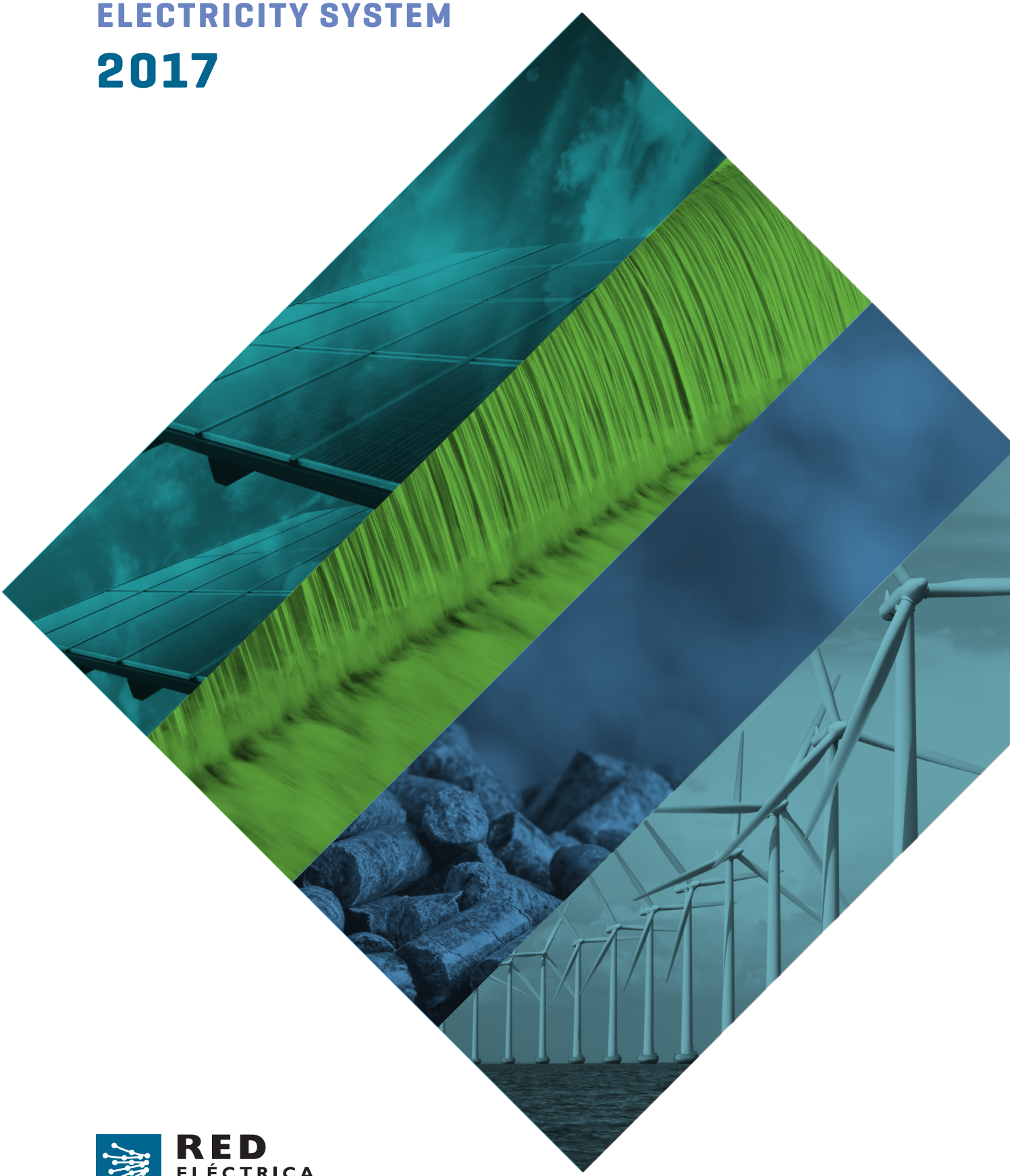
RENEWABLE ENERGY IN THE SPANISH ELECTRICITY SYSTEM

2017



RED ELÉCTRICA DE ESPAÑA

SUMMARY

PRESENTATION

Red Eléctrica de España (REE), as transmission agent and operator of the Spanish electricity system, makes a significant effort to integrate renewable energy. The Control Centre of Renewable Energies (CECRE), is the pioneering technological tool that has been facing up to the challenge of managing and incorporating this type of energy into of the electricity system under safe and reliable conditions.

In addition to this important role, Red Eléctrica has also added the objective of consolidating itself as a benchmark regarding statistical information on electricity in Spain. In line with this objective, Red Eléctrica has published the second edition of the 'Renewable energy in the Spanish electricity system' report, which presents a high-level overview of the behaviour and contribution of renewable energy in Spain in 2017, as well as how it has evolved over recent years.

This report is broken down into five main chapters. The first chapter 'Renewable energy in 2017' is a summary chapter and provides the reader with a global overview of the behaviour of renewable energy throughout the year and consolidates the data that will appear in more detail in the subsequent main chapters: Energy from the wind, Energy from water, Energy from the sun and Energy from the Earth and sea.

In addition, the report is supplemented by data files that can be downloaded in different formats. This information is available in the statistics section of the corporate website (www.ree.es/en), along with other publications and statistical series that Red Eléctrica periodically makes available to the 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 the following e-mail address redelectrica@ree.es is made available to the public, as a channel through which suggestions and observations may be submitted.

01

RENEWABLE ENERGY IN 2017

The production of renewable energy in the Spanish electricity system closed 2017 with the lowest figures of the last eight years, as a result of the low contribution of hydro.

INSTALLED RENEWABLE POWER CAPACITY

48,185
MW

46%

OF THE TOTAL INSTALLED ELECTRICITY GENERATION CAPACITY IN SPAIN IN 2017

RENEWABLE ENERGY GENERATION 2017

84,505
GWh

-16.3%

COMPARED TO 2016

At the end of 2017, renewable energy in Spain represented 46% of the installed power capacity in the entire set of power generating facilities, standing at 48,185 MW. This figure is the result of a growth trend over the years and that as of 2013 has remained practically unchanged, with just a small variation of 0.6% in the last five years.

Regarding electricity generation in 2017, overall renewable energy production, directly affected as a result of a lack of hydroelectric power generation, closed the year at 84,505 GWh, registering a decrease of 16.3% compared to the previous year; the lowest production since 2009. Similarly, renewables reduced their share in the overall generation mix nationwide to 32.1%, compared to 38.4% the previous year. As for the peninsular electricity system, which represents almost 95% of the total generation nationwide, the share of renewables stood at 33.7% in 2017.

The fall in renewable generation in 2017 was offset by an increase in the share of thermal generation, mainly coming from combined-cycle and coal-fired power stations, which consequently resulted in a 17.9% increase in CO2 emissions with regard to the previous year.

Wind energy continues to be the most relevant renewable technology in the national electricity generation mix with a share of 18.2 % of the total production in 2017, ranking second only to nuclear. In comparison to other sources of renewable energy, wind energy alone accounted for almost 57% of all renewable generation in 2017.

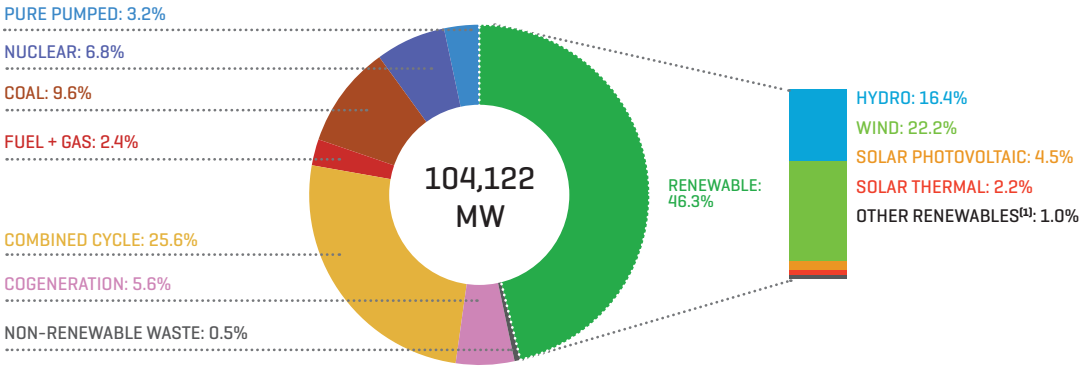
Since 2008, wind has been the technology that has contributed most to total renewable generation, due mainly to the fact that installed wind power capacity has grown year on year and because of its regularity in terms of annual generation. In fact, unlike hydro, whose dependence on meteorological conditions is extremely high, wind energy production is much more constant throughout the year, although it too has a certain degree of dependence on meteorological conditions.

By autonomous community, Castilla y León, Galicia, Andalusia and Castilla-La Mancha are the regions in which more than half of the installed renewable power capacity of the national electricity system is concentrated. Of these regions, noteworthy are Castilla y León and Castilla-La Mancha due to their high share of renewables, more than 70% of their installed power capacity is of renewable origin.

In terms of generation, noteworthy is that in six autonomous communities more than 40% of the annual production was of renewable origin. Castilla y León and Navarra with 64% and 61%, respectively, are at the top of the list.

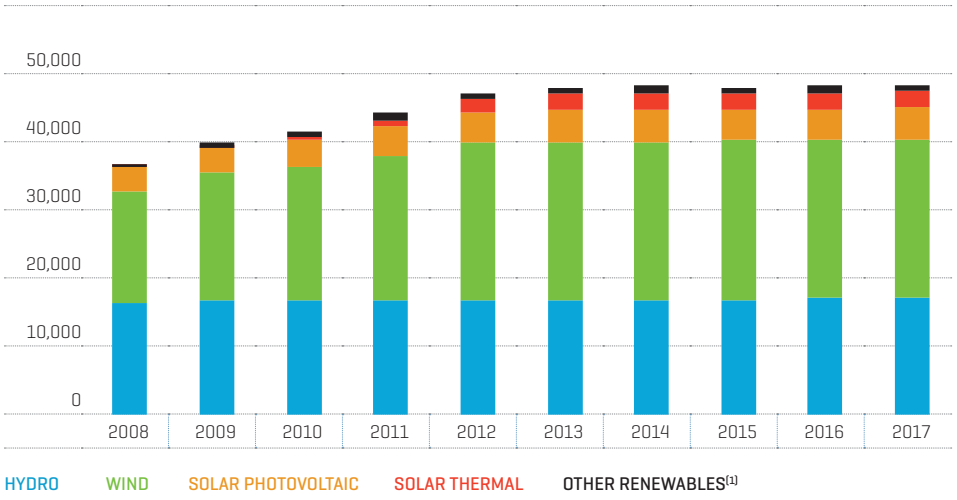
In comparison with the rest of the European countries, Spain ranked in sixth position in volume of renewable generation in 2017. Regarding the share of renewables with respect to total generation, Spain's figures remain above the average values of a specific group of European countries that do have multi-year data series available for comparison, and which also have shown a positive evolution brought about as a result of the targets established by the European Union in terms of renewables and emissions.

Breakdown of installed power capacity at 31.12.2017. National electricity system (%)



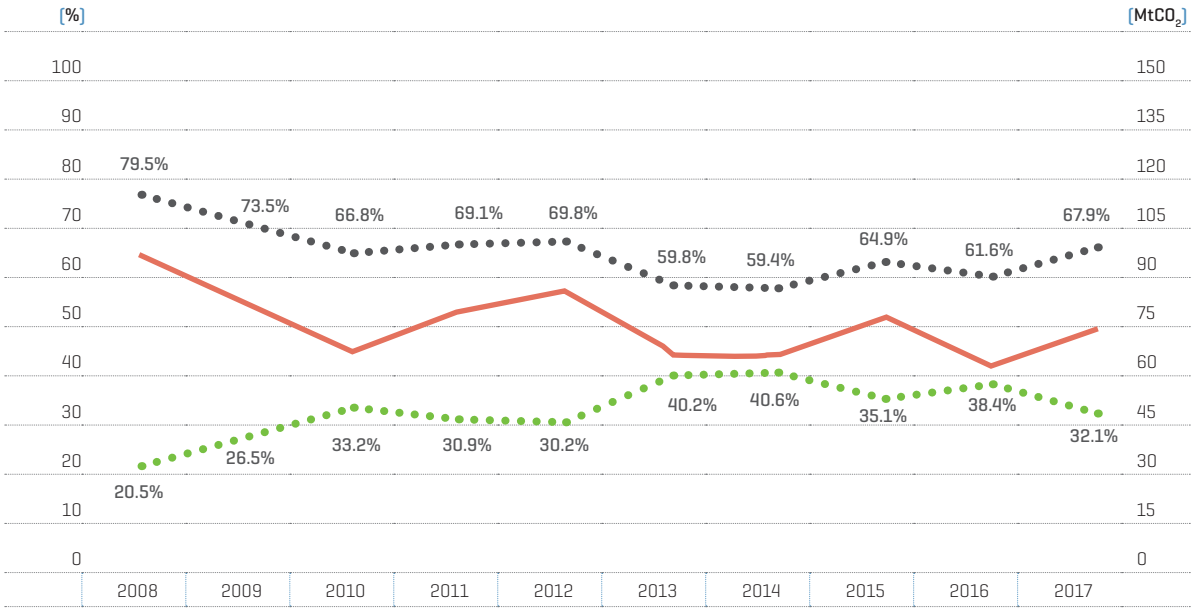
(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.

Evolution of installed renewable power capacity. National electricity system (MW)



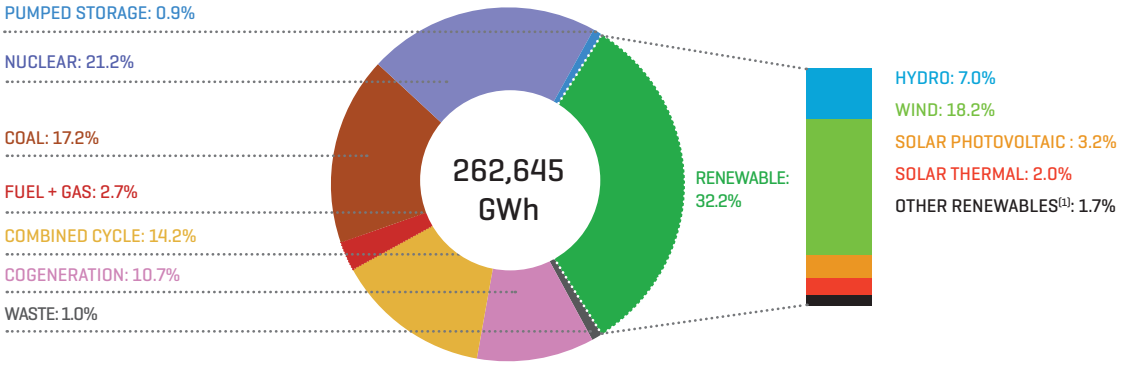
(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.
Source: National Commission for Markets and Competition (CNMC) until 2014.

Evolution of renewable/non-renewable generation and CO_2 emissions associated with electricity generation. National electricity system



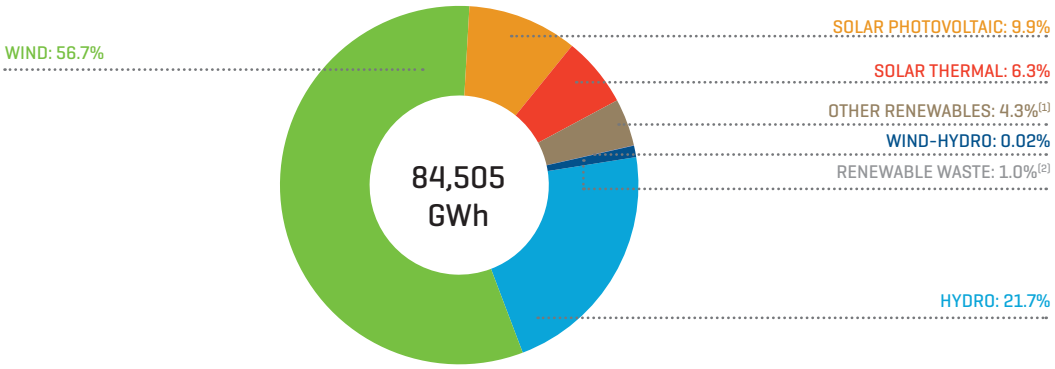
RENEWABLES: HYDRO, WIND, SOLAR PHOTOVOLTAIC, SOLAR THERMAL AND REMAINING RENEWABLES
NON-RENEWABLES: NUCLEAR, PUMPED STORAGE, COAL, FUEL/GAS, COMBINED CYCLE, COGENERATION AND WASTE
EMISSIONS (MILLION tCO_2)

Renewable energy generation structure in 2017. National electricity system [%]



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

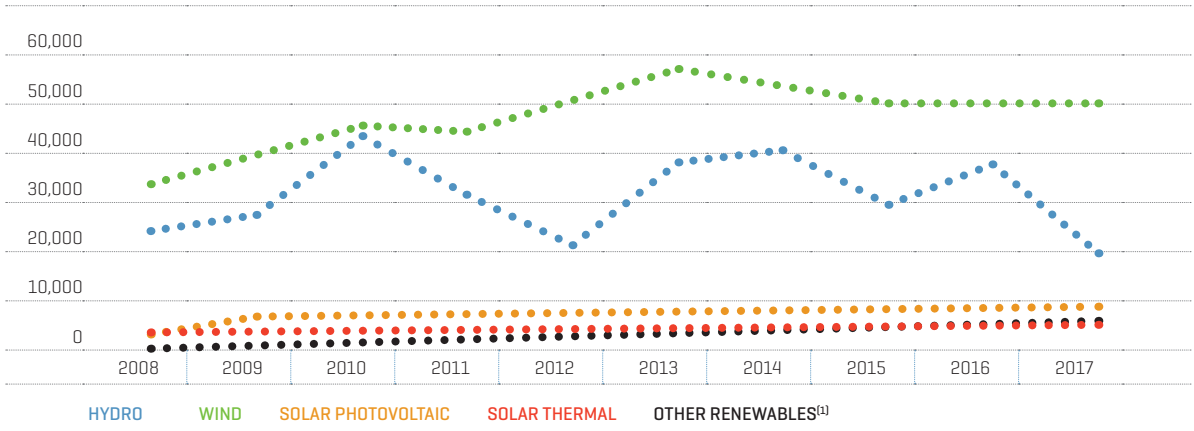
Annual renewable energy generation structure in 2017. National electricity system [%]



(1) Includes biogas, biomass, marine hydro and geothermal.

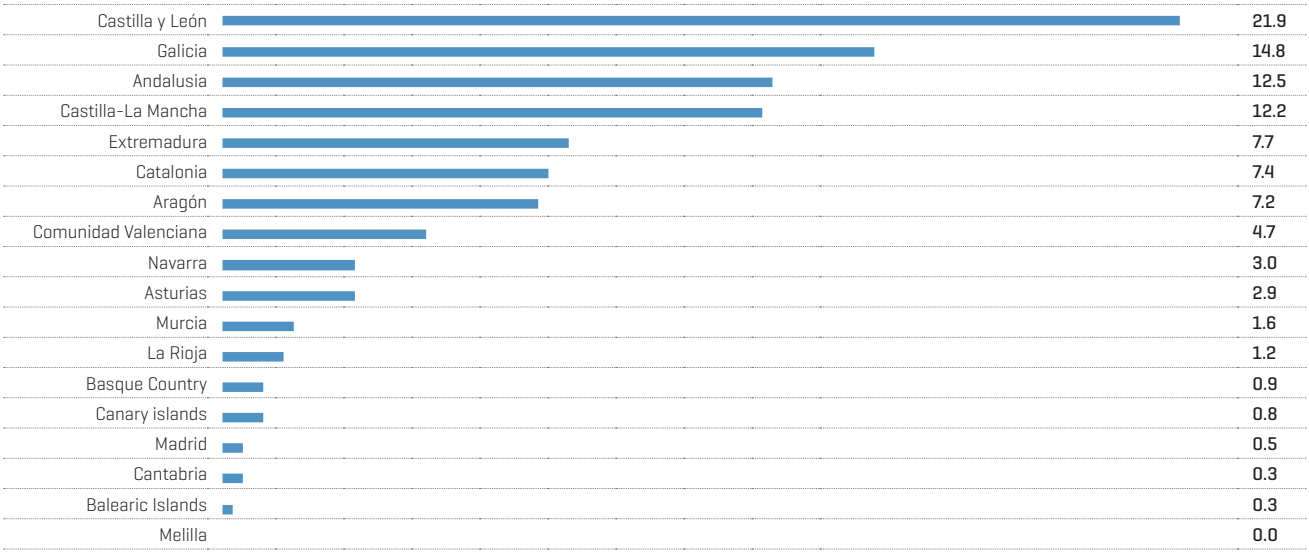
(2) 50% of generation obtained using urban solid waste is considered as renewable.

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

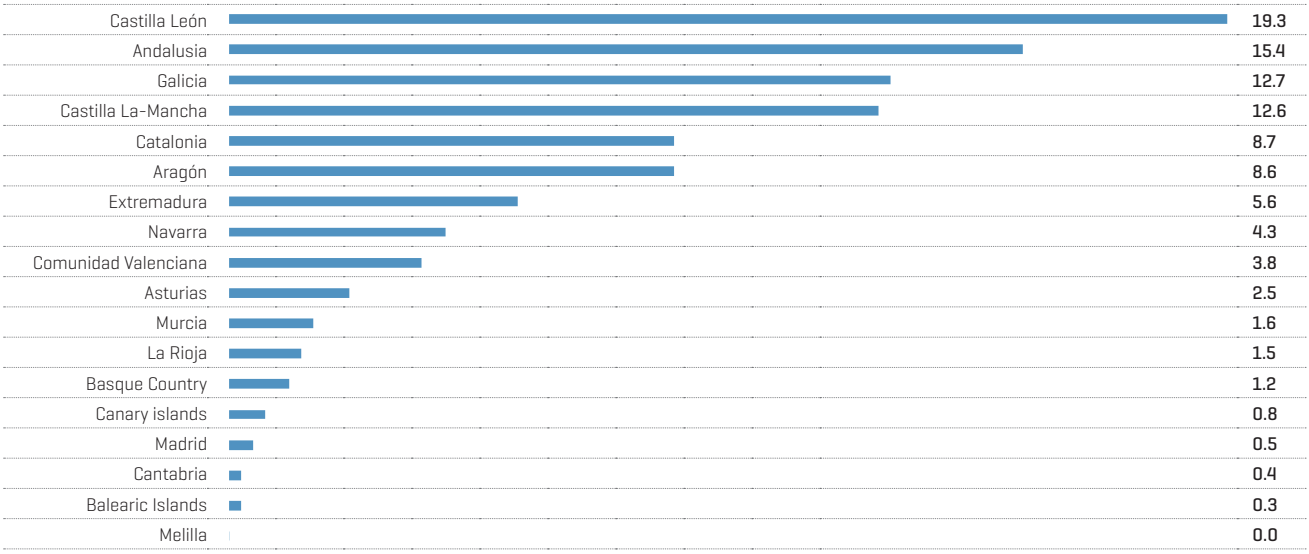


(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.
Data regarding the Balearic Islands and the Canary Islands available as of 2006 and Melilla since 2007.

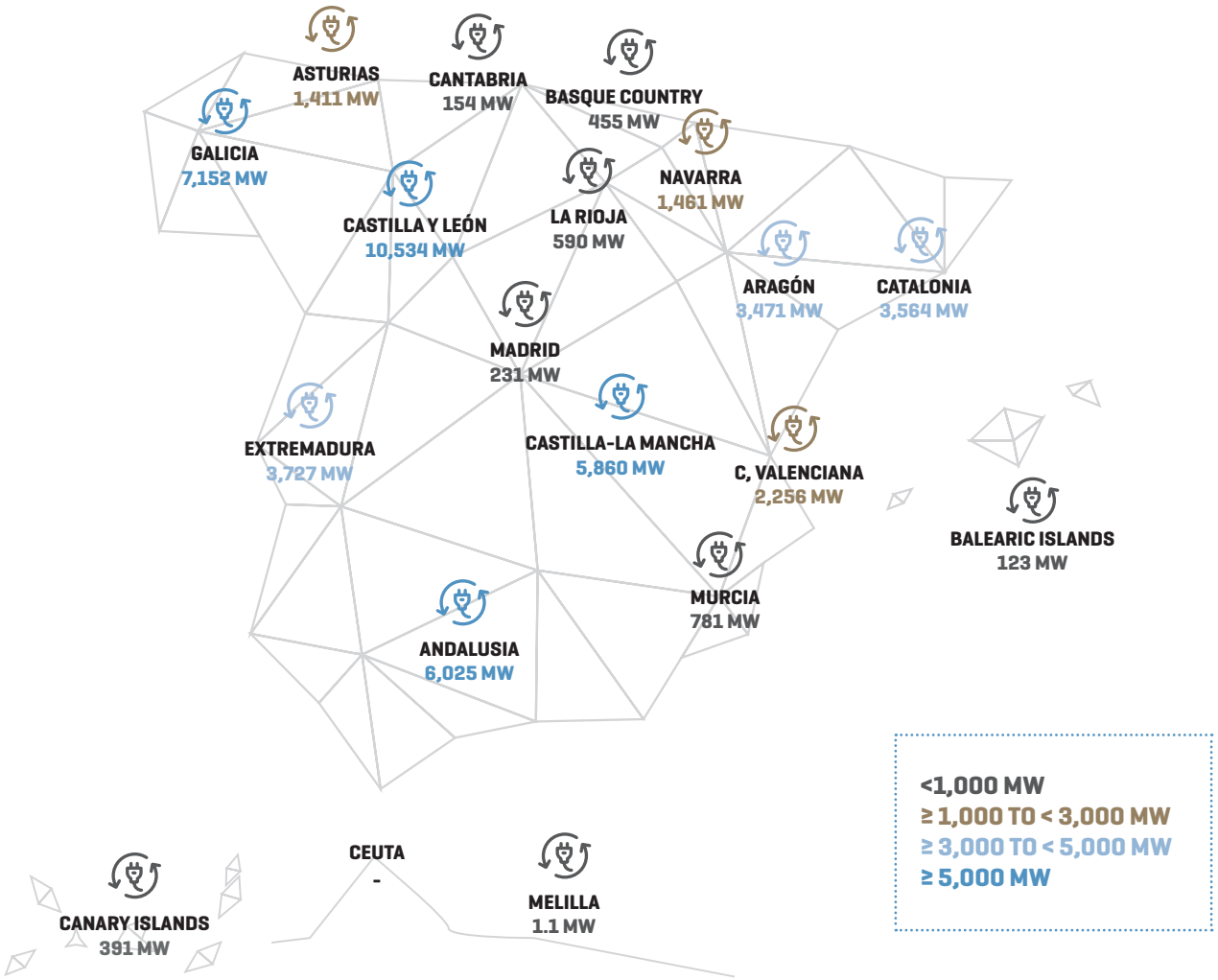
Share of installed renewable power capacity per autonomous community in relation to national renewable power capacity as at 31.12.2017 (%)



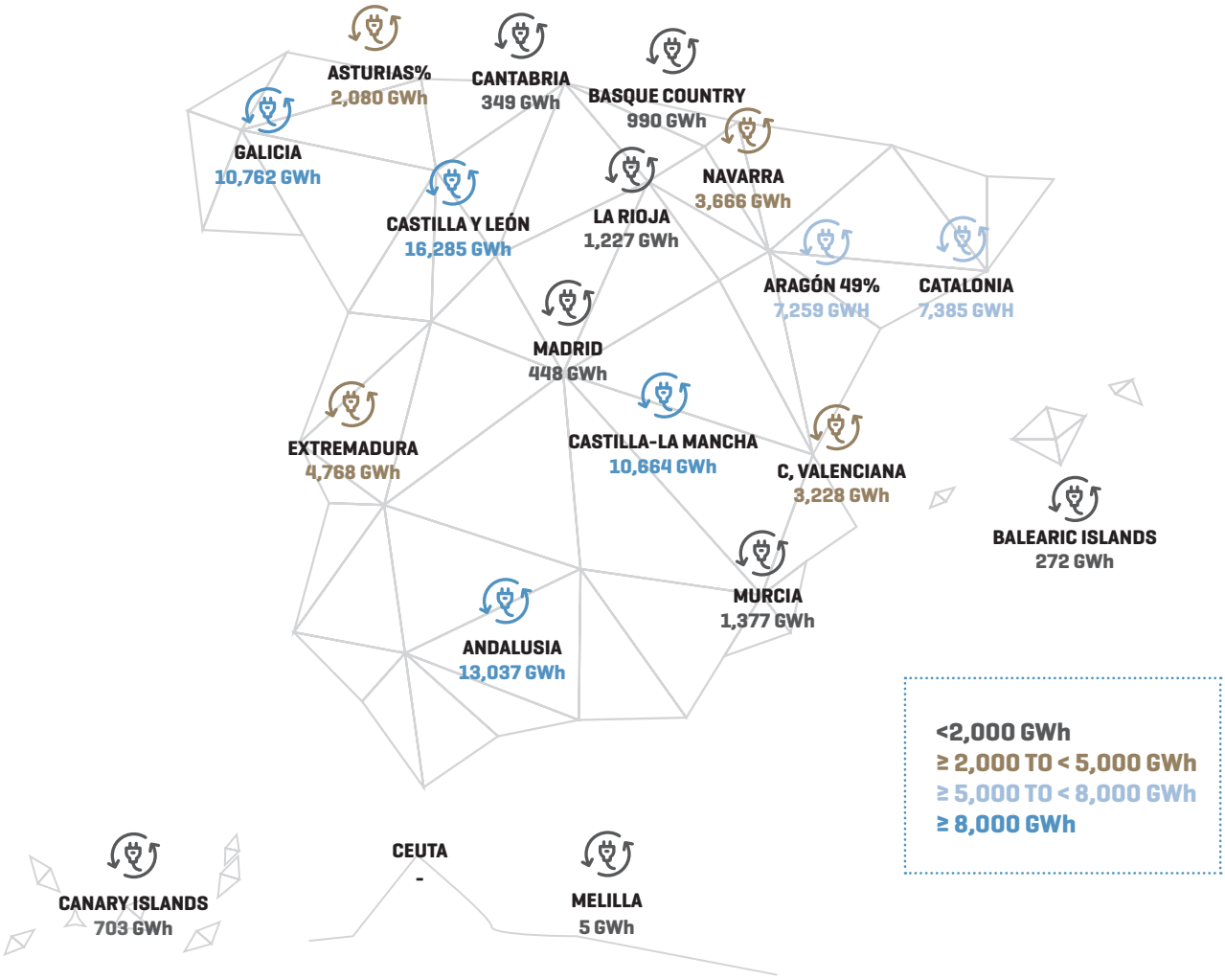
Share of renewable generation per autonomous community in relation to national renewable generation as at 31.12.2017 (%)



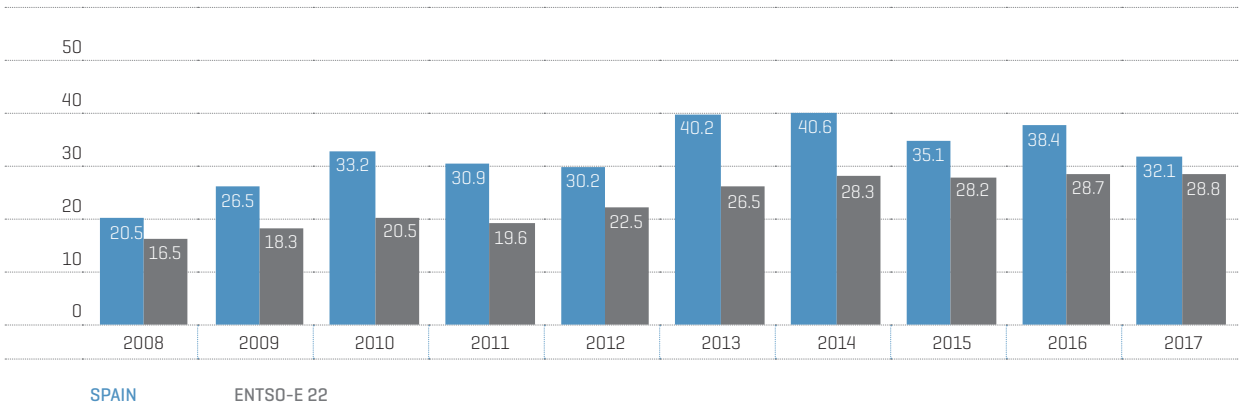
Renewable power installed as at 31.12.2017. National electricity system per autonomous community [MW]



Renewable generation in 2017. National electricity system per autonomous community (GWh)

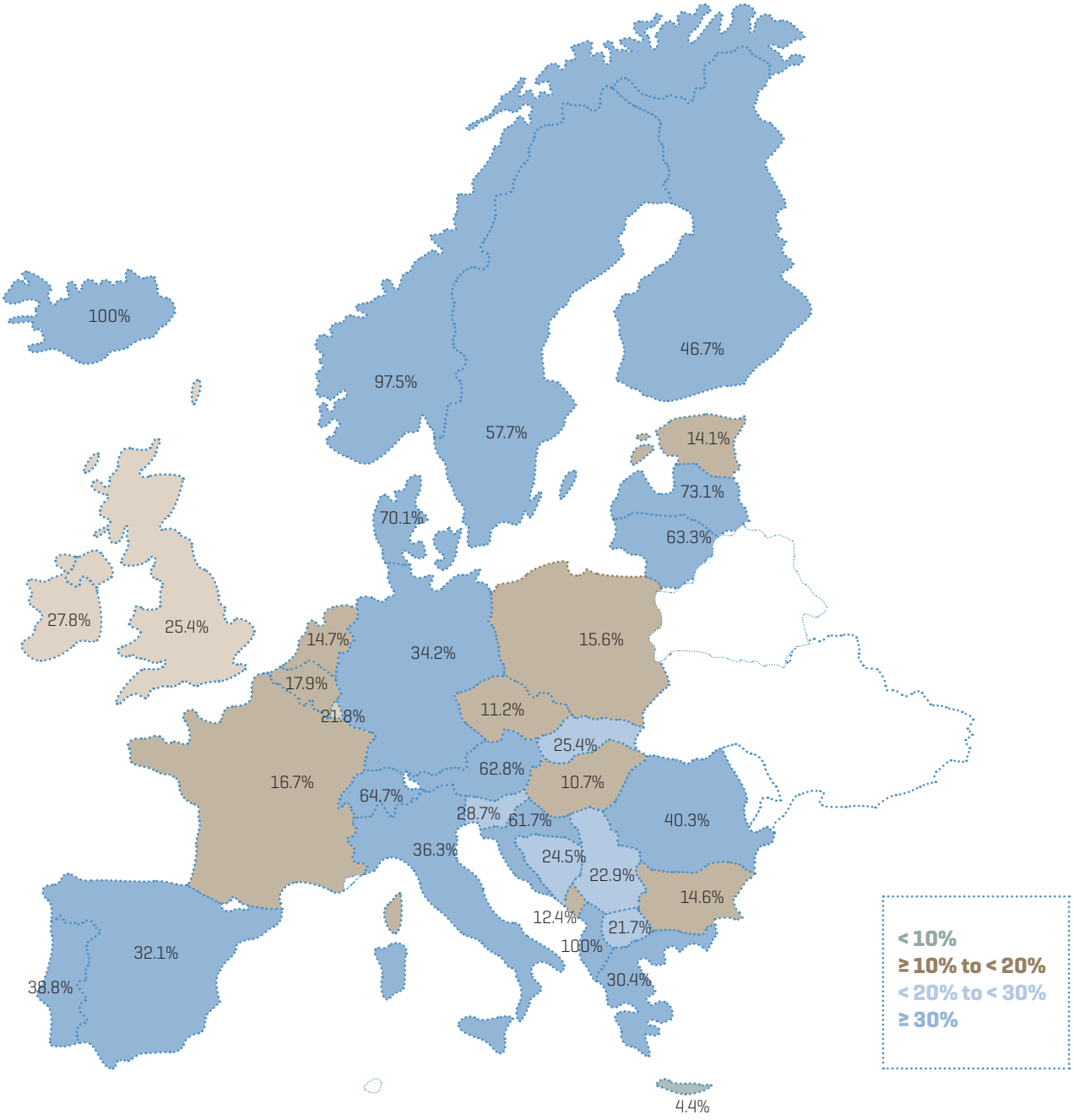


Renewable generation regarding total generation in spain and the average of a selection of ENTSO-E 22 member countries[1] (%)



(1) Due to the unavailability of data for the whole series of some countries, the evolution chart contains information only from: Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, France, FYROM (Macedonia), Germany, Greece, Holland, Hungary, Italy, Luxembourg, Poland, Portugal, Czech Republic, Romania, Slovakia, Slovenia, Spain,and Switzerland.

Share renewable generation over total generation within ENTSO-E in 2017 [%]



Source: ENTSO-E. Data Portal 19 April 2018. Spain REE, Great Britain includes data for Northern Ireland.

02

ENERGY FROM THE WIND

Wind power is the main renewable source of electricity generation nationwide. Currently, Spain is ranked second among the European leaders in installed wind power capacity.

INSTALLED WIND POWER CAPACITY

23,132
MW

22.2%

OF THE TOTAL INSTALLED ELECTRICITY GENERATION CAPACITY IN SPAIN IN 2017

WIND ENERGY GENERATION IN 2017

47,897
GWh

SECOND

SOURCE OF ELECTRICITY GENERATION IN 2017

Wind power is the main renewable source of electricity generation in Spain, with 23,132 MW of installed power capacity by the end of 2017. Although this figure has remained relatively unchanged over the last five years, with only slight variations, at the end of 2017 this technology represented 22.2% of the total installed power capacity in the country as a whole and accounted for 18.2% of the electricity generation in 2017.

In 2017, wind energy generated in Spain stood at 47,897 GWh, which represents an increase of 0.4% over the previous year. Despite this slight increase, wind power continues to be the second source of electricity generation after nuclear, maintaining its relatively high share in the overall generation mix of around 20%, which was also the maximum value registered in 2013.

With regard to the entire set of renewable technologies, wind is the most relevant in both installed power capacity and generation. Specifically, it accounts for almost half of the total installed renewable power capacity, and during 2017 it increased its share in the total peninsular renewable generation mix to 56.7% (47.7% in 2016), mainly due to the decrease in hydroelectric power generation.

The highest monthly wind energy generation in 2017 was registered in the month of December with 5,788 GWh, a figure that is 5.2% less than the monthly maximum of the previous year registered in February. Moreover, in December and February it was the technology that contributed the most to the total production of the peninsular electricity system, reaching a share of close to 25% in both months.

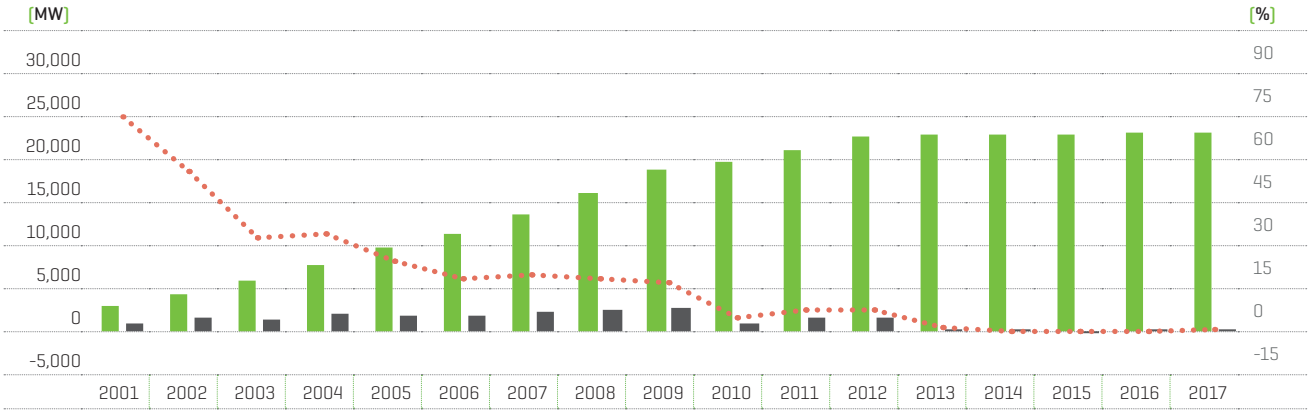
The high variability associated with wind energy generation in order to cover hourly demand, means that its participation in the mix has fluctuated between minimum values of 1.0% (on 24 March at 11:00 am), up to 68.5% (on 27 December at 4:00 am).

The average contribution of wind energy generation to demand coverage was higher in the off-peak hours, with an average share that stood at nearly 23%, while this share fell to an average value of 17.4% in the peak hours of the day.

By autonomous community, Castilla y León is the region with the most installed wind power capacity, representing almost 24% of the national total, followed by Castilla-La Mancha, Galicia and Andalusia. These four autonomous communities alone account for 70% of the installed wind power capacity in Spain.

Compared with other European countries, Spain continues to be the country with the second highest installed wind power capacity behind Germany, which is clearly the leader with a little over 55 GW of installed power capacity, followed by Great Britain in third place. In terms of generation share, the clear leader is Denmark, where wind energy accounts for more than 50% of its electricity production, with Spain currently ranking fifth. Nonetheless, of the largest European countries, Spain remains the leader in wind energy contribution, followed by Germany.

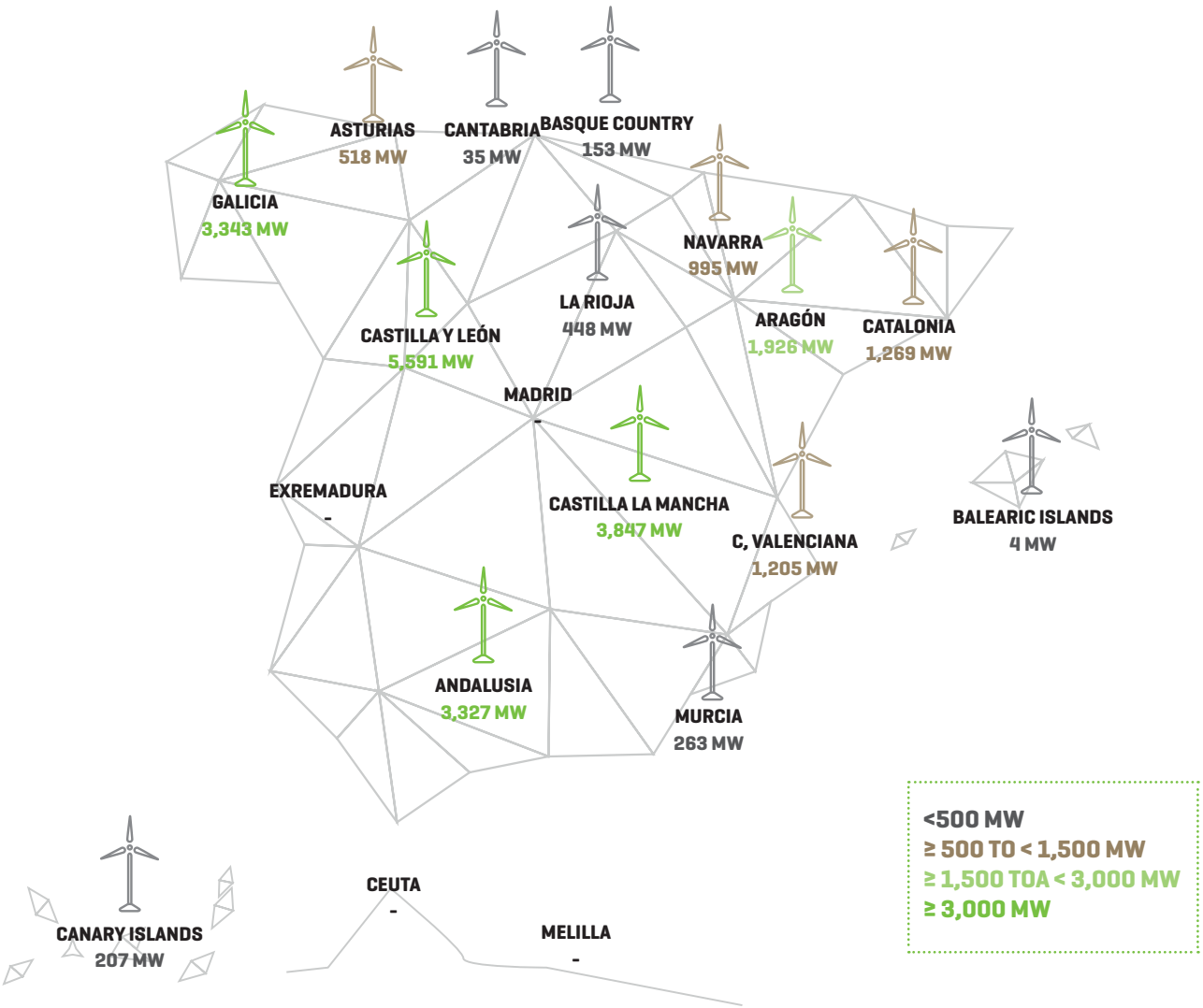
Installed wind power capacity. National electricity system



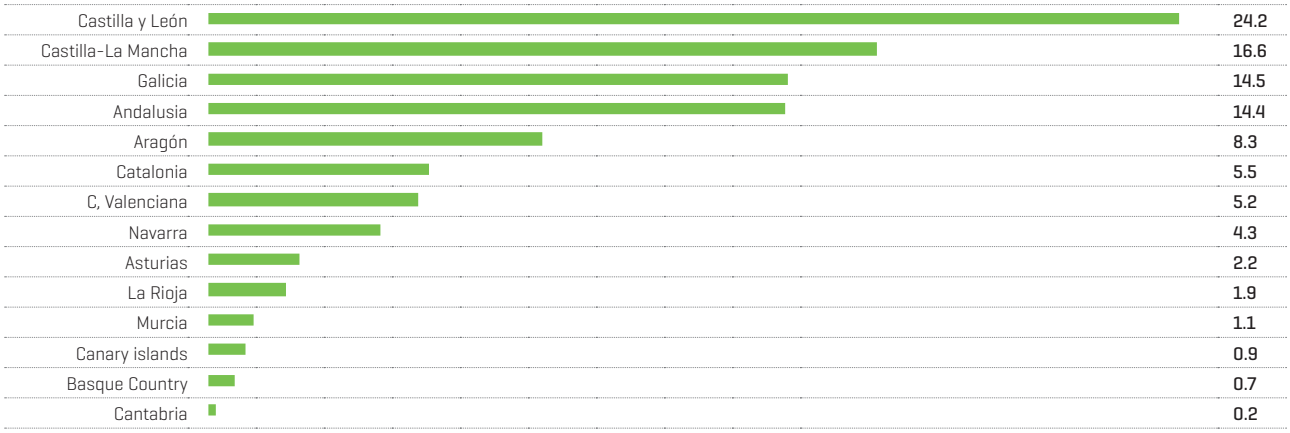
CUMULATIVE [MW] YEAR [MW] VARIATION [%]

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

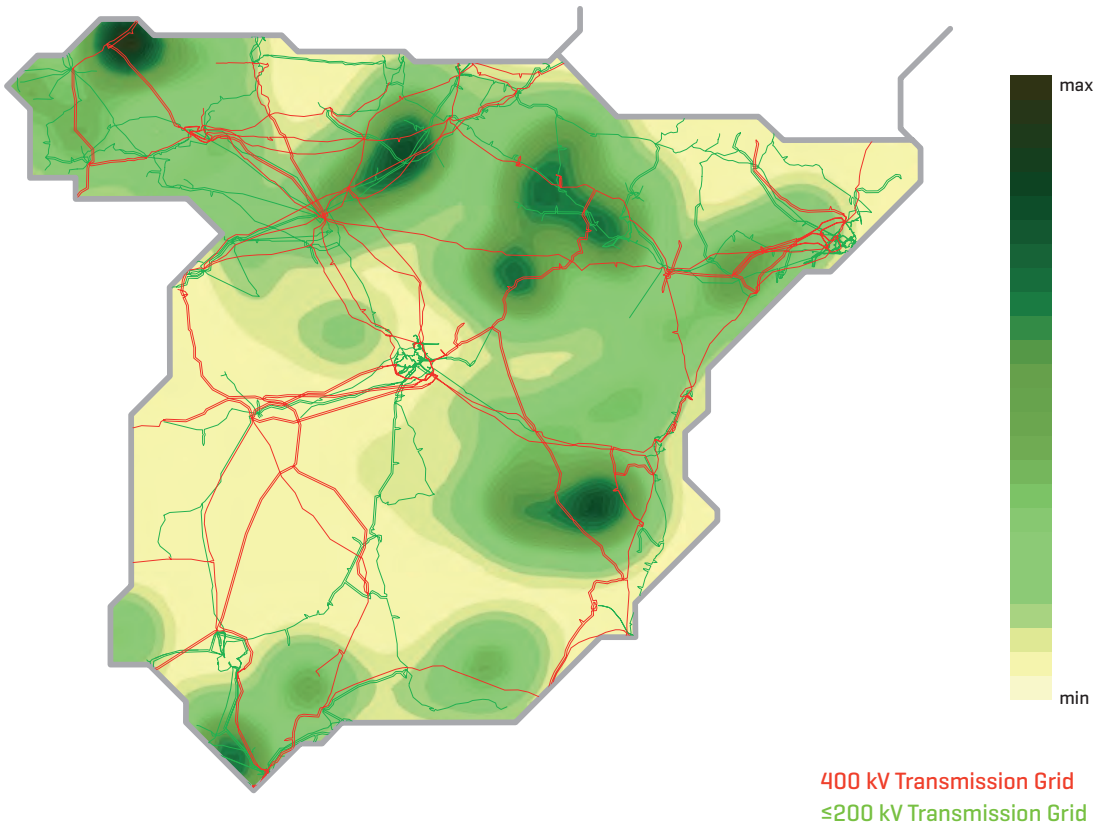
Installed wind power capacity as at 31.12.2017. National electricity system per autonomous community [MW]



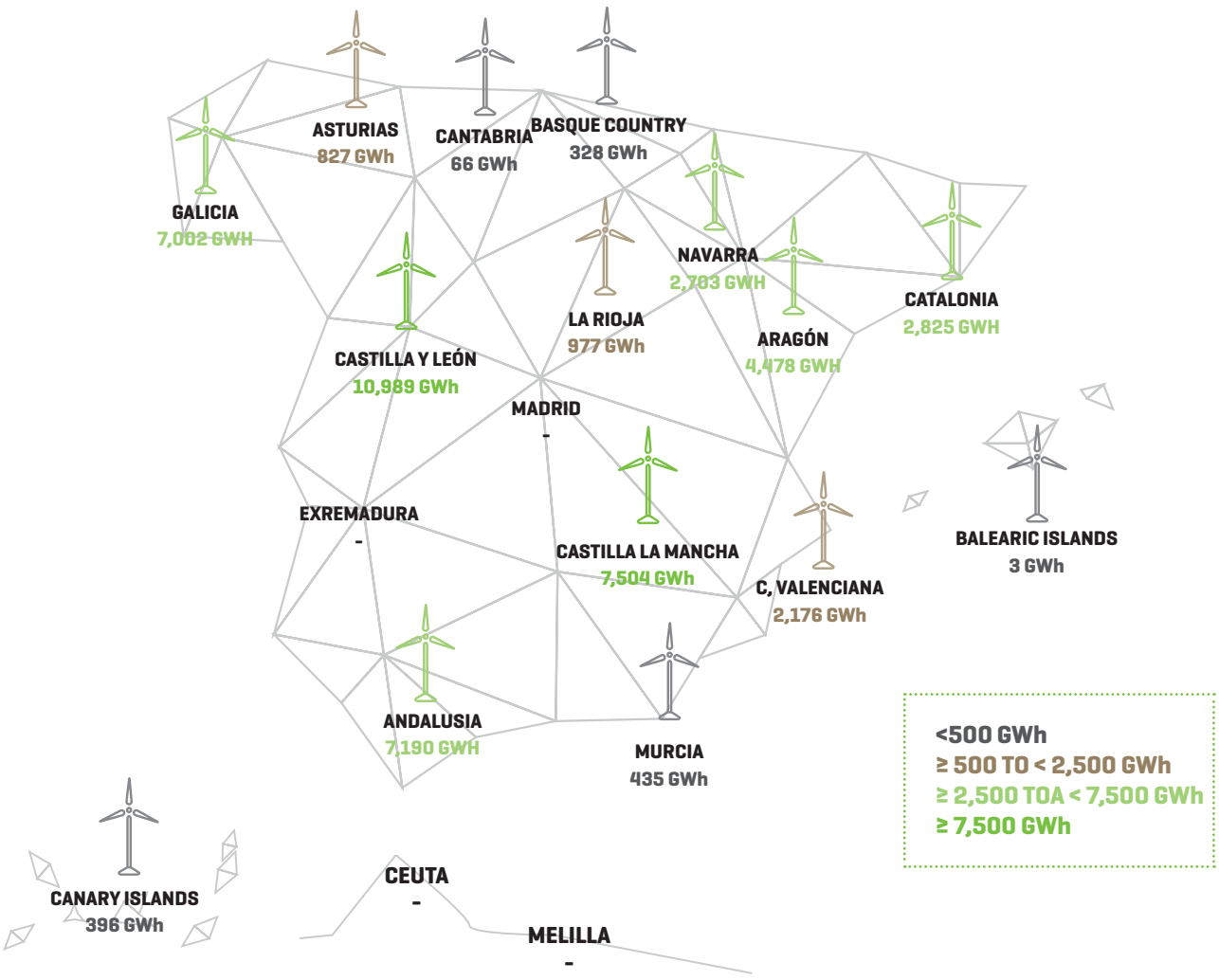
Share of installed wind power capacity in relation to the national total [%]



Geographical distribution of wind energy facilities on the Spanish peninsula as at 31.12.2017 [%]

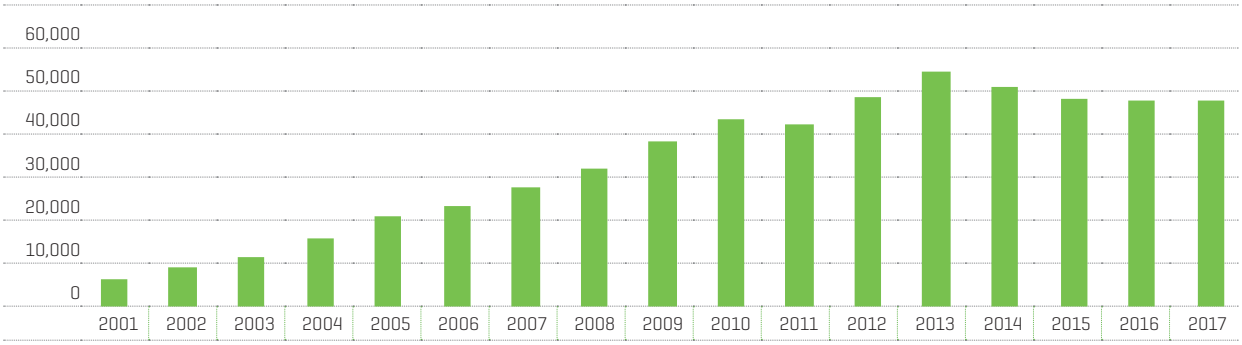


Wind energy generation in 2017. National electricity system per autonomous community [GWh]



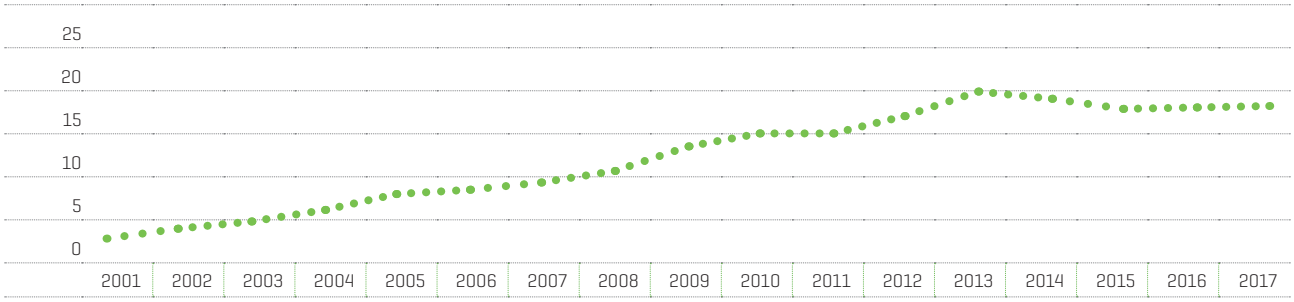
Castilla y León, Castilla-La Mancha, Galicia and Andalusia account for nearly 70% of all wind energy generated in Spain in 2017.

Wind energy generation. National electricity system [GWh]



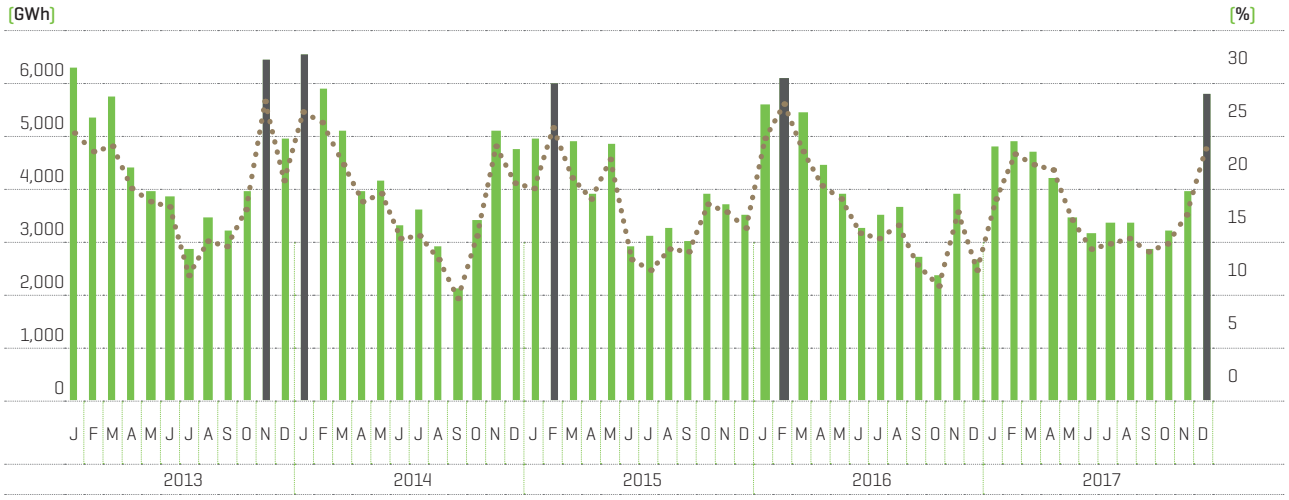
Data regarding the Balearic Islands and Canary islands available as of 2006 and Ceuta and Melilla as of 2007.

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



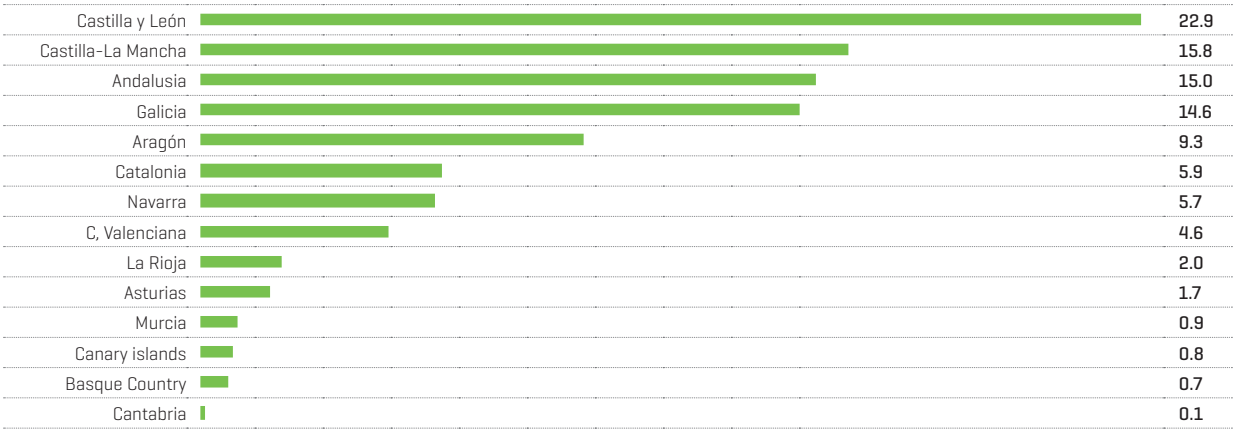
Data regarding the Balearic Islands and Canary islands available as of 2006 and Ceuta and Melilla as of 2007.

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

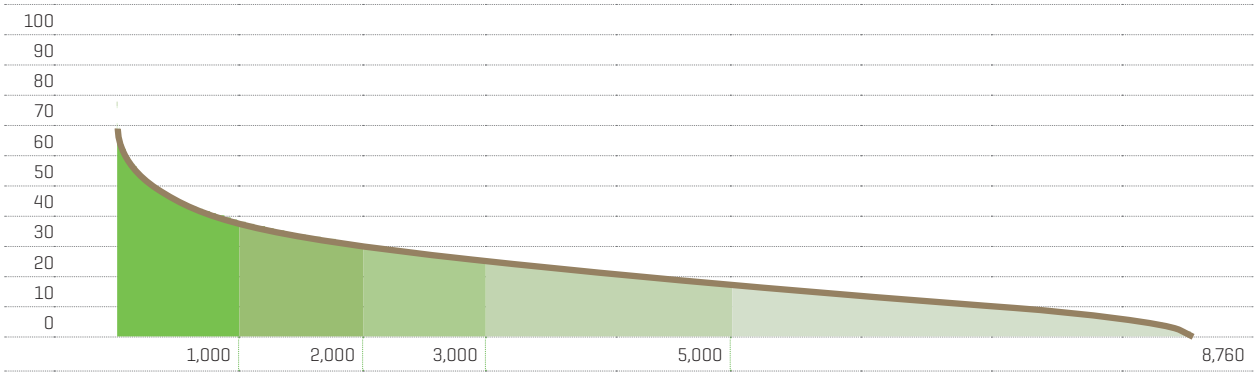


WIND ENERGY GENERATION [GWh] MONTHLY MAXIMUM VALUE [GWh] WIND ENERGY GENERATION / TOTAL GENERATION [%]
Data regarding the Balearic Islands and Canary islands available as of 2006 and Ceuta and Melilla as of 2007.

Share of wind energy generation per autonomous community in relation to total national wind generation [%]

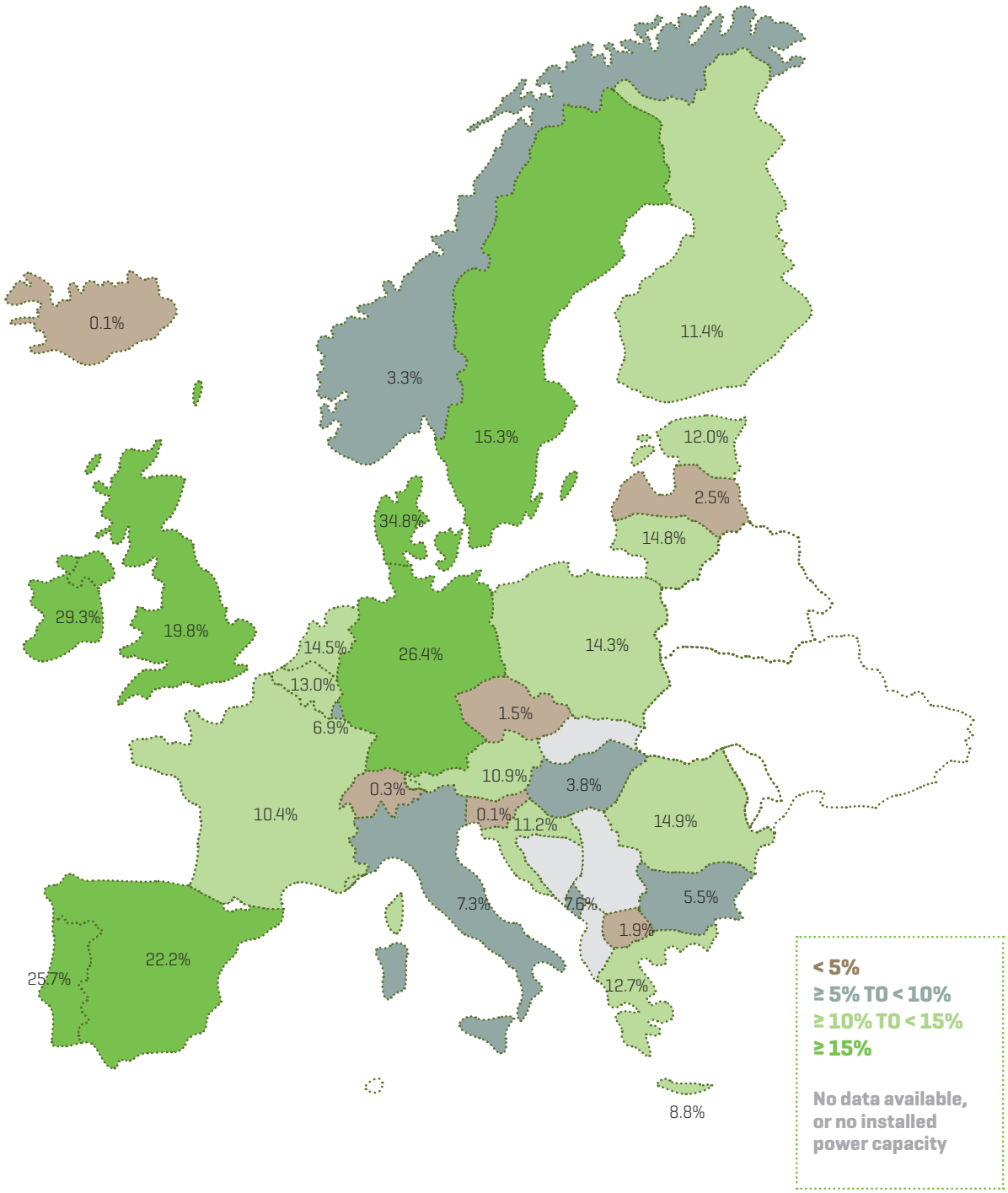


Monotonous curve [1] of the share of wind energy generation in demand coverage Spanish peninsular electricity system [%]



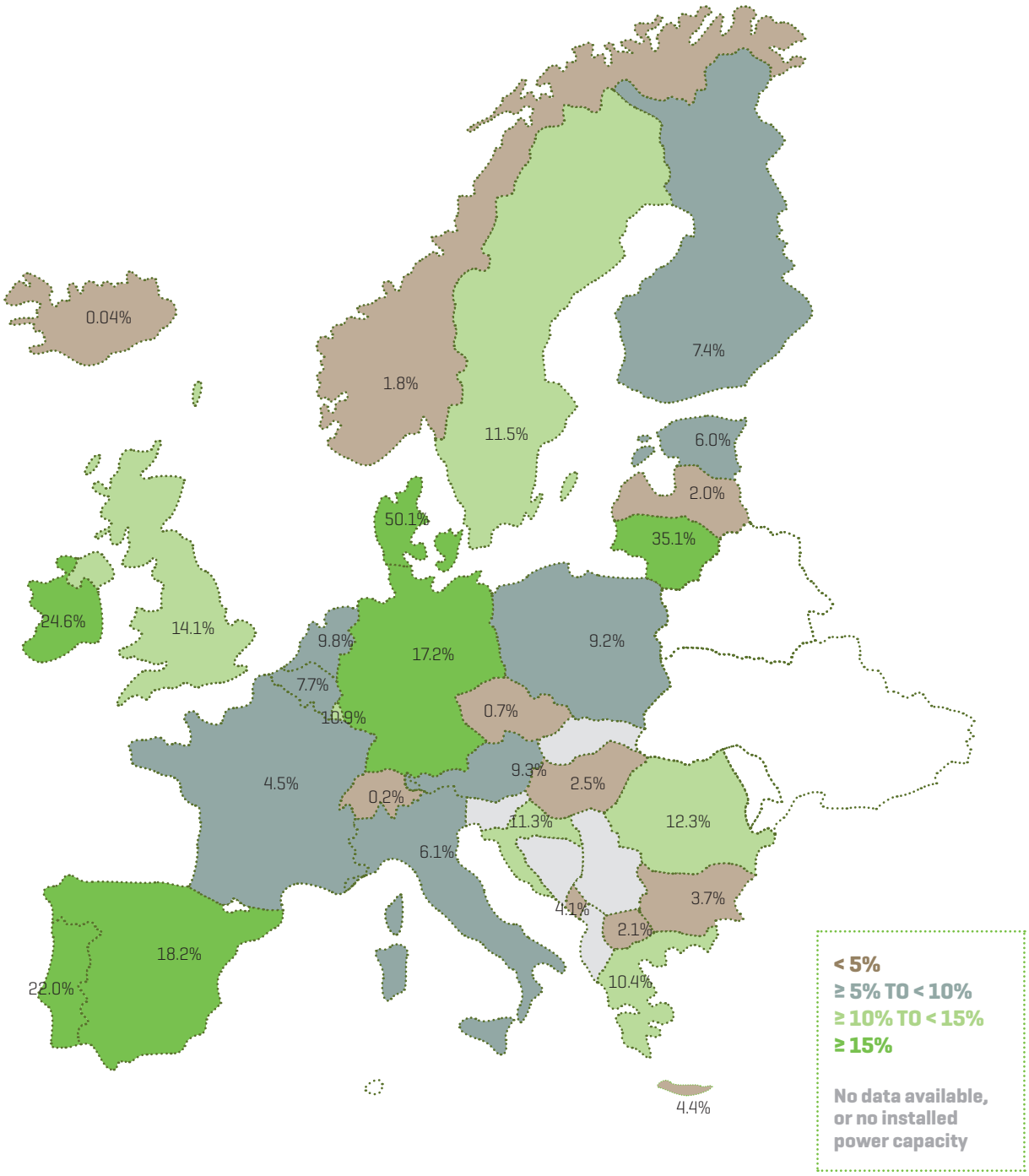
(1) Representation of the share of wind energy generation in demand coverage throughout the whole of the year divided in hourly periods and sorted by its greater to lesser share in the generation mix

Installed wind power capacity in relation to total power capacity in ENTSO-E member countries as at 31.12.2017 [%]



Source: ENTSO-E. Data Portal 19 April 2018. Spain REE, Great Britain includes data for Northern Ireland.

Share of wind generation over total generation within ENTSO-E in 2017 [%]



Source: ENTSO-E. Data Portal 19 April 2018. Spain REE, Great Britain includes data for Northern Ireland.

03

ENERGY FROM WATER

Hydroelectric power generation, limited by abnormally low rainfall, fell in 2017 to the lowest level recorded in the last twelve years, reaching only 18,364 GWh. As a result, this limited production has meant that this technology was only able to contribute 7% to the total production nationwide.

INSTALLED HYDROPOWER CAPACITY

17,032
MW

16.4%

OF OVERALL INSTALLED POWER CAPACITY NATIONWIDE

HYDROELECTRIC GENERATION IN 2017

18,364
GWh

-49%

COMPARED TO 2016

In the past, **Hydropower** was traditionally the main renewable source of electricity generation in Spain, however, in 2009 it was overtaken by wind energy and since then it has clearly remained the second source of renewable energy in terms of installed power capacity, standing at 17,032 MW by the end of 2017 (without taking into account pure pumped storage). Regarding total national installed power capacity, hydropower represents 16.4%, which ranks it as the third energy technology behind combined cycle and wind.

Hydroelectric power generation in Spain is extremely variable, reaching over 40,000 GWh in wet years, while in dry years said volume is reduced by almost half. On average, 2017 was a very dry year, with hydroelectric power generation standing at just 18,364 GWh, a value that is 49% less than in 2016 and the lowest value since 2005. In this regard, hydropower contributed only 7.0% to the total national production of electricity, far from the 13.7% contribution recorded in 2016.

With regard to the entire set of renewable technologies, hydropower ranked second behind wind with 21.7% of the total renewable energy generated nationwide.

Historically, the months of winter and spring are periods in which there is a greater contribution of hydroelectric power generation due mainly to the snow-melt and also to the greater rainfall registered in these months. In 2017, March was the month in which more hydroelectric power generation was produced with just over 2,697 GWh (48.4% less than the previous year's monthly maximum value registered in April, and the lowest generation registered since December 2012).

One of the main advantages of this technology compared to other renewables is its manageability, which is evident when observing the half-hour profile associated to hydroelectric production compared to total generation, and which brings to the forefront that the greatest contribution of this technology coincides with the peaks of demand in the morning and in the late evening.

As for hydroelectric reserves, the year 2017 ended with hydro reserves below their statistical average level, setting the lowest figure of the entire historical series. By month, hydro reserves were below the statistical average throughout the whole year and below the statistical minimum in the last two months of the year, standing at 26.3% of reservoir capacity at year-end, which represents almost thirteen percentage points less than in 2016.

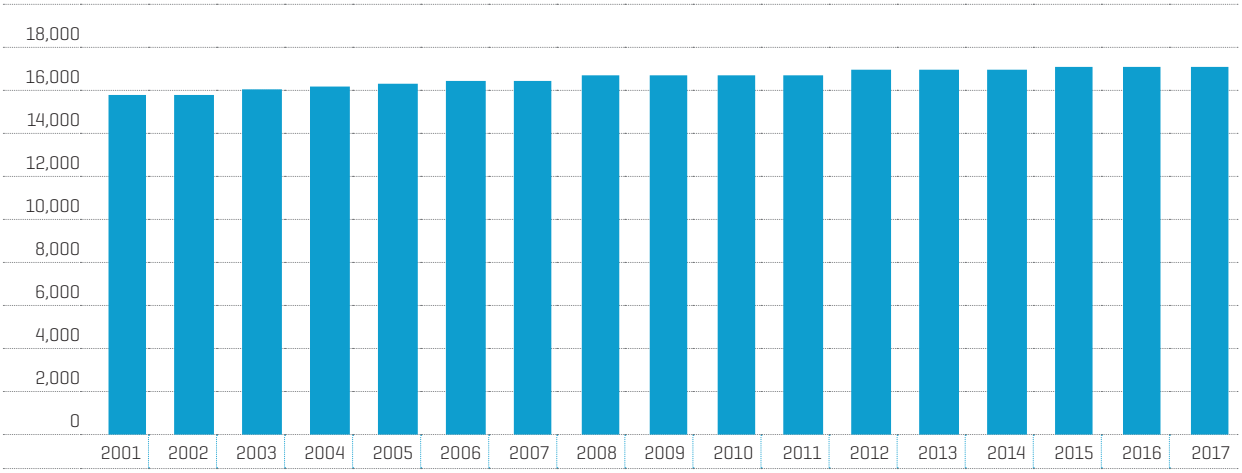
The minimum daily values of the percentage of annual reserves and of the overall national reserves, recorded on 8 December, have set all-time lows, even lower than the those registered in January 1976 and December 1995, respectively.

Producible hydroelectric power in 2017 stood at 0.53, which is a long way from the value of 1.12 registered the previous year and the second lowest in history, second only to the value of 0.43 registered in 1949.

By autonomous community, Castilla y León is the region with the most installed hydropower capacity, almost 26% of the national total. This is due to the fact that the Duero basin, the second most important basin on the Iberian Peninsula, lies exclusively in this region. It is followed by Galicia with about 22% of the national total, a region that holds much of the northern basin and which is the most relevant in terms of installed power capacity and includes Asturias, Cantabria and part of the Basque Country.

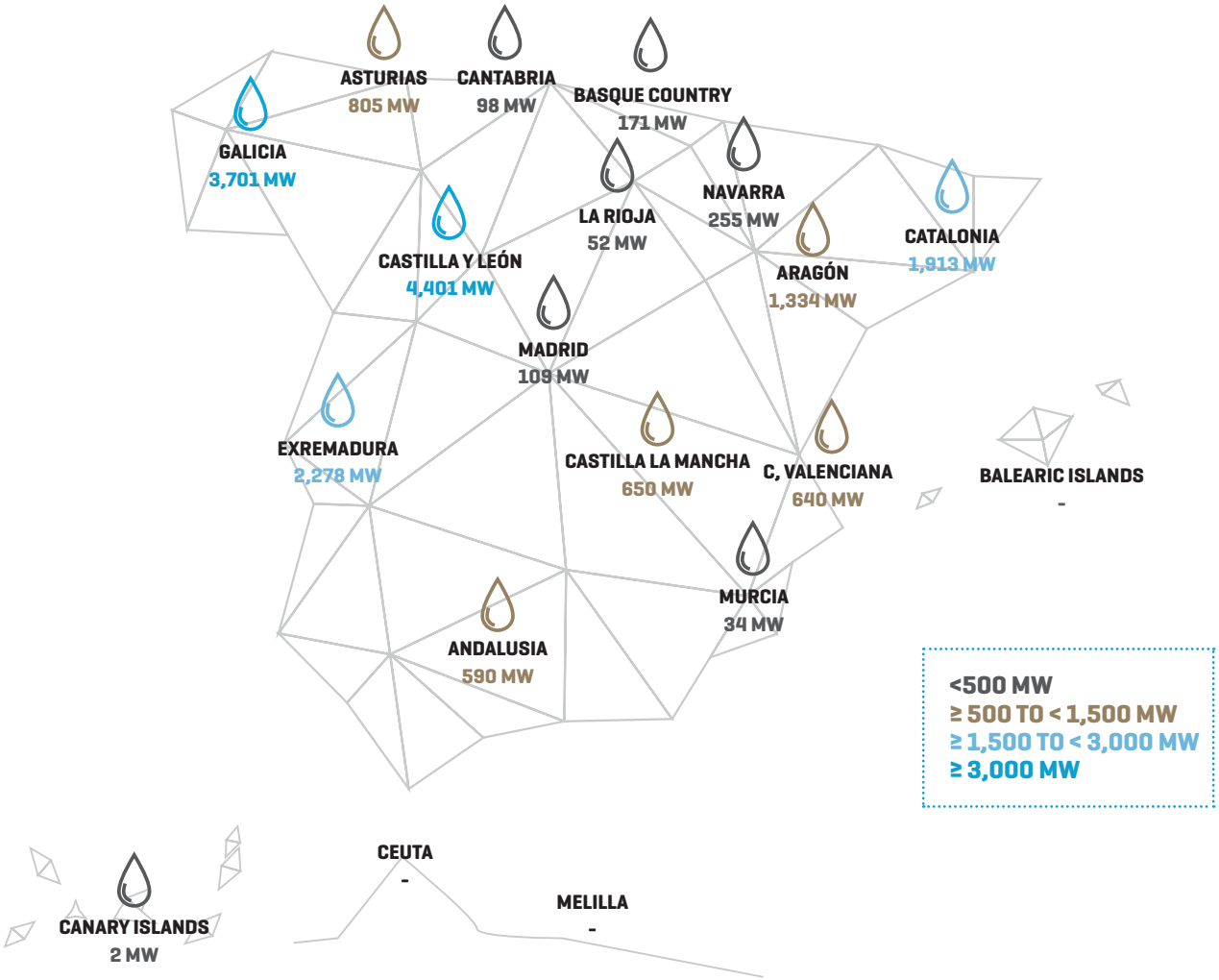
In comparison with other European countries, in 2017 Spain was ranked eighth regarding the amount of electrical energy generated using this technology. However, hydro is at the tail-end in terms of its share in the overall annual generation mix.

Installed hydropower capacity. National electricity system [MW]

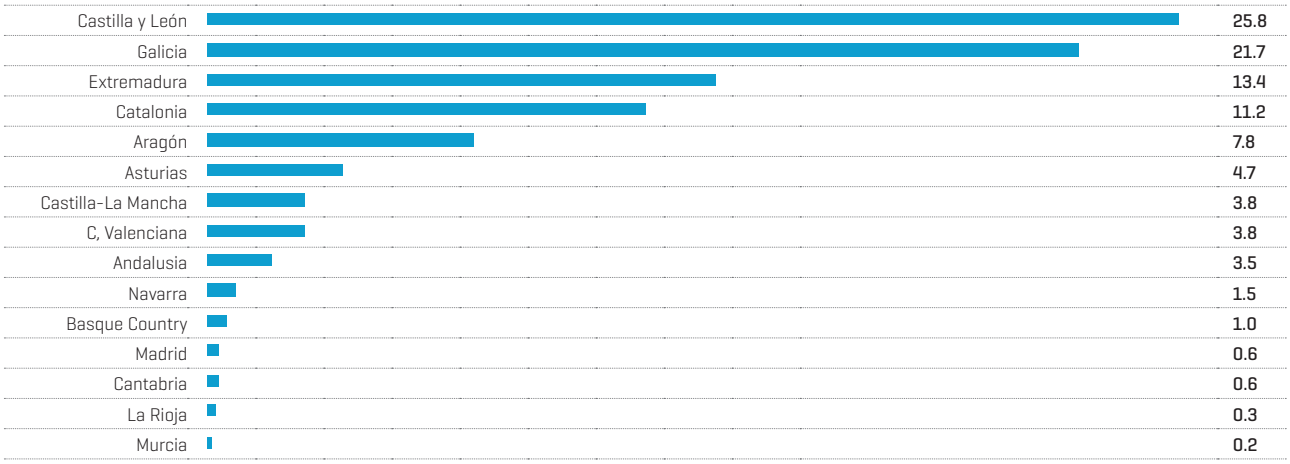


Source: Non-HMU hydropower capacity data was provided until 2014 by the National Markets and Competition Commission (CNMC)

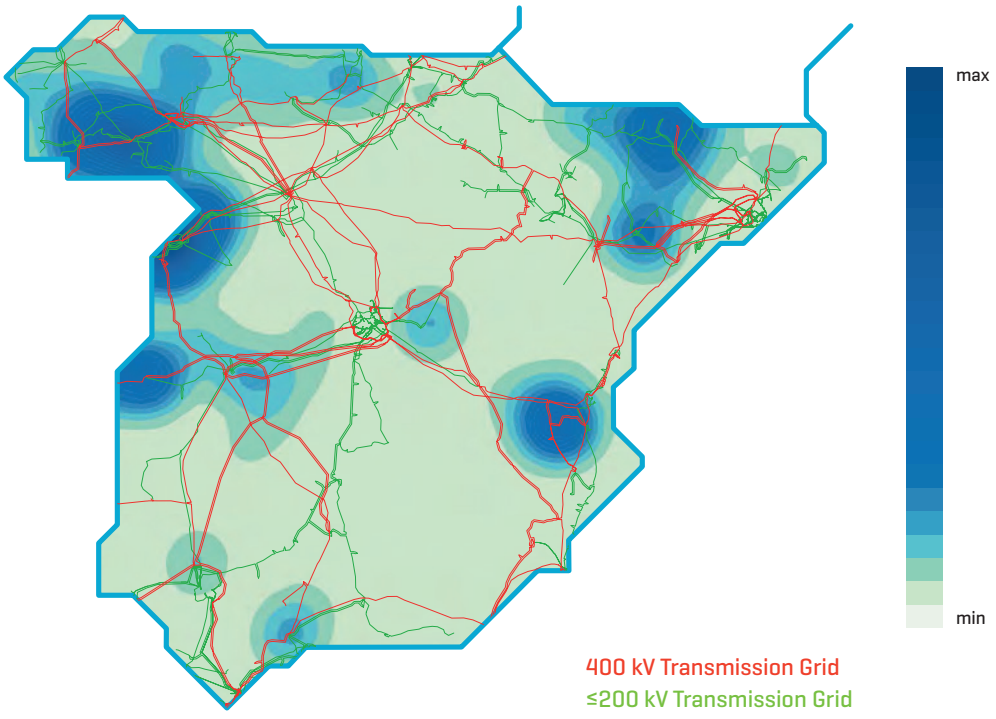
Installed hydropower capacity as at 31.12.2017. National electricity system per autonomous community



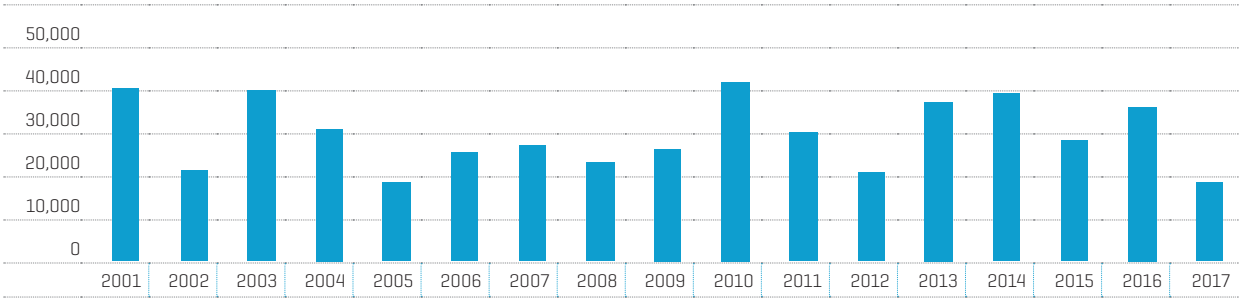
Share of installed hydropower capacity per autonomous community [%]



Geographical distribution of hydroelectric power stations on the peninsula as at 31.12.2017

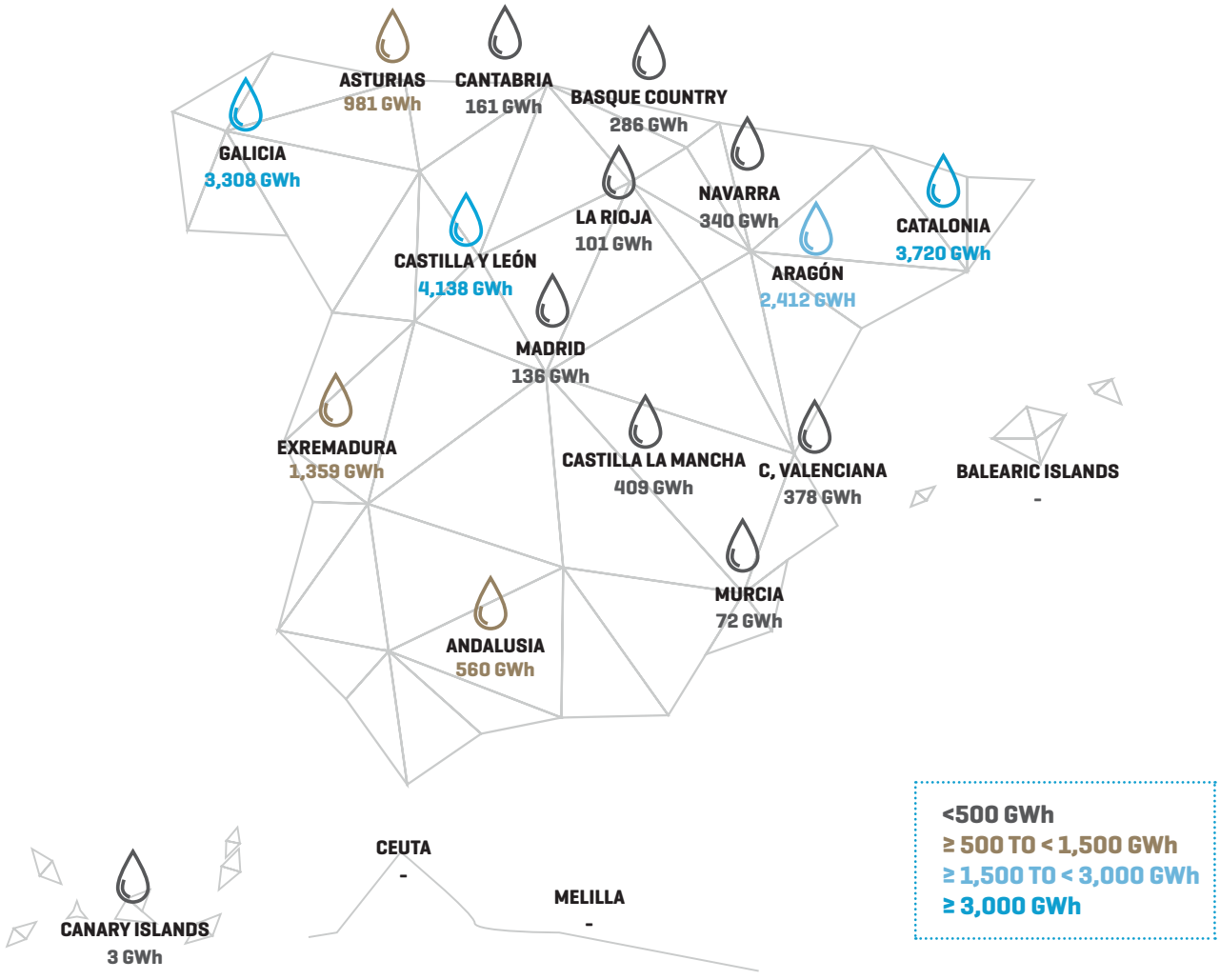


Hydroelectric power generation national electricity system (GWh)

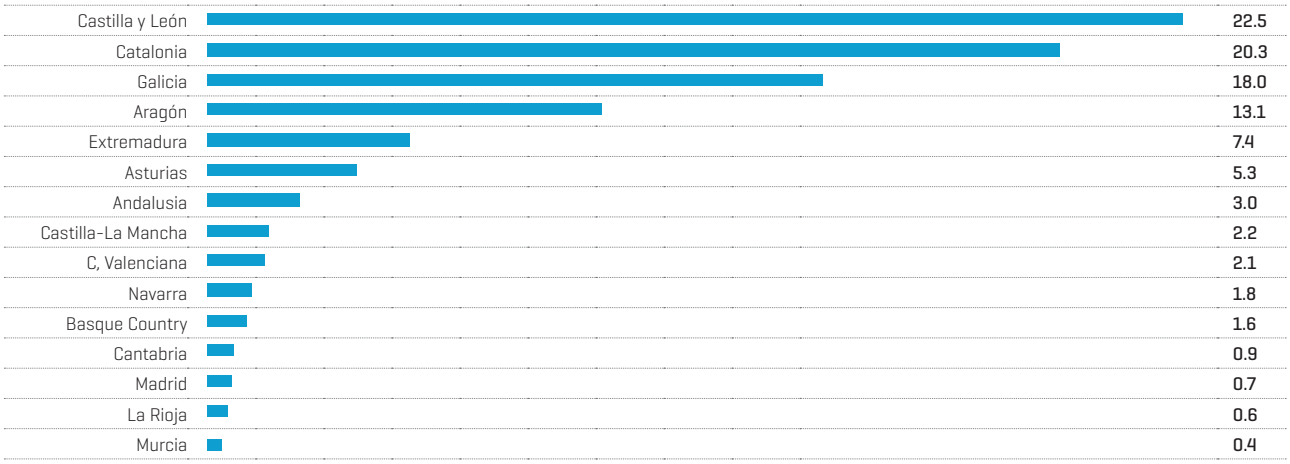


Data regarding the Canary Islands available as of 2006.

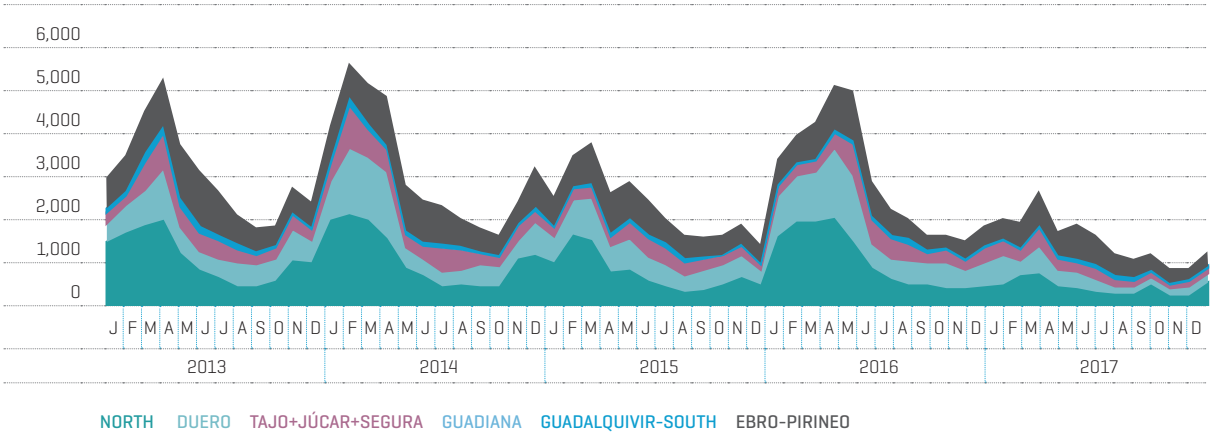
Hydroelectric power generation as at 2017. National electricity system per autonomous community



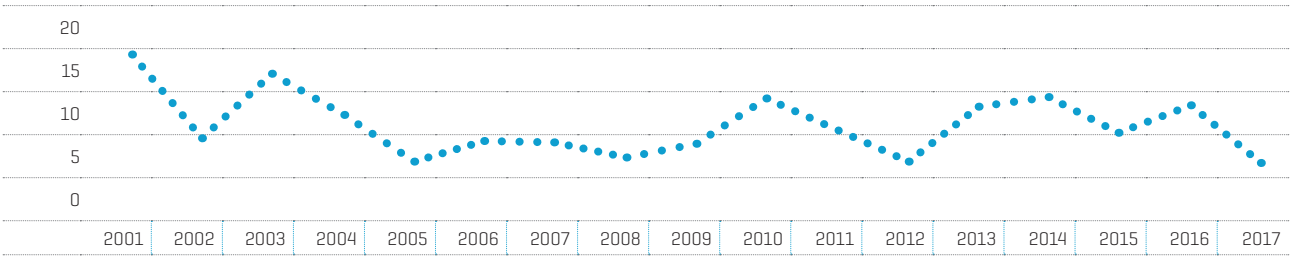
Hydroelectric power generation of each autonomous community over total national hydroelectric generation [%]



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

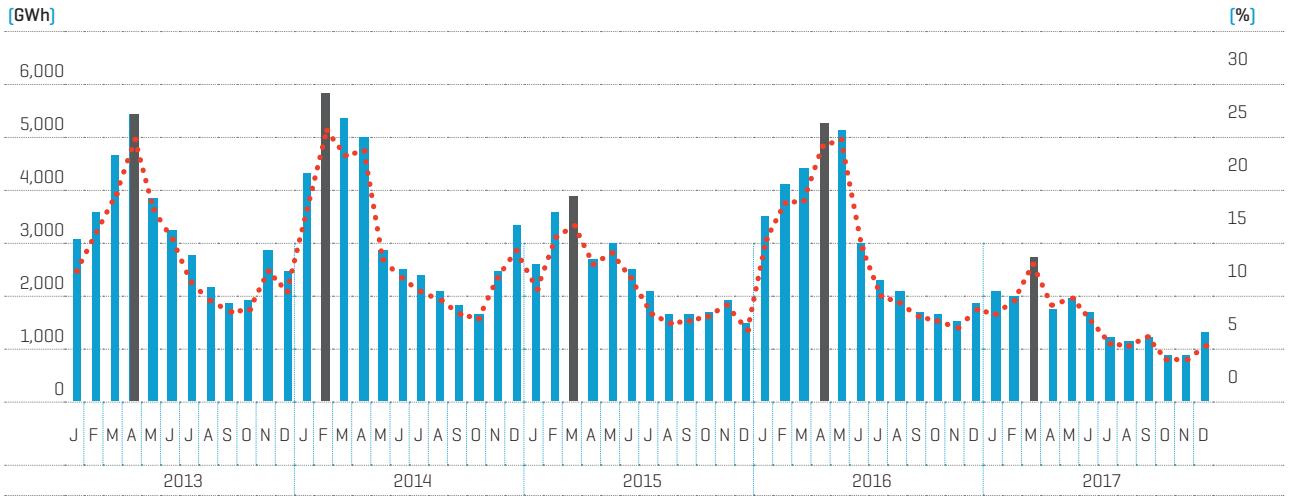


Share of hydro in the total generation mix. National electricity system [%]



Data regarding the Canary Islands available as of 2006.

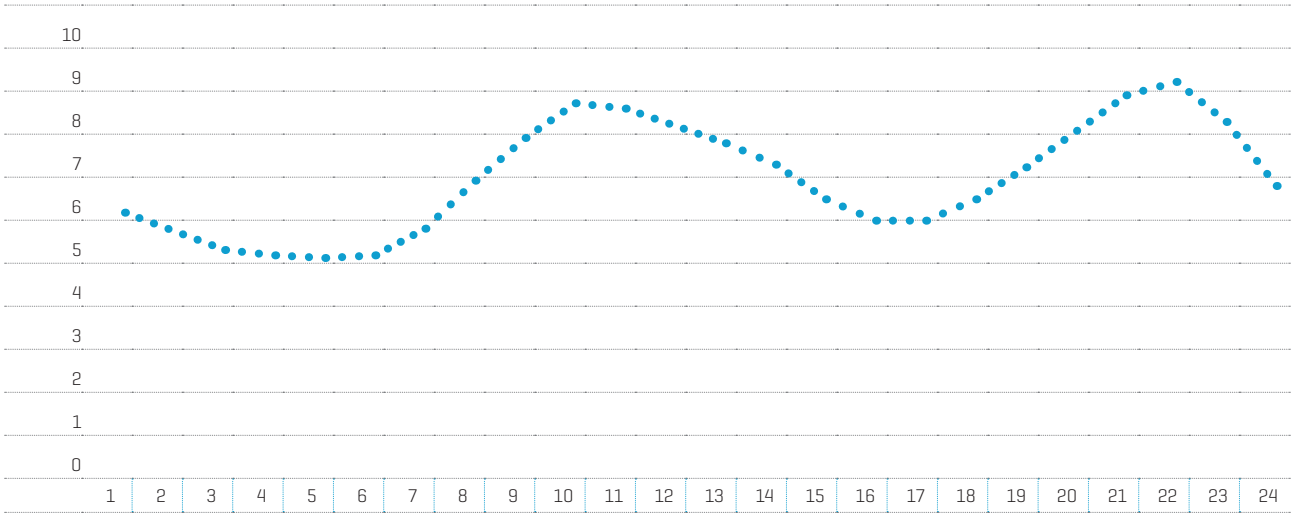
National hydroelectric power generation, monthly maximum values and share in the total generation mix. National electricity system



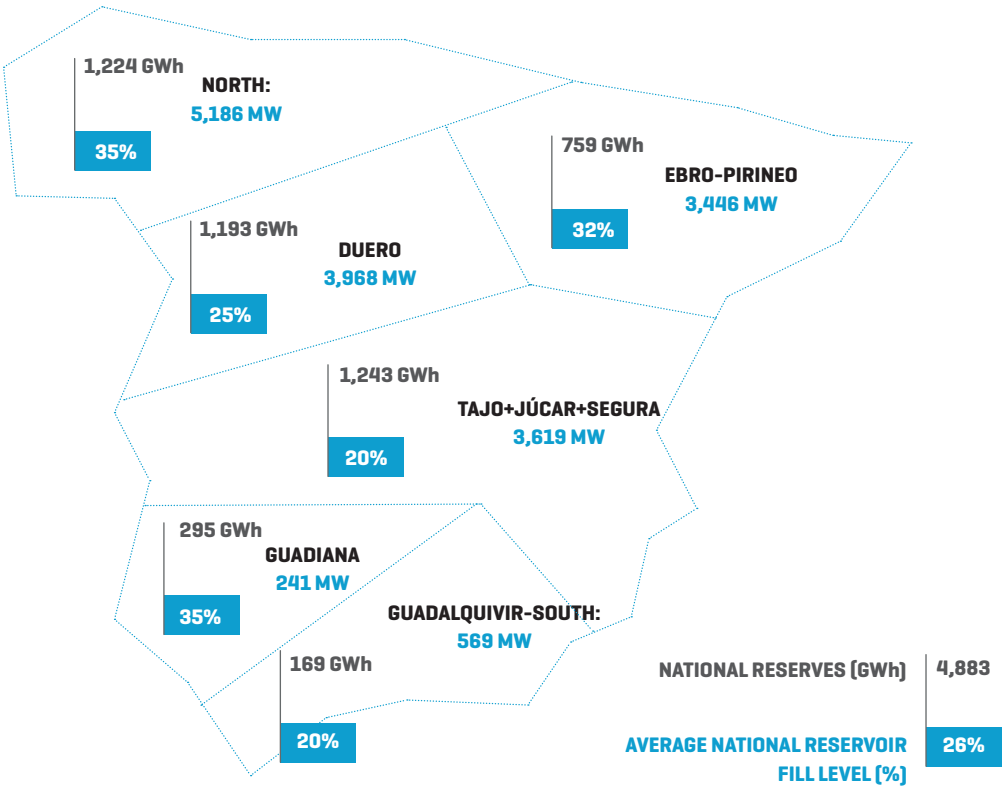
HYDROELECTRIC POWER GENERATION (GWh) MONTHLY MAXIMUM VALUE (GWh) HYDROELECTRIC POWER GENERATION / TOTAL GENERATION (%)

Data regarding the Canary Islands available as of 2006.

Average hourly share of hydropower in total generation in 2017 [%] Peninsular electricity system



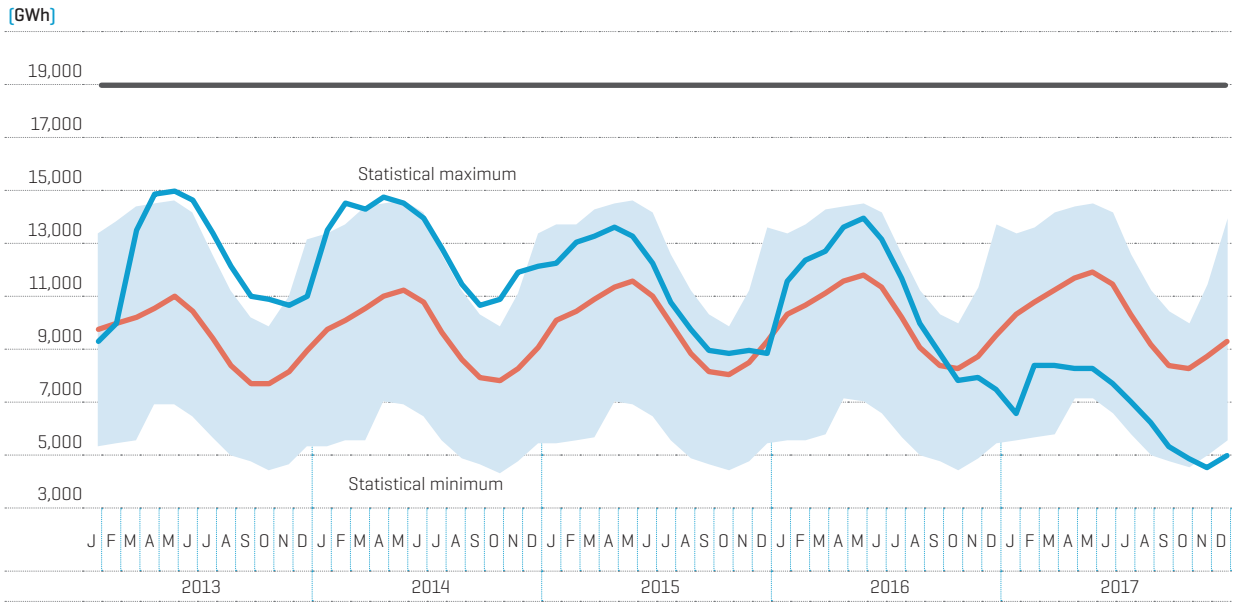
Installed hydropower capacity and hydroelectric reserves by hydrographic basin as at 31 december (GWh and%)



Extreme values of peninsular hydroelectric reserves

		2017			Historical values	
		GWh	**Date**	**%**	**Date**	**%**
Maximum	Annual	5,009	20-may.	55.9	May 1969	92.0
	Hyper-annual	3,840	1-jan.	40.1	April 1979	91.1
	Overall total	**8,345**	**14-mar.**	**45.0**	**April 1979**	**86.6**
Minimum	Annual	2,157	8-dec.	24.1	January 1976	24.9
	Hyper-annual	2,107	8-dec.	22.0	November 1983	17.6
	Overall total	**4,264**	**8-dec.**	**23.0**	**October 1995**	**23.6**

Total hydroelectric reserves. Peninsular electricity system

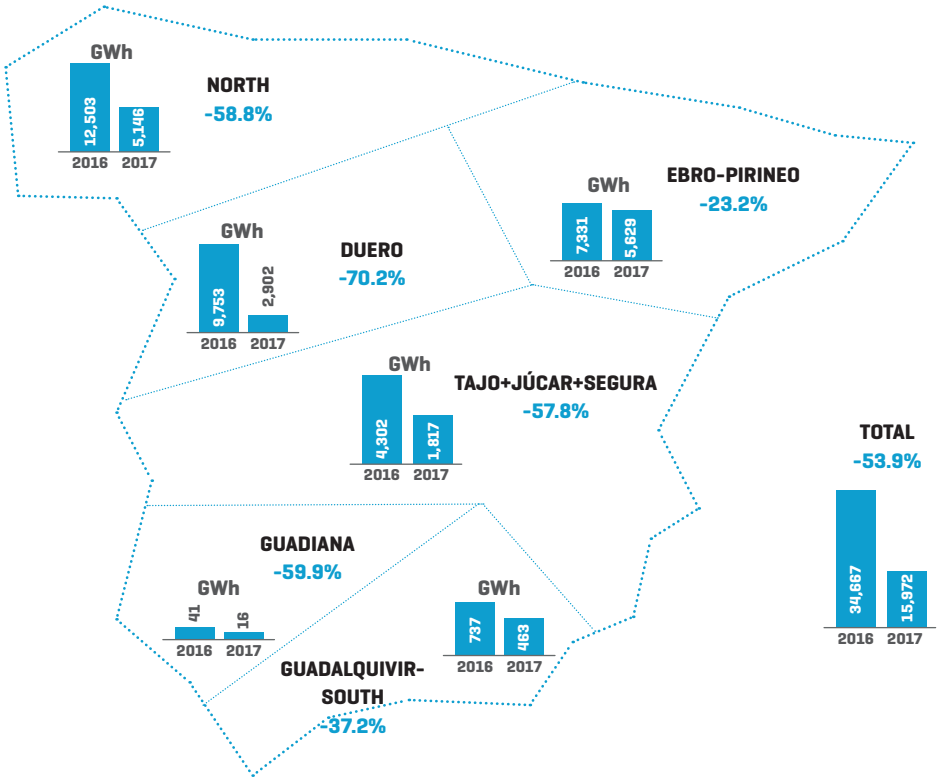


STATISTICAL AVERAGE (GWh) MAXIMUM CAPACITY (GWh) RESERVES (GWh)

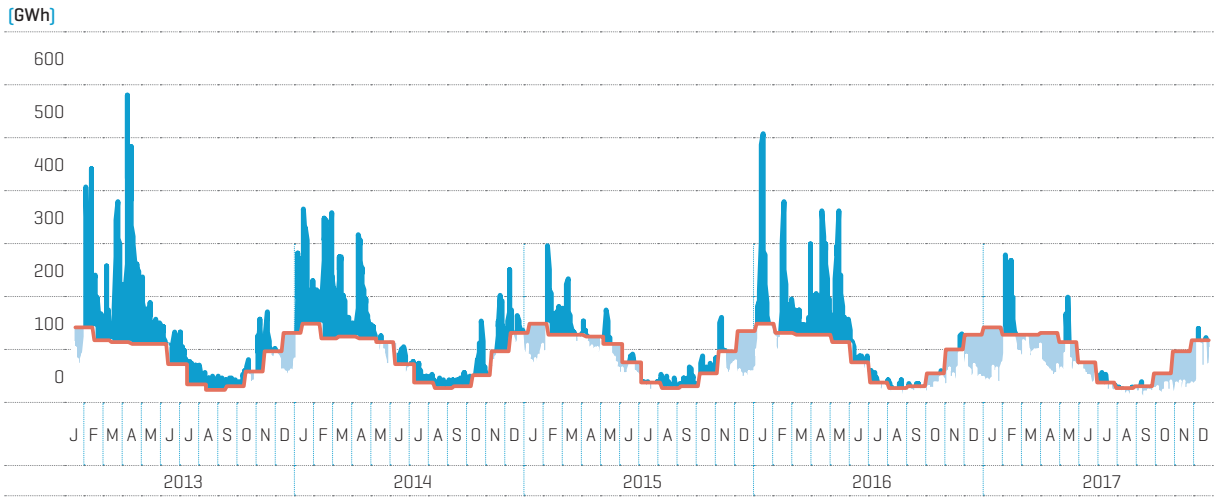
Statistical maximum and minimum levels: average of the maximum and minimum values for the last 20 years.

The hydro reserves of the complete set of reservoirs nationwide closed 2017 with the lowest level of the historical series since records began in 1990.

Producible hydroelectric energy by hydrographic basin and annual

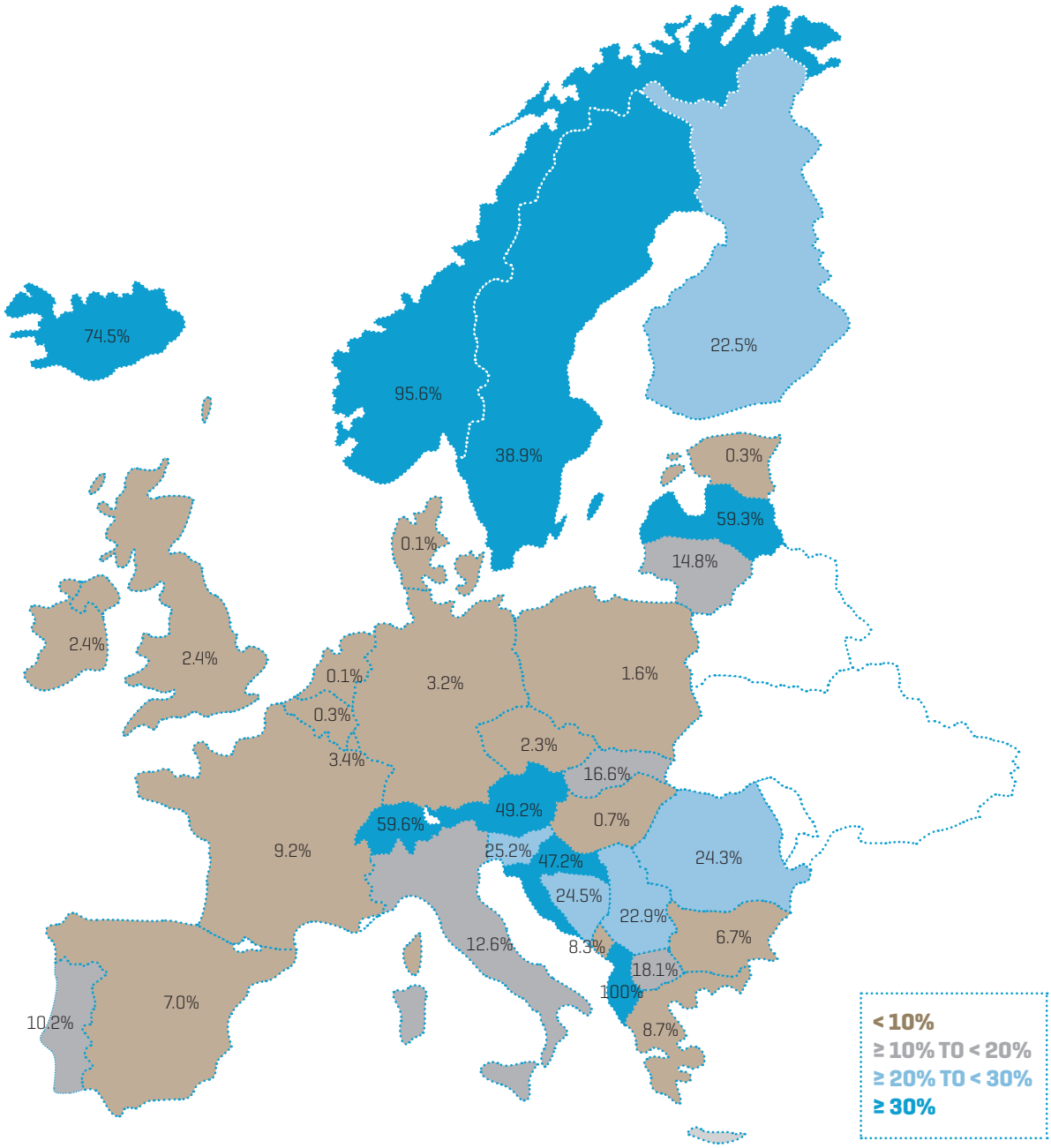


Daily producible hydroelectric energy compared with the historical average producible. Peninsular electricity system



WET DRY HISTORICAL AVERAGE PRODUCIBLE

Share of hydraulic generation over total generation within ENTSO-E in 2017 [%]



Source: ENTSO-E. Data Portal 19 April 2018. Spain REE, Great Britain includes data for Northern Ireland.

04

ENERGY FROM THE SUN

Solar energy is the third renewable source of electricity generation in Spain with 6,991 MW by the end of 2017, representing approximately 7% of the installed power capacity nationwide. This technology also produces a little over 5% of total electricity generation.

INSTALLED SOLAR POWER CAPACITY

6,991
MW

6.7%

OF OVERALL INSTALLED POWER CAPACITY NATIONWIDE

Installed **solar power** capacity by the end of 2017 stood at 6,991 MW (4,687 MW correspond to solar photovoltaic and 2,304 MW to solar thermal), representing about 6.7% of the total installed power capacity in Spain.

Solar power capacity has remained virtually unchanged in the last four years following a long period of continued growth. The greatest increases in photovoltaic were recorded in 2007 and 2008, reaching a record annual growth of 2,733 MW of new installed power capacity in 2008. This positive growth trend continued until 2013 with more than 250 MW installed each year on average, but this has remained virtually unchanged since then. As for solar thermal, after the strong growth registered in 2012 with almost 1 GW of new installed power capacity, since 2014 it has also experienced only slight changes.

Solar energy generation in Spain, in line with the evolution shown by installed power capacity, has registered small variations in the last four years, remaining at generation levels of around 13,000 GWh per year. In 2017, it grew by 5.2% compared to the previous year, reaching 13,733 GWh, which represents a share of 5.2% of the total generation nationwide in 2017 (3.2% of photovoltaic and 2.0% solar thermal).

SOLAR ENERGY GENERATION IN 2017

13,733
GWh

5.2%

OF THE TOTAL ENERGY GENERATED IN SPAIN

During 2017, the maximum monthly value of solar photovoltaic generation occurred in July and was only 1% lower than the maximum registered the previous year. Seasonality is an important factor for this technology and greatly conditions solar energy generation levels throughout the year. As such, generation from May to August registers fairly similar values, while these values fall between November and February by almost half.

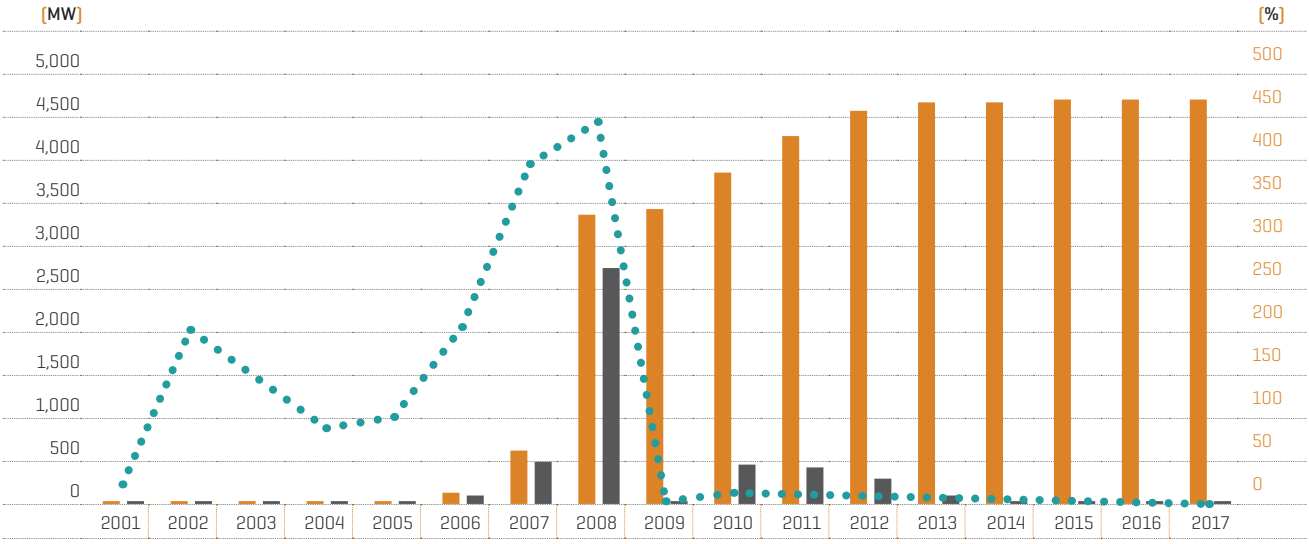
In the case of solar thermal, the maximum monthly generation in 2017 also occurred in July and was 1.5% lower than the maximum registered in 2016. The seasonality of this technology is similar to that of solar photovoltaic, although its daily production is distributed more evenly throughout the day due to the ability of some of these generating stations to store some of the heat they harness from the sun and which then enables it to be used at some later stage to generate electricity.

By autonomous community, Castilla-La Mancha is the region with the greatest level of installed solar photovoltaic power capacity, almost 20% of the national total, closely followed by Andalusia and a little further behind is Extremadura and Castilla y León. Together, these four autonomous communities represent 61% of the installed solar photovoltaic power capacity in Spain. However, by contrast, the level of installed solar photovoltaic power capacity in each of the autonomous communities of the Cantabrian coast is below 1% of the overall national total.

In the case of solar thermal, only six autonomous communities have this type of technology installed, with Andalusia being the region with the highest installed power capacity followed by Extremadura; together totalling 80% of the total installed power capacity of this technology in these two regions.

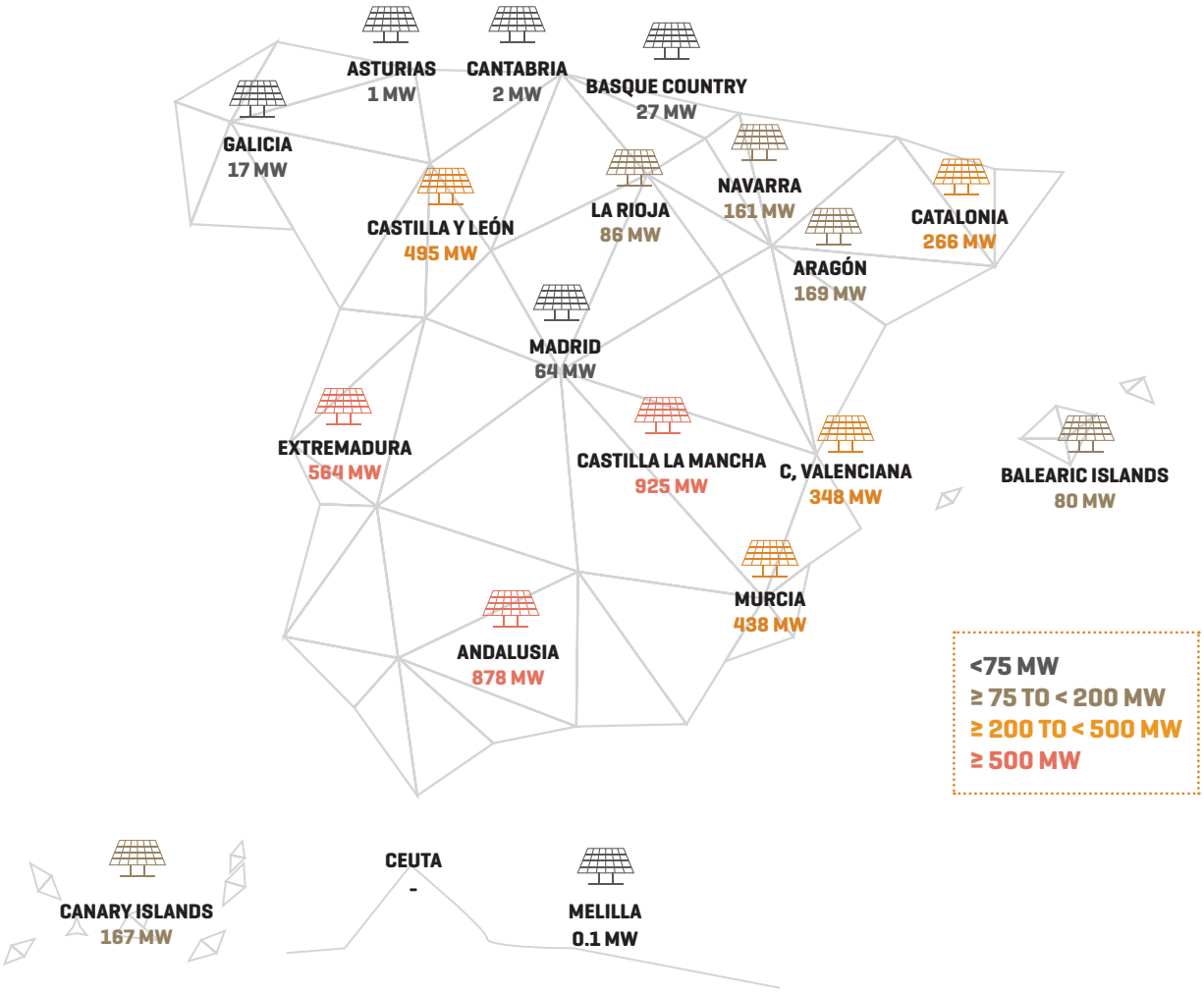
As for the situation of solar technology in Europe, Spain is ranked fourth regarding installed solar power capacity, far behind Germany which is the undisputed leader with over 42 GW of installed capacity. However, in spite of Germany's greater installed power capacity, the fact that it has fewer hours of sunshine in comparison with the countries of southern Europe means that in the ranking regarding the contribution of solar energy to the total generation of each country, it is the countries in the south of Europe that show better figures in relation to their installed solar power capacity. In this regard, Italy and Greece are the countries with the greatest contribution of solar energy in their energy mix. Spain is ranked fourth behind Germany.

Installed solar photovoltaic (PV) power capacity. National electricity system

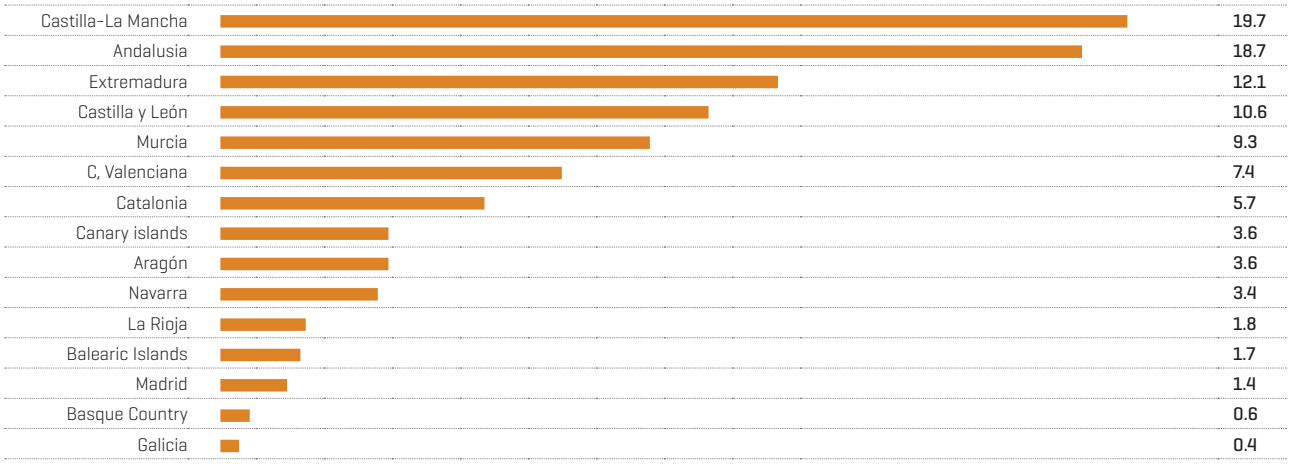


Source: National Commission for Markets and Competition (CNMC) until 2014. Data regarding the Balearic Islands and the Canary Islands available as of 2006 and Melilla since 2007.

Installed solar photovoltaic (PV) power capacity as at 31.12.2017. National electricity system per autonomous community [MW]

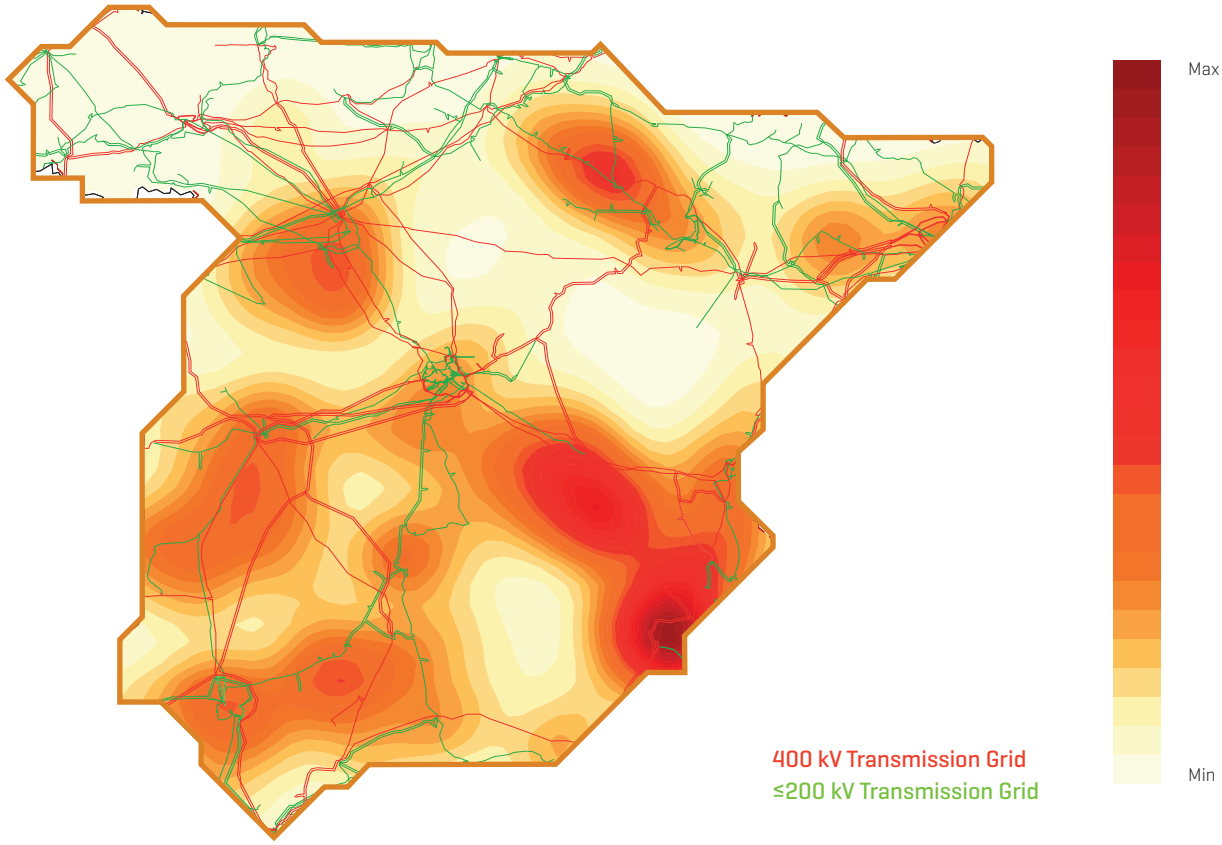


Share of solar PV power capacity per autonomous community in relation to the national total as at 31.12.2017 (%)

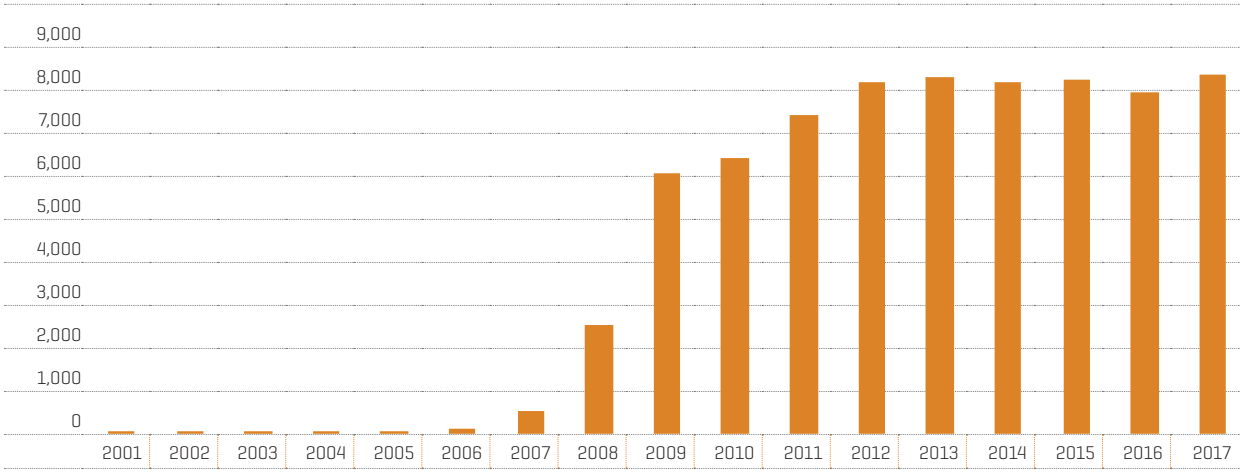


Cantabria, Asturias and Melilla are not included as their share of this technology is very small and would not be easily seen in the graph.

Geographical distribution of solar photovoltaic facilities on the peninsula as at 31.12.2017

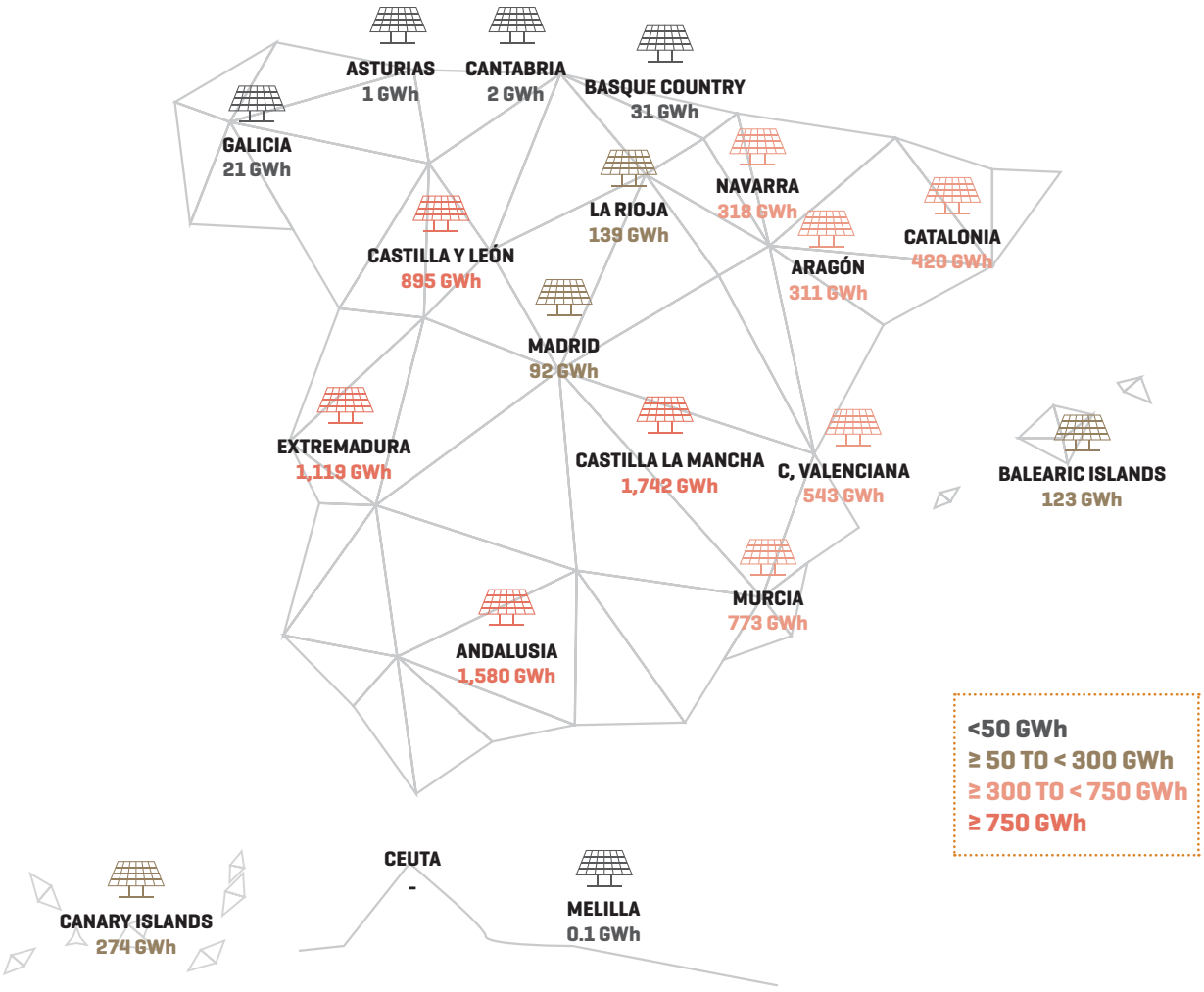


Solar PV energy generation. National electricity system [GWh]

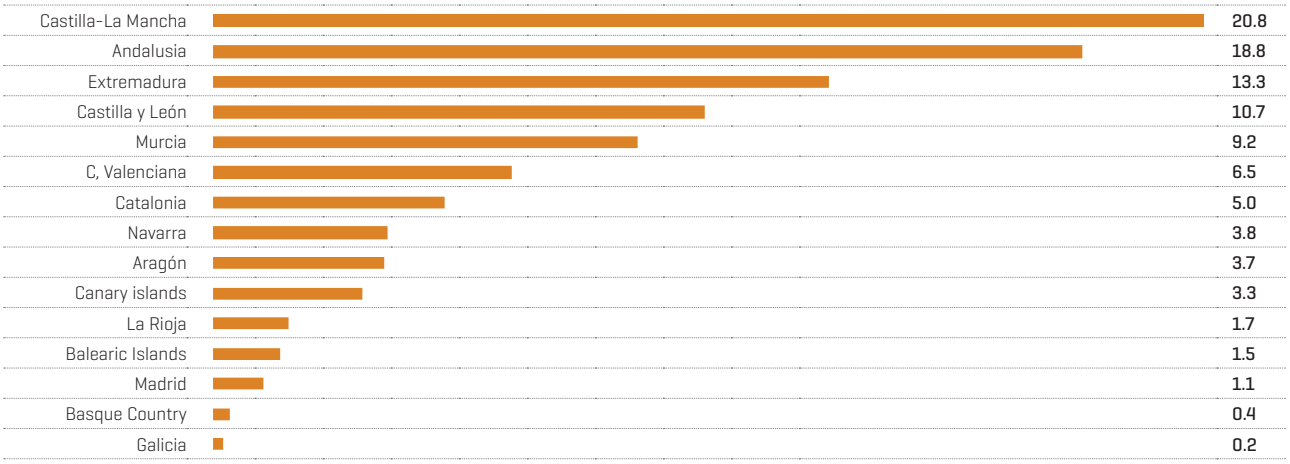


Data regarding the Balearic Islands and the Canary Islands available as of 2006 and Melilla since 2007.

Solar PV energy generation in 2017. National electricity system per autonomous community [GWh]

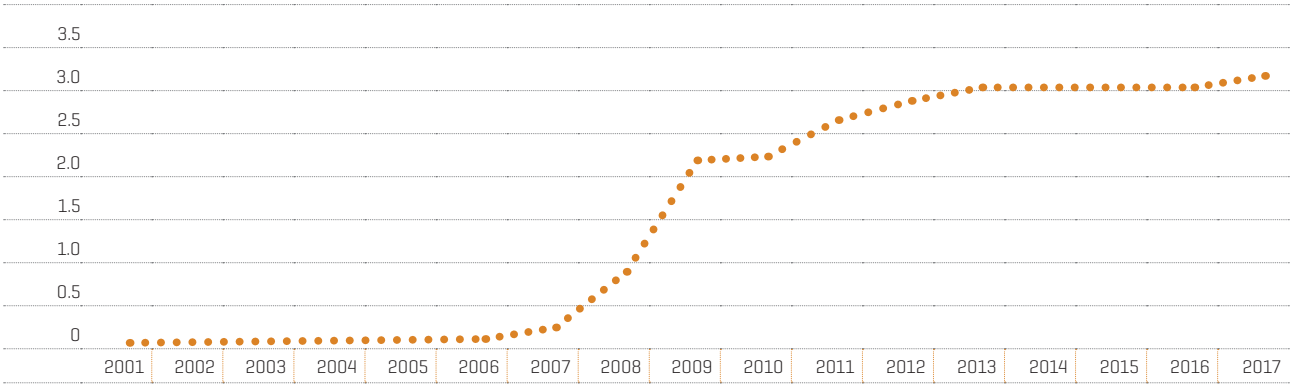


Share of solar PV energy generation per autonomous community in relation to the national total [%]



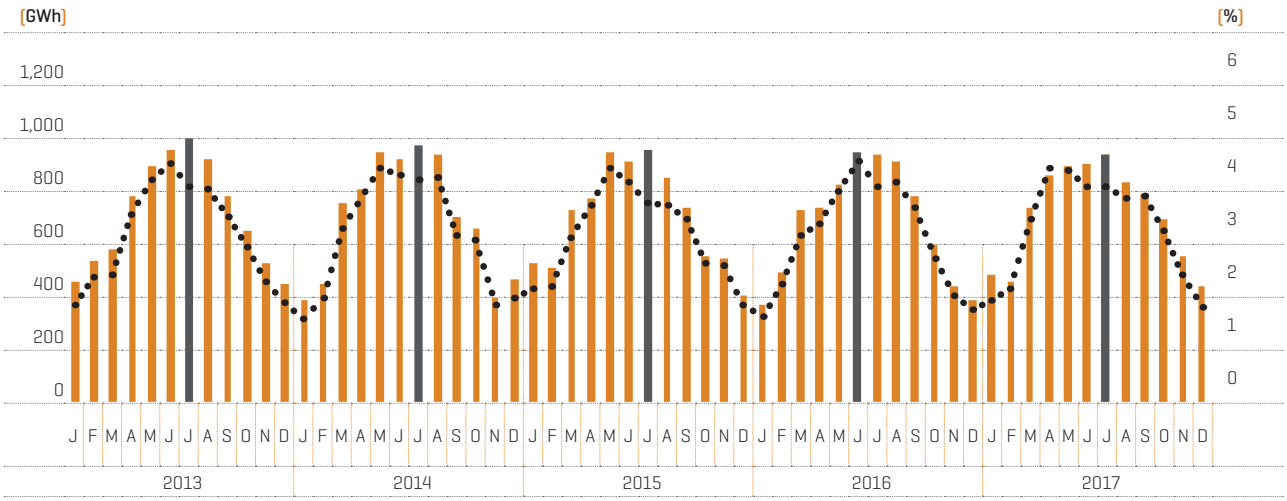
Cantabria, Asturias and Melilla are not included as their share of this technology is very small and would not be easily seen in the graph.

Share of solar PV energy generation in the total generation mix. National electricity system [%]



Data regarding the Balearic Islands and Canary islands available as of 2006 and Ceuta and Melilla as of 2007.

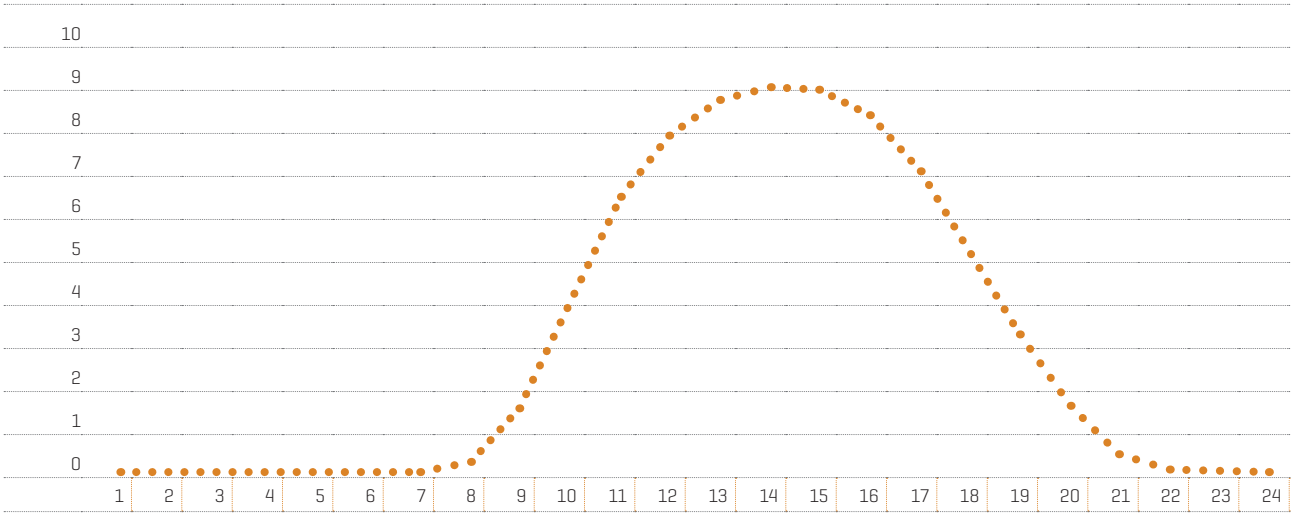
Solar PV energy generation, monthly maximum values and share in the total generation mix. National electricity system



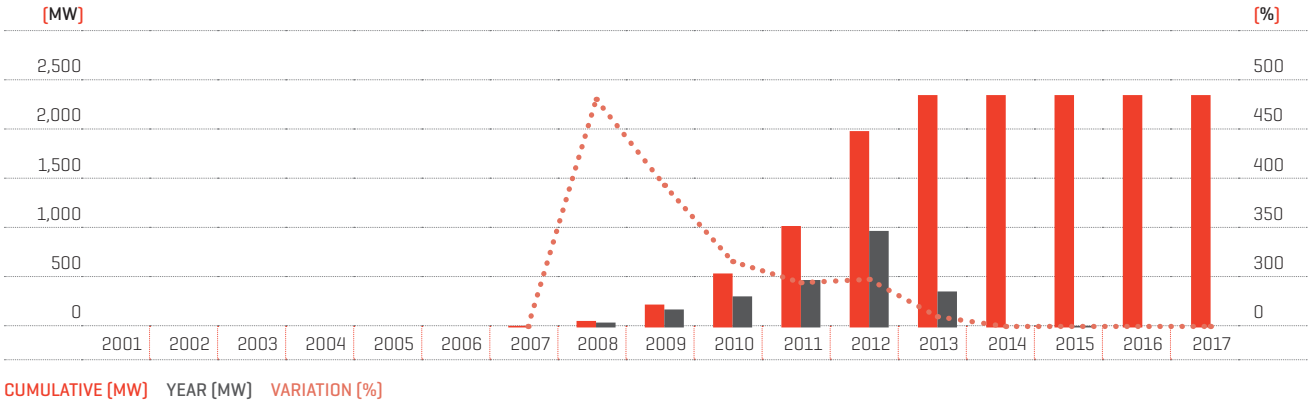
SOLAR PHOTOVOLTAIC ENERGY GENERATION (GWh) MONTHLY MAXIMUM (GWh) SOLAR PHOTOVOLTAIC ENERGY GENERATION/TOTAL GENERATION (%)

Data regarding the Balearic Islands and Canary islands available as of 2006 and Ceuta and Melilla as of 2007.

Average hourly share of solar PV in total generation in 2017 (%) Peninsular electricity system

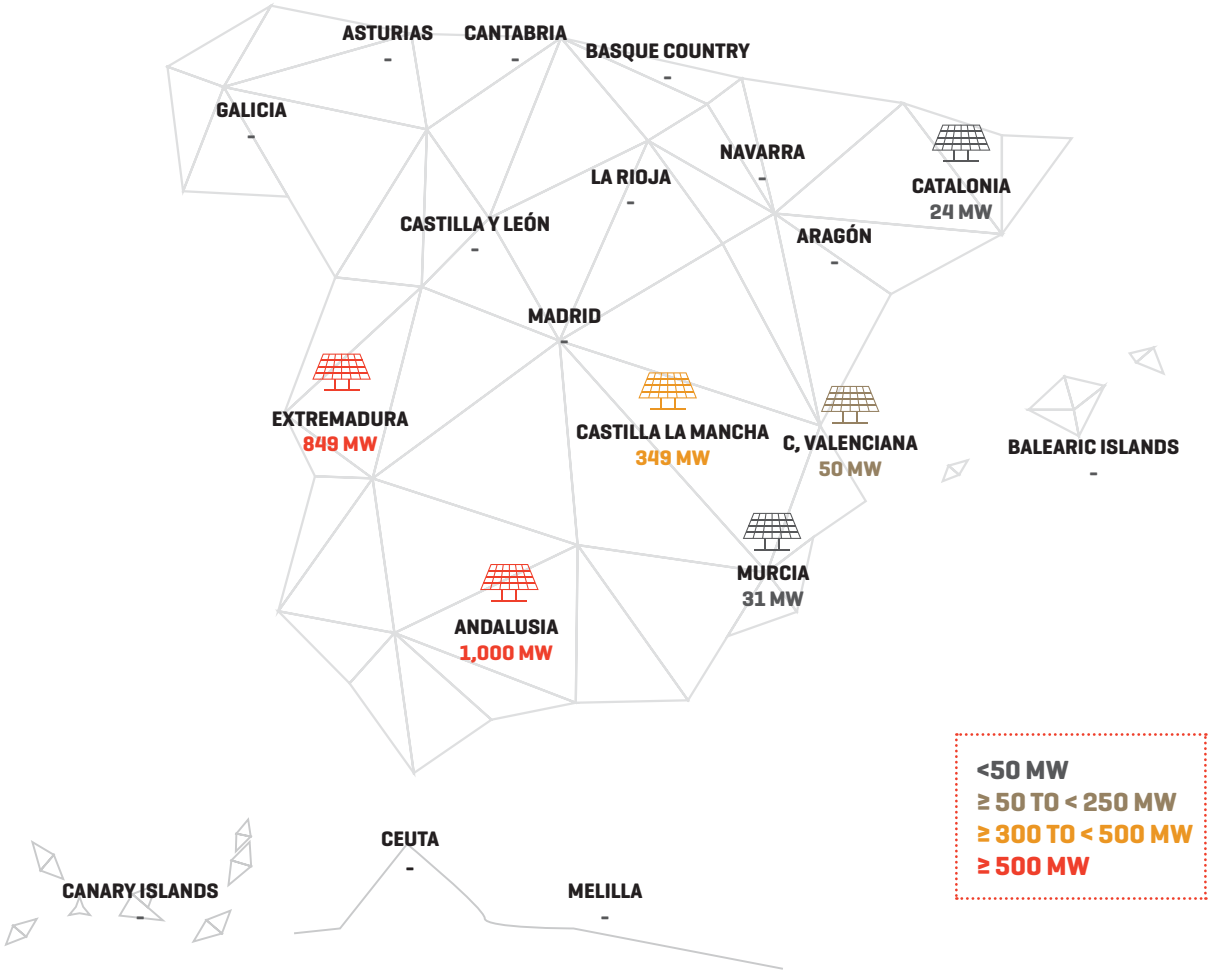


Installed solar thermal power capacity. National electricity system

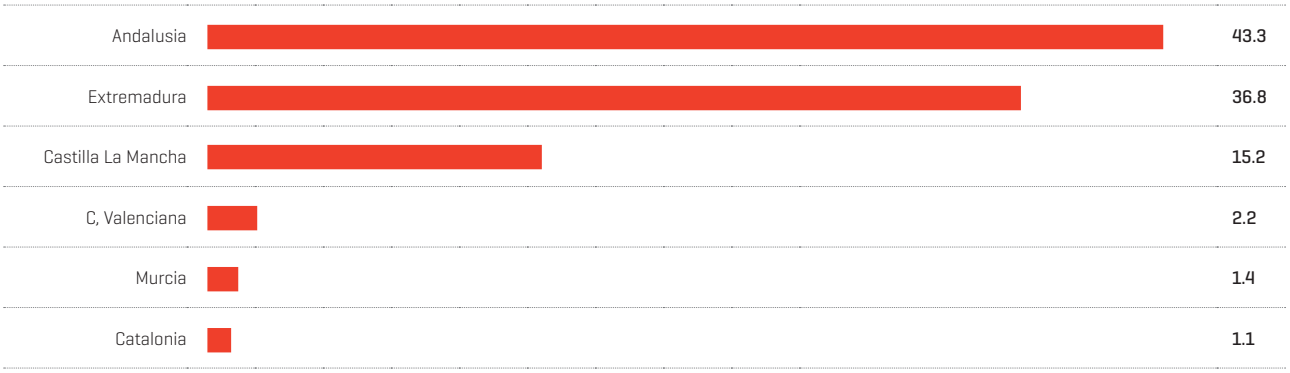


Source: National Commission for Markets and Competition (CNMC) until 2014.

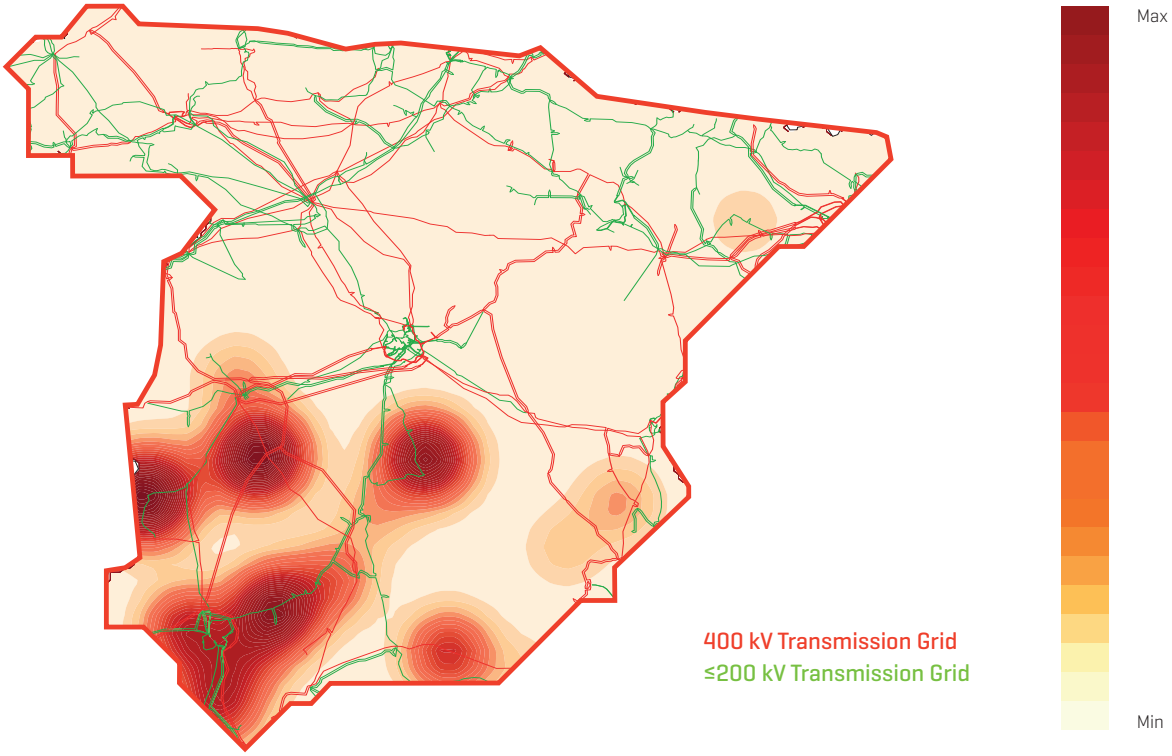
Installed solar thermal power capacity as at 31.12.2017. National electricity system per autonomous community [MW]



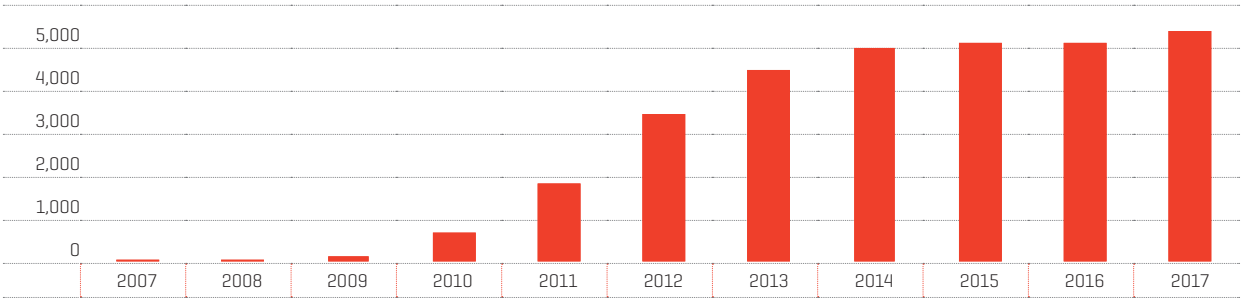
Share of solar thermal power capacity per autonomous community in relation to the national total [%]



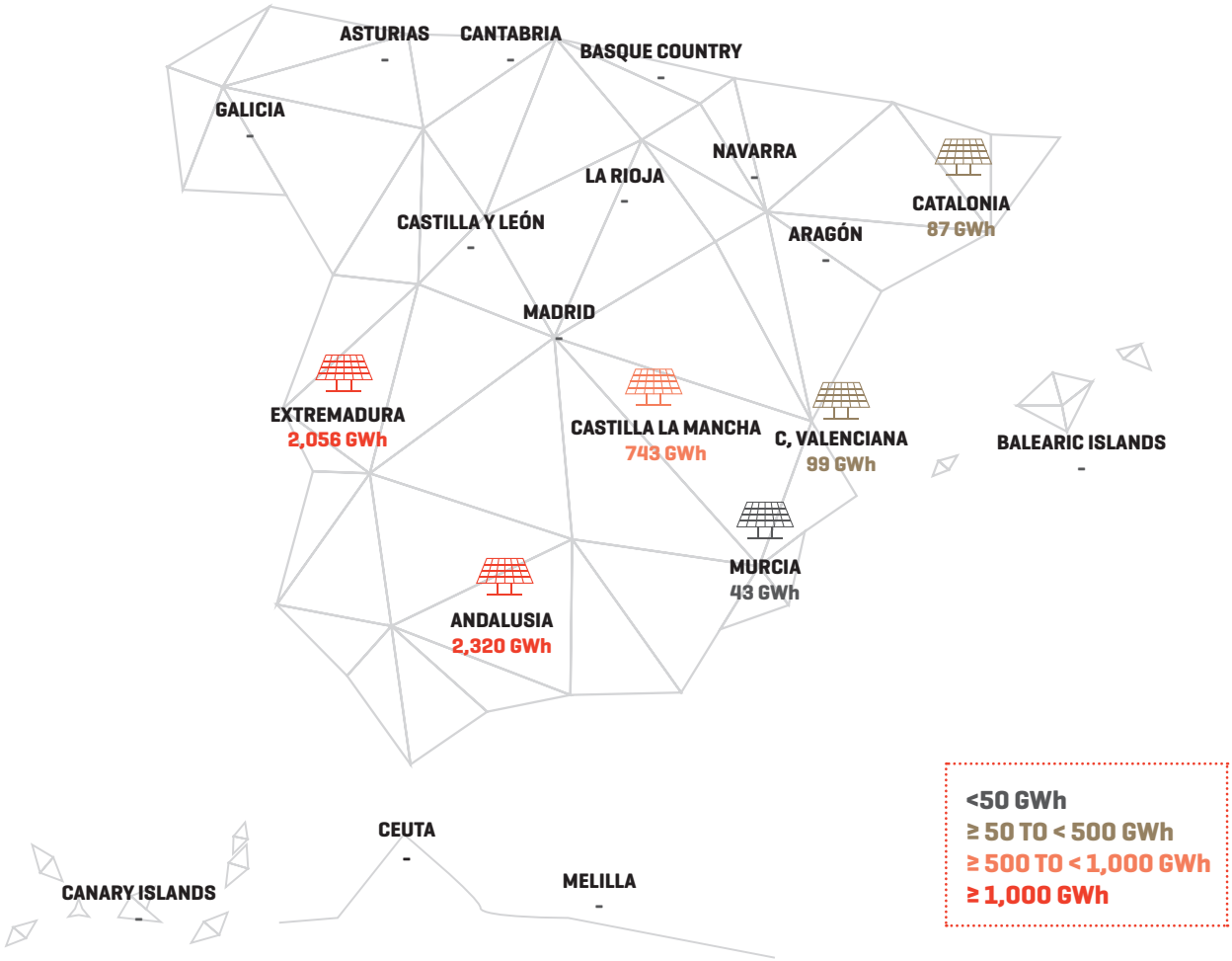
Geographical distribution of solar thermal facilities on the peninsula as at 31.12.2017



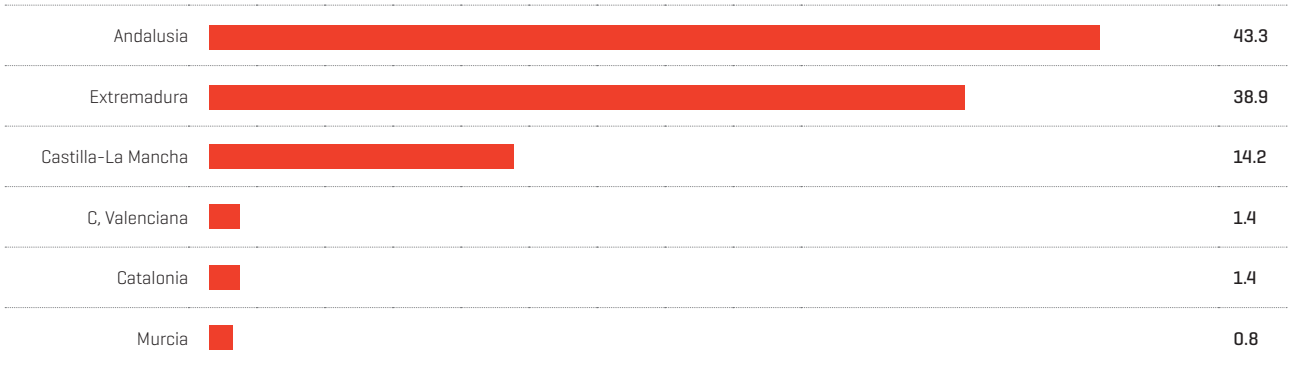
Solar thermal energy generation. National electricity system [GWh]



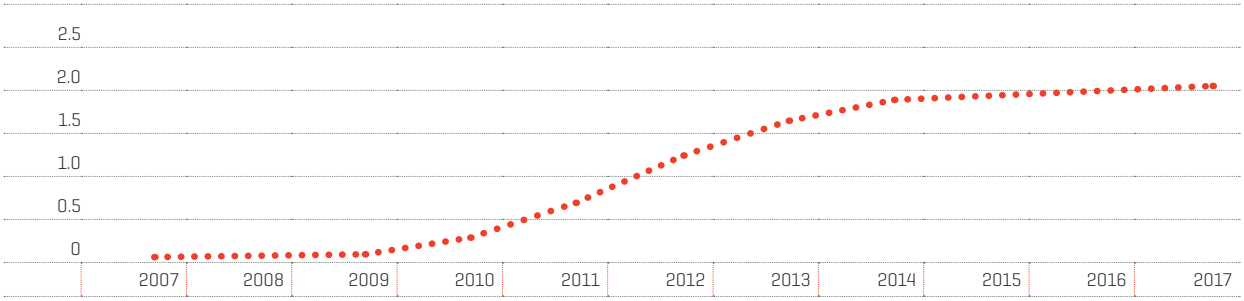
Solar thermal energy generation in 2017. National electricity system per autonomous community [GWh]



Share of thermal solar energy generation community in relation to the national total [%]

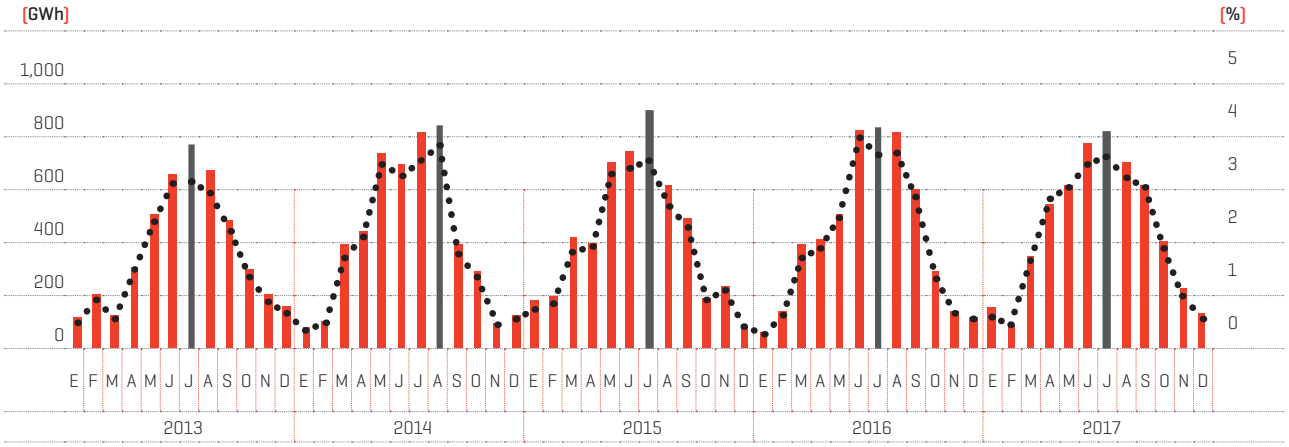


Share of solar thermal energy generation in the total generation mix. National electricity system [%]



Data regarding the Balearic Islands and Canary islands available as of 2006 and Ceuta and Melilla as of 2007.

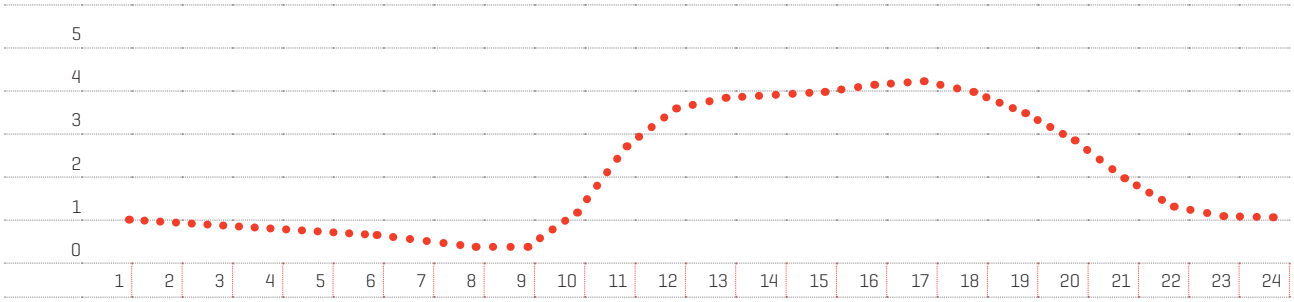
National solar thermal energy generation, monthly maximum values and share in the total generation mix. National electricity system



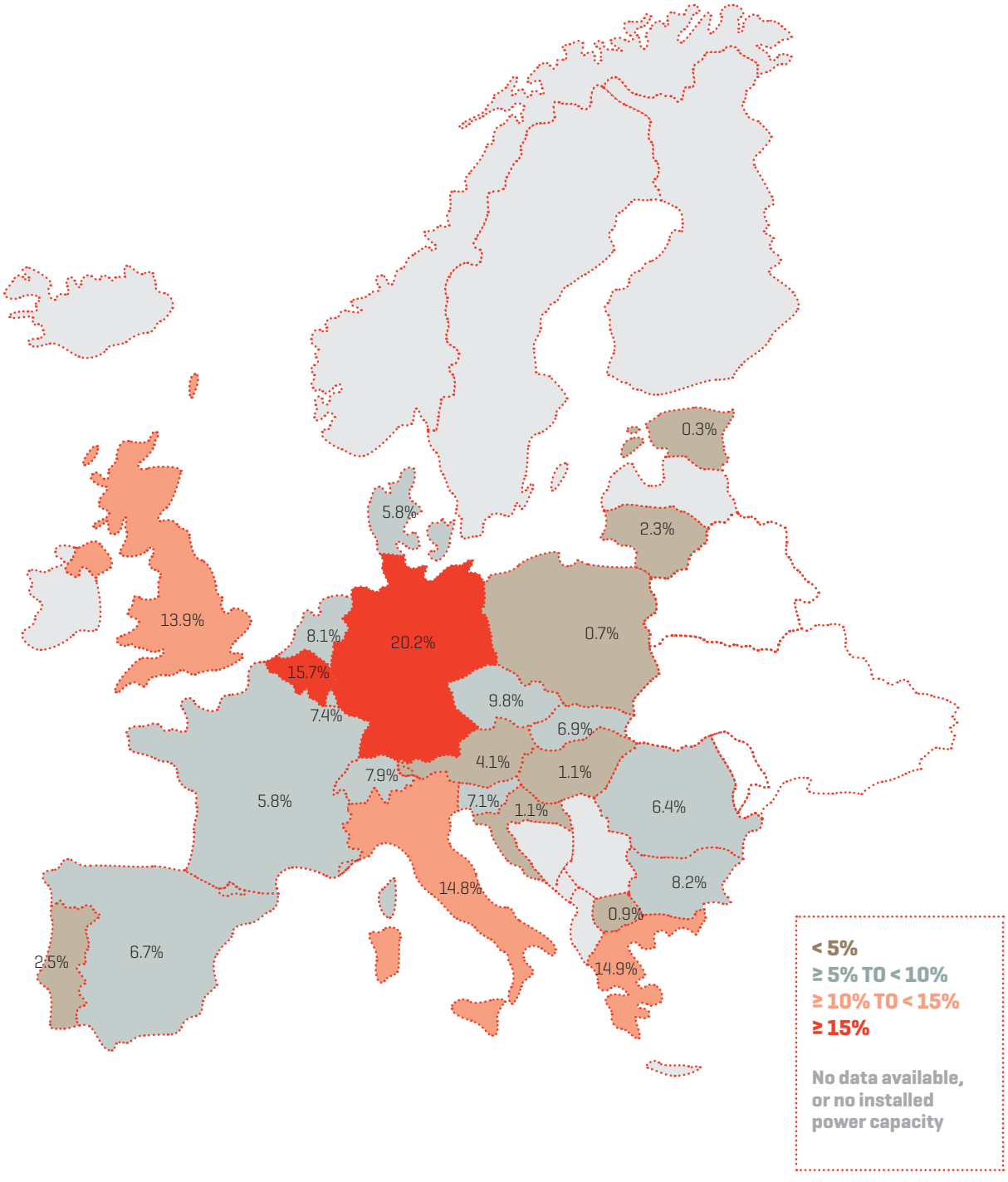
SOLAR THERMAL ENERGY GENERATION [GWh] MONTHLY MAXIMUM [GWh] SOLAR THERMAL ENERGY GENERATION/TOTAL GENERATION [%]

Data regarding the Balearic Islands and Canary islands available as of 2006 and Ceuta and Melilla as of 2007.

Average hourly share of solar thermal in total generation in 2017 [%] Peninsular electricity system

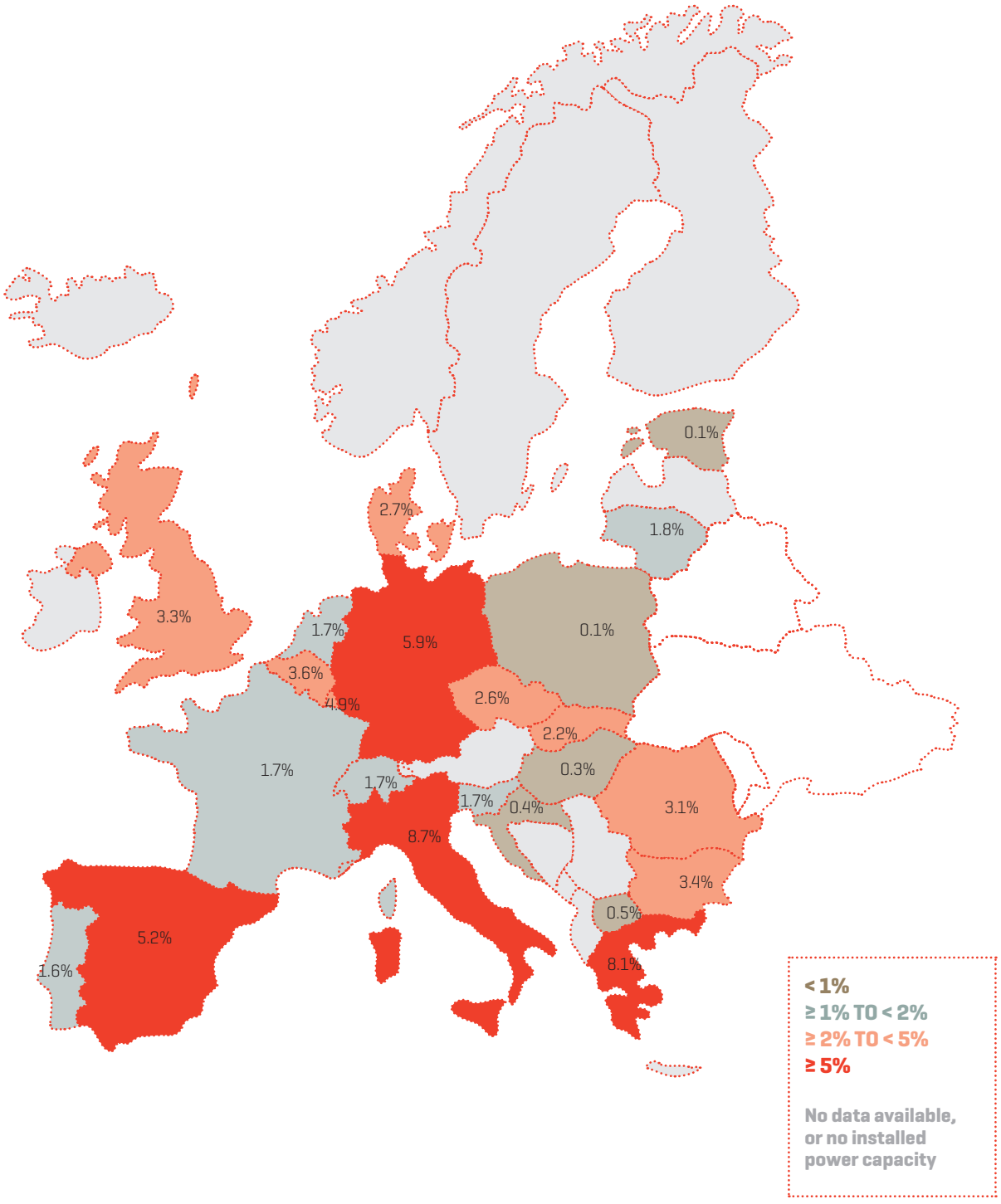


Solar power capacity in relation to total power capacity in ENTSO-E member countries in 2017 (%)



Source: ENTSO-E. Data Portal 19 April 2018. Spain REE, Great Britain includes data for Northern Ireland.

Share of solar generation over total generation within ENTSO-E in 2017 [%]



Source: ENTSO-E. Data Portal 19 April 2018. Spain REE, Great Britain includes data for Northern Ireland.

05

ENERGY FROM THE EARTH AND THE SEA

At the end of 2017, the set of renewable technologies that use other very diverse sources, headed by biomass, represented 1% of installed power capacity in Spain and around 2% of overall production.

AGGREGATE POWER CAPACITY FROM OTHER RENEWABLE TECHNOLOGIES

1,031
MW IN 2017

1.0%
OF OVERALL INSTALLED POWER CAPACITY NATIONWIDE

AGGREGATE GENERATION FROM OTHER RENEWABLE TECHNOLOGIES

4,512
GWh

+6.7%
COMPARED TO 2016

This section contains aggregate information regarding a set of renewable technologies that use other very diverse sources and which, when grouped together, account for 2.1% of installed renewable energy capacity, representing barely 1% of the total installed power capacity in Spain. In 2017, this group of technologies generated 4,512 GWh of electrical energy, representing just 1.7% of the total electricity production.

In this group of technologies, we can identify four main subgroups: biomass and biogas (853 MW); renewable waste, which considers 50% of municipal solid waste as a renewable source of energy (162 MW); the hydro-wind power station installed on the island of El Hierro (11 MW); and 5 MW of marine hydro.

It should be noted that the evolution of these aggregated energies has been constant for more than a decade (1), with their installed power capacity going from 379 MW in 2001 to 1,031 MW in 2017. However, their share in the Spanish electricity generation mix is still minor, not exceeding 2.1% in any year.

Because of its particularity, noteworthy is the hydro-wind power station of Gorona del Viento which in 2017 allowed renewable energy to cover 46.5% of the annual generation of the island of El Hierro. In addition, in the month of July renewable generation covered 80% of the demand on the island and for eight consecutive days in the month of June, renewable energies covered 100% of the demand.

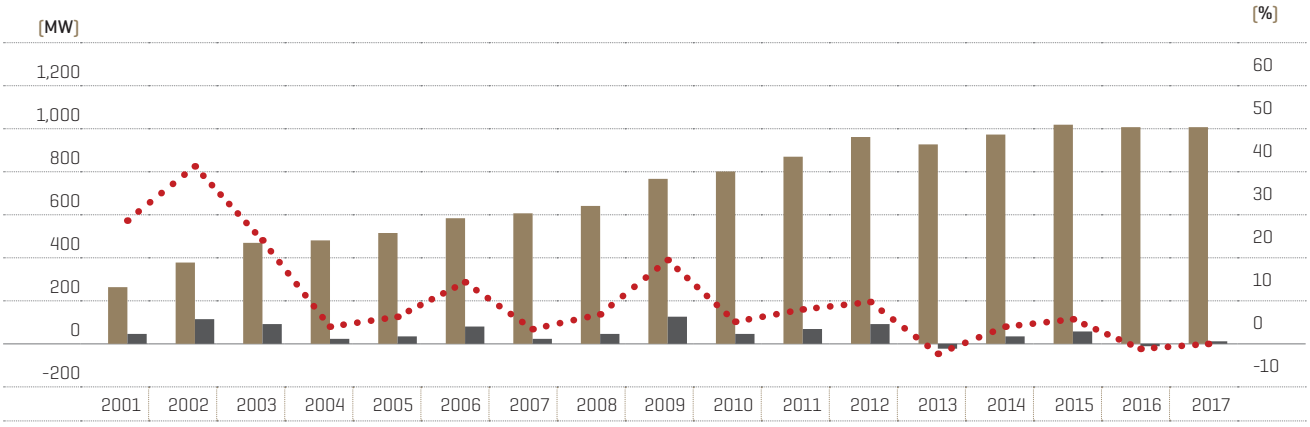
Because of its particularity, noteworthy is the hydro-wind power station of Gorona del Viento which in 2017 allowed 46.5% of the annual generation of the island of El Hierro to be covered with renewable energy. In addition, in the month of July it managed to provide sufficient renewable generation to cover 80% of the demand of this island, and for eight consecutive days of the month of June renewable energy covered 100% of the demand.

By autonomous community, Andalusia, with 230 MW is the region with the highest installed power capacity of this group of renewables, accounting for 22% of the total nationwide. It is followed by the Basque Country, Catalonia and Galicia, which together represent almost 37% of the installed power capacity of this type of renewables.

With regard to Europe, Spain is at the tail-end of most European countries who have implemented this type of renewable energy. Iceland is leader with a weight of 26% of this type of energy in its total installed capacity, followed by Finland and Denmark with 12% and 11% respectively. Regarding the contribution of these technologies to the total production of each country, Iceland continues in first place with 25%, followed by Denmark and Finland with percentages close to 17%.

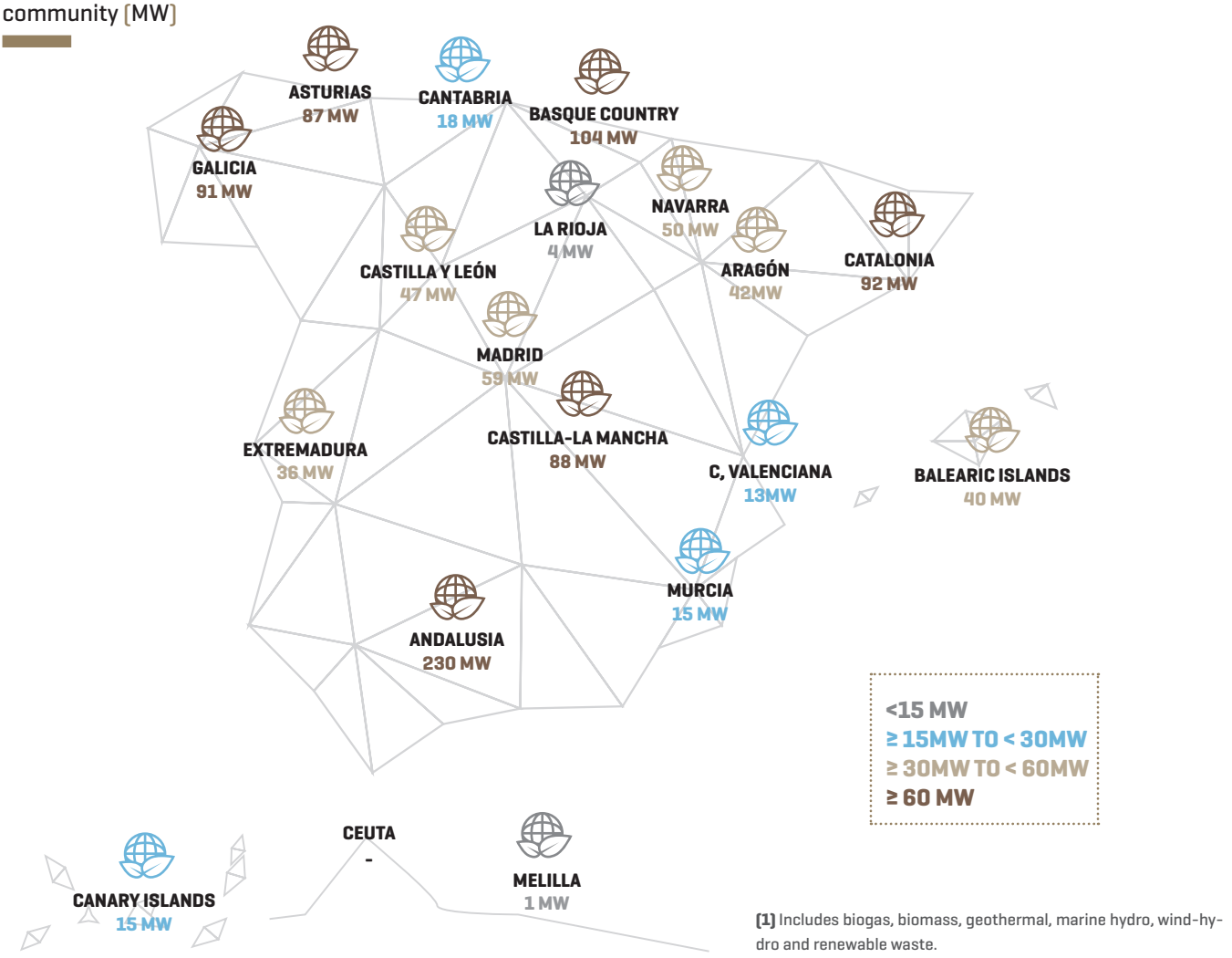
(1) The evolution over the years of these technologies has been affected by reorganisations due to regulatory changes as was the case in 2015 resulting from the coming into force of Royal Decree 413/2014 on electricity generation by means of Renewables, Cogeneration and Waste. This is the reason why the installed power capacity of these technologies has shown a decrease as of that year.

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



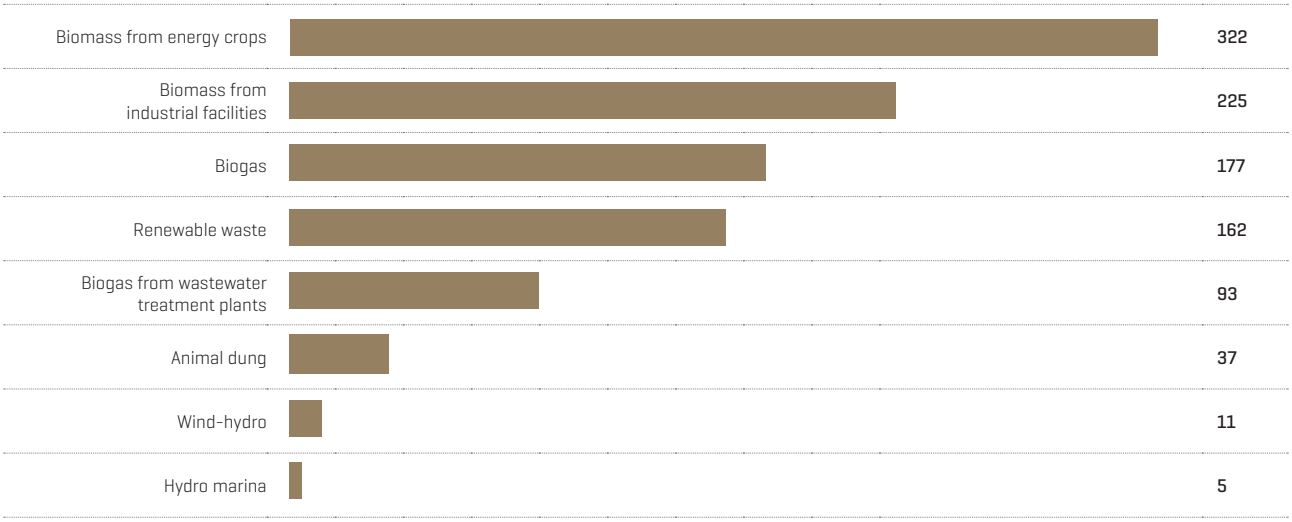
(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.
Source: Data from the National Commission for Markets and Competition (CNMC) until 2014. Data regarding the Balearic Islands and the Canary Islands available as of 2006 and Melilla since 2007.

Other renewables [1]. Installed power capacity as at 31.12.2017. National electricity system per autonomous community [MW]

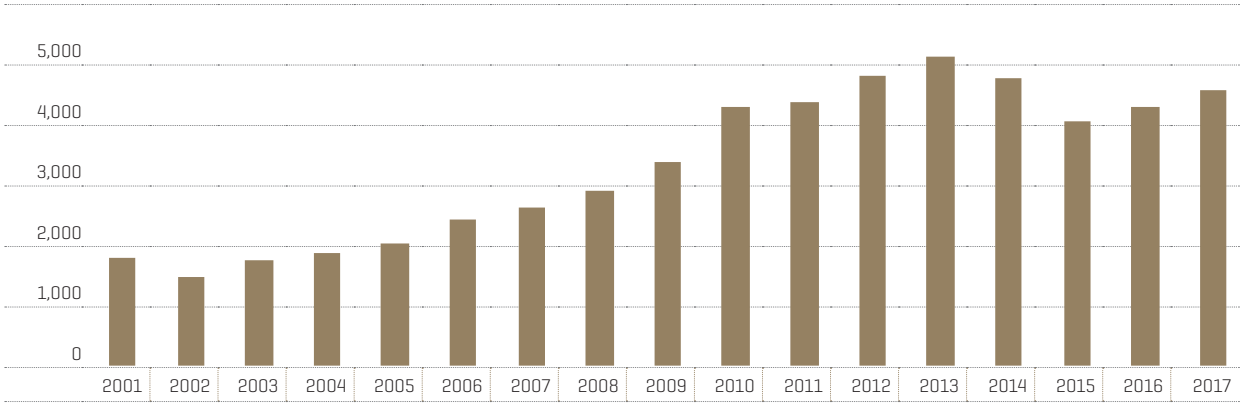


(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.

Other renewables. Installed power capacity per fuel type as at 31.12.2017. National electricity system (MW)

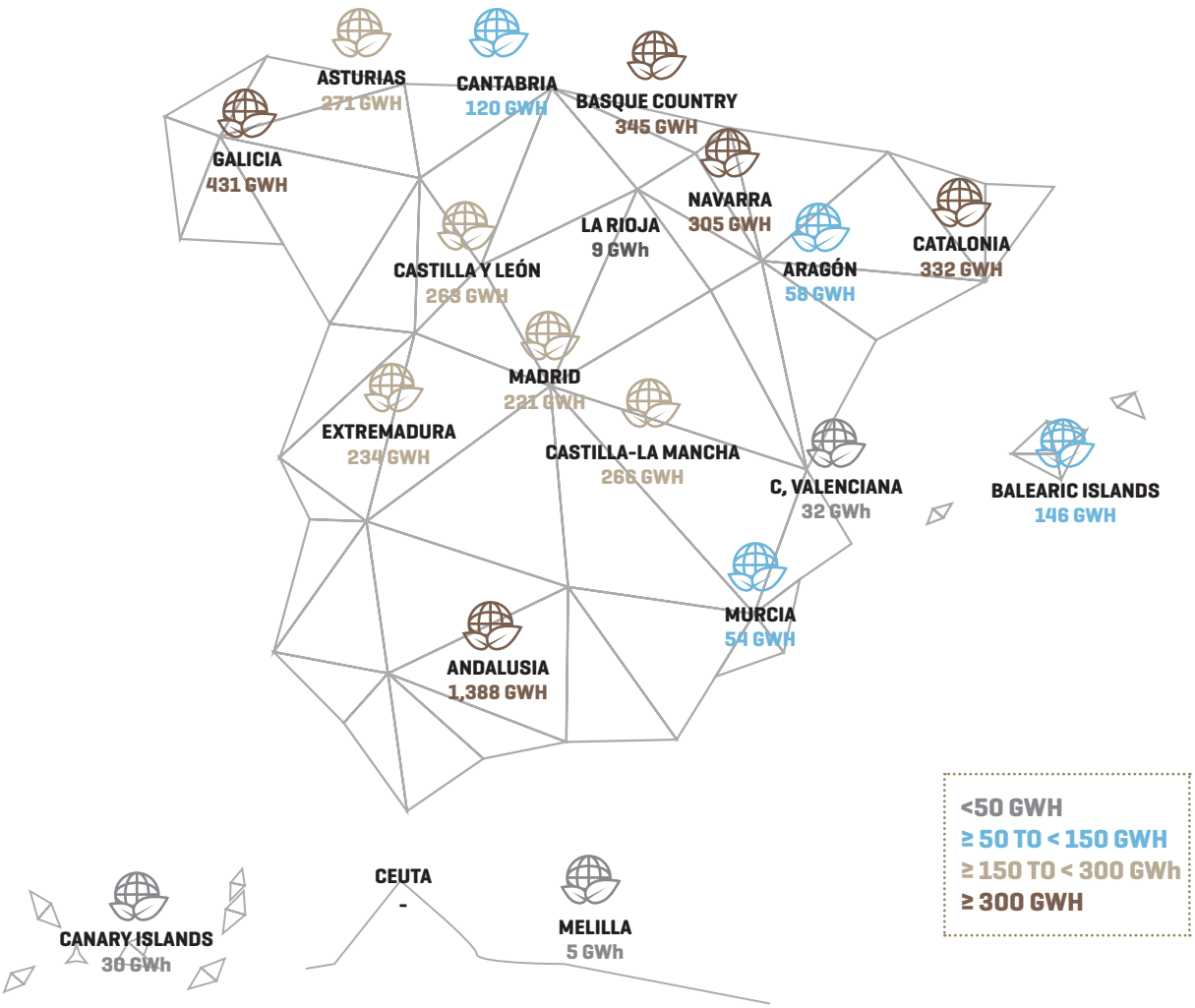


Generation from other renewables[1]. National electricity system (GWh)



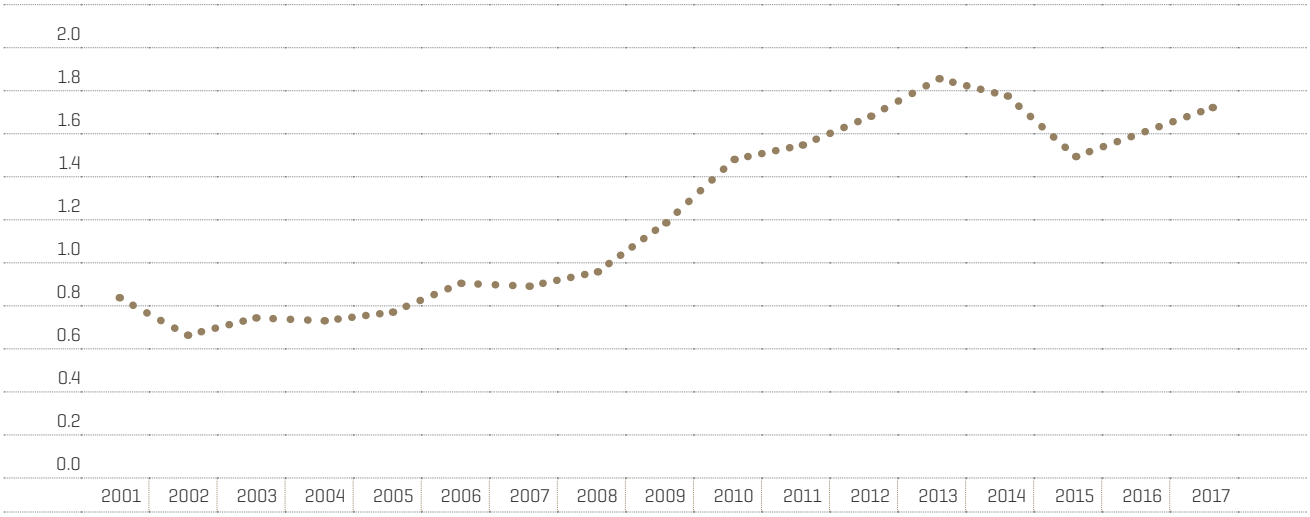
(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.
Data regarding the Balearic Islands and the Canary Islands available as of 2006 and Melilla since 2007.

Generation from other renewables [1] in 2017. National electricity system per autonomous community (GWh)



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

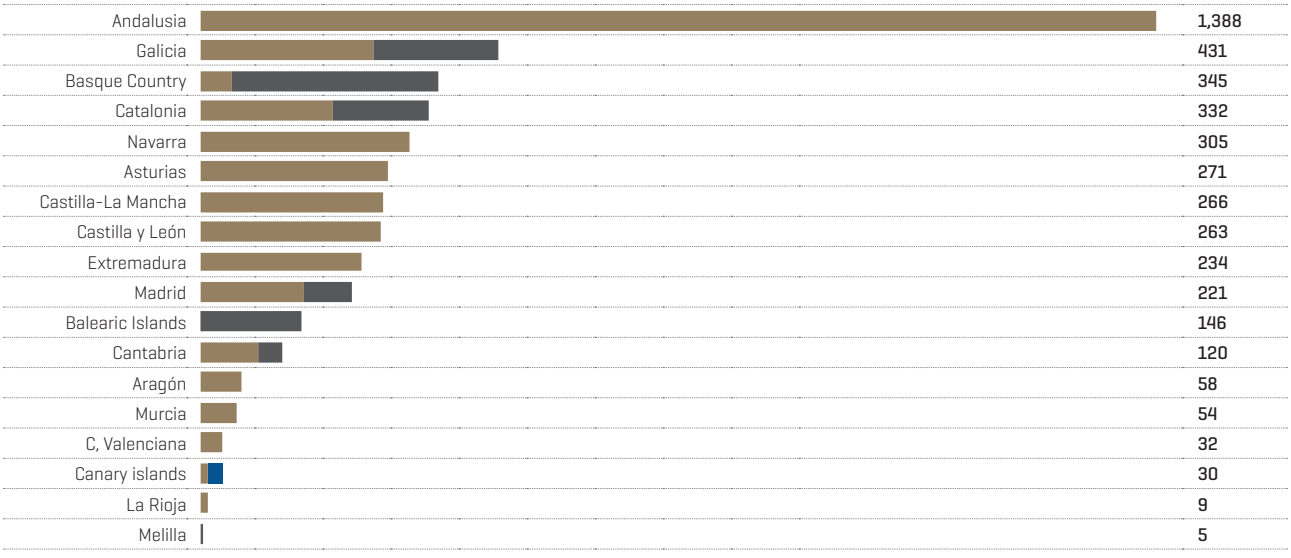
Share of generation from other renewables[1] in the total generation mix. National electricity system (%)



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

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

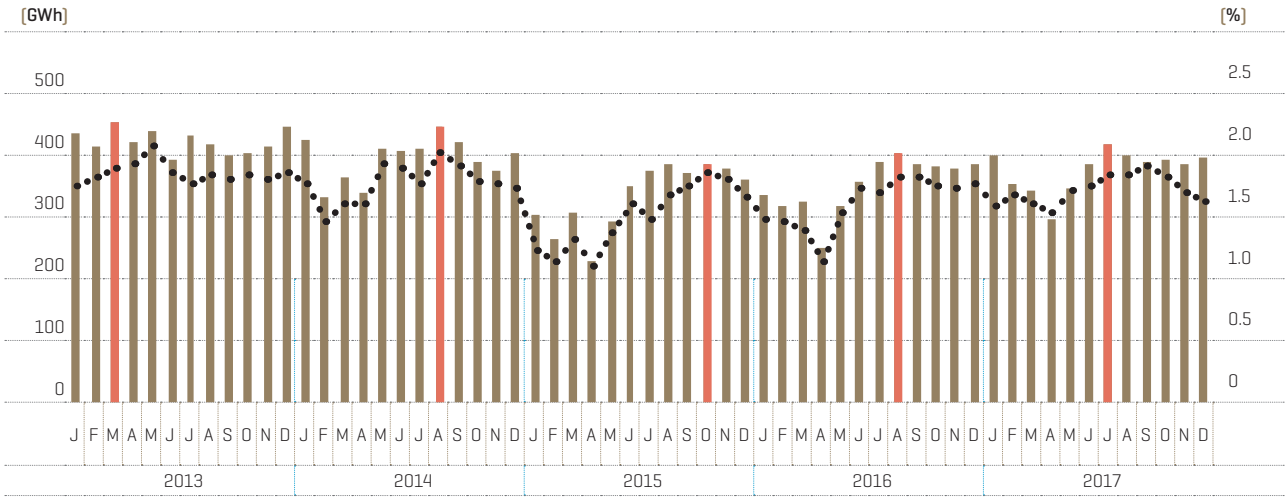
Generation from other renewables[1] per region And type of technology in 2017 (GWh)



OTHER RENEWABLES[1] RENEWABLE WASTE WIND-HYDRO

(1) Includes biomass, biogas and marine hydro.

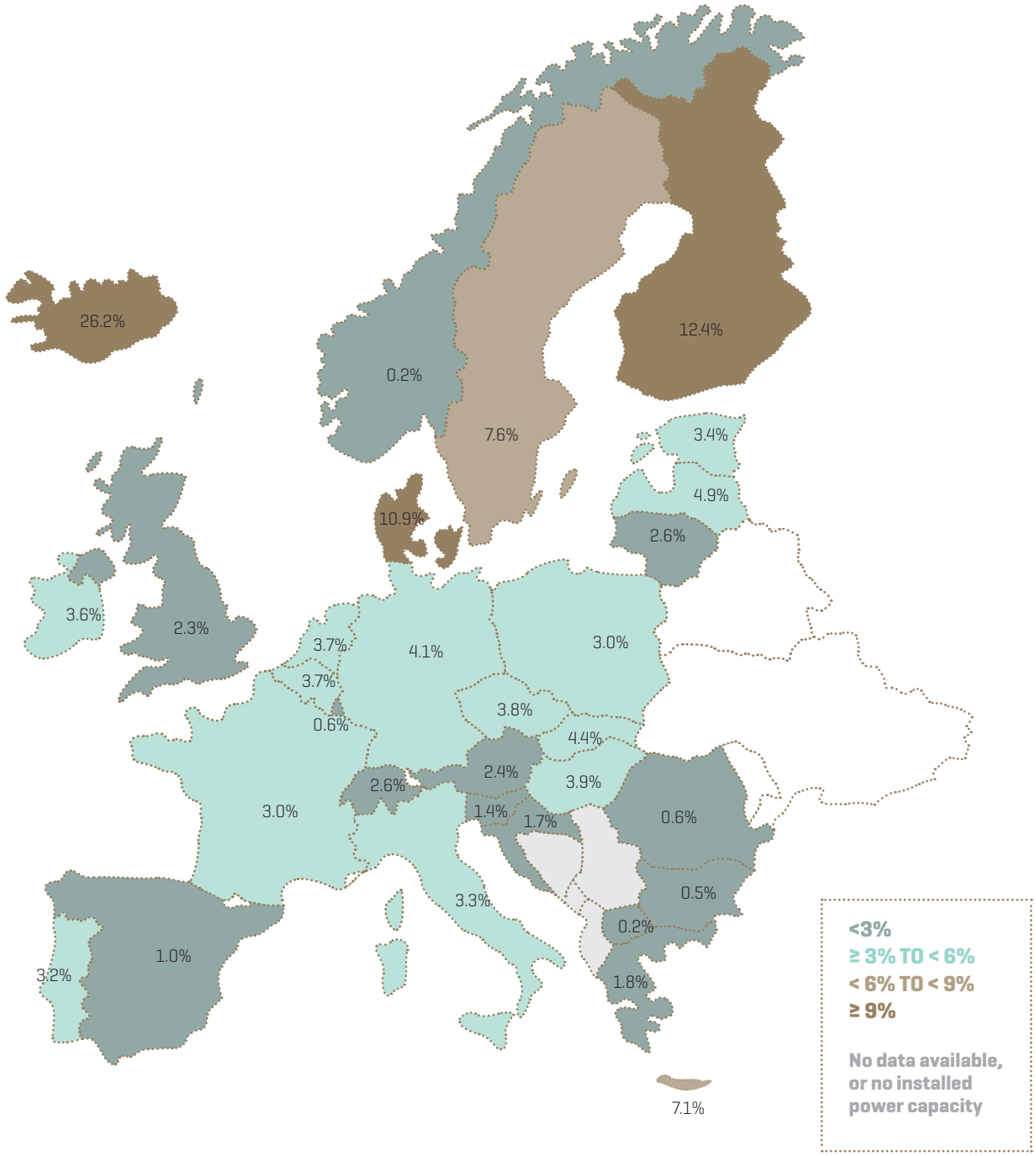
National generation from other renewables [1], monthly maximum values and share in the total generation mix. National electricity system



REMAINING RENEWABLES GENERATION [GWh] MONTHLY MAXIMUM [GWh] REMAINING RENEWABLES GENERATION/TOTAL GENERATION [%]

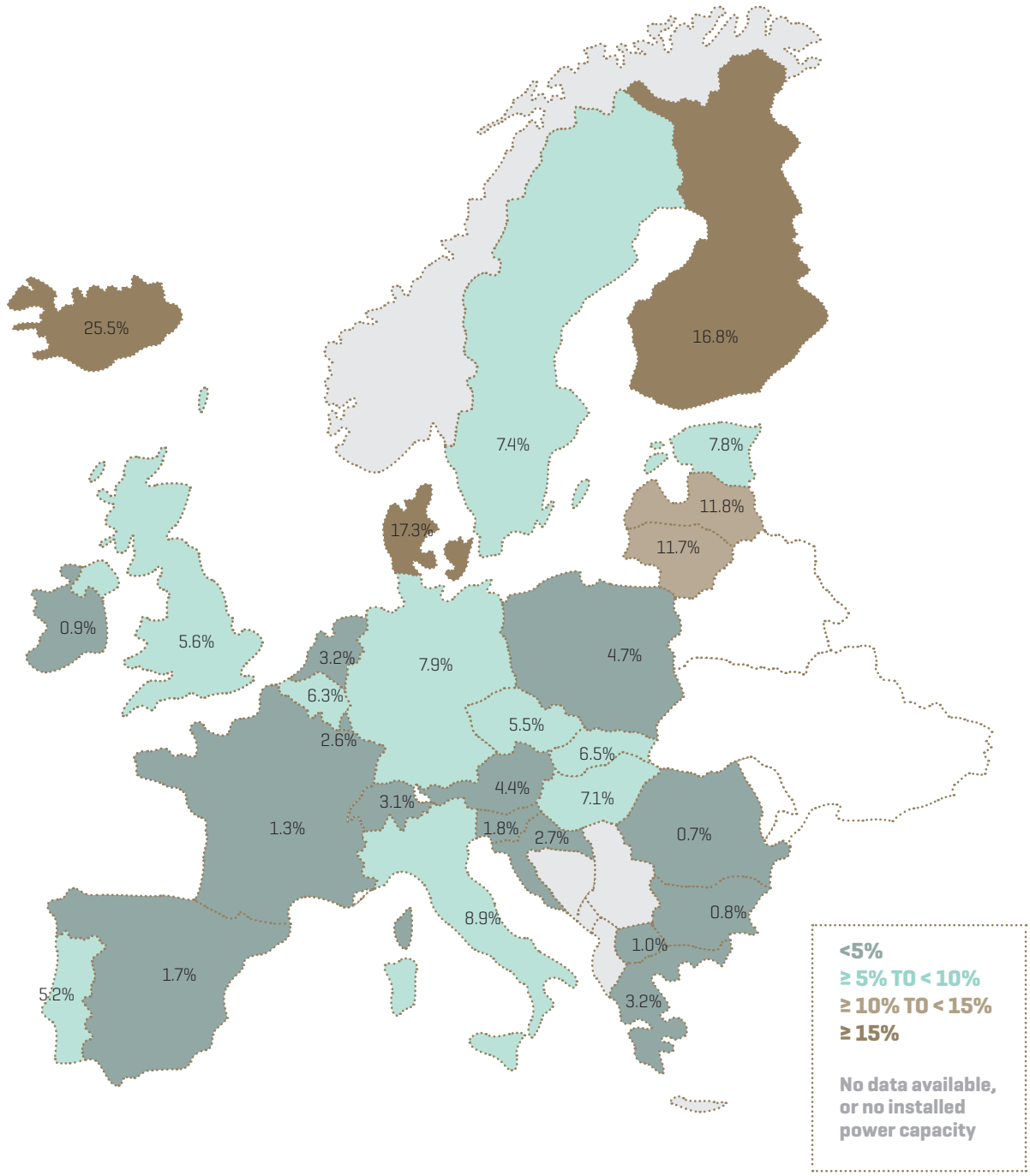
(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste
Data regarding the Balearic Islands and the Canary Islands available as of 2006 and Melilla since 2007.

Power capacity of other renewables in relation to total capacity in ENTSO-E member countries in 2017 [1] (%)



Source: ENTSO-E. Data Portal 19 April 2018. Spain REE, Great Britain includes data for Northern Ireland.
(1) ENTSO-E countries include biomass, biogas, geothermal, wind-hydro, marine hydro and renewable waste technologies.

Share of other renewables generation over total generation within ENTSO-E in 2017 [1] [%]



Source: ENTSO-E. Data Portal 19 April 2018. Spain REE, Great Britain includes data for Northern Ireland.

(1) ENTSO-E countries include biomass, biogas, geothermal, wind-hydro, marine hydro and renewable waste technologies.

GLOSSARY

BIOGAS
Combustible gaseous fuel that is generated naturally or in specific devices, as a consequence of the reactions of biodegradation of organic matter, through the action of microorganisms and other factors, in the absence of oxygen (i.e. in an anaerobic environment). This gaseous fuel constitutes a source of renewable energy and can be used to produce electricity.

BIOMASS
Non-fossil organic material of biological origin that constitutes a source of renewable energy.

COGENERATION
Process through which electricity and useful thermal and/or mechanical energy are obtained simultaneously.

GEOTHERMAL
Geothermal energy is a source of renewable energy that takes advantage of the Earth's natural heat and that appears in the form of hot gases or liquids rising along the faults from underlying bodies of hot rock or through the circulation and convection of water reservoirs resulting in a hydrothermal process that takes place between fluids and rocks.

HYDROELECTRIC RESERVES
The hydroelectric reserve of a reservoir, at any given time, is the quantity of electricity that could be produced in the reservoir's own power station and in all the power stations situated downstream, with the total drainage of its current useable water reserves at that time and providing that drainage occurs without natural contributions. The annual regime reservoirs are those in which the fill and drainage cycle occurs over a one-year period. Hyper-annual regime reservoirs are those which allow the variations in rainfall to be offset in cycles of more than one year.

HYDRO MANAGEMENT UNIT (HMU)
Each set of hydropower stations belonging to the same hydroelectric basin and the same individual agent.

INSTALLED POWER CAPACITY
Electrical energy capacity that a power station can generate and deliver under ideal conditions.

MARINE HYDRO
Generation of electrical energy by taking advantage of some aspect of the physical or chemical properties of the oceans, i.e., tidal energy, wave energy, ocean currents, etc.

MIXED PUMPED STORAGE
Production of electricity generated by power stations capable of generating electrical energy with or without prior pumping from its lower reservoir or catchment area. When there is a water surplus, the power station will function as a conventional power station, also having the possibility of storing energy by pumping water from the lower to the upper reservoir.

NON-RENEWABLE ENERGY
Includes pumped storage, nuclear, coal, fuel/gas, combined cycle, cogeneration and non-renewable waste.

PRODUCIBLE HYDROELECTRIC ENERGY
Maximum quantity of electricity that theoretically could be produced considering the water supplies registered during a certain period of time, and once the supplies for irrigation or uses other than the generation of electricity have been subtracted.

PRODUCIBLE HYDROELECTRIC INDEX
This is the quotient between the producible energy and the average producible energy, both related to the same period and to the same hydroelectric equipment. A producible hydroelectric index of less than 1 indicates that the period is dry, while if greater than 1 it is a wet period.

PURE PUMPED STORAGE
Production of electricity by hydroelectric power stations whose associated reservoir does not receive any natural water inputs, but this comes from it being pumped up from a lower reservoir or catchment area.

RENEWABLE ENERGY
Includes hydro, wind-hydro, wind, solar photovoltaic, solar thermal, biogas, biomass, marine hydro, geothermal and renewable waste.

RENEWABLE WASTE
Non-fossil organic material of biological origin resulting from municipal solid waste and some commercial and non- hazardous industrial waste. 50% of municipal solid waste, also known as Municipal Solid Waste (MSW) is considered renewable.

SOLAR PHOTOVOLTAIC (PV)
Solar light converted into electricity through the use of solar cells, usually of a semiconductor material that, when exposed to light, generates electricity.

SOLAR THERMAL
Heat produced by solar radiation that can be used for the production of mechanical energy and, from this, electrical energy.

WASTE
Combustible materials resulting from a product or by-product of waste which, when processed, produces energy for purposes such as heating and electricity generation.

WIND-HYDRO
Production of electricity through the integration of a wind farm, a pumping unit and a hydroelectric power station. The operation allows the wind farm to supply electricity directly to the grid and, simultaneously, to feed a pump that moves water from a catchment area to a reservoir upstream, as an energy storage system. The hydroelectric power station harnesses the stored potential energy, guaranteeing the electricity supply and the stability of the grid.

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