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# RENEWABLE ELECTRICITY IN REVIEW

PORTUGAL NEEDS  
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Associação  
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# RENEWABLE ELECTRICITY IN REVIEW

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# ENERGY PANORAMA AT NATIONAL AND EUROPEAN COMMUNITY LEVEL

In 2022, the price of electricity increased quite significantly given the abrupt rise in the price of natural gas. An energy crisis was installed then, initially resulting from the EU sanctions applied to Russia through the reduction on natural gas purchases. In 2023, although there had not yet been a ceasefire by Russia, natural gas prices dropped to values close to those from 2021, which led to a **reduction in hourly electricity prices on the wholesale market**.

At the national level, the reduction in the electricity prices was also due to the growing renewable capacity (currently 18.7 GW) that allowed an **all-time high in the incorporation of renewables** in the electricity production (70.6%). The **gas-for-power price cap in the Iberian market mechanism** has thus become obsolete. Nevertheless, this mechanism contributed to savings of €45.53/MWh in 2022 and €2.77/MWh in 2023. According to the agreement between Portugal and Spain, announced by the European Commission (EC), the mechanism will not be implemented in 2024.

At the European level, the EC has followed up on the initiatives of the **REPowerEU** legislative package that was created to reduce the dependency on fossil fuels, in particular Russian natural gas, and to accelerate the transition to renewable energies and to more resilient and safe energy systems. In this sense, the launch of the public consultation for the **Net-Zero Industry Act** (NZIA) reflects the EC's commitment to ensure its leading role in the transition to zero emissions technologies and to safeguard the objectives of the REPowerEU.

In February, the **Additionality Delegated Act** entered into force, setting new targets to the production of green hydrogen and the conditions it should meet to be considered a renewable fuel of non-biological origin (RFNBO). Later, in November, a **European pilot auction** was launched, with a second auction planned for the spring of 2024. The auction comprised 800 M€ to finance green hydrogen projects with a minimum capacity of 5 MW. Amongst the evaluation criteria, in alignment with the NZIA, the preference for equipment produced in the Europe was highlighted.

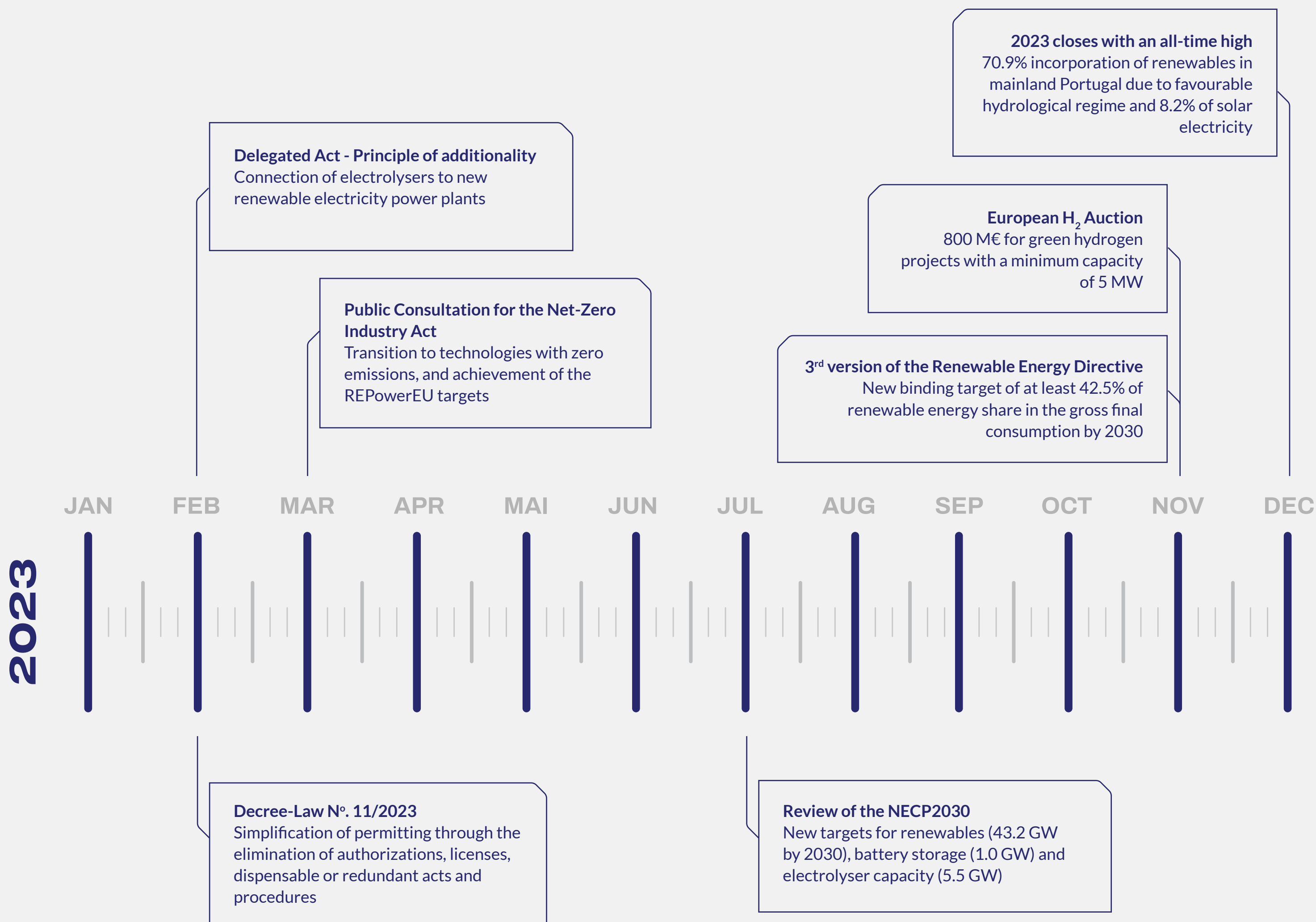
Also in November, the third version of the **Renewable Energy Directive** (RED III) came into force, setting the target for the renewable incorporation in the final energy consumption to 42.5% by 2030, with an additional 2.5% indicative top up to allow the target of 45% to be achieved, for which all Member States should contribute. Hence, new objectives and developments were established for topics already in progress, such as:

- integration of renewable energy into buildings;
- assessment of the areas of the zones for compliance with the targets 2030;
- definition of the areas of the acceleration zones for the implementation of renewable energy;
- increased public participation;
- definition of zones for grid and storage infrastructure;
- simplification of the permit-granting processes;
- adequacy of the resources provided to the competent authorities;
- classification of renewable energy projects as projects of overriding public interest.

It should also be highlighted that an increase in renewable capacity and storage needs will rely on the access to equipment that is largely based on rare earths and critical materials. To this end, the EU has reached a provisional understanding on the **Critical Raw Materials Act**, within the framework of REPowerEU, to diversify the supply chain, to integrate principles of circularity, and to promote research on the efficiency of use and alternatives.

On the national panorama, the simplification of permitting procedures moved forward with the publication of the **Decree-Law No. 11/2023**, of February the 10th, already announced by the Government in 2022 as a new SIMPLEX package. DL11/2023 removes several situations where case-by-case analysis was mandatory and redefines the thresholds for the projects to undergo Environmental Impact Assessment (EIA), and creates a set of measures to put tacit approvals into practice. The elimination of EIA for green hydrogen projects with electrolyzers

# ENERGY PANORAMA AT NATIONAL AND EUROPEAN COMMUNITY LEVEL



connected to new electricity plants running on renewable sources also stands out.

Portugal is tackling its energy transition challenge on several fronts, as can be understood through the figures presented in the following pages, one of them being the development of the **offshore wind sector**. In this sense, it is worth highlighting the public consultation for the proposed

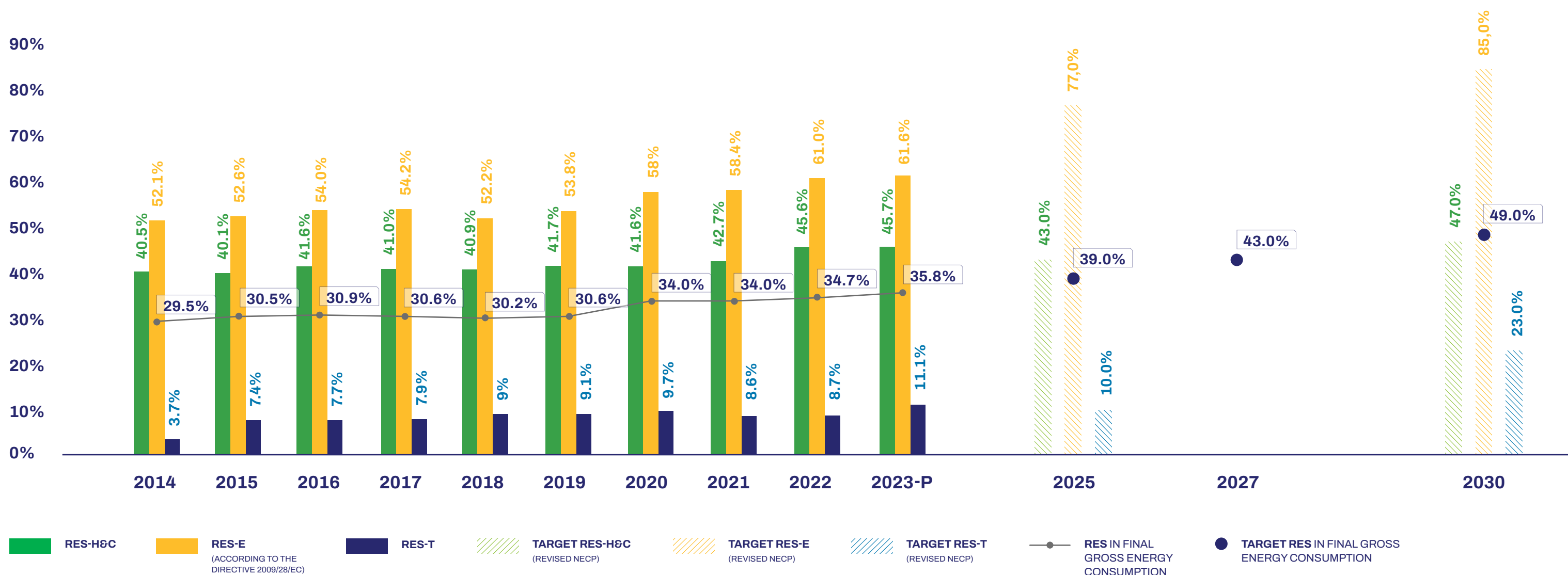
Allocation Plan for Offshore Renewable Energies (“PAER”), which took place between October the 30<sup>th</sup> and December the 13<sup>th</sup>, which had a significant public turnout.

# IMPACT OF THE RENEWABLE SECTOR ON THE ENERGY DEPENDENCY AND NATIONAL ECONOMY

As shown in Figure 1, the share of renewables is shaped as a consistent increase in electricity consumption (yellow bars), in heating and cooling (green bars), in transport (blue bars), and final energy consumption (grey line).

In July 2023, the review of the National Energy and Climate Plan (NECP2030) was submitted, which features a new target for renewables: 43.2 GW of installed capacity by 2030. The target for 2030 (2025) in terms of the share of renewables in the electricity consumption is 85% (77%); in heating and cooling 47% (43%); in transport 23% (10%); and in gross final energy consumption 49% (39%).

FIGURE 1 - RENEWABLE SHARE IN ELECTRICITY CONSUMPTION (RES-E), HEATING AND COOLING (RES-H&C), TRANSPORT (RES-T) AND GROSS FINAL ENERGY CONSUMPTION, AND REVISED NECP2030 TARGETS.  
SOURCES: DGEG, REVISED NECP, APREN ANALYSIS.



An estimate by APREN\* for 2023 points to a persistent increase in the share of renewables, compared to 2022. In both years, the 2025 target (as per the revised NECP2030) for the renewables share in heating and cooling (dashed green) has already been surpassed. The 60% target for the renewables share in the electricity consumption by 2020 has only been reached in 2022.

It should be noted that to achieve the ambitious targets for the share of renewables in the electricity consumption (dashed yellow) and in transport (dashed blue), for both 2030 and 2025, will require considerably accelerated growth for them to happen.

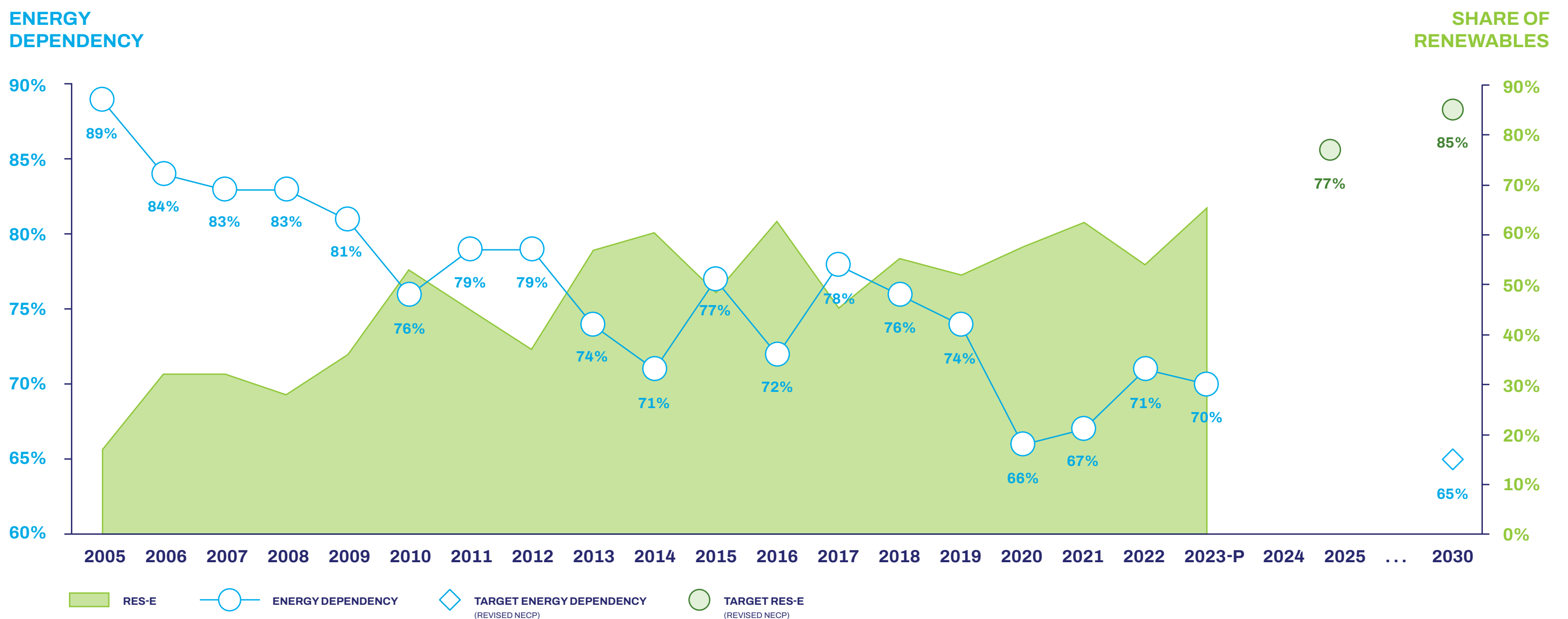
\* Share of RES in electricity, transport, and heating and cooling for 2023 (estimated) calculated through linear regression recurring to historical data published by DGEG.

# IMPACT OF THE RENEWABLE SECTOR ON THE ENERGY DEPENDENCY AND NATIONAL ECONOMY

Regarding the energy dependence, Figure 2 depicts a significant intra-annual variability, which is due to variable renewable resources, namely hydro. Nonetheless, a noteworthy downward trend has been felt since 2017, particularly in the year 2020 when, amid the pandemic crisis, the country's energy dependence was very close to the target of 65% set in the NECP2030.

An estimate by APREN\* shows an energy dependence of 70% for 2023, after the increase registered in 2022 that was due to the higher consumption, a consequence of the atypical 3-year global economic contraction, and to the lower availability of hydro resource in that year.

FIGURE 2 - ENERGY DEPENDENCY RATE AND SHARE OF RES-E UNTIL 2023 AND NPEC 2030 TARGETS.  
SOURCES: DGEG, REVISED NECP, APREN ANALYSIS.



In 2023, the share of renewables in electricity generation reached an all-time high of 65.4% (real value). Thanks to increased rainfall and to the boost in solar capacity in that year, the positive impact from integrating more renewable electricity in the national energy system becomes evident, allowing the country a greater energy independence.

The operationalisation of the REPowerEU in Portugal can take its first steps in a more favourable framework.

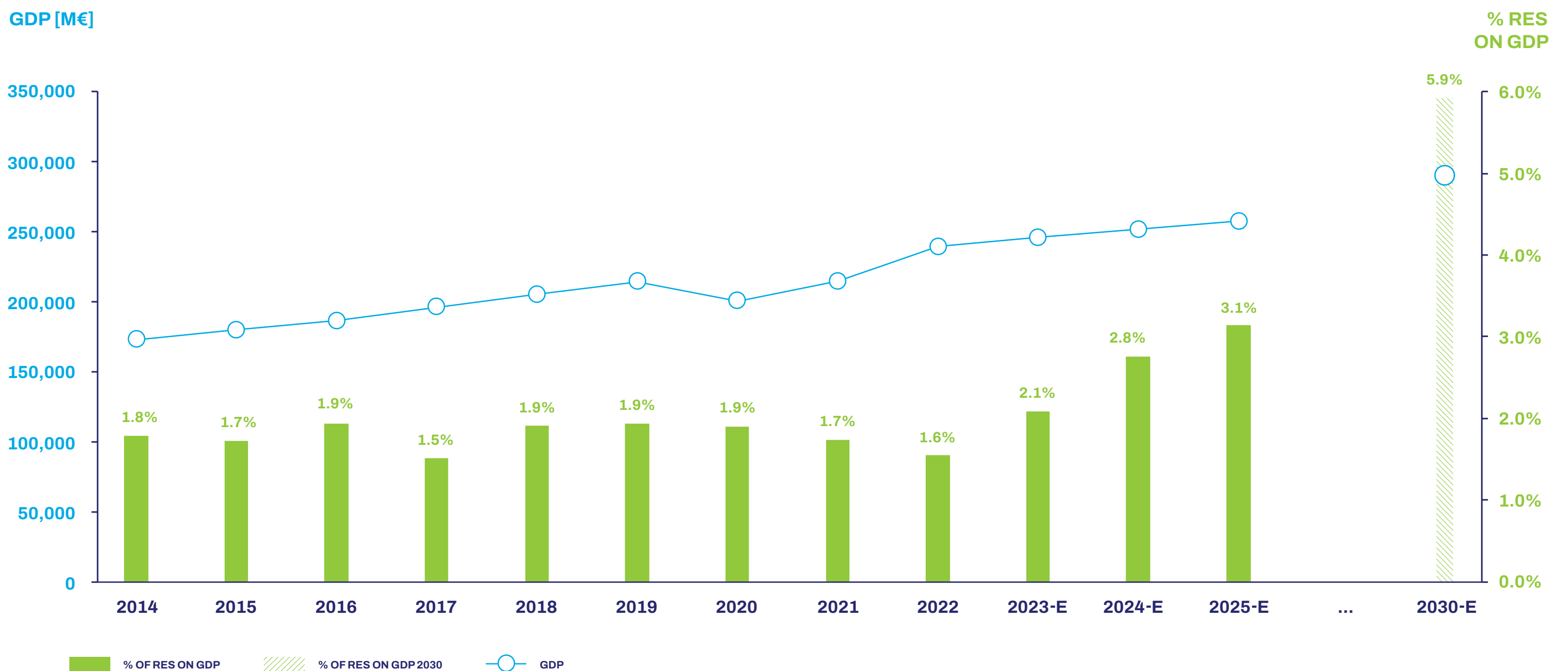
\* Energy dependence for 2023 (estimated) calculated through linear regression recurring to historical data published by DGEG.

# IMPACT OF THE RENEWABLE SECTOR ON THE ENERGY DEPENDENCY AND NATIONAL ECONOMY

Since 2020, followed by the pandemic peak, the Gross Domestic Product (GDP) has seen a steady growth. In 2023, the GDP grew 2.3% in comparison to the previous year (according to an estimate by INE, on the 30th of January 2024), standing close to 245 000 M€ - once more, an all-time high.

Over the last decade, the contribution rate from renewable electricity production has represented between 1.5% and 2.1% of the GDP (Figure 3). Although 2022 registered the lowest value of the last 5 years, it is estimated that 2023 saw an historical maximum. A continuous increase is expected for the coming years, with forecasted values reaching up to 3.1% in 2025 and 5.9% in 2030, in line with the RES incentives and NECP2030 targets.

FIGURE 3 - IMPACT OF THE GROSS ADDED VALUE (GAV) PRODUCED BY THE RENEWABLE ELECTRICITY SECTOR ON THE GDP.  
SOURCES: DELOITTE 2023, INE, APREN ANALYSIS.

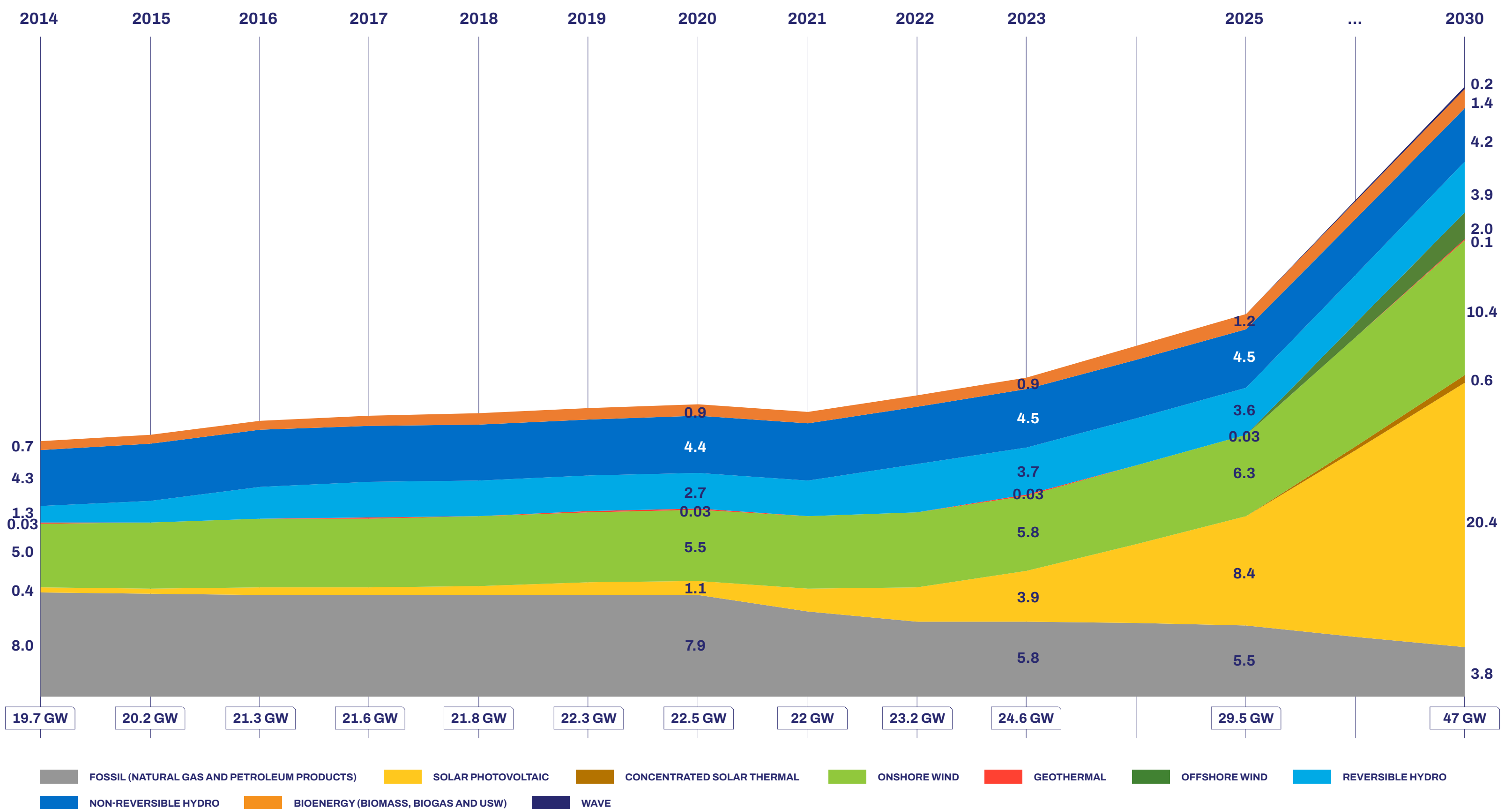


# THE ELECTRICITY IN 2023

In 2023, approximately 1.30 GW of renewable power were installed, mostly solar photovoltaics with more than half being decentralised production. These figures were possible through the increased investment in RES, partly driven by the Recovery and Resilience Plan (RRP) support conveyed through the Environmental Fund, and given the entry into operation of some of the projects from the 2019 solar auction and others prior to this procedure, namely small production units (UPPs).

Figure 4 shows that, over the years, the installed capacity in the electricity system has gradually increased. As of 2021, the replacement of the fossil resource by solar, wind and water resources becomes evident, especially with the closure of the last coal-fired power plant. Today, the country has an electricity production capacity of approximately 24.6 GW, with around 76% corresponding to renewables.

FIGURE 4 - EVOLUTION OF THE INSTALLED CAPACITY IN THE PORTUGUESE ELECTRICITY SYSTEM. SOURCES: REN, DGEG, REVISED NECP, APREN ANALYSIS.





# THE ELECTRICITY IN 2023

According to the revised PNEC2030 targets, which integrates the goals of the Fit-for-55 and REPowerEU, the electricity production capacity will continue to grow until 2025 and, more prominently, by 2030. By 2025, the main increase will be in solar photovoltaics, which is expected to reach an operating capacity of 8.4 GW with about one-third being decentralized, in onshore wind, totalling 6.3 GW, and in biomass/biogas and urban solid waste (USW) achieving 2 GW. By 2030, a greater growth is foreseen for photovoltaics, which is ought to reach 20.4 GW, and for onshore wind, with 10.4 GW. The latter will encompass over-equipment and repowering of some of the existing plants to accomplish the target set.

In the 2030 horizon, a capacity of 1 GW in battery storage and 5.5 GW of electrolysis capacity for green hydrogen production are also included. In addition to the previous set of technologies, the target of 2 GW of offshore wind and the allocation of 10 GW for interconnections and corresponding interconnections for future implementation in the following years. Considering that only 25 MW of offshore wind are currently installed, the opportunity for the country is quite clear. Yet, to establish a local value chain that answers to the projects' requirements and subsequent operation and maintenance, in alignment with the NZIA, will be a challenging endeavour.

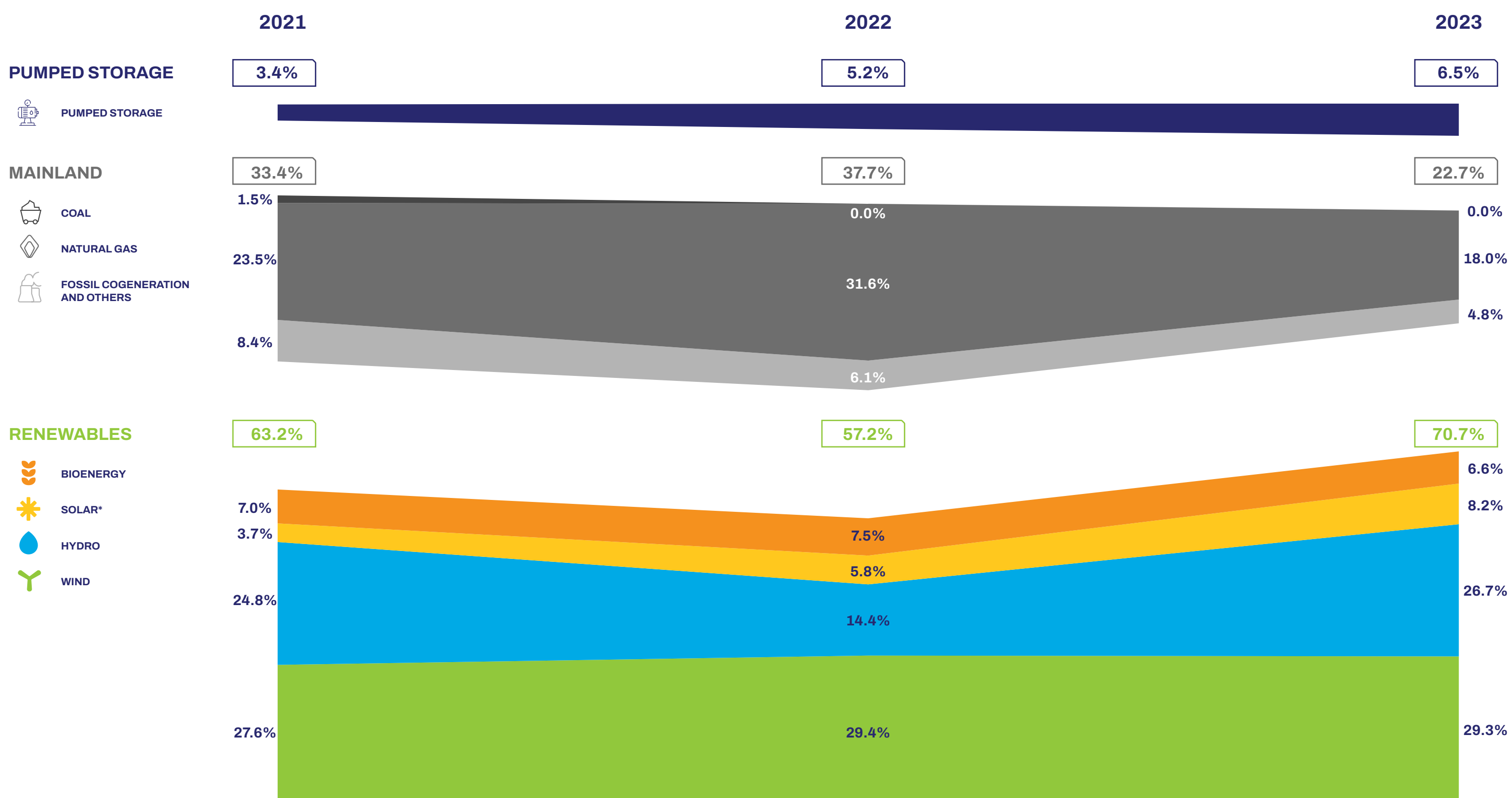
The increase of around 0.3 GW sought for hydro power must also be mentioned, specifically the improvement in pumping capacity, which is a central piece to the balancing of the electricity system and to ensure the safety of supply, and the 0.1 GW of geothermal energy, to be implemented in the islands of São Miguel and Santa Maria in the Azores islands.

# THE ELECTRICITY IN 2023

In 2023, the total electricity production by power plants in mainland Portugal equalled 44,120 GWh, 70.7% of which came from renewable sources - an all-time high for renewable generation. This sum was mostly supported by wind technology, with 29.3%, followed by hydro, with 26.7%, solar photovoltaics (excluding decentralised), with 8.2%, and biomass, with 6.6%.

In retrospective, represented in Figure 5, the electricity production from fossil fuels was reduced by 15% (12%) compared to the overall electricity production in 2022 (2021), given the almost two-fold contribution of hydro, and the reduction of capacity in thermal plants. A substantial increase in solar electricity also took place, totalling 3.9 GW of capacity by the end of 2023.

FIGURE 5 - EVOLUTION OF THE ELECTRICITY PRODUCTION MIX IN MAINLAND PORTUGAL FROM 2021 TO 2023.  
SOURCES: REN, APREN ANALYSIS.



Regarding the annual specific yield of each renewable technology, the values for hydro and wind are between 2,627 and 2,227 GWh

per GW installed, respectively, whilst biomass has the highest value, 3,369 GWh/GW, and solar the lowest, 928 GWh/GW.

\*Does not include decentralized production.

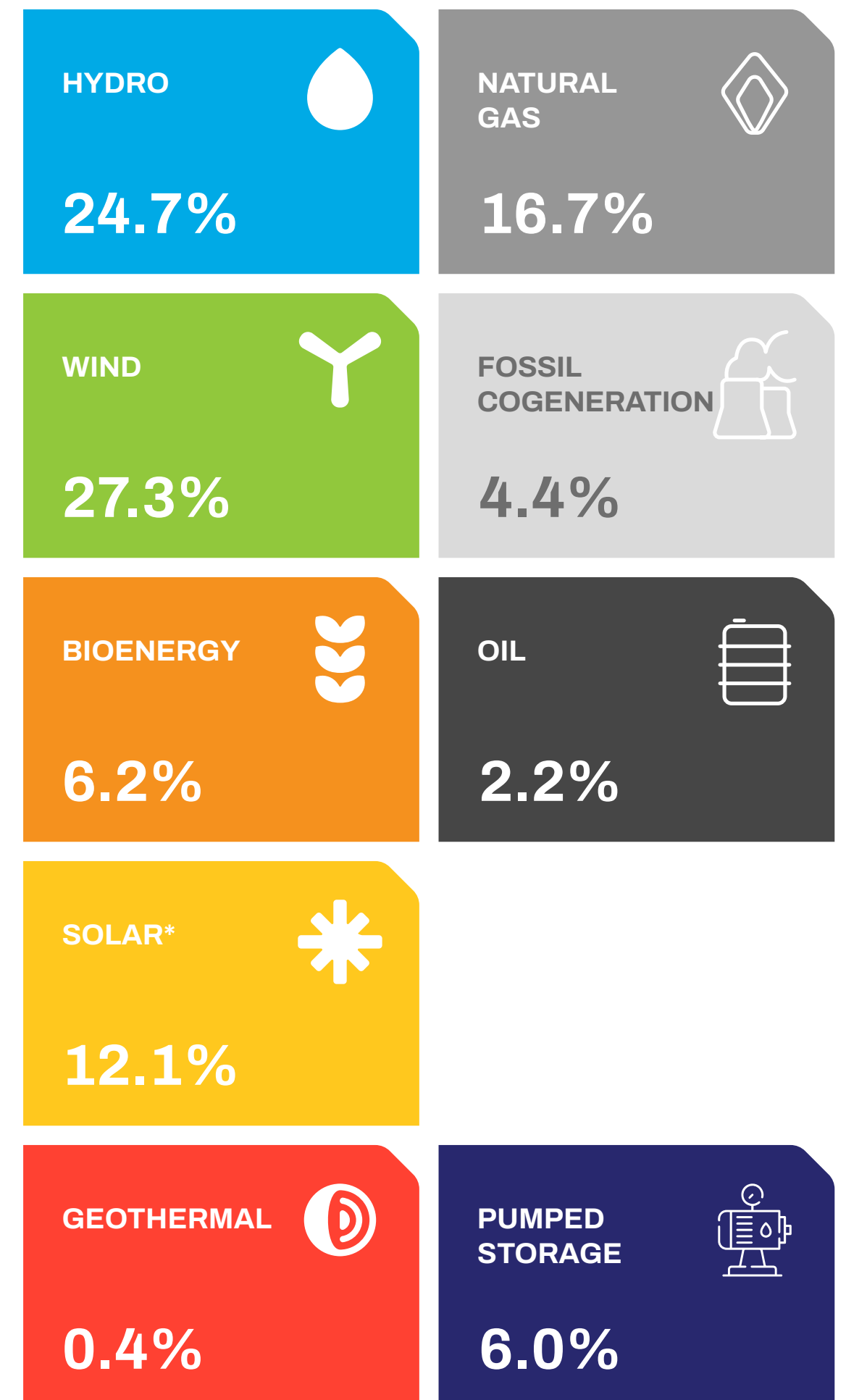
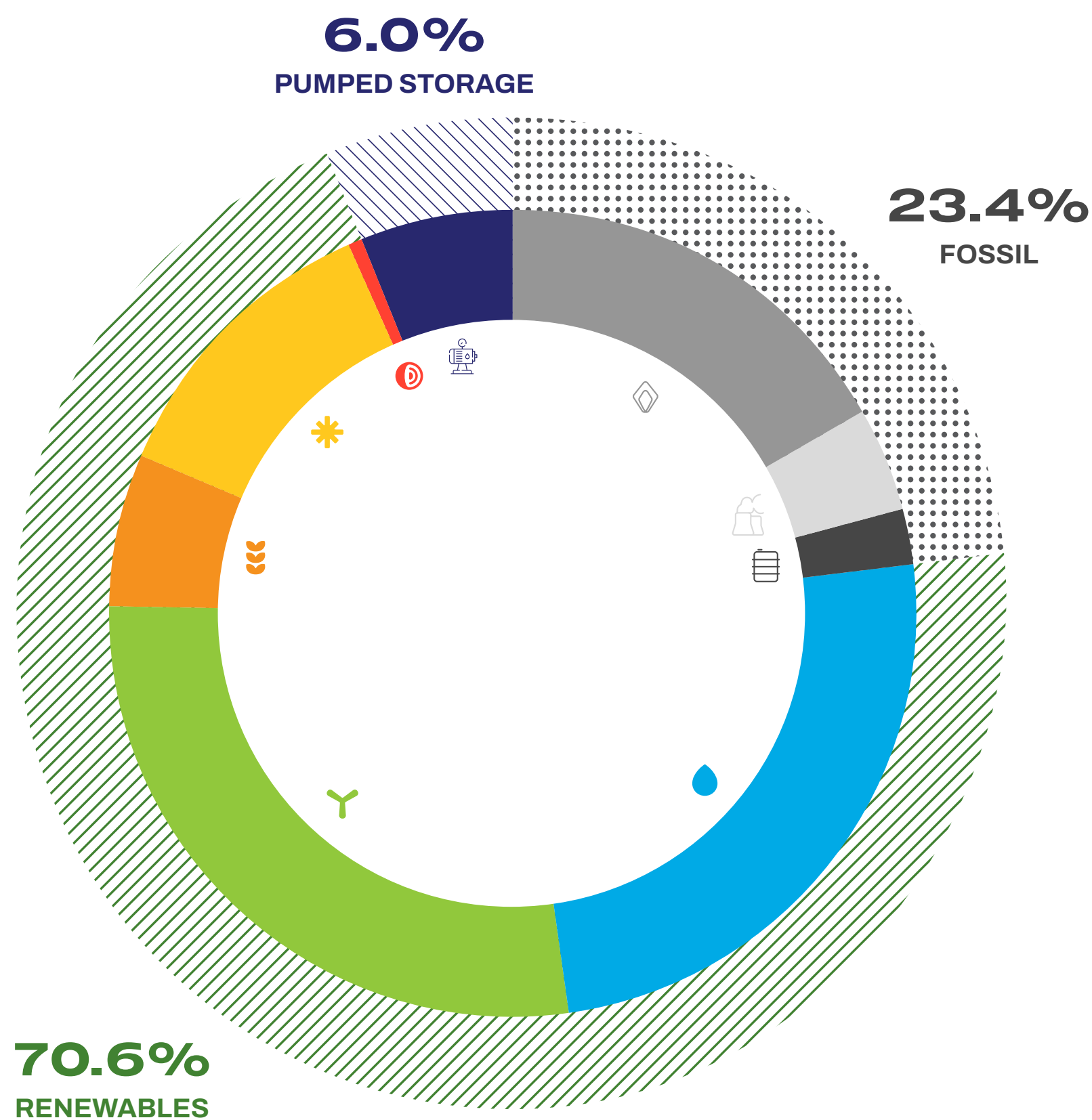
# THE ELECTRICITY IN 2023

At the national scope, hence including the electricity production in the Autonomous Regions (AR), which totals 1,771 GWh, and all the decentralised capacity, the contribution of renewables is slightly reduced to 70.6%, as shown in Figure 6. This is due to the increased weight of fossil sources in the production mix, which rises to 23.4%,

since in the AR fuel and diesel still play a key role in the energy supply. On the other hand, there is a considerable boost in the overall solar contribution given the production from the decentralised assets (12.1%).

FIGURE 6 - ELECTRICITY PRODUCTION MIX IN MAINLAND PORTUGAL AND AUTONOMOUS REGIONS, IN 2023, INCLUDING DECENTRALISED PRODUCTION.  
SOURCES: REN, EDA, EEM, DGEG 2024, APREN ANALYSIS.

## NATIONAL MIX 2023



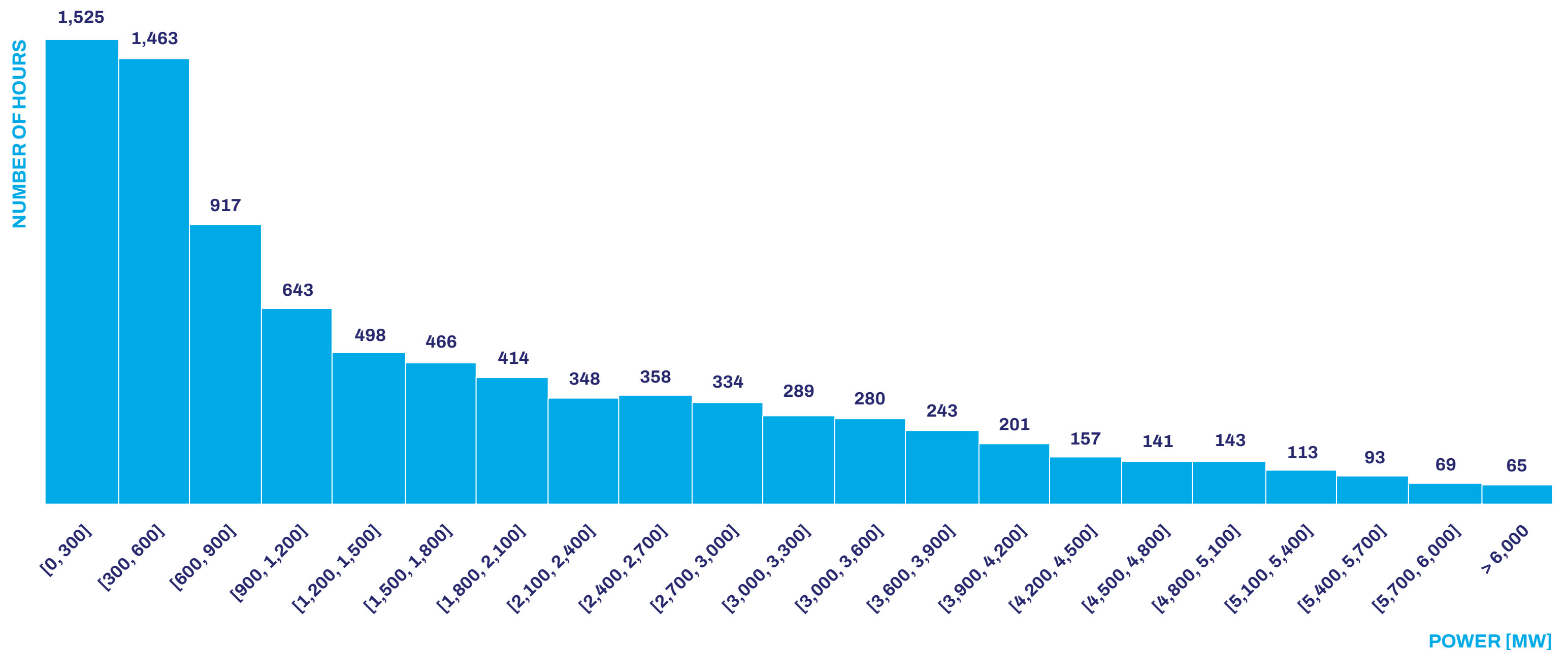
\*Includes decentralised production.

# THE ELECTRICITY IN 2023

A more detailed analysis of the performance of the most representative renewables in the electricity system\*, in mainland Portugal, in 2023, is represented in Figures 7.1-7.4 as the operational load hours for each technology.

For hydro, the highest annual number of hours (around 3,900) happens for operational loads of up to 900 MW (Figure 7.1); for wind, it features 3,738 hours between 0 and 1,000 MW (Figure 7.2); in the case of solar, excluding nighttime and considering that the resource is almost symmetrical throughout daytime, all power regimes are distributed homogeneously during more than 4,000 hours in the year (Figure 7.3); and for biomass, there is a period of approximately 3,356 hours of operation between 320 and 350 MW (Figure 7.4).

FIGURE 7.1 - YEARLY FREQUENCY DISTRIBUTION OF THE MEAN OPERATIONAL LOAD FOR **HYDRO**, IN 2023.  
SOURCE: REN, APREN ANALYSIS.



\*Does not include decentralised production.

# THE ELECTRICITY IN 2023



FIGURE 7.2 - YEARLY FREQUENCY DISTRIBUTION OF THE MEAN OPERATIONAL LOAD FOR **WIND**, IN 2023.  
SOURCE: REN, APREN ANALYSIS.

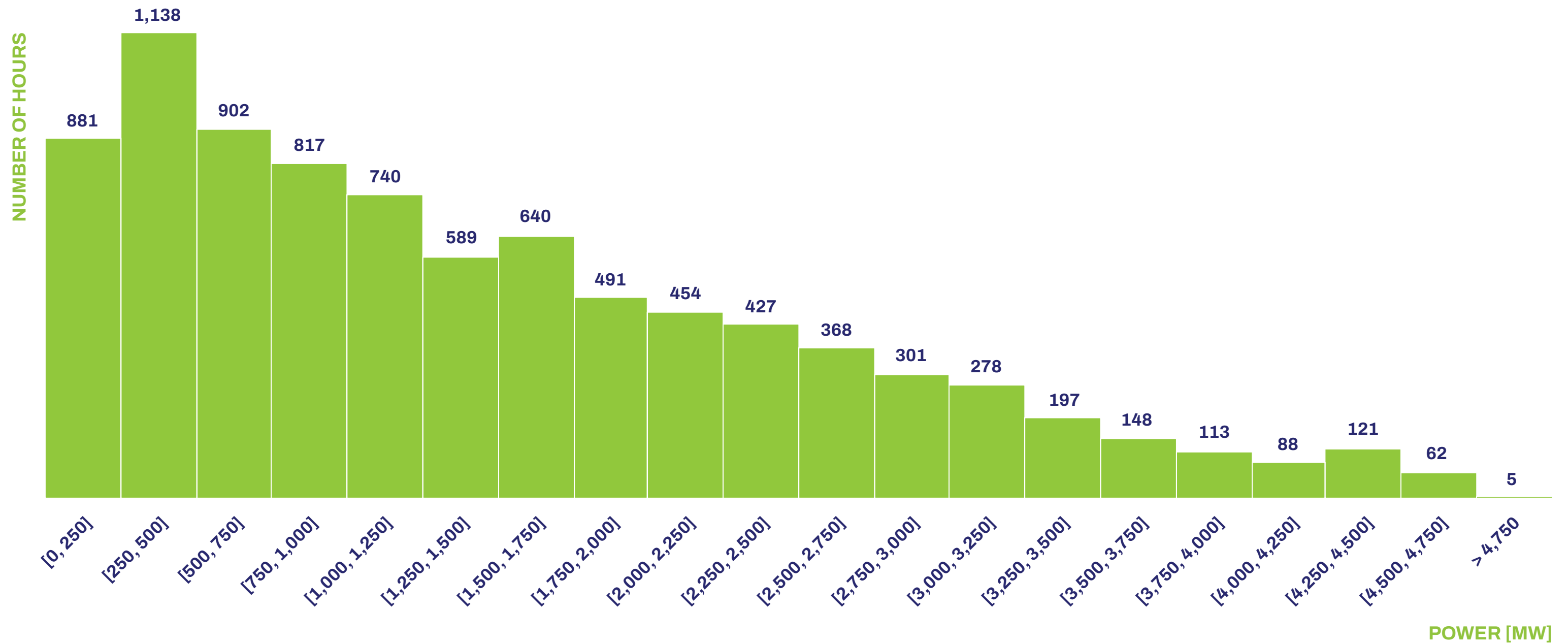
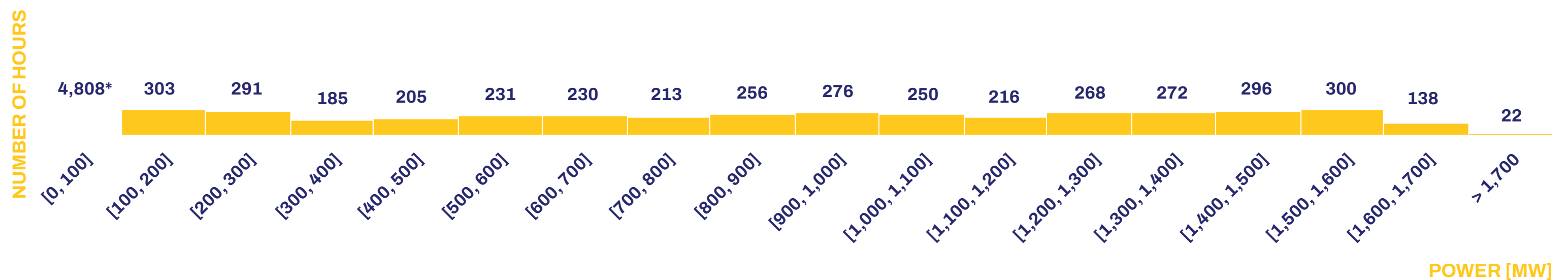
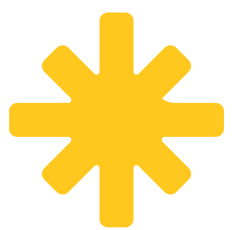


FIGURE 7.3 - YEARLY FREQUENCY DISTRIBUTION OF THE MEAN OPERATIONAL LOAD FOR **SOLAR**, IN 2023.  
SOURCE: REN, APREN ANALYSIS.

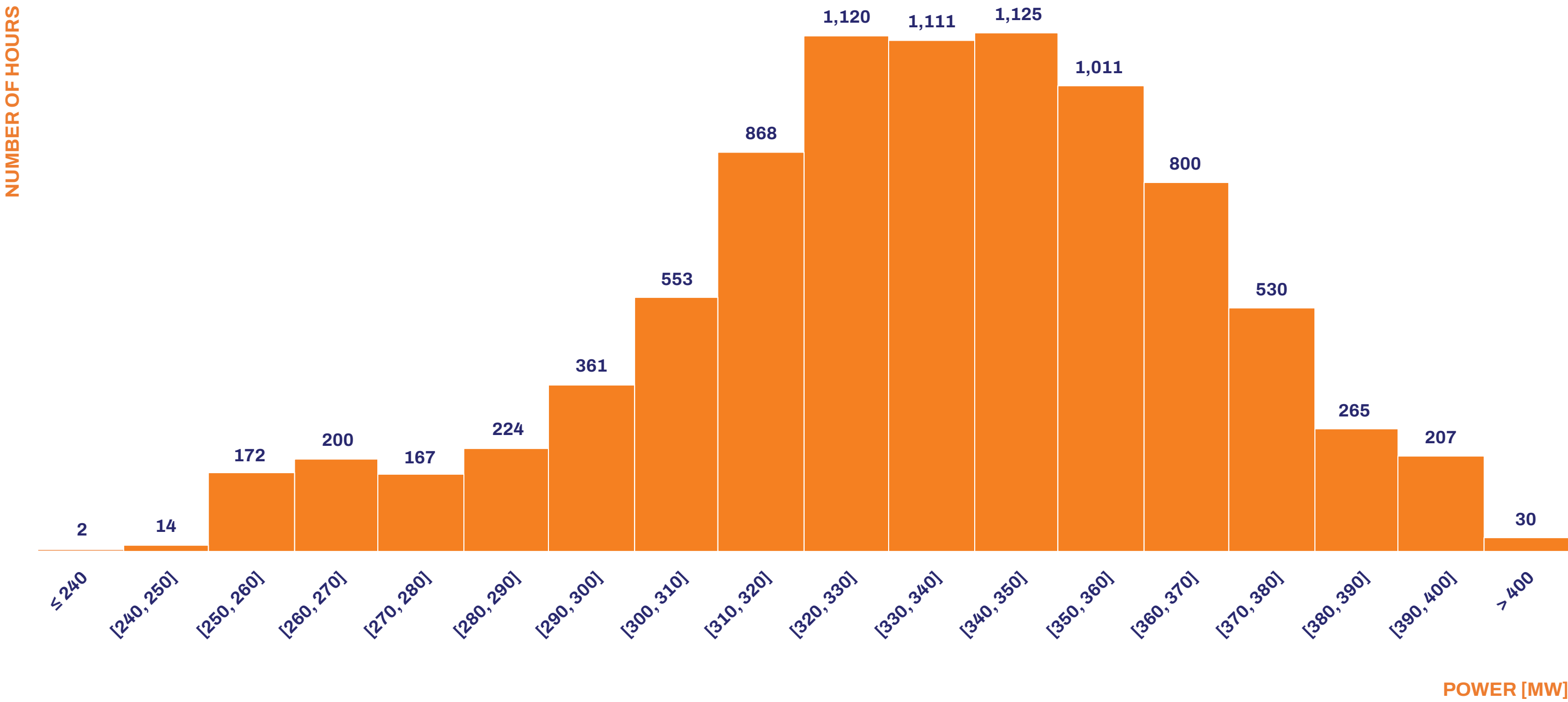


\*For representation purposes, the hours with operating load below 100 MW have been omitted.

# THE ELECTRICITY IN 2023



FIGURE 7.4 - YEARLY FREQUENCY DISTRIBUTION OF THE MEAN OPERATIONAL LOAD FOR BIOMASS, IN 2023.  
SOURCE: REN.

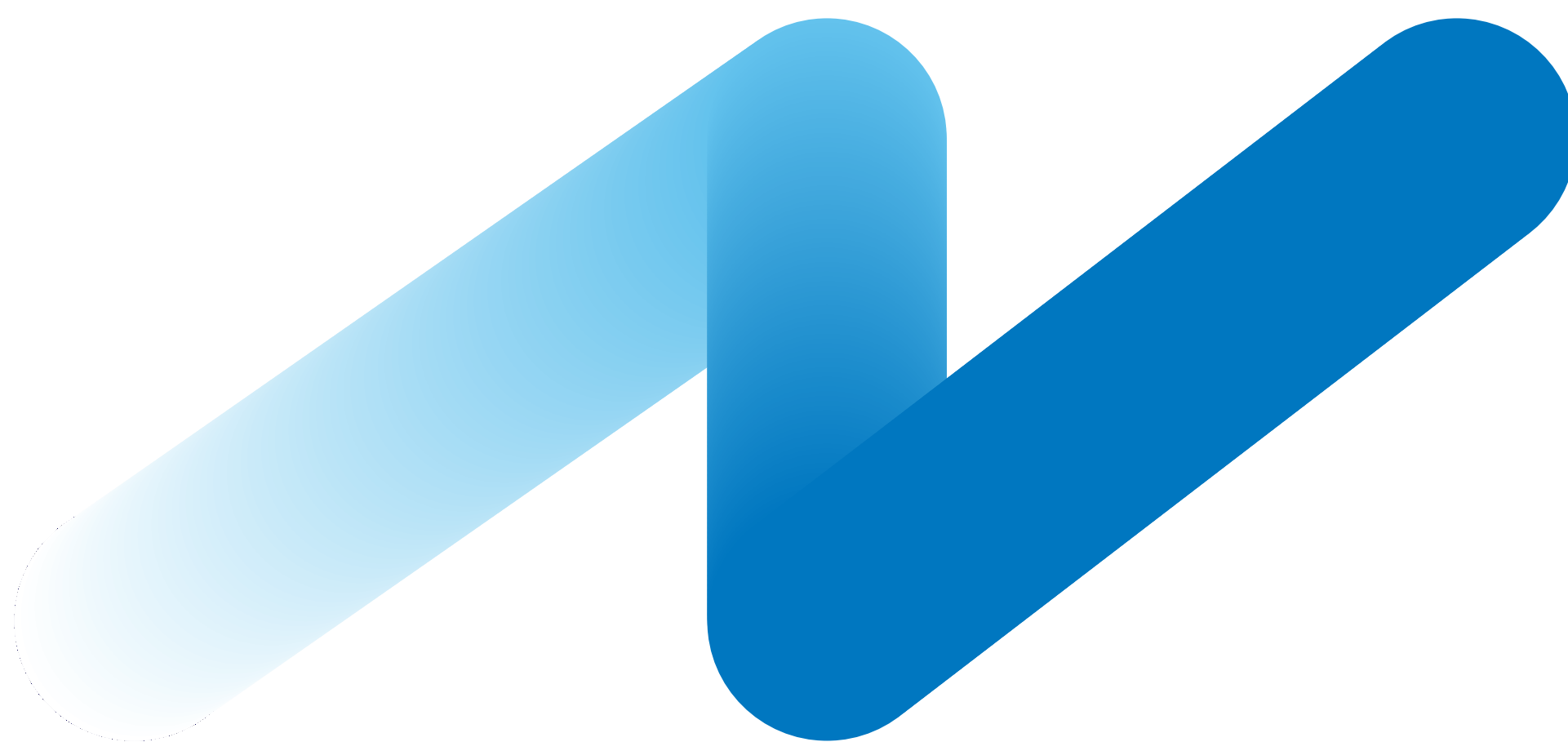


# THE ELECTRICITY IN 2023

Remarkably, 2023 ended with two months of high renewable productivity, with 80% of renewable share in the electricity production (83.4% in November and 81.3% in December), which allowed for a total of 1,015 non-consecutive hours on 100% renewables. This was the result of considerable hydro and wind productivity, demonstrating the high resilience of the national electricity system when facing larger levels of renewable integration.

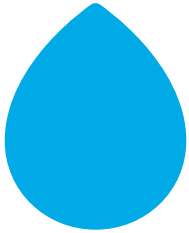
The seasonality and complementarity between different renewables in 2023 can be grasped through the following figures:

- hydro production performed best in the months of January, November and December (with an operation regime above 3,000 MW for 75% of the time in January), in utter contrast to May, July, and August ([Figure 8.1](#));
- wind's mean operating load, on the other hand, was located slightly above 1,000 MW, topping up to 2,000 MW in the autumn and winter, whereas it is more consistent and lower during the summer ([Figure 8.2](#));
- solar photovoltaics operated longer and at higher load rates during spring and summer, especially in July and August, when the mean stayed above 500 MW, as consequence of the circadian cycle ([Figure 8.3](#)). To attend also on the greater number of daytime hours than nighttime from March to September portrayed by the positive median;
- biomass was steadily operating at a reduced capacity range that is typical of a baseload profile, with a mean of around 330 MW ([Figure 8.4](#)).

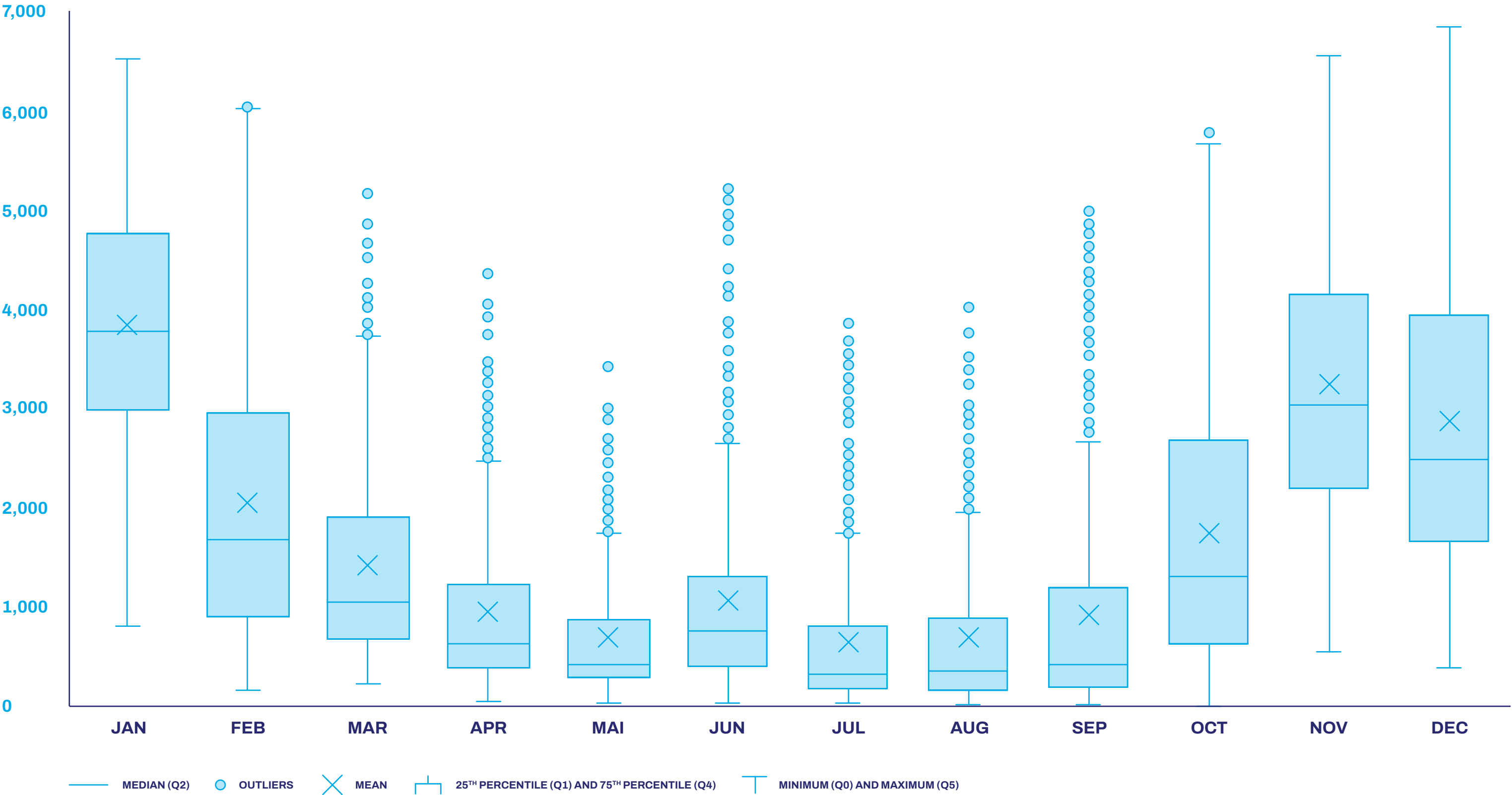


# THE ELECTRICITY IN 2023

FIGURE 8.1 - MONTHLY DISTRIBUTION OF THE HOURLY MEAN OPERATIONAL LOAD FOR HYDRO, IN 2023.  
SOURCE: REN.



POWER [MW]

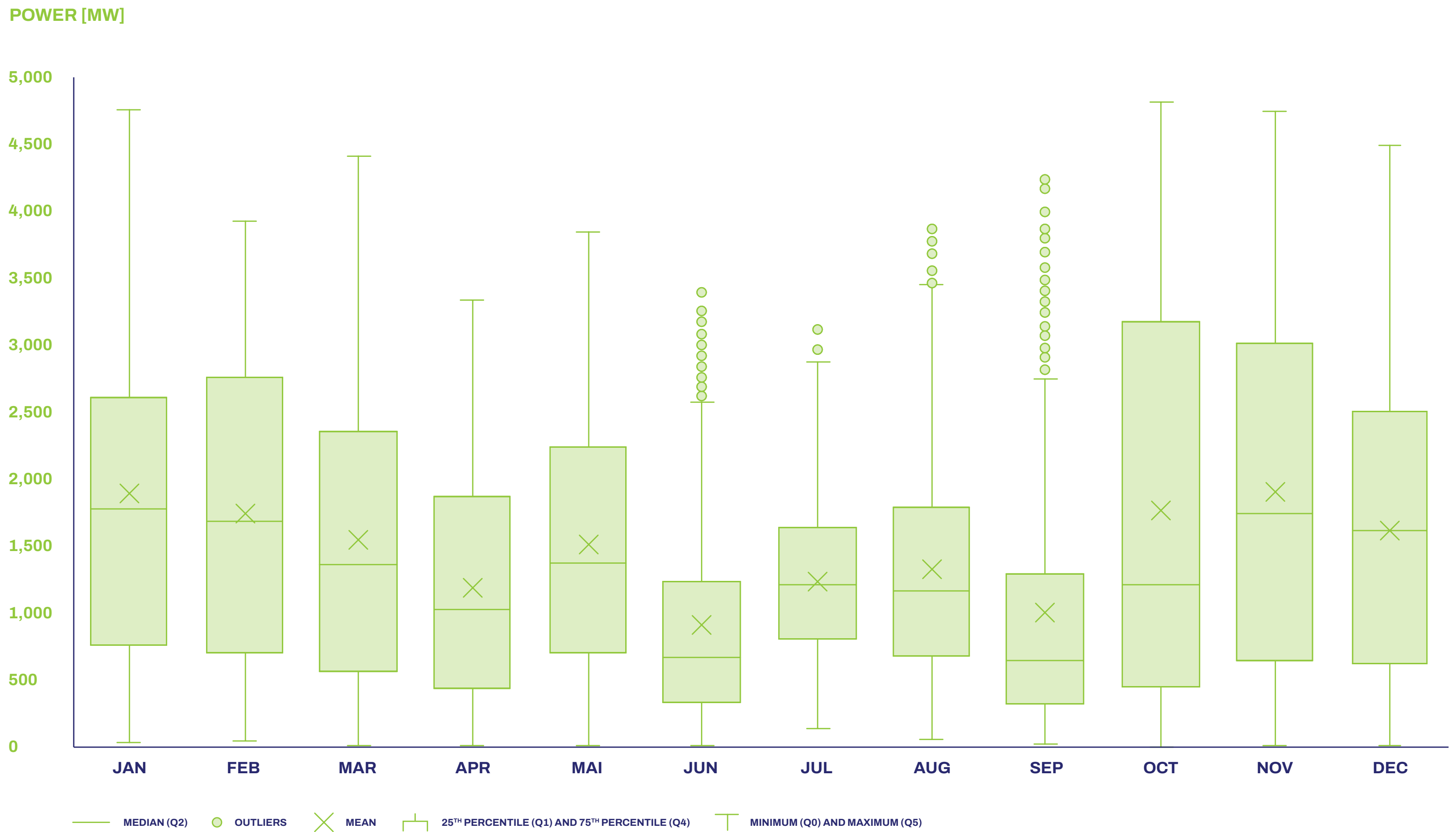




# THE ELECTRICITY IN 2023



FIGURE 8.2 - MONTHLY DISTRIBUTION OF THE HOURLY MEAN OPERATIONAL LOAD FOR WIND, IN 2023.  
SOURCE: REN.



# THE ELECTRICITY IN 2023



FIGURE 8.3 - MONTHLY DISTRIBUTION OF THE HOURLY MEAN OPERATIONAL LOAD FOR SOLAR IN 2023.  
SOURCE: REN, APREN ANALYSIS.

POWER [MW]

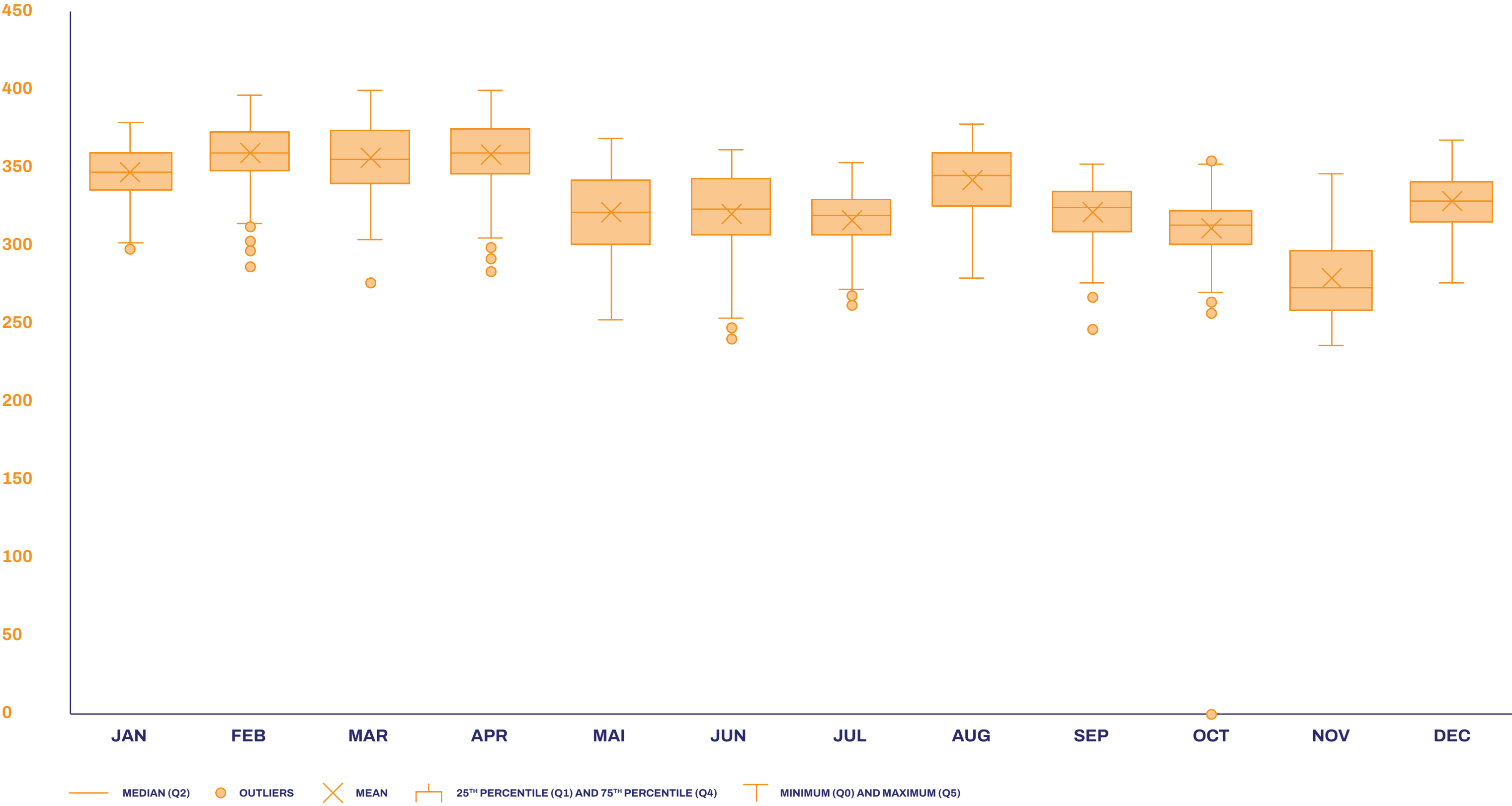


# THE ELECTRICITY IN 2023



FIGURE 8.4 - MONTHLY DISTRIBUTION OF THE HOURLY MEAN OPERATIONAL LOAD FOR BIOMASS, IN 2023.  
SOURCE: REN, APREN ANALYSIS.

POWER [MW]



# THE ELECTRICITY IN 2023

Figures 9.1 and 9.2 show the mean hourly capacity for all days in 2023. Again, the complementarity among renewables is apparent, with the hydro resource being scarcer in the hot months and the making use of its dispatchability very noticeable at the beginning and end of daytime (when electricity consumption increases rapidly). On the other hand, wind seems to be more consistent on an intra-day basis, with higher inter-day variation and lower resource in June and August (Figure 9.1).

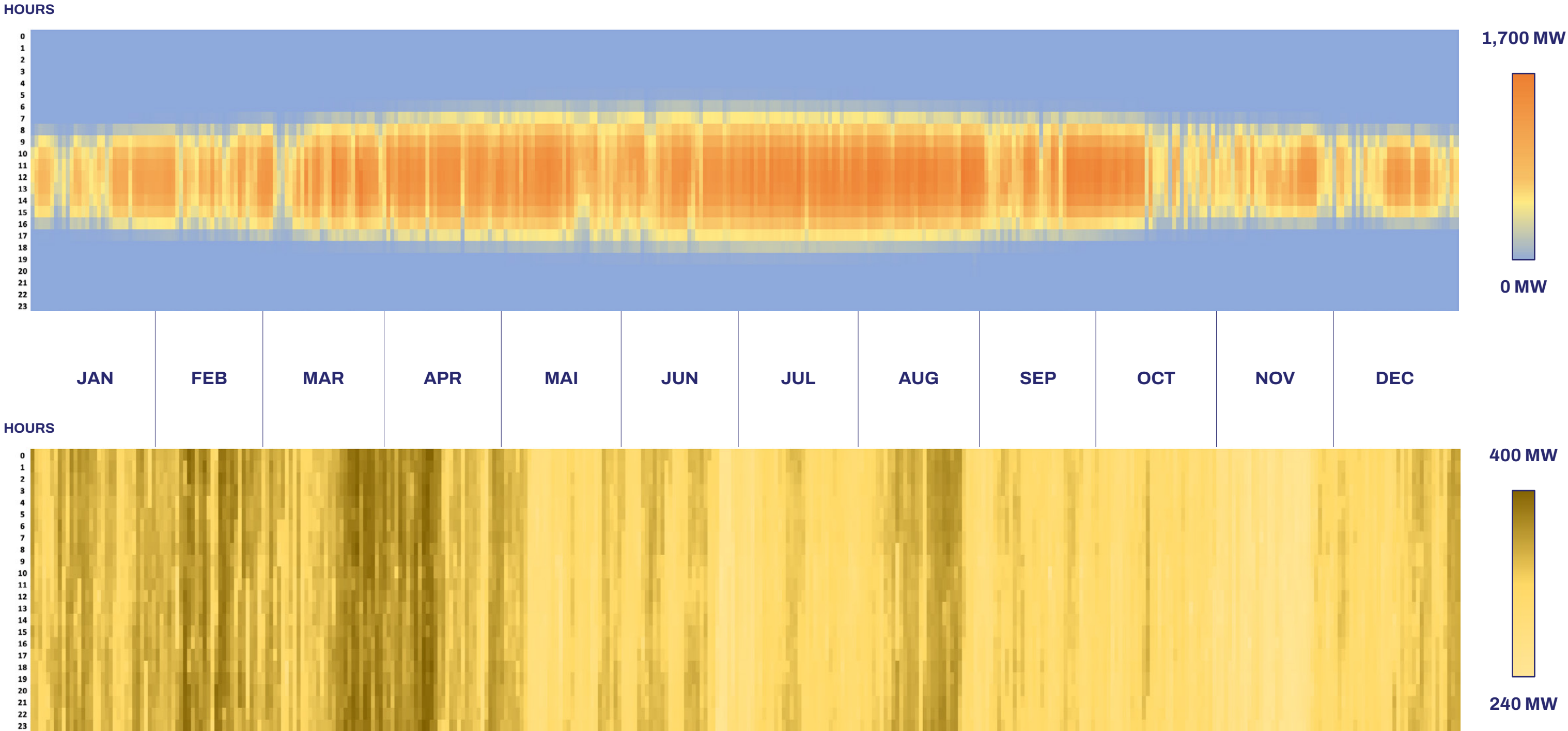
As for solar, it is evident the circadian cycle and the greatest operating capacity during the zenith, as well as the periods of residual production, associated with periods of cloudiness, or none, during the evening. The consistent regime of biomass production is also visible, with months of higher production that correspond to the harvest season, late winter, and spring, or to the storage of excess resource, late summer (Figure 9.2).

FIGURE 9.1 - HOURLY DISTRIBUTION OF THE MEAN OPERATIONAL LOAD, IN 2023, FOR HYDRO AND WIND, RESPECTIVELY.  
SOURCE: REN, APREN ANALYSIS.



# THE ELECTRICITY IN 2023

FIGURE 9.2 - HOURLY DISTRIBUTION OF THE MEAN OPERATIONAL LOAD, IN 2023, FOR SOLAR AND BIOMASS, RESPECTIVELY  
SOURCE: REN, APREN ANALYSIS.

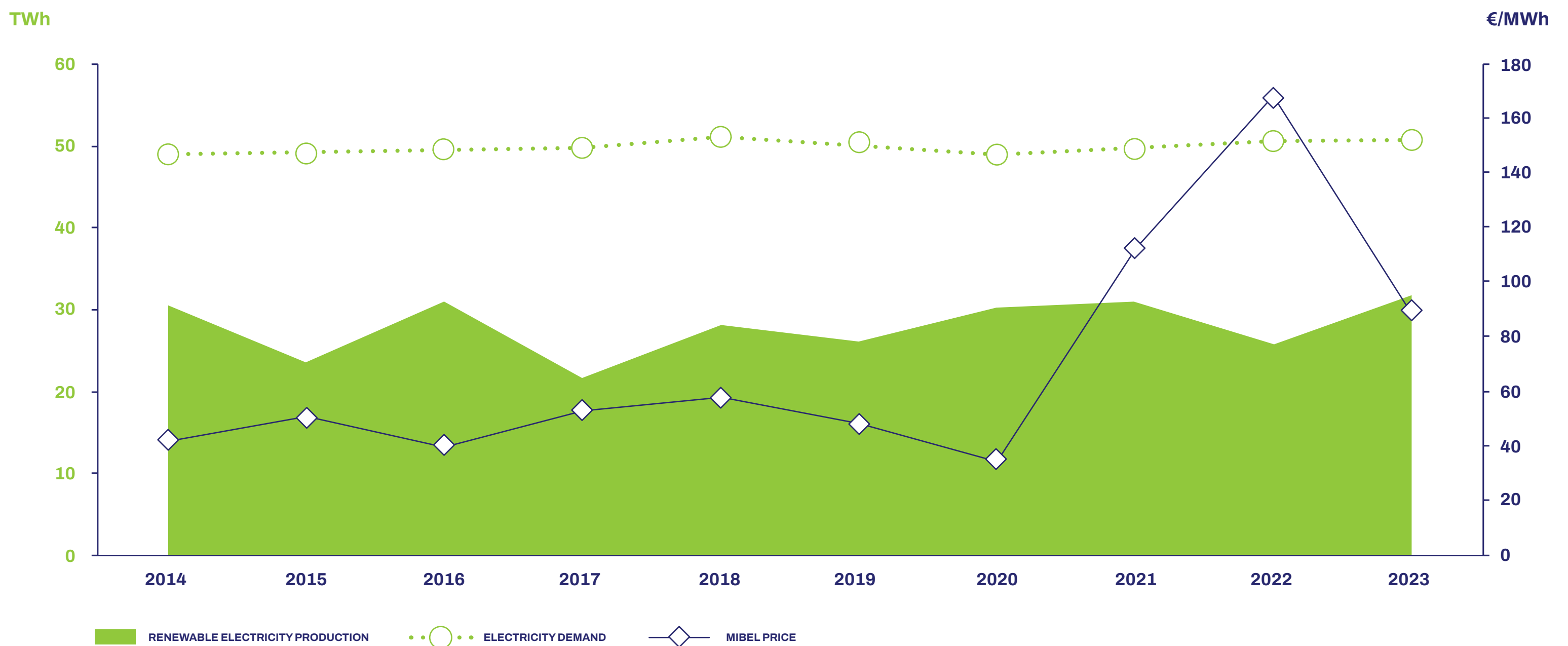


# ELECTRICITY MARKET 2023

In 2023, the average annual hourly price in the Iberian Electricity Market (MIBEL) was 88.3 €/MWh, a reduction of almost half compared to 2022's figures. For 9 months in the year, minimum prices of €0/MWh were experienced, except in February, June, and September.

Figure 10 shows the positive impact of renewable electricity production, which contributed to the decrease of the daily and intra-day hourly wholesale price. This aspect is quite explicit in the period between 2014 and 2017 and in 2019, whilst 2018 was an atypical year for the European Market and in 2020 the pandemic crisis was installed. In 2023, after the dramatic increase in prices, the inverse proportion between renewable production and wholesale prices seems to be resuming.

FIGURE 10 - MIBEL ELECTRICITY PRICE, RENEWABLE ELECTRICITY PRODUCTION AND ELECTRICITY DEMAND IN MAINLAND  
SOURCES: OMIE, REN, APREN ANALYSIS.



As for the renewable production, in 2023, it corresponded to 31.2 TWh, an all-time high. It is also worth mentioning the period of 6 days, between the 31<sup>st</sup> of October and the 6<sup>th</sup> of November, when renewable electricity exceeded the national demand, totalling 149 hours of an average market price of €19.17/MWh and a few hours minimum price equal to zero.

After increasing to 49.5 TWh, in 2021, having seen a reduction in 2020 due to the pandemic crisis, the electricity consumption reached 50.7 TWh in 2023. This represents a slight increase compared to 2022, when a restraint in consumption was felt due to the energy crisis, which reflects the return to activity levels from the pre-pandemic state.

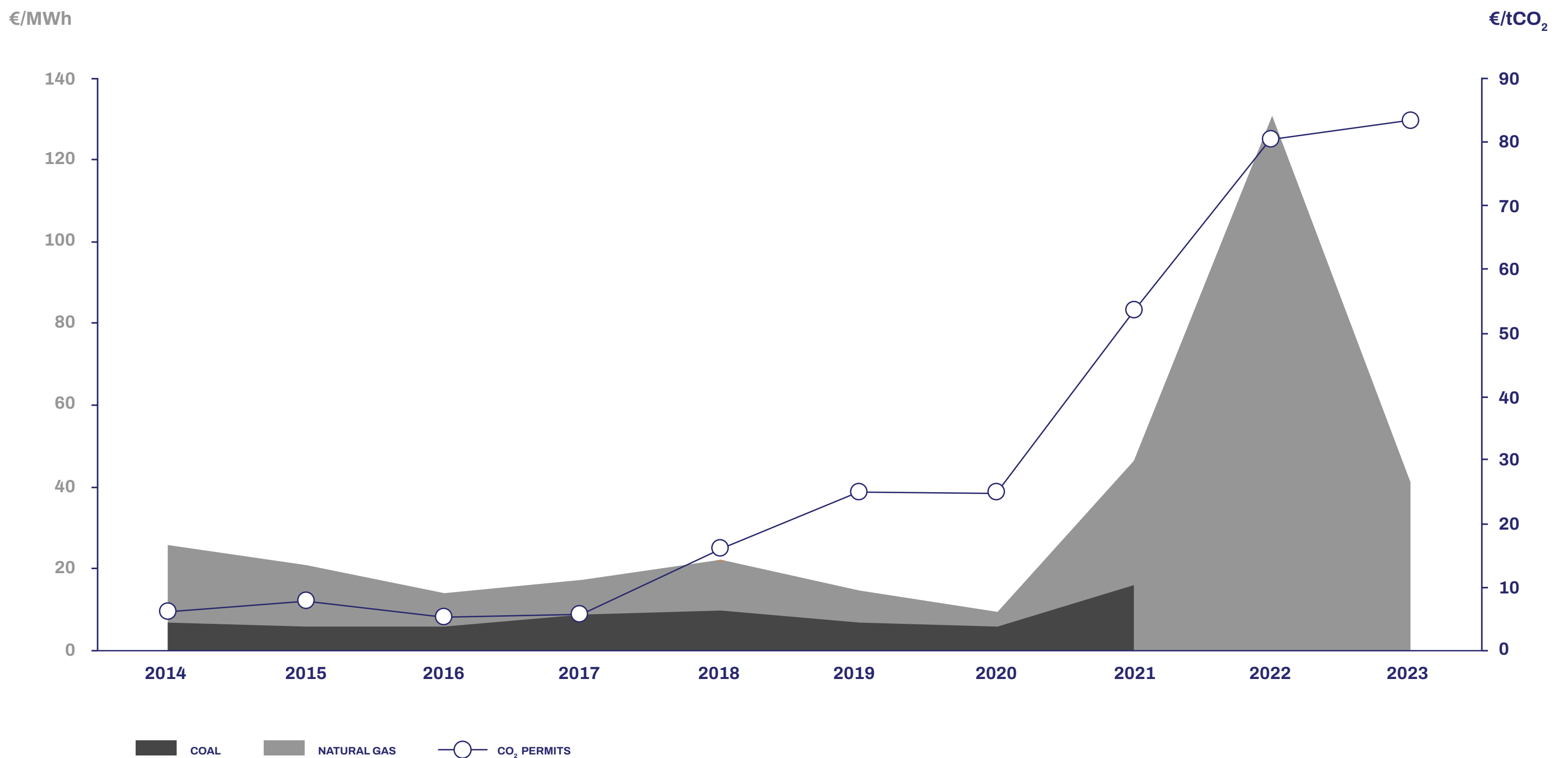
# ELECTRICITY MARKET 2023

In relation to the previous graph, Figure 11 shows the decrease in the price of natural gas to €41.3/MWh in 2023, much due to the gas-for-power price cap in the Iberian market.


On the other hand, the consistent increase in the price of CO<sub>2</sub> permits, since 2017, as part of the decarbonisation policies established at European level, also plays a key role in reducing the wholesale price of electricity. In 2023, the average price was 85.3 €/tCO<sub>2</sub>, having enabled savings in CO<sub>2</sub> permits of around 750 M€.

Focusing on the historical data, a relationship seems to occur, since 2018, between the price reduction of coal and CO<sub>2</sub> permits and the reduction in the MIBEL price, a period when the country was still very dependent on electricity produced in coal-fired plants. To be noted that from 2021 on no more coal-based electricity was produced.

FIGURE 11 - PRICE OF THE COMMODITIES: COAL, NATURAL GAS, AND CO<sub>2</sub> PERMITS, IN 2023.  
SOURCES: DGEG, THE WORLD BANK, SENDECO<sub>2</sub>, APREN ANALYSIS.



# ELECTRICITY MARKET 2023



Despite the dramatic reduction in the price of natural gas, the average price of allowances increased slightly in 2023, yet less pronouncedly than in previous years. This was due to both the contraction of economic activity at European level and, on the other hand, to the uncertainty in investments associated with the revision of the Green Deal, which updated the reduction target for GHG emissions in the EU Emissions Trading System (ETS) from 43% to 63% in 2030. Such context has led to a lower allocation of CO<sub>2</sub> permits by the industry and energy sectors in the ETS, along with the increase in renewable energy production capacity. It is expected that in 2024 the average price will stay around 70 €/tCO<sub>2</sub>, according to a study of January 2024 from CarbonPulse, and that it will continue to grow in the future. It is also important to mention that free permits allocated to sectors covered by the Carbon Border Adjustment Mechanism, in force since October 2023, will be phased out from 2027 onwards, so it is likely that additional pressure for the rise in CO<sub>2</sub> permits prices will originate from this mechanism as well.

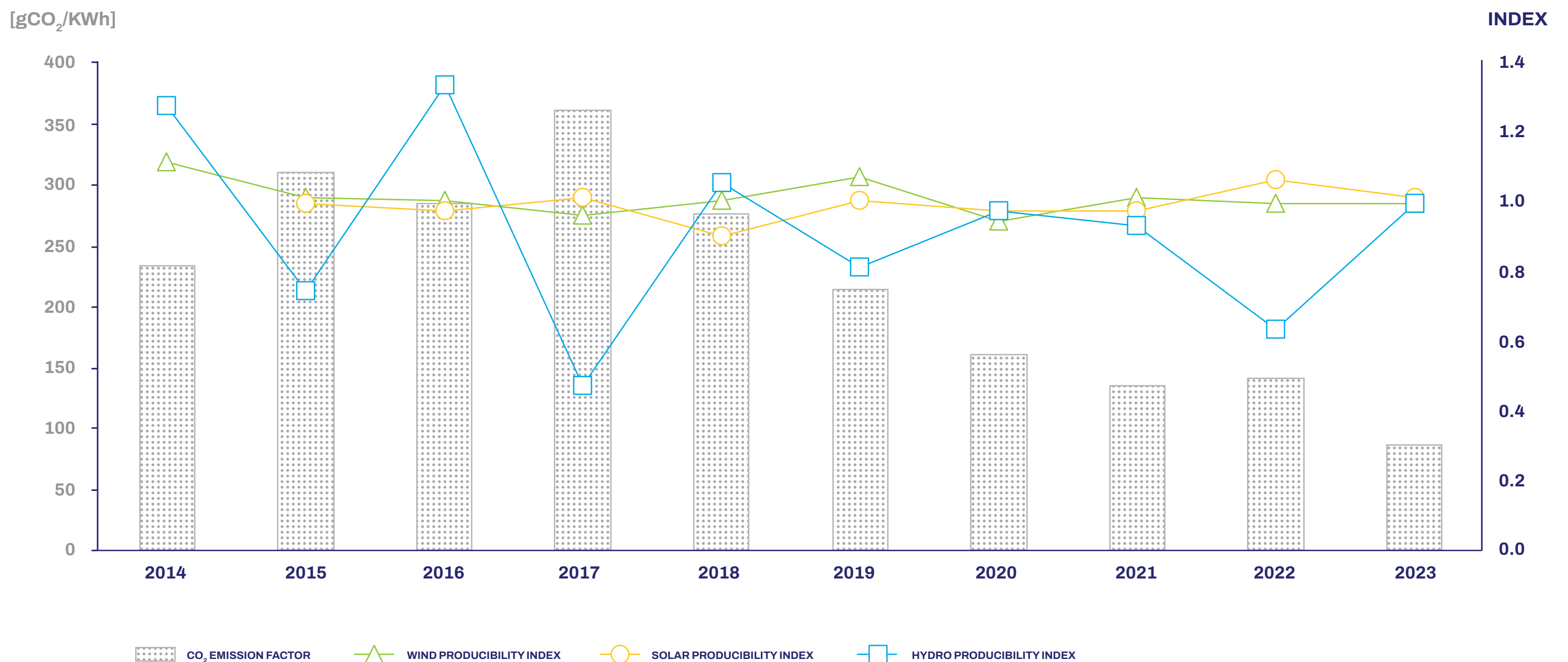


# ELECTRICITY MARKET 2023

In 2023, the electricity sector was responsible for the emission of 3.6 MtCO<sub>2</sub>eq, i.e. 42% less than in 2022, resulting from the improved renewable capacity and the greater share of renewables in the production of electricity, as well as the reduced operation of combined-cycle power plants.

Such emissions translated into 85.8 grams of CO<sub>2</sub> emitted by each kWh produced, which represents a significant decrease compared to the previous year, representing an all-time low. Consequently, 9.7 Mt of CO<sub>2</sub> emissions were avoided in 2023.

FIGURE 12 - CO<sub>2</sub> EMISSION FACTORS AND HYDRO, WIND AND SOLAR PRODUCIBILITY INDEXES, IN 2023.  
SOURCE: REN, APREN ANALYSIS.



As shown in Figure 12, the specific emissions from the electricity production sector have been declining since 2017, which was a very dry year that featured the lowest value of hydro production ever recorded (0.47), and the maximum specific emissions (360 gCO<sub>2</sub>/kWh) of the

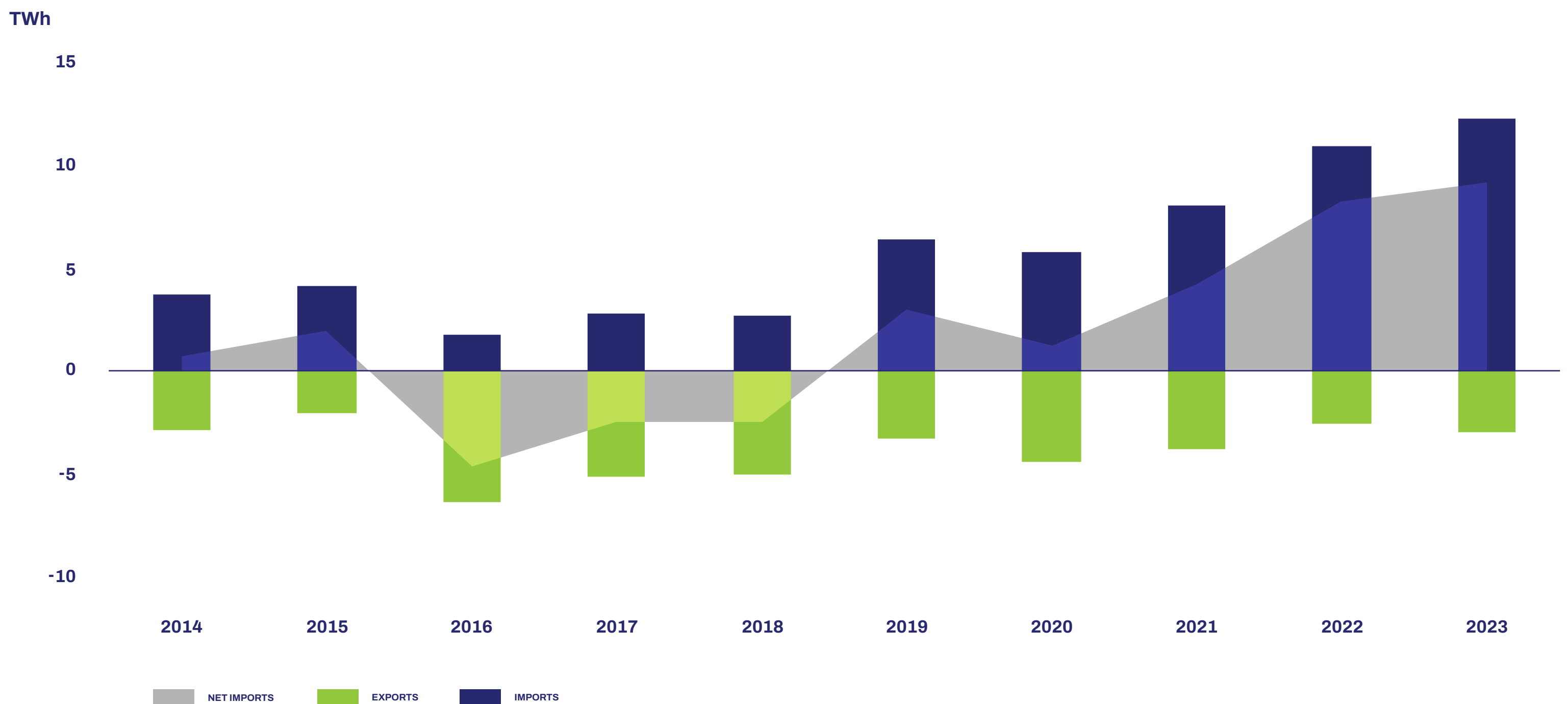
last decade. Conversely, 2023 was favourable in terms of water, wind, and solar resources, with producibility indexes of 0.99, 0.99 and 1.01, respectively.

# INTERNATIONAL TRADES IN PORTUGAL

Although the renewable production grew in 2023, the imports balance remained in the same order of magnitude as that of 2022. In fact, there was a slight increase of around 10% that translated into a total of 10.2 TWh, i.e. 13.5 TWh of imports and 3.3 TWh of exports, as shown in Figure 13.

The imports incurred prevented the production of non-renewable electricity with a greater impact on the nationwide emissions value. Still, despite the registered renewable share all-time high, which led to the decline in production from fossil fuels, it is considered that the imports balance was due to the increase in consumption, compared to 2022, making electricity imports more competitive in the Iberian market offers.

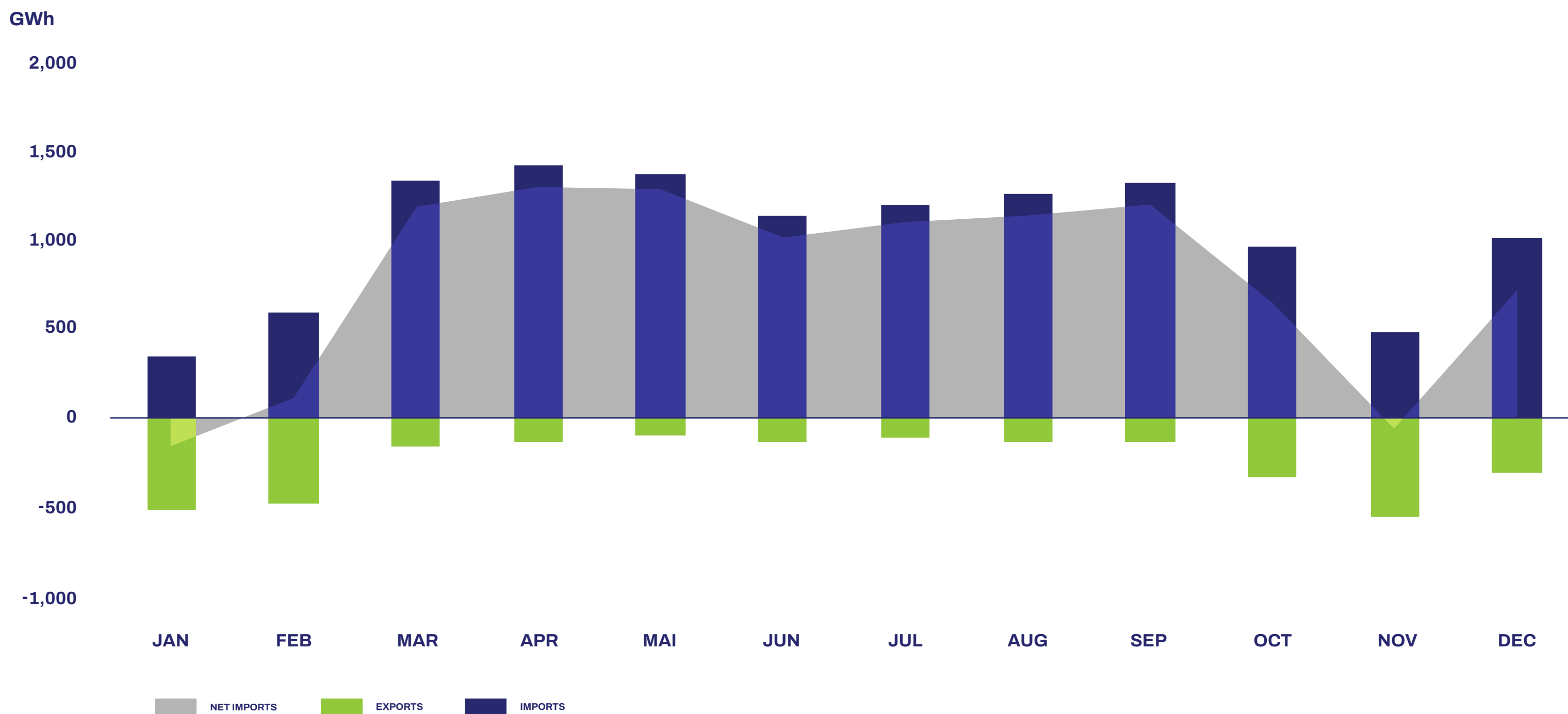
FIGURE 13 - INTERNATIONAL ELECTRICITY TRADE IN PORTUGAL BETWEEN 2014 AND 2023.  
SOURCE: REN, APREN ANALYSIS.



# INTERNATIONAL TRADES IN PORTUGAL

Zooming in the year 2023 (Figure 14), it can be observed that in January and November exports were higher than imports, mainly because of the favourable weather conditions for hydro and wind production, whereas in April the levels of imports topped up to 1,550 GWh. It is anticipated that, given the projected growth in its capacity, solar production will have a strong impact on these balances, especially in the sunnier months. To note that the massive renewable contribution in 2023 contributed to savings in the imports of: fuels fossils, around 1,950 M€; and electricity, around 626 M€.

FIGURE 14 - MONTHLY INTERNATIONAL ELECTRICITY TRADE IN PORTUGAL, IN 2023.  
SOURCE: REN, APREN ANALYSIS.



# OUTLOOK FOR 2024

The year of 2023 closed with favourable figures, yet the largest challenges in the sector have seen limited progress and raised uncertainty concerning the development of new projects. The figures for last year were mainly the result of a **favourable hydro regime** and the **increase in the solar capacity** in operation, as can be seen in the mapping of Figure 15. The predominance of solar technology is evident in the centre-south of the country, while wind and hydro are more pronouncedly present in the centre-north.

The optimistic scenario experienced in 2023 is, however, below the ideal conditions to achieving the level of **decarbonisation** and **competitiveness** required for the Portuguese economy, both based on the energy transition, key to ensuring a secure, predictable, and competitive **energy system**. This will also foster a reduction in costs for the end-user and reduce vulnerability and exposure to geopolitical tensions.

It is, therefore, necessary to implement and operationalise the sector's strategies and regulations, creating visibility to the completion of the projects and ensuring that the attractiveness of private capital is kept up.

Despite the several legislative revisions, essential conditions remain to be put in place, namely in the permitting of projects, regarding digitalisation, streamlining of procedures, and reduction of contact points. The urge for grid planning, construction, expansion, and management, in line with the needs for the integration of greater renewable capacity, have not yet been addressed accordingly. Finally, it is also urgent for the involved **entities to readapt**, considering today's and future needs.

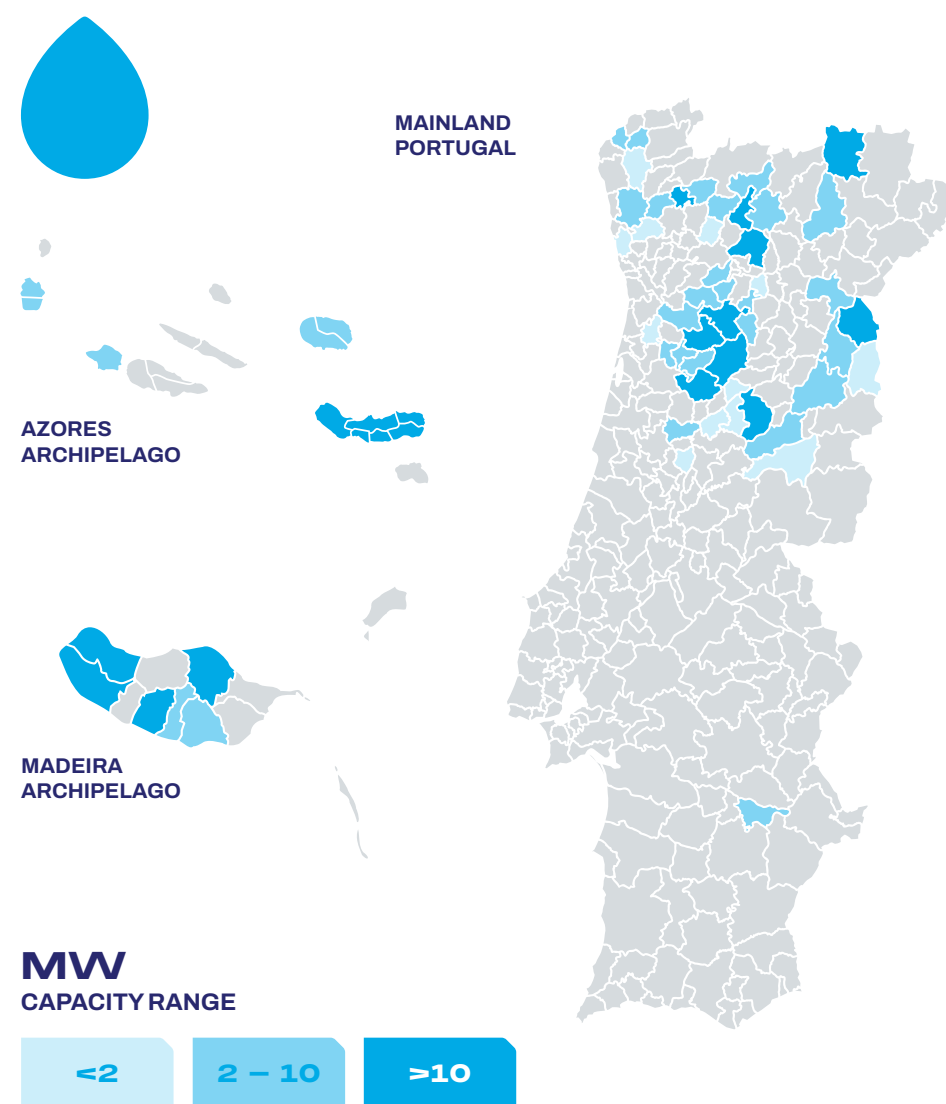
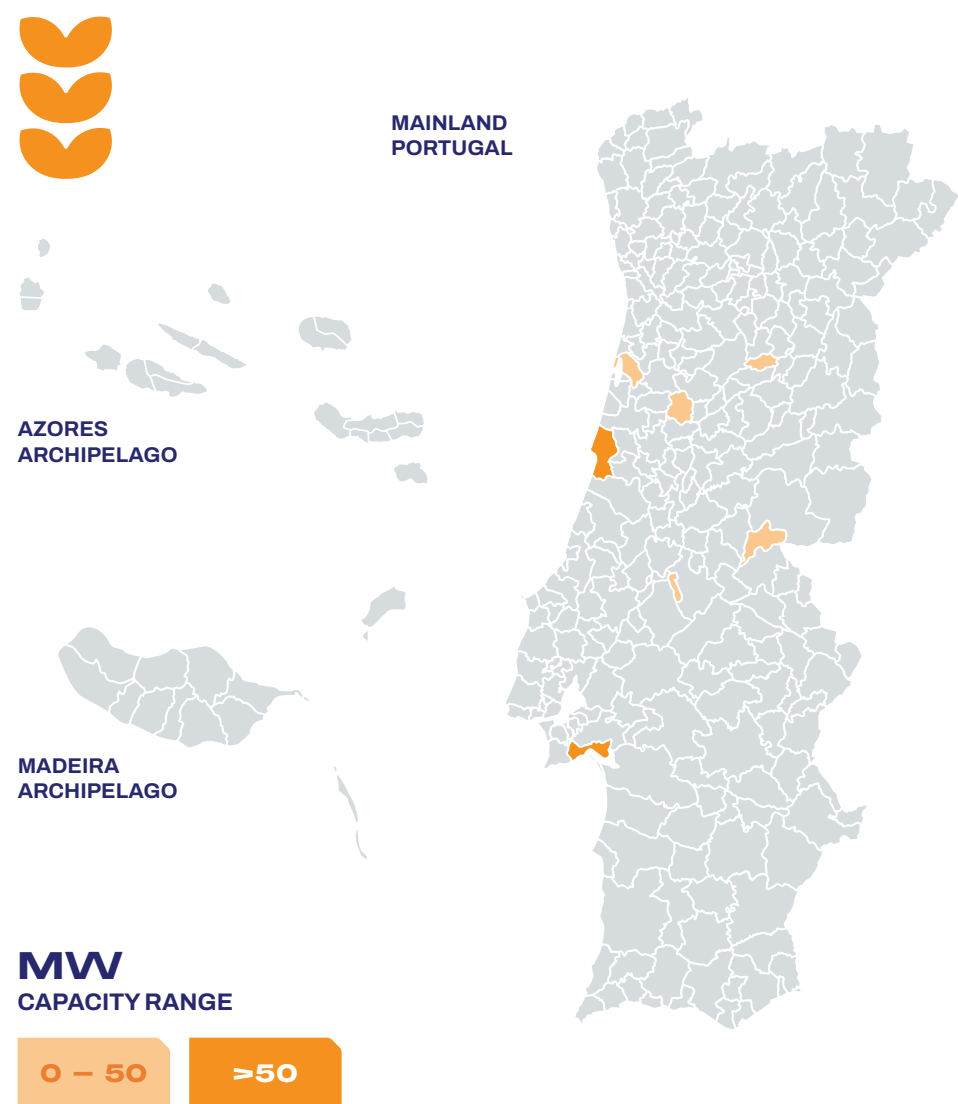
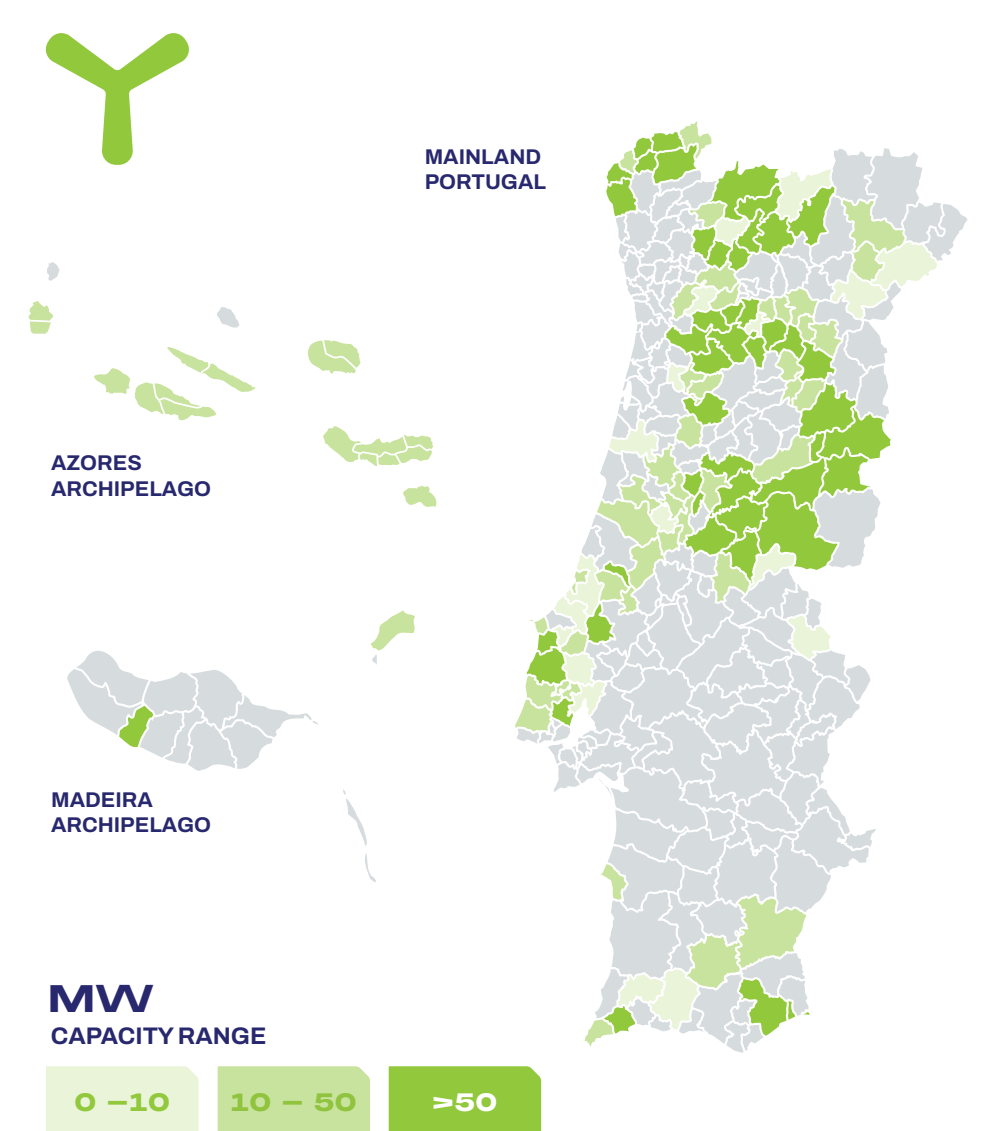
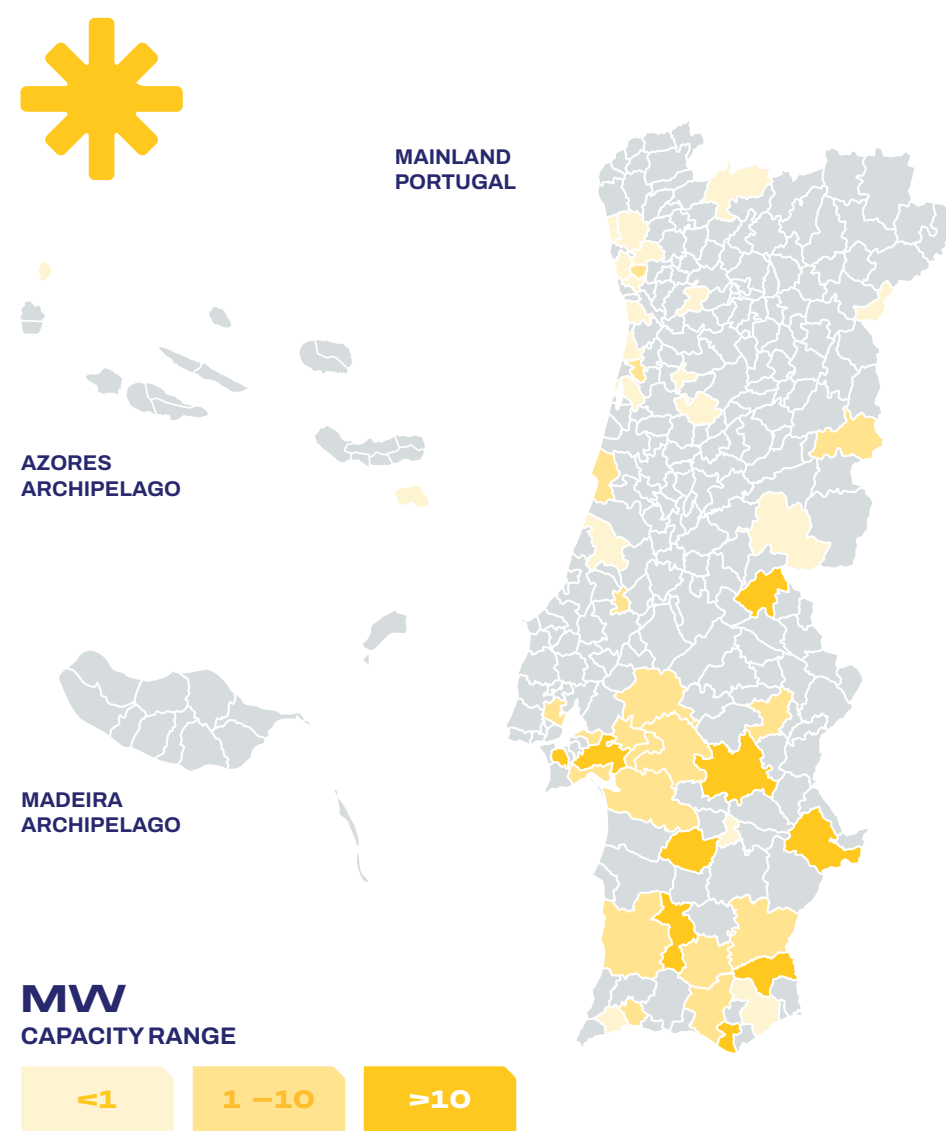
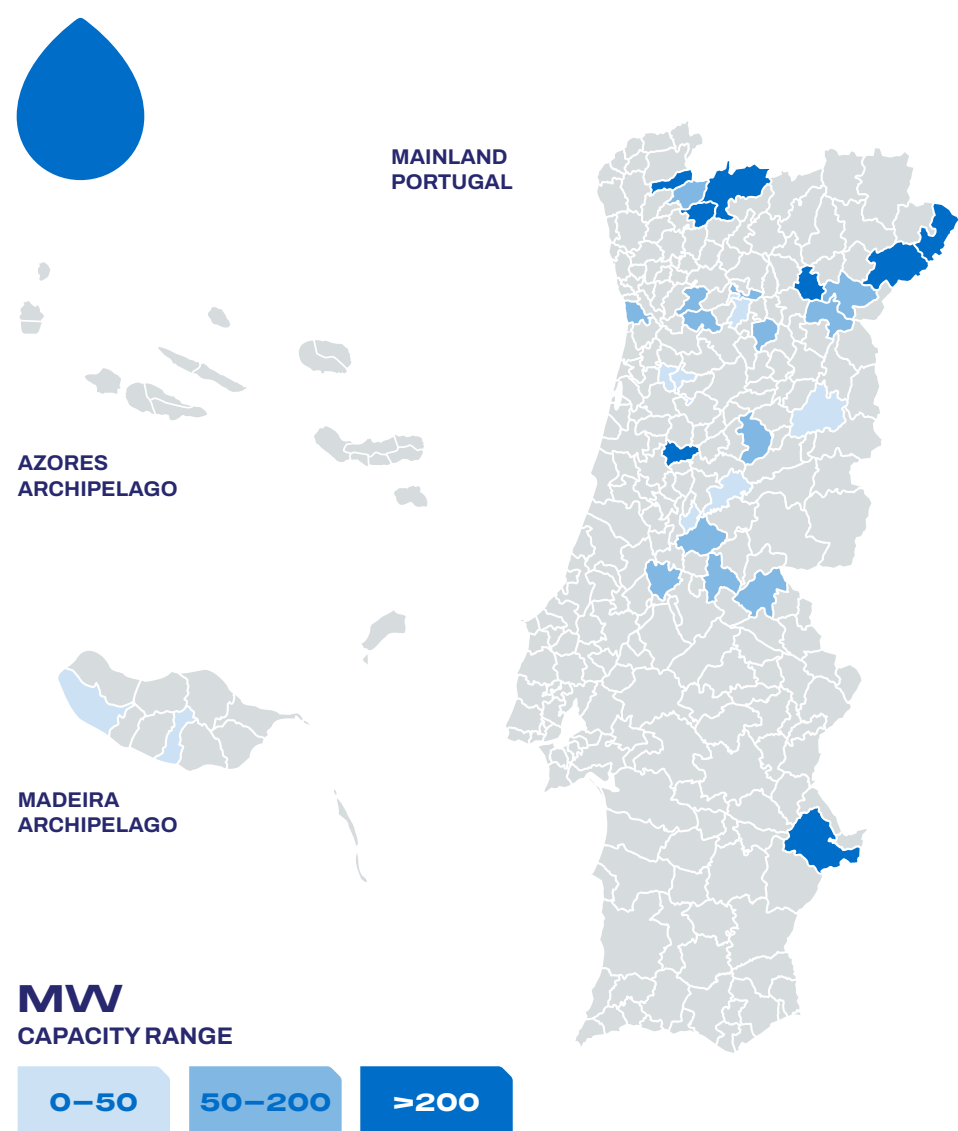
In the current economic context of **high inflation** and a more restrictive monetary policy, an additional **uncertainty** concerning future investments has been experienced. Moreover, the electricity market has encompassed much more **volatile** price predictions, with special **impact on the renewable sector** that is characterised for its capital-intensity and negligible variable costs.



In the horizon 2024, the following milestones arise:

- the creation of **stability mechanisms**, as pointed out in the electricity market reform, combined with the predictability of the project's timings, safeguarding the investment decisions;
- **private investment** for value creation in the renewable electricity sector, which, with a regulatory framework capable of providing stability and visibility needed for the implementation of the current strategy, will be able to create more than 200,000 direct and indirect jobs, and to contribute to the country's wealth in 5.9% of the GDP by 2030.

FIGURE 15 - GEOGRAPHIC DISTRIBUTION OF THE ELECTRICITY POWER PLANTS OWNED BY APREN'S ASSOCIATES.  
 SOURCE: APREN YEARBOOK 2023. (NOTE THAT THE MAPPING DOES NOT REFLECT THE TOTAL NATIONAL CAPACITY).



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