
Renewable Energy in the Spanish Electricity System

2020



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Glossary of terms:

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Information prepared with data available as at 11 April 2021

Published by

RED ELÉCTRICA DE ESPAÑA

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Coordination of publication

Corporate Image and Brand Department

Technical management

Department of Access to Information on the Electricity System

Graphic design and layout

EUROPUBLIC

Other details of the publication

Date of publication: June 2021

English Translation by

Wayman English International

www.waymanenglish.com

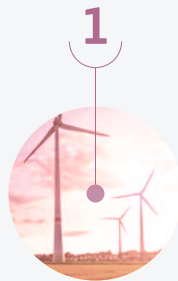
This English version is a translation of the original and authentic Spanish text found in the 'Las Energías Renovables en el Sistema Eléctrico Español 2020' report, originally issued in Spanish. In the event of discrepancy, the original Spanish language version shall prevail.

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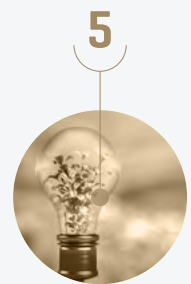
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Presentation

During 2020, in an energy scenario marked by the outbreak of the COVID-19 pandemic, the European institutions have continued to make progress in the energy transition by submitting various proposals that address the European Green Deal, a cross-cutting package of actions that proposes a new strategy to achieve a prosperous and just society, based on an efficient economy regarding the consumption of resources and which sets the goal of achieving climate neutrality in 2050. In order to move forward in the achievement of this goal, the European Union revised the reduction target it had initially set for 2030, compared with 1990 levels, and increased it to 55%. This new target was endorsed by the European Council in December 2020.

The European Commission, in addition to presenting legislative proposals, has published important strategies that aim to develop technologies that favour decarbonisation and that will complement conventional renewable energy in order to guarantee supply in the most economically efficient way.

In this context, the electricity sector has an important role to play in decarbonisation and in the energy transition and the Red Eléctrica Group, as a central player in the electricity system, is a key agent in the change of the energy model whose main elements must be the electrification of the economy, the maximum integration of renewables in the energy mix and efficiency, while guaranteeing security of supply at all times.

The success of this energy transition will be based on connecting renewable resources to the transmission grid at the required rate. One example was the high number of grid connections for renewable resources that took place in the last two years. During 2020, our entire power generation fleet incorporated nearly 4,800 MW of new installed renewable power capacity. In addition, energy storage and cross-border connections are key instruments to ensure the integration of renewable energy.

In order to enable the operation of an electricity system with such a high penetration of renewable energy under safe conditions, the control and supervision work carried out by Red Eléctrica's Control Centre of Renewable Energies (CECRE) is essential. In this regard, since its creation in 2006, CECRE has been a pioneering centre of worldwide reference, and is currently a key tool in the energy transition process.

Society's interest in learning more about the importance of the measures taken to combat climate change and the evolution of electricity generation using renewable technologies, together with our commitment to be a benchmark in the reporting of statistical information regarding electricity in Spain, has prompted us, for the fifth consecutive year, to present this 'Renewable energy in the Spanish electricity system' report; a publication that provides a high-level overview of how renewable energy has been managed, integrated and used in the Spanish electricity system in 2020, as well as how renewables have evolved over recent years.

This report begins with the chapter 'Renewable Energy in 2020', which consolidates the data on all renewables in order to give the reader a comprehensive overview of how renewables have fared throughout the year and their contribution to the overall generation mix.

This document provides a breakdown of the data regarding wind, water, sun, earth and sea energy. Additionally, the report is supplemented by data files that may be downloaded in various different formats. This information is available in the [REData](#) section of the corporate website: www.ree.es/en, together with other publications and statistical series that Red Eléctrica periodically makes available to the general public for their consultation and use.

As part of its continued effort to improve, Red Eléctrica's aim is to offer a quality service for all users. To this end, a contact form has been made available in the REData section of the corporate website, as a channel through which suggestions and observations may be submitted.

NOTE: Each chapter of this report additionally provides a comparison between ENTSO-E member states regarding renewable power capacity and generation. Comparisons are based on information that is publicly available on the ENTSO-E Transparency Platform. The information used is governed by Regulation [EU] No 543/2013, which establishes the common and standardised criteria that must be followed by member states when submitting data. For this reason, discrepancies exist with specific data regarding power capacity and generation data published in the Spanish Electricity System and Renewable Energy reports. With regard to power capacity, the data extracted from the aforementioned platform includes generation units with an installed power capacity equal to or greater than 1 MW and refers to power capacity available for System Operation. The differences in generation are due to the use of consolidated measurement data at a national level in the drafting of said reports.



1

Renewable energy in 2020

The power capacity of Spain's renewable generation fleet reached 59,860 MW at year-end and 44% of total generation in 2020 was produced with renewables, both values represent all-time highs.

During 2020, with an energy landscape marked by the COVID-19 pandemic, in Spain there was an 8.7% increase in installed renewable power capacity compared to the previous year, which represented a growth of 4,782 MW. Renewable energy facilities account for 54% of the power generation fleet in Spain.

This increase in installed renewable power capacity was mainly due to the growth in solar photovoltaic, which accounted for 61.3% of the new power capacity. Wind power contributed an additional 1,802 MW and for the first time surpassed the installed power capacity of combined cycle.

110,566 GWh

RENEWABLE ENERGY GENERATION



44 %

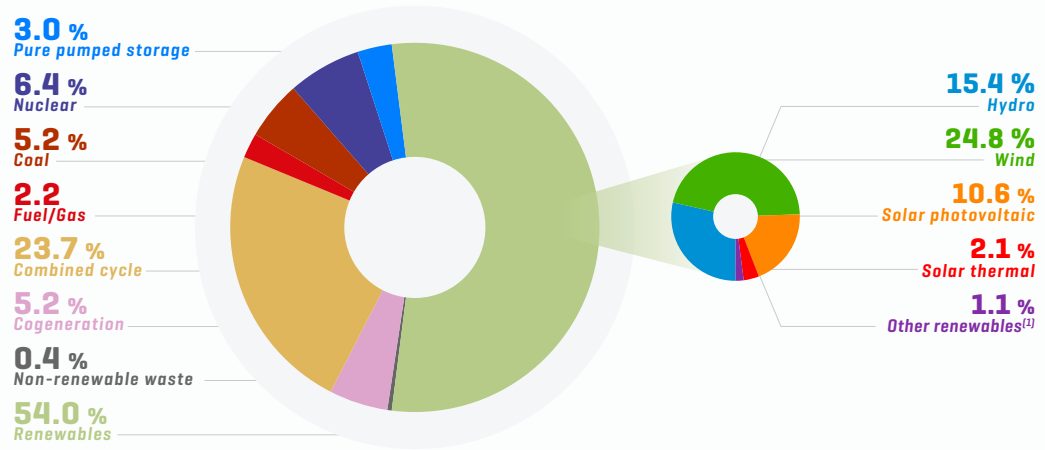
OF TOTAL GENERATION



The increase in installed renewable power capacity was mainly due to the growth in solar photovoltaic, which accounted for 61.3% of the new power capacity.

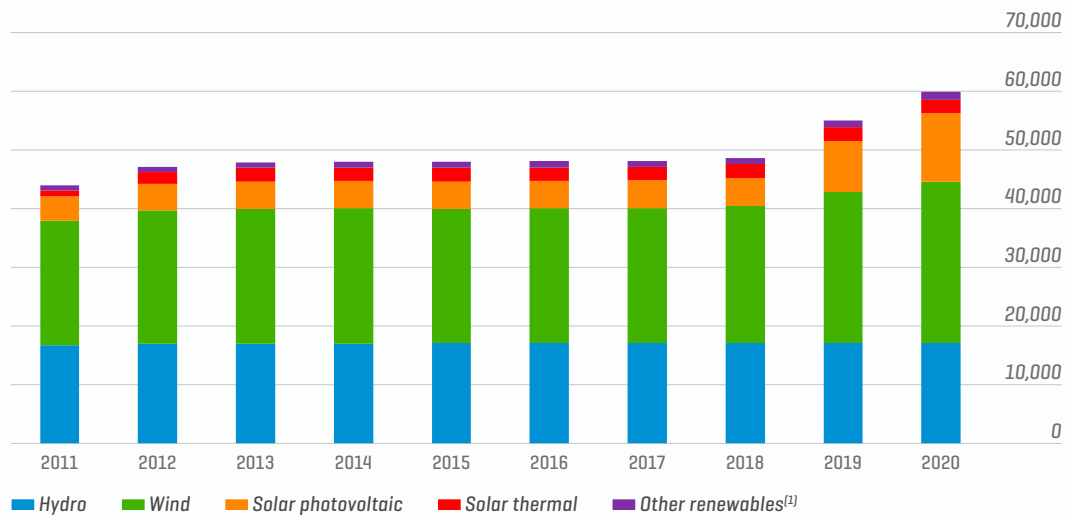


Breakdown of installed power capacity as at 31.12.2020. National electricity system %



[1] Includes biogas, biomass, geothermal, marine-hydro, wind-hydro and renewable waste.

Evolution of installed renewable power capacity. National electricity system MW



[1] Includes biogas, biomass, geothermal, marine-hydro, wind-hydro and renewable waste.

Source: Spanish National Markets and Competition Commission (CNMC) until 2014.

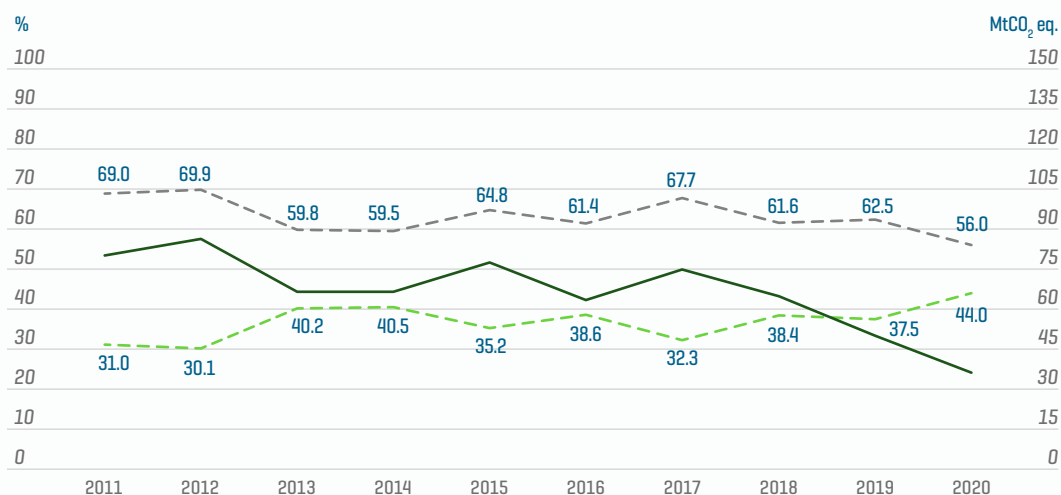


The contribution of renewable energy to national electricity generation in 2020 has set a new all-time high, reaching a share of 44% in the electricity generation mix, 3.5 percentage

points higher than the previous all-time high recorded in 2014, when renewables accounted for 40.5% of the electricity generation mix nationwide.

Evolution of renewable/non-renewable generation and CO₂eq emissions associated with electricity generation. National electricity system.

% and tCO₂eq



- Renewables: hydro, wind-hydro, wind, solar photovoltaic, solar thermal, renewable waste and other renewables.
- - - Non-renewables: nuclear, coal, fuel/gas, combined cycle, cogeneration, pumped storage and non-renewable waste.
- Emissions [tCO₂ eq.]

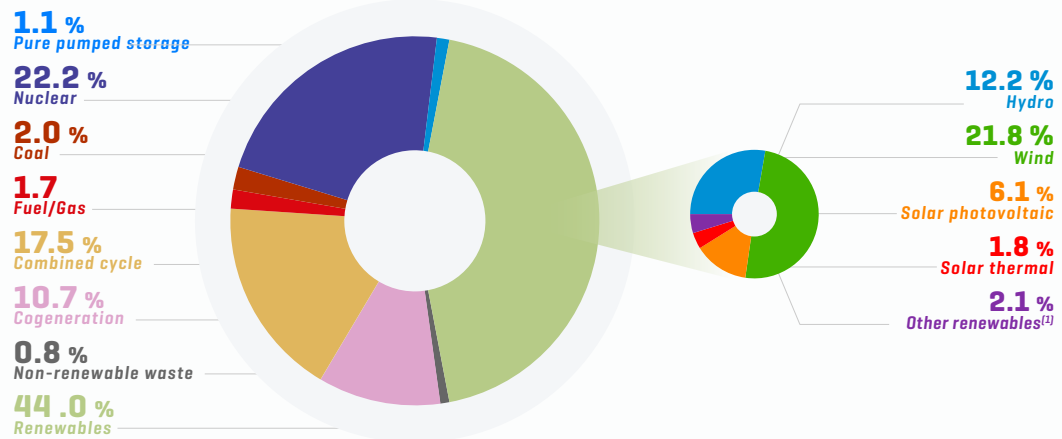
This higher share of renewable energy generation in 2020 is mainly due to the increase in hydro and solar photovoltaic power production, 23.8% and 65.2% respectively, compared with the previous year. These values were the result of favourable weather conditions and the increase in installed renewable power capacity in the national electricity system.

In addition to the significant increase of 12.9% in renewable generation nationwide, the 60.4% decrease in coal-fired generation in 2020 meant that CO₂ equivalent emissions associated with electricity generation reached an all-time low of 36 million tonnes of CO₂ equivalent, 27.8% lower than in 2019 and 67.5% below the emission levels registered in 2007.



Breakdown of the electricity generation mix in 2020. National electricity system

%



[1] Includes biogas, biomass, geothermal, marine-hydro, wind-hydro and renewable waste.

Wind power continues to be the most important renewable technology in the national generation mix, accounting for 21.8% of the total production, the highest annual share recorded to date, and ranking second in the generation mix, only behind nuclear, whose share stood at 22.2%.

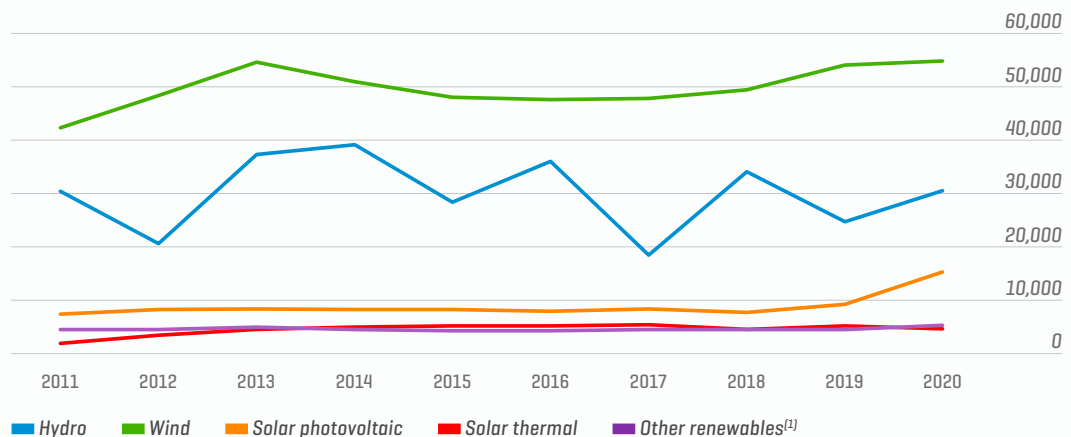
Production from wind power continued to grow for the fourth consecutive year, with a variation in 2020 of 1.2% compared to 2019.

In total, 54,899 GWh were produced with this technology, also reaching a new all-time record for wind power generation, 0.3% higher than the previous maximum record registered in 2013.

During 2020, solar photovoltaic facilities increased their installed power capacity nationwide by 33.4% and produced 65.2% more than in 2019, reaching 15,289 GWh, which represented a new annual generation record and a 6.1% share of the peninsular generation mix.

Evolution of renewable energy generation. National electricity system

GWh



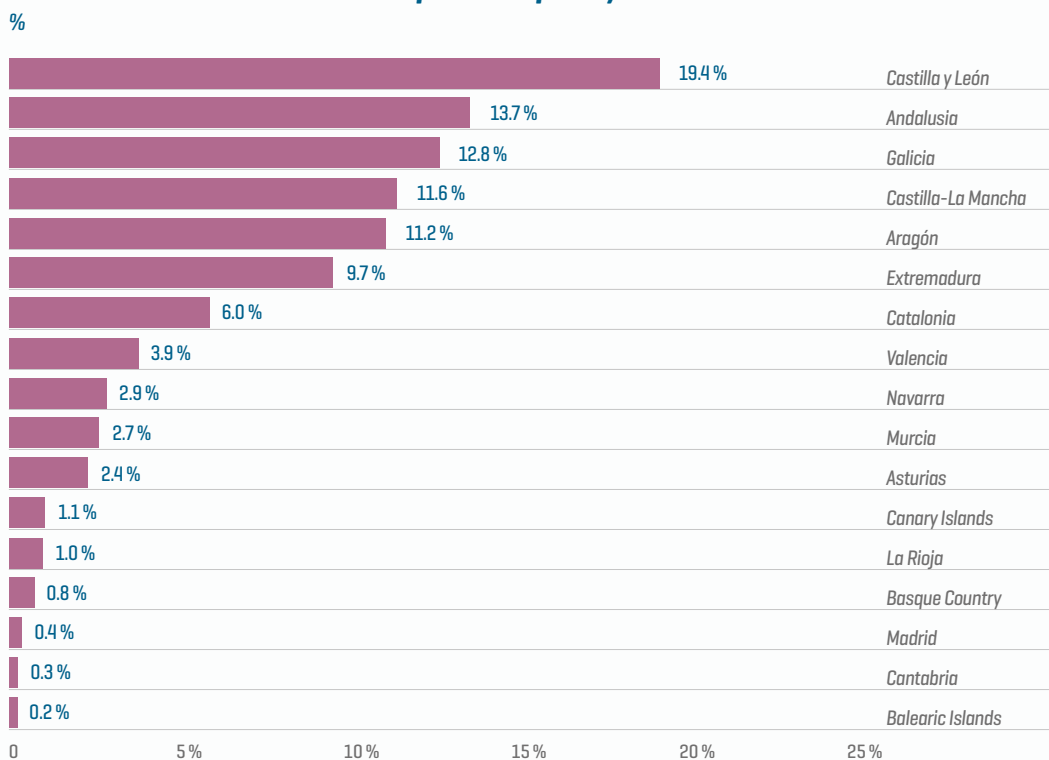
[1] Includes biogas, biomass, geothermal, marine-hydro, wind-hydro and renewable waste.



From the point of view of the autonomous communities (regions in Spain), most of the installed renewable power capacity is located in four regions, Castilla y León, Andalusia, Galicia and Castilla-La Mancha, which account for almost 57.6 of the total installed renewable power capacity nationwide.

Regarding the national electricity system as a whole, Castilla y León stands out as the autonomous community with the most installed renewable power capacity, with 95% of its power generation fleet being renewable, followed by Castilla-La Mancha with 75%.

Share of the installed renewable power capacity per Autonomous Community in relation to national renewable power capacity as at 31.12.2020

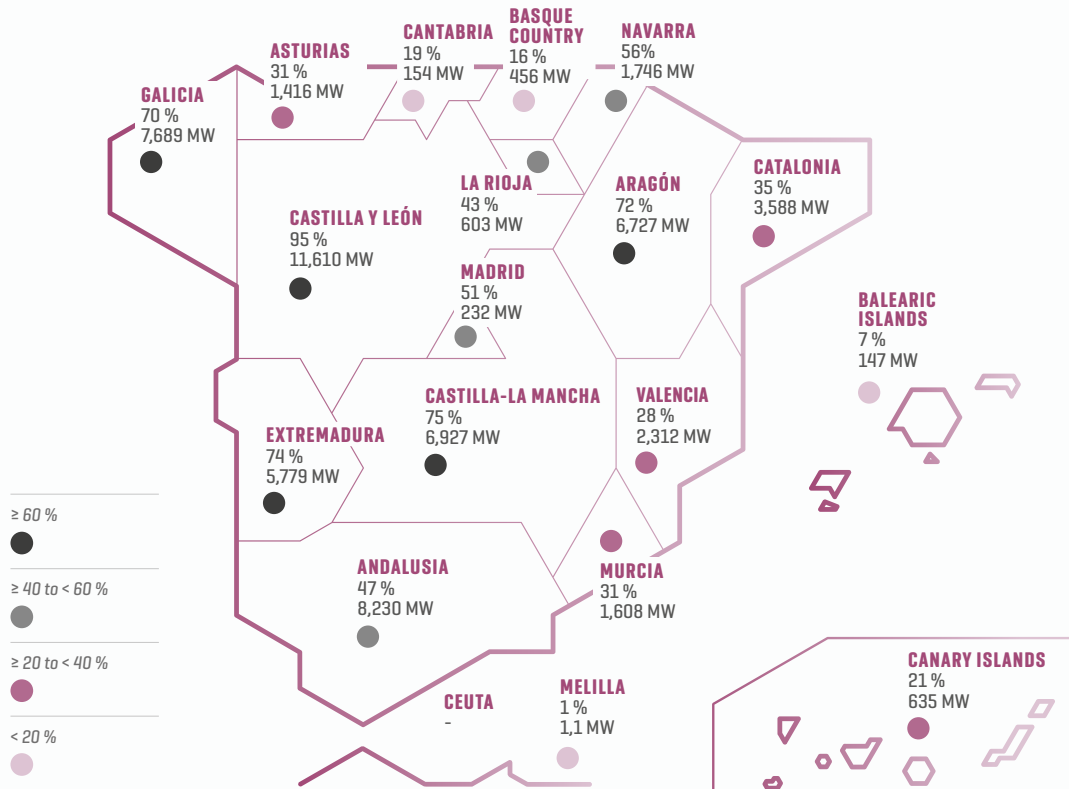


The greatest variation in installed renewable power capacity was in solar photovoltaic, which grew by 33.4% in 2020 compared to the previous year. The largest increase was recorded in Extremadura, which ended 2020 with more than double the installed solar photovoltaic capacity than in 2019, making it the leading technology in the region's installed power capacity structure with a 32.9% share.

In 2020, Andalusia was the second autonomous community with the second largest installed renewable generation capacity, with 8,230 MW as at 31 December 2020, an increase of 11.8% compared to 2019. This increase is mainly due to the 46% growth in installed solar photovoltaic power capacity.



Ratio regarding renewable power capacity/total power capacity (%) and renewable power capacity [MW] per Autonomous Community as at 31.12.2020

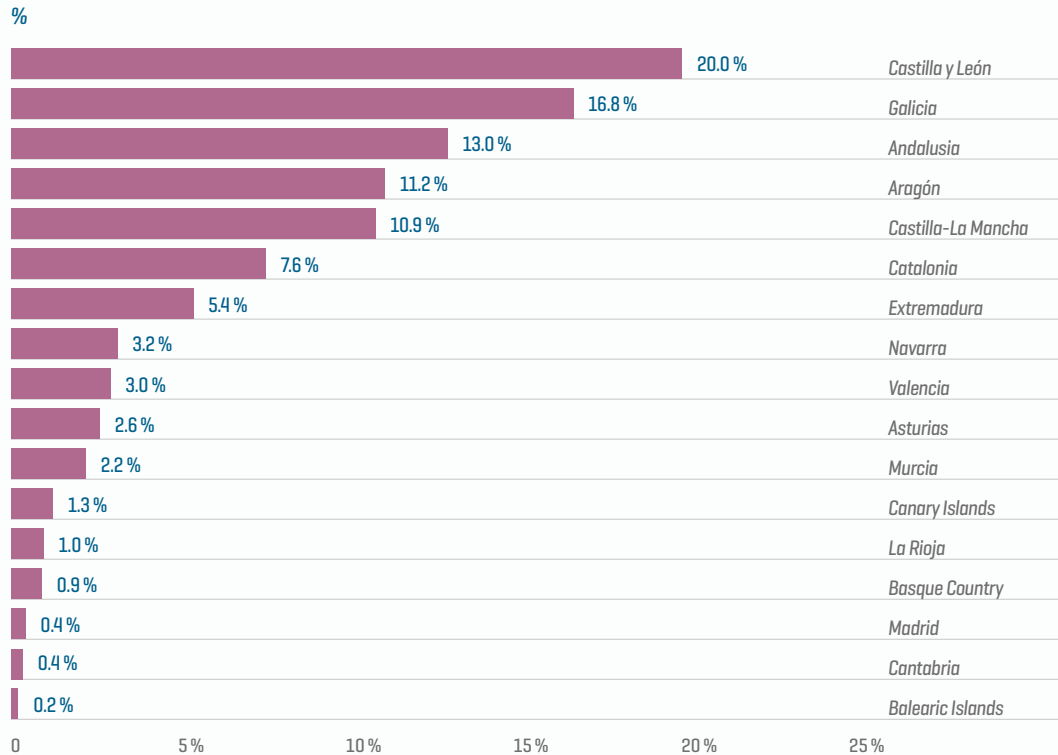


Generation with renewable energy sources per autonomous community depends heavily on the distribution of installed power capacity within the Community and on the climatic conditions of each year. In 2020, Aragón was the autonomous community with the highest growth in renewable generation, with an increase of 48.7% compared to the previous year, driven by the increase in photovoltaic, wind and hydro, which produced 358.9%, 36.4% and 36.1% more than in 2019, respectively.

This higher level of renewable generation is due to the fact that Aragón has been one of the autonomous communities with the greatest increase in installed renewable power capacity [24.5% compared to 2019], which now accounts for 71.7% of all production capacity in the region, with wind power as the leading technology in terms of installed capacity.



Share of the renewable power generation per Autonomous Community in relation to national renewable power generation as at 31.12.2020



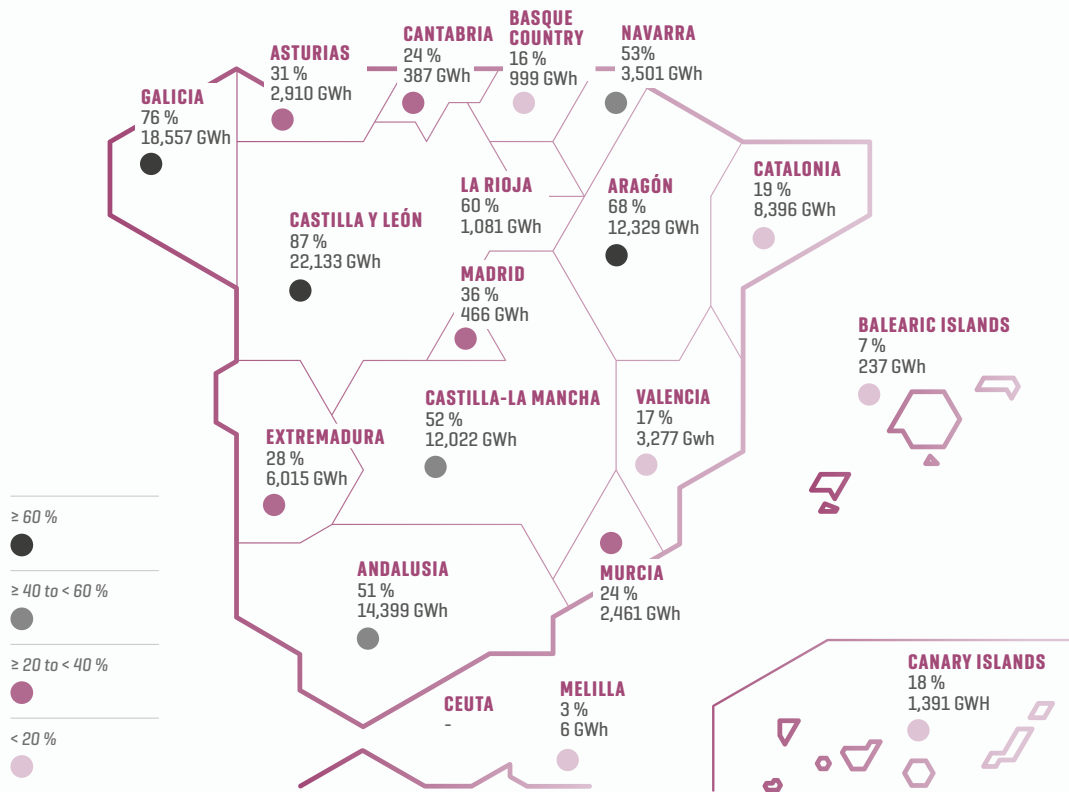
In 2020, the autonomous communities of Andalusia, Castilla-La Mancha and Navarra had renewable generation that accounted for approximately 50% of their energy mix, whereas renewable generation in La Rioja and Aragón accounted for more than 60%. In Galicia, generation coming from renewable sources accounted for 76% of their electricity generation mix, the highest share recorded in this community since records began.

Lastly, Castilla y León continues to be the autonomous community with the highest renewable energy generation, with 87% of its production coming from renewable sources in 2020, with wind power being the leading technology, accounting for 49.4% of the total.





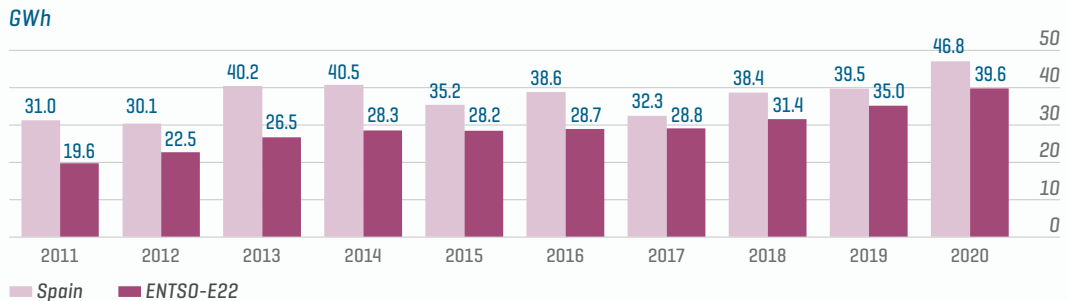
Ratio regarding renewable generation/total generation (%) and renewable generation (GWh) per Autonomous Community in 2020.



In comparison with the rest of Europe, Spain ranked fourth in 2020 in terms of renewable generation volume. In terms of the share of renewables in total generation, Spain remains above average for the group of European

countries for which data is available that covers a number of years and in which a positive evolution is also observed, driven by the targets set by the European Union in terms of renewables and emissions.

Renewable generation over total generation in Spain and in a selection of ENTSO-E22 member states^[1]



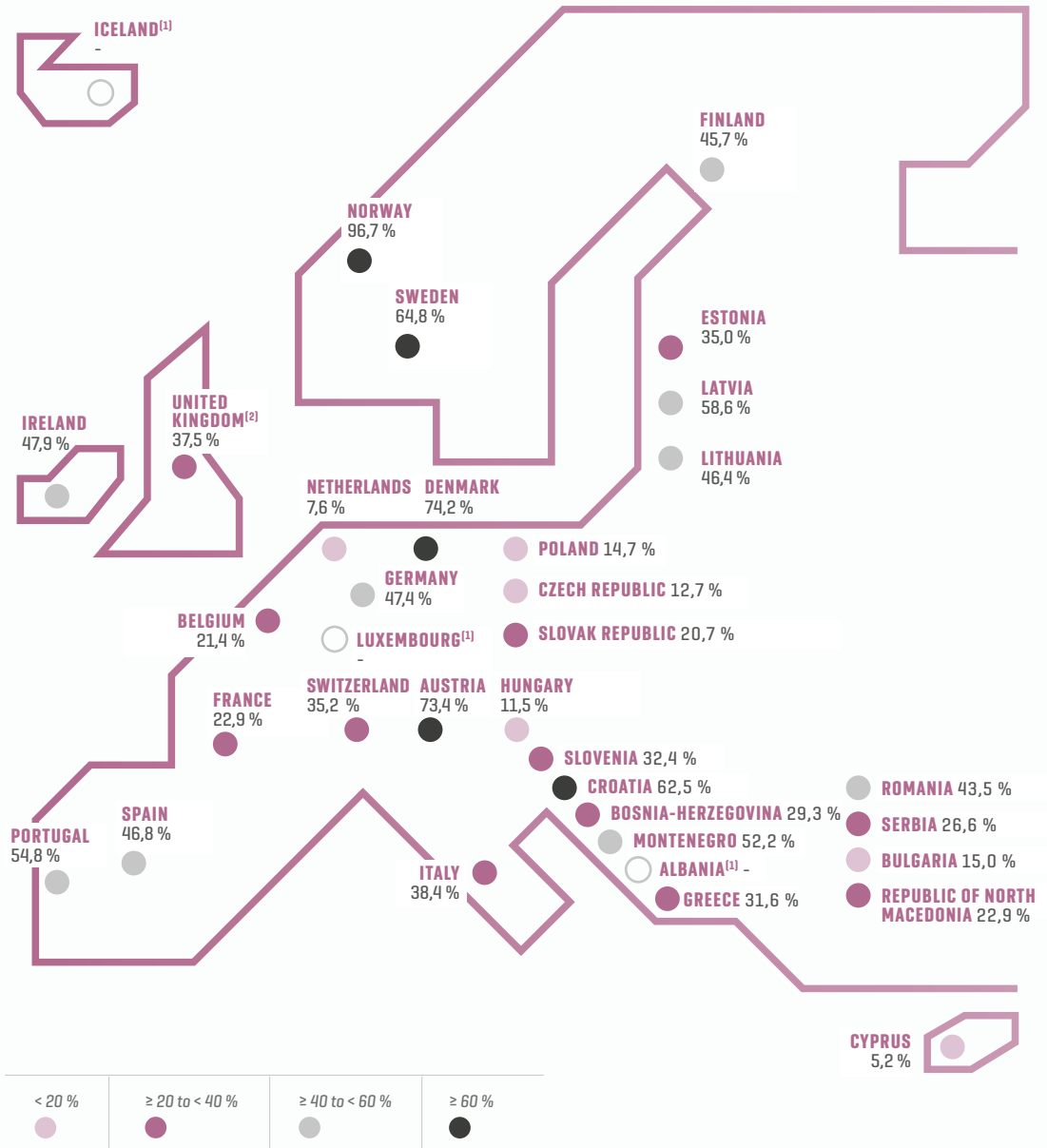
[1] Due to the unavailability of data for the whole period for some countries, the evolution graph contains information from: Austria, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Luxembourg, the Netherlands, North Macedonia, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Switzerland.

As of 2019 the source used is the ENTSO-E Transparency Platform, subject to Regulation [EU] No 543/2013. This data comes from the real-time systems and therefore differs from the consolidated data used for the specific case of Spain at national level, which is obtained using a power measurement system.



Renewable energy over total generation in ENTSO-E member states in 2020

%



Source: data obtained from the ENTSO-E Transparency Platform as at 26/2/2021. The data is governed by Regulation [EU] No 543/2013, and is obtained from real-time systems and therefore differs from the consolidated data used for the specific case of Spain at national level, which is obtained using a power measurement system.

[1] Data not available.

[2] Includes Northern Ireland.



2

Energy from the wind

Wind energy, the leading renewable energy source in Spain, is for the first time the technology with the largest share in the power capacity structure [24.8%].

Wind power generation remains the main renewable source in Spain, with an installed power capacity of 27,485 MW; a figure that increased nationwide in 2020 by 1,802 MW, a rise of 7.0% compared to 2019. In total, **it represents 24.8% of the overall installed capacity nationwide, ranking it for the first time as the technology with the highest installed power capacity in the national generation fleet.**

2020 was a record year for wind power generation in Spain, marking an all-time **annual record high**, reaching 54,899 GWh, which represented an increase of 0.3% over the previous maximum value set in 2013 and 1.2% above that generated in 2019. Wind power has consolidated its position as the second largest energy generating source after nuclear power, with a share of almost 22% in the national generation mix, once again surpassing the high levels of participation of previous years, which had never exceeded 21% of total generation.

With regard to the set of renewables as a whole, wind production in 2020 continued to lead with almost 50% of the total renewable energy generated in Spain, although it was slightly lower than last year, due to the increase in hydroelectric generation, as 2020 was considered a wet year.

The highest monthly wind power generation of the year was achieved in the months of October and December, the latter being the month with the highest share in generation mix with 31.3% of the total national generation.

2020 was a record year for wind power generation in Spain, setting an all-time annual high of 54,899 GWh.

WIND POWER GENERATION NATIONWIDE

54,899 GWh

ANNUAL ALL-TIME HIGH



+1.2%

COMPARED TO WIND POWER GENERATION NATIONWIDE IN 2019

The high variability of the wind means that the contribution of wind power generation to the hourly coverage of demand fluctuates considerably. During the year, hours were recorded whose percentage of hourly coverage of demand was less than 1%, the minimum value being registered on 12 February at midday, whereas the maximum value, with almost 55% of demand coverage, was registered on 1 March at 8:00 a.m. The average contribution of wind power generation to demand coverage was higher in the valley hours, with an average share of 24%, and a slightly lower average share of 21.6% during the peak hours of the day.

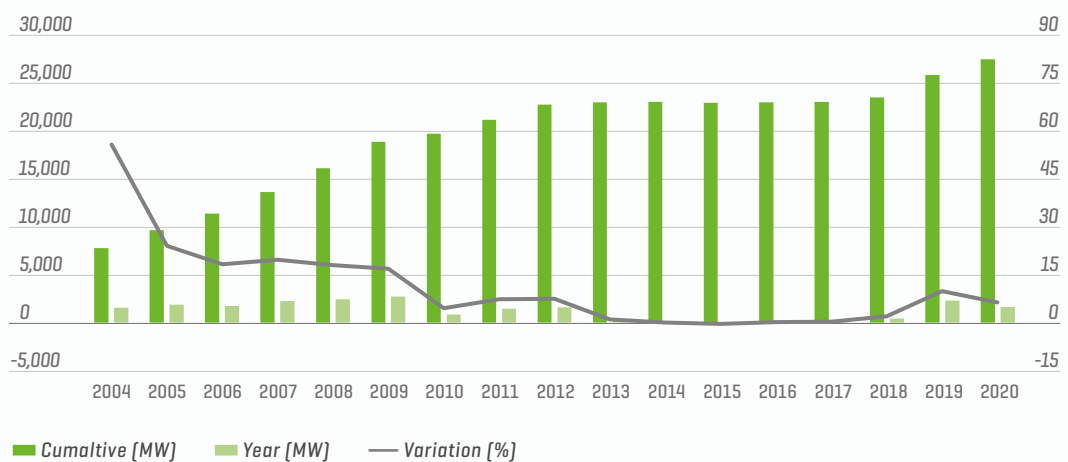


The wind producible index in 2020 reached a value of 0.99, slightly below the average for the last ten years. Wind power has a marked seasonality, with higher utilisation between October and April and lower between May and September. In 2020, the highest indexes were recorded in October and December, with values exceeding 1.4 in both cases.

In terms of autonomous communities, Castilla y León continued to be the region with the most installed wind power capacity, accounting for almost 23% of the total capacity nationwide. In second place is Aragón with 15.6% of the total, the region with the greatest increase in capacity during the year, with an increase of 33% compared to the previous year. It is followed by Castilla-La Mancha and Galicia with values of around 14% of the total installed capacity nationwide. These four regions alone account for more than 66% of the total installed wind power capacity in Spain. On the other hand, noteworthy are the Balearic Islands, Cantabria, Extremadura and the Basque Country, with less than 1% of installed power capacity compared to the national total.

Spain remains the second country in the ranking with the largest installed wind power capacity in Europe, behind Germany, which is the clear leader with just over 60 GW installed, followed in third place by France. In terms of the contribution of this energy source with respect to total generation, the leader continues to be Denmark with close to 60% of its production coming from wind, with Spain in seventh place.

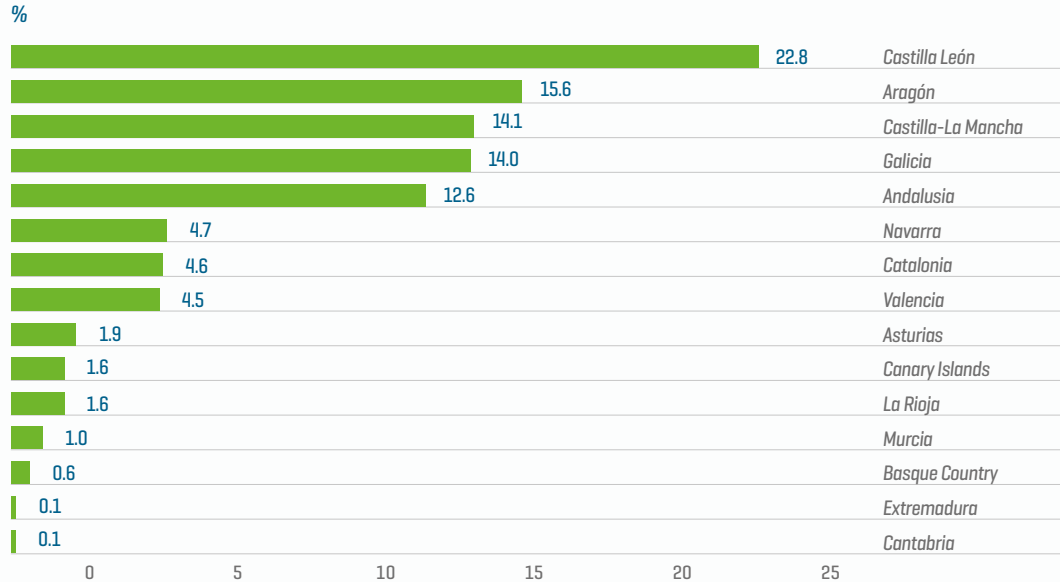
Installed wind power capacity. National electricity system MW and %



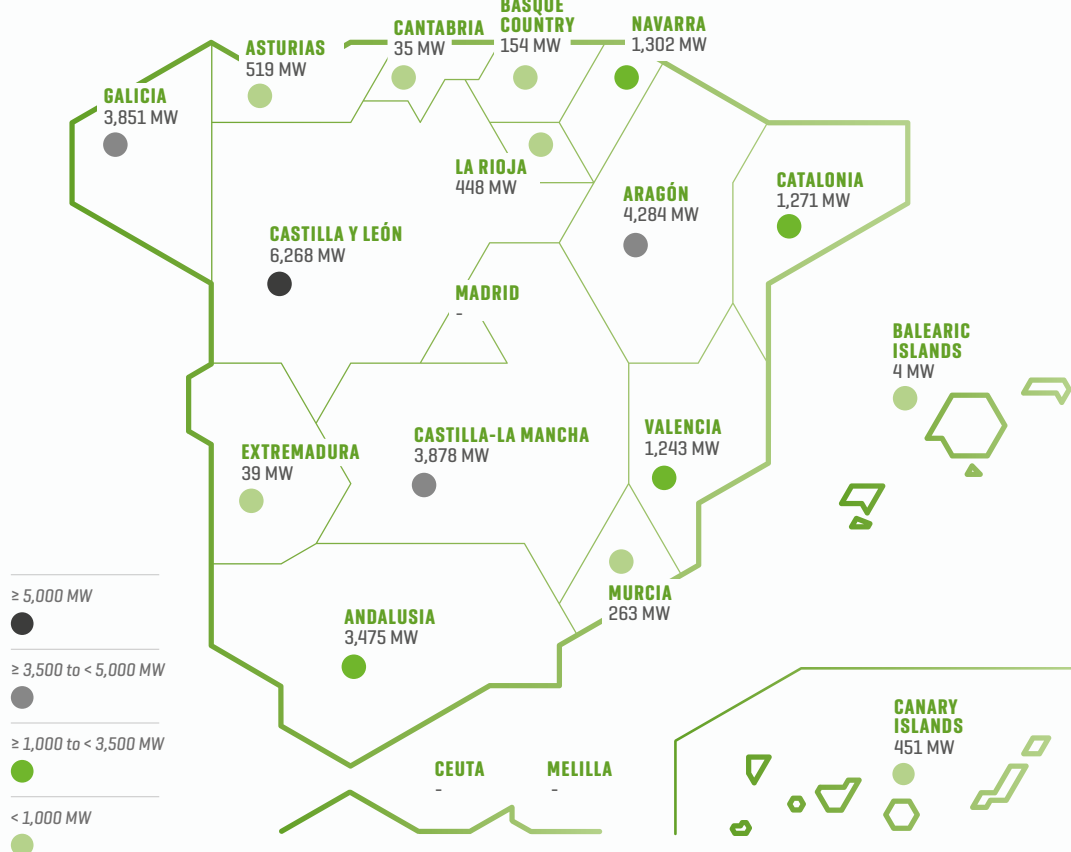
Source: Spanish National Markets and Competition Commission (CNMC) until 2014. Data for the Balearic Islands and Canary Islands available as of 2006.



Share of installed wind power capacity per Autonomous Community in relation to the total installed wind power capacity nationwide

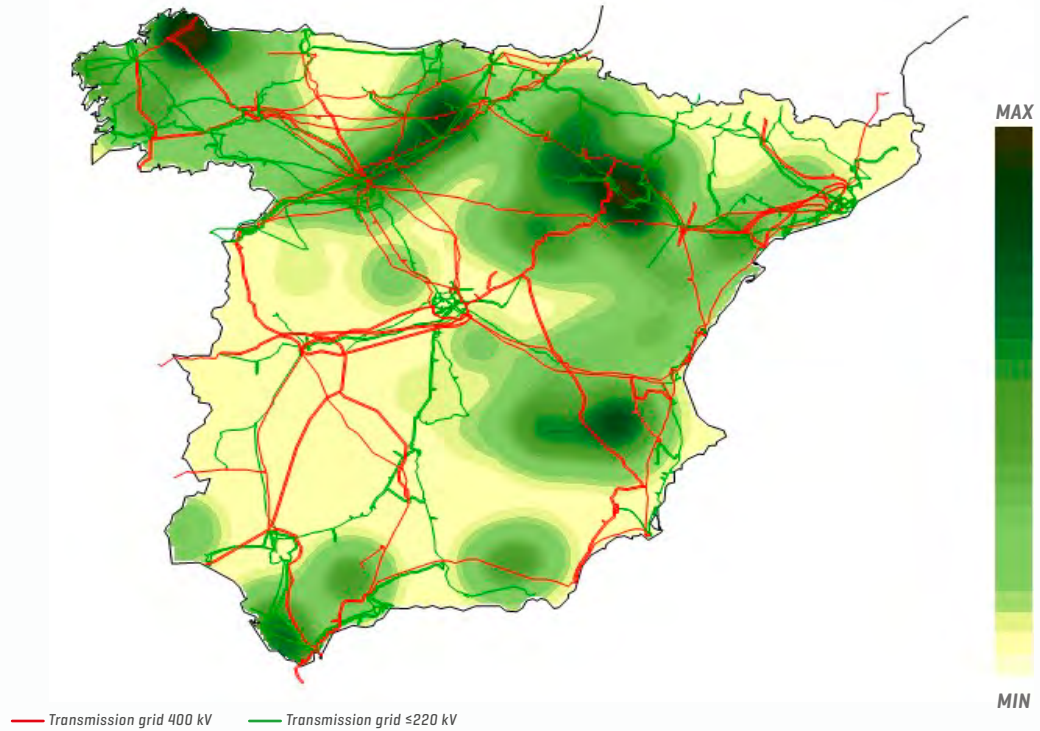


Installed wind power capacity per Autonomous Community as at 31.12.2020. National electricity system



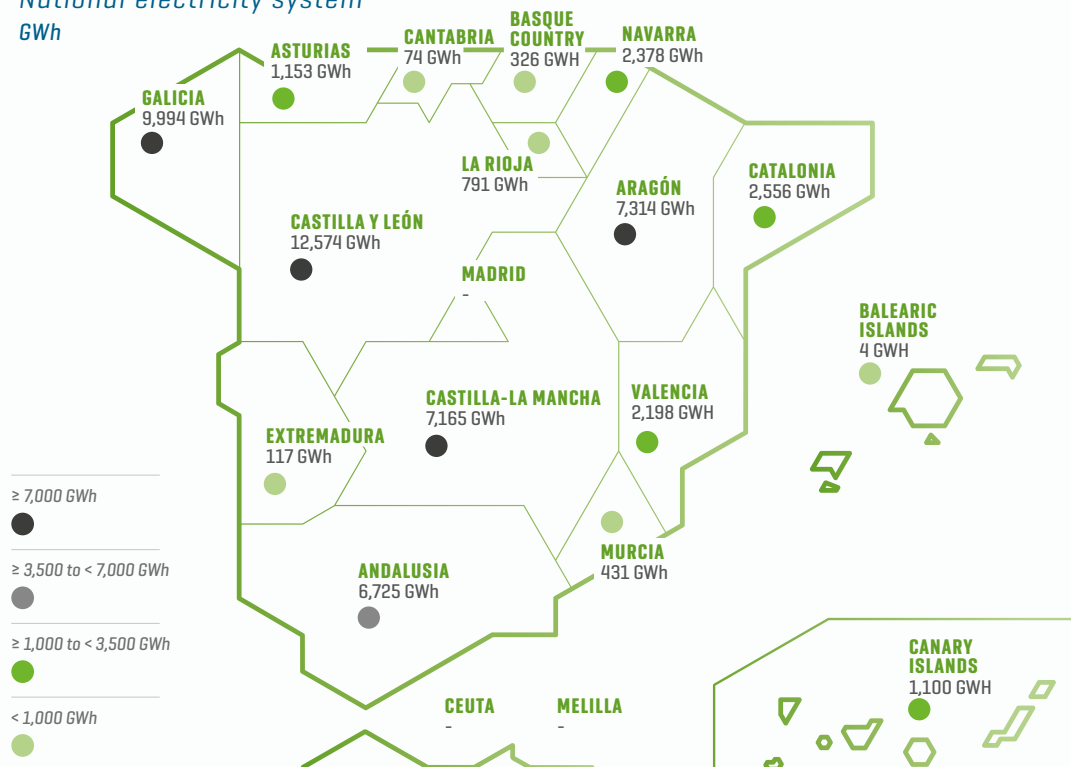


Geographical distribution of wind power facilities on the Spanish Peninsula as at 31.12.2020



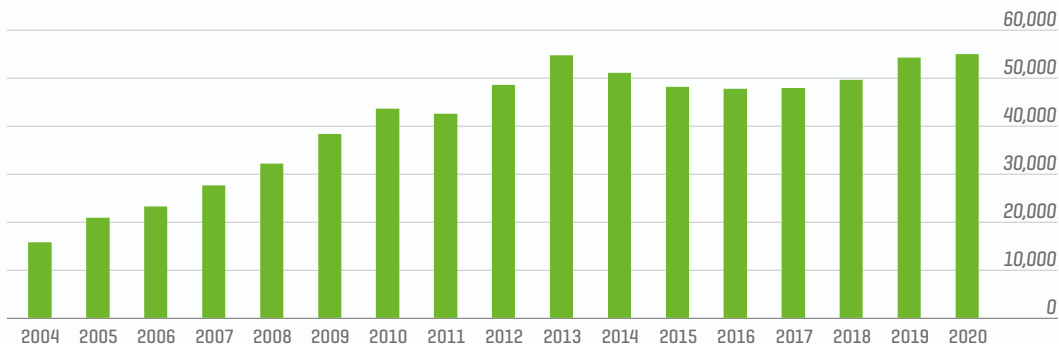
Wind power generation per Autonomous Community in 2020.

National electricity system
GWh



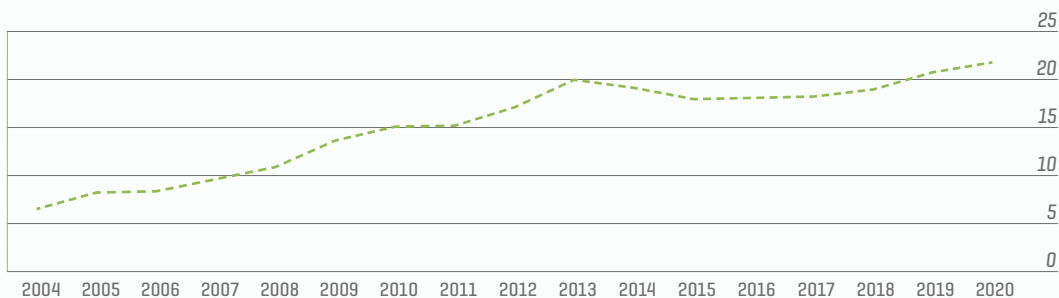


Wind power generation. National electricity system
GWh



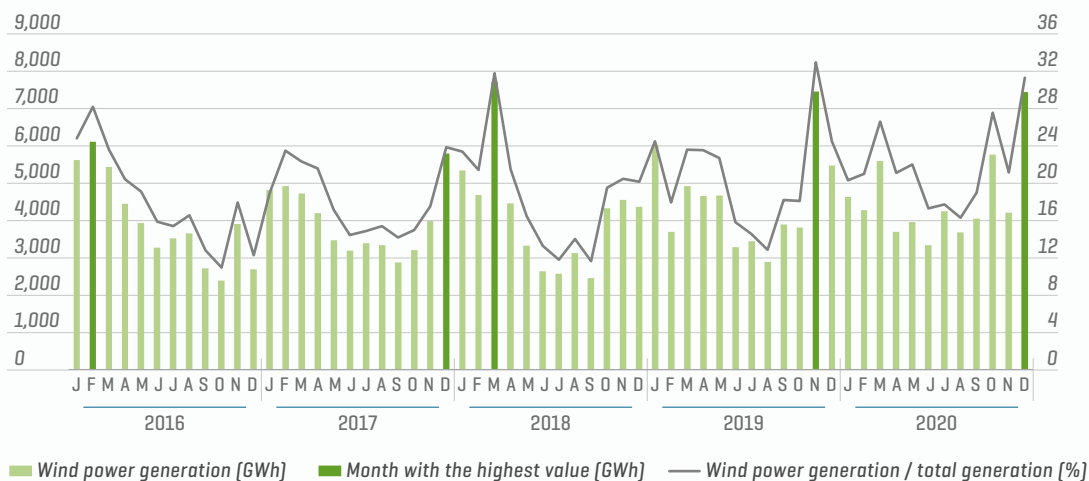
Source: Spanish National Markets and Competition Commission (CNMC) until 2014. Data for the Balearic Islands and Canary Islands available as of 2006.

Share of wind power generation in the total generation mix. National electricity system
MW



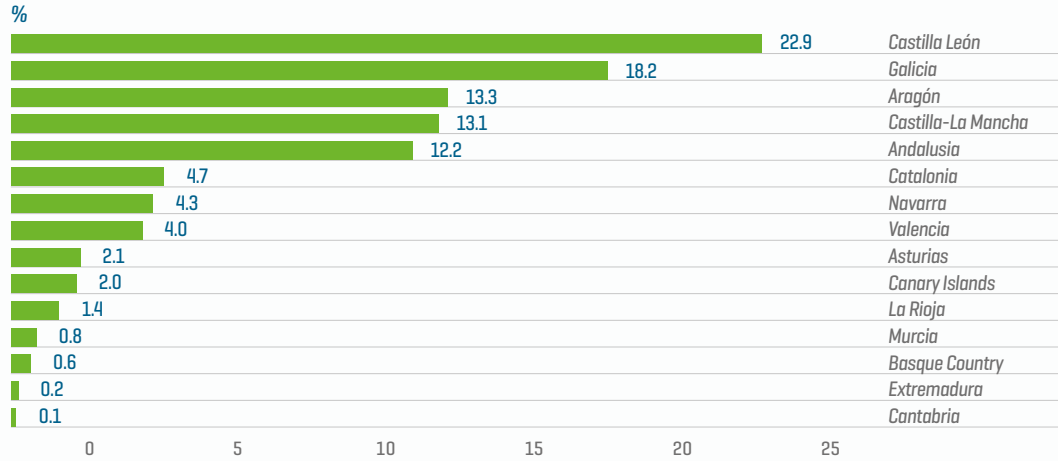
Data for the Balearic Islands and the Canary Islands available as of 2006.

National wind power generation, monthly maximum values and share in the total generation mix. National electricity system
GWh and %

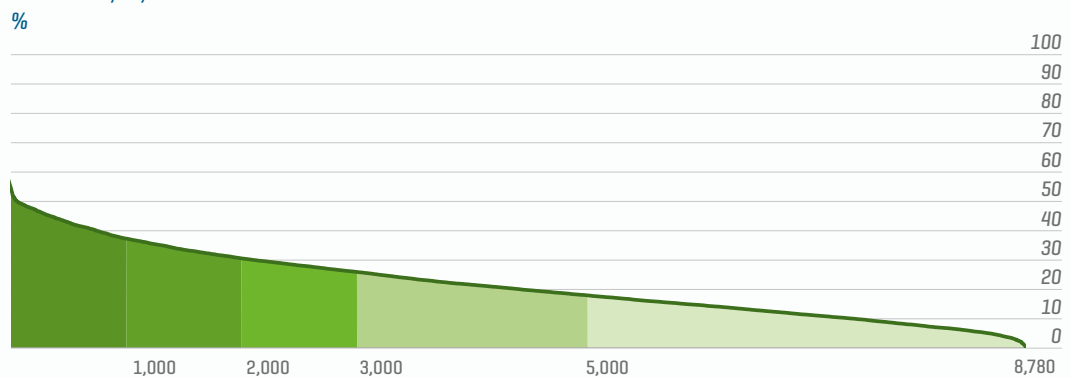




Share of wind power generation per Autonomous Community in relation to wind power generation nationwide

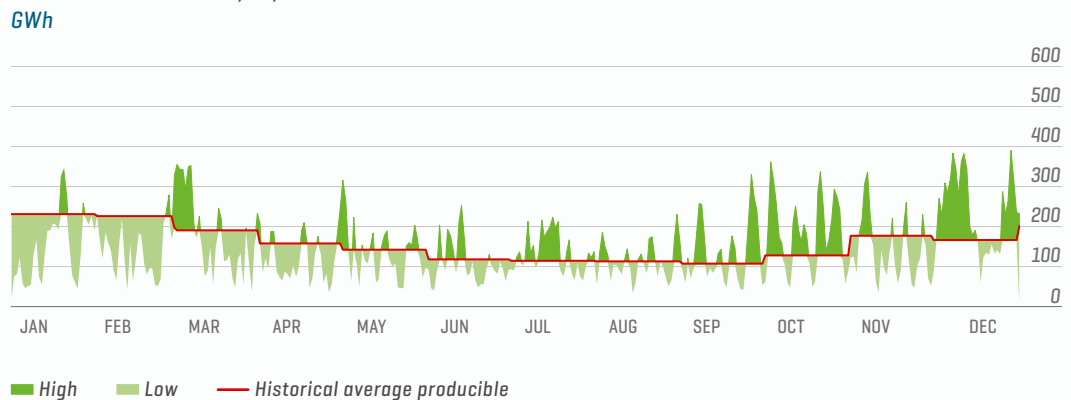


Monotonous curve of the share of wind power generation in demand coverage. National electricity system



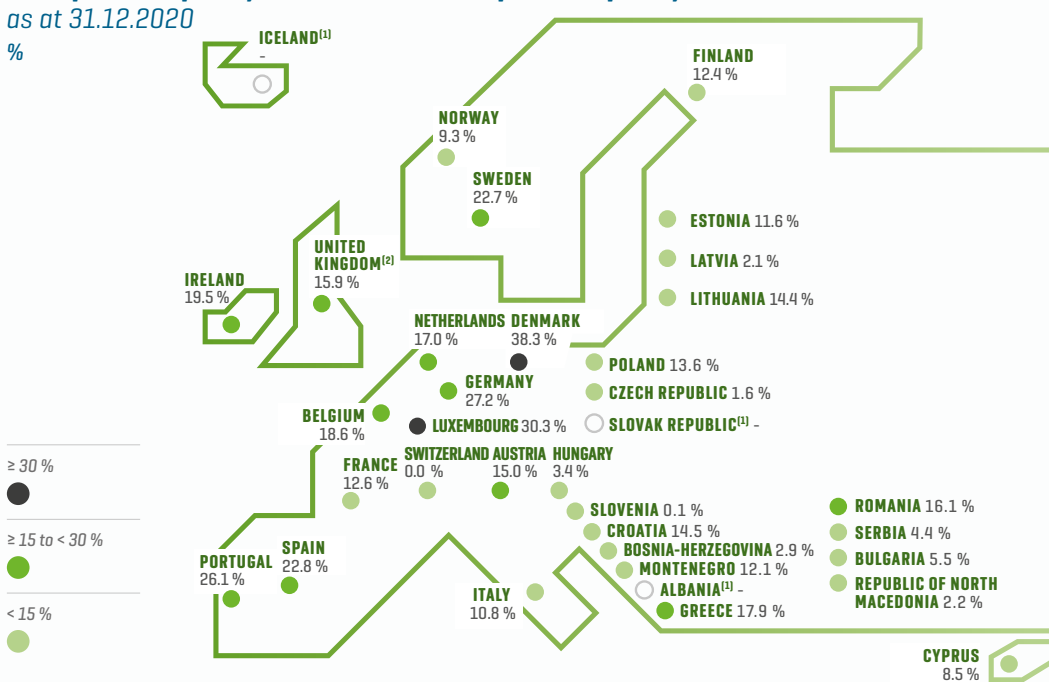
Representation of the share of wind power generation in demand coverage throughout the whole of the year divided into hourly periods and sorted by its greater to lesser share in the generation mix.

Daily producible wind power compared to the historical average producible. National electricity system





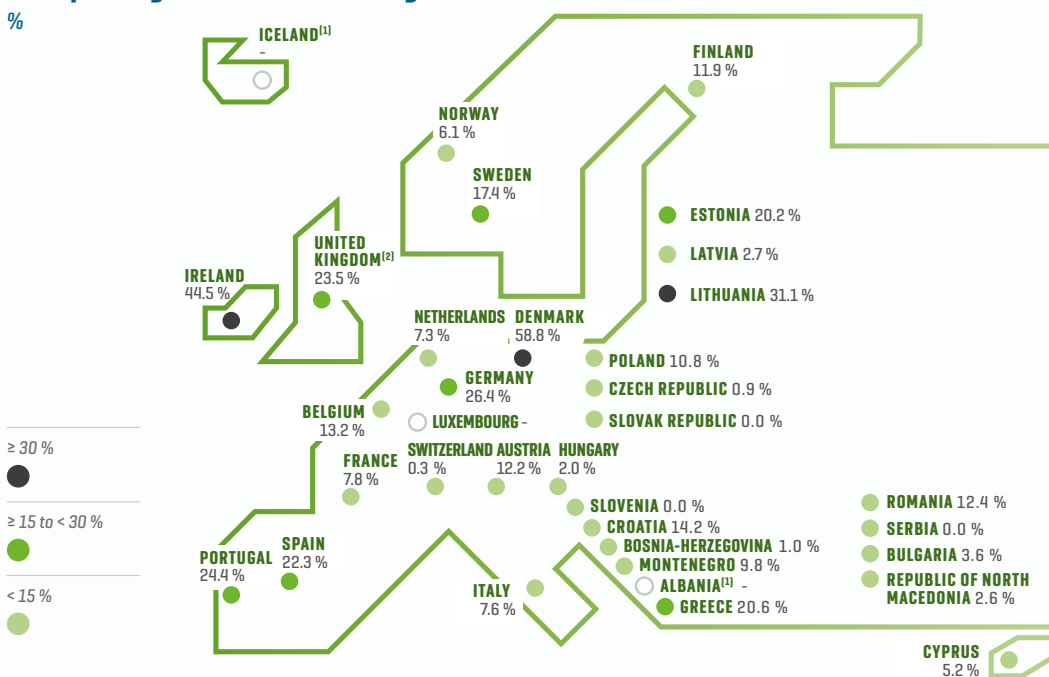
Wind power capacity over total installed power capacity in ENTSO-E member states as at 31.12.2020



Source: data obtained from the ENTSO-E Transparency Platform as at 26/2/2021. The data is governed by Regulation [EU] No 543/2013, and is obtained from real-time systems and therefore differs from the consolidated data used for the specific case of Spain at national level, which is obtained using a power measurement system.

[1] Data not available.
 [2] Includes Northern Ireland.

Wind power generation over total generation in ENTSO-E member states as at 31.12.2020



Source: data obtained from the ENTSO-E Transparency Platform as at 26/2/2021. The data is governed by Regulation [EU] No 543/2013, and includes generation units with an installed power capacity equal to or greater than 1 MW and therefore differs from the consolidated data used for the specific case of Spain at national level which considers total installed power capacity.

[1] Data not available.
 [2] Includes Northern Ireland.



3

Energy from water

Hydro continues to be the second largest source of renewable energy on the mainland behind wind power



Hydro was traditionally the main renewable source of energy in Spain, until it was overtaken by wind in 2009. Since then, it has clearly remained the second most important renewable source in terms of installed power capacity, with a total of 17,098 MW at the end of 2020 (without taking into account pure pumped storage). In terms of installed power capacity nationwide, hydro represents 15.4%, ranking it as the third energy technology behind wind and combined cycle.

Hydroelectric power generation in Spain is extremely variable, reaching over 40,000 GWh in wet years, while in dry years this volume is reduced by more than half. 2020 was a slightly wet year, with hydroelectric generation standing at 30,614 GWh, 23.8% less than in 2019. In this way, hydro contributed 12.2% to overall national generation, occupying fourth place among the energy generation technologies.

With regard to the renewable power generation fleet, hydro ranked second behind wind with 27.7% of the overall renewable energy generated nationwide.

The late winter and early spring are the periods with the greatest historical contribution of hydro power, mainly due to the snowmelt and also to the greater rainfall during these months.

Hydroelectric power generation was 24% higher than last year, due to higher rainfall, reaching 30,614 GWh.

This volume of production accounted for 12.2% of total national production, up from 9.5% in 2019.

30,614 GWh

TOTAL HYDROELECTRIC POWER GENERATION NATIONWIDE



+24 %

COMPARED TO HYDROELECTRIC POWER GENERATION IN 2019

In 2020, January was the month with the highest level of hydroelectric power generation with just over 3,729 GWh (19.6% less than the maximum value of the previous year). January was also the month in which this technology made the greatest contribution to overall production, accounting for 16.4% of the total generation mix in that month, followed by April (16.3%). This year, despite having a higher producible capacity than last year, generation was lower due to the health crisis, which caused a sharp drop in demand.

One of the main advantages of this technology compared to other renewable energies is its manageability, which becomes evident when observing the average daily curve of the share of hydro in the total generation mix, which shows how the greatest contribution of this technology coincides with the morning and evening demand peaks.



With regard to hydroelectric reserves, 2020 ended with reserves slightly above the statistical average level, despite it being a rather wet year on the whole.

Reserves, which in 2019 were below the statistical average in almost every month except December, have always been above average this year, with high values from April to July. 2020 ends with a reservoir capacity that stood at 50.8%, slightly lower than at the end of 2019 [0.2 percentage points].

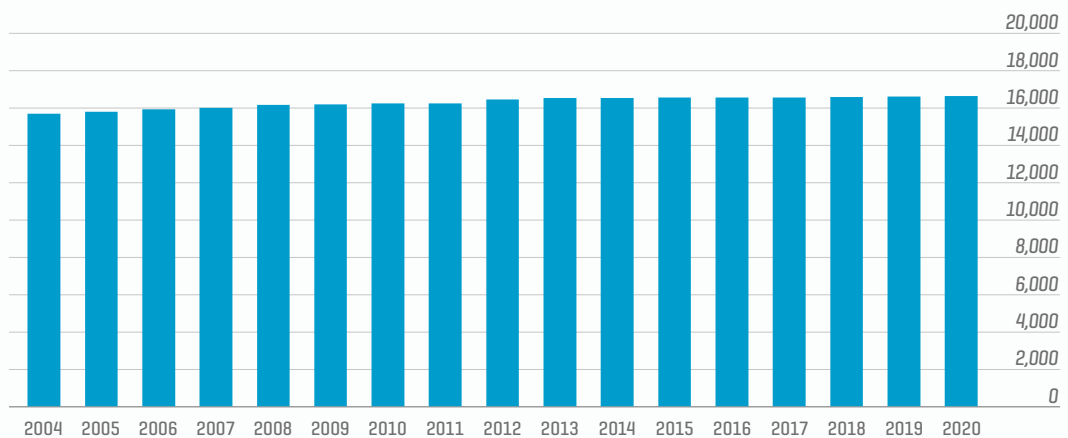
The producible hydroelectric index in 2020 reached a value of 1.03, which was higher than the previous year. Since 2004 there have only been 6 years with a producible hydroelectric index above 1 [wet year]. Generally, the months of January, April, May, October and December register producible hydroelectric index values above one [1].

By autonomous community, Castilla y León is the region with the most installed hydro power capacity with almost 26% of the national total. This is due to the fact that the Duero basin, the second largest basin on the Iberian Peninsula, lies exclusively in this Community. It is followed by Galicia with almost 22% of the national total, a region that holds much of the Northern basin and which is the most important in terms of installed power capacity and includes Asturias, Cantabria and part of the Basque Country. Five Communities account for almost 80% of the total installed power capacity, including, in addition to those mentioned, Extremadura, Catalonia and Aragón.

Castilla y León, Galicia, Catalonia and Aragón were the regions with the highest hydroelectric generation in 2020.

Compared to other European countries, Spain ranked fifth in 2020 in terms of energy generated with this technology. However, it is in the bottom half of the ranking, seventeenth, in terms of the share hydro in the overall generation mix.

Installed hydro power capacity. National electricity system MW

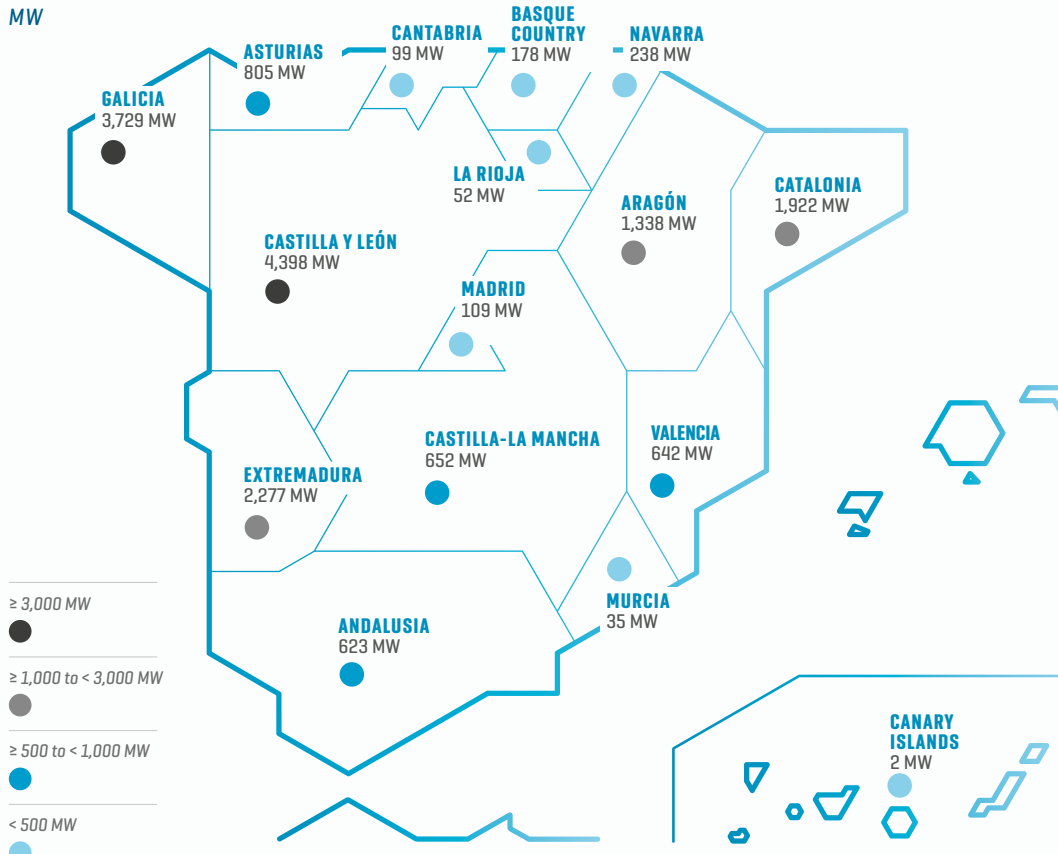


Source: Non-HMU [Hydro Management Unit] hydro power capacity data was provided by the Spanish National Markets and Competition Commission [CNMC] until 2014.



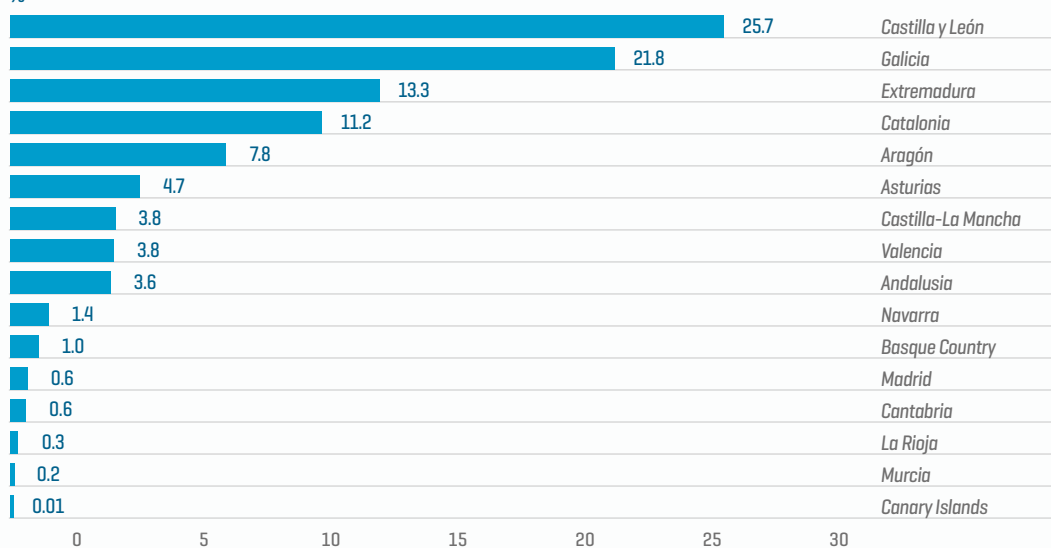
Installed hydro power capacity per Autonomous Community as at 31.12.2020. National electricity system

MW



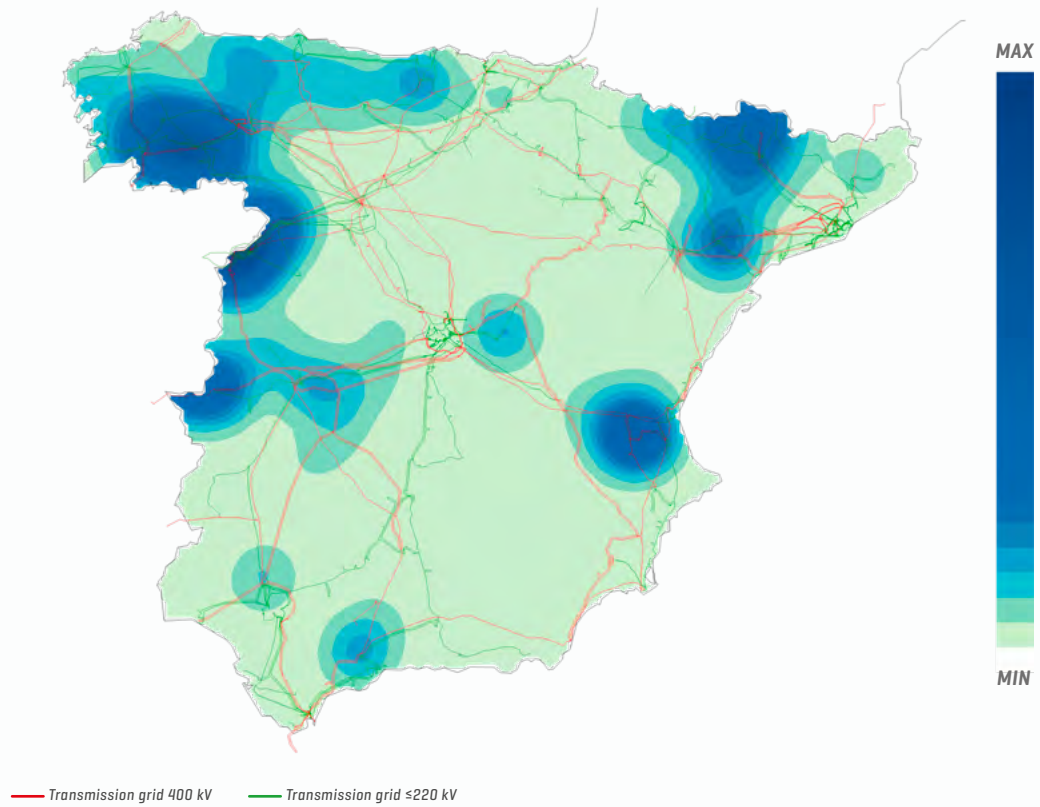
Share of installed hydro power capacity per Autonomous Community in relation to the total installed hydro power capacity nationwide

%

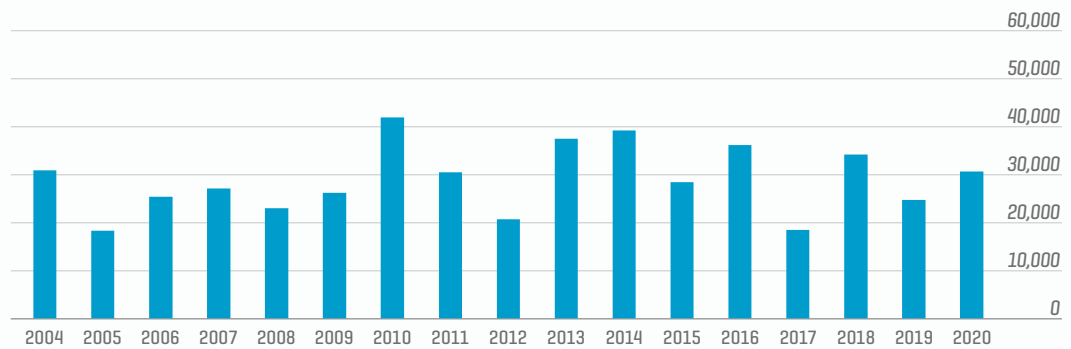




Geographical distribution of hydroelectric power facilities on the Spanish Peninsula as at 31.12.2020



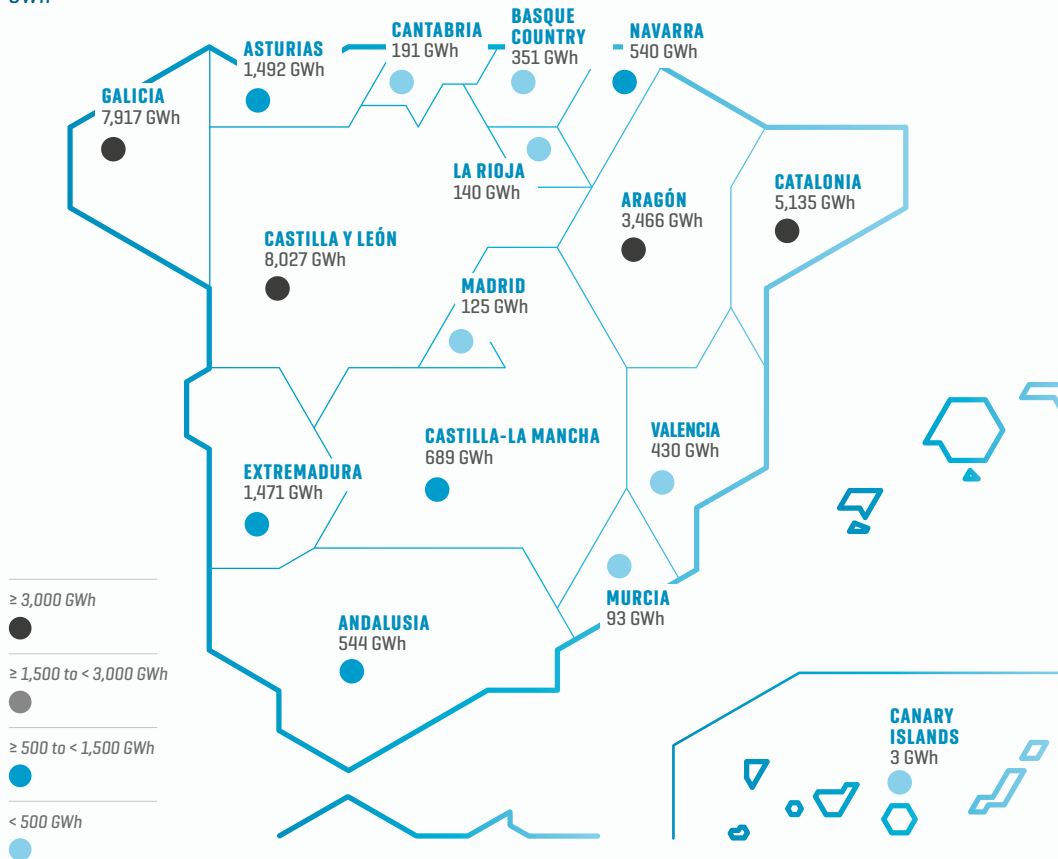
Hydroelectric power generation. National electricity system GWh



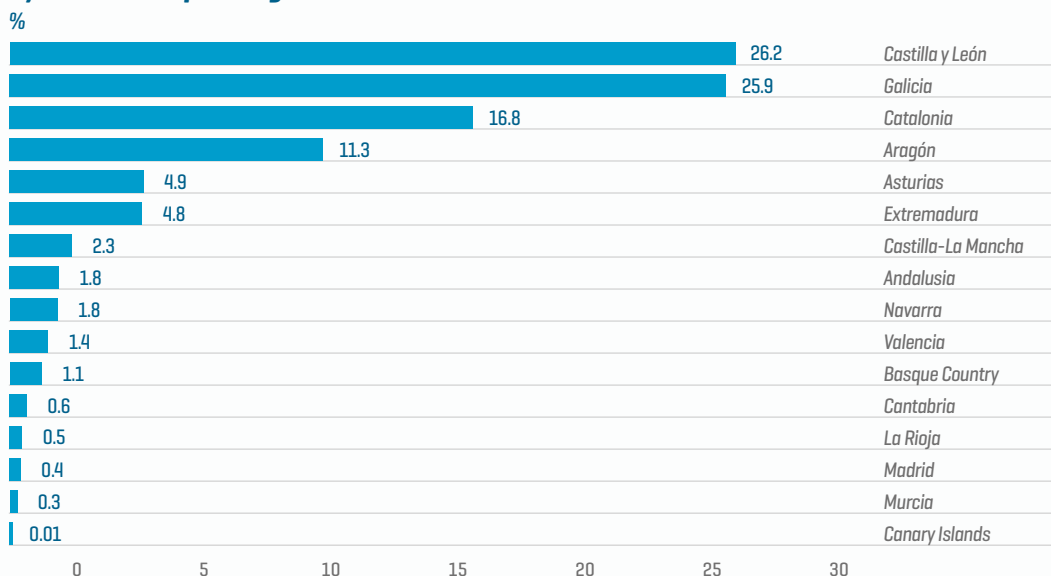
Data for the Canary Islands available as of 2006.



Hydroelectric power generation per Autonomous Community in 2020. National electricity system GWh

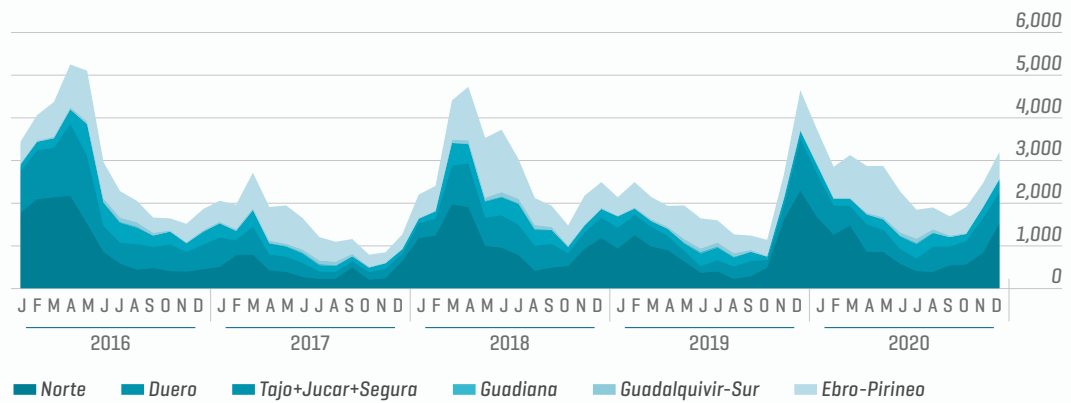


Hydroelectric power generation per Autonomous Community in relation to hydroelectric power generation nationwide

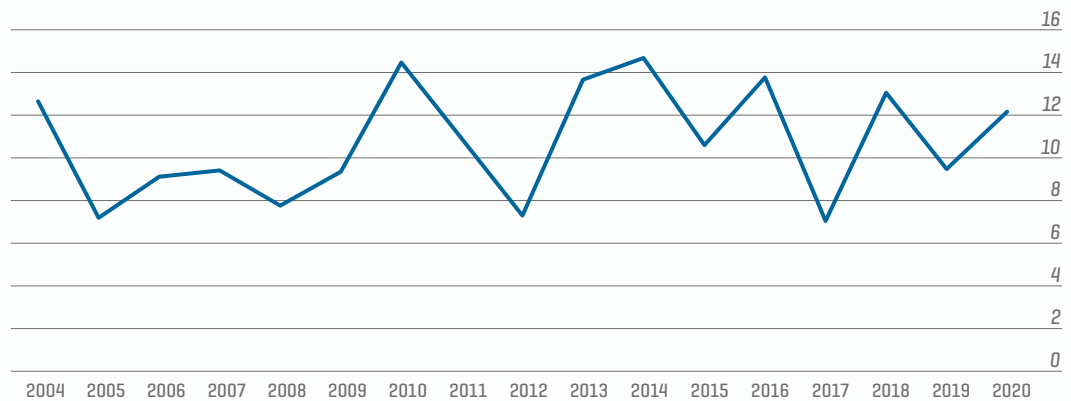




Hydroelectric power generation by hydrographic basin. Peninsular electricity system GWh

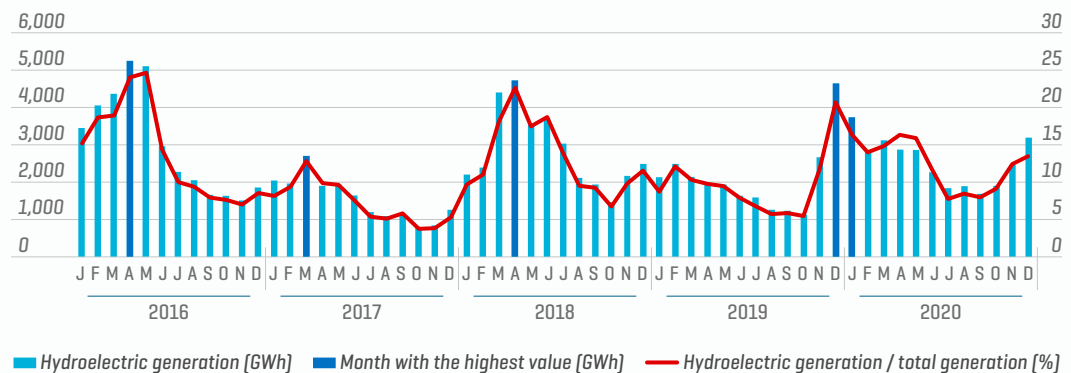


Share of hydro in the total generation mix. National electricity system %



Data for the Canary Islands available as of 2006.

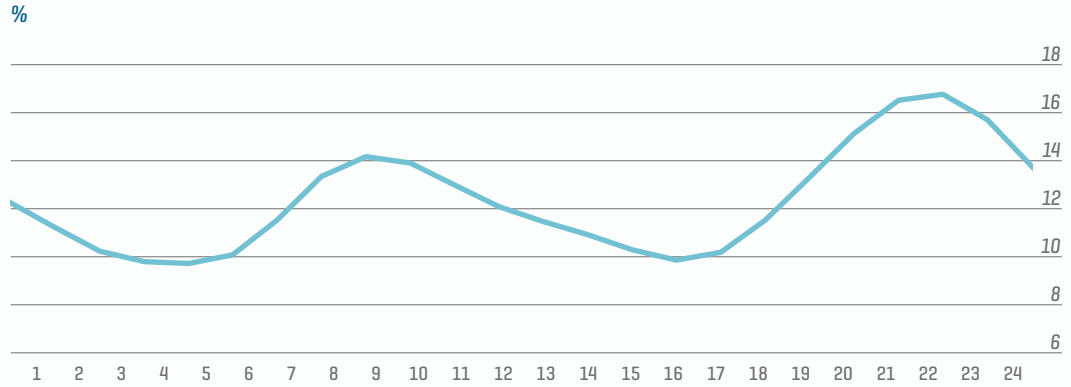
National hydroelectric power generation, monthly maximum values and share in the total generation mix. National electricity system GWh and %



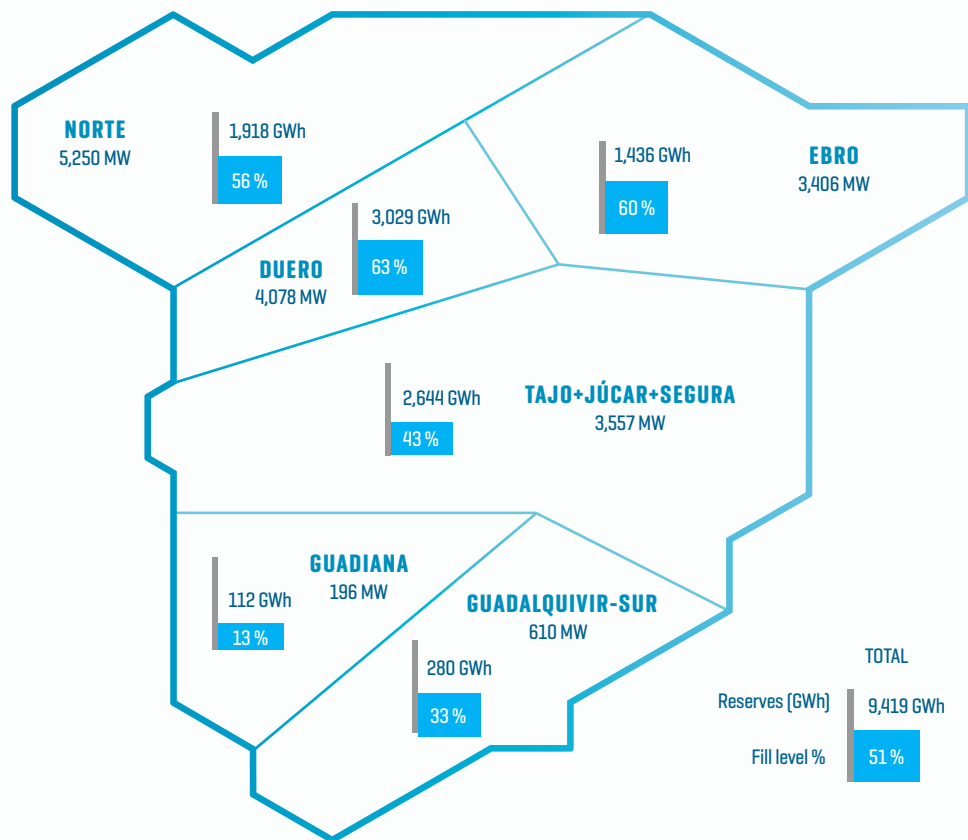
Data for the Canary Islands available as of 2006.



Average hourly share of hydroelectric power generation in relation to total generation in 2020. National electricity system



Installed power capacity and hydroelectric reserves by hydrographic basin as at 31.12.2020
GWh, MW and %

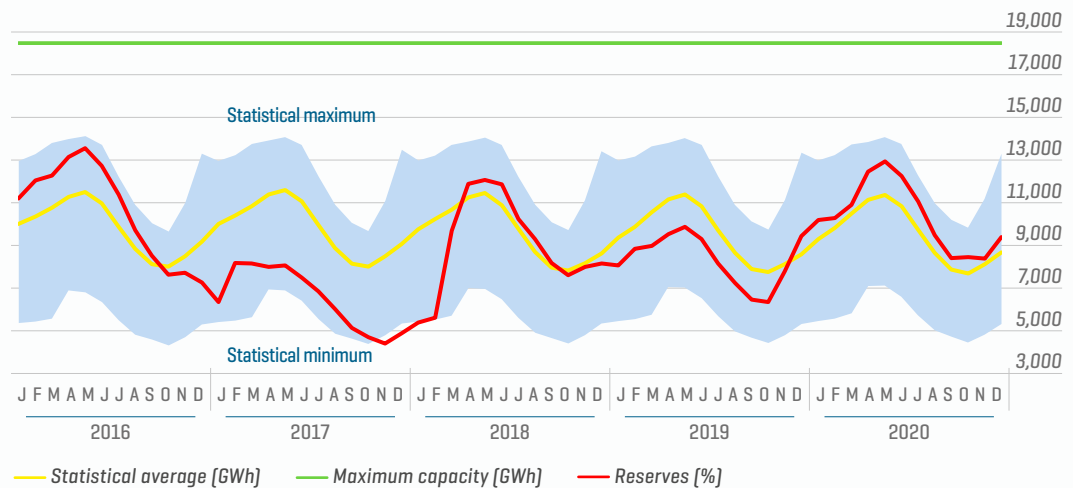




Extreme values of peninsular hydroelectric reserves

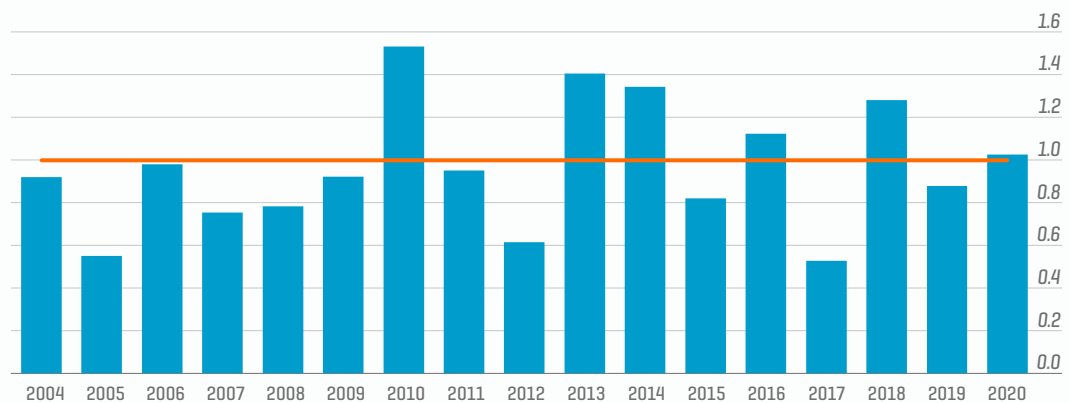
		2020			Historical values	
		GWh	Date	%	Date	%
Maximum	Annual	7,509	26-May.	83.7	May 1969	92.0
	Hyper-annual	5,529	2-jun.	57.8	April 1979	91.1
	Overall total	13,027	26-may.	70.3	April 1979	86.6
Minimum	Annual	4,104	20-oct.	45.8	8 December 2017	24.1
	Hyper-annual	3,715	3-jan.	38.8	noviembre 1983	17.6
	Overall total	8,133	20-oct.	43.9	8 December 2017	23.0

Total hydroelectric reserves. Peninsular electricity system GWh



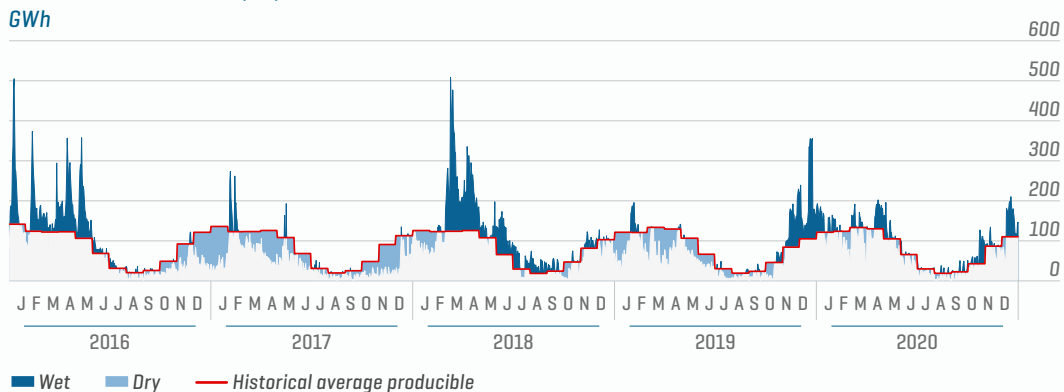
Statistical maximum and minimum values: average of the maximum and minimum values for the last 20 years.

Evolution of the producible hydroelectric index GWh

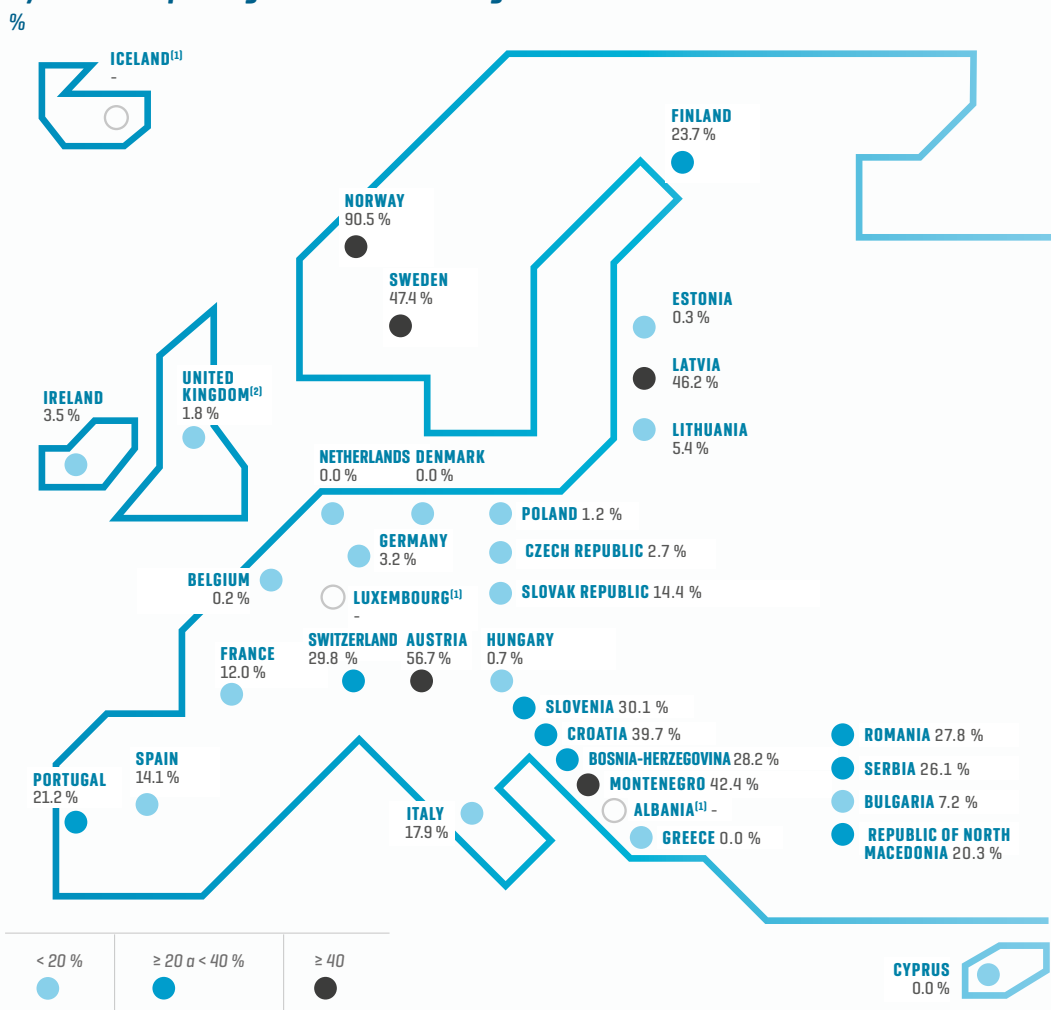




Daily producible hydroelectric power compared to the historical average producible. Peninsular electricity system



Hydroelectric power generation over total generation in ENTSO-E member states in 2020



Source: data obtained from the ENTSO-E Transparency Platform as at 26/2/2021. The data is governed by Regulation [EU] No 543/2013, and is obtained from real-time systems and therefore differs from the consolidated data used for the specific case of Spain at national level, which is obtained using a power measurement system.

[1] Data not available.

[2] Includes Northern Ireland.



4

Energy from the sun

Solar energy during 2020 registered maximum historical values both in installed power capacity and in generation. It closed the year as the third renewable source of electricity generation in Spain with 14,018 MW of installed power capacity. This technology already represents **almost 13% of the installed power capacity nationwide** and nearly 8% of the total generation.

Solar photovoltaic had been booming over recent years, but in 2020 it beat all records. While 2019 saw the largest increase in capacity, many of the facilities did not start to produce until 2020 when this technology began to continually beat production and coverage peaks.

The installed solar power capacity at the end of 2020 stood at 14,018 MW (11,714 MW correspond to solar photovoltaic and 2,304 MW to solar thermal), representing around 13% of the overall installed power capacity in Spain.

Following the historic growth registered in 2019 regarding solar photovoltaic (PV) capacity, 2020 closed with a 33% increase in capacity even in spite of the crisis caused by the pandemic. Excluding 2019, the figure for 2020 is the highest since 2008. Specifically, 2,931 new MW of PV were installed in 2020, bringing the total figure to 11,714 MW, which accounted for almost 11% of overall capacity and nearly 20% of renewable capacity.

Regarding solar thermal, after the large increase in 2012 with almost 1 GW of installed power capacity, since 2014 power capacity has remained stable, registering a total of 2,304 MW of installed power capacity by the end of 2020.

Solar power production in 2020 represented an all-time high in terms of coverage, with 7.9% of total generation for the year.

19,827 GWh

TOTAL SOLAR POWER
GENERATION NATIONWIDE



+37.5%

COMPARED TO SOLAR POWER
GENERATION IN 2019

Solar generation in Spain experienced a marked increase in 2020, higher than that recorded in 2019. Thus, in 2020, 19,827 GWh were generated for the year, 37.5% above the previous year and the highest annual value to date. This production also represents an all-time high in terms of coverage, with 7.9% of total generation for the year (6.1% for solar photovoltaic and the remaining 1.8% for solar thermal). The increase is due to a 21% rise in solar photovoltaic generation, while solar thermal saw its output decrease by 20%.



The months of June to August are the months with the highest production of solar photovoltaic generation, although from March to July, the all-time record for monthly generation set in August 2019 was beaten on a monthly basis. The maximum generation was recorded in July, with 1,903 MWh, almost double that of the previous year. Seasonality is an important factor in this technology and decisively influences its production throughout the year. Thus, from May to August, PV energy production has a share of around 8-9% in the generation mix, while it falls to almost half that in the months from November to February. The maximum coverage in 2020 was registered in June, with 9.3%.

During 2020, the all-time high for daily solar photovoltaic production was beaten, specifically on Friday, 21 June 2020, registering a value of 67,654 MWh. For its part, the maximum coverage took place on 3 May 2020, with a percentage of 11.9%. On 16 August, a new all-time maximum value for instantaneous photovoltaic generation was set in the peninsular electricity system, registering 7,282 MW at 1:54 p.m. At that time there was also a maximum of instantaneous solar power [photovoltaic + thermal], with a value of 9,390 MW.

In the case of solar thermal, July was the month with the highest generation and, although total production for the year has decreased, the maximum monthly production is 3% higher than in 2019, although it is 7% lower than in 2018. The seasonality of this technology is similar to that of photovoltaic, although its daily production is more evenly distributed throughout the day due to the capacity of these facilities to store part of the heat they obtain from the sun's rays and use it in the hours following its capture.

At regional level, Andalusia was in 2020 the region with the most installed solar photovoltaic capacity, with 22.8% of the total national installed power capacity, followed closely by Extremadura and further behind are Castilla-La Mancha, Murcia and Aragón. These five regions alone account for almost 82% of the installed photovoltaic power capacity in Spain. Conversely, the autonomous communities of the Cantabrian coast are below 0.5% of the national total regarding this technology.

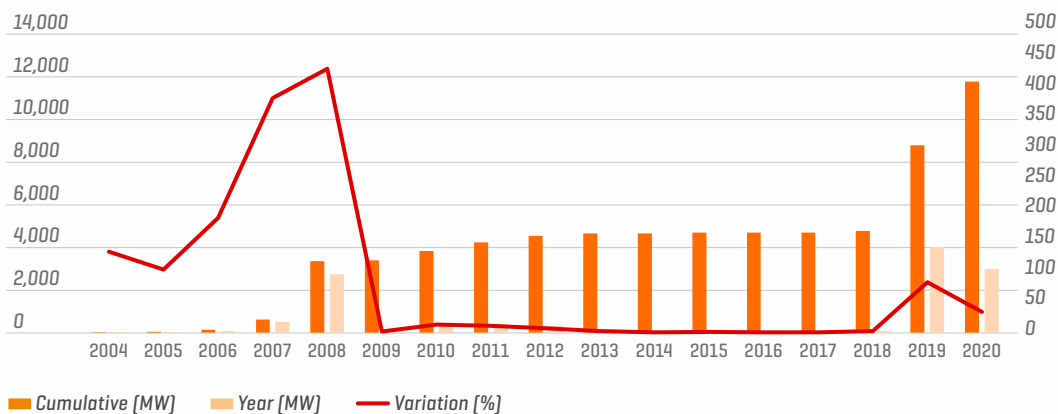
In the case of solar thermal, only 6 autonomous communities have this type of power generation technology installed, Andalusia being the region with the most installed power capacity followed by Extremadura, between both accounting for 80% of the total installed power capacity of this technology.

With regard to the situation of solar technology in Europe, Spain is in fourth place in the ranking of installed solar power capacity, far behind Germany, which is the undisputed leader with more than 48 GW of installed solar power capacity. However, if we analysed the share that this technology has regarding the total installed power capacity in each country, Spain would drop several places to eleventh position. Nevertheless, this year it is in third place in terms of production and also in third place, behind Greece and Germany, regarding the contribution of solar energy to the total generation mix of each country. If we compare the ratio of generation to installed capacity, Spain is again in third place, behind Italy and Portugal.



Installed solar photovoltaic power capacity. National electricity system

MW and %

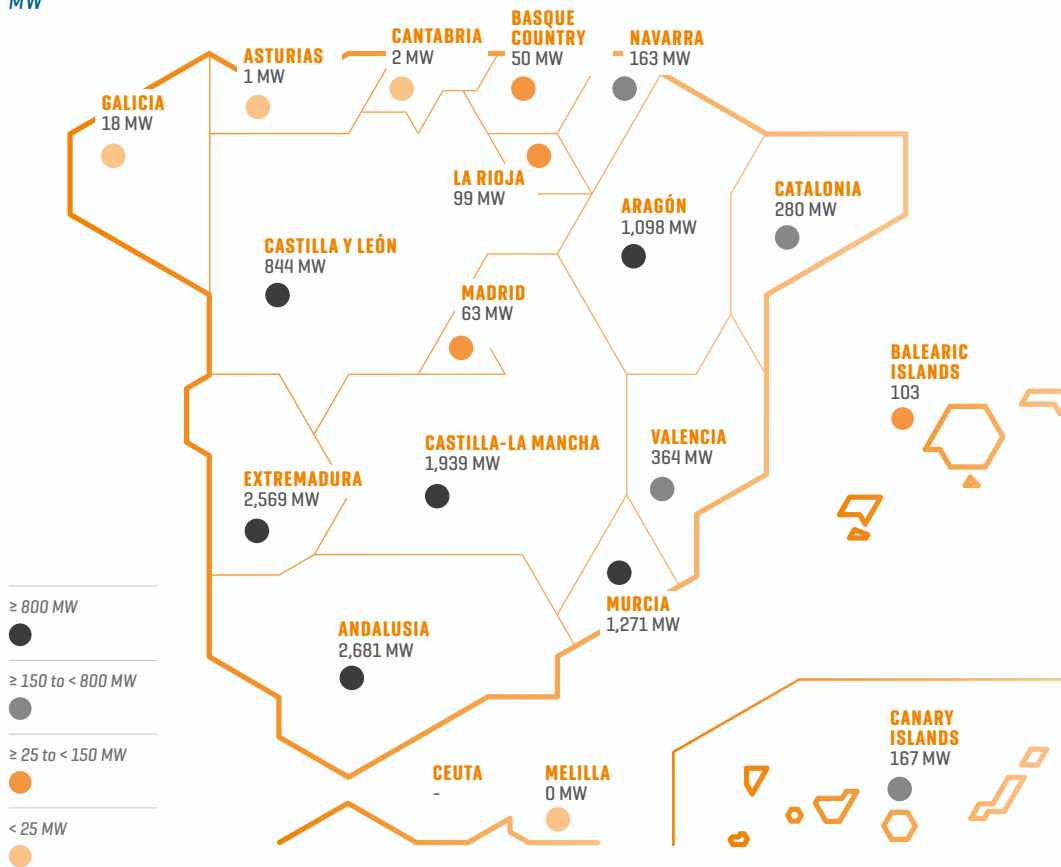


Source: Spanish National Markets and Competition Commission (CNMC) until 2014. Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

Installed solar photovoltaic power capacity per Autonomous Community

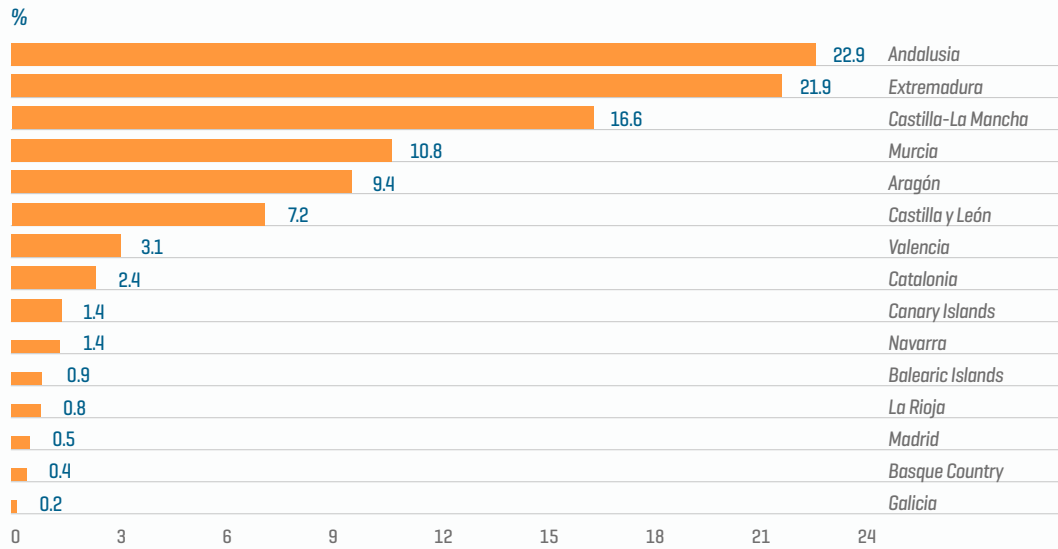
as at 31.12.2020. National electricity system

MW



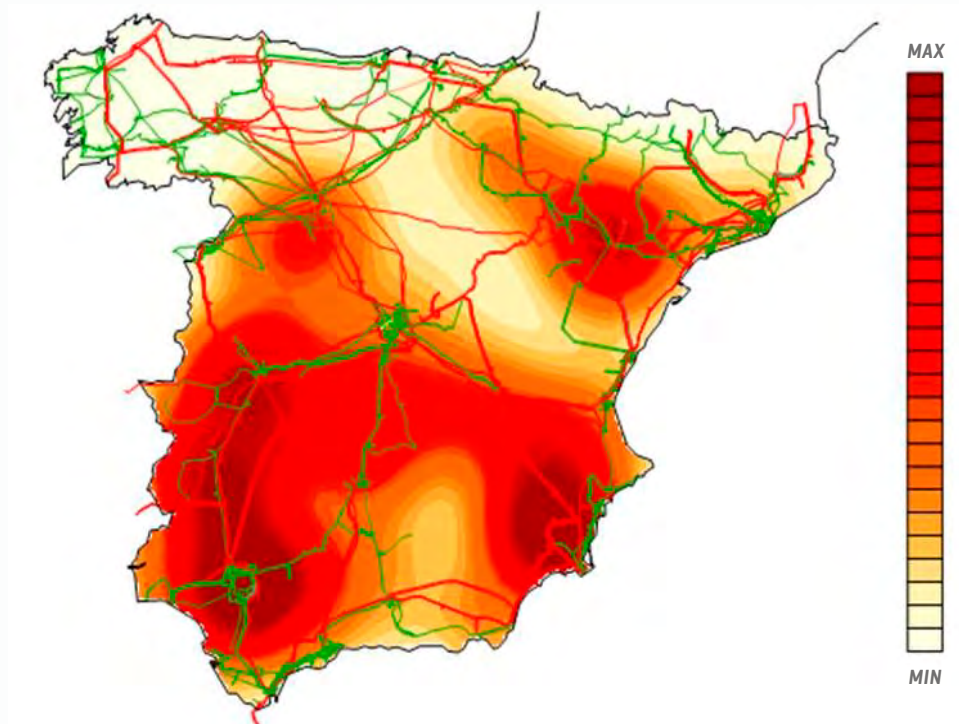


Share of photovoltaic solar capacity per Autonomous Community in relation to the installed photovoltaic capacity nationwide as at 31.12.2020



Cantabria, Asturias and Melilla are not included as their share in this technology is very small and would not be easily visible on the graph.

Geographical distribution of photovoltaic solar energy facilities on the Spanish Peninsula as at 31.12.2020

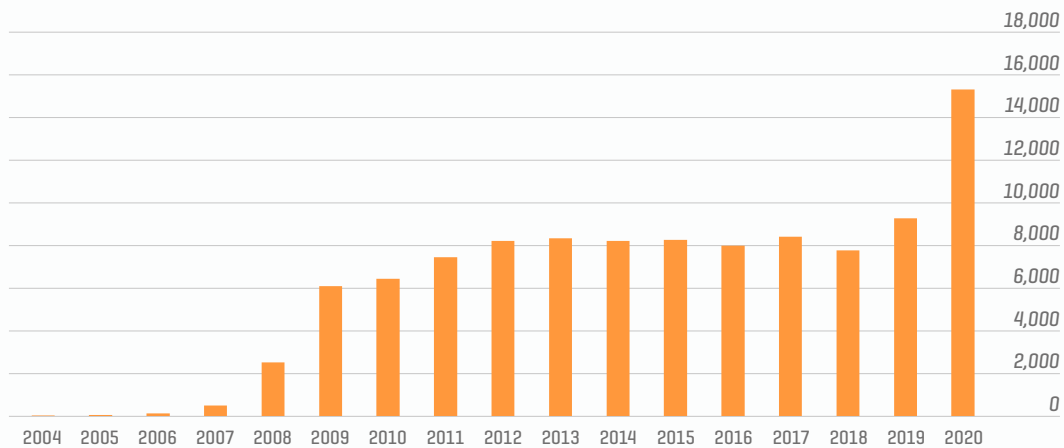


— Transmission grid 400 kV

— Transmission grid ≤220 kV

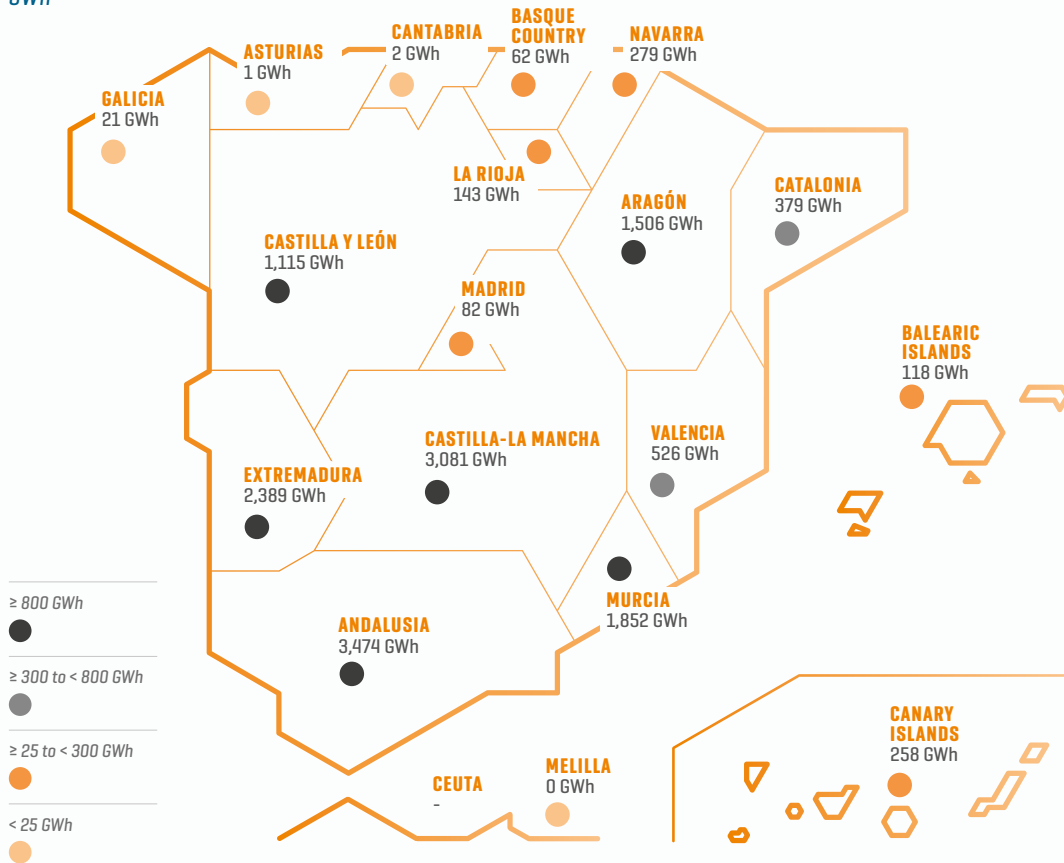


Solar photovoltaic power generation. National electricity system GWh



Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

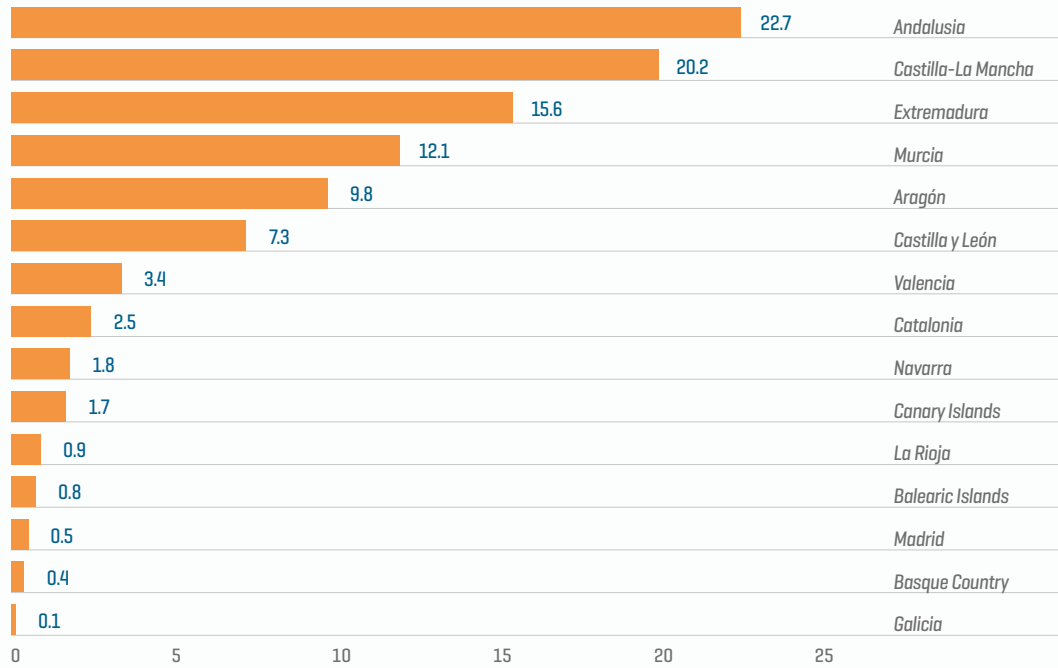
Solar photovoltaic power generation per Autonomous Community in 2020. National electricity system GWh





Solar photovoltaic power generation per Autonomous Community in relation to the total solar photovoltaic power generation nationwide

%

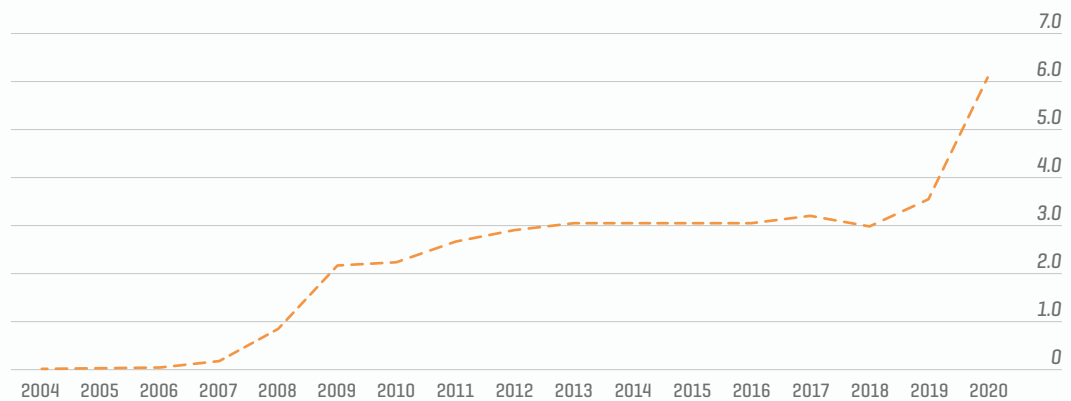


Cantabria, Asturias and Melilla are not included as their share in this technology is very small and would not be easily visible on the graph.

Share of solar photovoltaic power generation in relation to the total generation mix

National electricity system

%

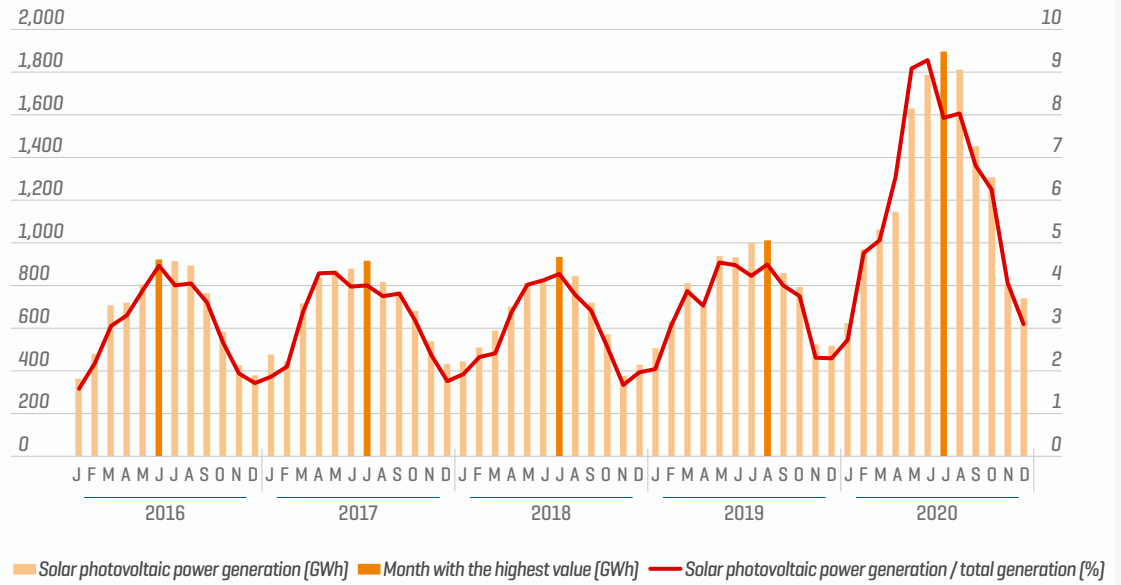


Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.



Solar photovoltaic power generation, monthly maximum values and share in the total generation mix. National electricity system

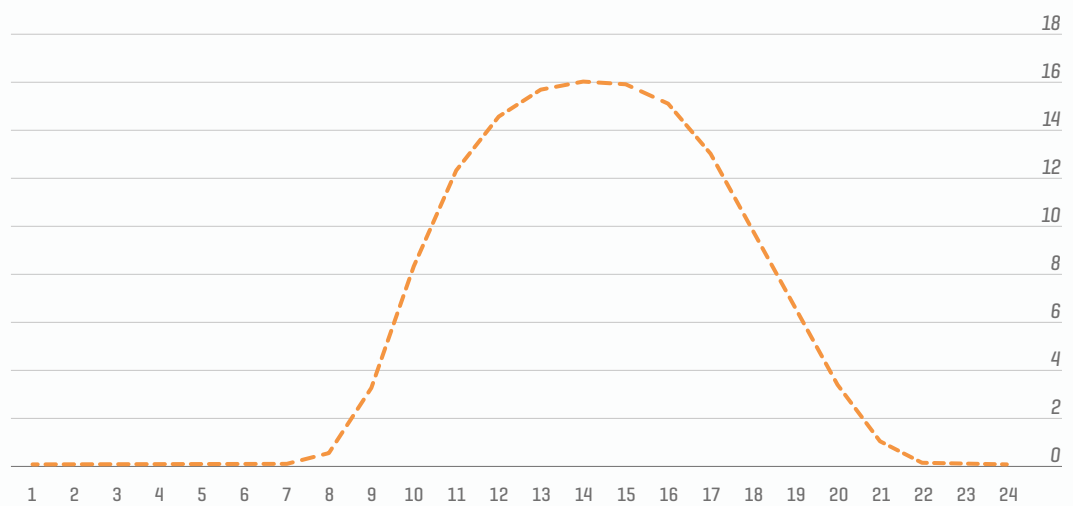
GWh and %



Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

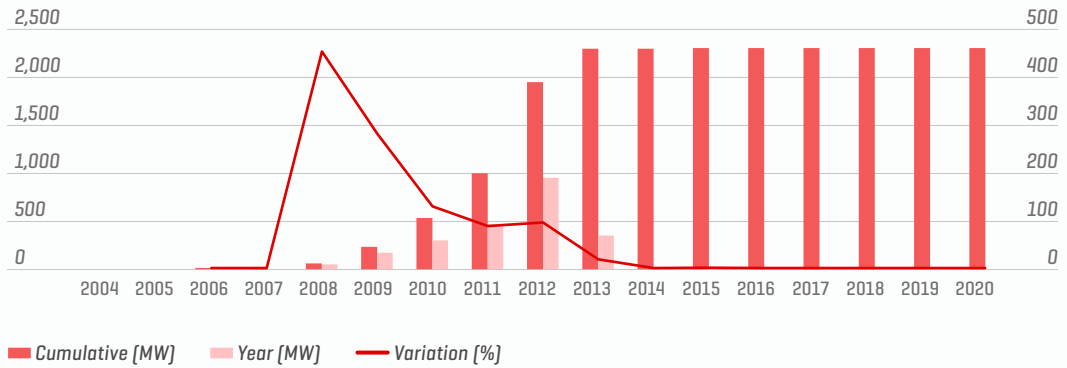
Average hourly share of solar photovoltaic power generation in relation to the total generation in 2020. National electricity system

%



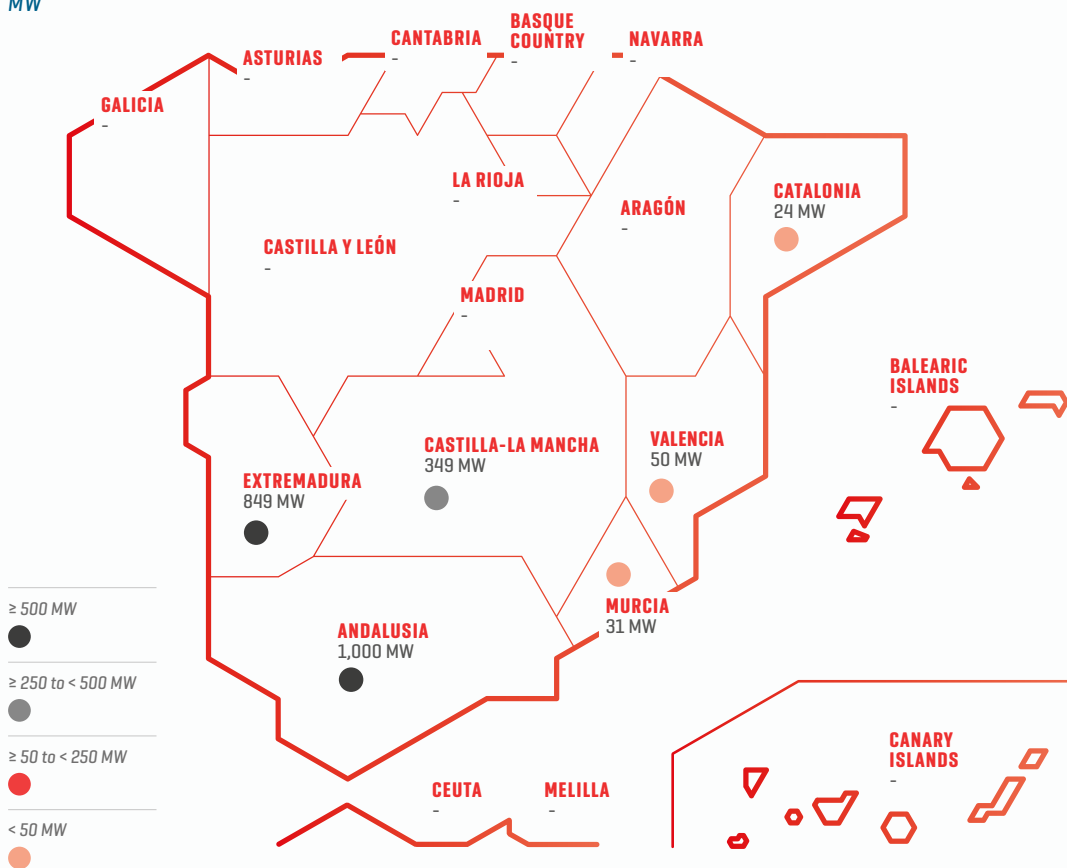


Installed solar thermal power capacity. National electricity system MW and %



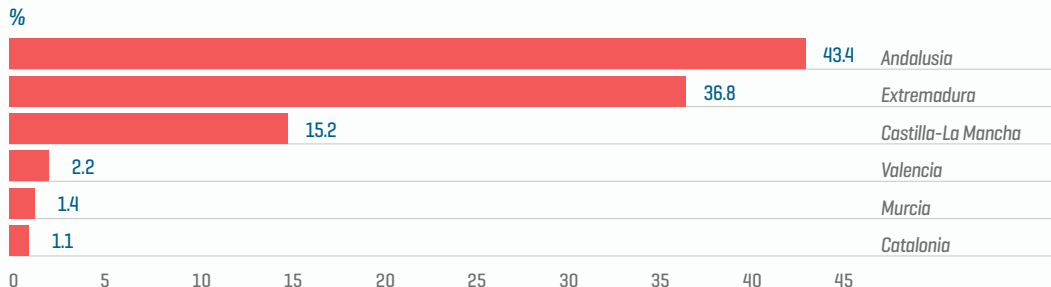
Source: National Commission of Markets and Competition (CNMC) until 2014.

Installed solar thermal power capacity per Autonomous Community as at 31.12.2020. National electricity system MW



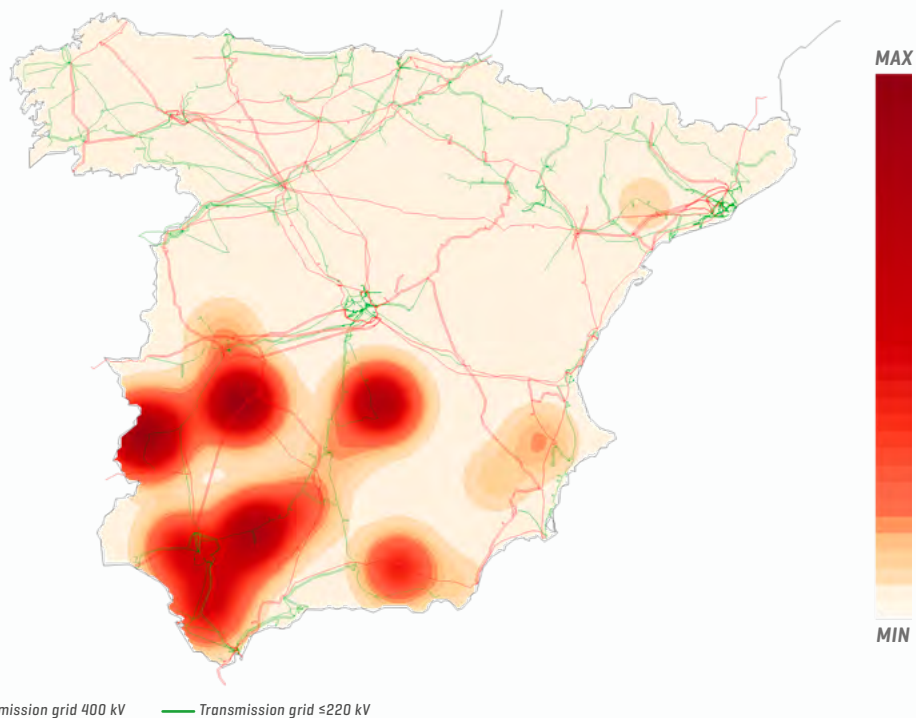


Share of installed solar thermal capacity per Autonomous Community in relation to the installed solar thermal capacity nationwide



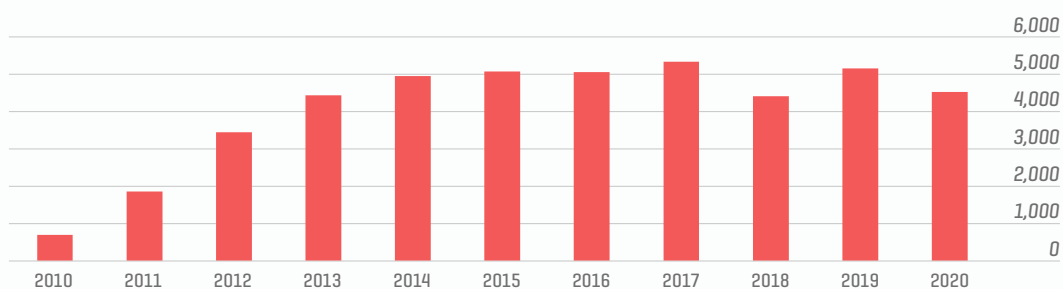
Geographical distribution of solar thermal facilities on the Spanish Peninsula as at 31.12.2020

MW



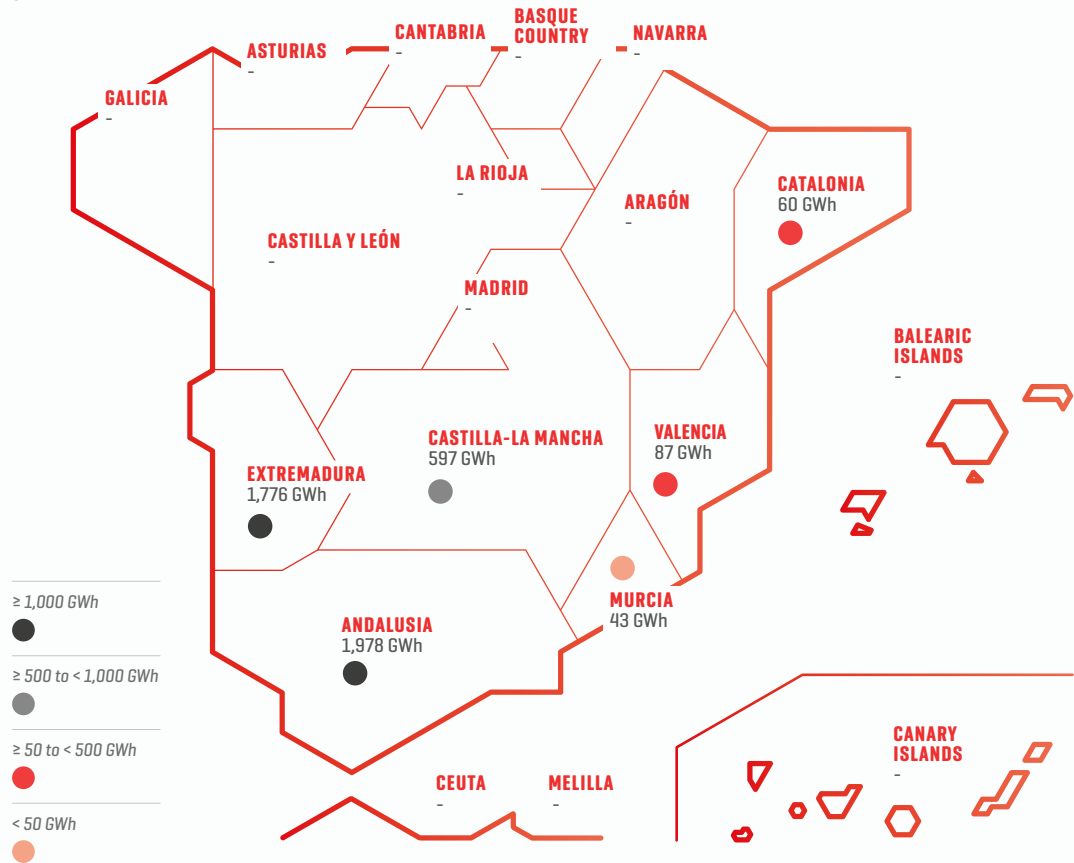
Solar thermal power generation. National electricity system

GWh

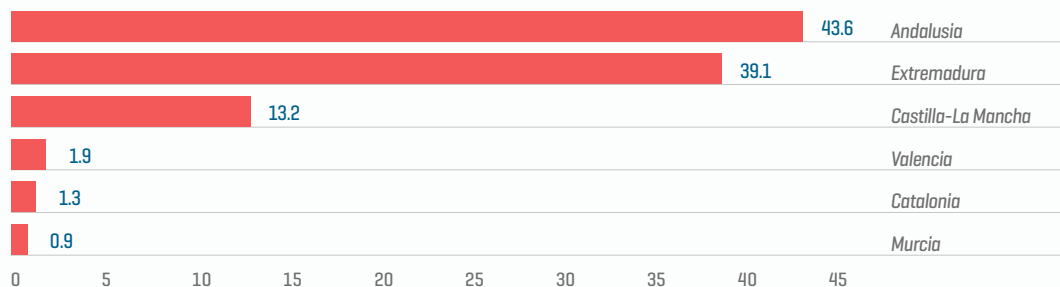




Solar thermal power generation per Autonomous Community in 2020. National electricity system GWh

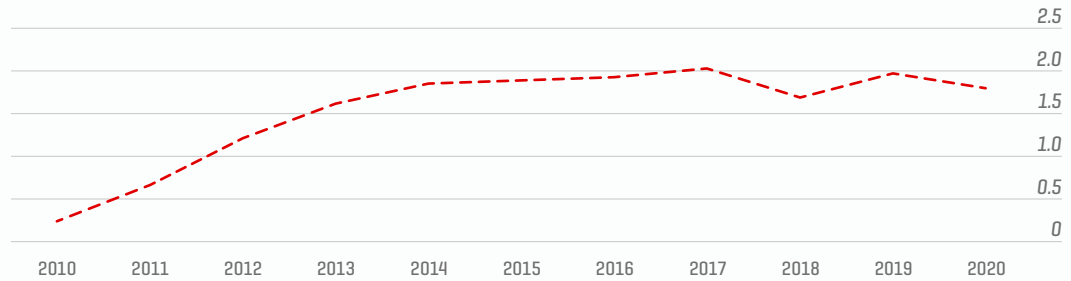


Solar thermal power generation per Autonomous Community in relation to the thermal power generation nationwide %

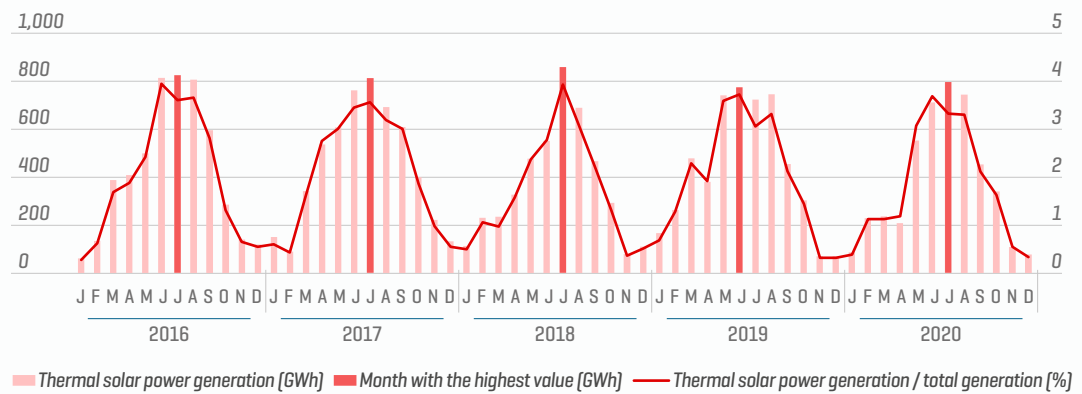




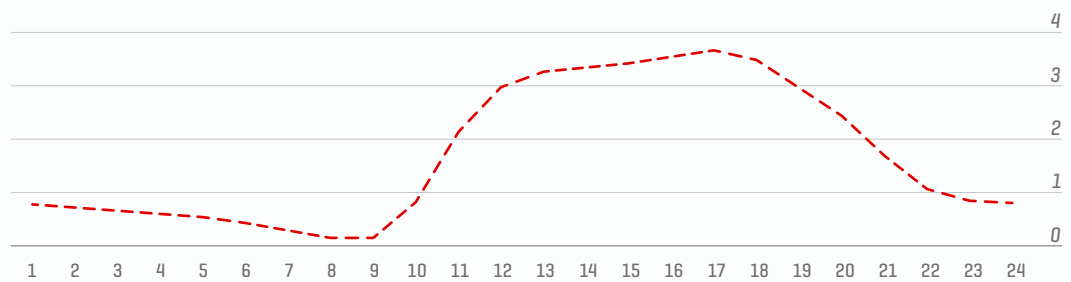
Share of solar thermal power generation. National electricity system
GWh



National solar thermal power generation, monthly maximum values and share in the total generation mix. National electricity system
GWh and %



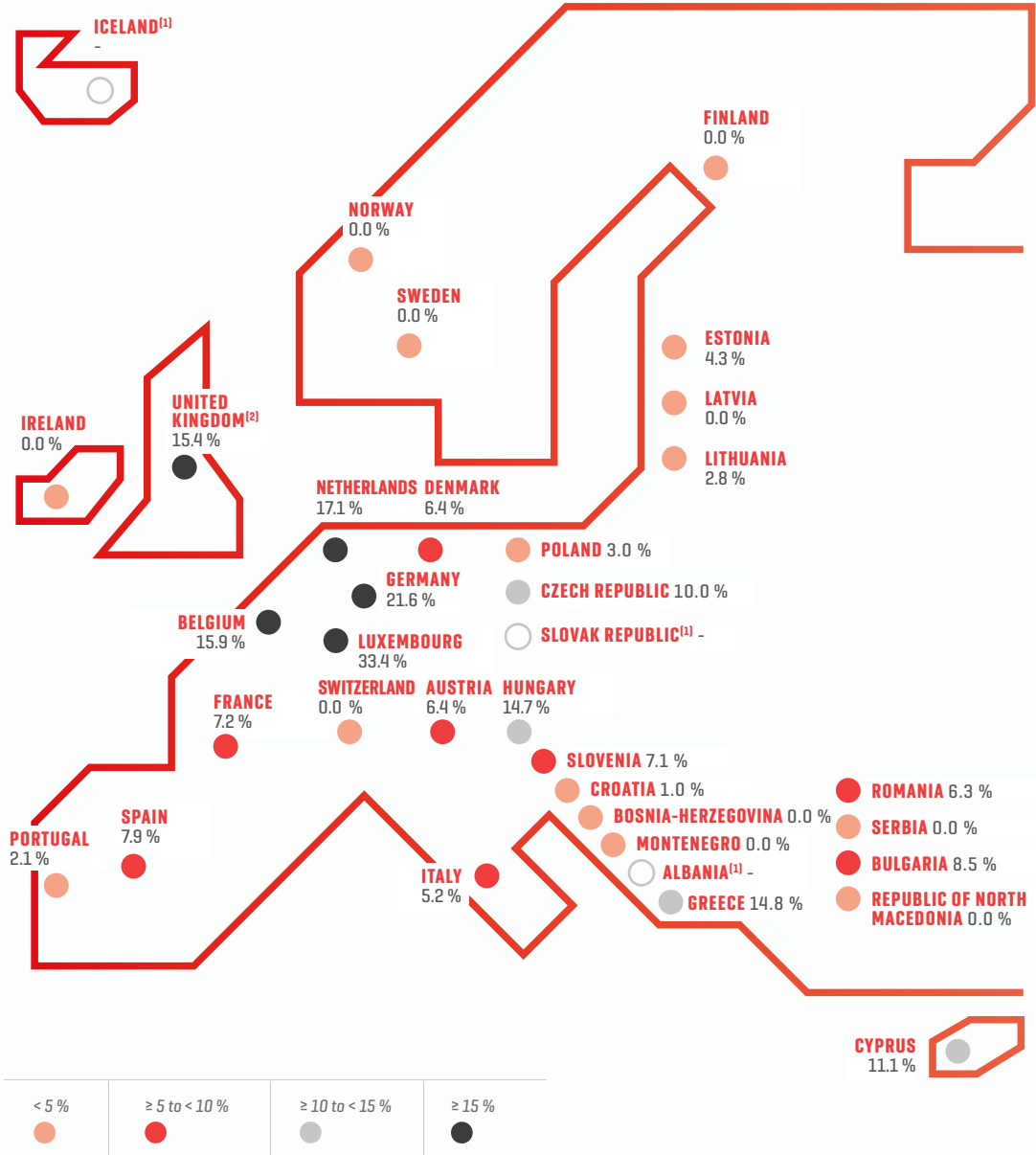
Average hourly share of solar thermal power generation in relation to the total generation in 2020. National electricity system
%





Solar power capacity over total installed power capacity in ENTSO-E member states as at 31.12.2020

%



Source: data obtained from the ENTSO-E Transparency Platform as at 26/2/2021. The data is governed by Regulation (EU) No 543/2013, and is obtained from real-time systems and therefore differs from the consolidated data used for the specific case of Spain at national level, which is obtained using a power measurement system.

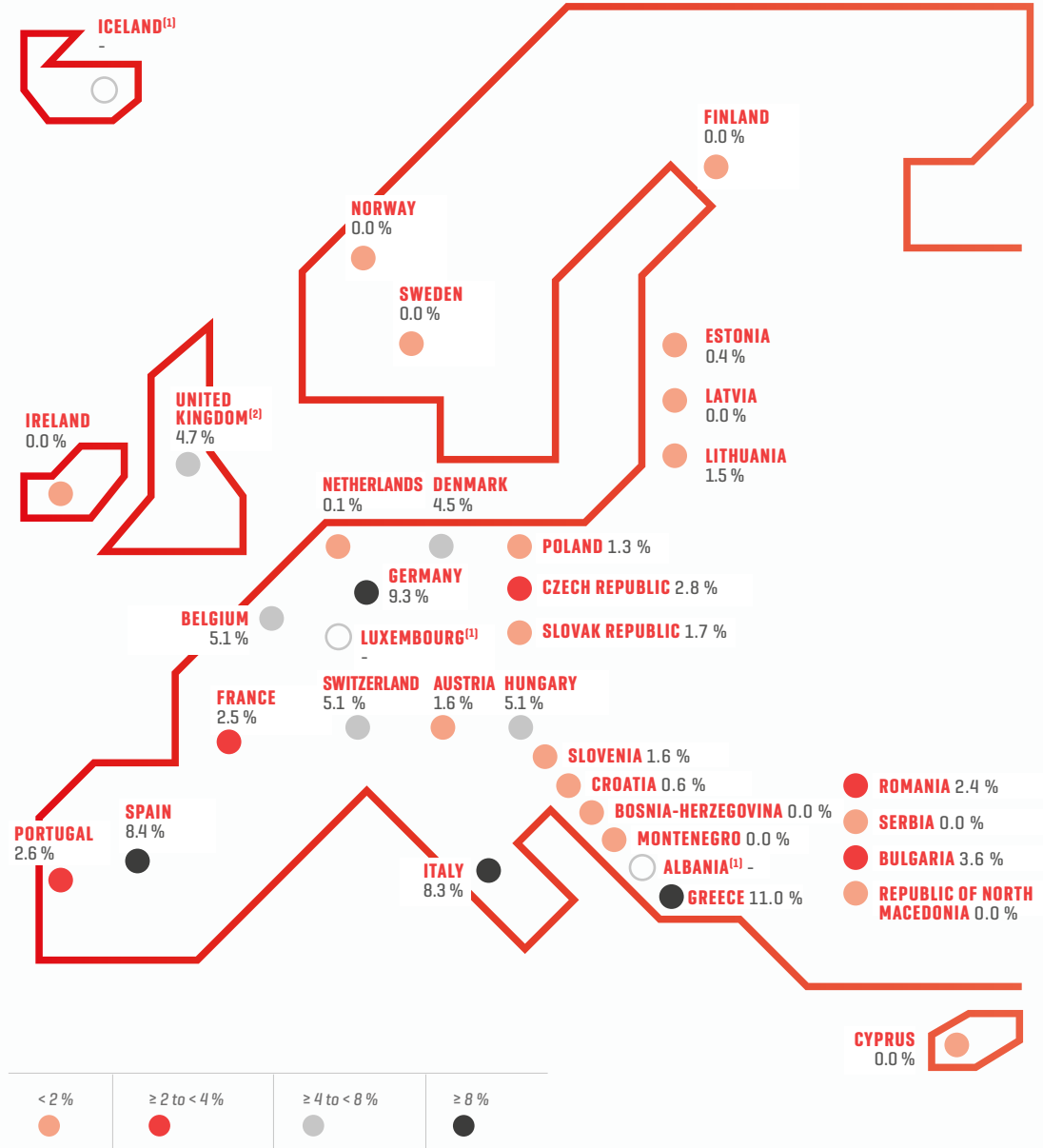
[1] Data not available.

[2] Includes Northern Ireland.



Solar power generation over total generation in ENTSO-E member states in 2020

%



Source: data obtained from the ENTSO-E Transparency Platform as at 26/2/2021. The data is governed by Regulation [EU] No 543/2013, and is obtained from real-time systems and therefore differs from the consolidated data used for the specific case of Spain at national level, which is obtained using a power measurement system.

[1] Data not available.

[2] Includes Northern Ireland.



5
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Energy from the earth and the sea

At the close of 2020, this set of renewables comprised of a wide range of sources, led by biomass, accounted for **1.1%** of the installed power capacity in Spain and slightly over 2% of the overall generation.

—

This chapter contains aggregate information on a group of renewable technologies that use a wide range of sources, which together account for 2.1% of the installed renewable energy capacity and 1.1% of the overall installed power capacity in Spain at the close of 2020. These energy technologies can be divided into four blocks: biomass and biogas (1,085.5 MW); renewable waste identified as 50% of municipal solid waste (157.3 MW); wind-hydro, installed on the island of El Hierro (11.3 MW); and marine energy 4.8 MW.

It should be noted that the evolution of this combined set of energy technologies has been constant for over a decade¹, going from 491 MW of power in 2004 to 1,259 MW in 2020. However, its share in the Spanish generation mix is still very low. During 2020, the combined set exceeded for the first time ever a share of 2% in the annual generation mix.

For yet another year, it is relevant to highlight the specific case of the Gorona del Viento wind-hydro power station which, in 2020, produced 42% of the annual generation of the island of El Hierro using renewable sources. Additionally, it was responsible for helping the Island be 100% renewable for more than 41 days throughout the year. During the months of July and August the integration of renewable energy reached 85% and 81% respectively.

By autonomous community, Andalusia is clearly the region with the most installed power capacity, with more than 35% of all the installed power capacity of this set of renewables. It is followed, in order, by Castilla-La Mancha, Castilla y León and Catalonia.

In 2020, the Gorona del Viento hydro-wind power station produced 42% of the annual generation of the island of El Hierro using renewable sources.

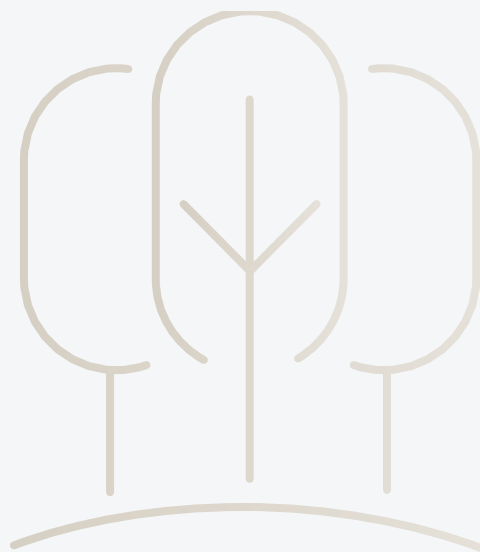
1,259 MW

INSTALLED POWER CAPACITY
IN 2020



+4.0%

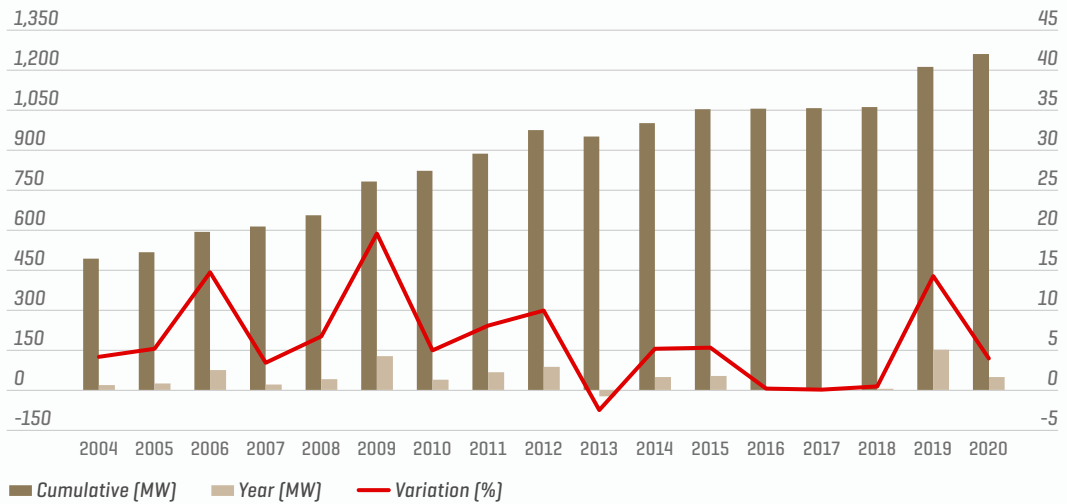
COMPARED TO 2019



1. The evolution of these technologies over the years has been affected by a reorganisation due to regulatory changes, as was the case in 2015 with Royal Decree 413/2014 on electricity generation from renewables, cogeneration and waste.



Other Renewables. Installed power capacity. National electricity system MW and %



Includes biogas, biomass, geothermal, marine-hydro, wind-hydro and renewable waste.

Source: Spanish National Markets and Competition Commission [CNMC] until 2014. Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

Other Renewables. Installed power capacity by Autonomous Community as at 31/12/2020. National electricity system MW

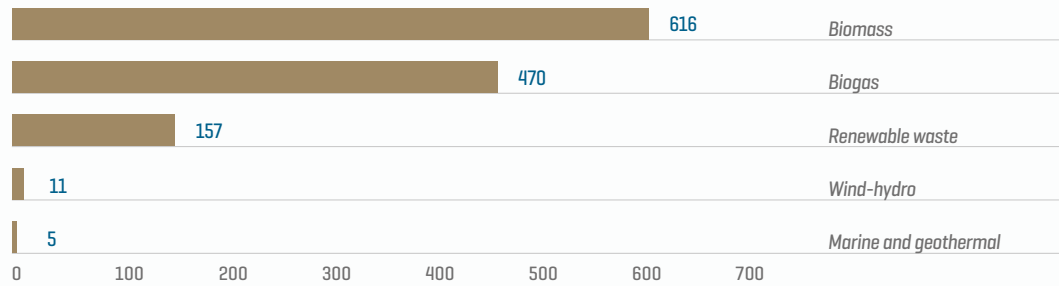




Other Renewables. Installed power capacity by fuel type as at 31.12.2020.

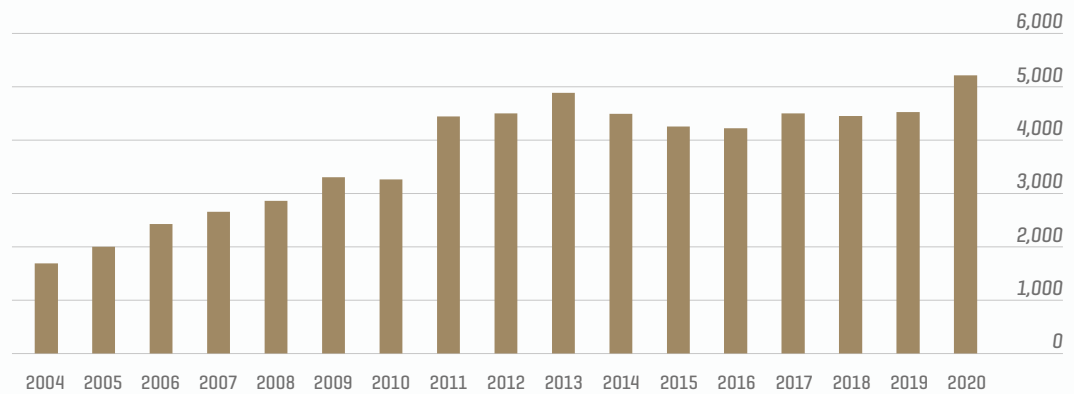
National electricity system

MW



Other Renewables. Electricity generation. National electricity system

GWh



Includes biogas, biomass, geothermal, marine-hydro, wind-hydro and renewable waste.

Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.





Electricity generation from 'Other Renewables' per Autonomous Community in 2020. National electricity system

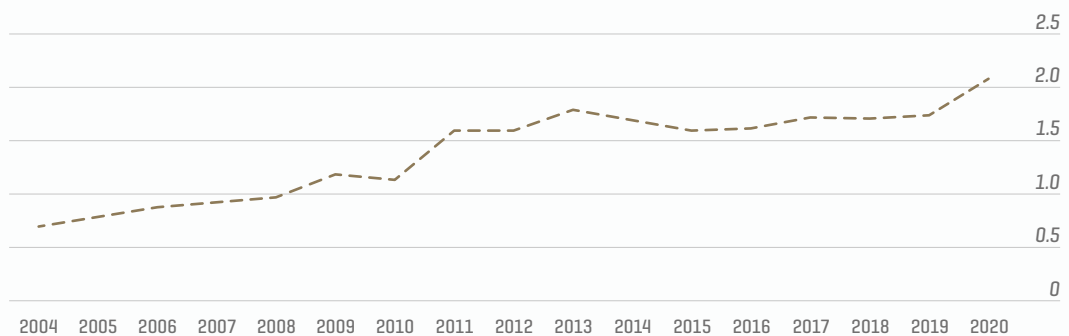
GWh



Includes biogas, biomass, geothermal, marine-hydro, wind-hydro and renewable waste.

Share of generation from 'Other Renewables' in the total generation mix. National electricity system

%

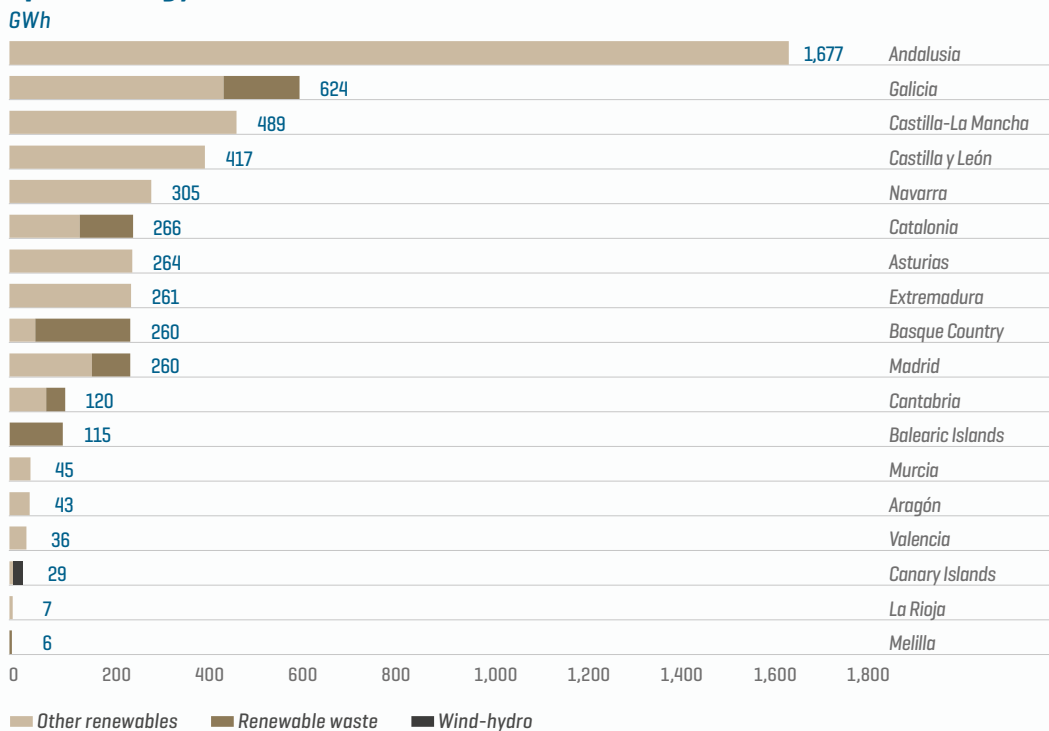


Includes biogas, biomass, geothermal, marine-hydro, wind-hydro and renewable waste.

Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

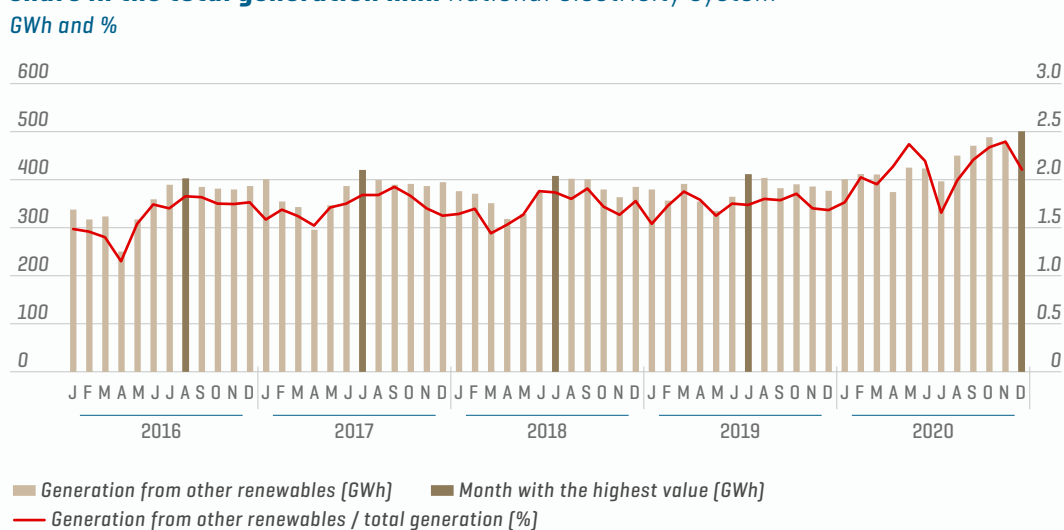


Generation from 'Other Renewables' per Autonomous Community and by type of technology in 2020



Includes biogas, biomass, geothermal, marine-hydro, wind-hydro and renewable waste.

National generation from 'Other Renewables', monthly maximum values and share in the total generation mix. National electricity system

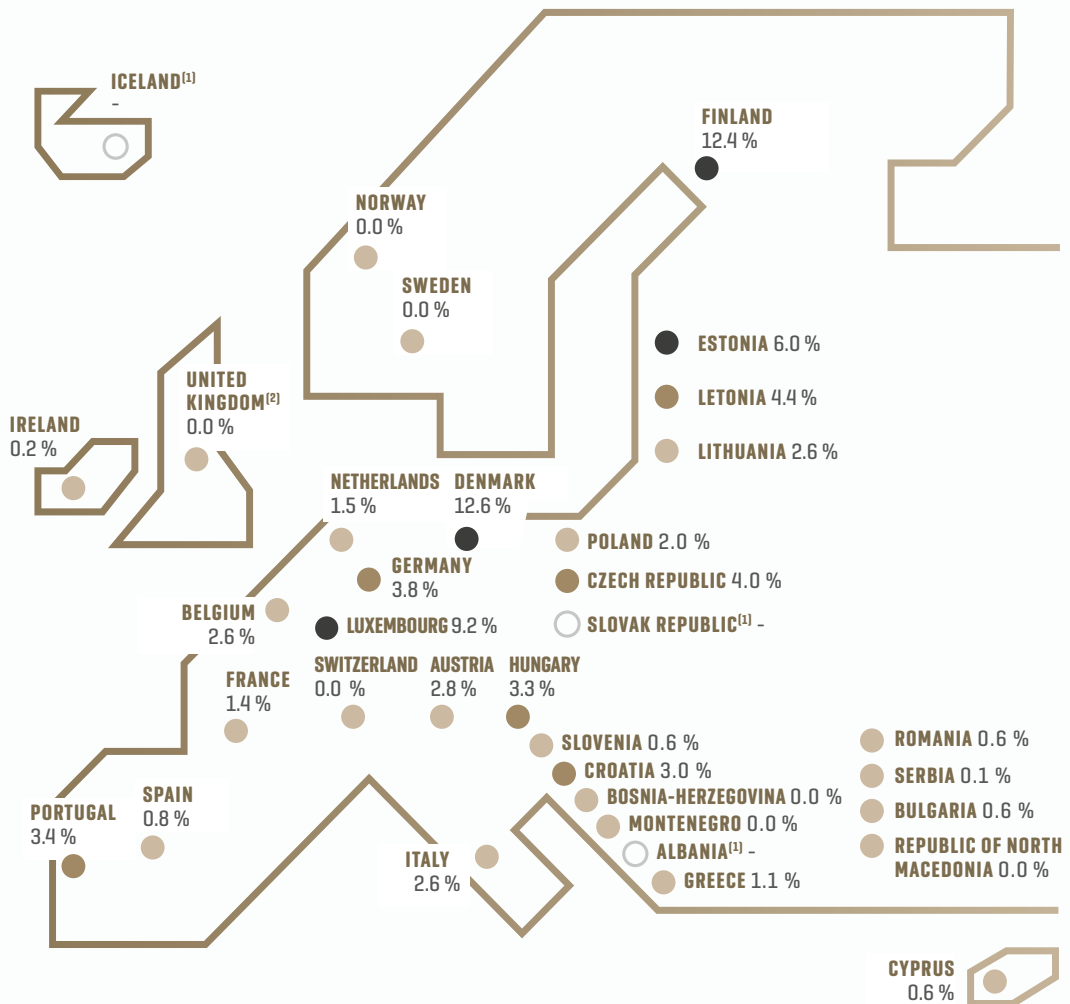


Includes biogas, biomass, geothermal, marine-hydro, wind-hydro and renewable waste.



Power capacity of 'Other Renewables' over total installed power capacity in ENTSO-E member states as at 31.12.2020

%



< 3 %



≥ 3 to < 6 %



≥ 6 %



Source: data obtained from the ENTSO-E Transparency Platform as at 26/2/2021. The data is governed by Regulation (EU) No 543/2013, and is obtained from real-time systems and therefore differs from the consolidated data used for the specific case of Spain at national level, which is obtained using a power measurement system.

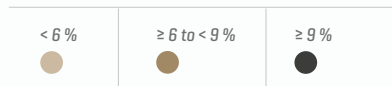
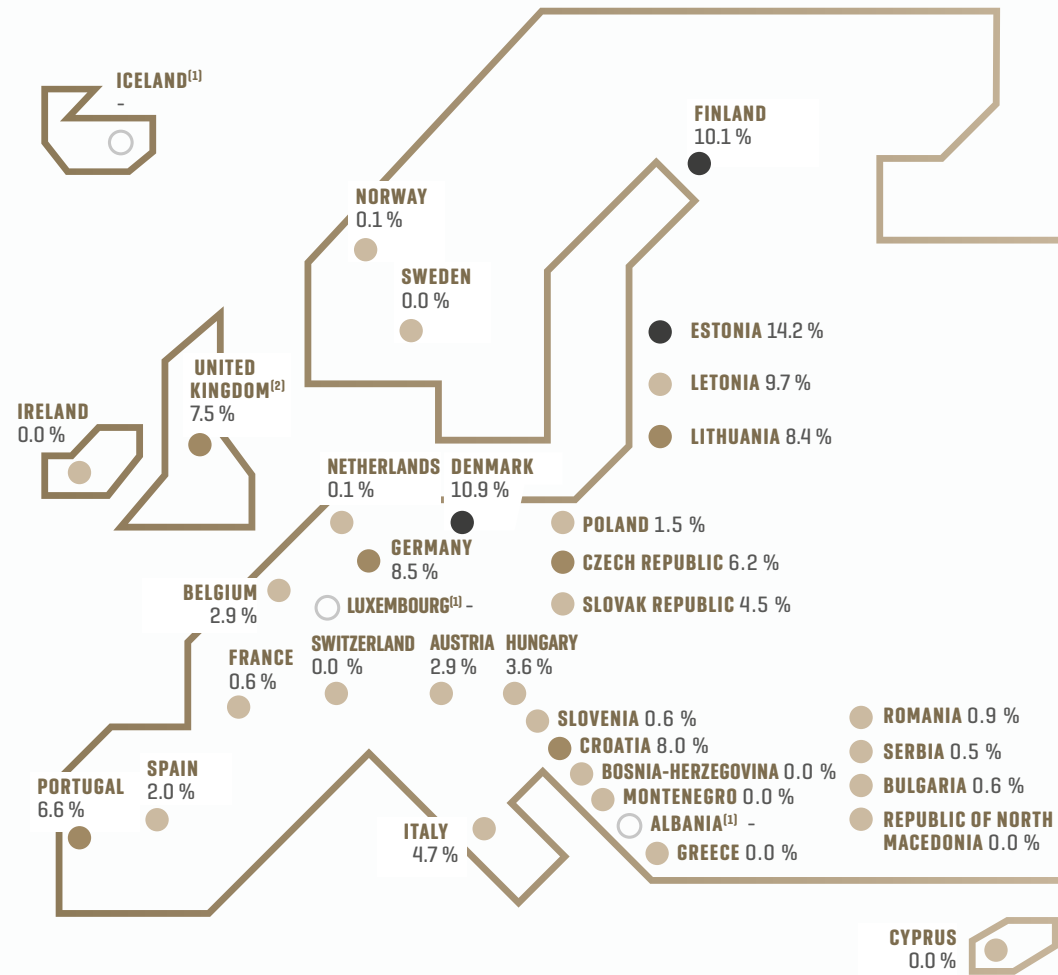
[1] Data not available.

[2] Includes Northern Ireland.



Power generation from 'Other Renewables' over total generation in ENTSO-E member states in 2020

%



Source: data obtained from the ENTSO-E Transparency Platform as at 26/2/2021. The data is governed by Regulation [EU] No 543/2013, and is obtained from real-time systems and therefore differs from the consolidated data used for the specific case of Spain at national level, which is obtained using a power measurement system.

[1] Data not available.

[2] Includes Northern Ireland.



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