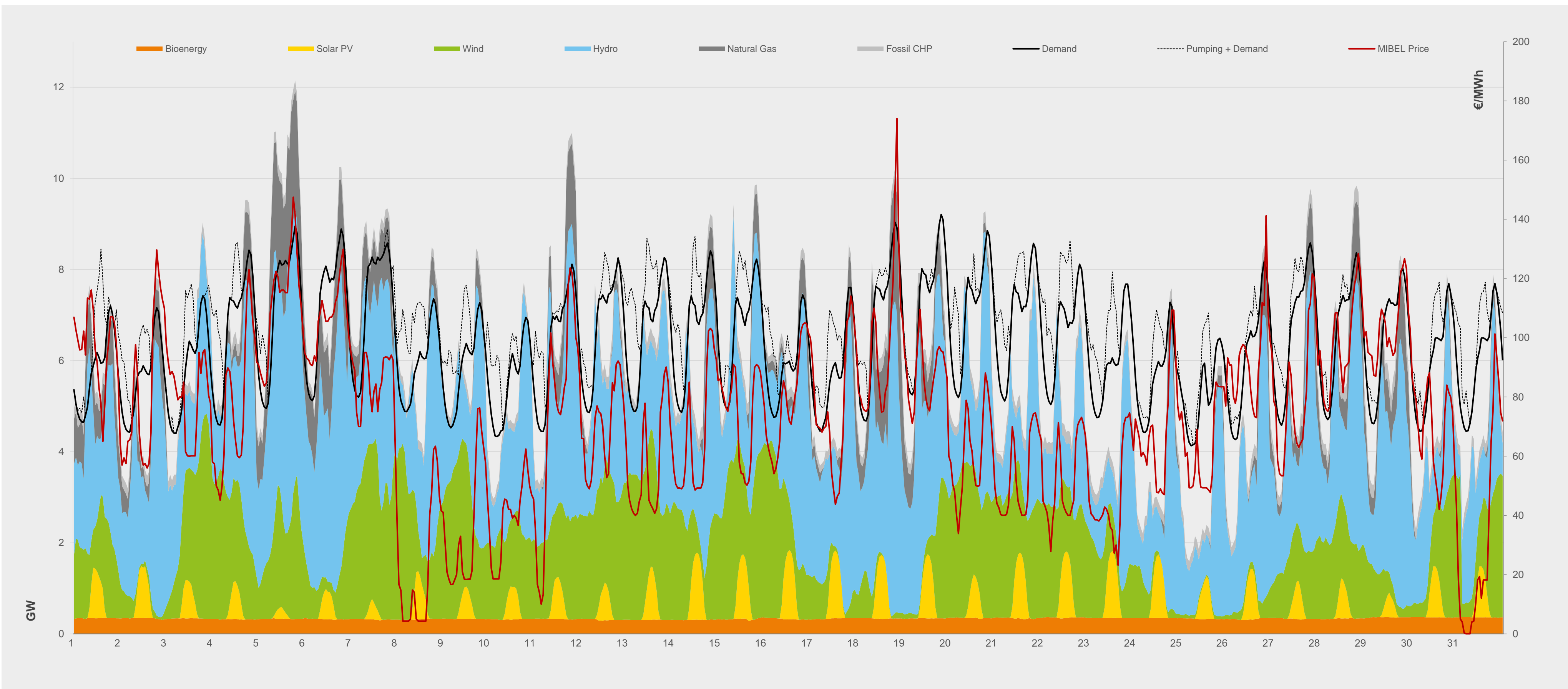
Indicators of the electricity sector (in comparison to December 2022)



^a Generation refers to the net power generation of the plants, considering the pumping production recently disclosed by REN. Pumping production is not accounted for in the percentage production from RES. Source: REN; Analysis APREN.

^b Consumption refers to the liquid generation of power of the plants, considering the import-export balance. Source: REN; Analysis APREN

Monthly analysis in Portugal: Load diagram for the month of December 2023

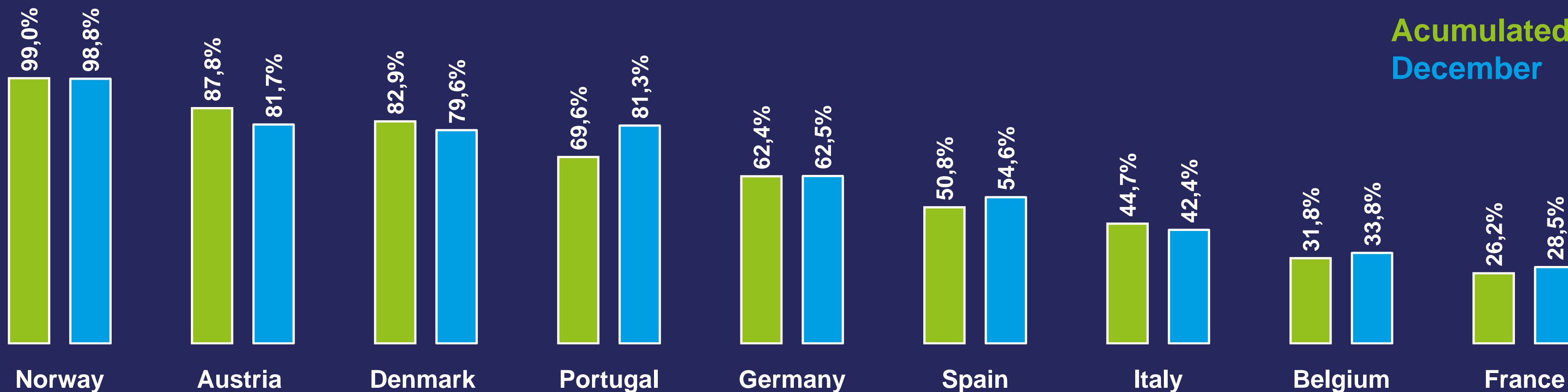


Source: REN; Analysis APREN

Renewable Electricity Europe

In this analysis, only the main countries of the different European markets were considered in order to obtain a representative picture of comparison.

Between January 1 and December 31, 2023, Portugal ranked as the fourth country with the highest renewable energy integration in electricity generation, trailing behind Norway, Austria, and Denmark, which achieved 99.0%, 87.8%, and 82.9% from RES (Renewable Energy Sources), respectively. From December 1 to 31, Portugal secured the third position in Europe for the highest renewable energy integration among the considered countries.



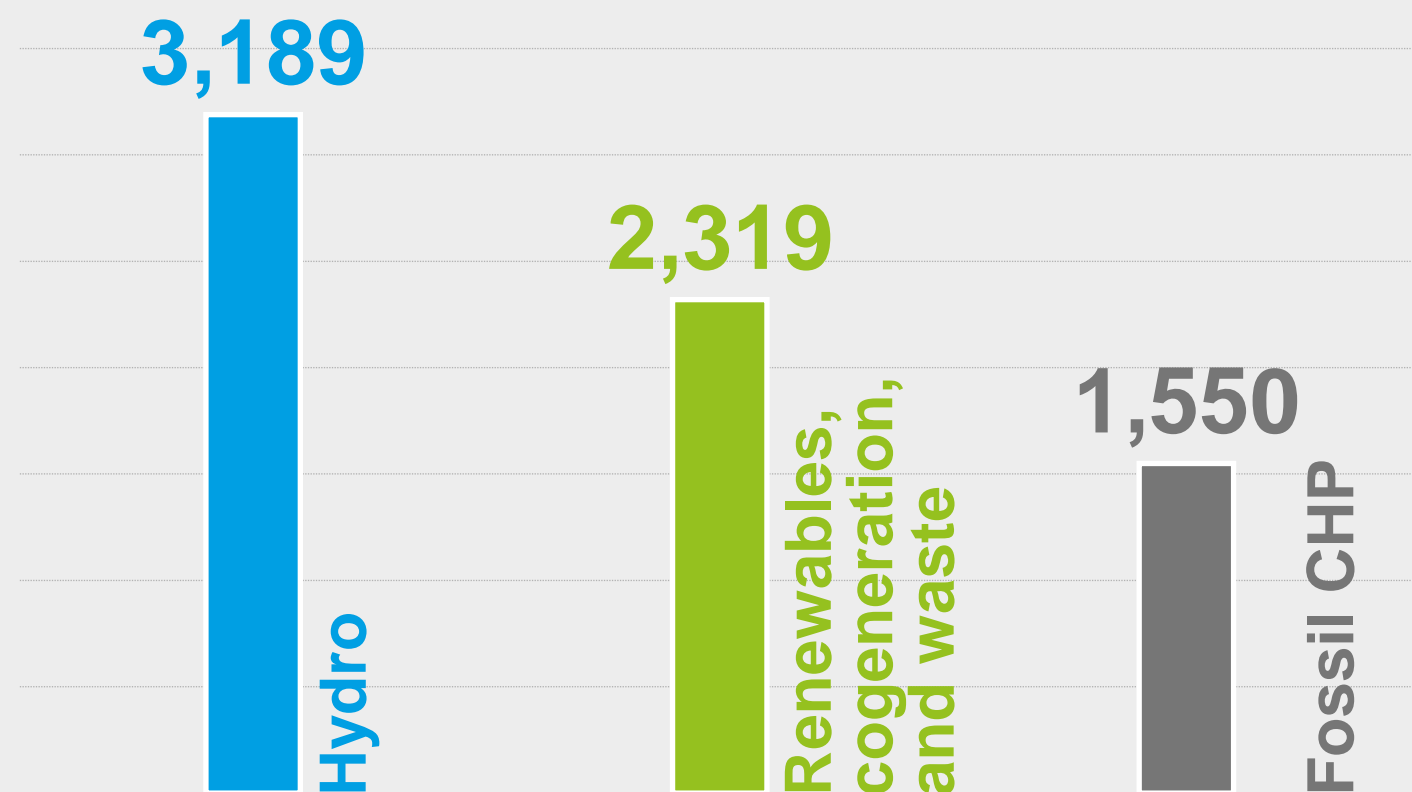
Renewable incorporation in the accumulated generation of electricity (Jan-Dec) and monthly (December).
Source: REN, Fraunhofer, REE, Terna, National Grid, ENTSO-E. Analysis APREN

Market price setting Portugal

Between January 1 and December 31, it was observed that the market closure technology with the highest number of hours was hydropower, totaling 3,189 non-consecutive hours, followed by renewables, cogeneration, and waste with 2,319 hours, and combined cycle thermal generation with 1,550 hours.

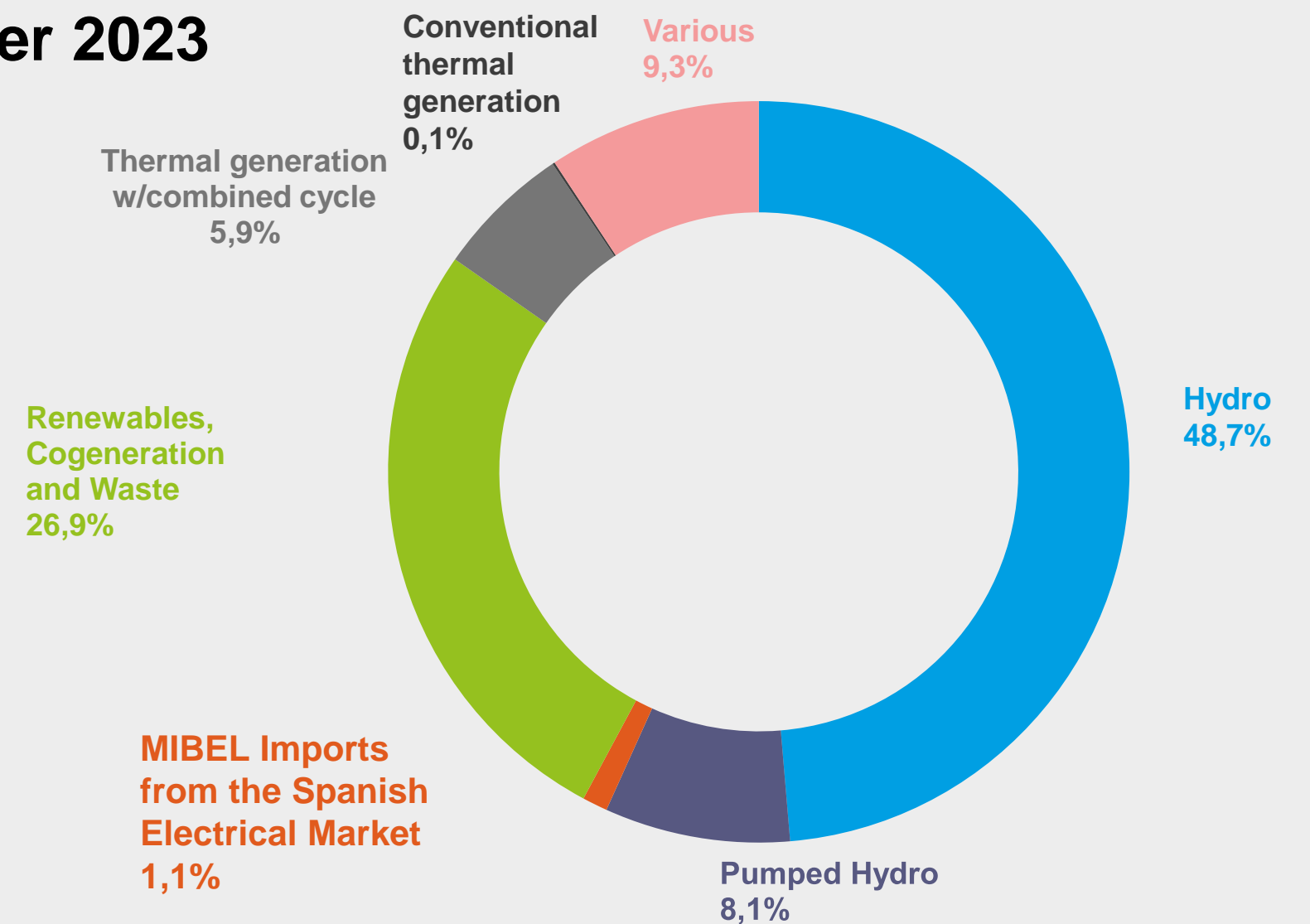


Accumulated January-December



Number of market price setting hours of the three main market setting technologies (Jan-2023 to Dec-2023).
Source: OMIE. Analysis APREN

December 2023



Percentage distribution of the number of market price setting hours of the various technologies, in a total 744 hours (December).
Source: OMIE. Analysis APREN

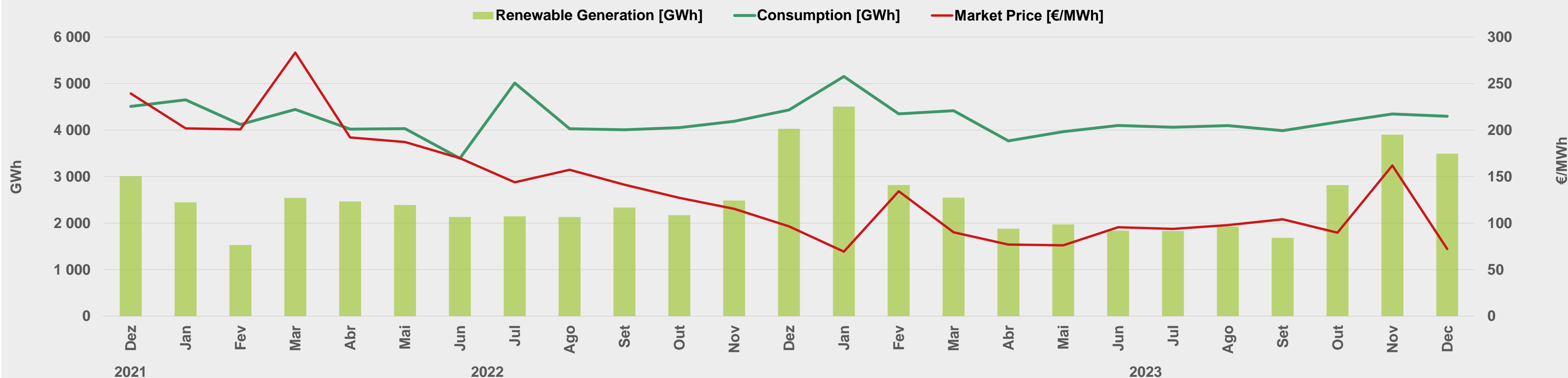
Electricity Market Portugal

Between January 1 and December 31, the average hourly price recorded in MIBEL in Portugal was €88.3 MWh^c, representing a decrease to less than half compared to the same period last year.

In the same period, 1 015 non-consecutive hours were recorded, in which renewable generation was sufficient to supply electricity consumption in mainland Portugal, with an average hourly price in the MIBEL of €65.4/MWh. From December 1 to 31, renewable generation offset 114 hours of consumption.



Accumulated January-December



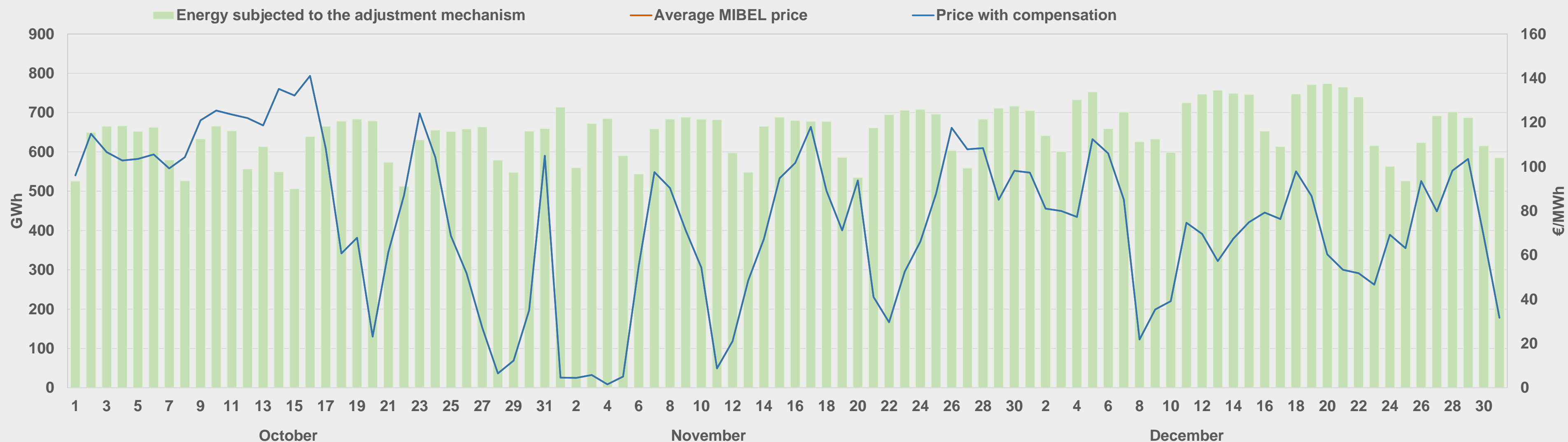
Number of market price setting hours of the three main market setting technologies (Dec-2021 to Dec-2023).
Source: OMIE. Analysis APREN
^c Arithmetic average of hourly prices

Electricity Market

Iberian gas price limit mechanism

Since June 15, 2022, when the Iberian natural gas price limit mechanism came into operation, until November 30, the mechanism generated savings of €17.86/MWh^c, which amounted to a reduction of 12.0 % in the average hourly price at MIBEL.

The savings due to the price limit of natural gas, correspond to the difference between the price without the mechanism and the price with the compensation to be paid to natural gas plants. During the months of April until December, the price limit on natural gas didn't introduce changes in the electricity prices. In total, 323.2 of the 401.9 TWh produced, were subjected to the consumer adjustment mechanism in the Iberian Peninsula.



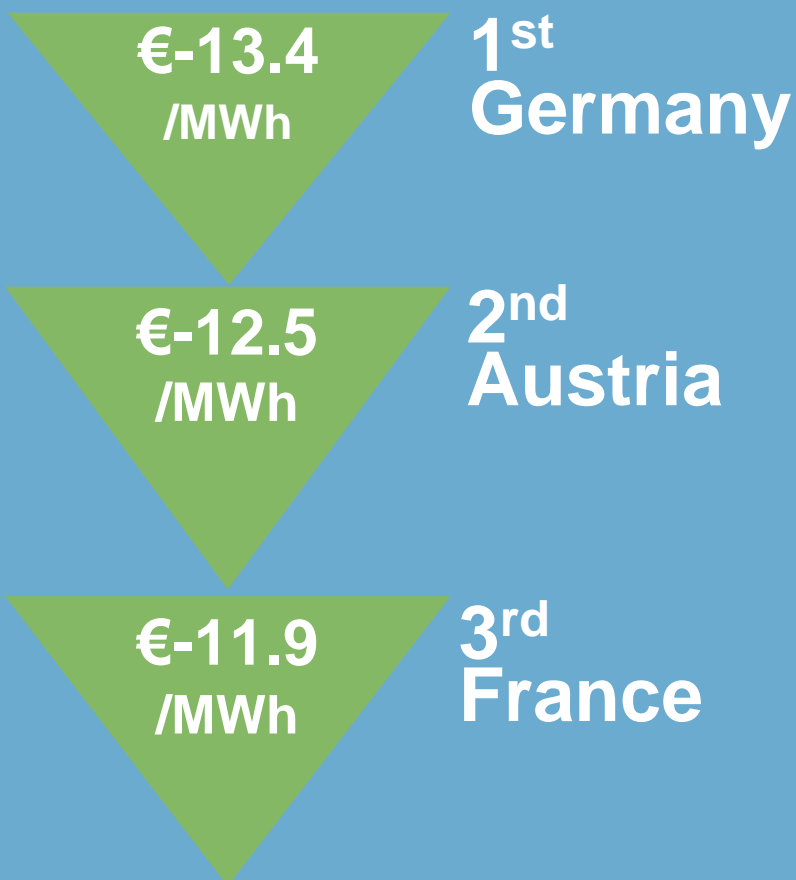
^c Arithmetic average hourly prices
Source: OMIE. Analysis APREN

Renewable Electricity Europe

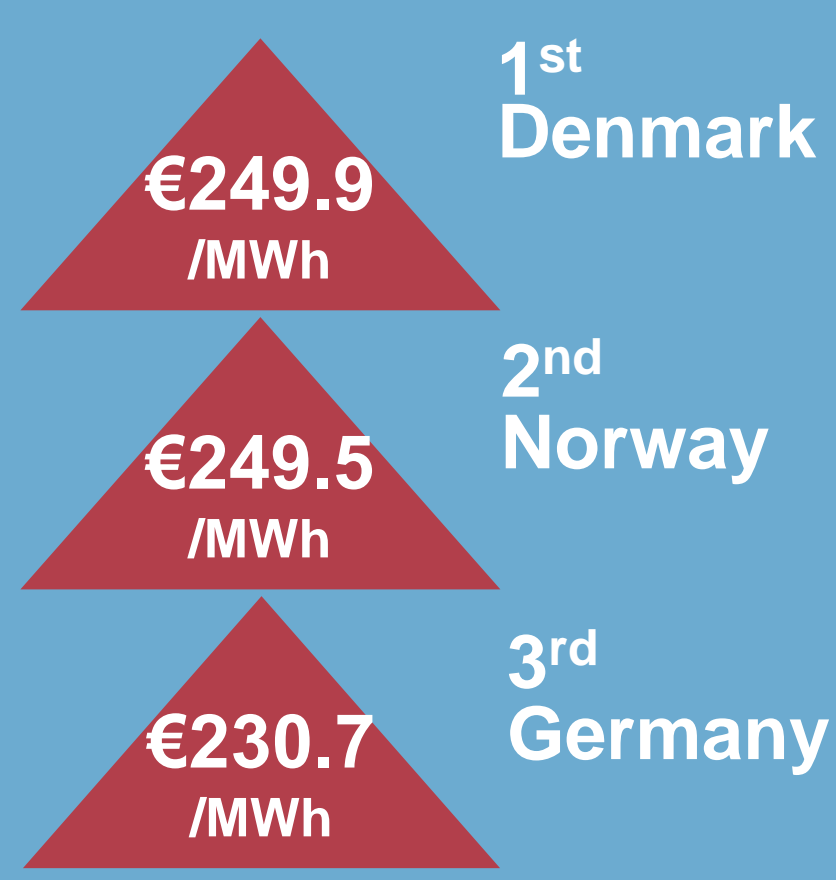
During the month of December 2023, there was a minimum hourly price at MIBEL in Portugal of €0.00/MWh, in 2 hours in which the market setting was with various technologies. The maximum hourly price reached €174/MWh, where the market set with renewables, cogeneration and waste.

With regard to prices in Europe, the average values fell across the board in all the markets analysed compared to the previous month.

Minimum Prices (Dec)

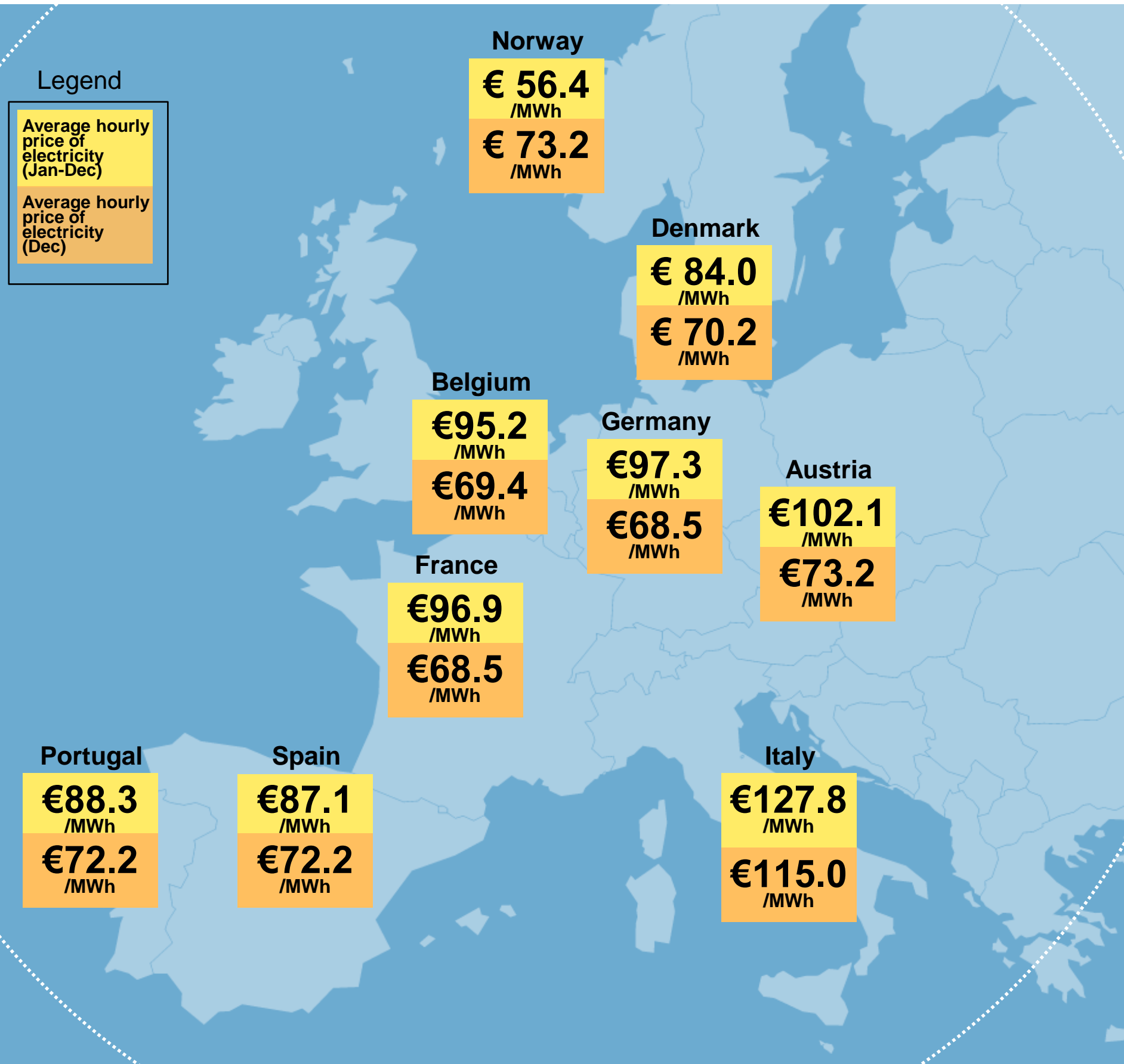


Maximum Prices (Dec)



Legend

Average hourly price of electricity (Jan-Dec)
Average hourly price of electricity (Dec)



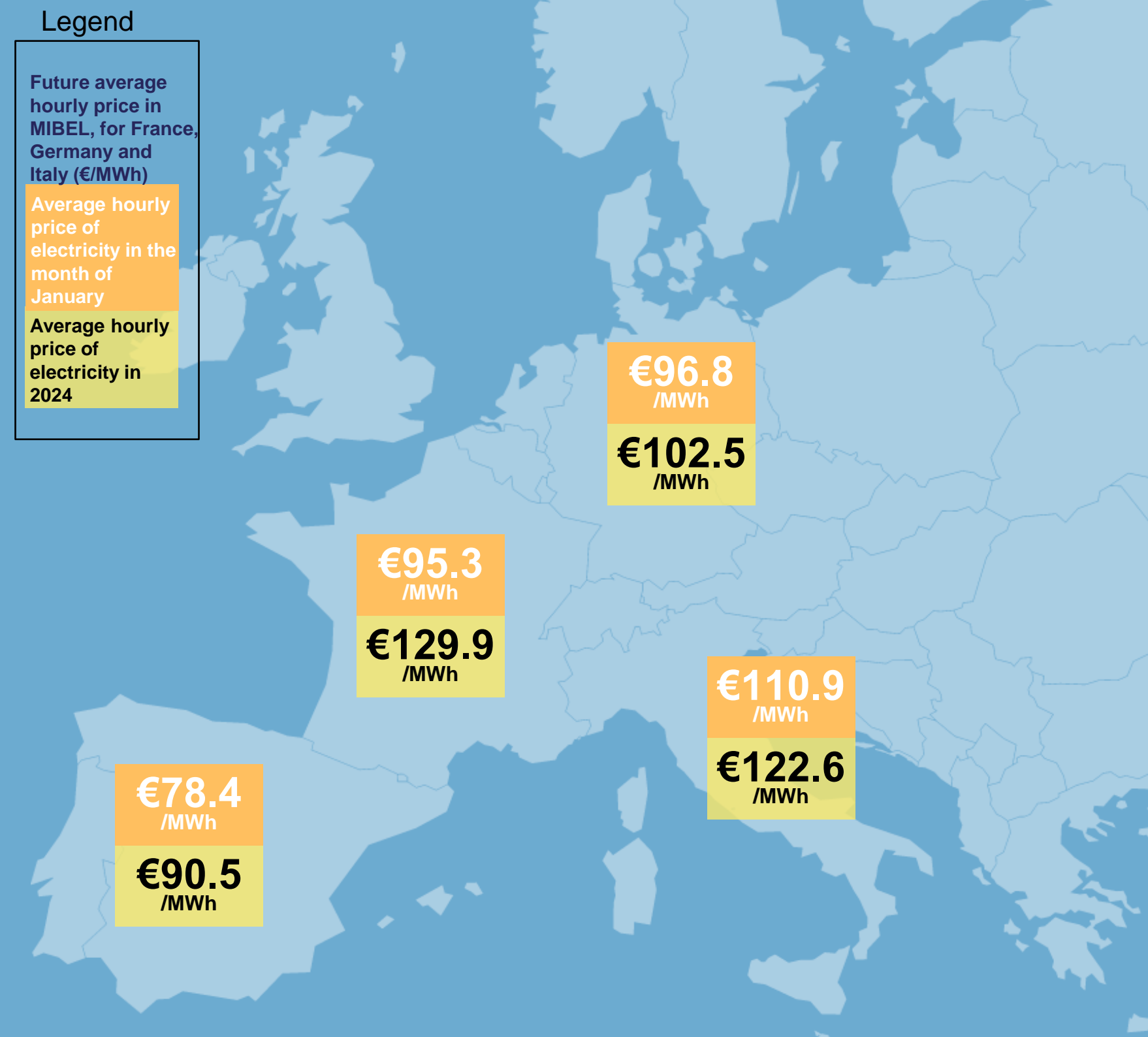
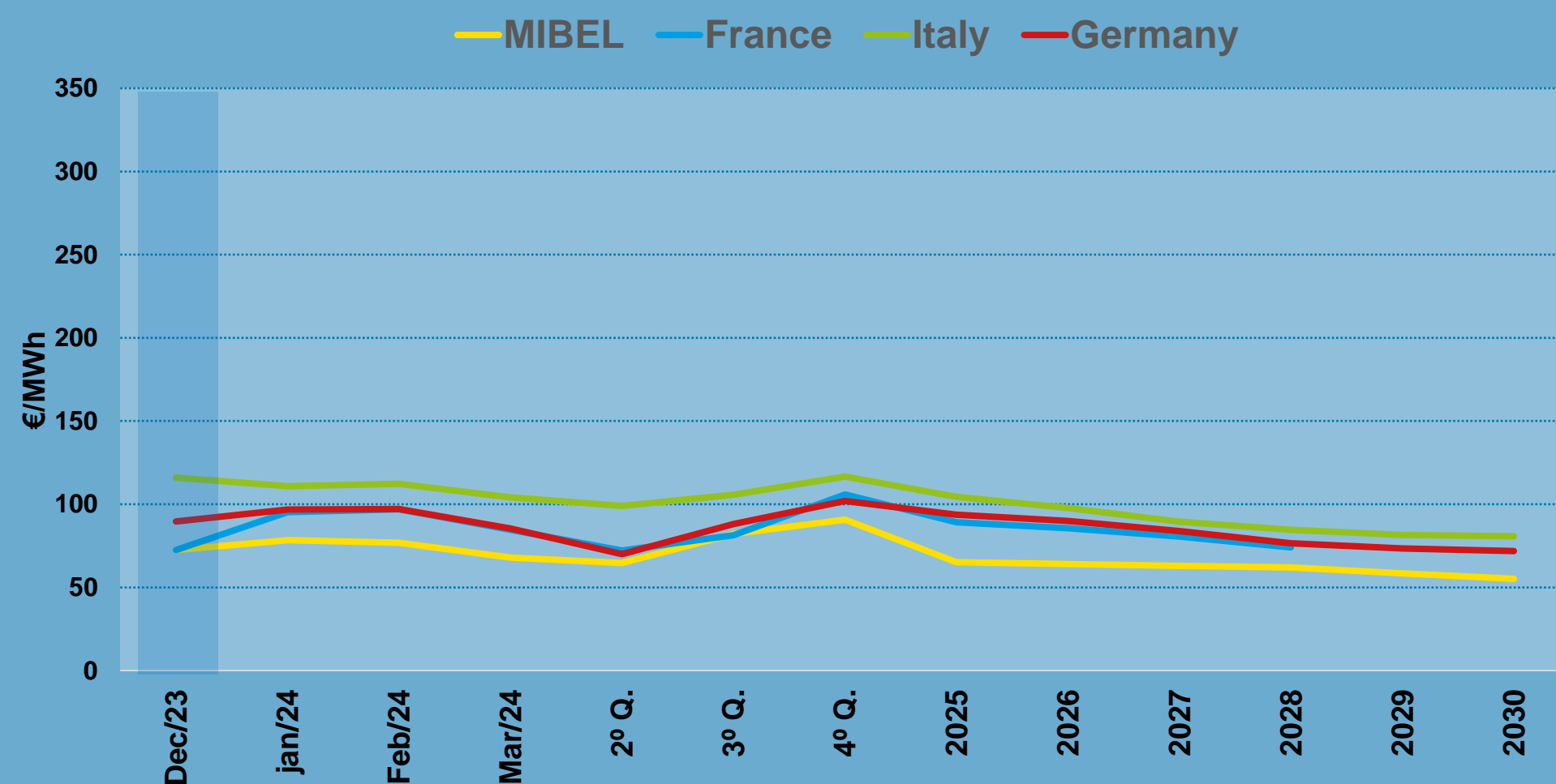
Source: ENTSO-E, OMIE. Analysis APREN

Future Electricity Market

The evolution of the average future hourly price is calculated based on the contracts for the purchase and sale of electricity ^d.

On the map to the right, the price values for the upcoming month (January) and the next year are presented. In both cases, the French and MIBEL markets show the lowest values, while the Italian and German markets show the highest.

MIBEL maintains the lowest values until 2030, stemming from the Iberian gas price limit mechanism until July of next year and the expected investment in renewable production until 2030.



^d Values updated on the 5th of January.
Source: OMIP, EEX. Analysis APREN

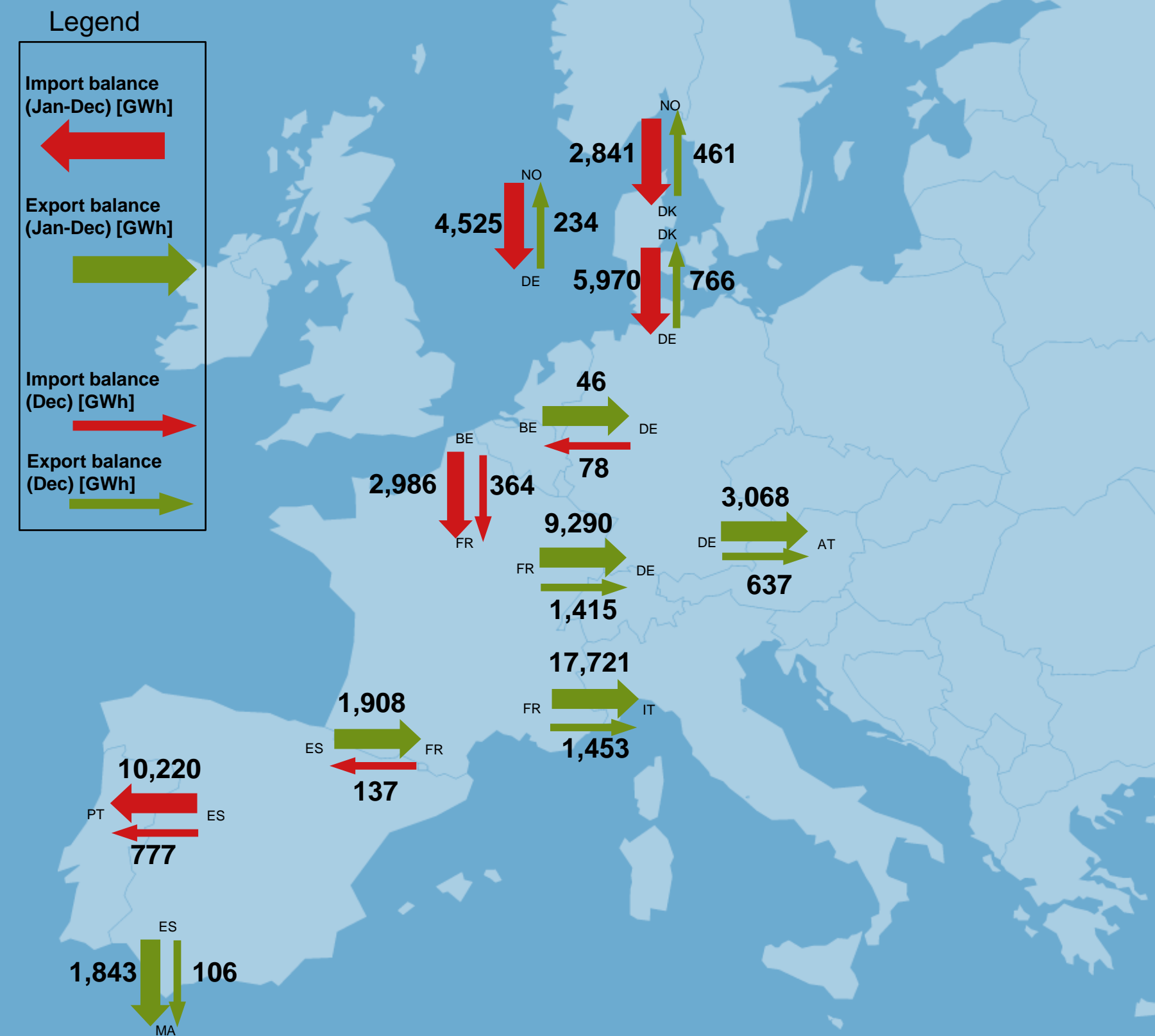
International trade

Europe

Between January 1 and December 31, 2023, the electricity system of Mainland Portugal recorded electricity imports equivalent to 13,548 GWh and exports of 3,328 GWh, with Portugal being an importer with a balance of 10,220 GWh.

Main Interconnection Indicators PT-ES

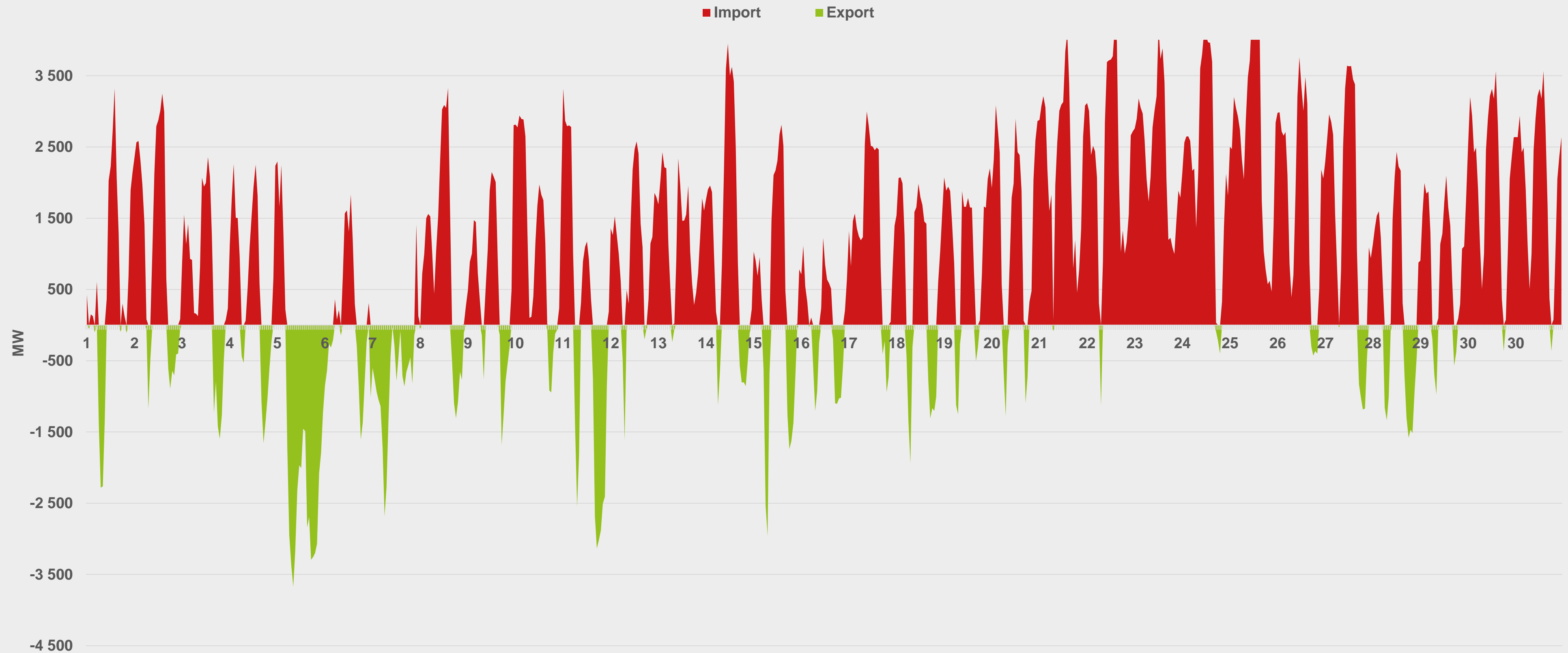
	PT-ES		ES-PT	
Usage	32.4% (Jan-Dec)	28.1% (Dec)	44.2% (Jan-Dec)	44.6% (Dec)
Congestion	2.8% (Jan-Dec)	2.4% (Dec)	6.6% (Jan-Dec)	3.9% (Dec)
Markets split	5.3% (Jan-Dec)	3.4% (Dec)	67.2% (Jan-Dec)	76.3% (Dec)



Source: ENTSO-E, OMIE. Analysis APREN

International trade: December

Diagram of imports and exports in Portugal



Source: REN. Analysis APREN

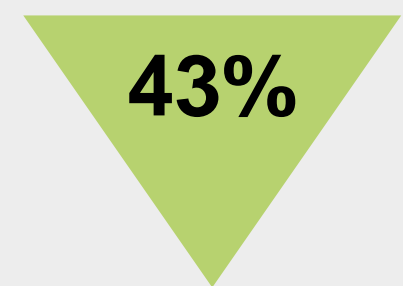
Power sector emissions

Between January 1 and December 31, 2023, specific emissions reached 82.2 gCO₂eq/kWh, with a total emissions from the power sector of 3.6 MtCO₂eq.

The European Emissions Trading System (EU-ETS) recorded an average price €85.3/tCO₂^c, a reduction in 5% compared to the same period in 2022.

Sector emissions

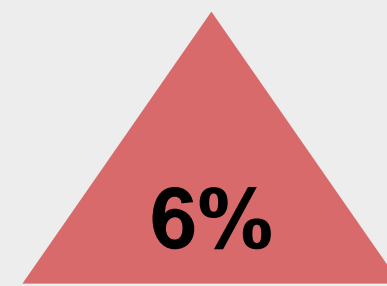
3.6
MtCO₂eq



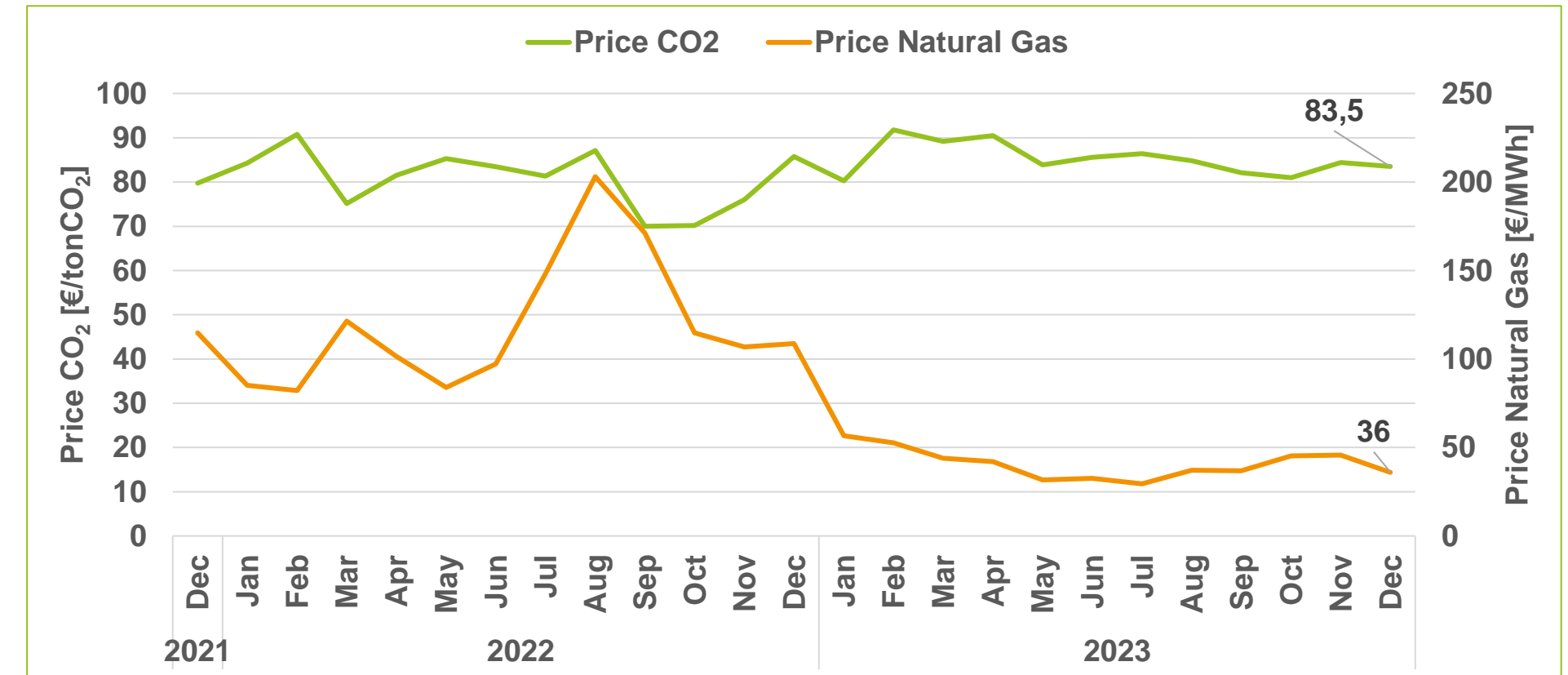
In comparison to Dec 2022

Allowances average price

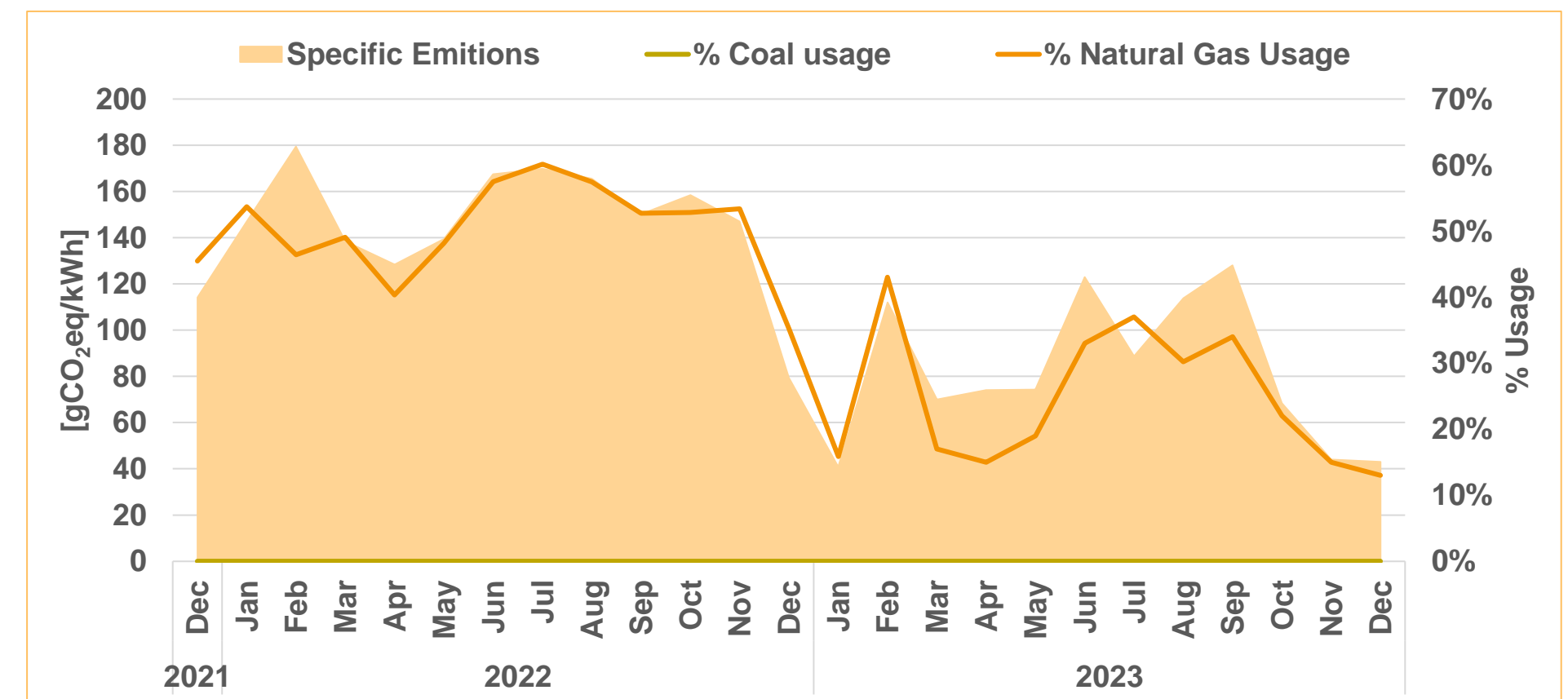
€85.5
/tCO₂



In comparison to Dec 2022



Price of CO₂ allowances in EU-ETS and natural gas price in Europe (Dec-2021 to Dec-2023).
Source: SendeCO2, WorldBank.



Specific emissions from the power sector of Mainland Portugal, % use of coal-free power plants and natural gas (Dec-2021 to Dec-2023).
Source: REN, DGEG, ERSE. Analysis APREN

^c Arithmetic average hourly prices
Source: OMIE, WorldBank.

Simulation of price formation without SRP

Renewables have avoided:

The indicators below identify the savings achieved between January 1 and December 31, 2023, due to the contribution Special Regime Production (SRP).

This study is conducted for SRP and includes all installed power of fossil cogeneration. Given that the capacity equivalent to this technology within the SRP is quite residual and that the other technologies are renewable, the figures are very close to the real savings generated by renewables.



€157.7 /MWh

Accumulated savings (Jan-Dec)

€103.5/MWh

Monthly savings (Dec)



€7,014.0M

Accumulated savings (Jan-Dec)

€617.2M

Monthly savings (Dec)

Environmental Service

The figures below identify the savings achieved between January 1 and December 31, 2023, in natural gas, CO₂ emissions and CO₂ emission allowances resulting from the renewable incorporation in electricity generation.

This analysis assumes that, in the absence of renewables, production would be ensured primarily by natural gas, followed by imported electricity.

Renewables have avoided:



€1,950 M
Imported Natural Gas
(Jan-Dec)

€174 M
Imported Natural Gas
(Dec)



€626 M
Imported Electricity
(Jan-Dec)

€78 M
Imported Electricity
(Dec)



9.7 MtCO₂eq
CO₂ emissions (Jan-Dec)

1.0 MtCo₂eq
CO₂ emissions (Dec)



€750 M
O₂ allowances (Jan-Dec)

€74.8 M
O₂ allowances (Dec)

Source: REN, REE, SendeCO2, WorldBank, DGEG, ERSE, Analysis APREN.

Note 1: For the estimate of the savings in imported natural gas, the price of natural gas in Europe indicated in the WorldBank has been considered.

Note 2: For the estimation of savings in imported electricity, the average price on the MIBEL market has been considered.



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