

**RENEWABLE ENERGY IN THE SPANISH
ELECTRICITY SYSTEM**

2019

Committed To Intelligent Energy

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RED
ELÉCTRICA
DE ESPAÑA

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PRESENTATION

During 2019, the concern within European institutions regarding the fight against climate change and the energy transition has not only allowed us to make progress towards achieving the targets set out in the regulatory measures known as the 'Clean energy for all Europeans' package, but it has also allowed further progress to be made in this field and, as a result, the European Green Deal was drafted and presented at the end of the year. This Green Deal establishes a series of actions which strive to make Europe the first climate-neutral continent (net-zero greenhouse gas emissions) by 2050.

In this context, the electricity sector is an essential player in the decarbonisation process and the energy transition, and consequently, Red Eléctrica de España (REE), in its role as sole transmission agent and operator of the Spanish electricity system, becomes a facilitating agent to ensure the electricity policies aimed at promoting the energy transition are successfully implemented.

The success of this 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 involving renewable resources that took place during 2019. Our complete set of generating facilities is now more renewable than ever with almost 6,700 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 transition process.

Society's interest in learning more about measures 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 fourth 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 2019, as well as how renewables have evolved over recent years.

This report begins with the chapter 'Renewable Energy in 2019', 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. Throughout this document we provide a breakdown of 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.



RENEWABLE ENERGY

IN 2019

The fall in renewable generation was caused by lower hydroelectric generation [-27.6%], as a consequence of a year with less rainfall, although the decrease in production with coal-fired facilities [-66%] has triggered a considerable reduction in CO₂ emissions.

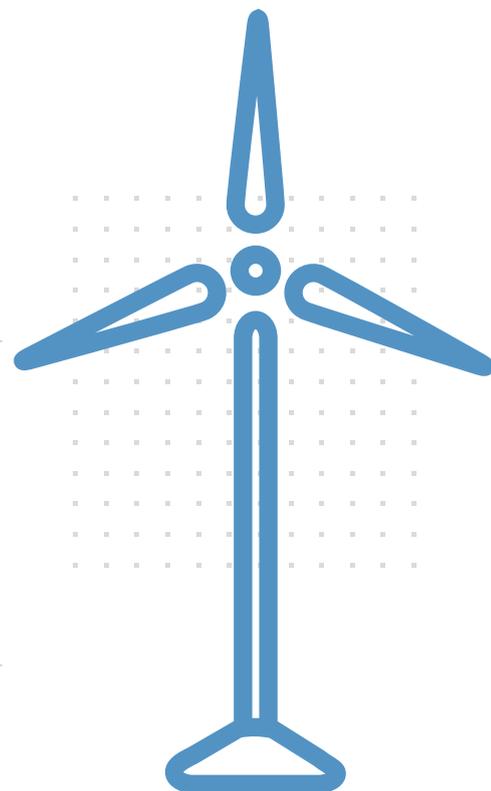
The complete set of generating facilities with renewable energy sources in Spain totalled 55,349 MW at the close of 2019, almost 38% of the total generation, a figure slightly lower than the share of these energy sources in 2018, which exceeded 38%.

97,888
GWh

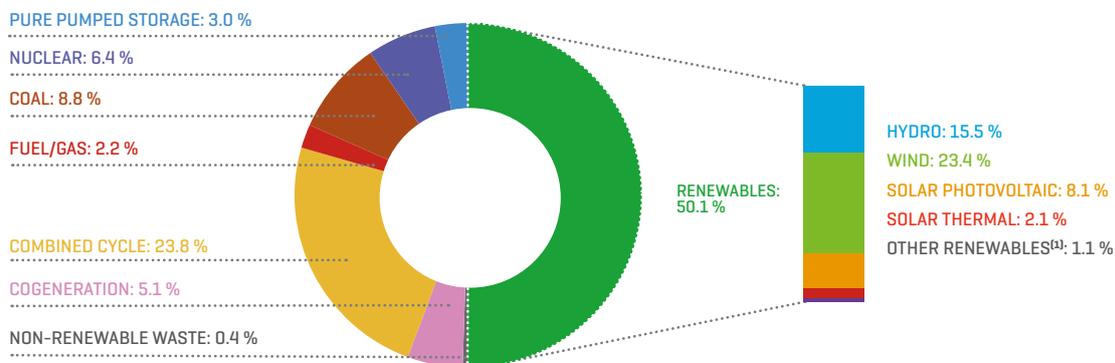
RENEWABLE ENERGY
GENERATION

38 %

OF THE TOTAL GENERATION



Breakdown of installed power capacity as at 31.12.2019. National electricity system [%]

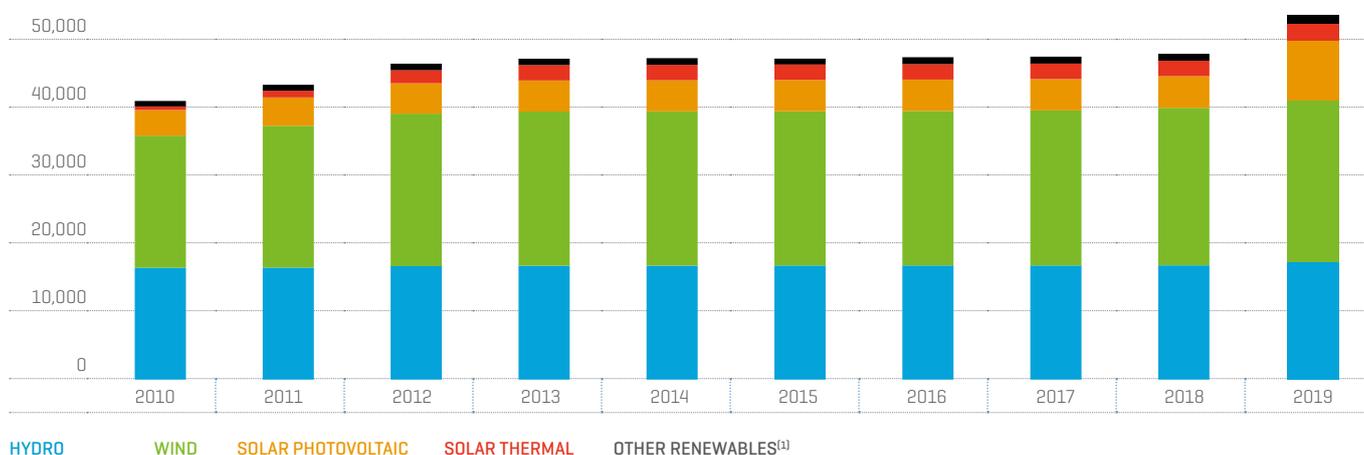


[1] Includes biogas, biomass, geothermal, marine, wind-hydro and renewable waste.

2019 saw the highest increase in renewable installed power capacity in the last ten years, almost 14% more than at the close of 2018, representing an increase of 6,693 MW. For the first time since statistical records began, 50.1% of the complete set of electricity generation facilities in Spain corresponds to renewable energy facilities.

This growth is mainly due to the increase in solar photovoltaic power, which contributed 63% of the new installed renewable power capacity. The second source, although a long way behind, which has contributed most to the new installed renewable capacity, was wind power with an additional 2,254 MW.

Evolution of installed renewable power capacity. National electricity system [MW]

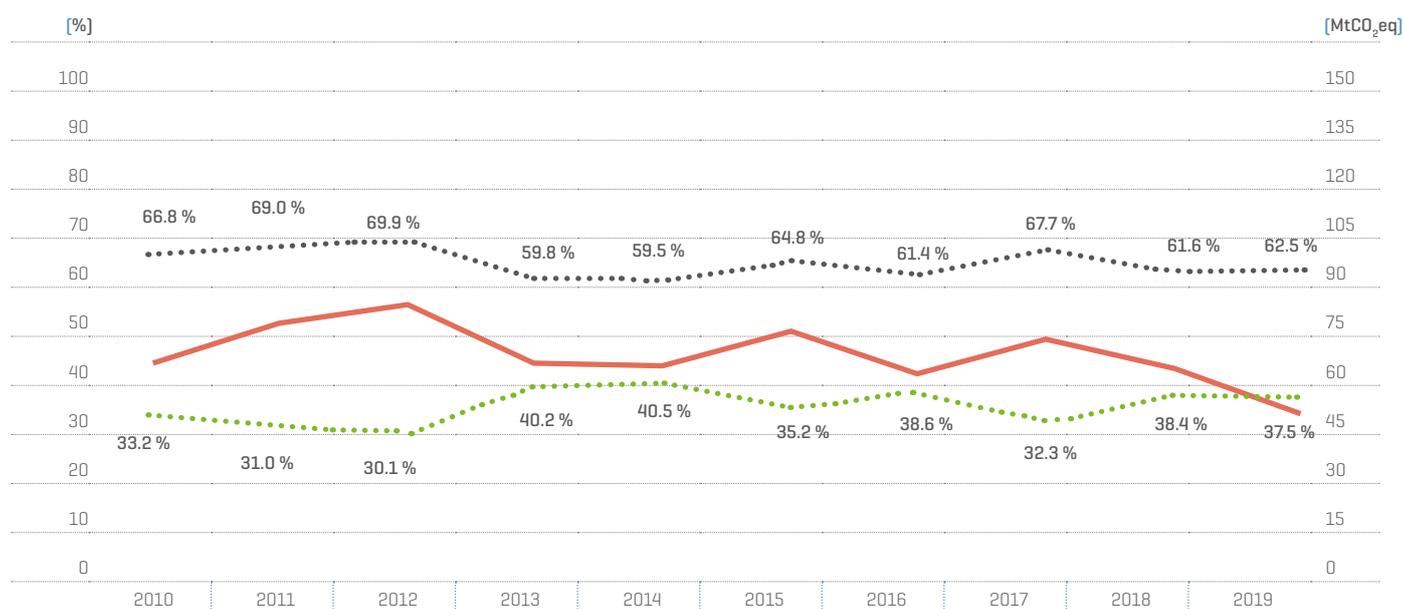


[1] Includes biogas, biomass, geothermal, marine, wind-hydro and renewable waste.

The contribution of renewable energies to national electricity generation this year was slightly lower than in the previous year, with a 37.5% share compared to 38.4% in 2018. Despite this decrease, the

share of renewable generation represents its fifth highest value in the last ten years.

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

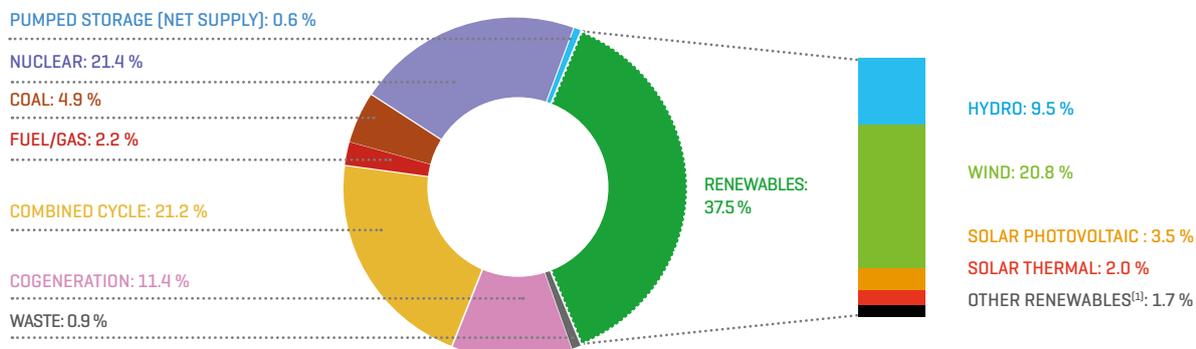


RENEWABLES: HYDRO, WIND-HYDRO, WIND, SOLAR PHOTOVOLTAIC, SOLAR THERMAL, RENEWABLE WASTE AND OTHER RENEWABLES
 NON-RENEWABLES: NUCLEAR, COAL, FUEL/GAS, COMBINED CYCLE, COGENERATION, PUMPED STORAGE AND NON-RENEWABLE WASTE
 EMISSIONS [tCO₂eq]

The fall in renewable generation was caused by lower hydroelectric generation, 27.6% less than the previous year, as a result of it being a year with less rainfall. However, without taking into account hydroelectric generation, the rest of the renewable technologies in the electricity system grew by 10.5% in 2019, as all of them recorded increases with respect to the previous year.

It should be noted that, although renewable generation was slightly lower, the sharp drop in production with coal-fired facilities, almost 66% less than in the previous year, triggered a considerable reduction in CO₂ equivalent emissions, which in 2019 reached an all-time low: 50 million tonnes of CO₂ equivalent, 23% less than in 2018.

Breakdown of the electricity generation mix in 2019. National electricity system [%]



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

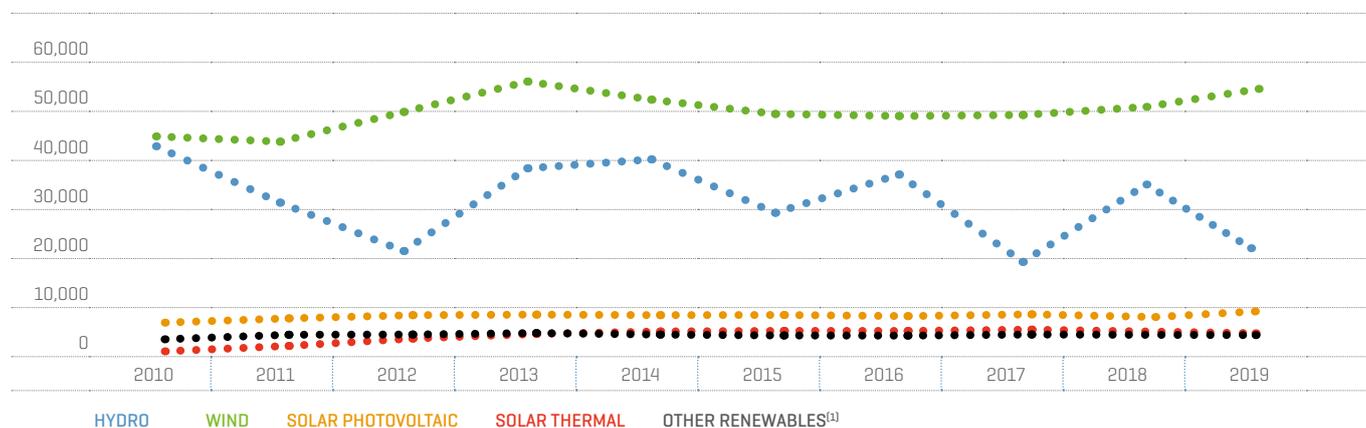
Wind energy continues to be the most important renewable technology in the national generation mix, accounting for 20.8% of the total production. This year it is behind nuclear and combined cycle production. However, it continues to be the most relevant renewable technology at a national level, as in 2019 it accounted for 55.4% of all renewables.

Wind power production has continued to grow for the third consecutive year, with an increase of 9.4% compared to 2018. In total, 54,238 GWh were produced with

this technology, which is very close to the all-time record for wind power production recorded in 2013, with 3.3% less installed renewable power capacity.

In 2019, solar photovoltaic facilities almost doubled their installed power capacity and increased their production by 19%, reaching 9,240 GWh, which is a new record for annual generation and represented a 3.5% share in the national generation mix.

Evolution of renewable energy generation. National electricity system [GWh]

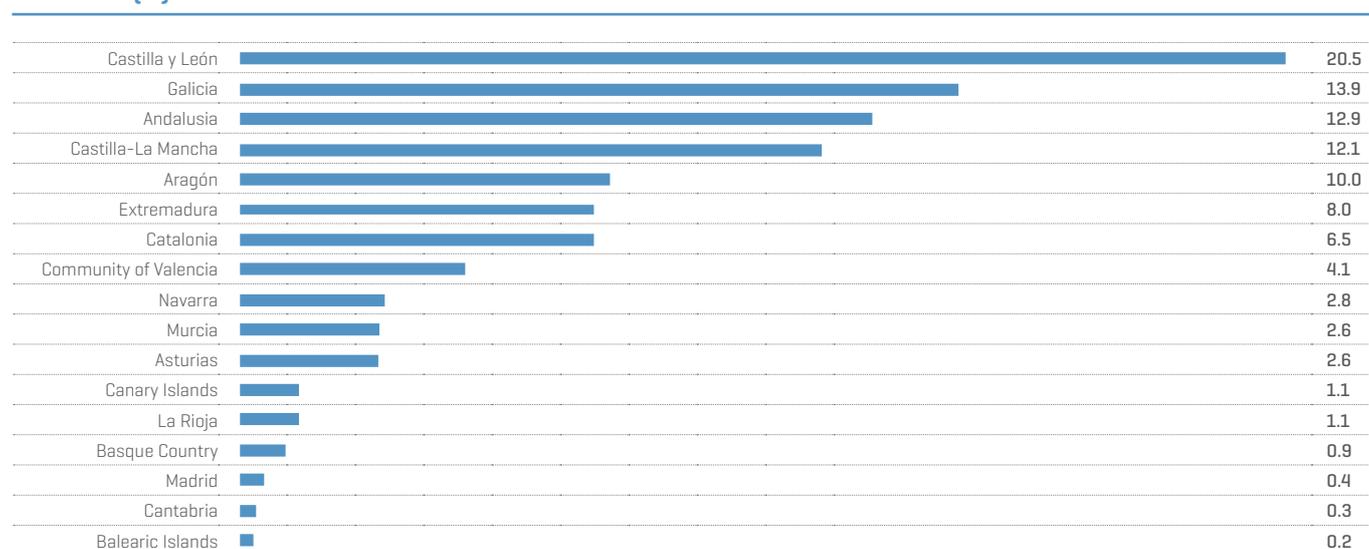


[1] Includes biogas, biomass, geothermal, marine, wind-hydro and renewable waste.

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, Galicia, Andalusia and Castilla-La Mancha, which account for almost 60% of the total installed renewable power capacity nationwide.

Of all the Autonomous Communities, Castilla y León and Castilla-La Mancha stand out above the rest, as more than 74% of their installed power capacity is renewable.

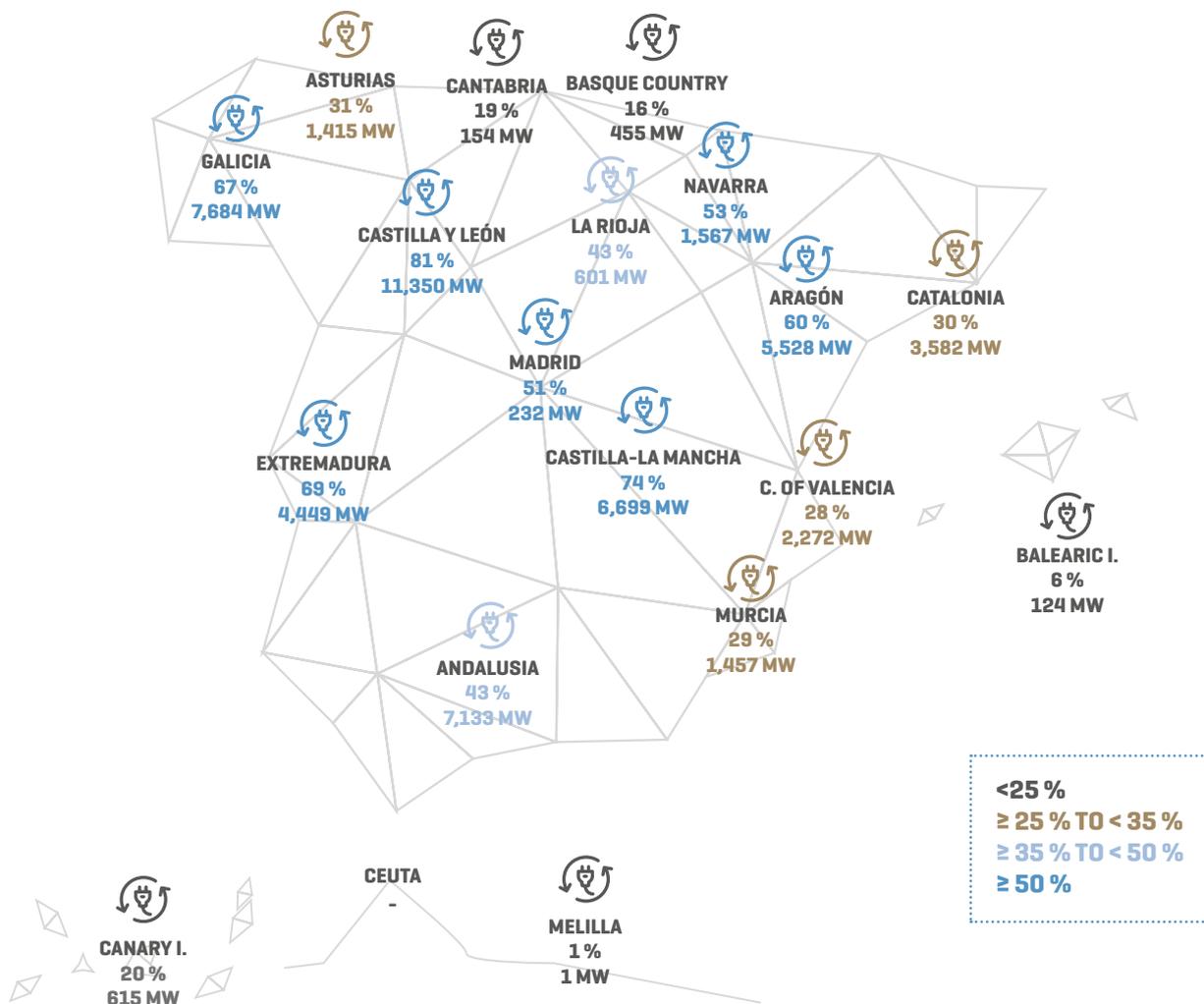
Share of the installed renewable power capacity per Autonomous Community in relation to national renewable power capacity as at 31.12.2019 [%]



The greatest variation in installed renewable power capacity was in solar photovoltaic which had a growth of 89.2 % compared to the previous year. The highest growth was recorded in Aragón, which multiplied the installed power capacity of this technology by more than five times in one year. Other significant

variations in solar photovoltaic, although not of the same magnitude, occurred in Murcia, which almost tripled its installed power capacity and Extremadura, which has doubled its installed capacity, and it is noteworthy that these two communities are now among the five with the largest installed solar photovoltaic power capacity.

Ratio regarding renewable power capacity/total power capacity (%) and renewable power capacity (MW) per Autonomous Community as at 31.12.2019



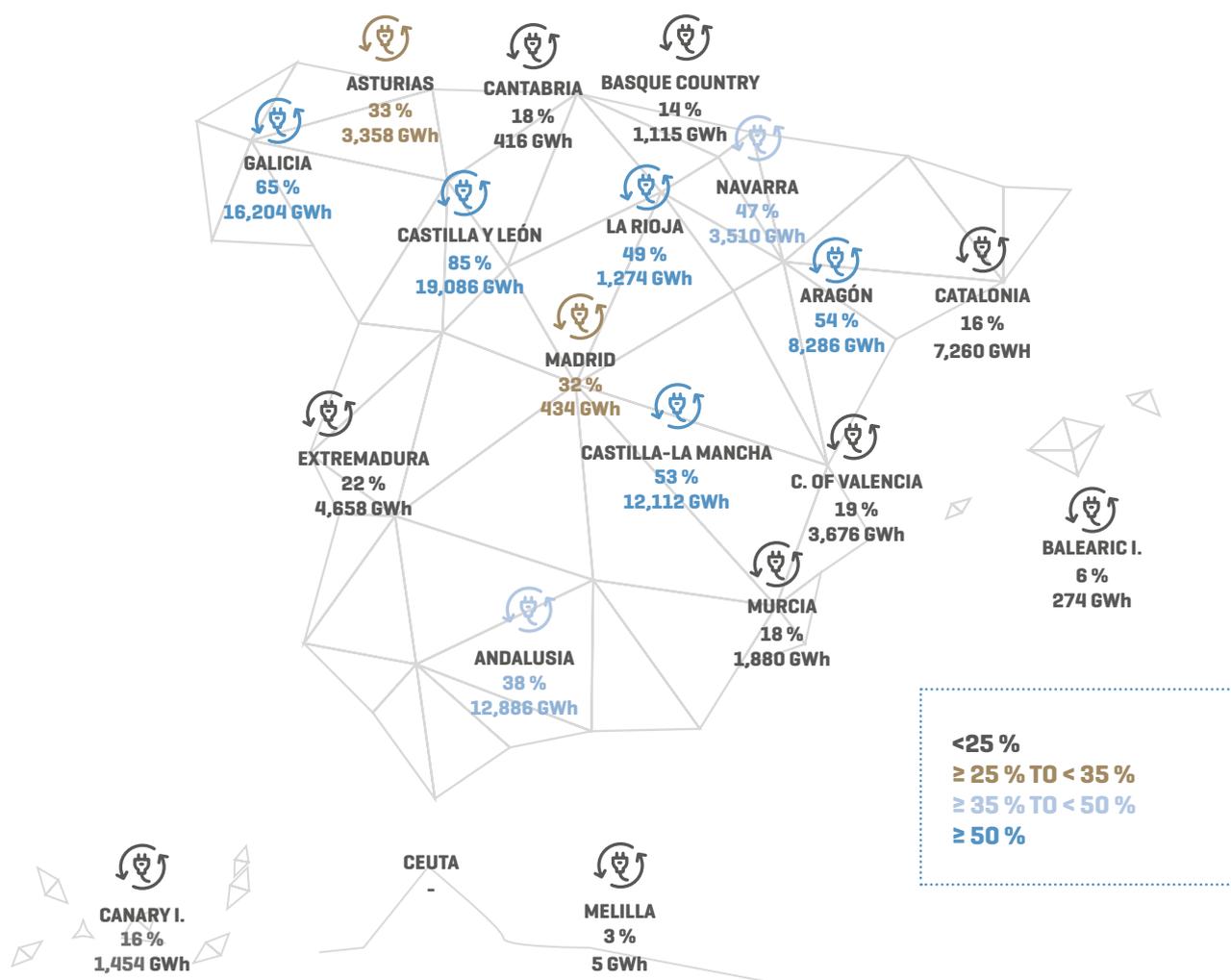
Generation with renewable energy sources per Autonomous Communities depends heavily on the distribution of installed power capacity within the Community and by the hydro reserves available each year. In 2019, the production of five of the Communities represented 70% of the total production. These are: Castilla y León, Galicia, Andalusia, Castilla-La Mancha and Aragón. In only four of the Autonomous

Communities was its generation from renewable sources greater than 50%: Castilla y León, Galicia, Aragón and Castilla-La Mancha. Noteworthy among them was the share of renewable generation in relation to total generation in Castilla y León, where these energy sources represented more than 85% of its total generation.

Share of the renewable generation per Autonomous Community in relation to national renewable generation as at 31.12.2019 [%]

Castilla y León	19.5
Galicia	16.6
Andalusia	13.2
Castilla La-Mancha	12.4
Aragón	8.5
Catalonia	7.4
Extremadura	4.8
Community of Valencia	3.8
Navarra	3.6
Asturias	3.4
Murcia	1.9
Canary Islands	1.5
La Rioja	1.3
Basque Country	1.1
Madrid	0.4
Cantabria	0.4
Balearic Islands	0.3

Ratio regarding renewable generation/total generation [%] and renewable generation [GWh] per Autonomous Community in 2019.





ENERGY FROM THE WIND

Wind power generation has increased by 9.4% compared to 2018, the highest increase since 2013.

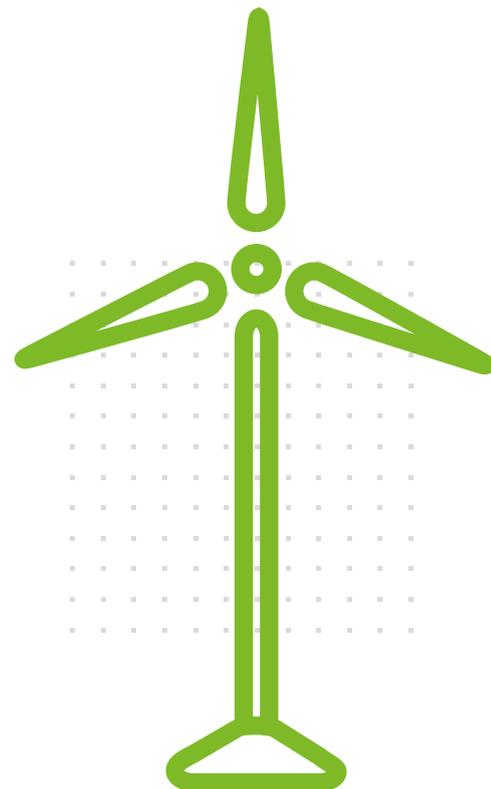
Wind power generation remains the main renewable source of energy in Spain, with an installed power capacity of 25,799 MW, which increased in the last year by more than 2,200 MW, 9.6 % compared to 2018.

20.8 %

OF THE TOTAL ENERGY
GENERATED AT A NATIONAL
LEVEL

+9.4 %

REGARDING WIND POWER
GENERATION AT A NATIONAL
LEVEL IN 2018



23.4 %

OF THE OVERALL INSTALLED
POWER CAPACITY
NATIONWIDE

Wind power generation remains the main renewable source in Spain, with an installed power capacity of 25,799 MW, which has increased in the last year by more than 2,200 MW, a rise of 9.6 % compared to 2018. In total, it represents 23.4% of the national installed power capacity, closely following combined cycle, which is the technology with the highest share in the energy mix, with 23.8%.

The high variability that wind power generation presents in the hourly coverage of demand means that its share, during 2019, ranged from a minimum value of 1.2% on 21 October at 1:00 p.m. to a maximum value of 56% on 3 November at 5:00 a.m.

The average contribution of wind power generation to demand coverage was higher in the valley hours, with an average share of 24.3%, and an average share of 21.1% during the peak hours of the day.

The producible wind power index in 2019 reached a value of 1.07, which is above average.

At Autonomous Community level, Castilla y León is the region with the most installed wind power capacity with almost 24% of installed wind power capacity nationwide, followed by Castilla-La Mancha, Galicia and Andalusia. These four regions alone account for almost 70% of installed wind power capacity in Spain. On the other hand, noteworthy are the Balearic Islands, Cantabria, Extremadura and the Basque Country which have less than 1% of installed wind power capacity nationwide.

55 %

OF THE TOTAL RENEWABLE
ENERGY GENERATED AT A
NATIONAL LEVEL

Wind power generated in 2019 increased by 9.4% compared to 2018, the highest increase since 2013. However, it was in the Canary Islands where the increase in production exceeded almost 83% of the average for 2018. Wind power accounts for 20.8% of total national generation and is the third largest source after nuclear and combined cycle, exceeding the 20% share it registered in 2013.

In the complete set of renewable energy facilities, in 2019, wind energy continued to be the leading technology during the year, representing just over 55% of the total renewable energy generated nationally, much higher than last year's figure, due to the fall in hydroelectric generation, as 2019 was a dry year.

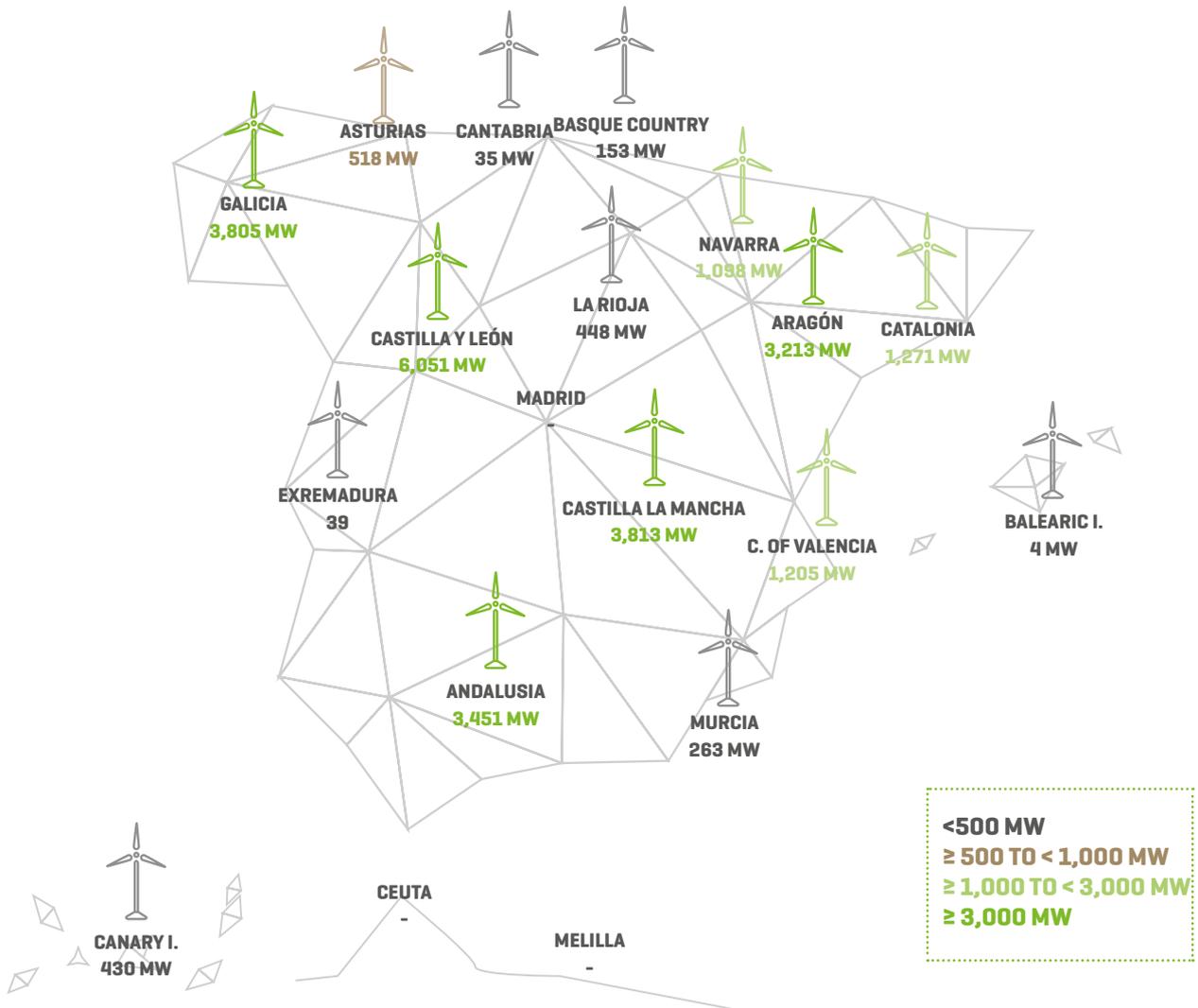
The highest monthly wind power generation of the year was recorded in November, which is also the month in which the all-time monthly record of wind power in the total generation mix was registered, representing 32.9% of the total generation nationwide.

Installed wind power capacity. National electricity system



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

Installed wind power capacity per Autonomous Community as at 31.12.2019. National electricity system (MW)

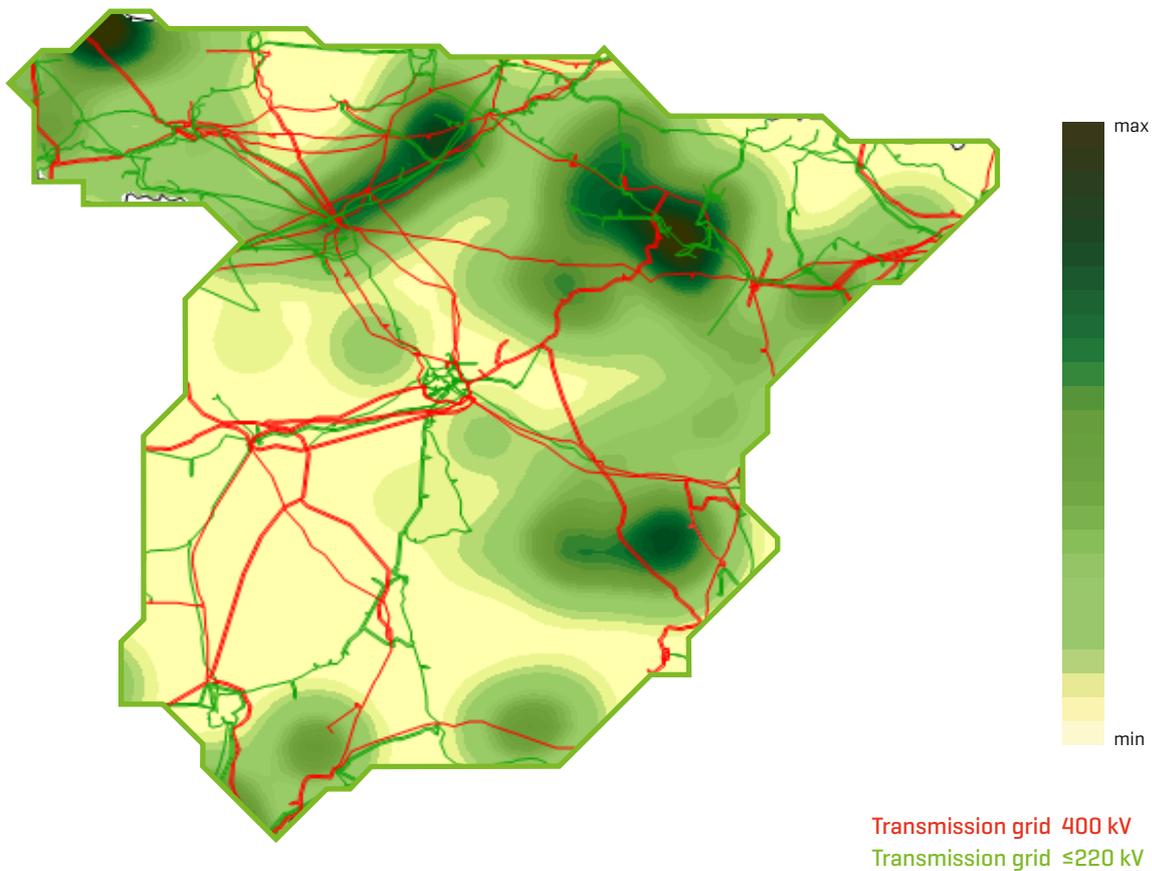


Energy from the Wind

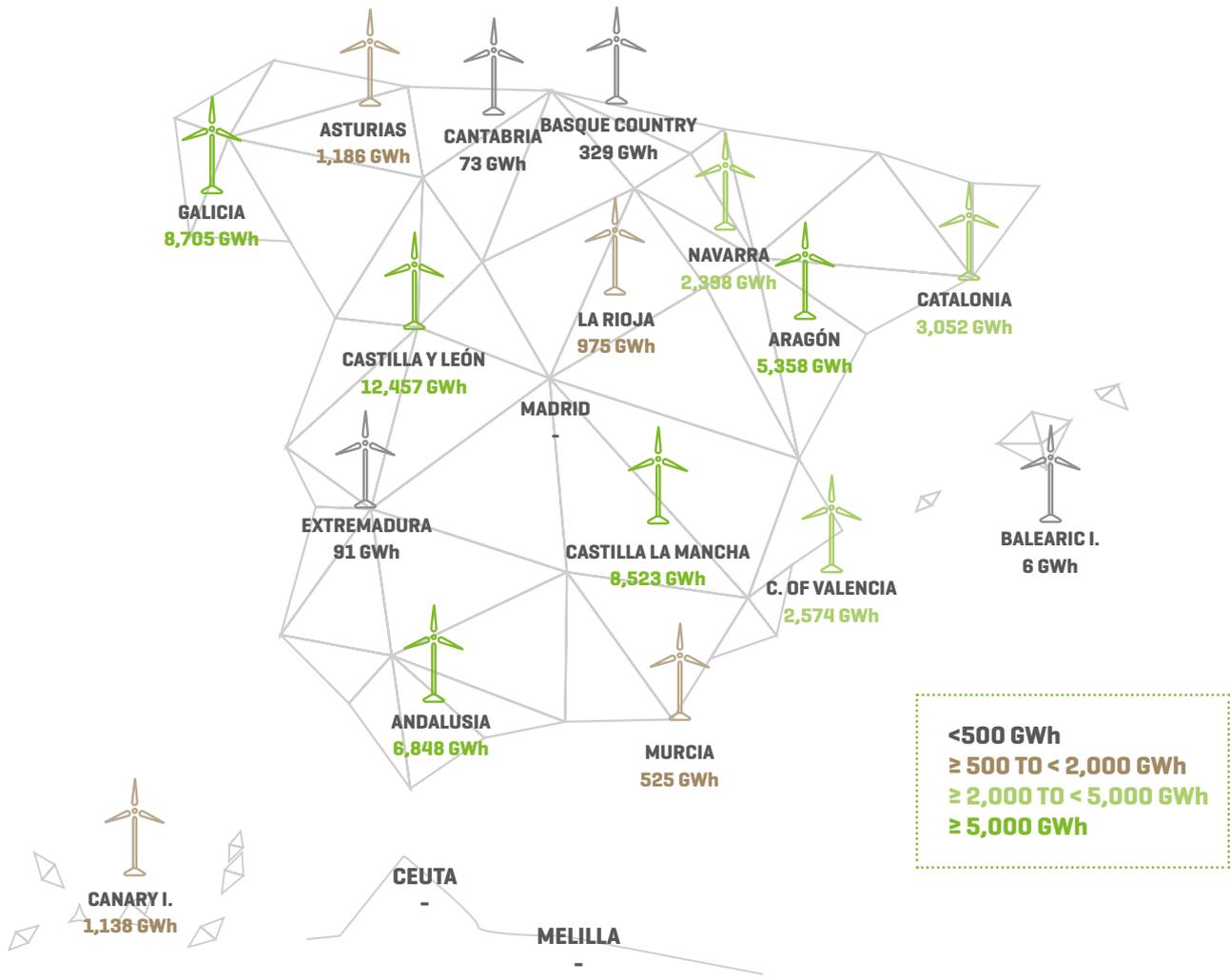
Share of installed wind power capacity per Autonomous Community in relation to the total installed wind power capacity nationwide [%]

Castilla y León	23.5
Castilla-La Mancha	14.8
Galicia	14.8
Andalusia	13.4
Aragón	12.5
Catalonia	4.9
C. of Valencia	4.7
Navarra	4.2
Asturias	2.0
La Rioja	1.7
Canary I.	1.7
Murcia	1.0
Basque Country	0.6
Extremadura	0.2
Cantabria	0.1

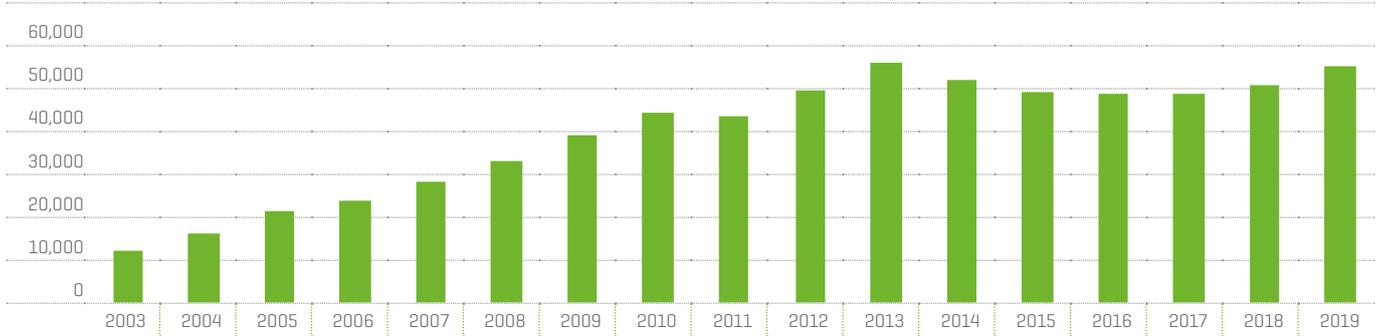
Geographical distribution of wind power facilities on the Spanish Peninsula as at 31.12.2019



Wind power generation per Autonomous Community in 2019. National electricity system (GWh)

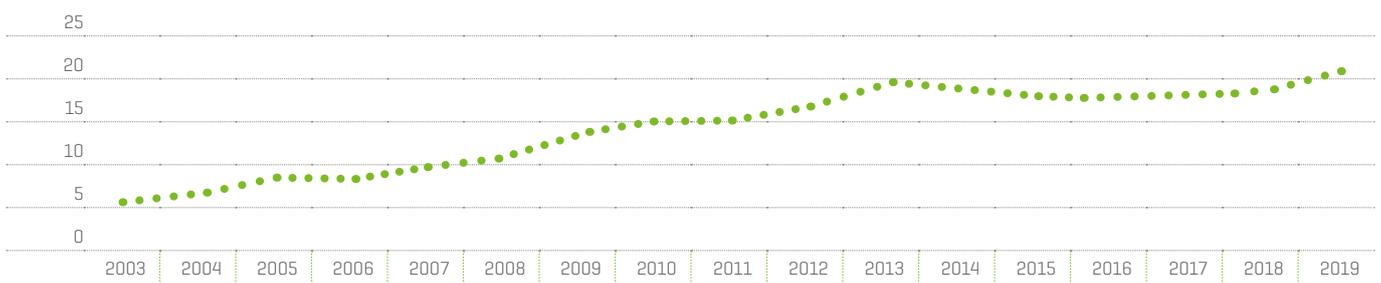


Wind power generation. National electricity system (GWh)



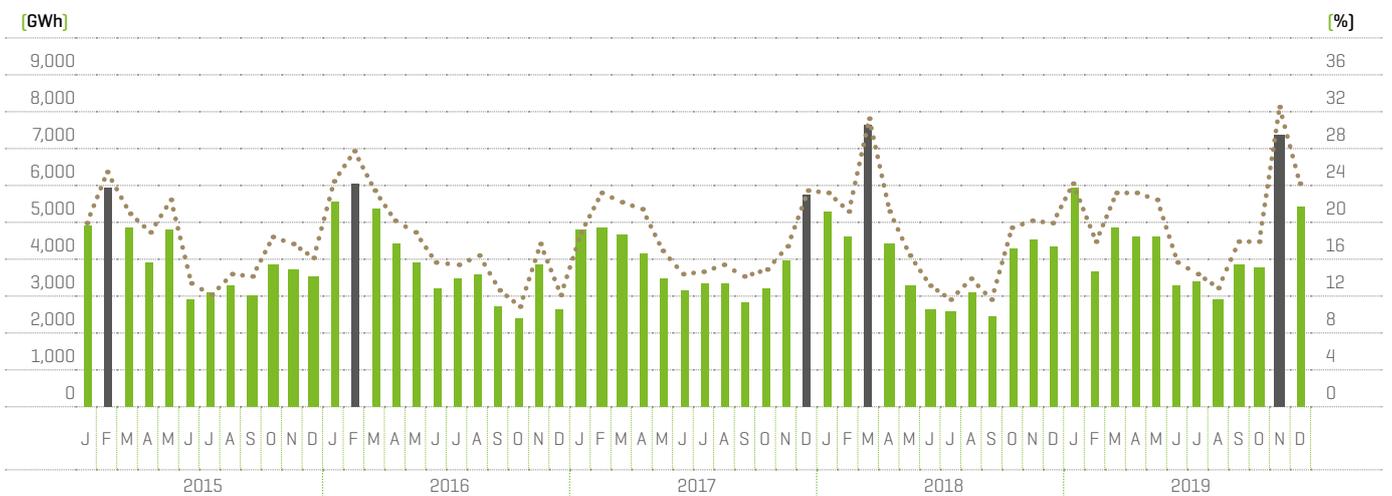
Data for the Balearic Islands and the Canary Islands available as of 2006.

Share of wind power generation in the total generation mix. National electricity system (%)



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.

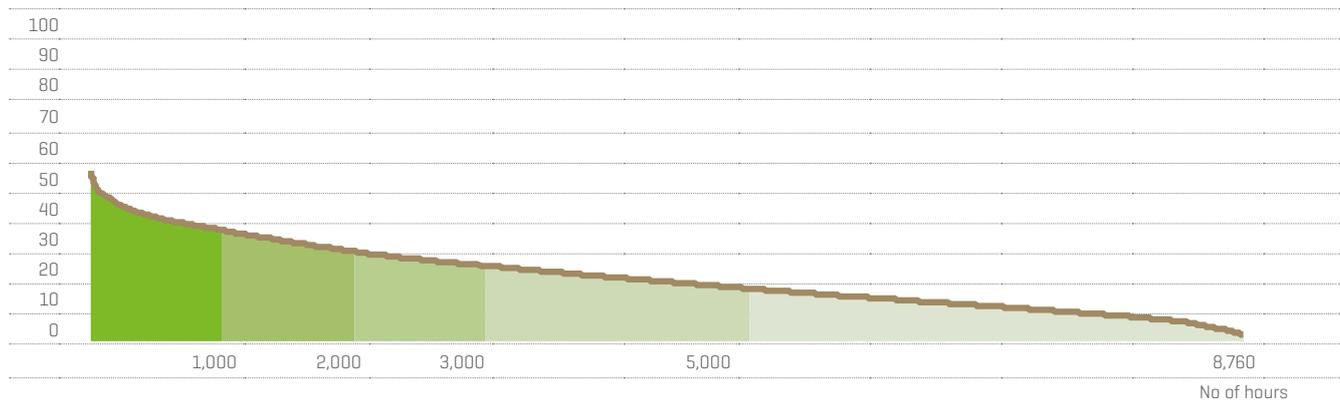


WIND POWER GENERATION (GWh) MONTH WITH THE HIGHEST VALUE (GWh) WIND POWER GENERATION / TOTAL GENERATION (%)

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

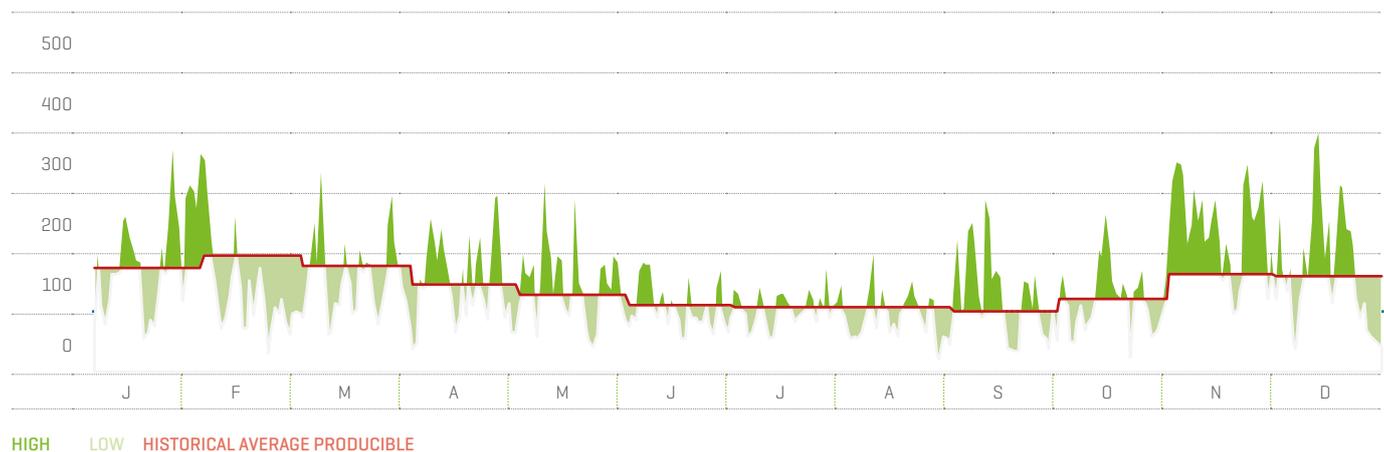
Castilla León	23.0
Galicia	16.0
Castilla La-Mancha	15.7
Andalusia	12.6
Aragón	9.9
Catalonia	5.6
C. of Valencia	4.7
Navarra	4.4
Asturias	2.2
Canary Islands	2.1
La Rioja	1.8
Murcia	1.0
Basque Country	0.6
Extremadura	0.2
Cantabria	0.1

Monotonous curve ^[1] of the share of wind power generation in demand coverage. National electricity system [%]



[1] 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. Peninsular electricity system [GWh]



HIGH LOW HISTORICAL AVERAGE PRODUCIBLE



3

ENERGY FROM WATER

Of all the renewable energies, hydro continues to be the second largest source of national renewable generation after wind power.

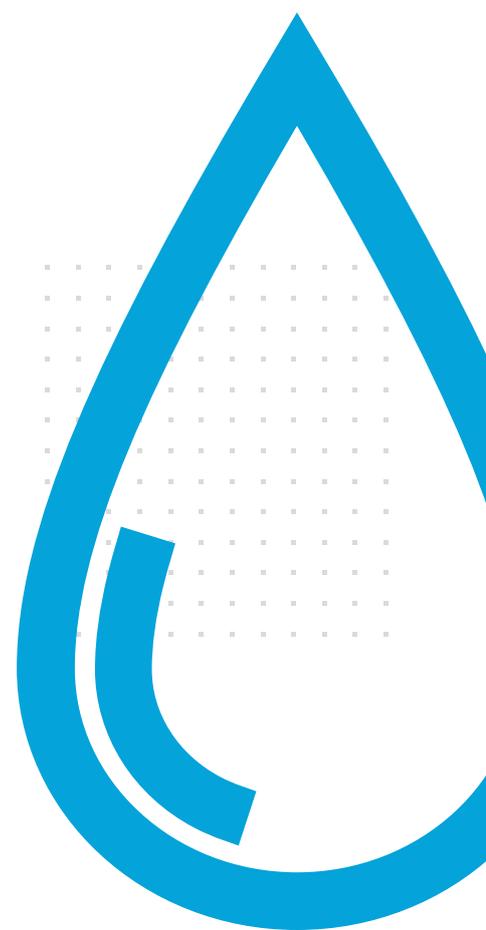
Hydroelectric generation is 28 % lower than last year, due to less rainfall, falling to 24,712 GWh. This production represented 9.5% of the total national generation, 13.1% less than last year.

24,712
GWh

HYDROELECTRIC GENERATION
IN SPAIN

9.5 %

OF THE TOTAL NATIONAL
GENERATION



17,085
MW

INSTALLED HYDRO POWER
CAPACITY

15.5 %

OF THE OVERALL INSTALLED
POWER CAPACITY
NATIONWIDE

-27.6 %

HYDROELECTRIC
GENERATION COMPARED TO
2018

25.2 %

OF THE TOTAL RENEWABLE
ENERGY GENERATED
NATIONWIDE

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 17,085 MW by the end of 2019 (without taking into account pure pumped storage). In terms of national installed power capacity, hydro power represents 15.5%, ranking it as the third energy technology behind combined cycle and wind.

Hydroelectric 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. 2019 was a dry year, with hydroelectric generation standing at 24,712 GWh, 27.6% less than in 2018. In this way, hydro contributed 9.5% to overall national generation, occupying fifth place among the generation technologies.

With regard to the entire set of renewables, hydro ranked second behind wind with 25.2% 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.

In 2019, December was the month of greatest hydroelectric generation with just over 4,600 GWh (1.7% less than the maximum value of the previous year). December was also the month in which this technology made the greatest contribution to overall production, accounting for almost 21% of the total generation mix in that month.

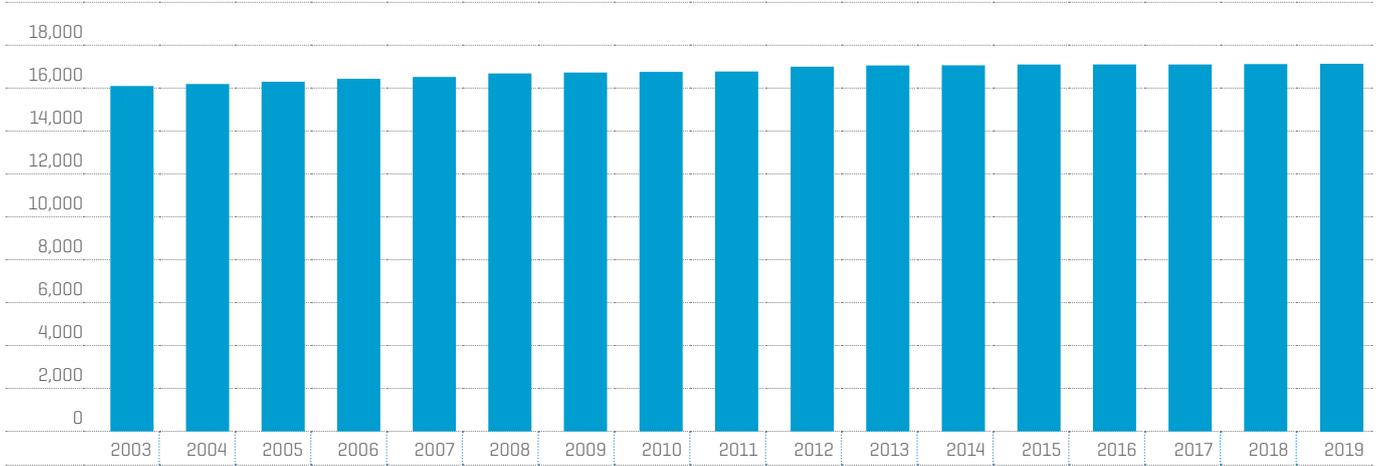
One of the main advantages of this technology compared to other renewable energies is its manageability, which becomes evident when observing the average daily curve of the share of hydro in the total generation mix, which shows how the greatest contribution of this technology coincides with the morning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

With regard to hydroelectric reserves, 2019 ended with reserves above the statistical average level, even though it was a rather dry year on the whole.

Reserves were below the statistical average every month of the year, with the exception of December. 2019 ended with a rate of 51.0% in terms reservoir capacity which means almost seven percentage points more than at the end of 2018. The peninsular producible hydroelectric index in 2019 reached a value of 0.88, which was lower than the 1.28 of the previous year.

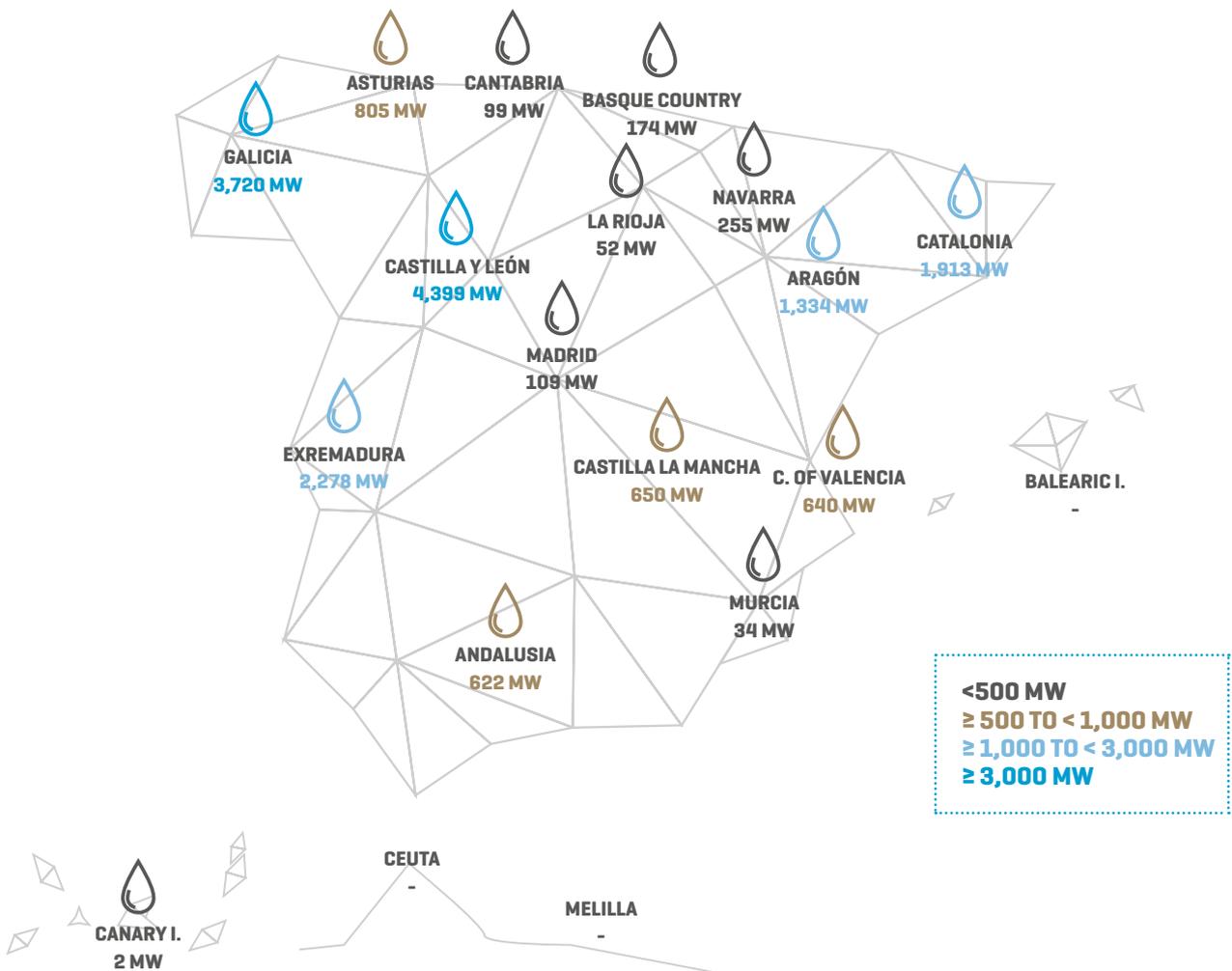
By Autonomous Community, Castilla y León is the region with the most installed hydro power capacity with almost 26% of the national total. This is due to the fact that the Duero basin, the second largest basin on the Iberian Peninsula, lies exclusively in this Community. It is followed by Galicia with 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.

Installed hydro power capacity. National electricity system [MW]



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

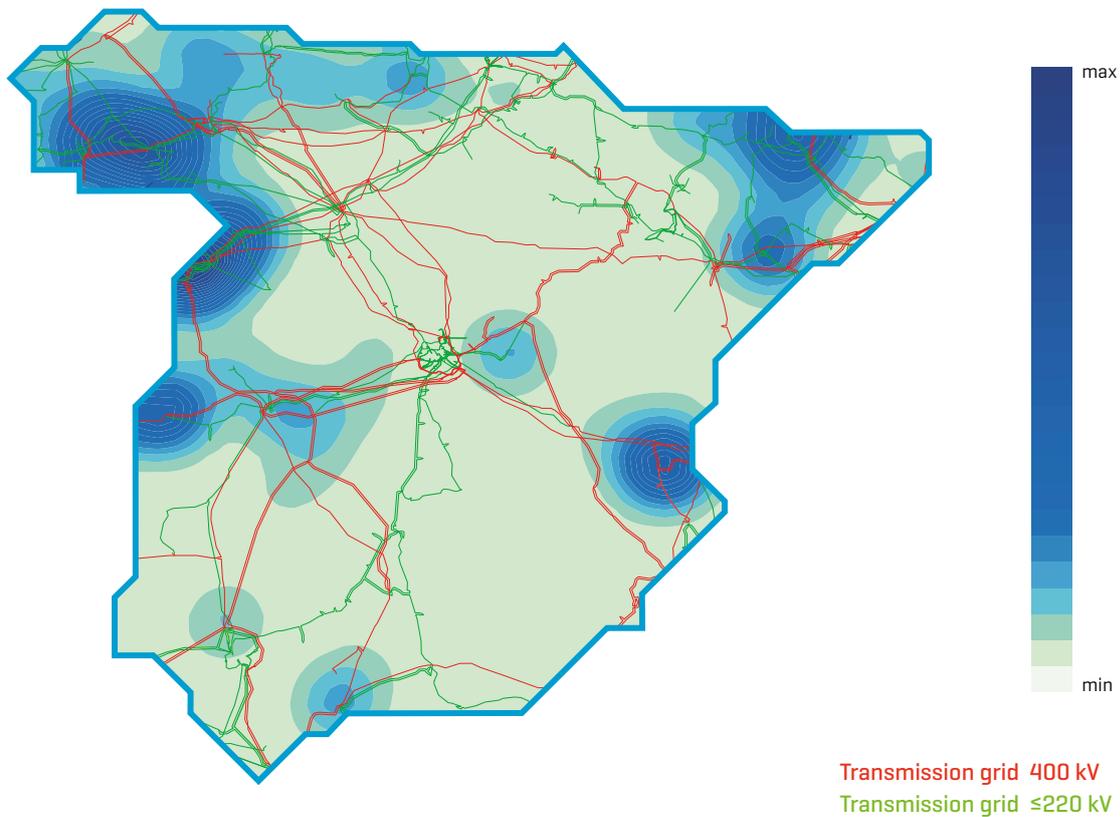
Installed hydro power capacity per Autonomous Community as at 31.12.2019. National electricity system [MW]



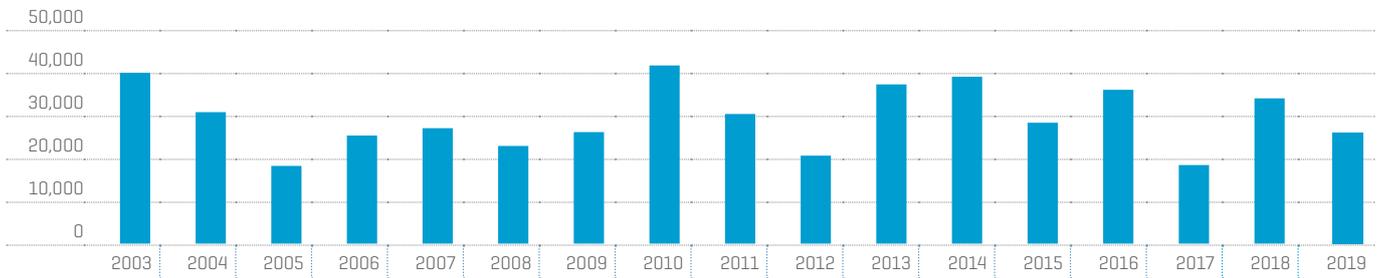
Share of installed hydro power capacity per Autonomous Community in relation to the total installed hydro power capacity nationwide [%]

Castilla y León	25.7
Galicia	21.8
Extremadura	13.3
Catalonia	11.2
Aragón	7.8
Asturias	4.7
Castilla-La Mancha	3.8
C. of Valencia	3.7
Andalusia	3.6
Navarra	1.5
Basque Country	1.0
Madrid	0.6
Cantabria	0.6
La Rioja	0.3
Murcia	0.2
Canary I.	0.01

Geographical distribution of hydro power facilities on the Spanish Peninsula as at 31.12.2019

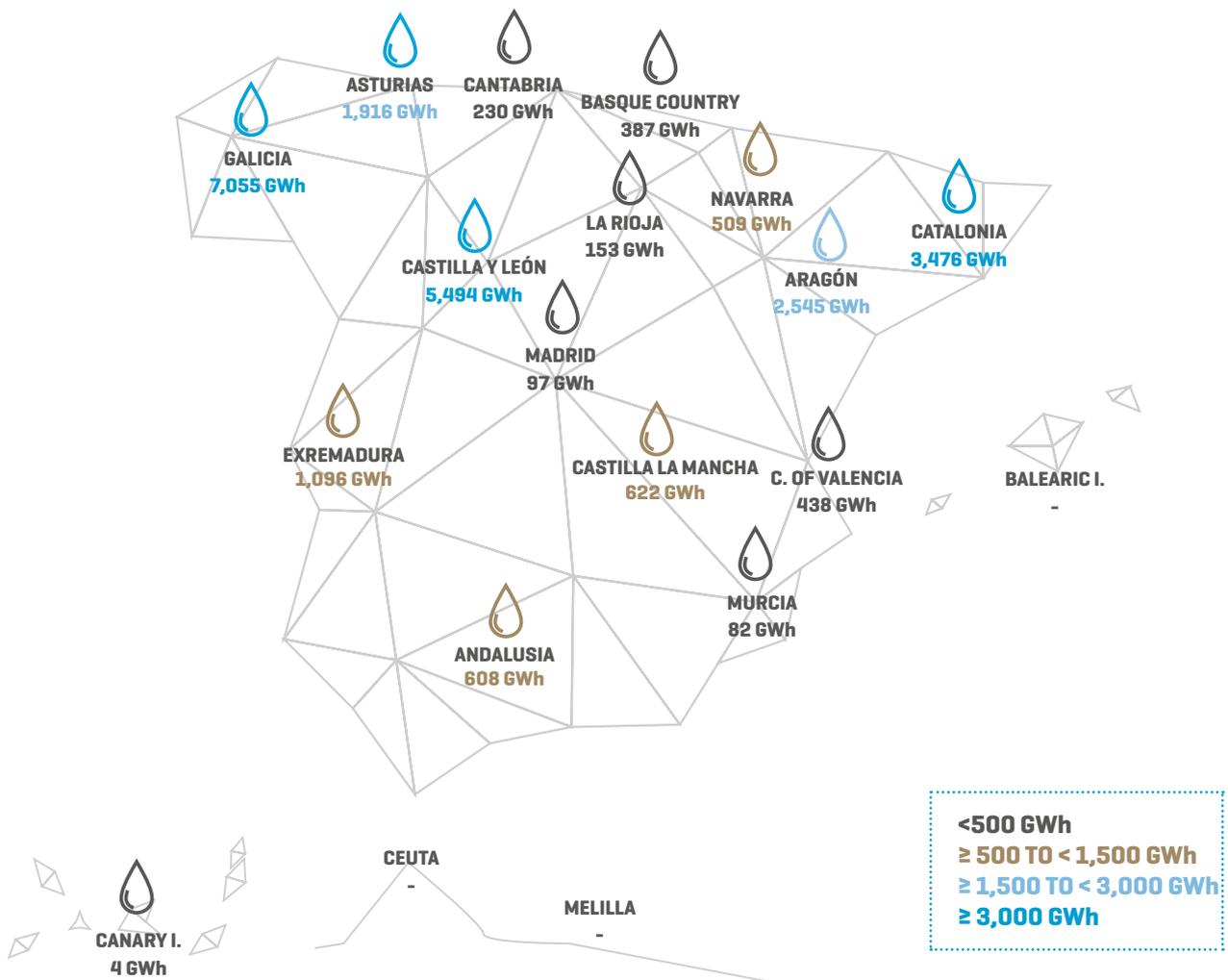


Hydroelectric generation. National electricity system [GWh]



Data for the Canary Islands available as of 2006.

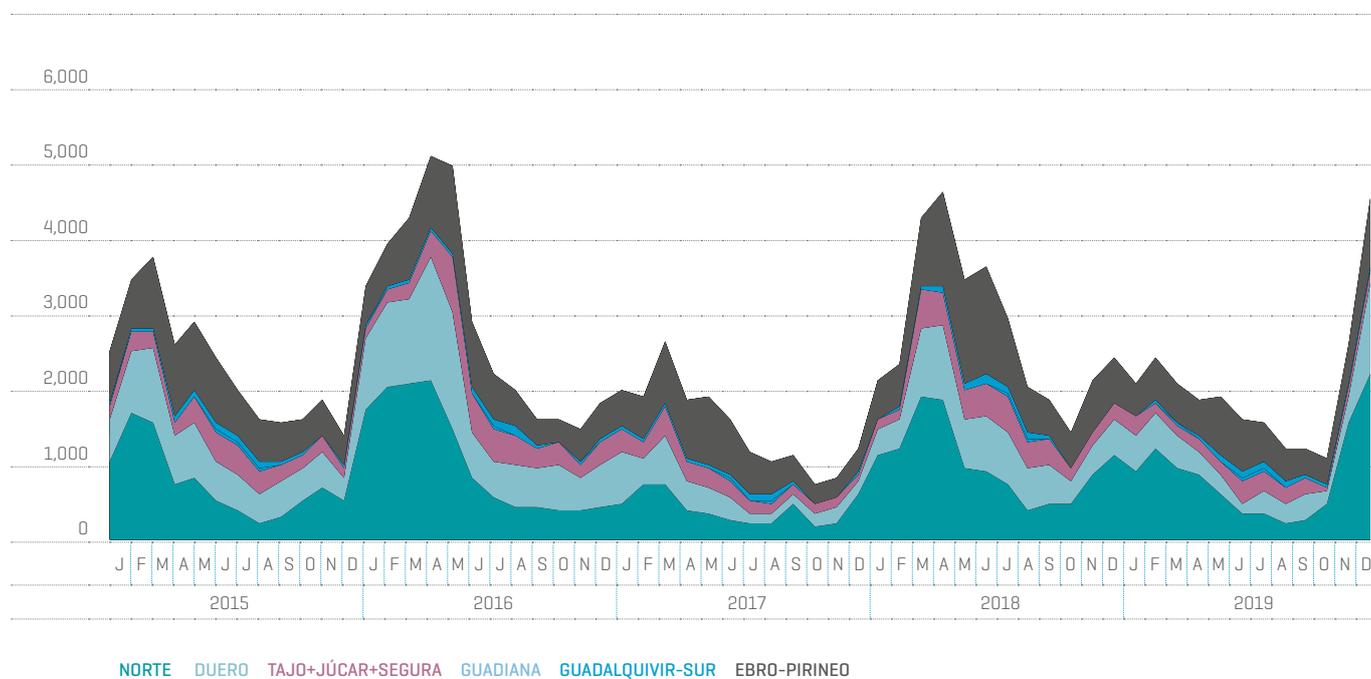
Hydroelectric generation per Autonomous Community in 2019. National electricity system [GWh]



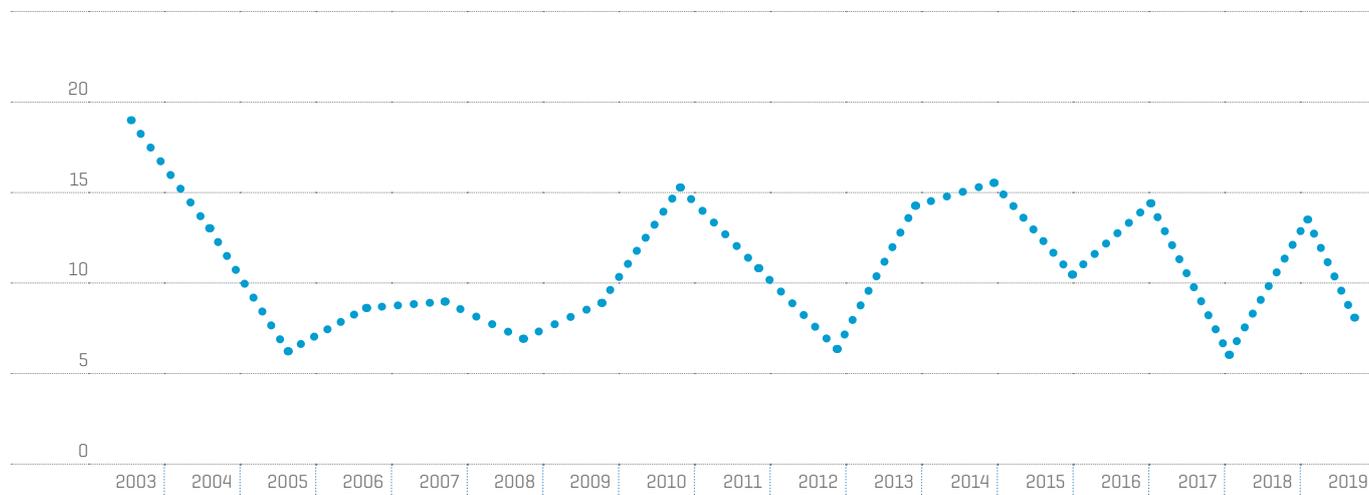
Hydroelectric generation per Autonomous Community in relation to hydroelectric generation nationwide [%]

Galicia	28.5
Castilla y León	22.2
Catalonia	14.1
Aragón	10.3
Asturias	7.8
Extremadura	4.4
Castilla-La Mancha	2.5
Andalusia	2.5
Navarra	2.1
C. of Valencia	1.8
Basque Country	1.6
Cantabria	0.9
La Rioja	0.6
Madrid	0.4
Murcia	0.3
Canary I.	0.01

Hydroelectric generation by hydrographic basin. Peninsular electricity system [GWh]

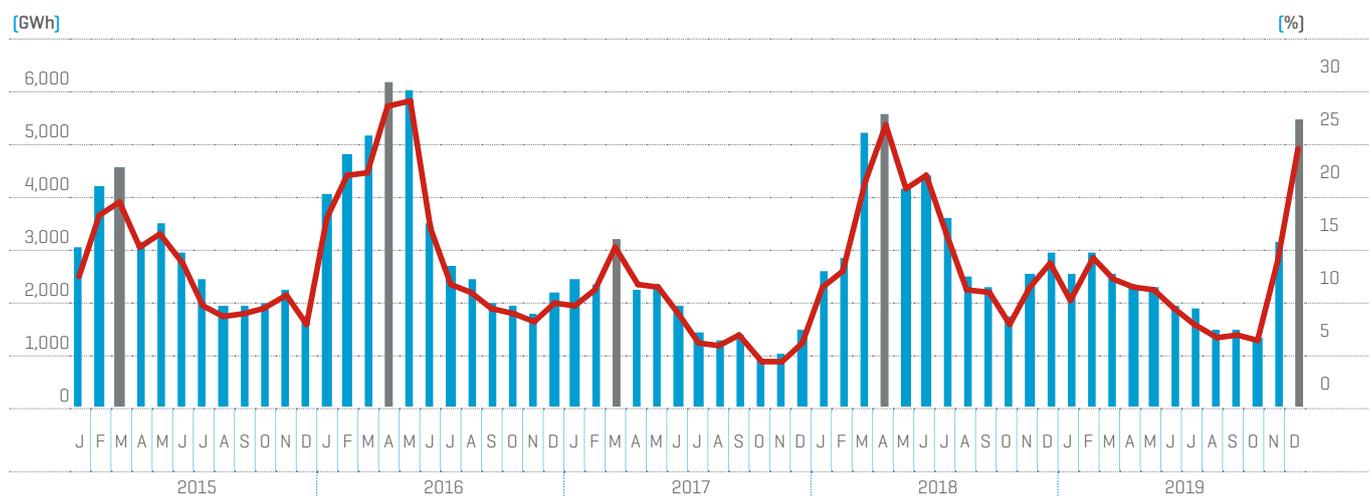


Share of hydro in the total generation mix. National electricity system [%]



Data for the Canary Islands available as of 2006.

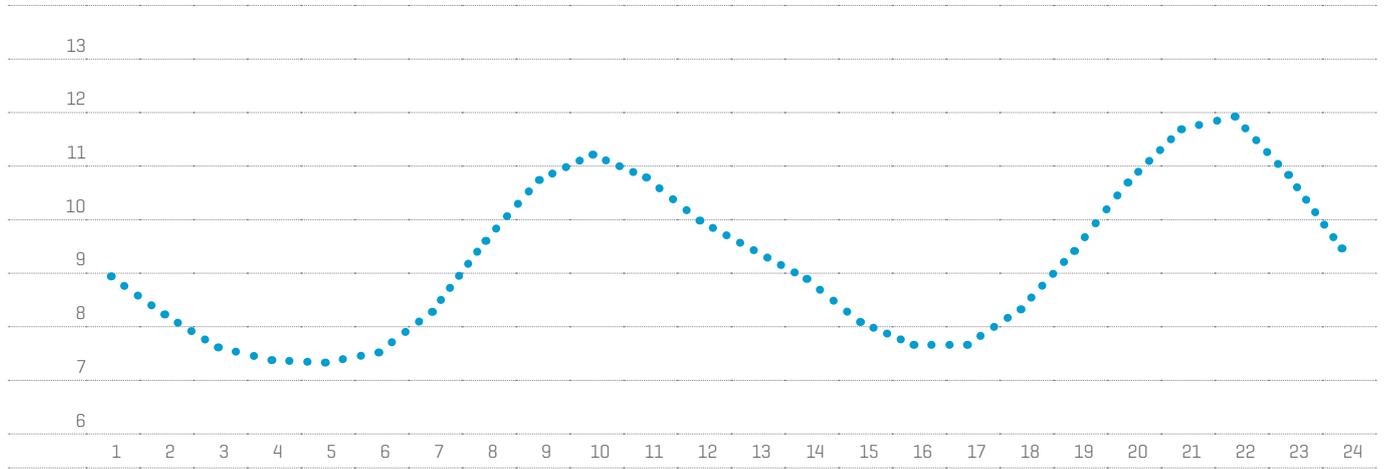
National hydroelectric generation, monthly maximum values and share in the total generation mix. National electricity system.



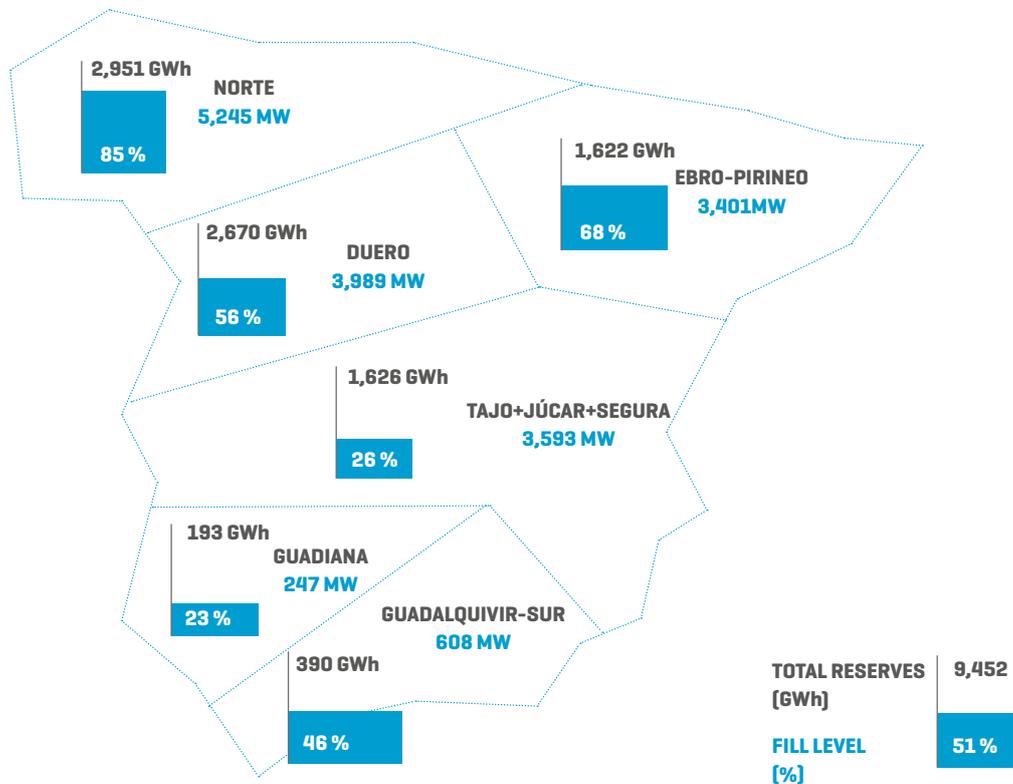
HYDROELECTRIC GENERATION [GWh] MONTH WITH THE HIGHEST VALUE [GWh] HYDROELECTRIC GENERATION / TOTAL GENERATION [%]

Data for the Canary Islands available as of 2006.

Average hourly share of hydroelectric generation in relation to total generation in 2019 [%] National electricity system.



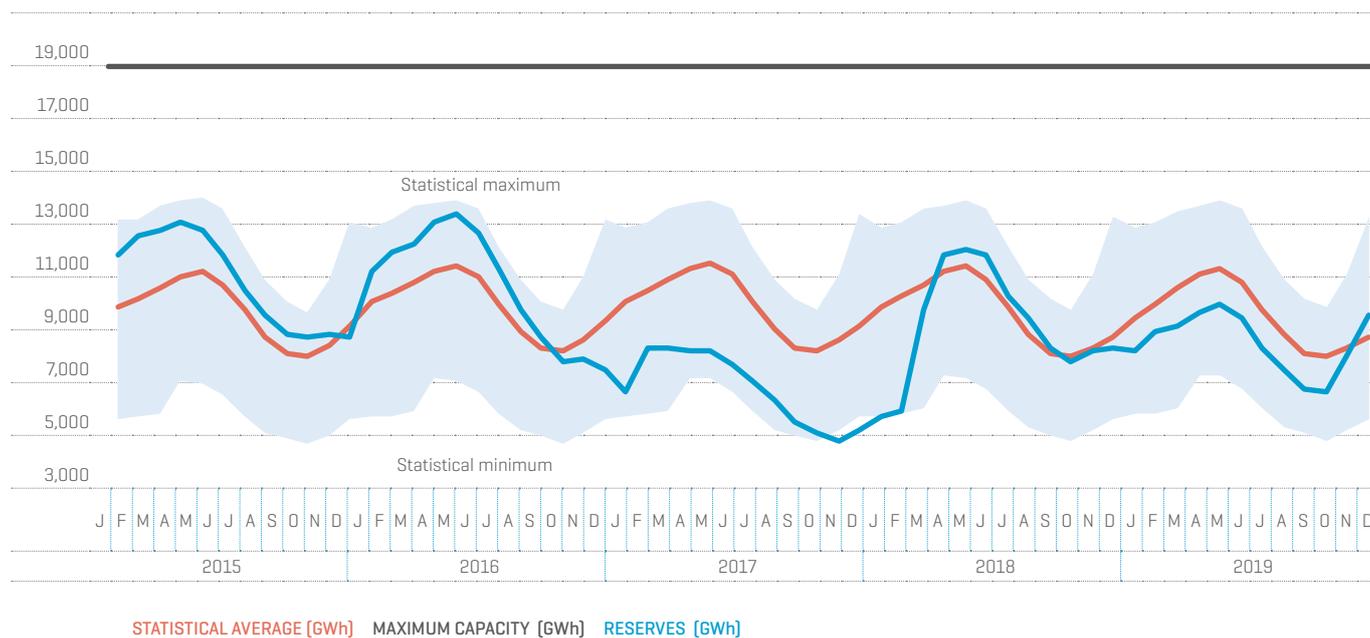
Installed power capacity and hydroelectric reserves by hydrographic basin as at 31.12.2019 [GWh, MW and %]



Extreme values of peninsular hydroelectric reserves

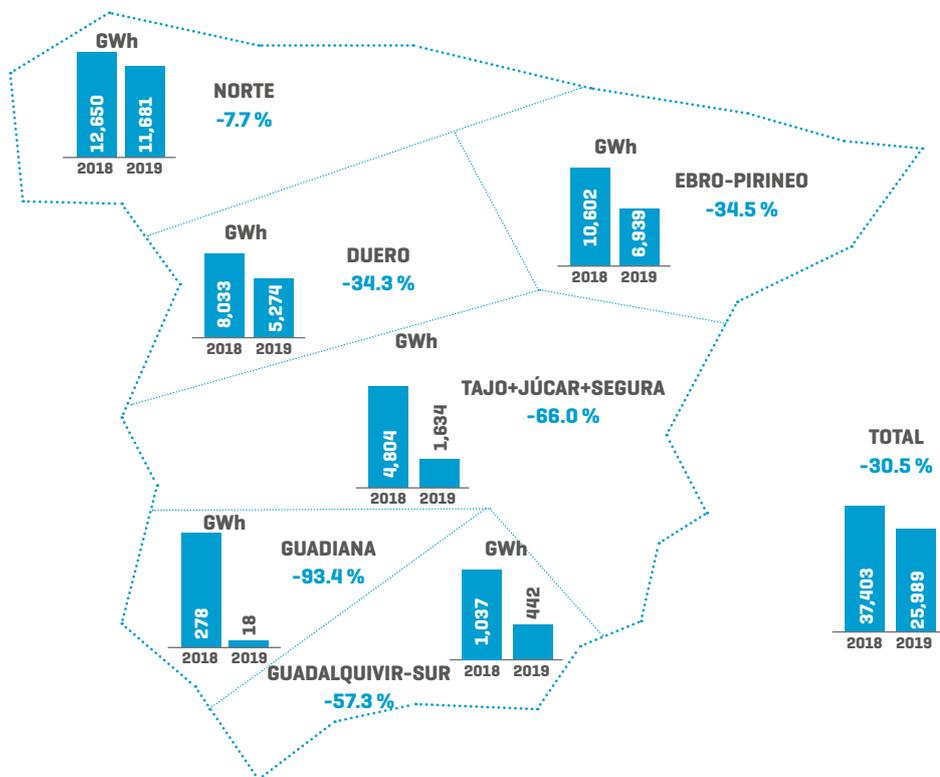
		2019			Historical values	
		GWh	Date	%	Date	%
Maximum	Annual	6,251	21-May	69.7	May 1969	92.0
	Hyper-annual	3,693	14-May	38.6	April 1979	91.1
	Overall total	9,936	21-May	53.6	April 1979	86.6
Minimum	Annual	3,396	15-Oct	37.9	December 2017	24.1
	Hyper-annual	2,801	8-Oct	29.3	November 1983	17.6
	Overall total	6,199	15-Oct	33.4	December 2017	23.0

Total hydroelectric reserves. Peninsular electricity system (GWh)

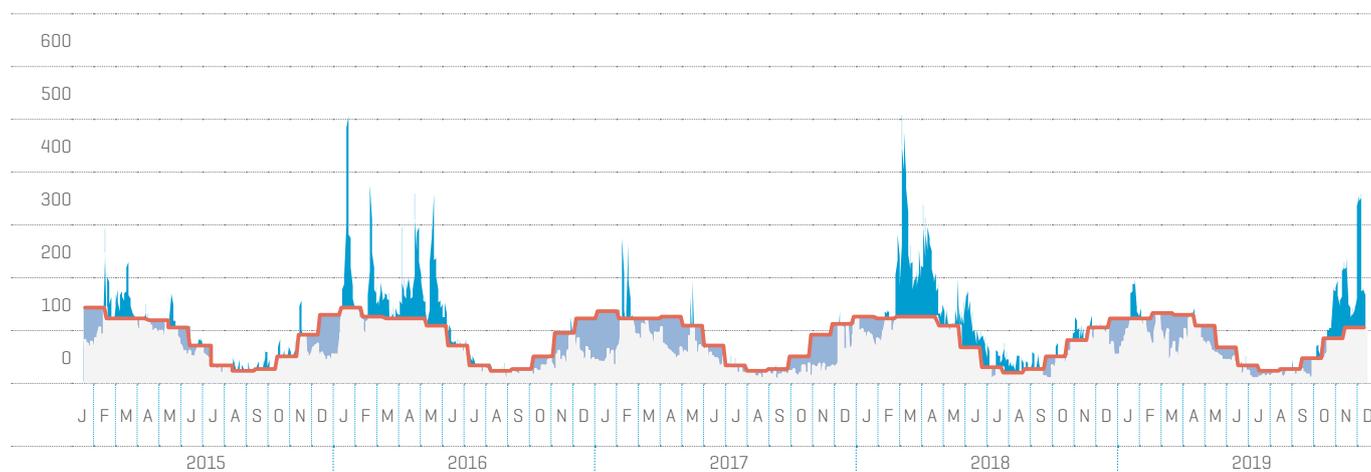


Statistical maximum and minimum values: average of the maximum and minimum values for the last 20 years.

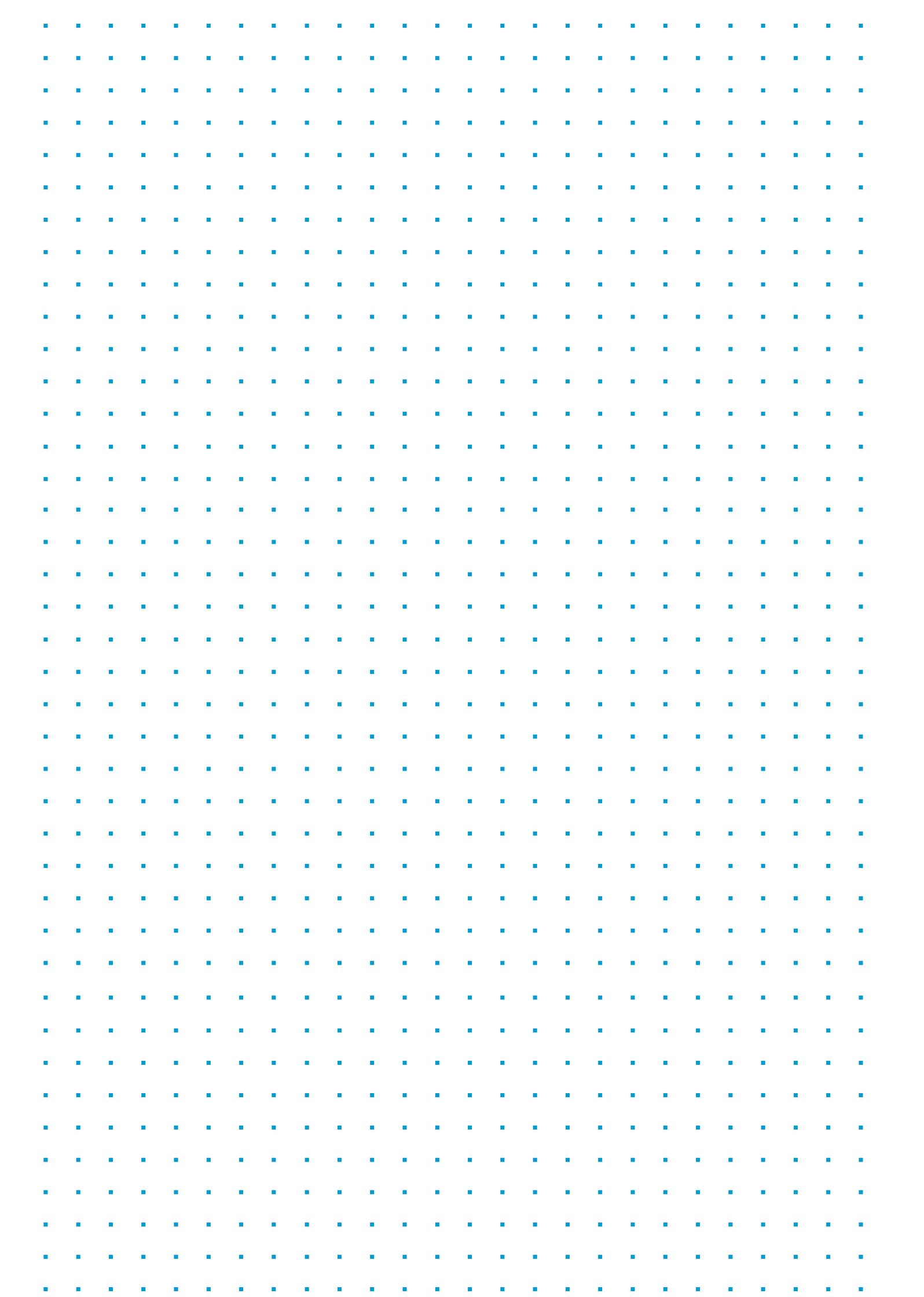
Producible hydroelectric power by hydrographic basin and annual variation (GWh and %)



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



WET DRY HISTORICAL AVERAGE PRODUCIBLE



4



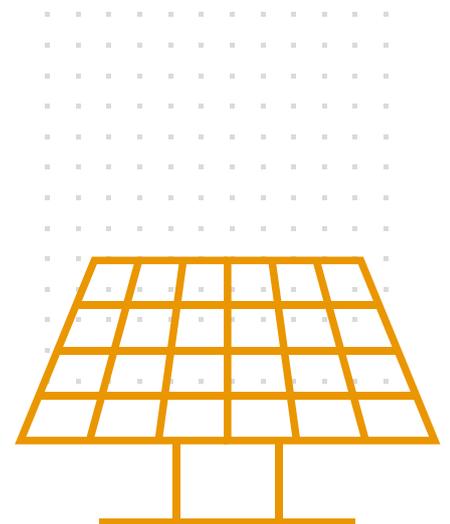
ENERGY FROM THE SUN

In 2019, there was an increase of 89% in installed solar photovoltaic power capacity (with a total of almost 9,000 MW installed), the highest in history, and regarding solar generation, this was 18.2% above the previous year, the highest annual value recorded so far (14,407 GWh).

Solar energy during 2019 registered maximum historical values both in installed power capacity and in generation. It is the third renewable source of electricity generation in Spain with 11,217 MW of installed power capacity at the close of 2019.

10 %
OF THE OVERALL INSTALLED
POWER CAPACITY NATIONWIDE

5.5 %
OF THE NATIONAL
ELECTRICITY GENERATION
MIX



The installed solar power capacity by the end of 2019 was 11,217 MW (8,913 MW for solar photovoltaic and 2,304 MW for solar thermal), representing around 10% of the overall installed power capacity in Spain.

After five years in which the growth of solar photovoltaic power had stabilised, with increases that barely exceeded 0.5%, in 2019 we reached the historic figure of almost 9,000 MW of installed capacity, which represents an increase of almost 90% compared to 2018. The 4,201 MW increase in new installed solar power capacity is the highest in history, surpassing the record figure of 2,733 MW of new capacity in 2008, which remained virtually unchanged from 2013 to 2019.

Regarding solar thermal, after the large increase in 2012 with almost 1 GW of installed power capacity, since 2014 it has remained stable, registering a total of 2,304 MW of installed power capacity by the end of 2019. Like installed power capacity, solar generation in Spain experienced a significant increase in 2019, after the decrease of about 11% registered in 2018, and where average growth from 2014 to 2017 was just 1.9%. Thus, therefore, this year an annual total of 14,407 GWh was generated, 18.2% more than the previous year and the highest annual value recorded to date. This production represented 5.5% of the total generation for the year, 3.5% for photovoltaic and the remaining 2.0% for solar thermal.

Both July and August are months with the highest production of solar photovoltaic generation, 1,002 MWh and 1,013 MWh, respectively, being the two all-time high values, 3% and 4% above the previous records set in July 2013.

SOLAR POWER GENERATION IN RELATION TO THE TOTAL GENERATION FROM RENEWABLE ENERGIES

5.5 %

Seasonality is an important factor in this technology and greatly impacts on its productions throughout the year. From May to August, generation had a share of over 4% compared to the previous year, while it fell by almost half in the months from November to February.

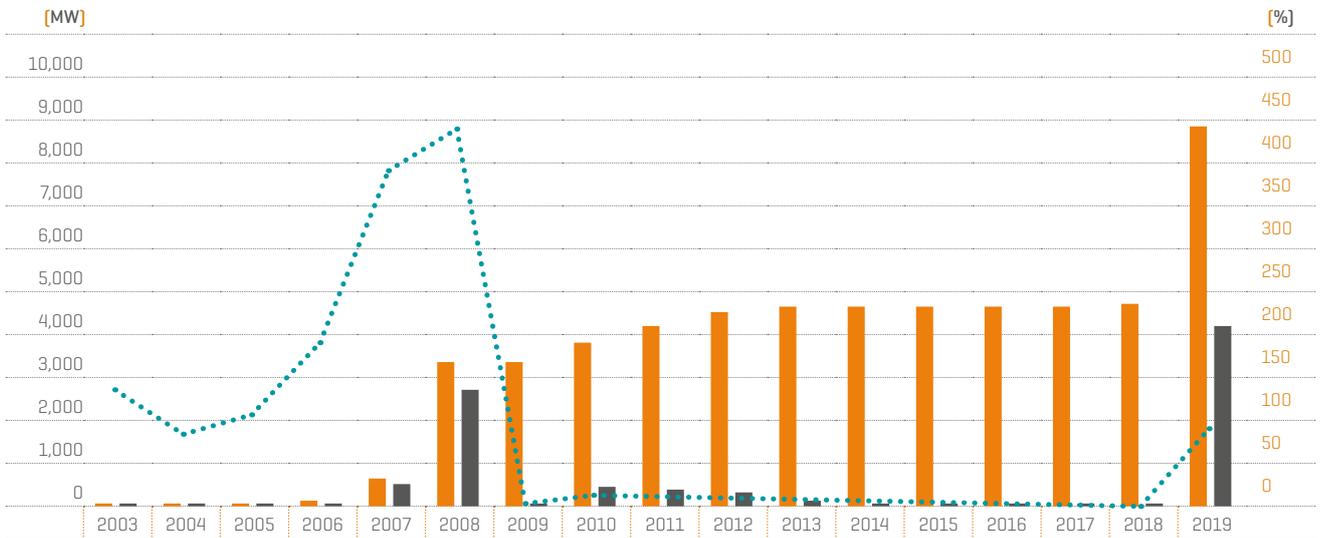
During 2019, the maximum daily solar photovoltaic production was reached on Friday 23 August 2019, with a value of 34,786 MWh. On the same day, a new all-time record of instantaneous power for photovoltaic generation was set in the peninsular electricity system, registering 4,698 MW at 2:25 p.m.

In the case of solar thermal July was the month with the highest generation, although unlike photovoltaic it was almost 10% 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.

The distribution of the two solar technologies is quite different in the various Autonomous Communities. Andalusia is the region with the most solar photovoltaic power installed with more than 20% of the total national installed power capacity, followed

closely by Castilla-La Mancha and a little further behind by Extremadura and Murcia. Just these four communities account for 66% of the total installed photovoltaic power capacity in Spain. On the other hand, noteworthy are the Communities of the Cantabrian coast, all of them are below 0.6% of the national total. In the case of solar thermal only 6 Communities have this type of facility, 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.

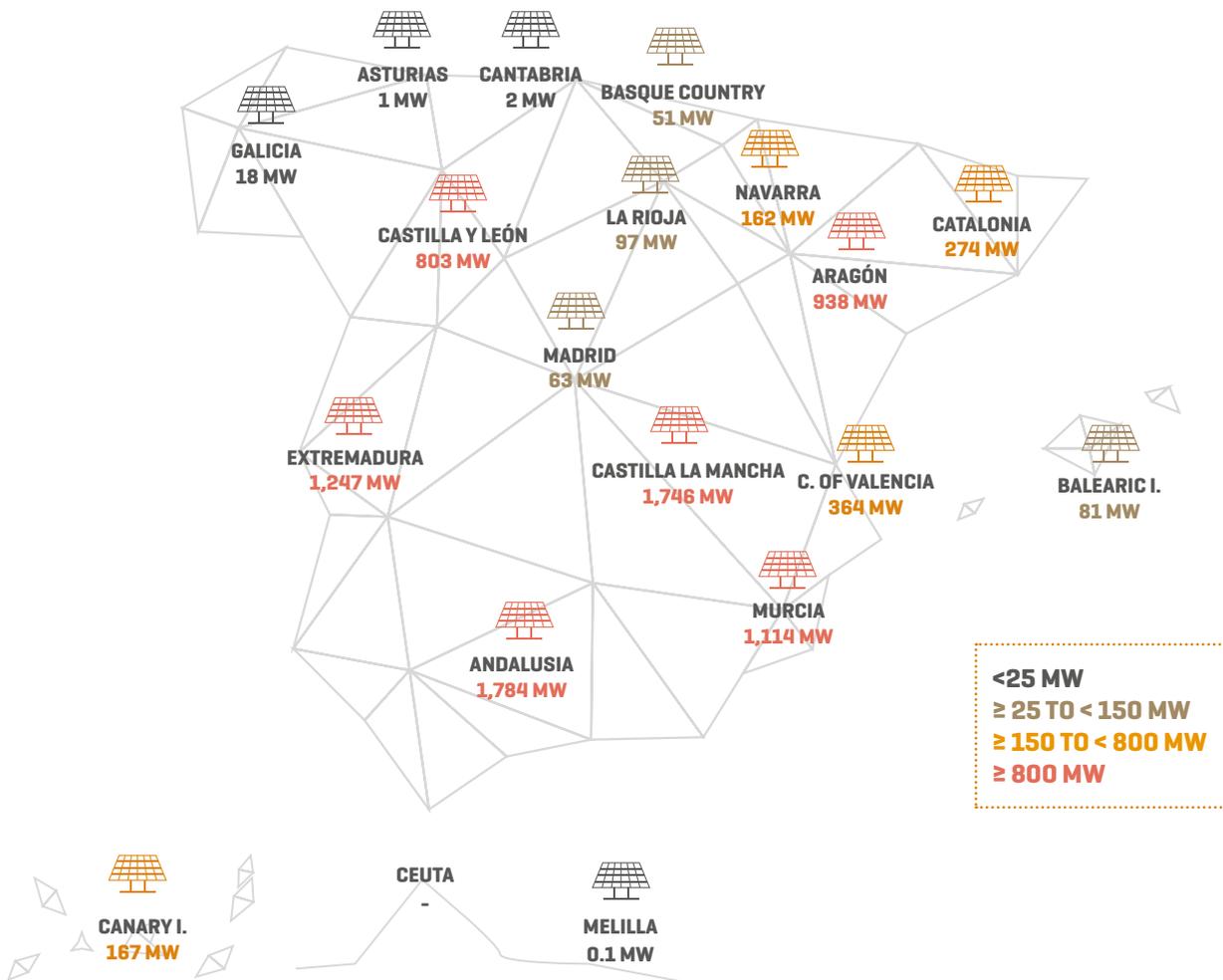
Installed solar photovoltaic power capacity. National electricity system



CUMULATIVE [MW] YEAR [MW] VARIATION [%]

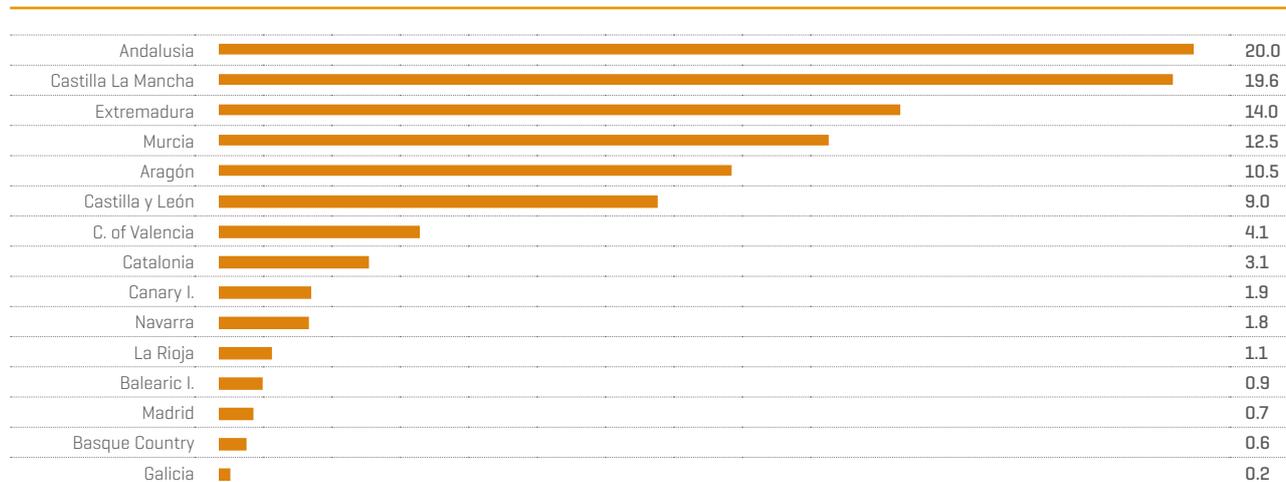
Source: National Commission of Markets and Competition [CNMC] until 2014. Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

Installed solar photovoltaic power capacity per Autonomous Community as at 31.12.2019. National electricity system [MW]



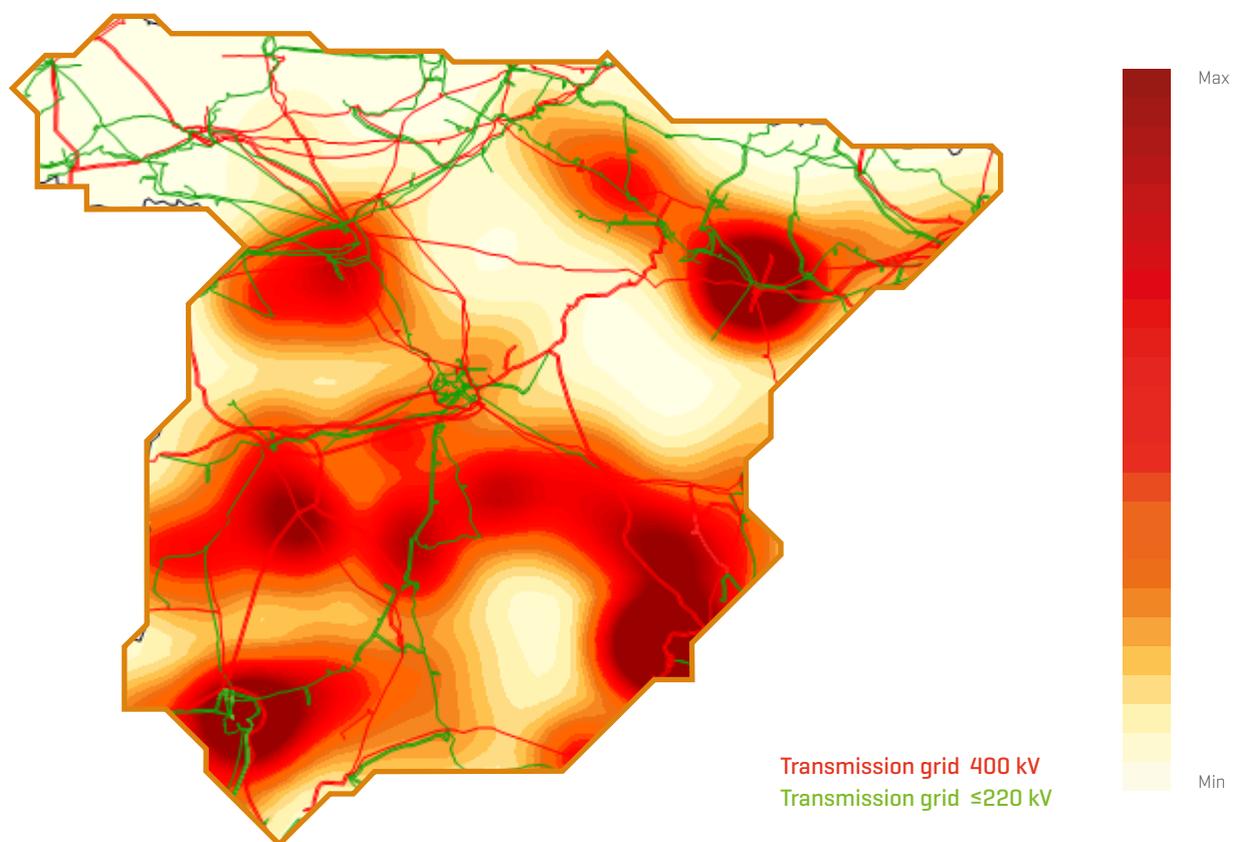
Energy from the Sun

Share of photovoltaic solar capacity per Autonomous Community in relation to the installed photovoltaic capacity nationwide [%]

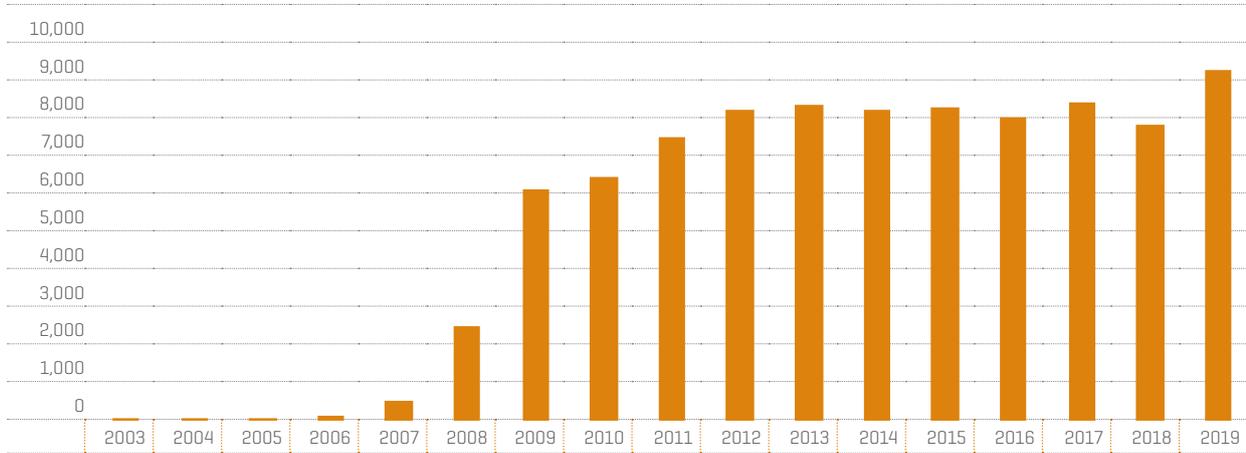


Cantabria, Asturias and Melilla are not included as their share in this technology is very small and would not be easily visible on the graph.

Geographical distribution of photovoltaic solar energy facilities on the Spanish Peninsula as at 31.12.2019

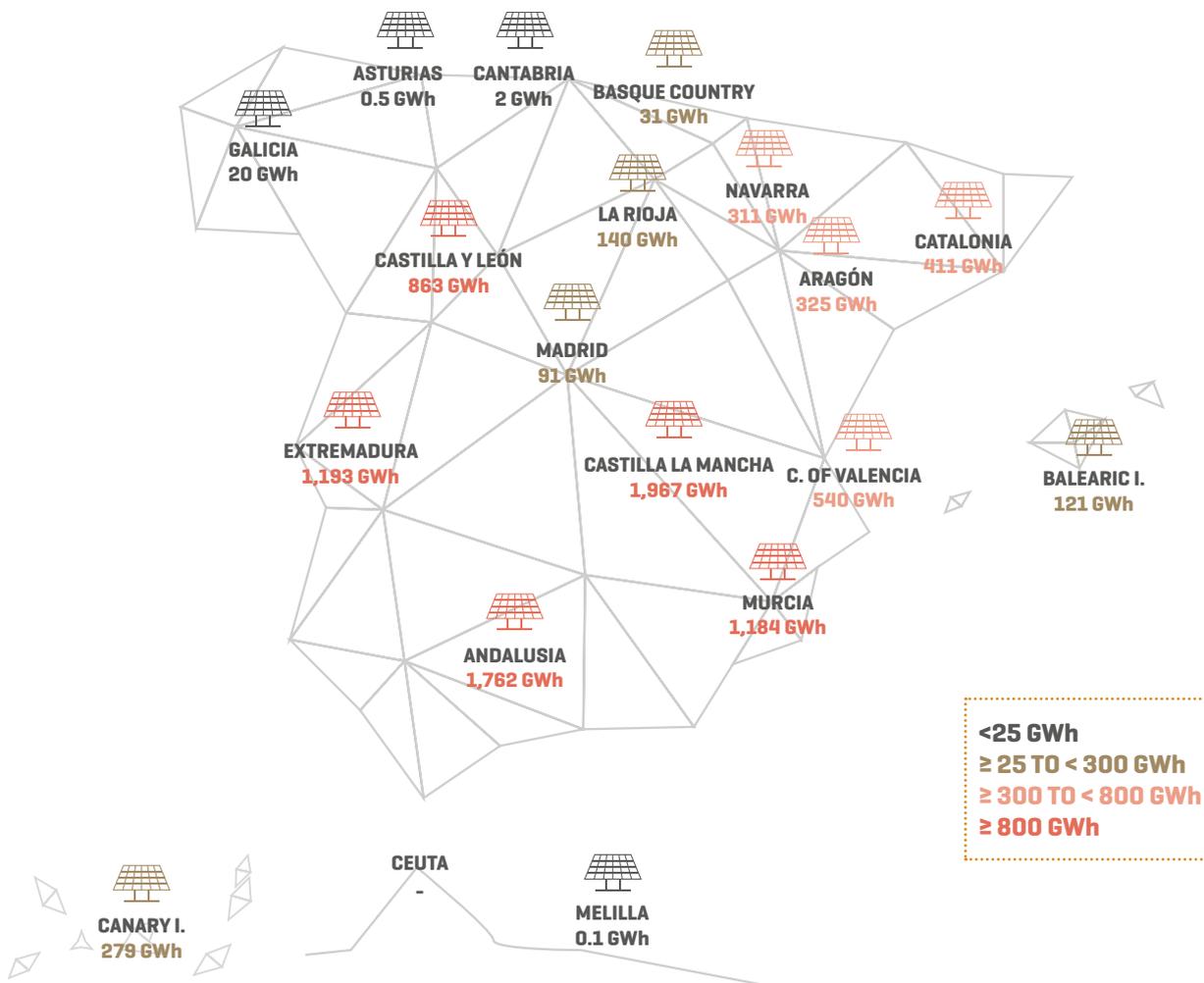


Solar photovoltaic power generation. National electricity system (GWh)

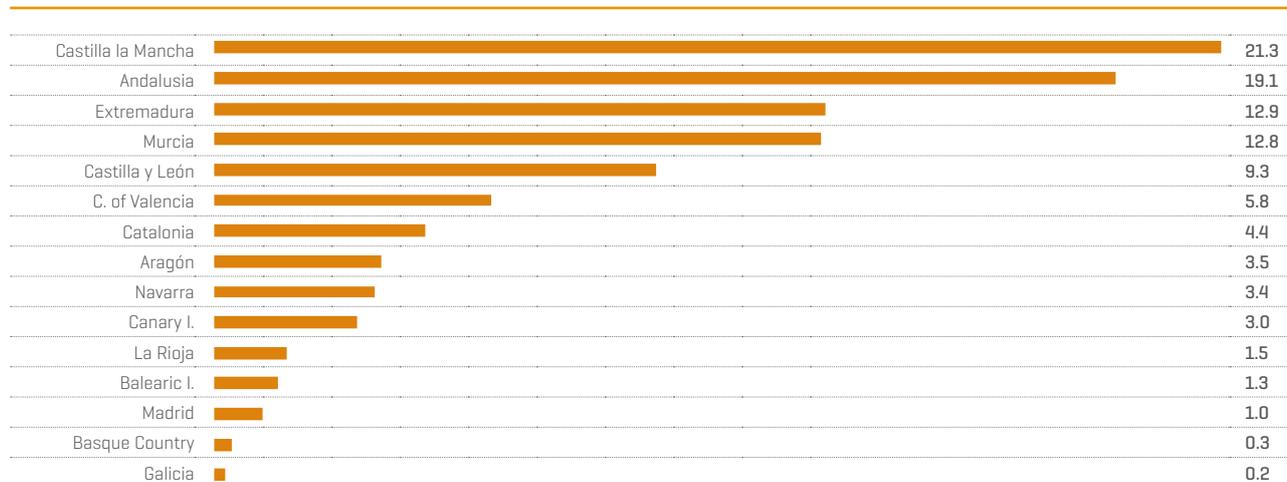


Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

Solar photovoltaic power generation per Autonomous Community in 2019. National electricity system. (GWh)

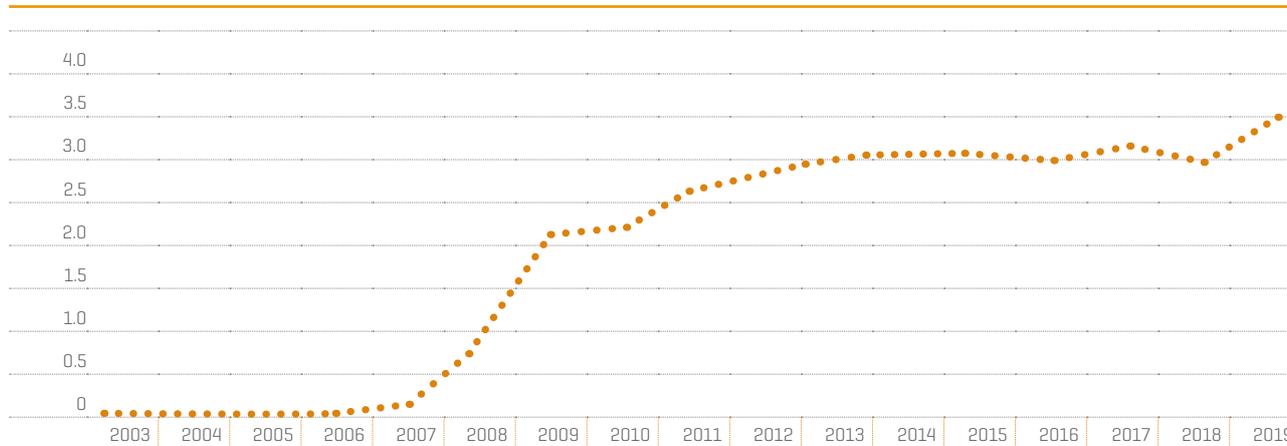


Solar photovoltaic power generation per Autonomous Community in relation to the total solar photovoltaic power generation nationwide [%]



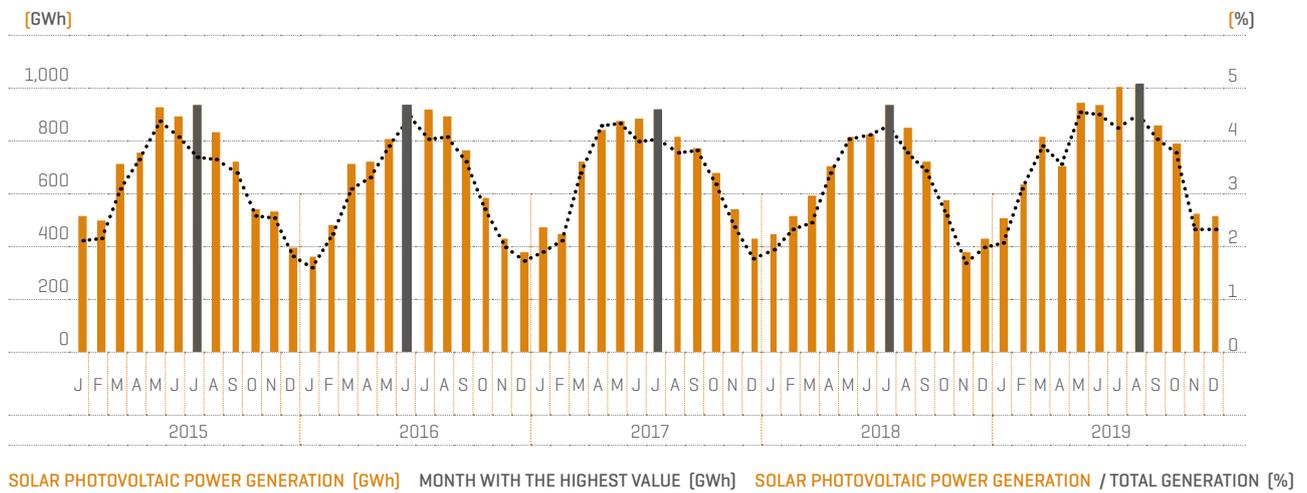
Cantabria, Asturias and Melilla are not included as their share in this technology is very small and would not be easily visible on the graph.

Share of solar photovoltaic power generation in relation to the total generation mix. National electricity system [%]

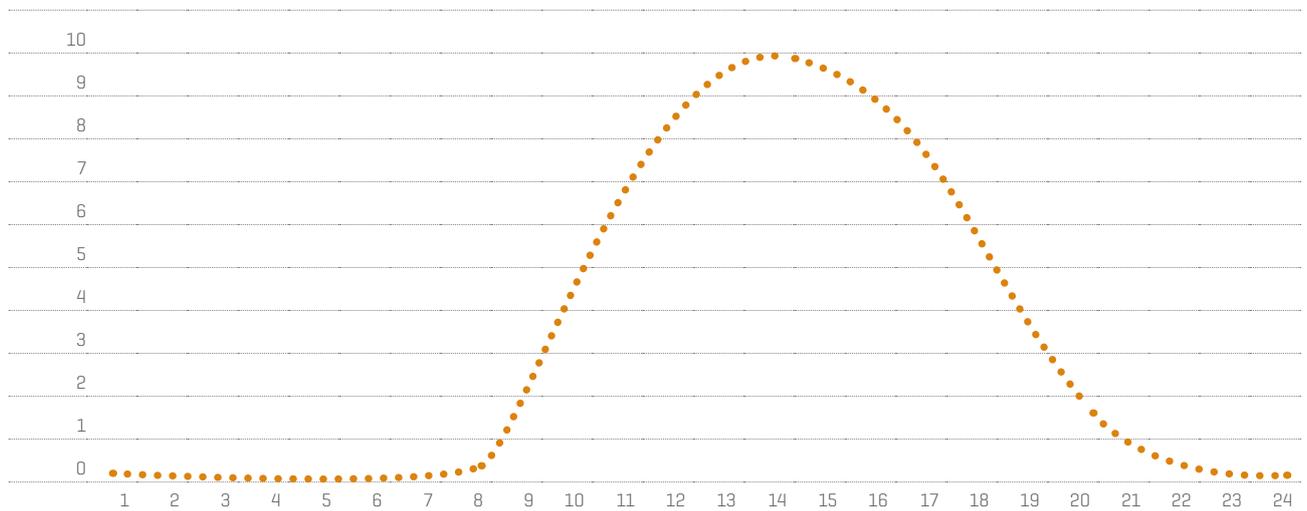


Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

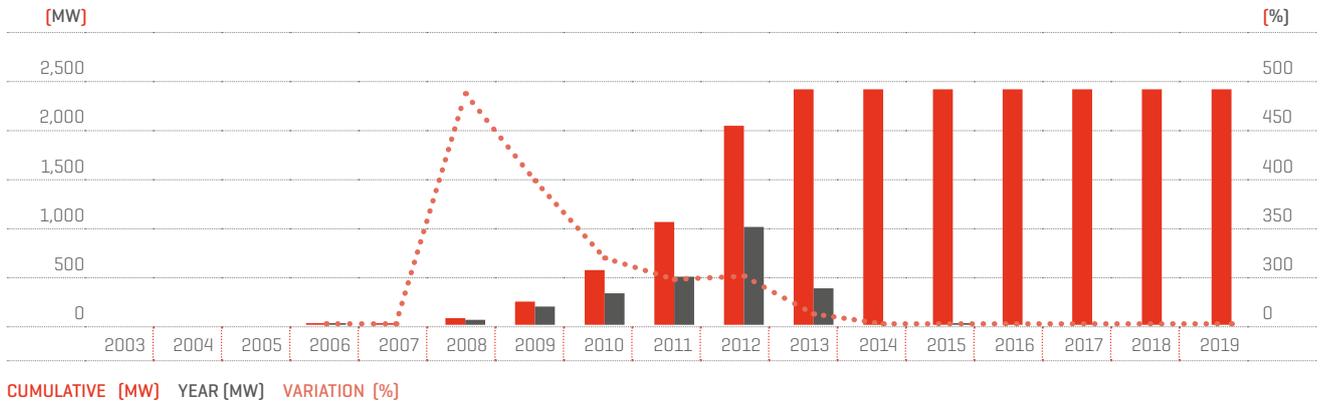
Solar photovoltaic power generation, monthly maximum values and share in the total generation mix. National electricity system



Average hourly share of solar photovoltaic power generation in relation to the total generation in 2019. National electricity system [%]

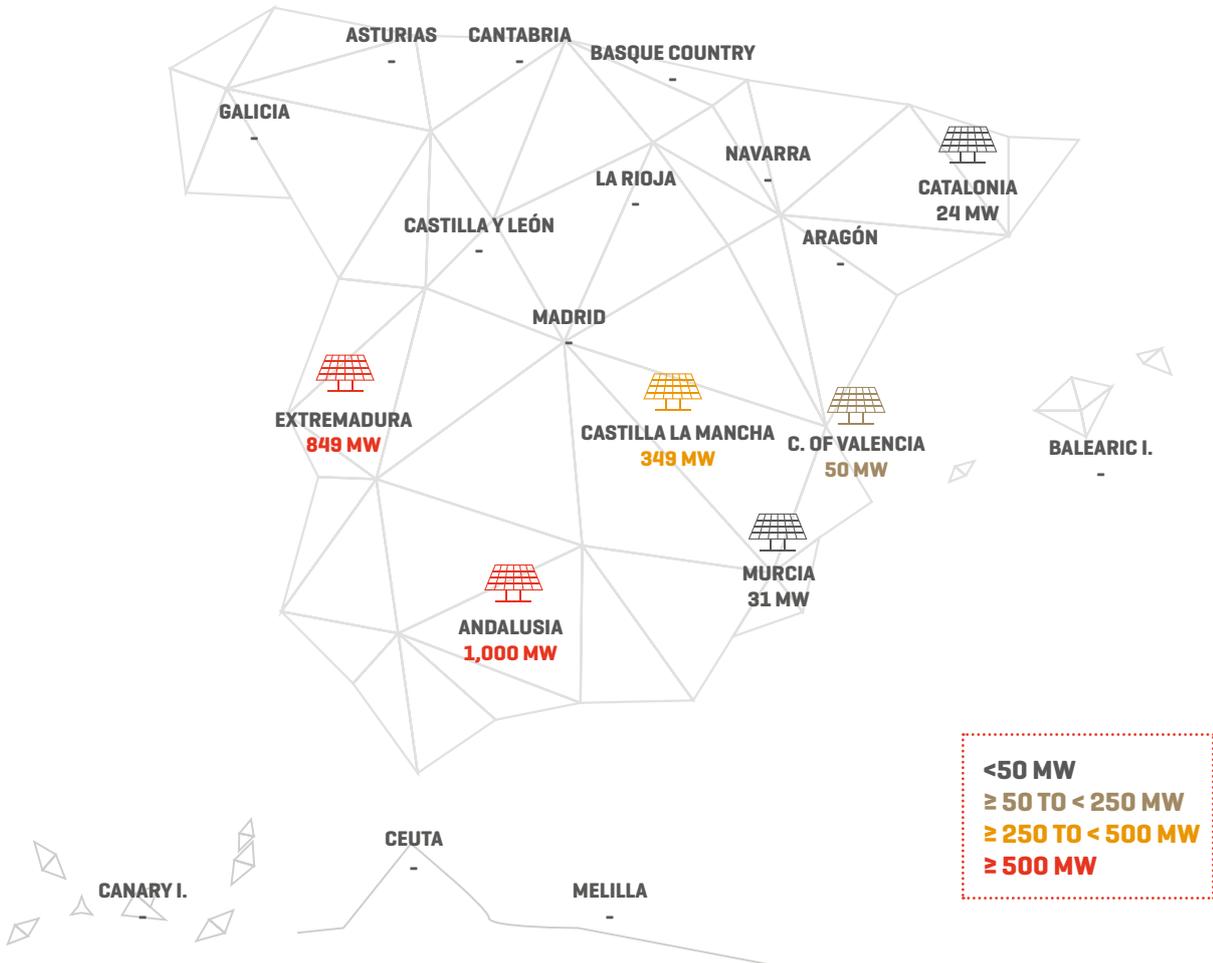


Installed solar thermal power capacity. National electricity system

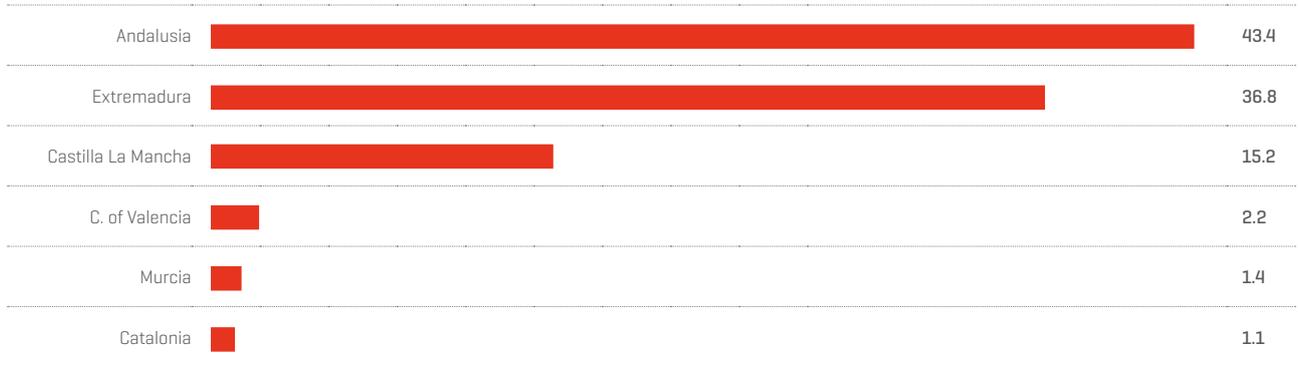


Source: National Commission of Markets and Competition (CNMC) until 2014.

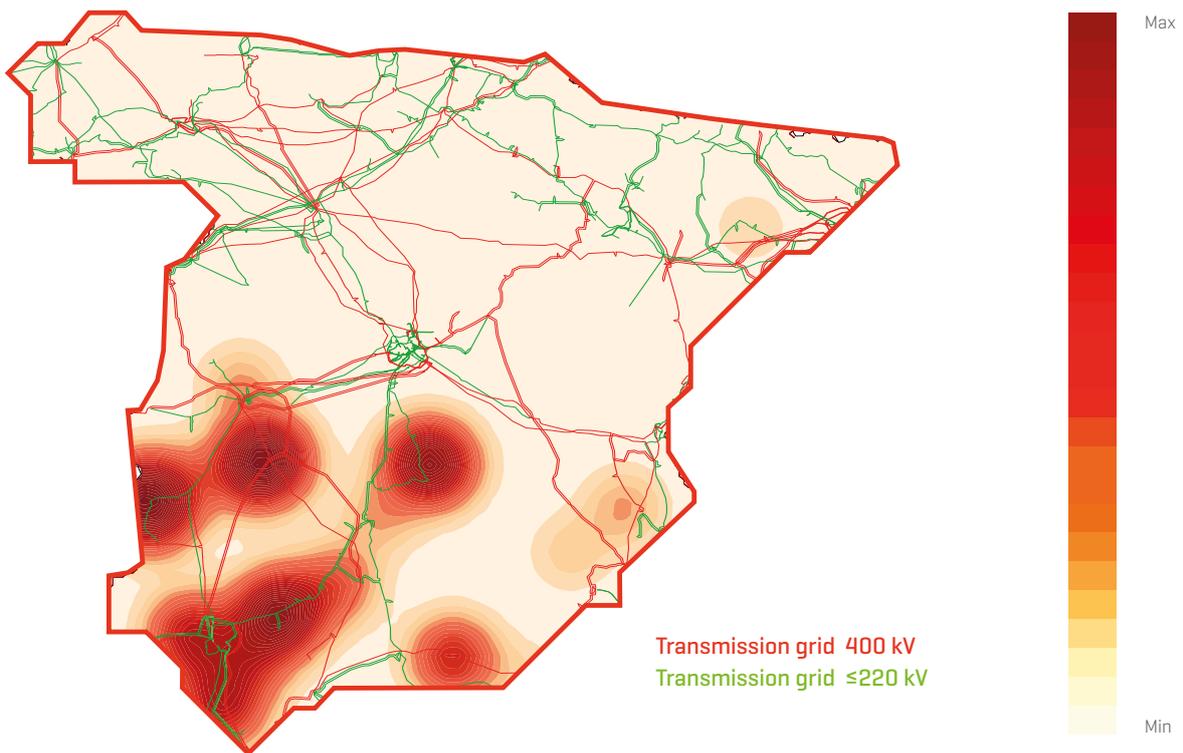
Installed solar thermal power capacity per Autonomous Community as at 31.12.2019. National electricity system (MW)



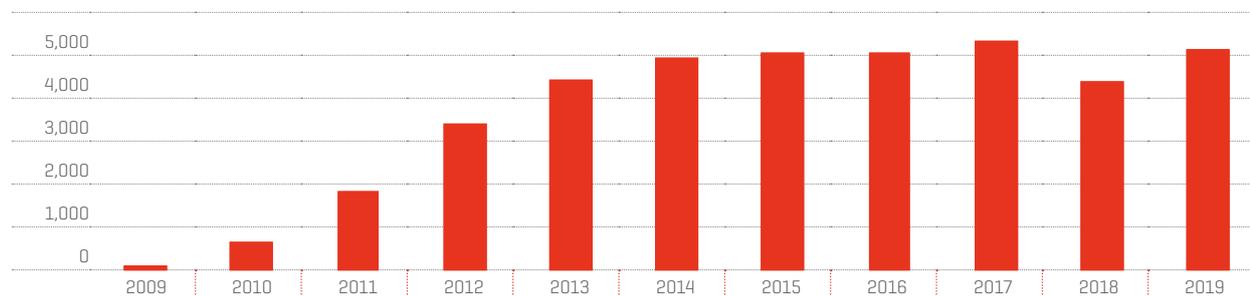
Share of installed solar thermal capacity per Autonomous Community in relation to the installed solar thermal capacity nationwide [%]



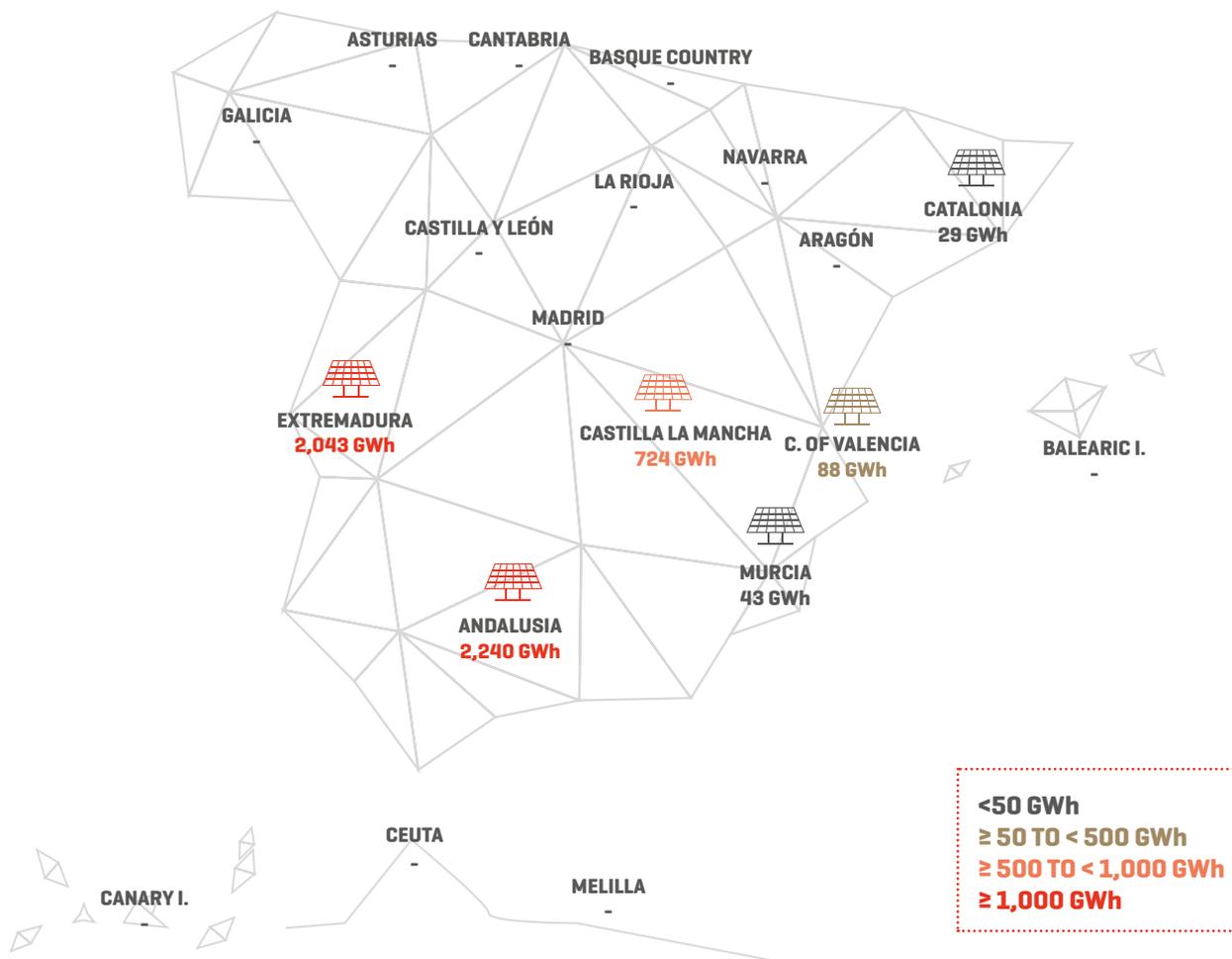
Geographical distribution of solar thermal facilities on the Spanish Peninsula as at 31.12.2019



Solar thermal power generation. National electricity system [GWh]



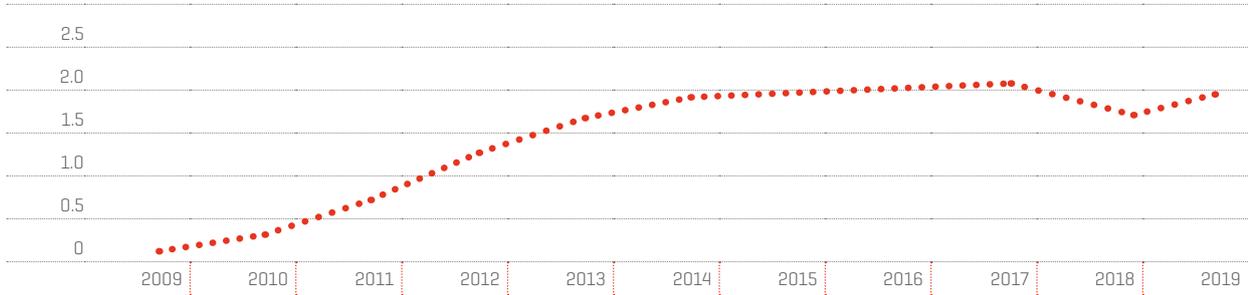
Solar thermal power generation per Autonomous Community in 2019. National electricity system (GWh)



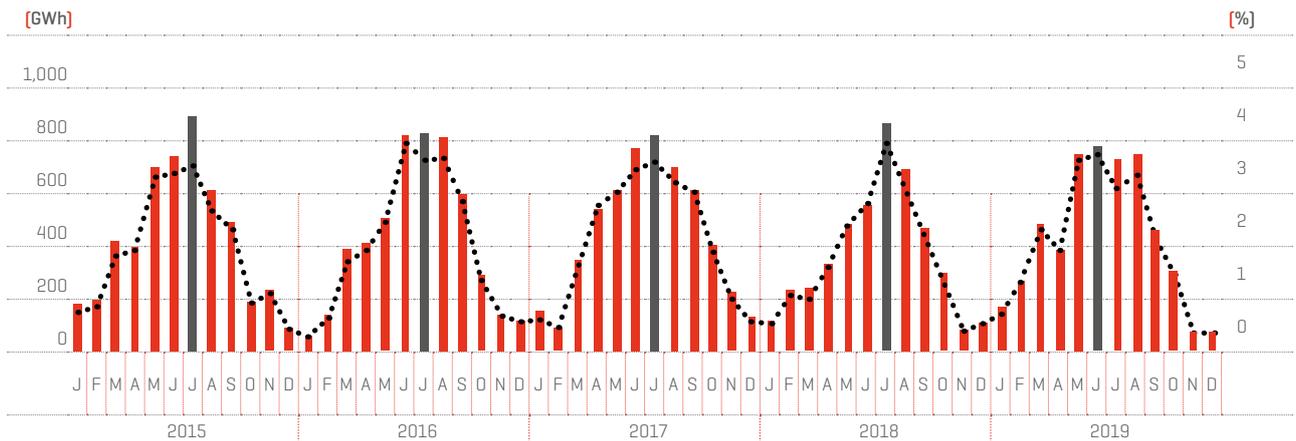
Solar thermal power generation per Autonomous Community in relation to the thermal power generation nationwide [%]

Andalusia	43.4
Extremadura	39.6
Castilla-La Mancha	14.0
C. of Valencia	1.7
Murcia	0.8
Catalonia	0.6

Share of solar thermal power generation in the total generation mix. National electricity system [%]

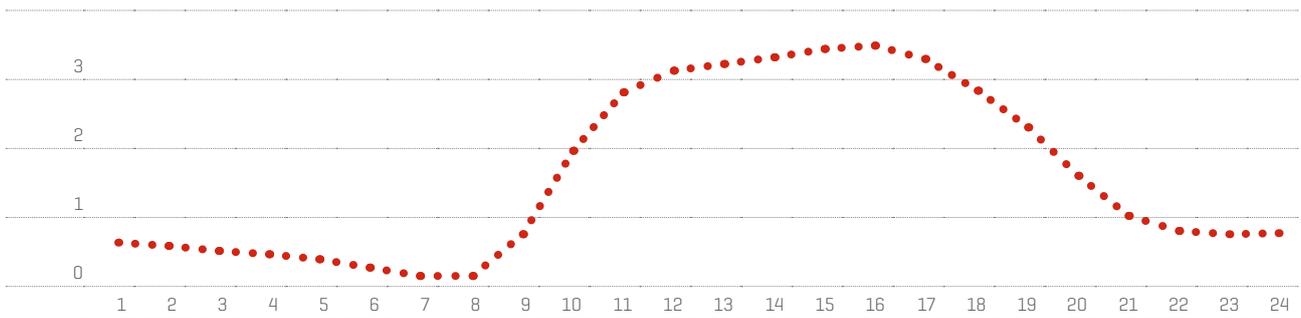


National solar thermal power generation, monthly maximum values and share in the total generation mix. National electricity system.



THERMAL SOLAR POWER GENERATION [GWh] MONTH WITH THE HIGHEST VALUE [GWh] THERMAL SOLAR POWER GENERATION / TOTAL GENERATION [%]

Average hourly share of solar thermal power generation in relation to the total generation in 2019. National electricity system. [%]





5

ENERGY FROM THE EARTH AND THE SEA

The evolution of this combined set of energies has been constant for more than a decade, increasing from 472 MW of installed power capacity in 2003 to 1,248 MW in 2019.

At the close of 2019, this set of renewables coming from a wide range of sources, led by biomass, accounted for 1.1% of the installed power capacity in Spain and just under 2% of the overall generation.

1,248
MW

INSTALLED POWER
CAPACITY IN 2019

+19 %

COMPARED TO 2018



4,531
GWh

GENERATION FROM
OTHER RENEWABLE
TECHNOLOGIES

ALMOST

2 %

OF THE TOTAL
GENERATION NATIONWIDE

This section contains aggregate information on a group of renewable technologies that use a wide range of sources, which together represent 2.3% of the installed renewable energy capacity and 1.1% of the total installed power capacity in Spain at the close of 2019. These energies can be divided into four blocks: biomass and biogas (1,071.7 MW); renewable waste identified as 50% of municipal solid waste (160.3 MW); wind-hydro, installed on the island of El Hierro (11.4 MW); and marine 4.8 MW. It should be noted that the evolution of this combined set of energies has been constant for over a decade [1], going from 472 MW of power in 2003 to 1,248 MW in 2019. However, its share in the Spanish generation mix is still very low, failing to reach 2% in any year.

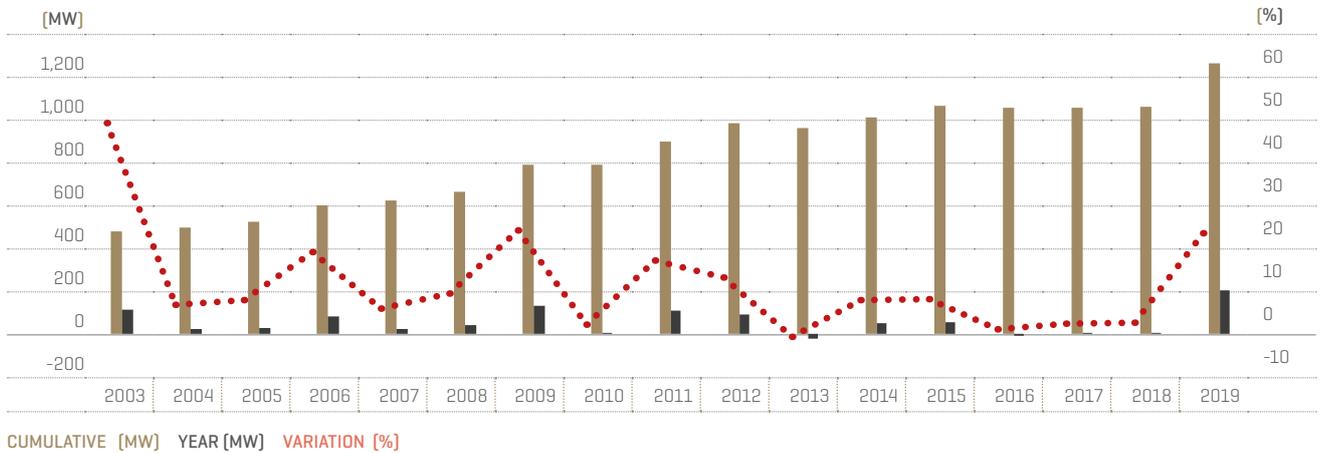
For yet another year, it is important to highlight the specific case of the Gorona del Viento wind-hydro facility which, in 2019, covered 54% of the annual generation on the island of El Hierro with renewable energy, being 100% renewable for more than 24 consecutive days. New records of renewable energy integration were achieved, reaching a level of 97% of the demand being covered with renewable generation in July.

By Autonomous Community, Andalusia is clearly the region with the most installed power capacity, with more than 22% of all the installed power capacity of this set of renewables. It is followed, in order, by Galicia, Castilla-La Mancha and the Basque Country.

[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 by means of Renewables, Cogeneration and Waste. This is the reason why there is a decrease in the installed power capacity as of that year.



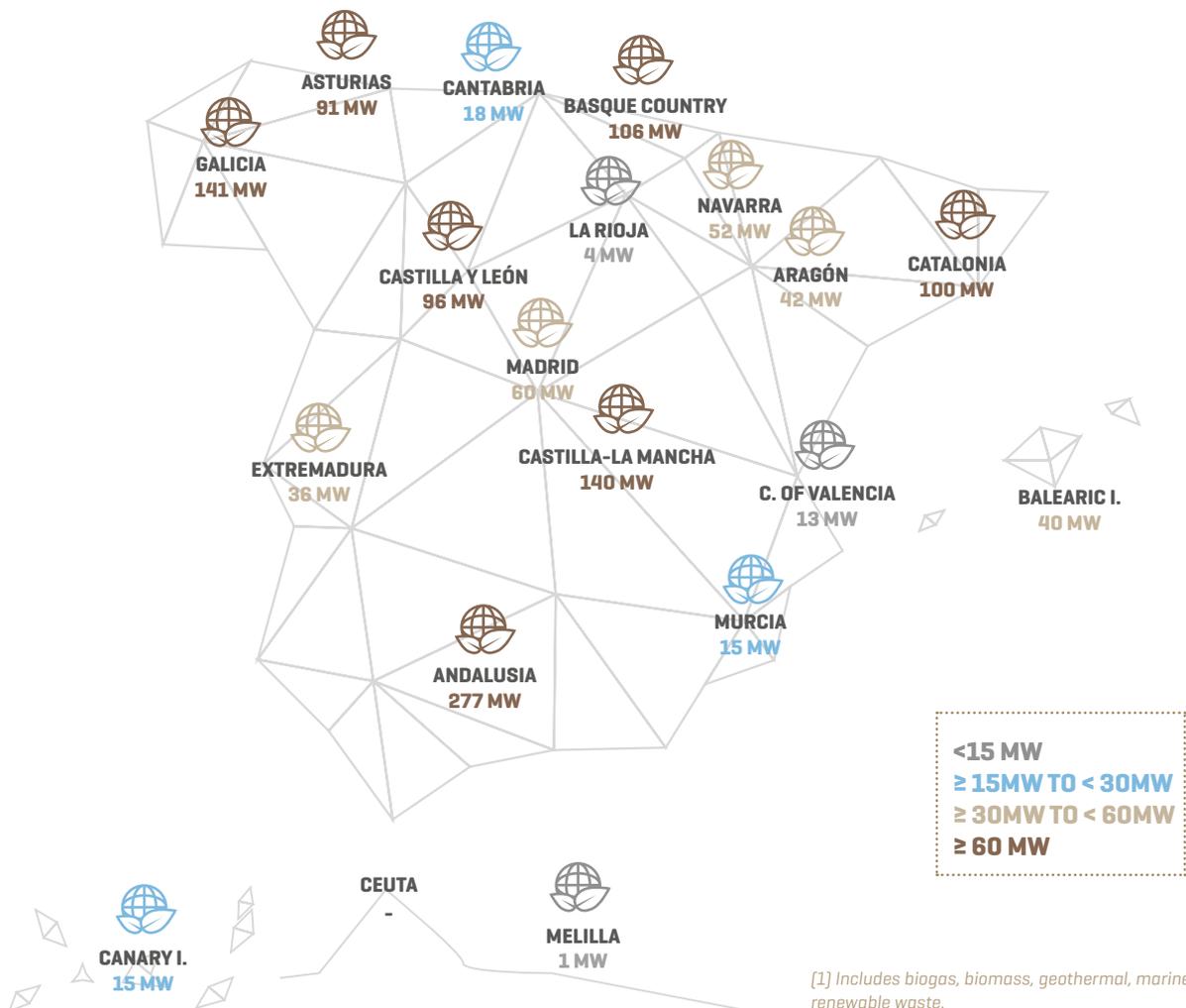
Other renewables^[1]. Installed power capacity. National electricity system.



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

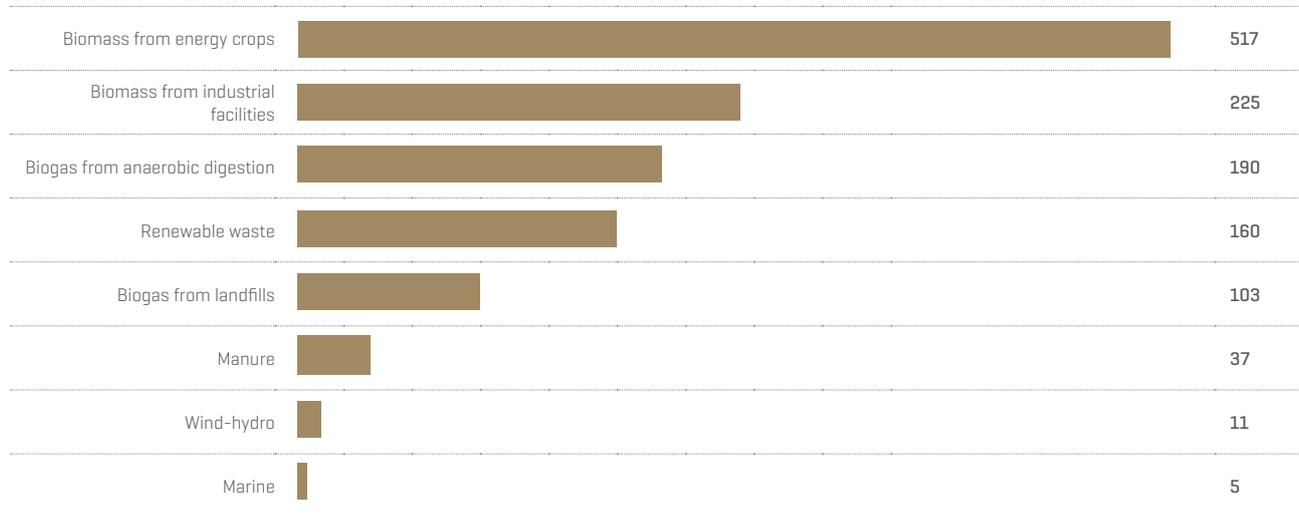
Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

Other renewables^[1]. Installed power capacity by Autonomous Community as at 31/12/2019. National electricity system [MW]

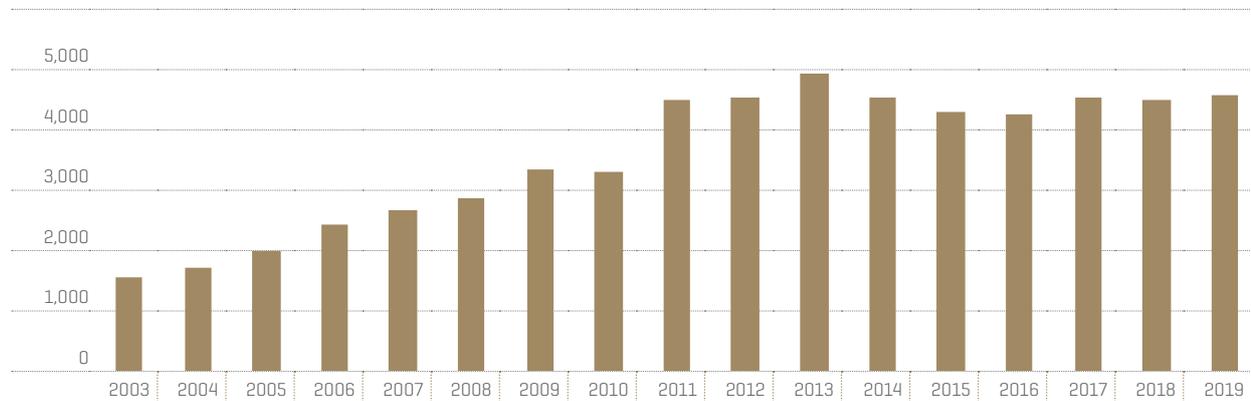


[1] Includes biogas, biomass, geothermal, marine, wind-hydro and renewable waste.

Other renewables. Installed power capacity by fuel type as at 31.12.2019. National electricity system (MW)

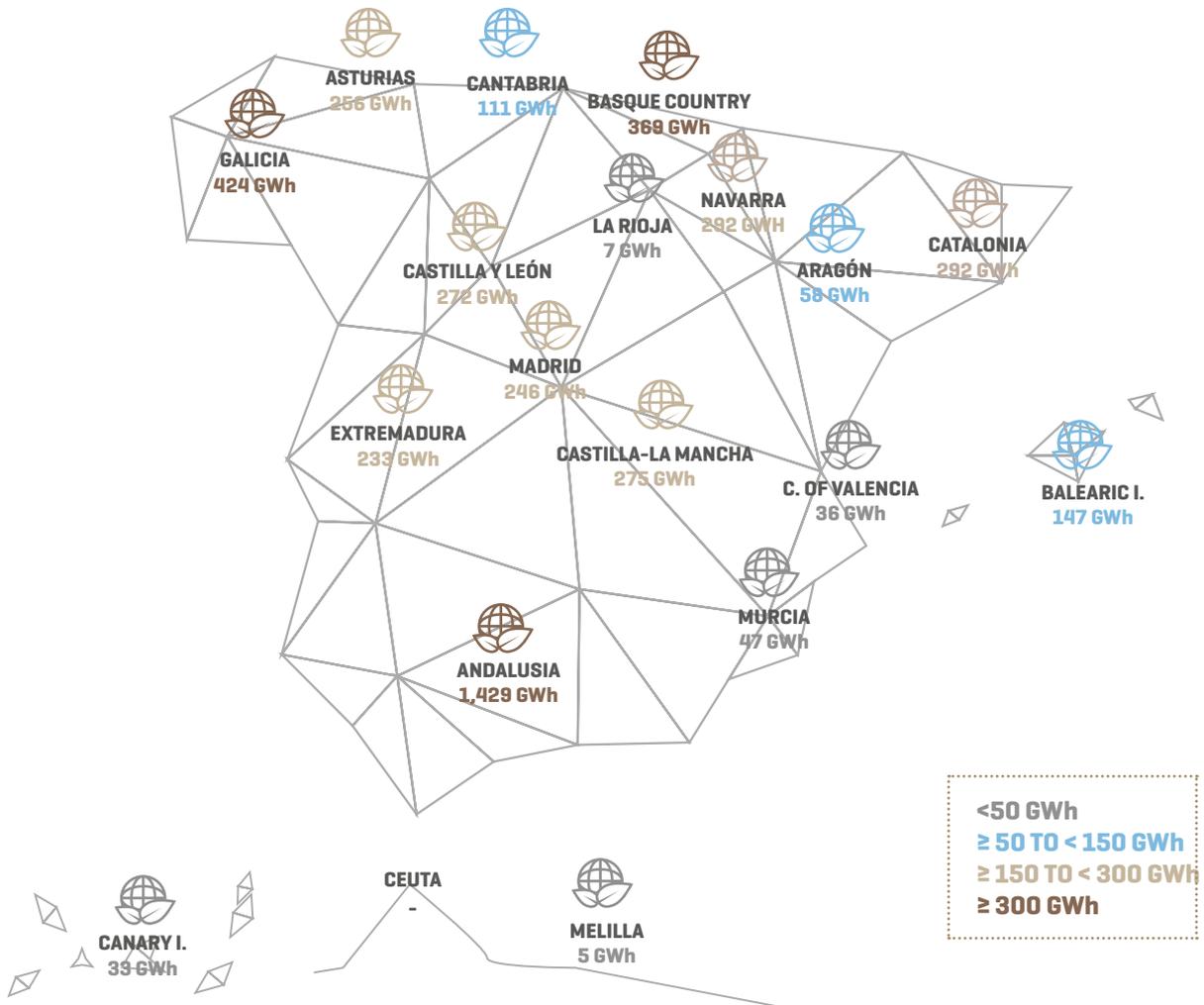


Other renewables^[1]. Electricity generation. National electricity system (GWh)



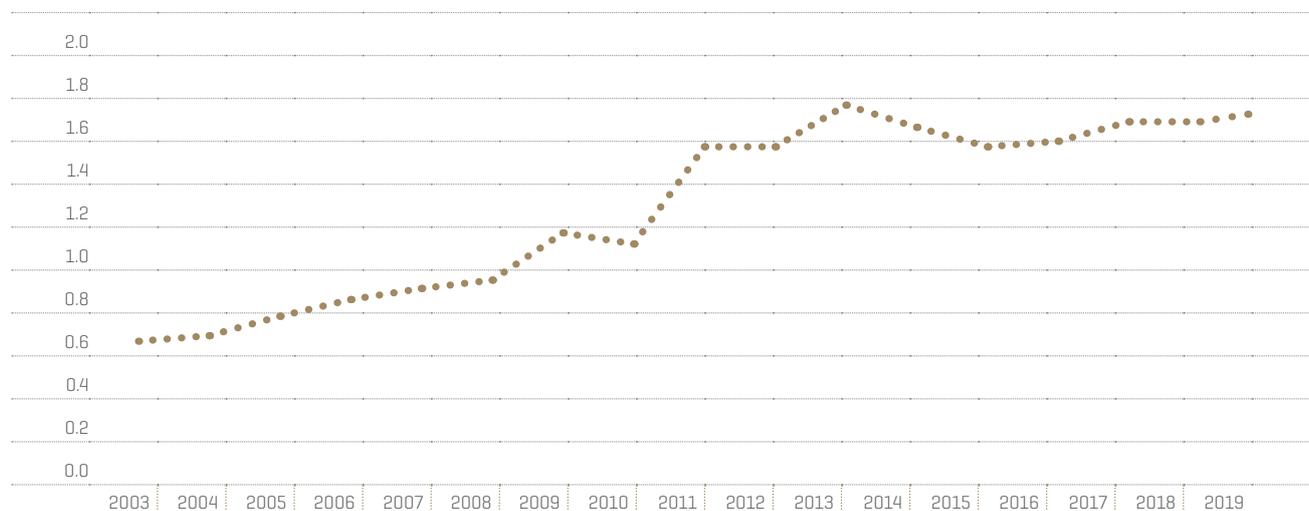
[1] Includes biogas, biomass, geothermal, marine, wind-hydro and renewable waste. . Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

Electricity generation from other renewables^[1] per Autonomous Community in 2019. National electricity system (GWh)



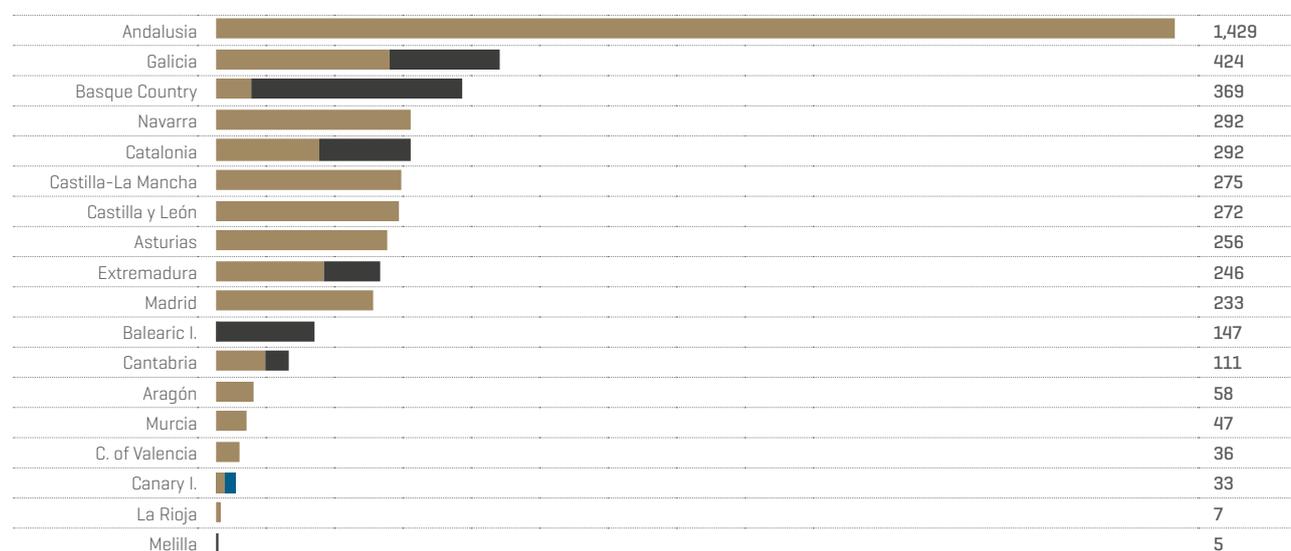
[1] Includes biogas, biomass, geothermal, marine, wind-hydro and renewable waste.

Share of generation from other renewables^[1] in the total generation mix. National electricity system [%]



[1] Includes biogas, biomass, geothermal, marine, wind-hydro and renewable waste. Data for the Balearic Islands and the Canary Islands available as of 2006 and Melilla as of 2007.

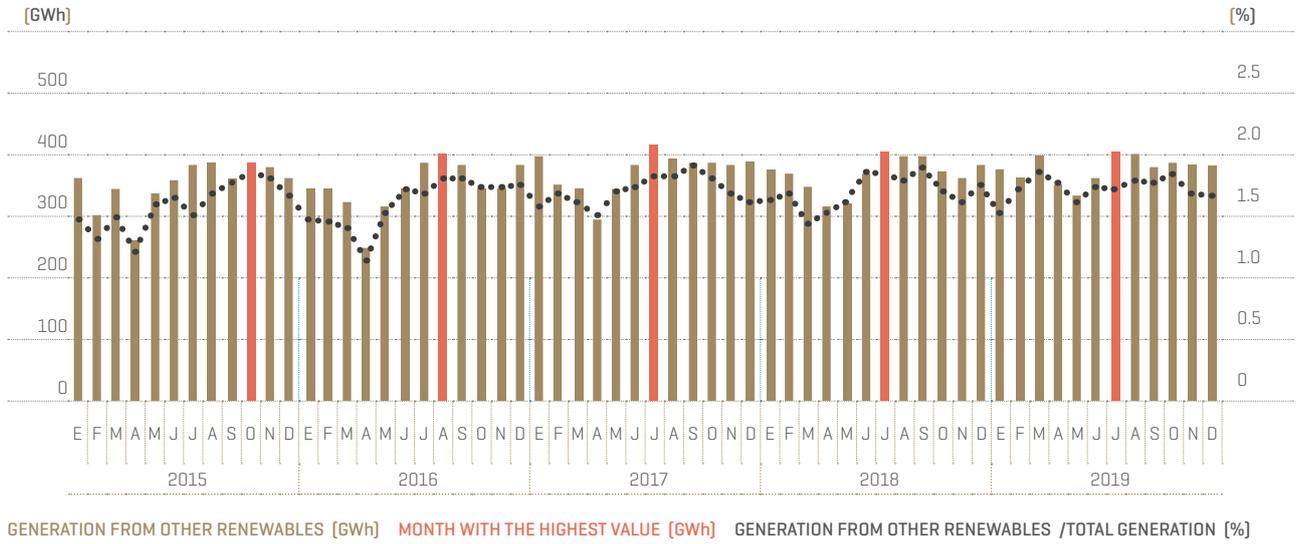
Generation from other renewables^[1] per Autonomous Community and type of technology in 2019 [GWh]



OTHER RENEWABLES^[1] RENEWABLE WASTE WIND-HYDRO

[1] Includes biogas, biomass, geothermal and marine.

National generation from other renewables^[1], monthly maximum values and share in the total generation mix. National electricity system



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

Glossary of terms:

<https://www.ree.es/en/glossary>

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