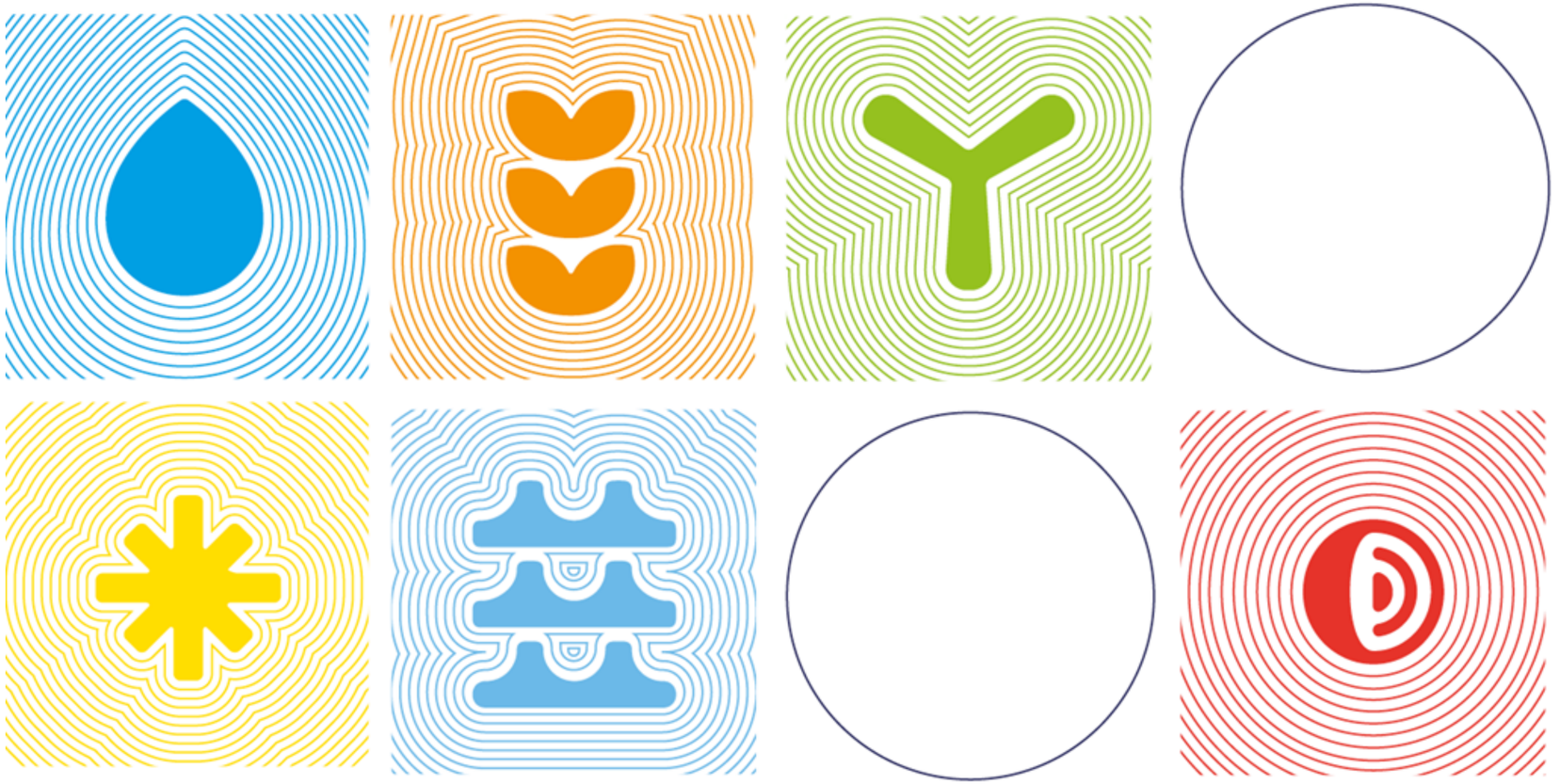
Renewable Electricity Bulletin
May 2023



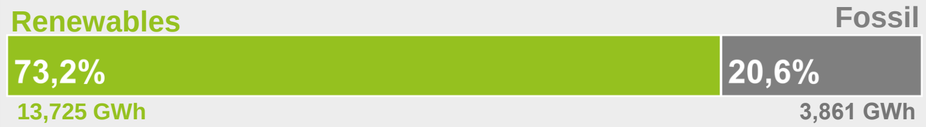
2023

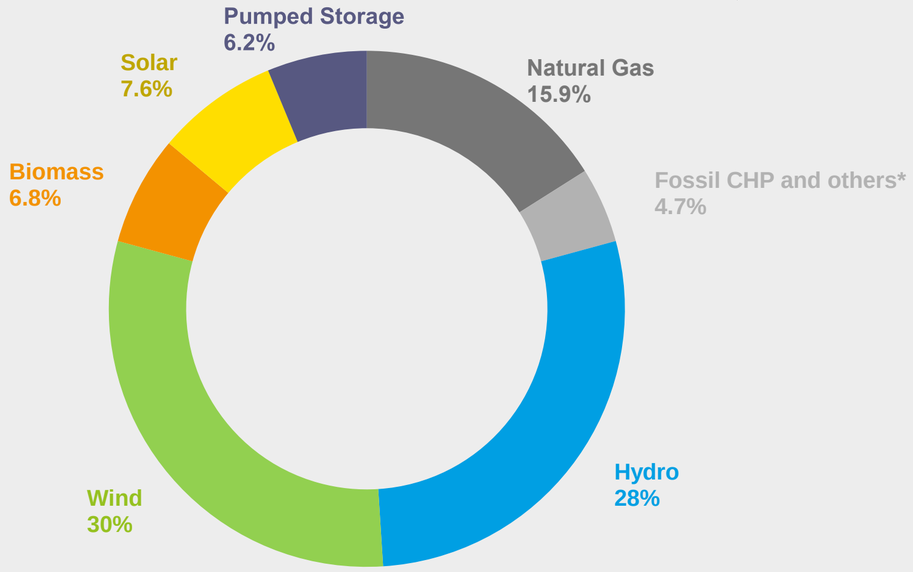
PORTUGAL NEEDS
OUR ENERGY

APREN

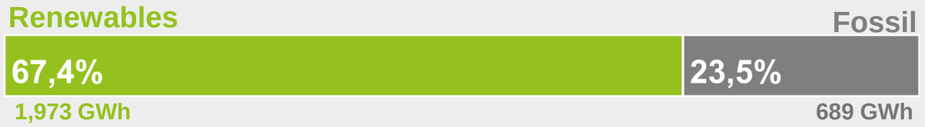
Executive Summary

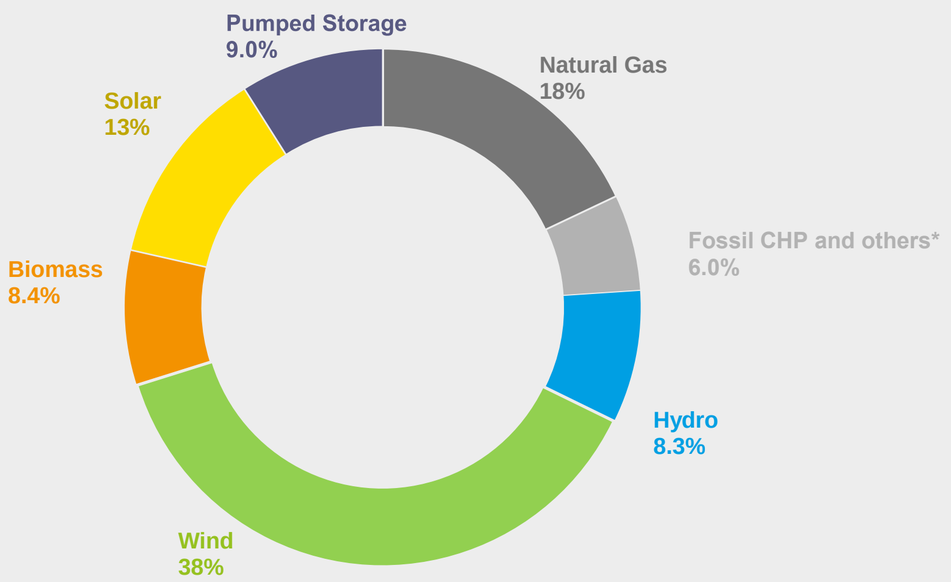
Accumulated Generation (Jan-May)





Monthly Generation (May)





Electricity sector indicators (Jan-May)

GWh	tCO_2	MWh	$MtCO_2eq$	GWh	gCO_2eq/kWh
18,751	€87.2	€88.5	1.4	4,022	74.3
Generation[a]	Price CO_2	MIBEL Price PT	CO_2 Emissions	Import balance	CO_2 specific emissions

[a]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.

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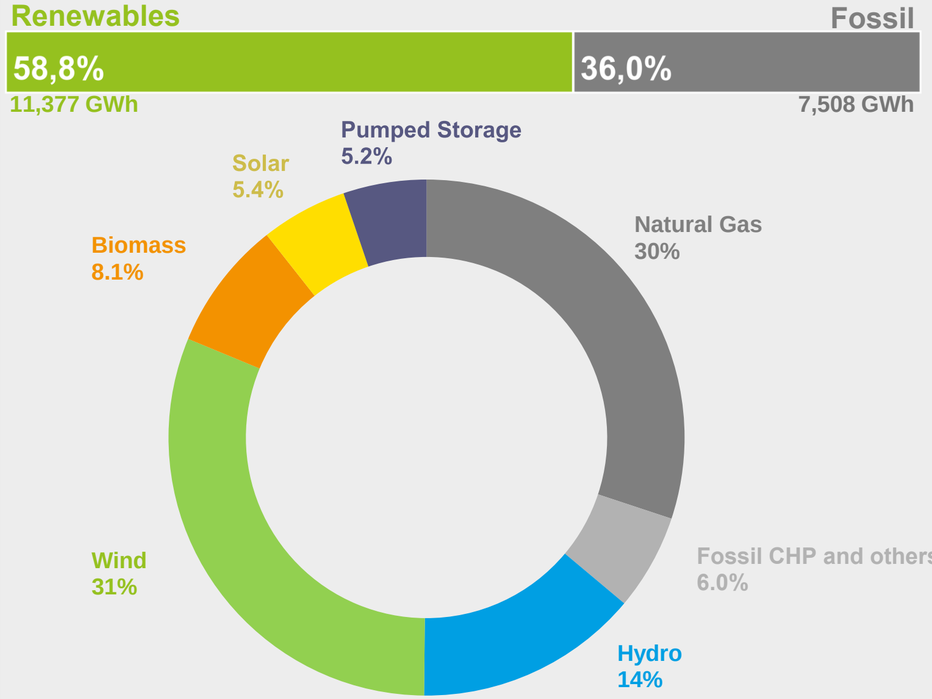
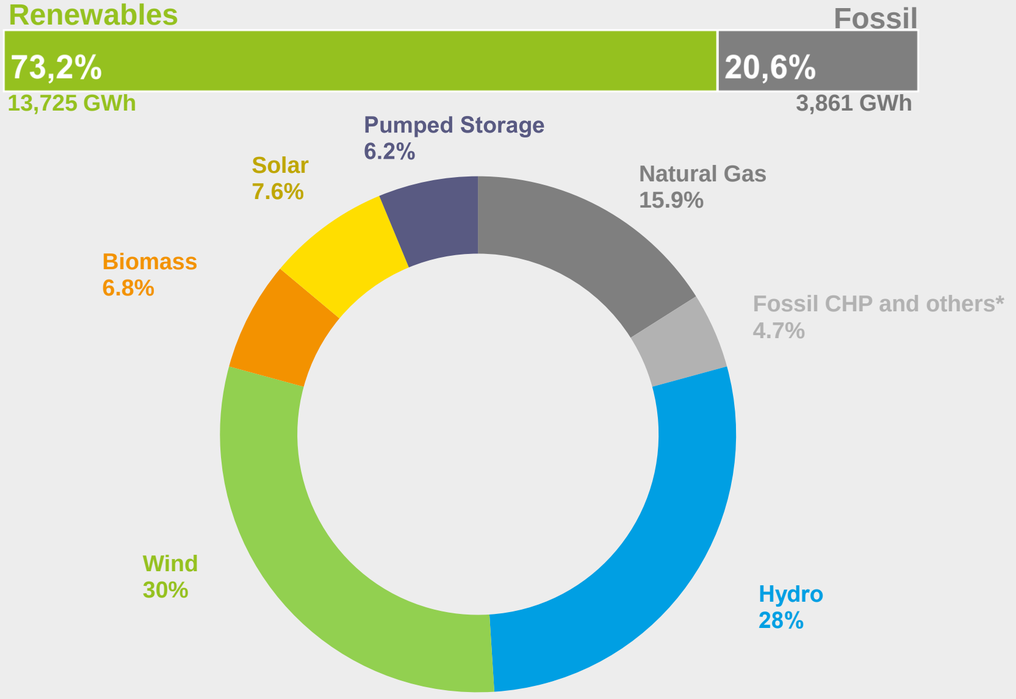
Executive Summary

Accumulated May 2022 (Jan-May)



Accumulated May 2023 (Jan-May)



Main indicators

In comparison to May 2022

3.7% ▲	14.4% ▲	-0.2% ▼			
GWh	%	GWh			
18,751	73.2	21,230	0.94	0.76	1.17
Generation[a]	Incorporation	Consumption[b]	Wind index	Hydro index	Solar index

[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
* Includes fuel oil, diesel, the non-biodegradable fraction of urban solid waste and other waste.
Source: REN, Analysis APREN

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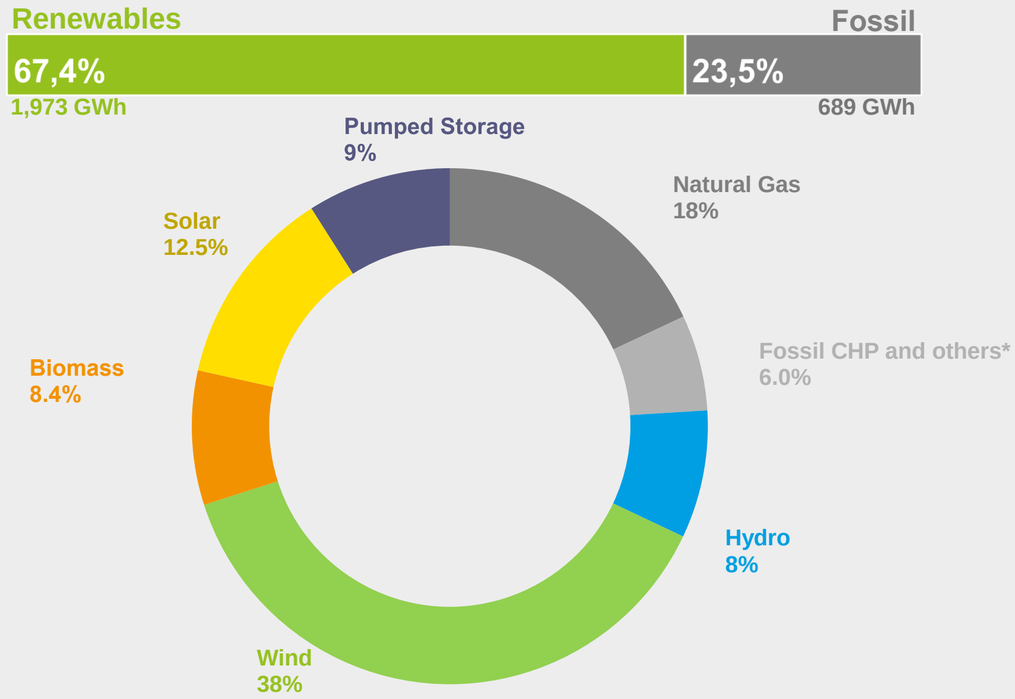
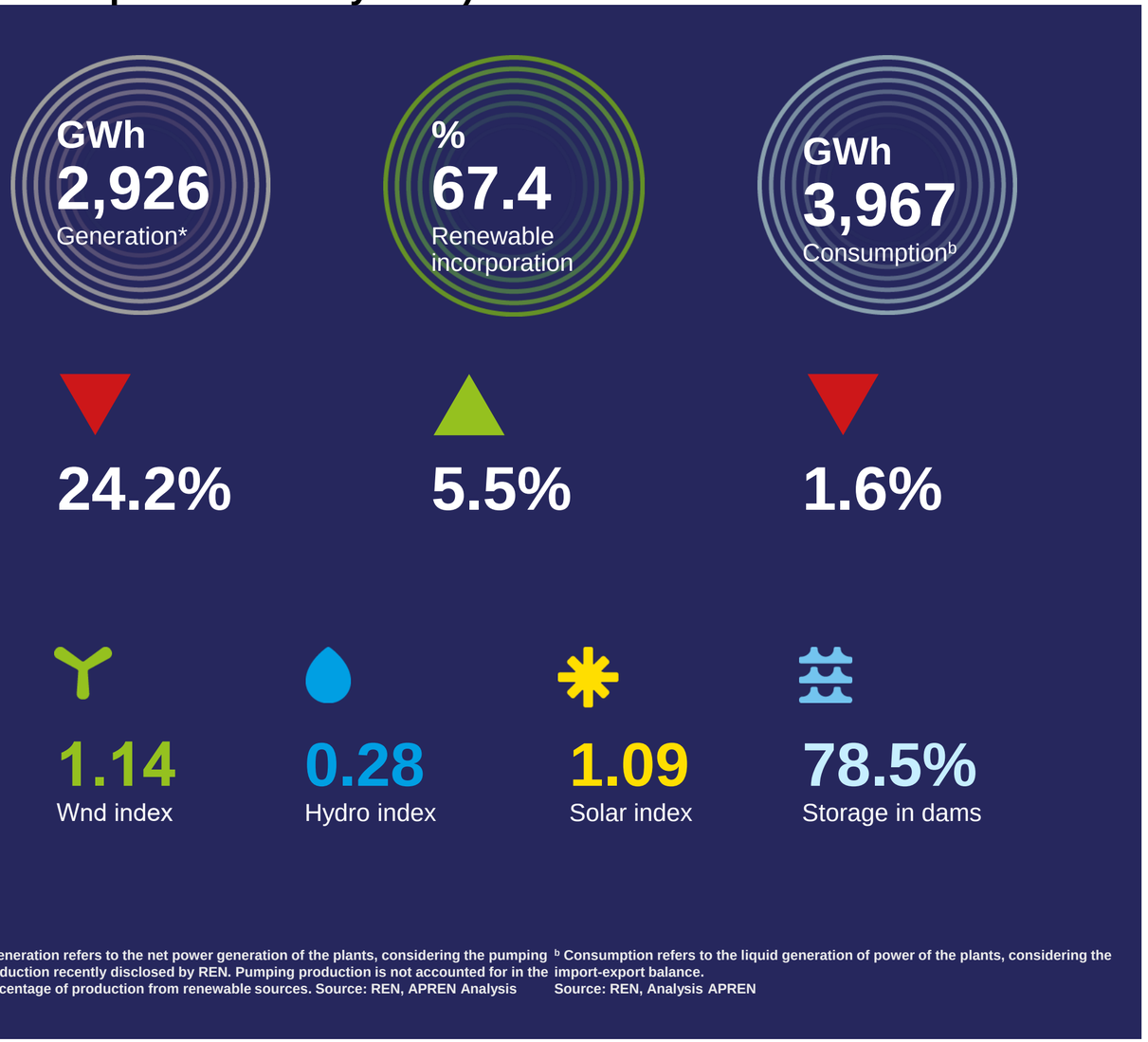
Monthly analysis in Portugal:
May



Between May 1 and 31, 2023, renewable incorporation was 67.4%, with a total of 2,926 GWh produced. The increase of 5.5% compared to May 2022 is mainly due to the decrease in fossil incorporation in 14.6%, with a total production of 689 GWh in comparison with the 1,472 GWh in May 2022.

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

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

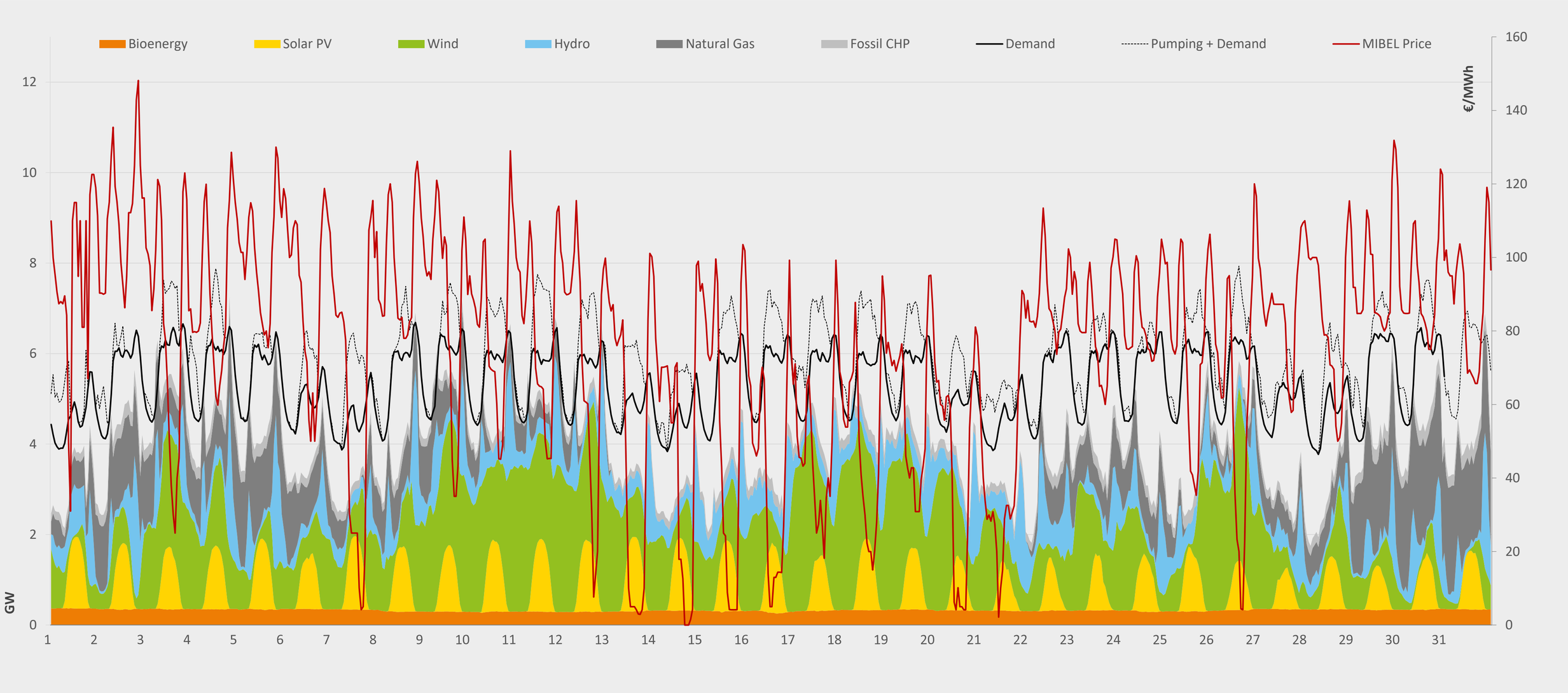


[a] Generation refers to the net power generation of the plants, considering the pumping production recently disclosed by REN. Pumping production is not accounted for in the percentage of production from renewable sources. Source: REN, APREN Analysis

[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 May 2023



Source: REN, Analysis APREN

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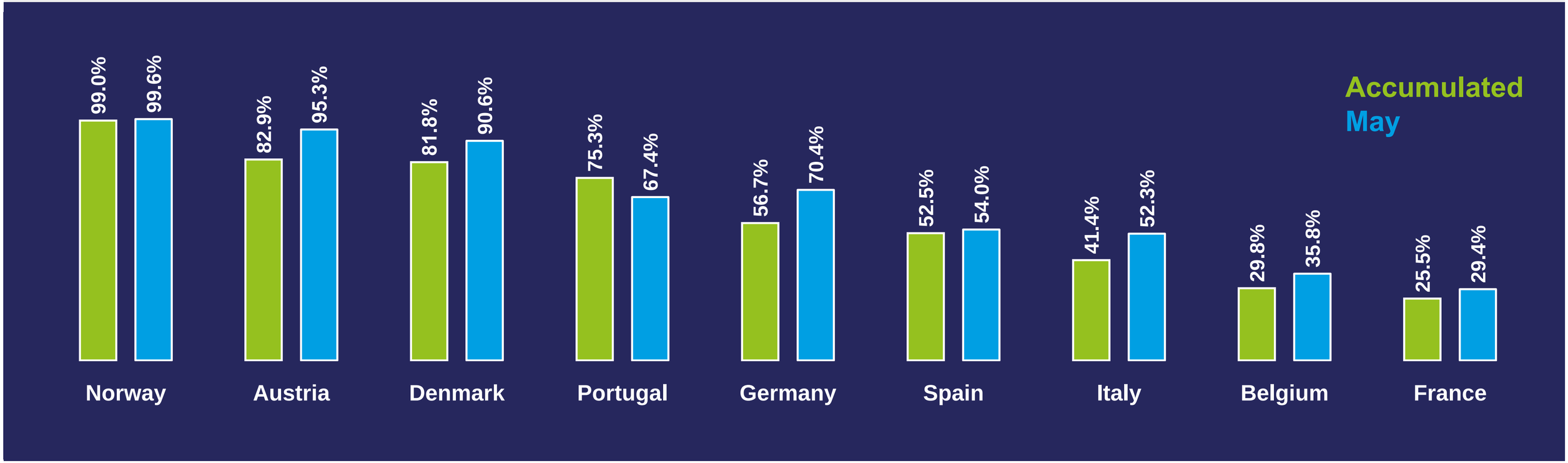
Renewable Electricity

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 May 31, 2023, Portugal was the fourth country with the highest renewable incorporation in electricity generation, behind Norway, Austria and Denmark, which obtained 99.0%,82.9% and 81.8% from RES, respectively. From 1 to 31 May, Portugal remained in fourth place in the countries considered, with the largest renewable incorporation in Europe.



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

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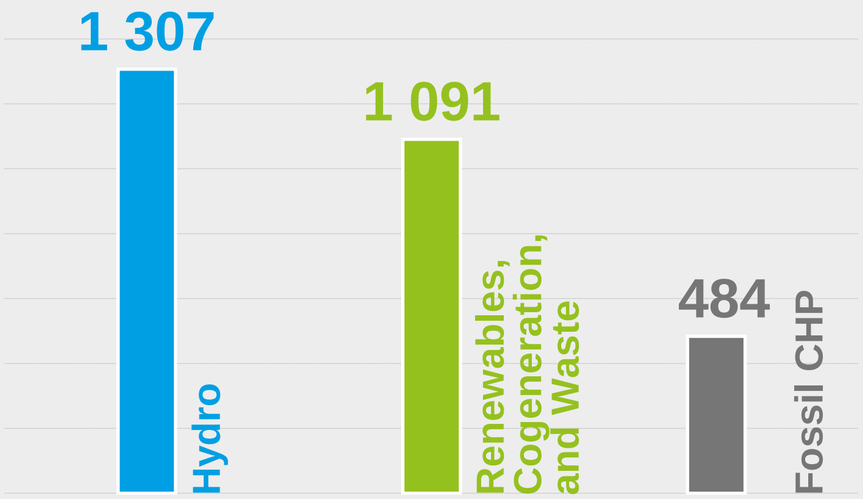
Market price setting

Portugal

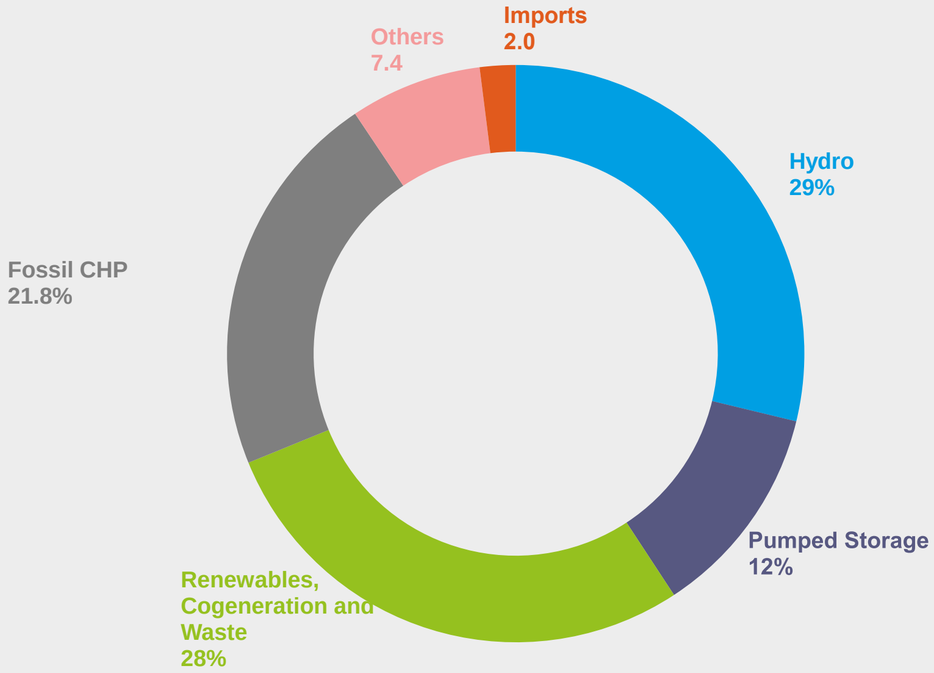
Between January 1 and May 31, hydro was the market price setting technology that recorded the most hours, with 1,307 non-consecutive hours, followed by renewables, cogeneration and waste with 1.091 hours, and thermal generation with combined cycle with 484 hours.

Accumulated January-May



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

May 2023



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

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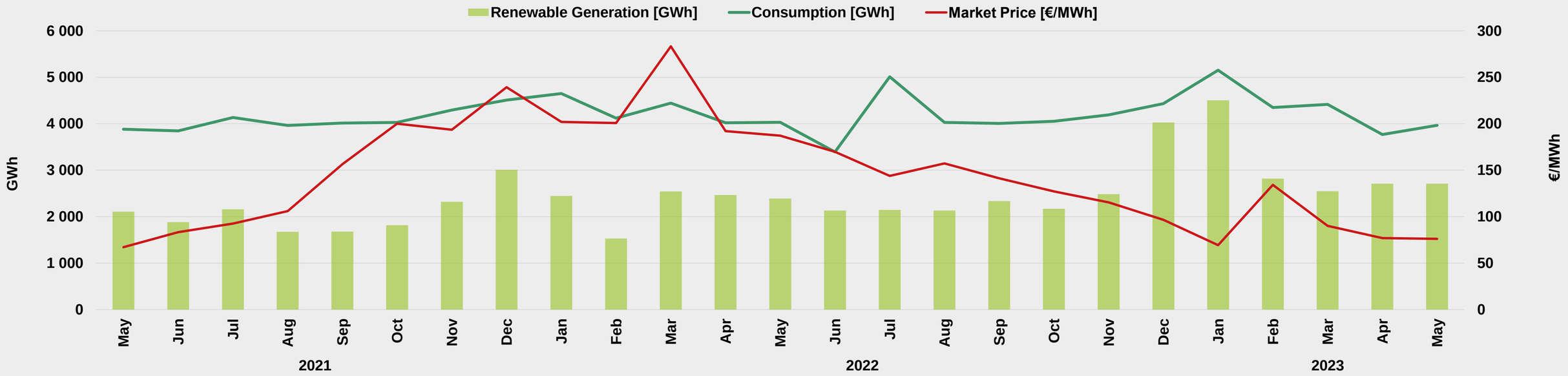
Electricity Market

Portugal

Between January 1 and May 31, the average hourly price recorded in MIBEL in Portugal was €88.5/MWh[c], represents a decrease in approximately half compared to the same period last year.

In the same period, 413 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 €59.4/MWh. From the May 1 to 31, renewable generation was sufficient to supply consumption for 4 non-consecutive hours.

Accumulated January-May



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

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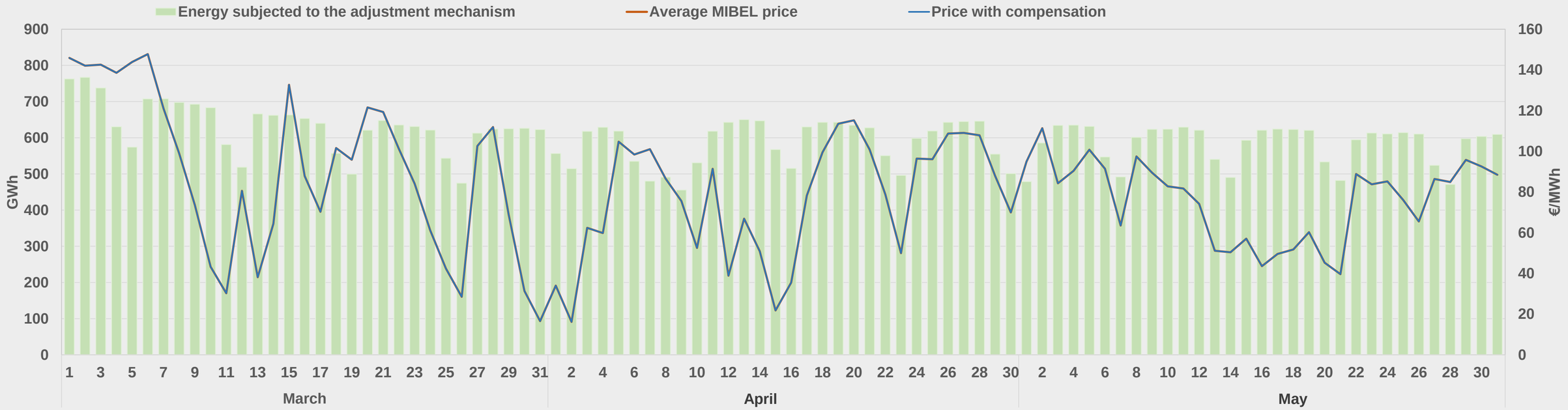
Electricity Market

Iberian gas price limit mechanism

Since June 15, 2022, when the Iberian natural gas price limit mechanism came into operation, until May 31, the mechanism generated savings of €28.75/MWh[c], which amounted to a reduction of 14.6% in the average hourly price at MIBEL.

The savings due to the price limit of natural gas, corresponding 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 March,April and May, the price limit on natural gas didn´t introduce changes in the eletricity prices. In total, 184.4 of the 260.5 TWh produced were subjected to the consumer ajustedment mechanism in the Iberian Peninsula.



[c] Arithmetic average hourly prices
Source: OMIE, Analysis APREN

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Renewable Electricity

Europe

During the month of May 2023, there was a minimum hourly price at MIBEL in Portugal of €0.0/MWh for 3 consecutive hours, in which the market setting was due to a combination of technologies. The maximum hourly price reached €148.1/MWh, where the market set with hydro.

Regarding prices in Europe, it should be noted that the average values were inferior to those of the previous month. Maximum and minimum prices were also inferior to those registered in the previous month.

Minimum Prices (May)

-€129.9 /MWh — 1st Germany

-€90.0 /MWh — 2nd Belgium

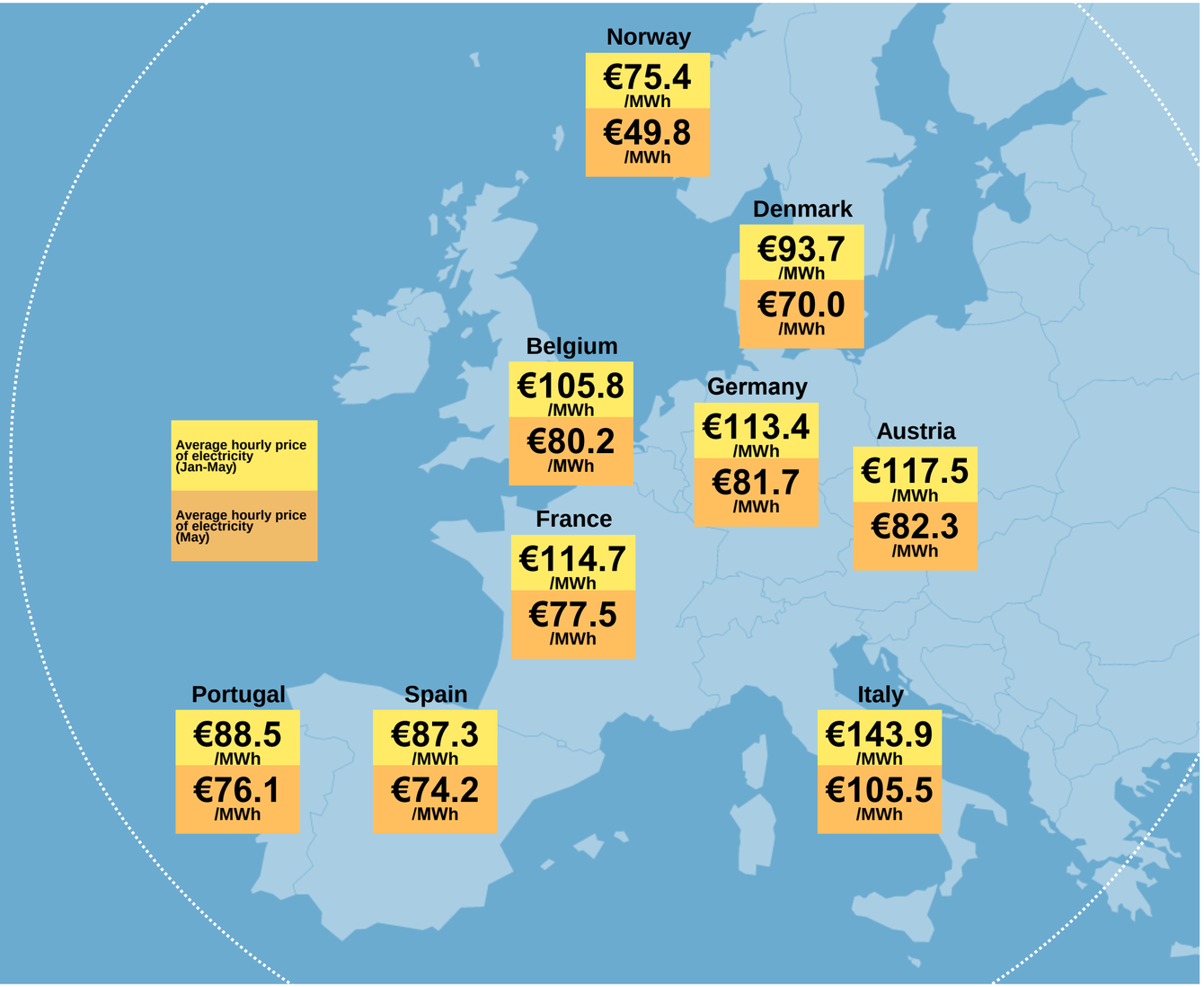
-€81.6 /MWh — 3rd Austria

Maximum Prices (May)

€192.9 /MWh — 1st Italy

€182.7 /MWh — 2nd Germany

€171.6 /MWh — 3rd Denamrk



Source: ENTSO-E, OMIE, Analysis APREN

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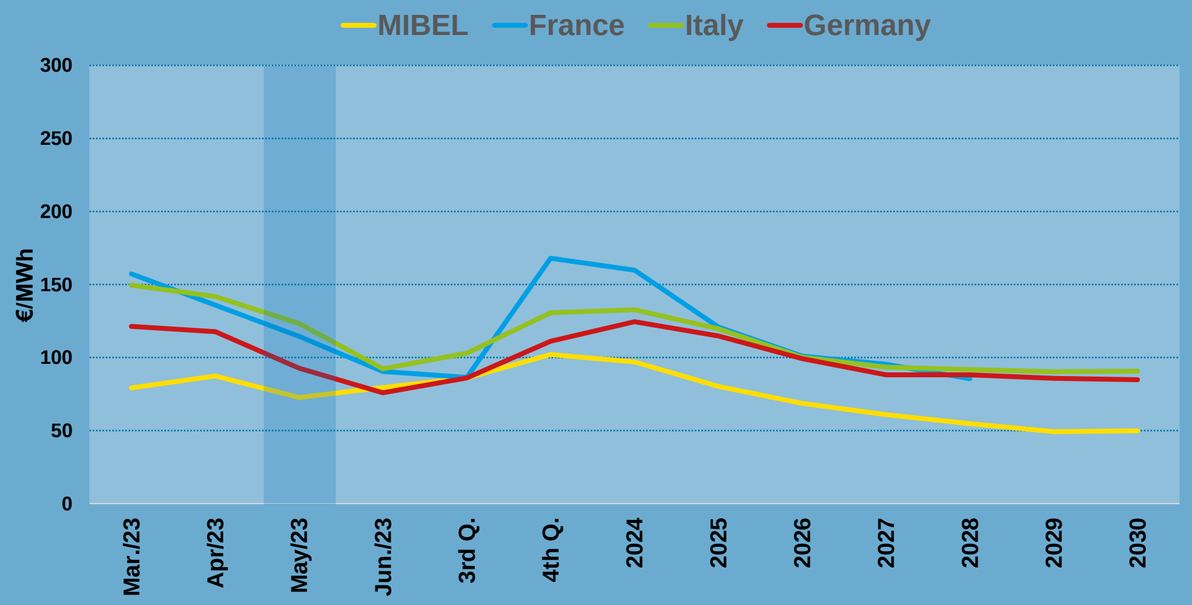
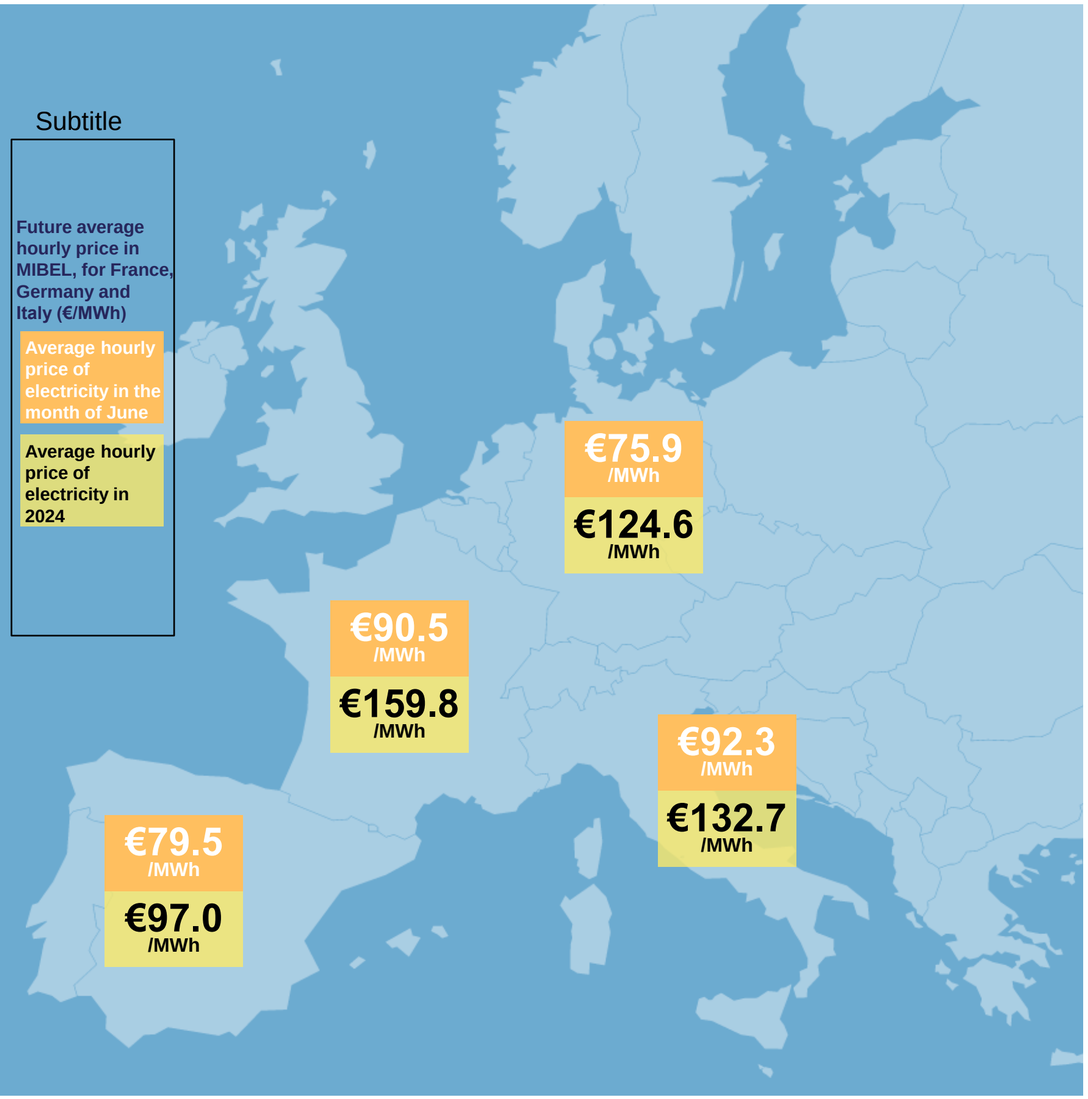
Future Electricity Market

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

The map on the right displays the price values for the next month (June) and for the next year. In both cases, MIBEL has the lowest values, while the French and German markets have the highest.

MIBEL also has the lowest figures by 2030, coming from the Iberian gas price limit mechanism by June next year, and from investment in renewable production.





d Values updated in the 1st of June.
Source: OMIP, EEX, Analysis APREN

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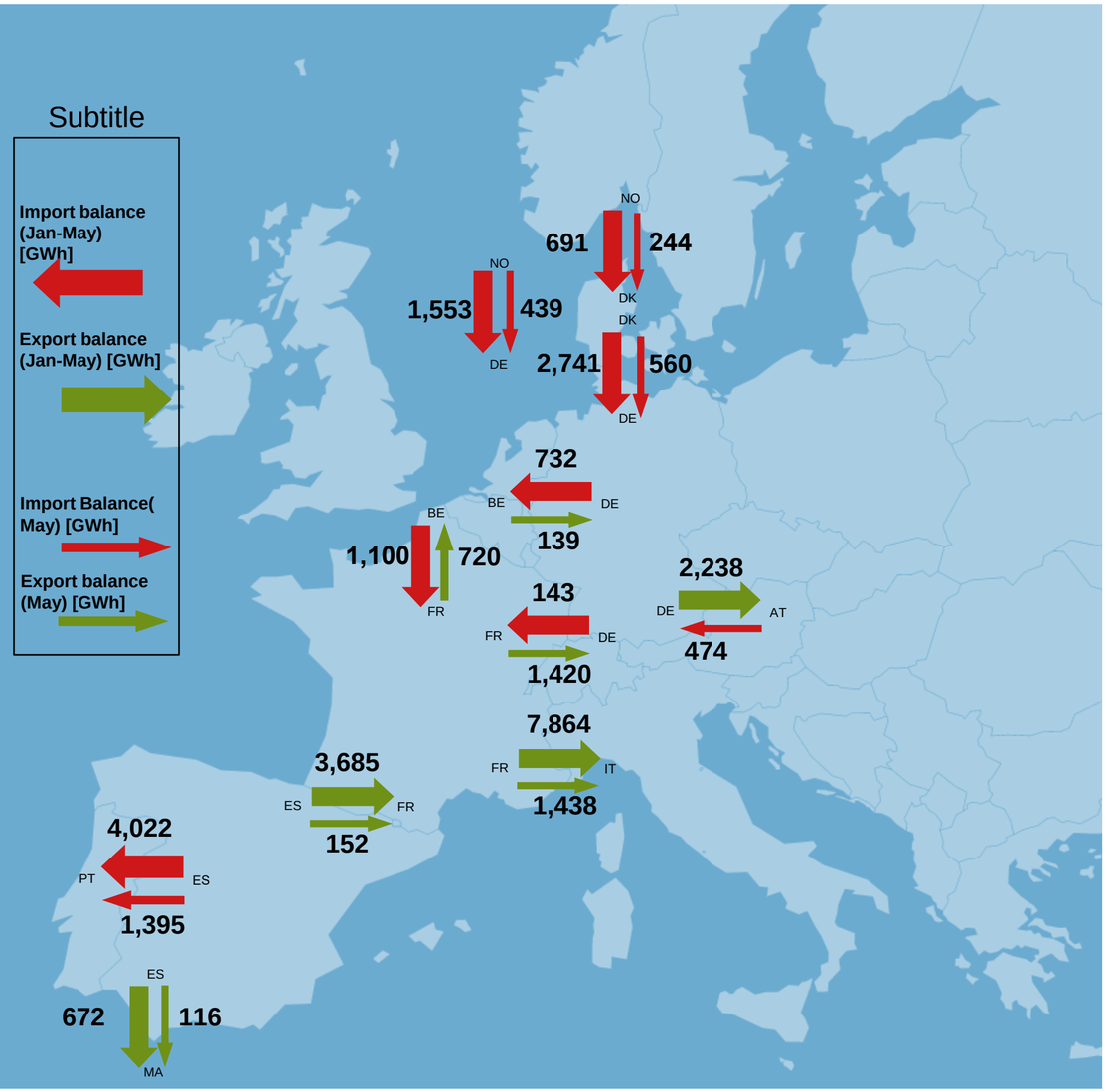
International trade

Europe

Between January 1 and May 31, 2023, the electricity system of Mainland Portugal recorded electricity imports equivalent to 5,528 GWh and exports of 1,506 GWh, with Portugal being an importer with a balance of 4,022 GWh.

Main Interconnection Indicators PT-ES

	PT-ES		ES-PT	
Usage	6.4% (Jan-May)	0.4% (May)	23.7% (Jan-May)	27.1% (May)
Congestion	0.0% (Jan-May)	0.0% (May)	0.1% (Jan-May)	0.0% (May)
Markets split	5.3% (Jan-May)	5.1% (May)	68.3% (Jan-May)	64.2% (May)



Source: ENTSO-E, OMIE, Analysis APREN

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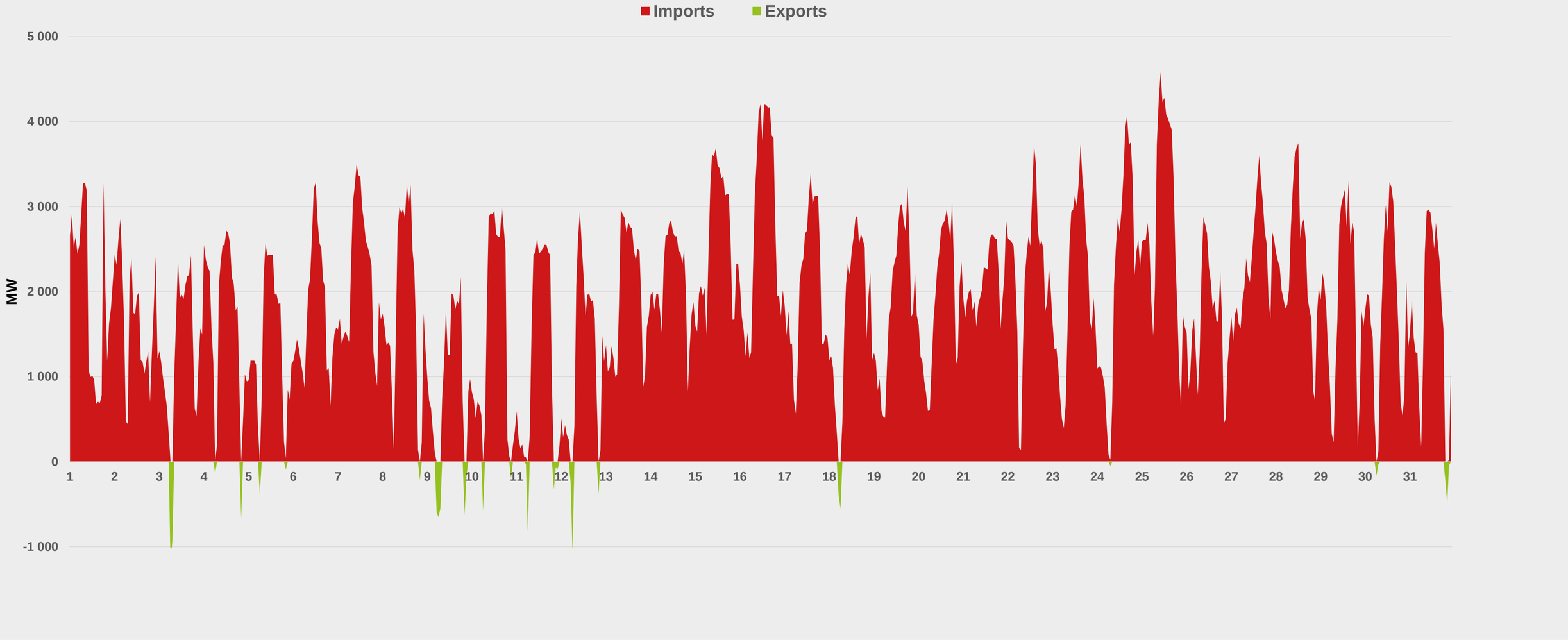
International trade: May

Diagram of imports and exports in Portugal



Source: REN, Analysis APREN

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Power sector emissions

Between January 1 and May 31 , 2023, specific emissions reached 74.3 gCO_2eq/kWh, with a total emissions from the power sector of 1.4 $MtCO_2eq$

The European Emissions Trading System (EU-ETS) recorded an average price of €87.2/tCO_2 [c], being this figure a reduction in 4% compared to the same period in 2022.

Sector emissions

1.4

$MTCO_2eq$

49%

In comparison to May 2022

Allowances average price

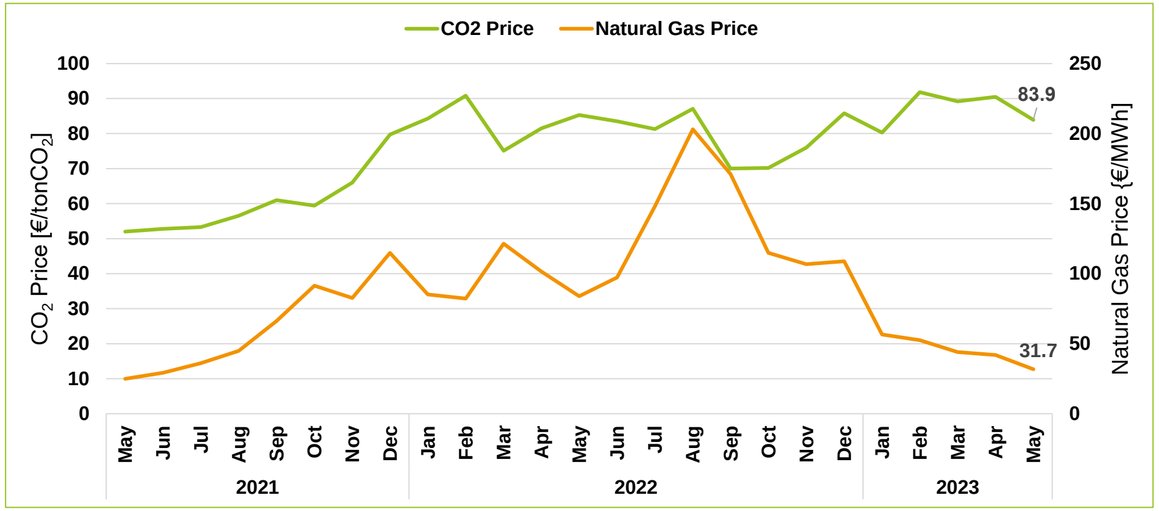
€87.2

/tCO_2

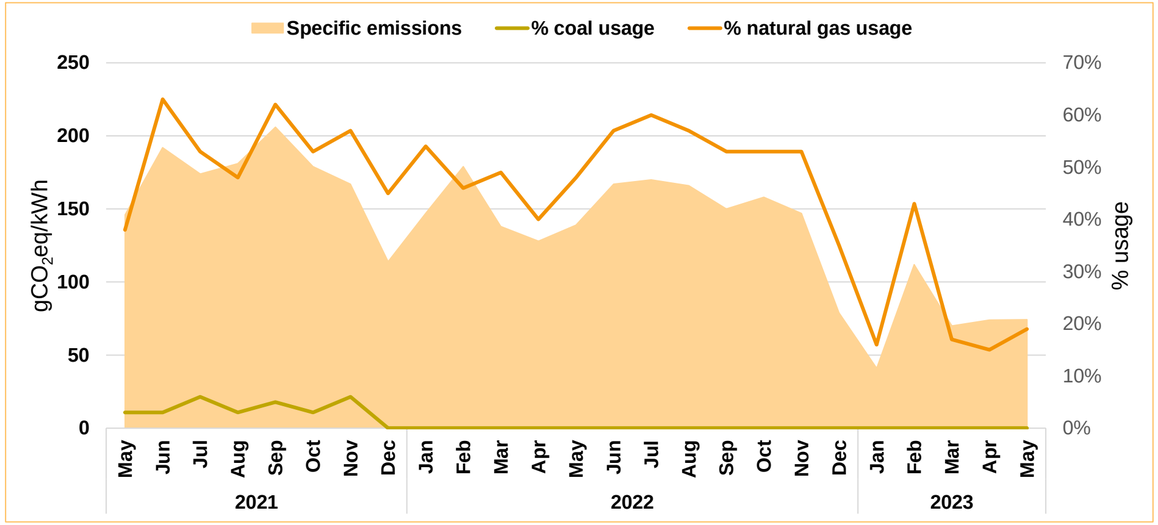
4%

In comparison to May 2022

[c] Arithmetic average hourly prices
Source: OMIE, WorldBank.



Price of CO_2 alowances in EU-ETS and natural gas price in Europe (May-2021 to May-2023).
Source: SendeCO2, WorldBank.



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

Simulation of price formation without SRP

Renewables have avoided:

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

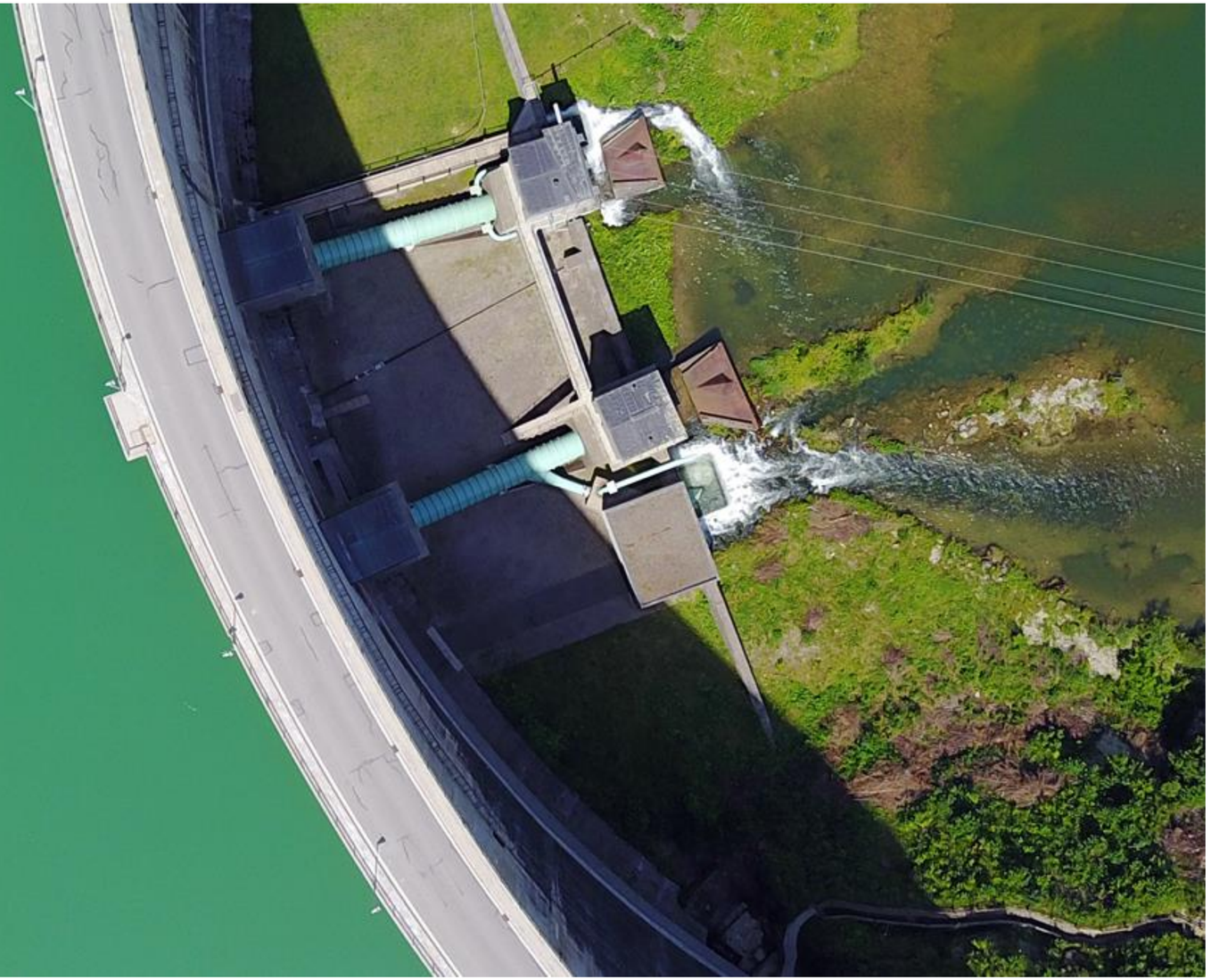
This study is conducted for SRP and includes all installed power of fossil cogeneration. Given that the capacity equivalent to this technology within the SRP is quite residual and that the other technologies are renewable, the figures are very close to the real savings generated by renewables.

€142.7/MWh
Accumulated savings (Jan-May)

€183.4/MWh
Monthly savings (May)

€2652.0 M
Accumulated savings (Jan-May)

€536,7 M
Monthly savings (May)



Source: OMIE, Analysis APREN.

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Environmental Service

The figures below identify the savings achieved between January 1 and May 31, 2023, in natural gas, CO_2 emissions and CO_2 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:

€887 M
Imported Natural Gas (Jan-May)

€125 M
Imported Natural Gas (May)

€374 M
Imported Electricity (Jan-May)

€0 M
Imported Electricity (May)

4.1 $MtCo_2eq$
CO_2 emissions (Jan-May)

0.7 $MtCo_2eq$
CO_2 emissions (May)

€315 M
CO_2 allowances (Jan-May)

€61.4 M
CO_2 allowances (May)

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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