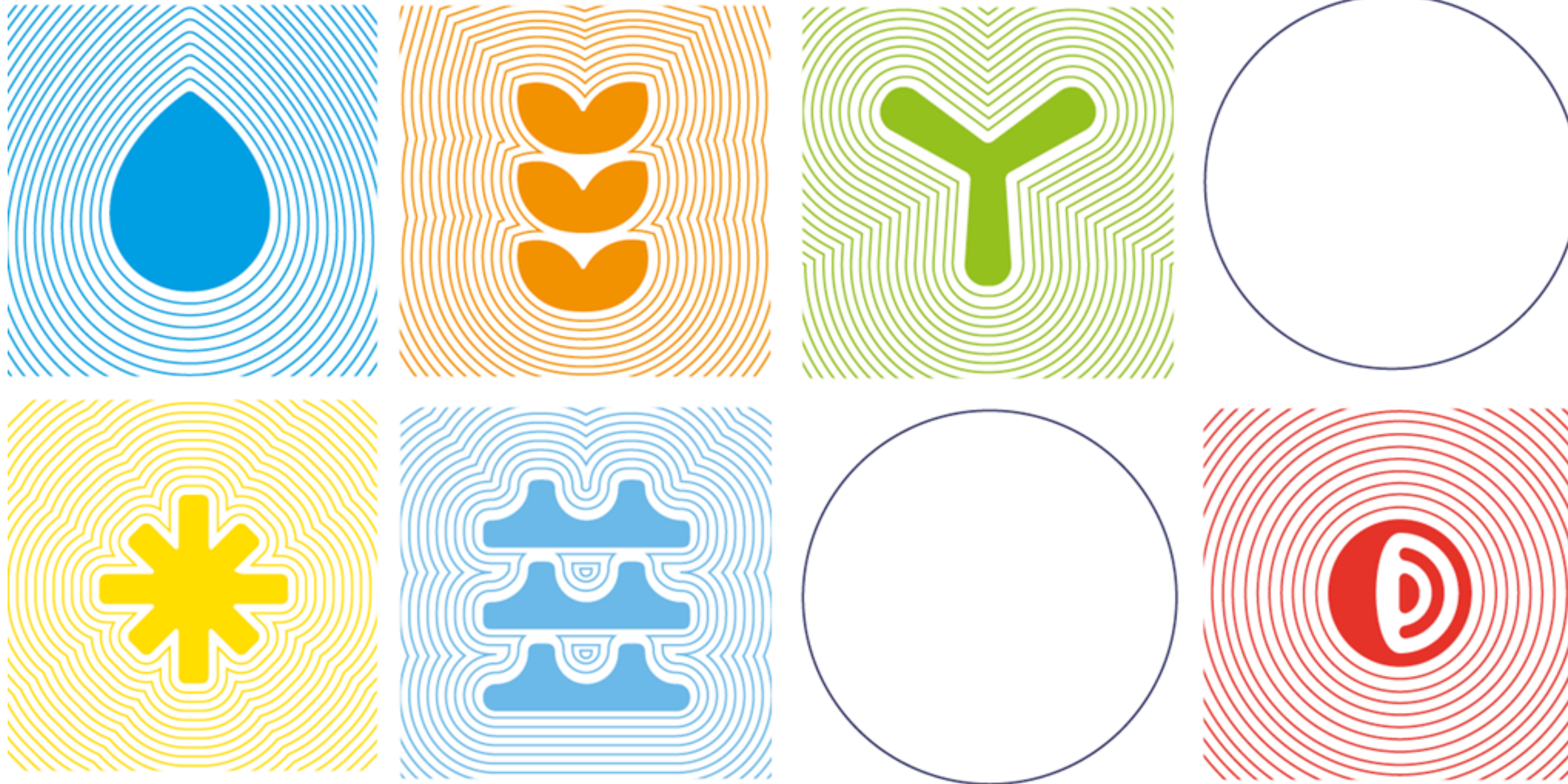


**Renewable Electricity Bulletin  
November 2023**

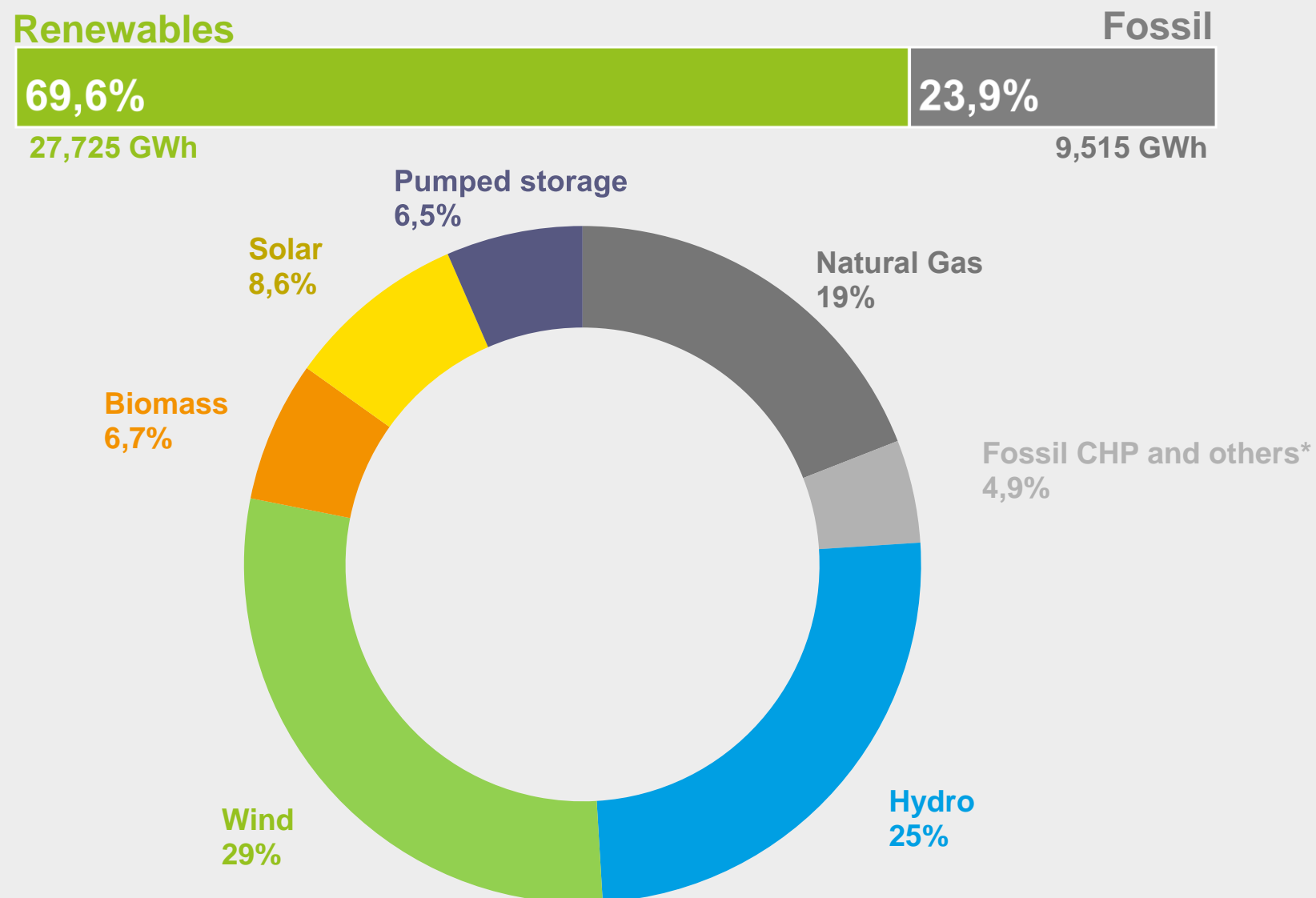


**2023**

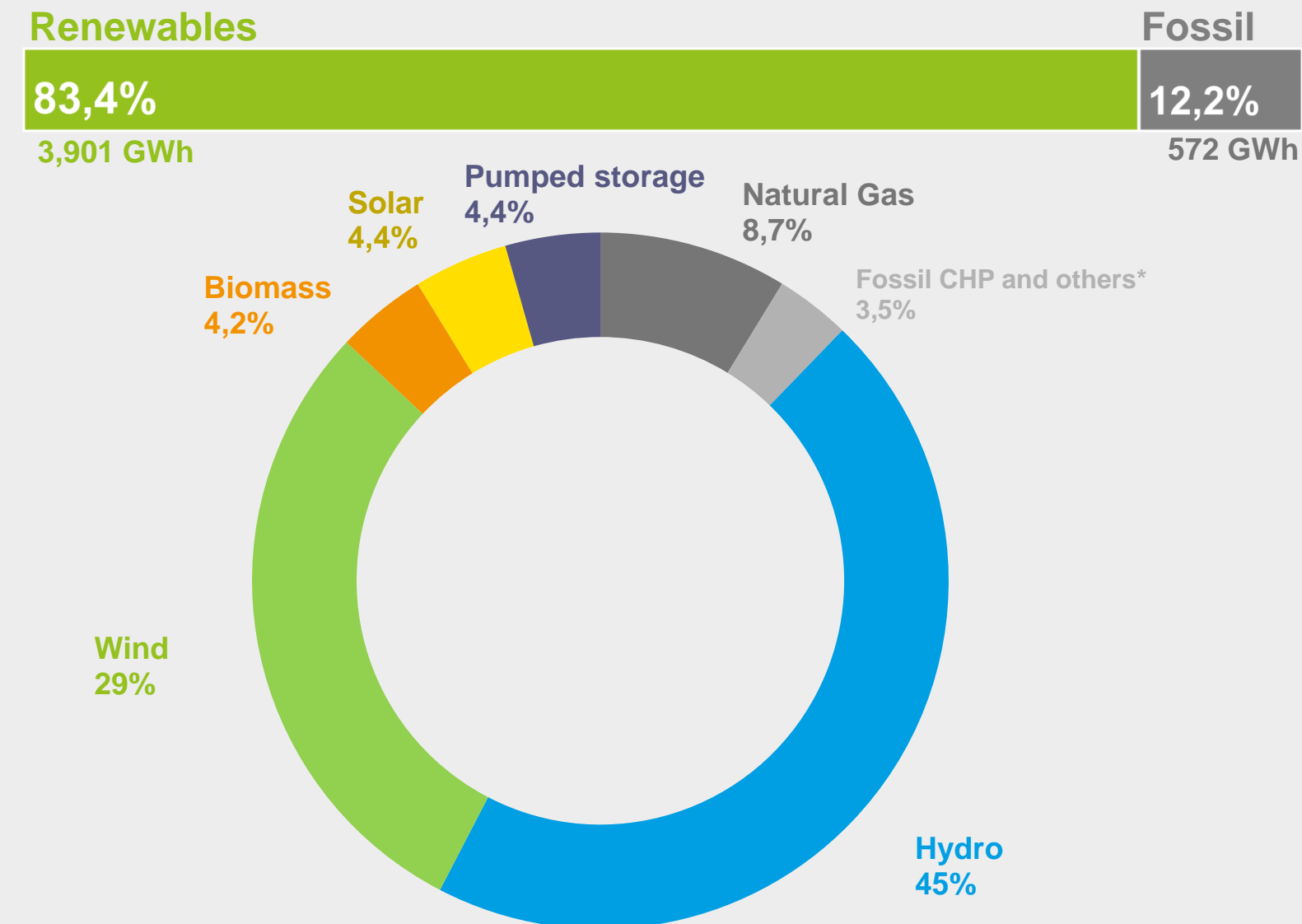
**PORTUGAL NEEDS  
OUR ENERGY**

# Executive Summary

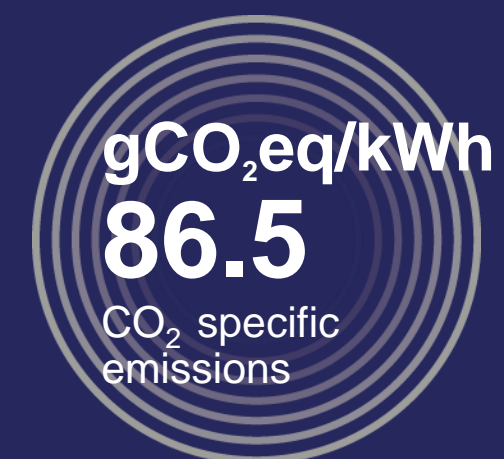
## Accumulated Generation (Jan-Nov)



## Monthly Generation (Nov)



## Electricity sector indicators (Jan-Nov)

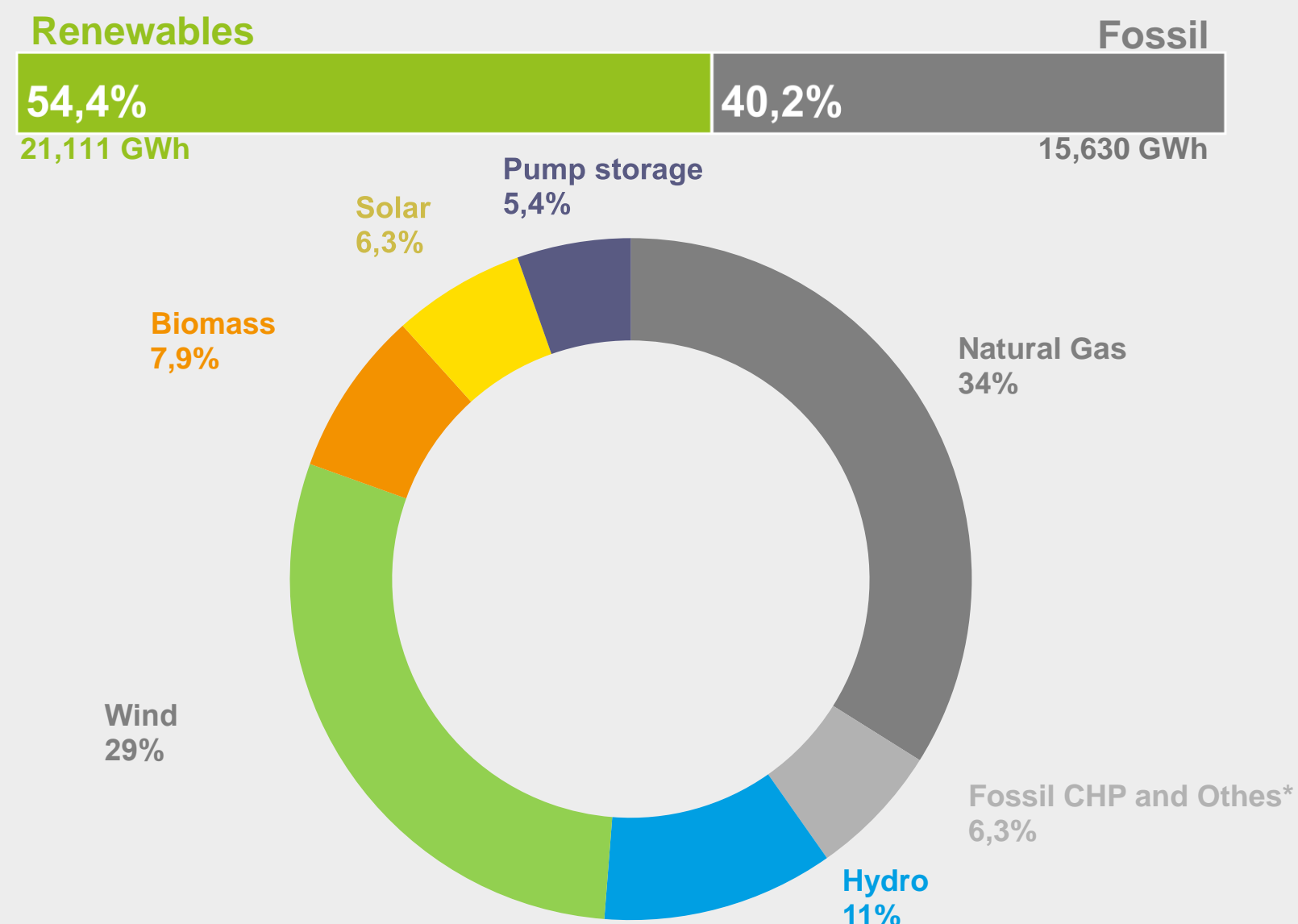


<sup>a</sup>Generation refers to the net power generation of the power plants, considering the production by pumping recently disclosed by REN. Pumping production is not accounted for in the percentage of production from renewable sources. Source: REN, Analysis APREN.

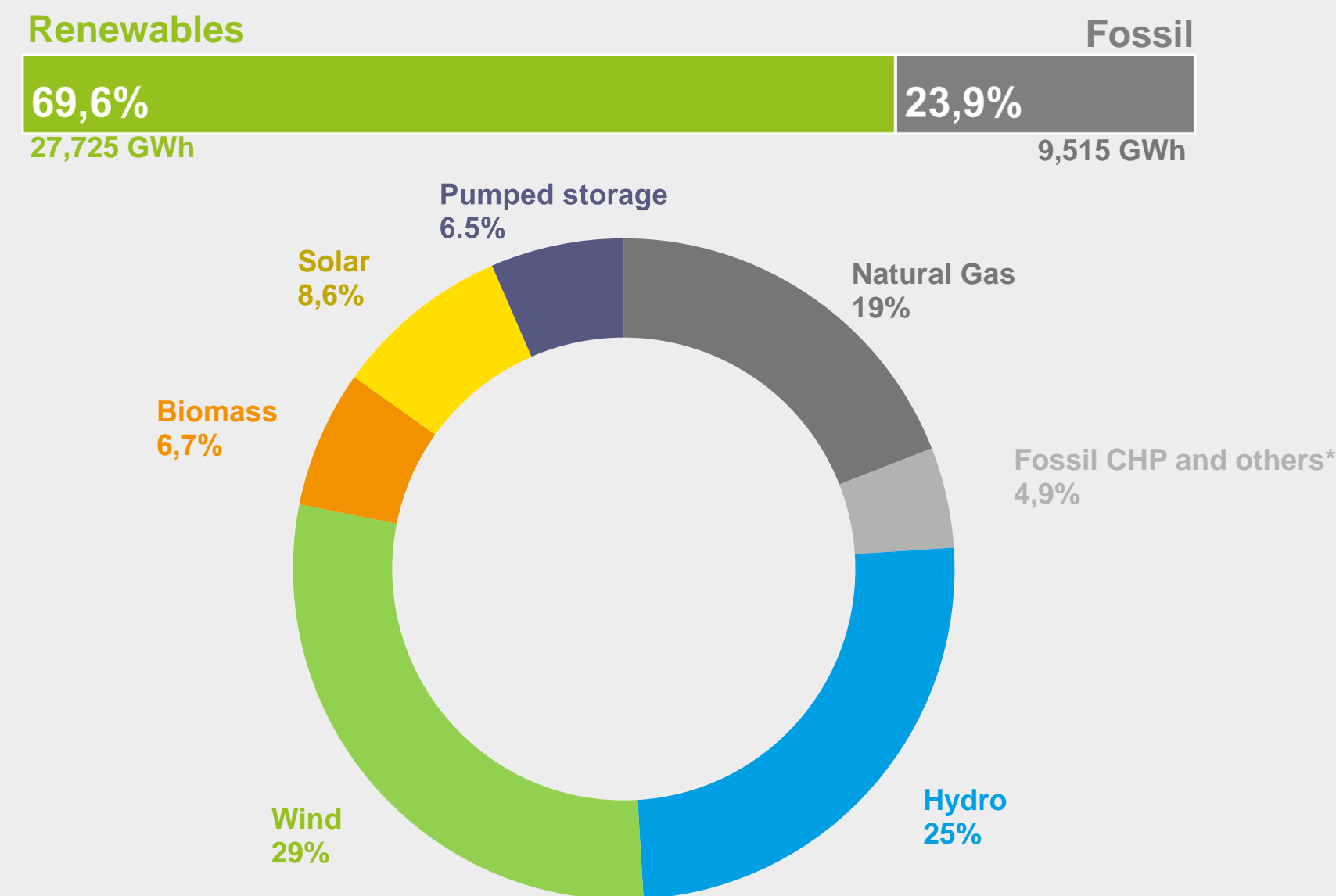
\* Includes fuel oil, diesel, the non-biodegradable fraction of urban solid waste and other waste.

# Executive Summary

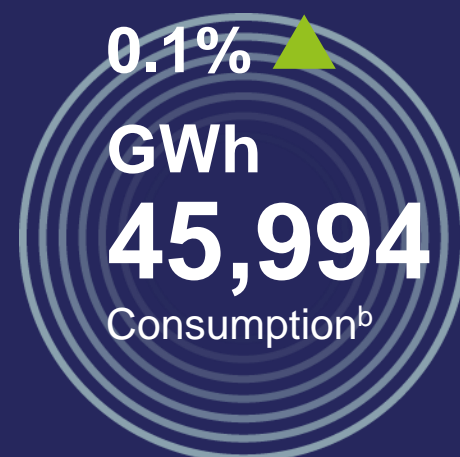
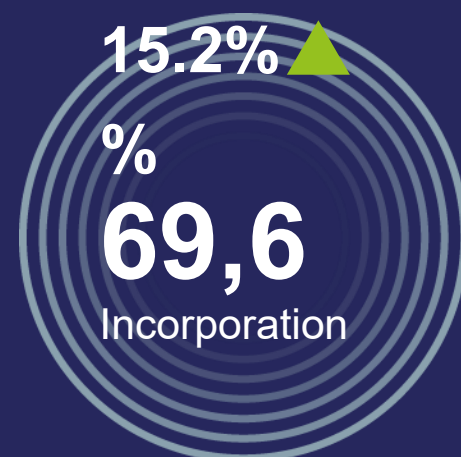
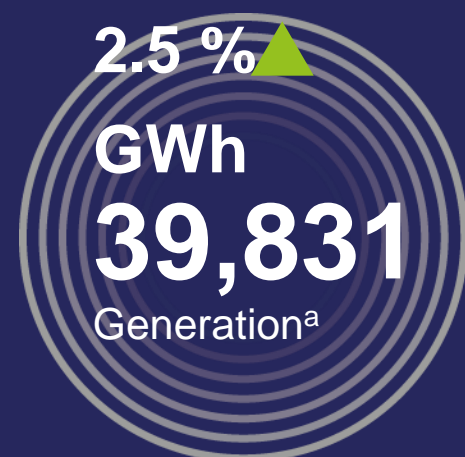
## Accumulated November 2022 (Jan-Nov)



## Accumulated November 2023 (Jan-Nov)



### Main indicators In comparison to November 2022

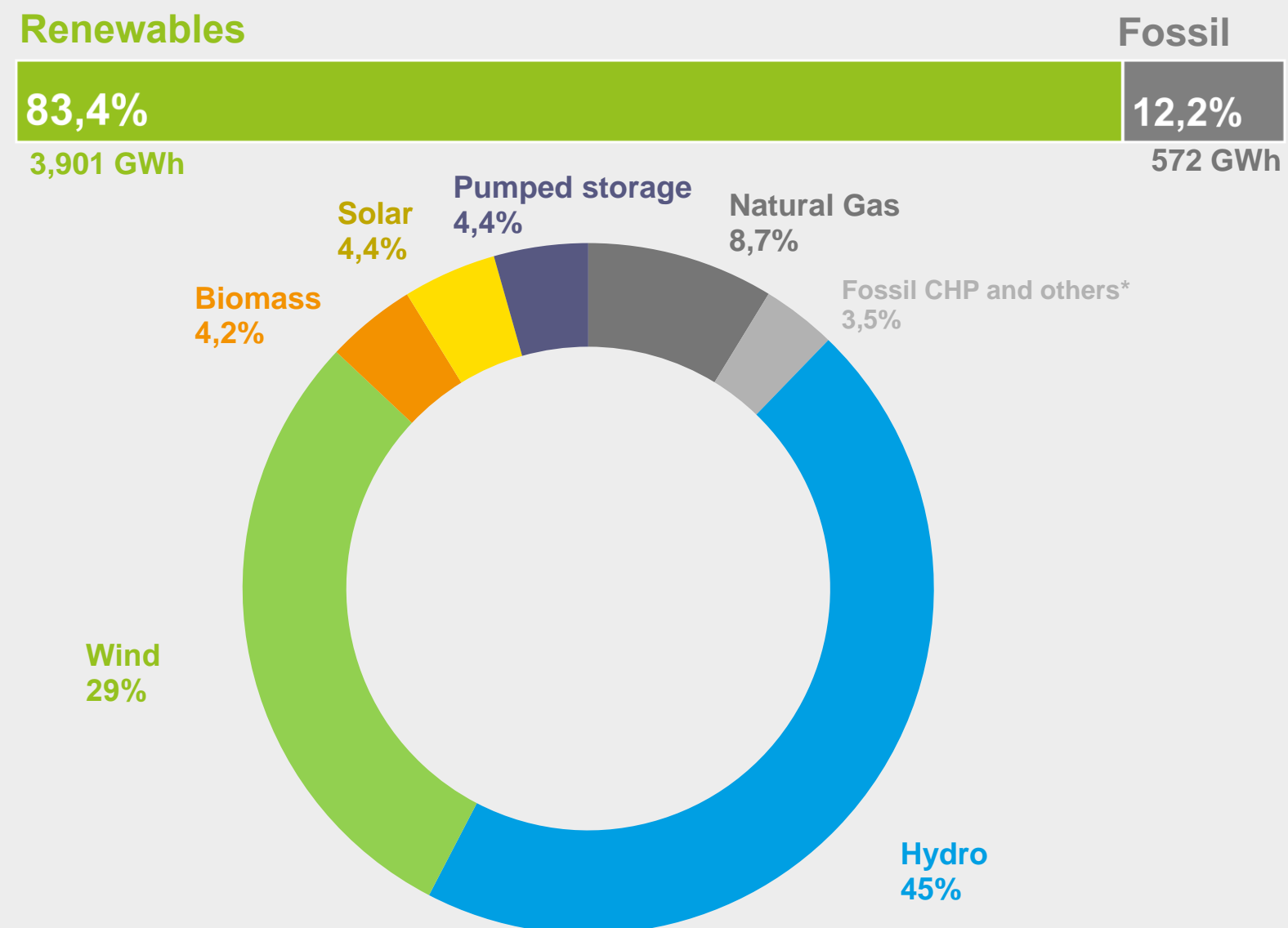


<sup>a</sup> Generation refers to the net power generation of the power plants, considering the production by pumped storage recently disclosed by REN. Pumping production is not accounted for in the percentage of production from renewable sources. Source: REN, Analysis APREN

<sup>b</sup> 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.

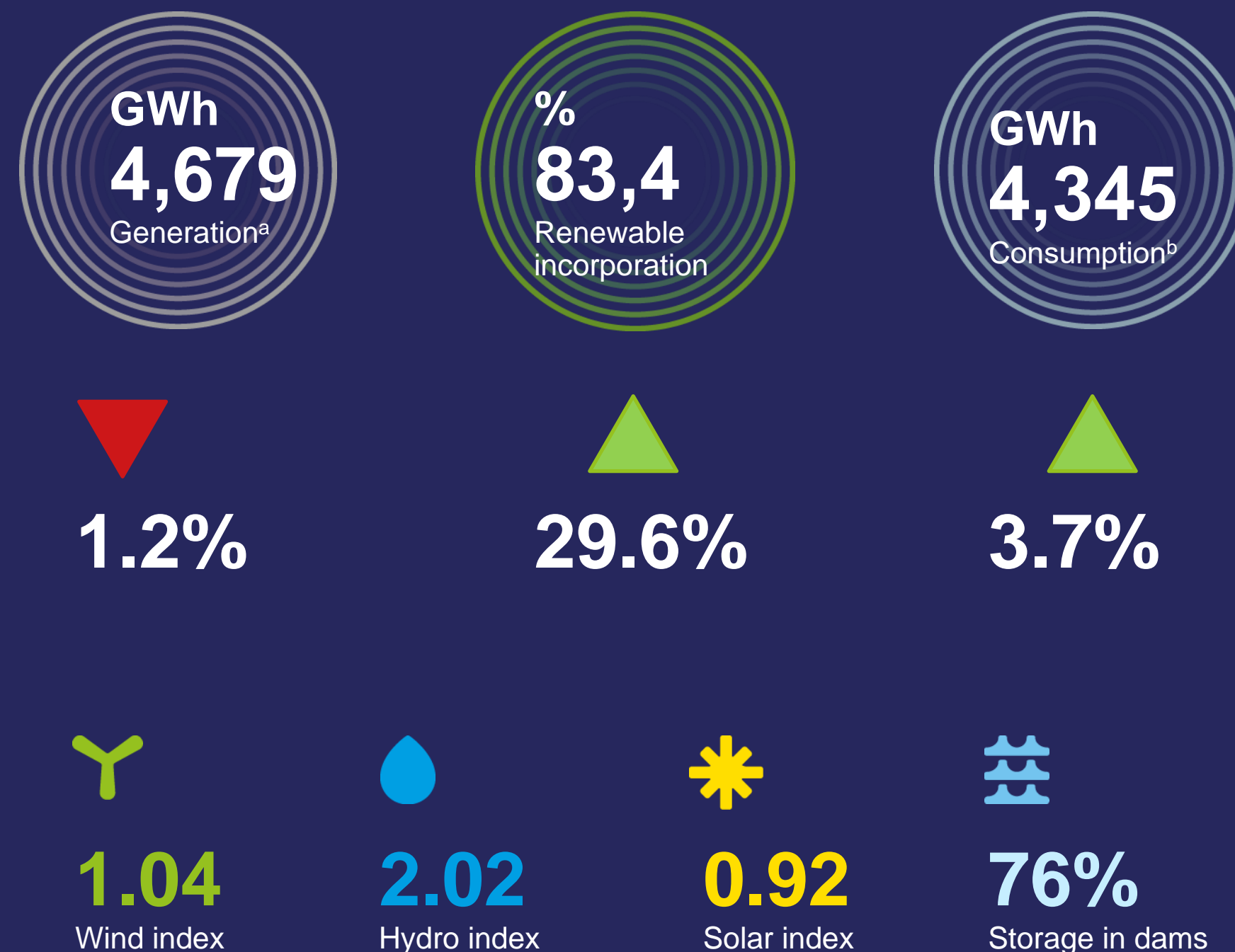
# Monthly analysis in Portugal: November



Between November 1 and 30, 2023, renewable energy integration was 83.4%, totaling 4,679 GWh produced. The 29.6% increase compared to November 2022 is attributed to a 33% rise in hydropower integration, generating 2,124 GWh compared to 544 GWh in November 2022, and a 22% reduction in natural gas integration, with a decrease in production from 1,443 GWh to 409 GWh.

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

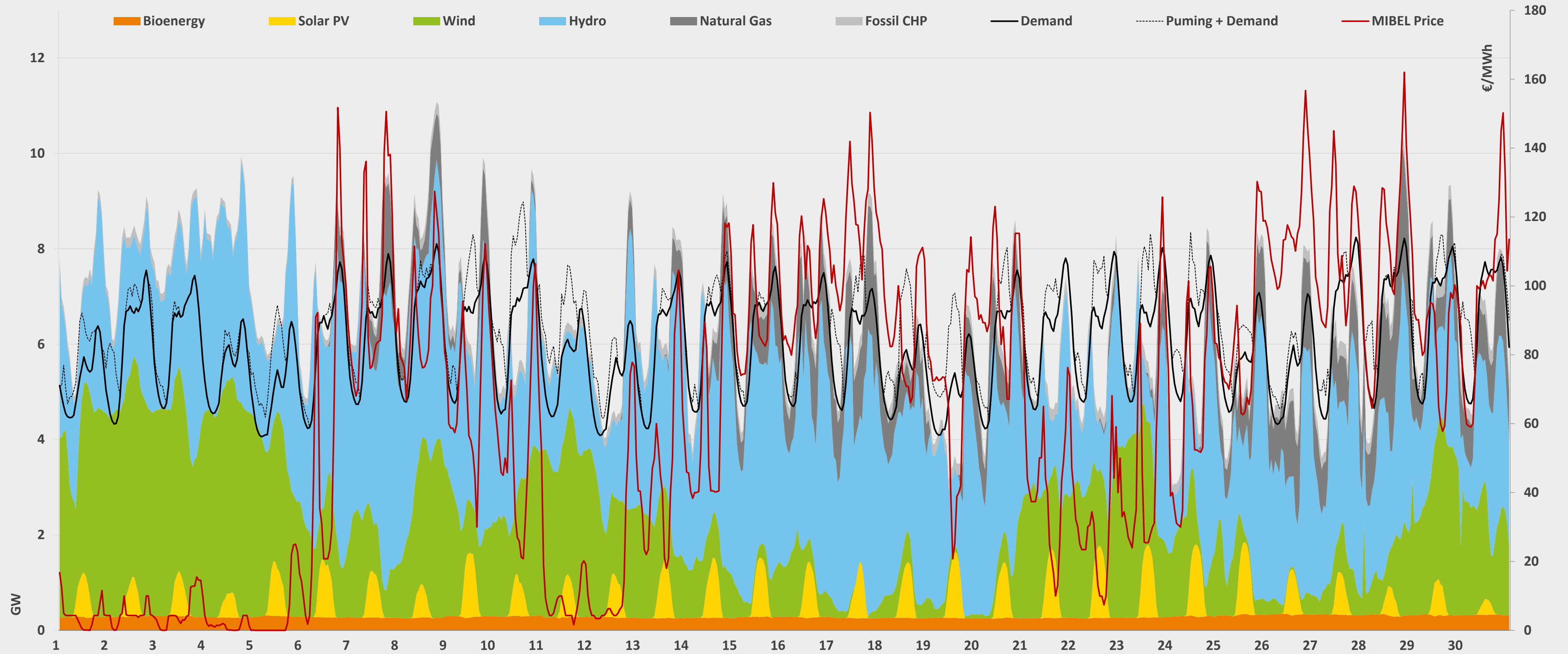
## Indicators of the electricity sector (in comparison to November 2022)



<sup>a</sup> 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.

<sup>b</sup> 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 November 2023

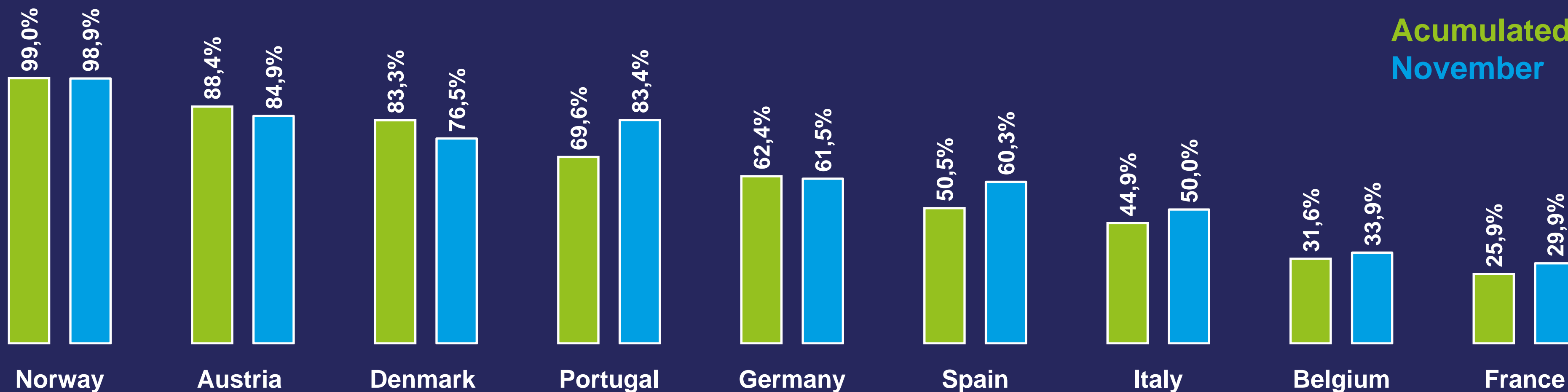


Source: REN; Analysis APREN

# 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 November 30, 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%, 88.4%, and 83.3% from RES (Renewable Energy Sources), respectively. From November 1 to 30, 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-Nov) and monthly (November).  
Source: REN, Fraunhofer, REE, Terna, National Grid, ENTSO-E. Analysis APREN

# Market price setting Portugal

Between January 1 and November 30, it was observed that the market closure technology with the highest number of hours was hydropower, totaling 2,827 non-consecutive hours, followed by renewables, cogeneration, and waste with 2,119 hours, and combined cycle thermal generation with 1,506 hours.

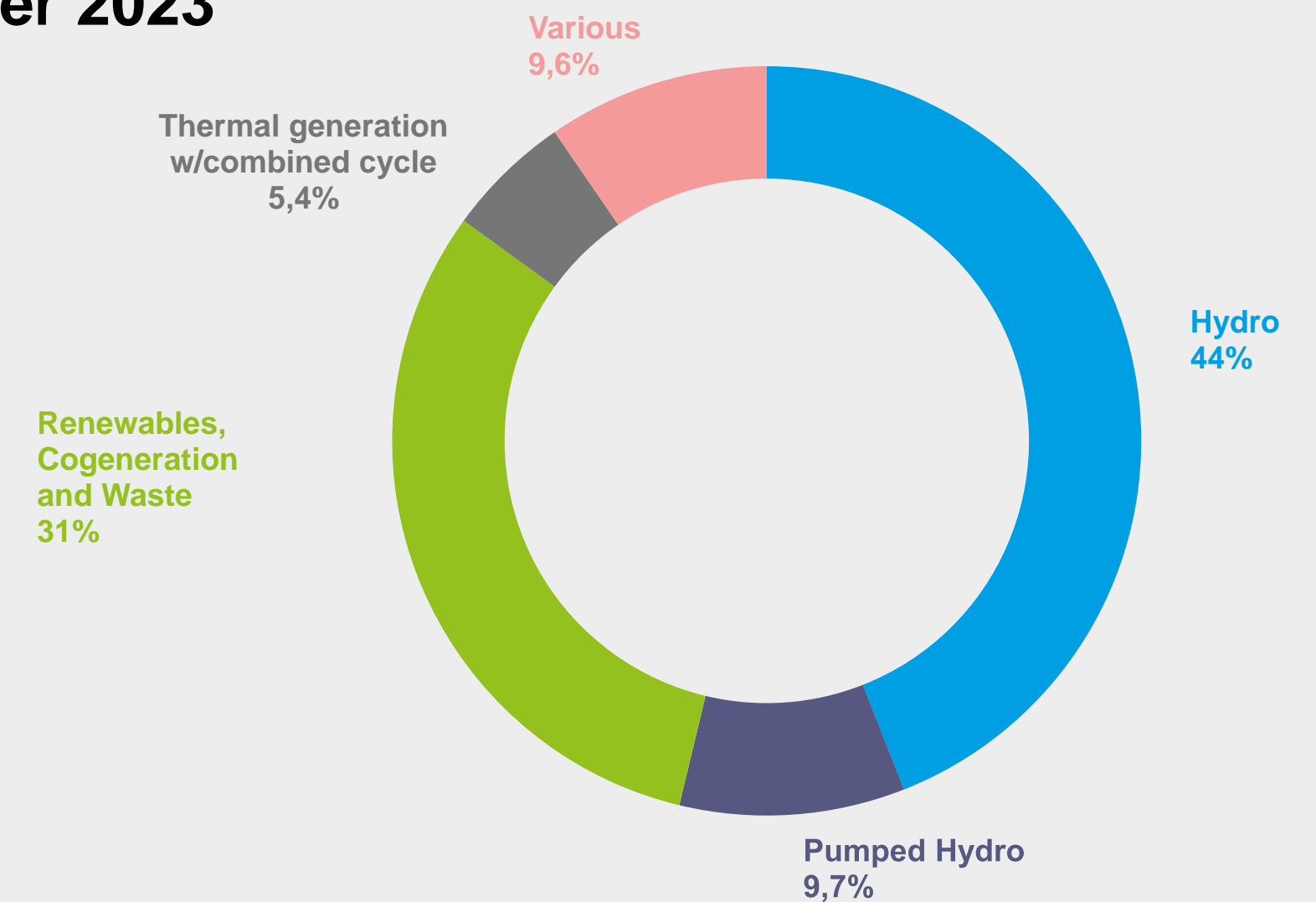


## Accumulated January-November



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

## November 2023



Percentage distribution of the number of market price setting hours of the various technologies, in a total 720 hours (November).  
Source: OMIE. Analysis APREN

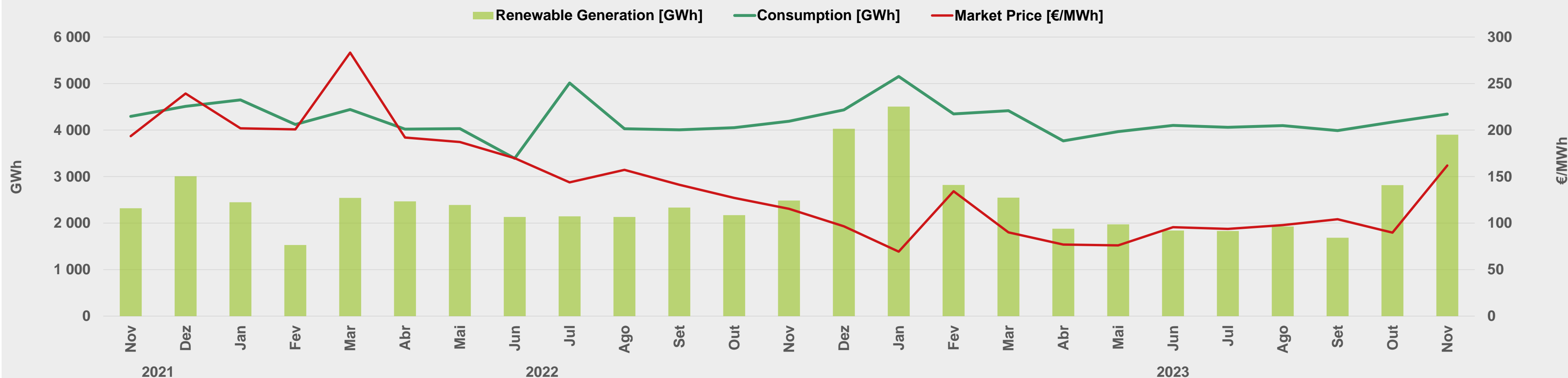
# Electricity Market Portugal

Between January 1 and November 30, the average hourly price recorded in MIBEL in Portugal was €89.8 MWh<sup>c</sup>, representing a decrease to less than half compared to the same period last year.

In the same period, 900 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 €59.2/MWh. From November 1 to 30, renewable generation offset 276 hours of consumption.



## Accumulated January-November



Number of market price setting hours of the three main market setting technologies (Nov-2021 to Nov-2023).  
Source: OMIE. Analysis APREN

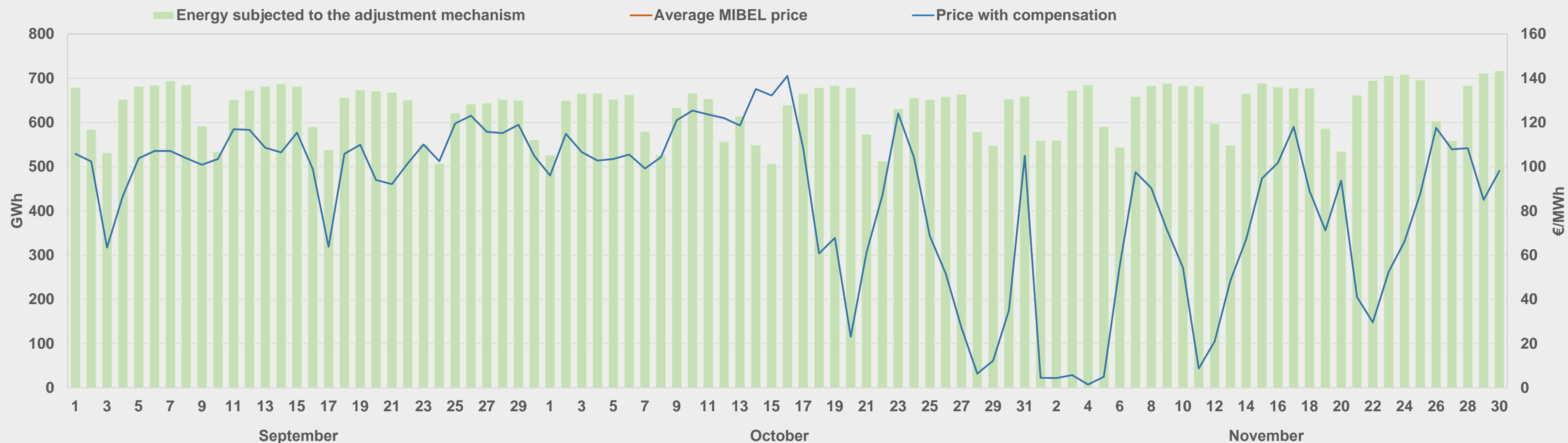


# Electricity Market

## 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 €18.90/MWh<sup>c</sup>, which amounted to a reduction of 15.3 % 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 November, the price limit on natural gas didn't introduce changes in the electricity prices. In total, 283.3 of the 377.6 TWh produced, were subjected to the consumer adjustment mechanism in the Iberian Peninsula.



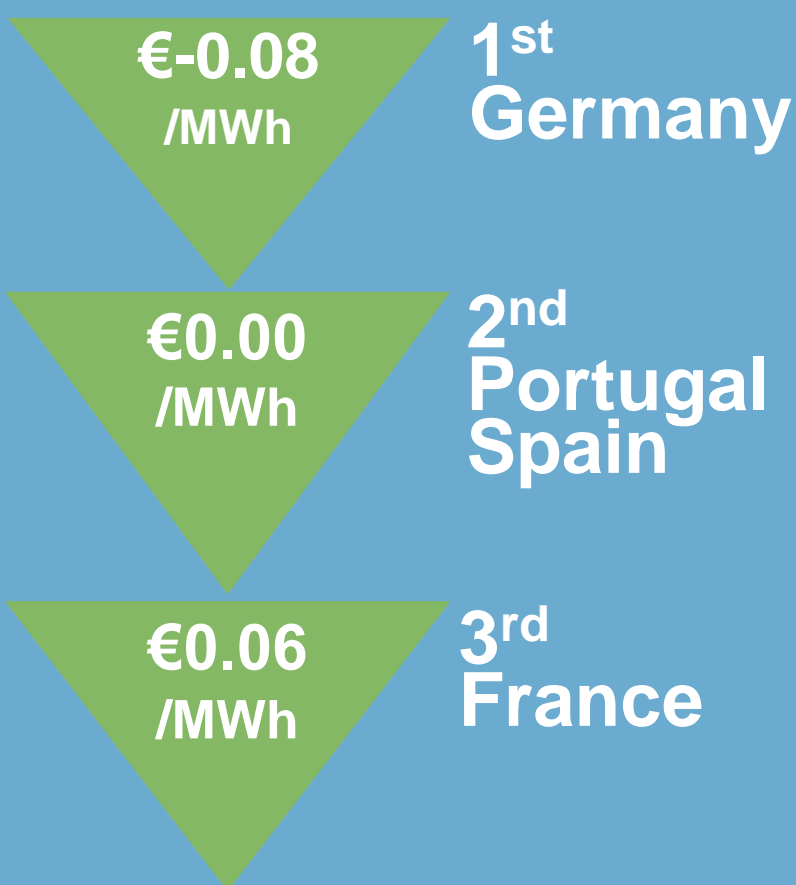
<sup>c</sup> Arithmetic average hourly prices  
Source: OMIE. Analysis APREN

# Renewable Electricity Europe

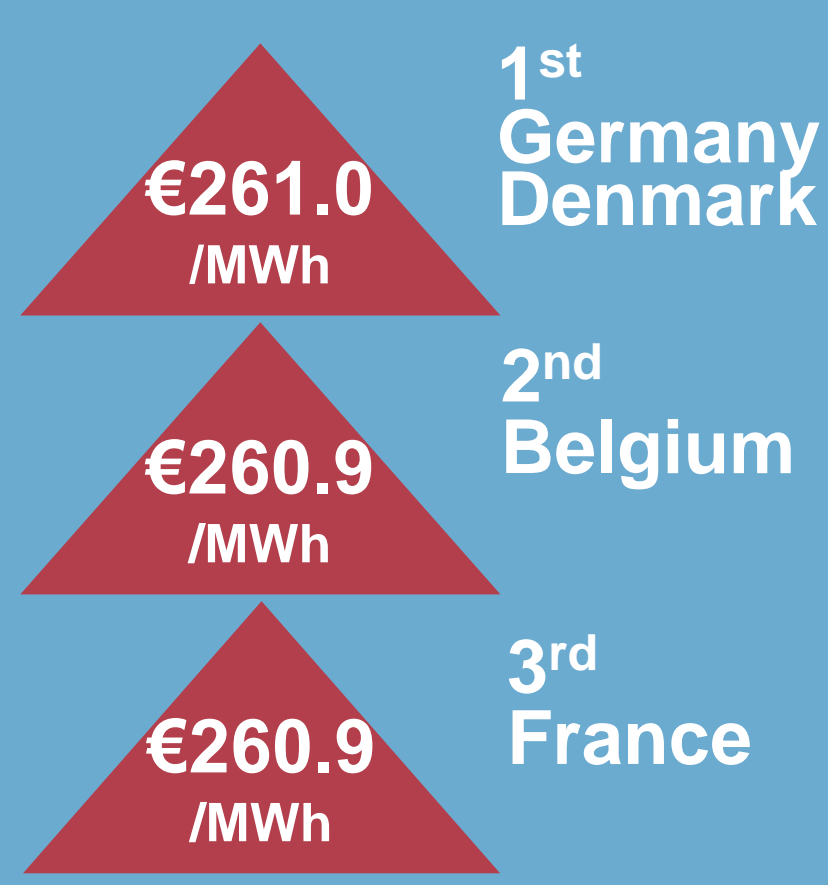
During the month of November 2023, there was a minimum hourly price at MIBEL in Portugal of €0.00/MWh, in 19 hours in which the market setting was with various technologies. The maximum hourly price reached €161.9/MWh, where the market set with renewables, cogeneration and waste.

Regarding the prices observed in Europe, it is noteworthy that average values increased in several countries, except for Austria, Spain, Italy, and Portugal. Both minimum and maximum prices increased compared to the previous month.

## Minimum Prices (Nov)

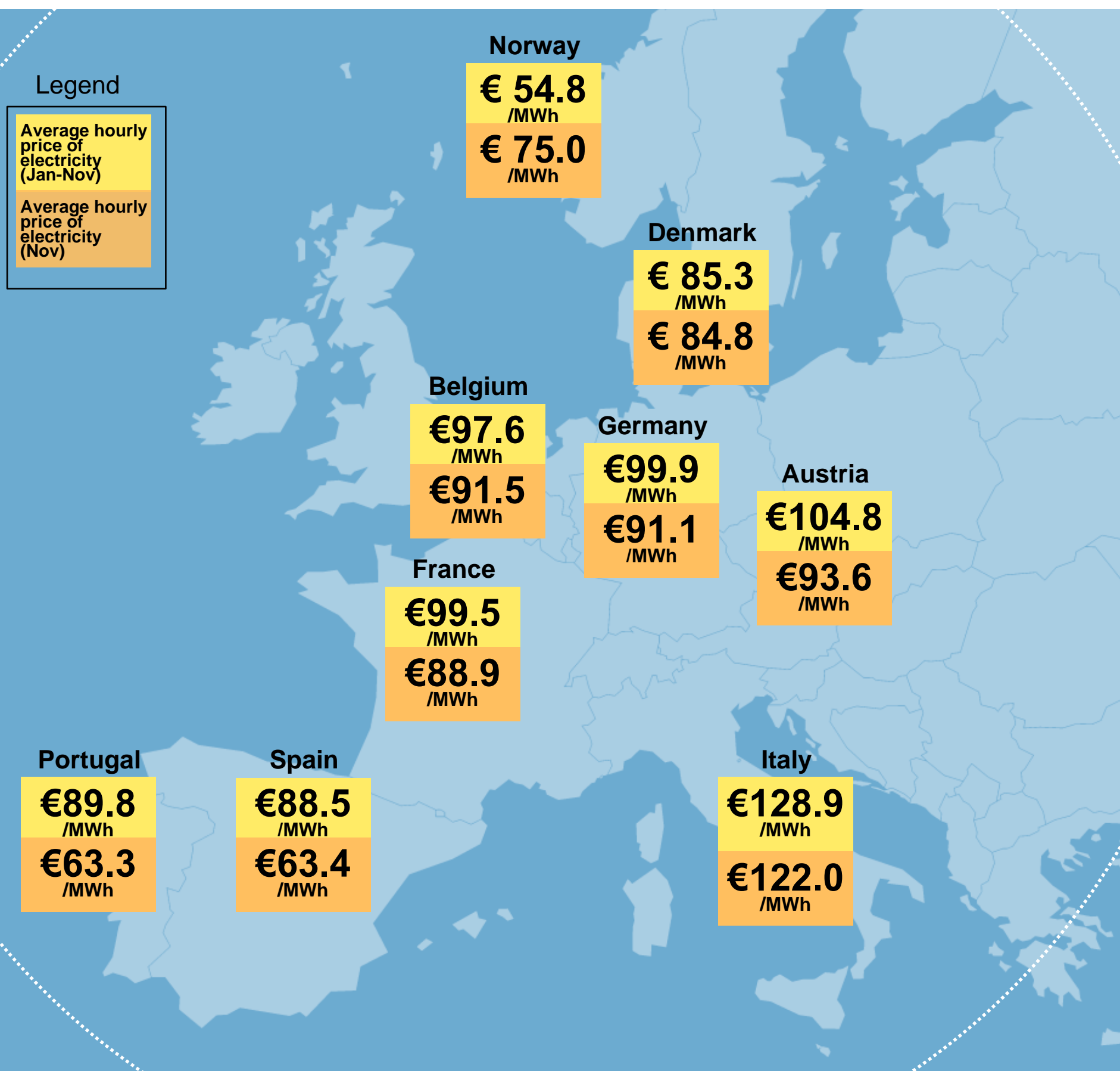


## Maximum Prices (Nov)



### Legend

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



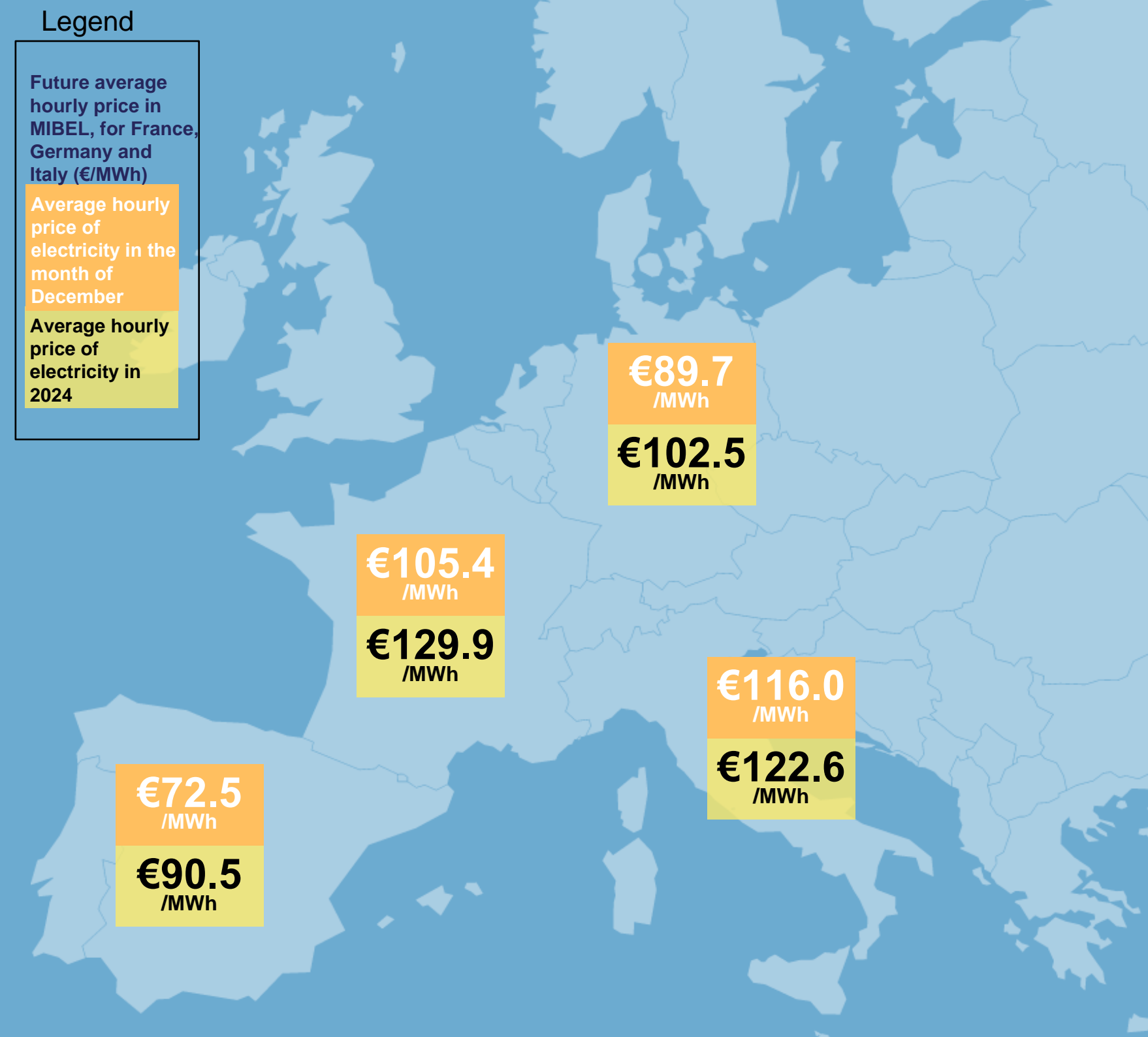
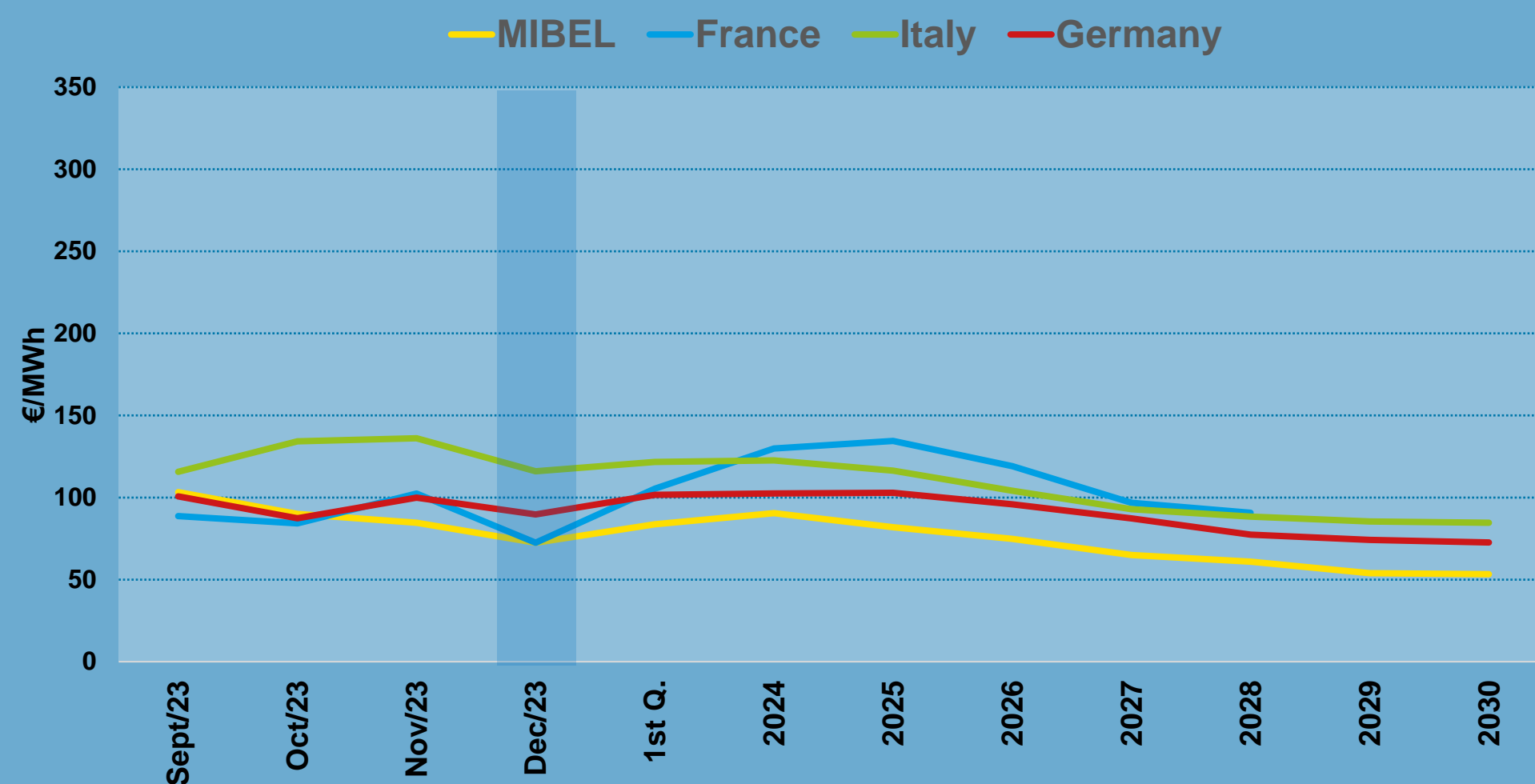
Source: ENTSO-E, OMIE. Analysis APREN

# Future Electricity Market

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

On the map to the right, the price values for the upcoming month (December) 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.



<sup>d</sup> Values updated on the 3<sup>rd</sup> of November.  
Source: OMIP, EEX. Analysis APREN

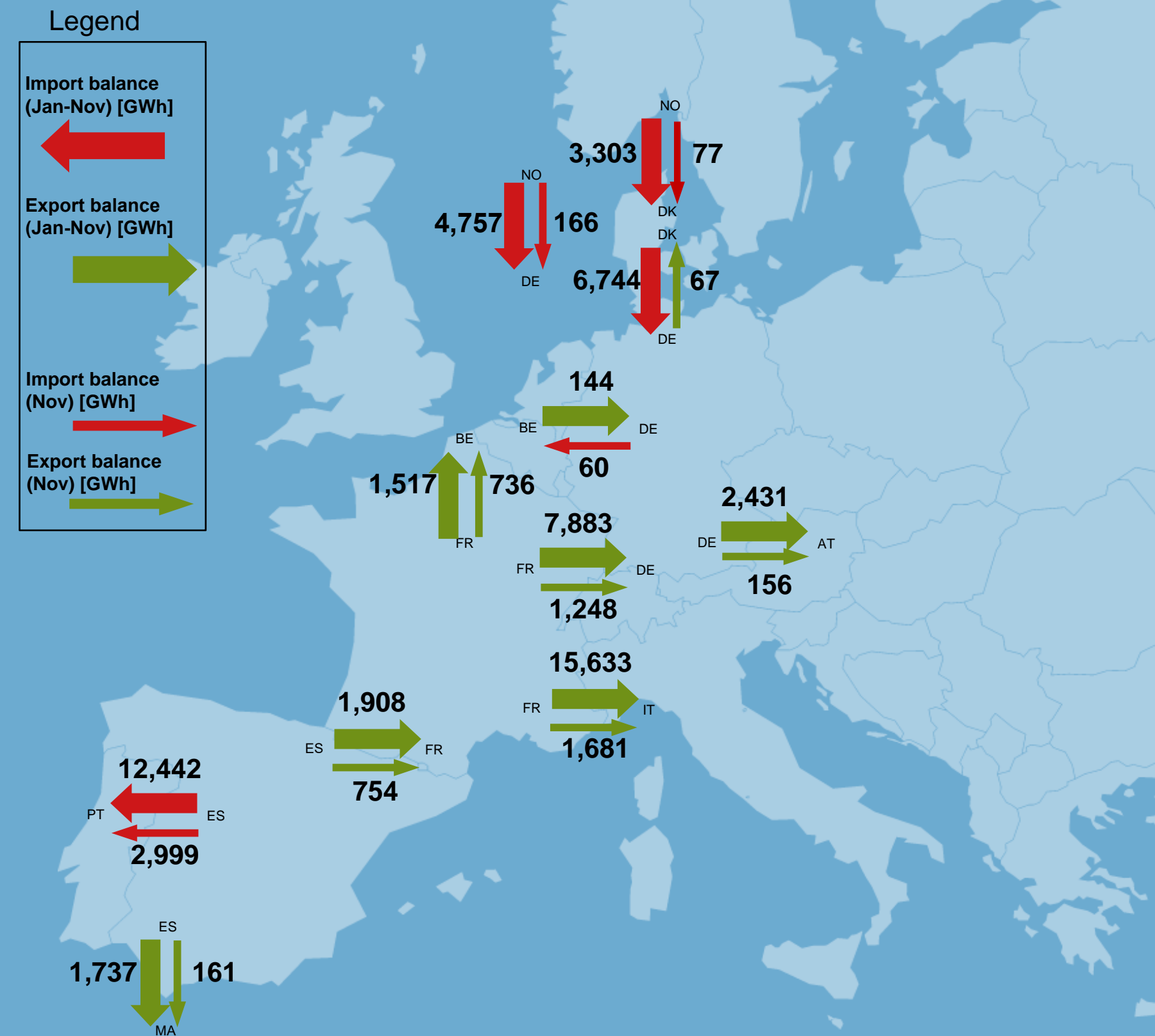
# International trade

## Europe

Between January 1 and November 30, 2023, the electricity system of Mainland Portugal recorded electricity imports equivalent to 12,442 GWh and exports of 2,999 GWh, with Portugal being an importer with a balance of 9,443 GWh.

### Main Interconnection Indicators PT-ES

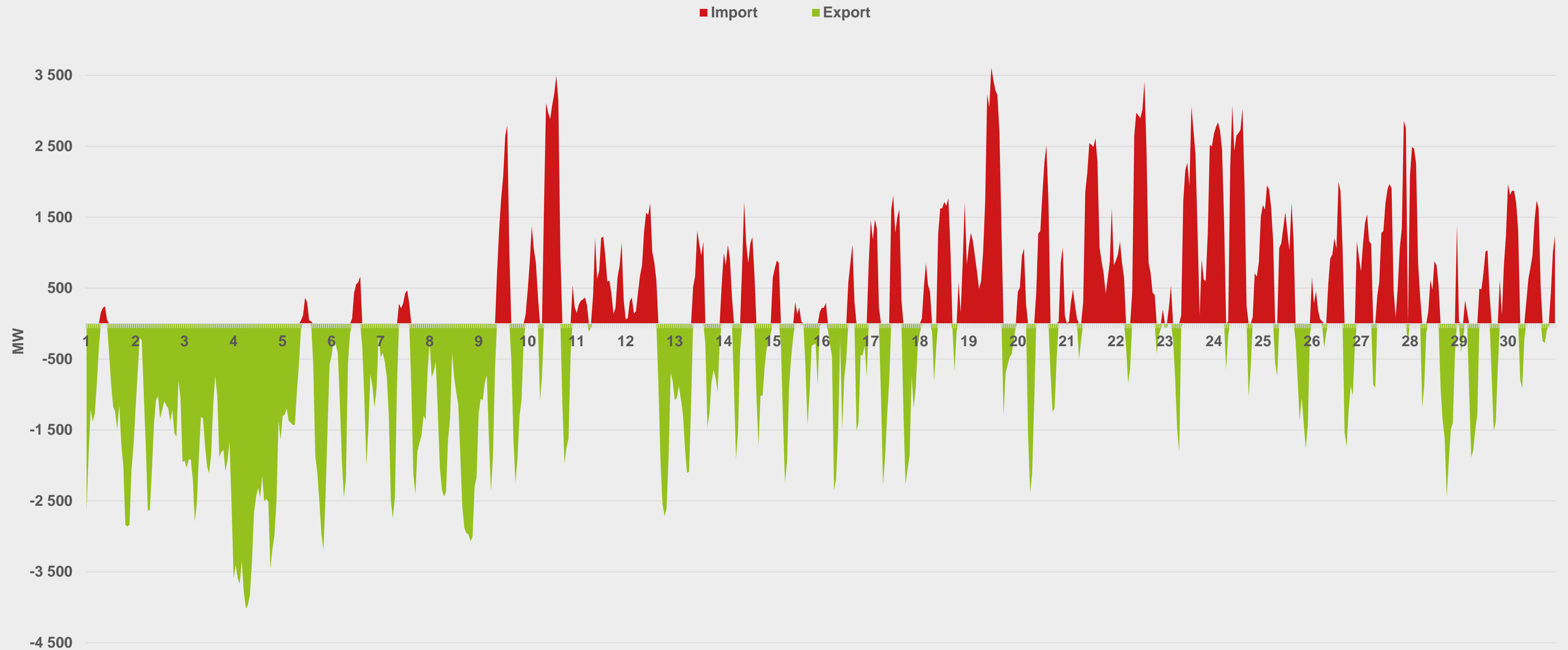
	PT-ES		ES-PT	
<b>Usage</b>	<b>8.8%</b> (Jan-Nov)	<b>37.3%</b> (Nov)	<b>23.5%</b> (Jan-Nov)	<b>31.7%</b> (Nov)
<b>Congestion</b>	<b>0.4%</b> (Jan-Nov)	<b>1.8%</b> (Nov)	<b>0.2%</b> (Jan-Nov)	<b>0.0%</b> (Nov)
<b>Markets split</b>	<b>5.5%</b> (Jan-Nov)	<b>1.0%</b> (Nov)	<b>66.4%</b> (Jan-Nov)	<b>68.8%</b> (Nov)



Source: ENTSO-E, OMIE. Analysis APREN

# International trade: November

## Diagram of imports and exports in Portugal



Source: REN. Analysis APREN

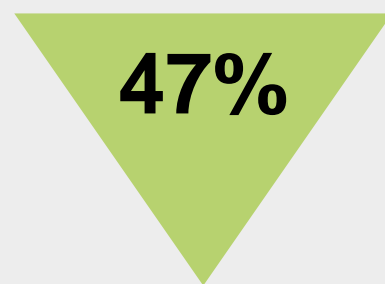
# Power sector emissions

Between January 1 and November 30, 2023, specific emissions reached 86.5 gCO<sub>2</sub>eq/kWh, with a total emissions from the power sector of 3.4 MtCO<sub>2</sub>eq.

The European Emissions Trading System (EU-ETS) recorded an average price €85.5/tCO<sub>2</sub><sup>c</sup>, a reduction in 6% compared to the same period in 2022.

## Sector emissions

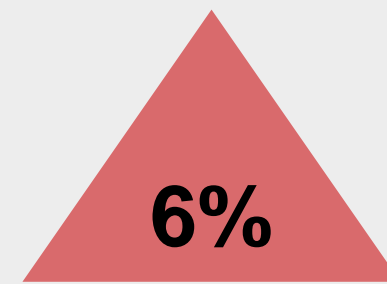
**3.4**  
MtCO<sub>2</sub>eq



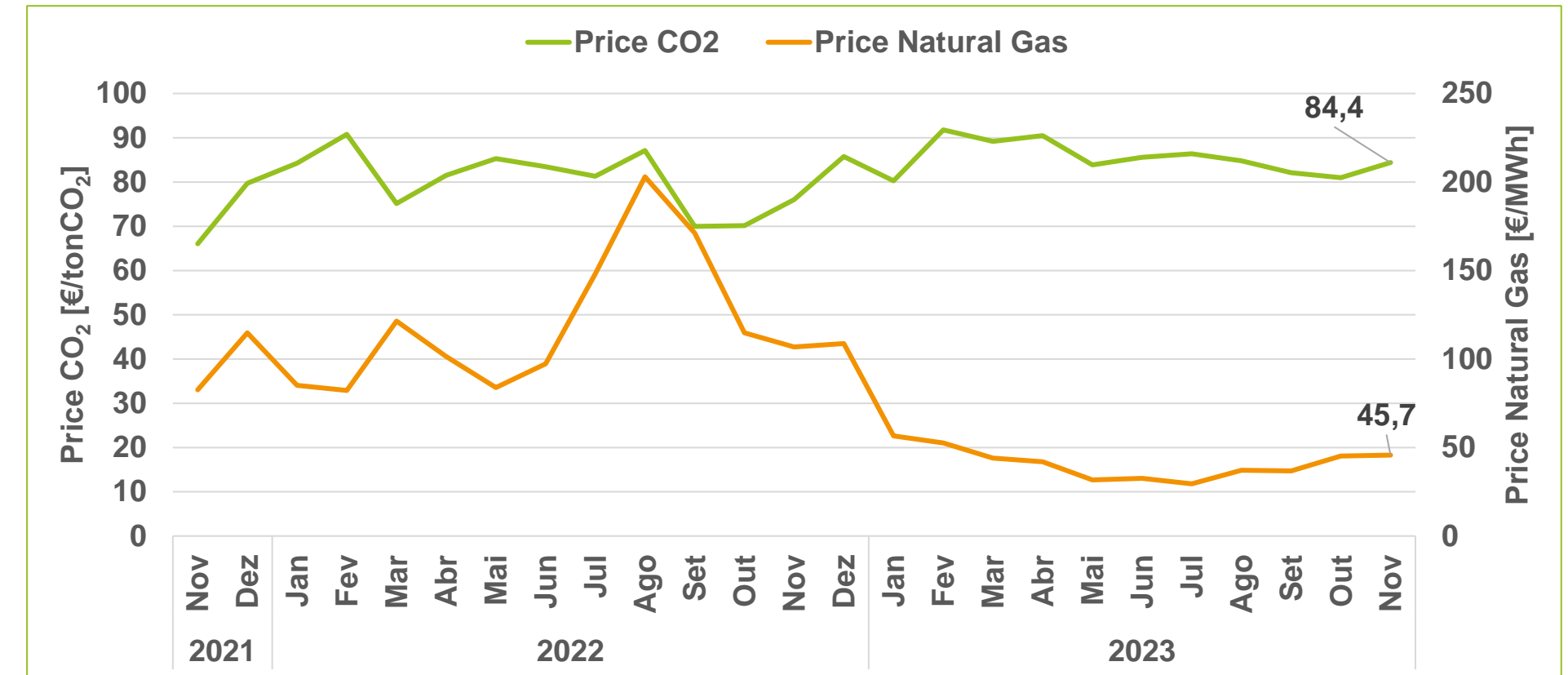
In comparison to Nov 2022

## Allowances average price

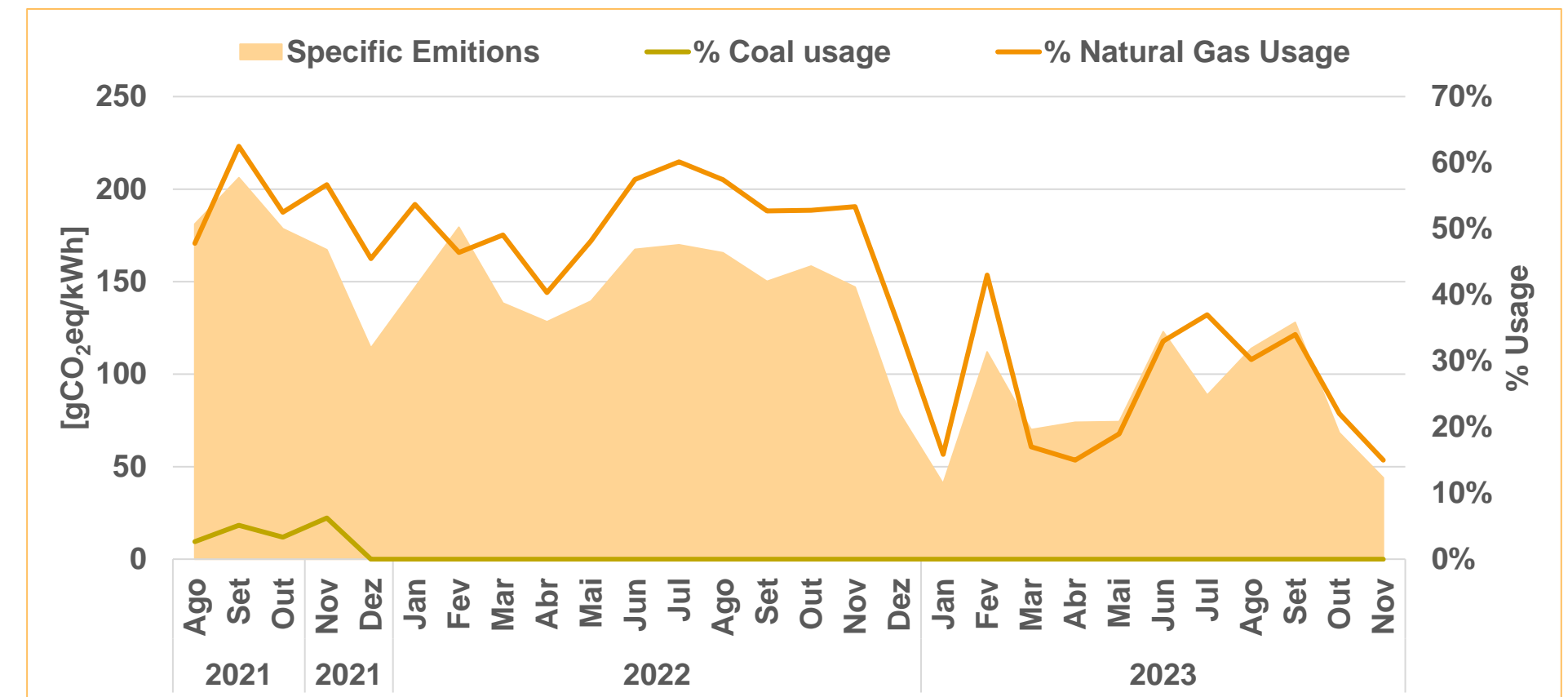
**€85.5**  
/tCO<sub>2</sub>



In comparison to Nov 2022



Price of CO<sub>2</sub> allowances in EU-ETS and natural gas price in Europe (Nov-2021 to Nov-2023).  
Source: SendeCO2, WorldBank.



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

<sup>c</sup> 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 November 30, 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.



**€159.9 /MWh**

Accumulated savings (Jan-Nov)

**€203.7/MWh**

Monthly savings (Nov)



**€5,815.2M**

Accumulated savings (Jan-Nov)

**€952.4M**

Monthly savings (Nov)

# Environmental Service

The figures below identify the savings achieved between January 1 and November 30, 2023, in natural gas, CO<sub>2</sub> emissions and CO<sub>2</sub> 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:



**€1,776 M**

Imported Natural Gas  
(Jan-Nov)

**€207 M**

Imported Natural Gas  
(Nov)



**€548 M**

Imported Electricity  
(Jan-Nov)

**€104 M**

Imported Electricity  
(Nov)



**8.7 MtCO<sub>2</sub>eq**

CO<sub>2</sub> emissions (Jan-Nov)

**1.0 MtCo<sub>2</sub>eq**

CO<sub>2</sub> emissions (Nov)



**€676 M**

O<sub>2</sub> allowances (Jan-Nov)

**€70.7 M**

O<sub>2</sub> allowances (Nov)

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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