COMMITED
TO
THE
INTELIGENT
ENERGY

2018






Renewable energy in the spanish electricity system

RED ELÉCTRICA DE ESPAÑA

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PRESENTATION

The regulatory package known as "Clean energy for all Europeans" set the goal of reducing 1990 greenhouse emissions levels by 40 % by the year 2030. This European commitment requires a strategy that will address the energy transition in order to decarbonise the economy over the coming decade. In Spain, the National Integrated Energy and Climate Plan (PNIEC 2021-2030) sets the targets for this transition, which entails a reduction in emissions, an increase in the share of renewables in comparison with final energy and an improvement in energy efficiency. Increased use of electricity and a mix of renewable generation will be essential to achieve these objectives.

In this context, the electricity sector will play an essential role in the energy transition and Red Eléctrica de España (REE), in its position as sole transporter and operator of the Spanish electricity system, becomes a facilitating agent to ensure the success of the electricity policies aimed at the energy transition.

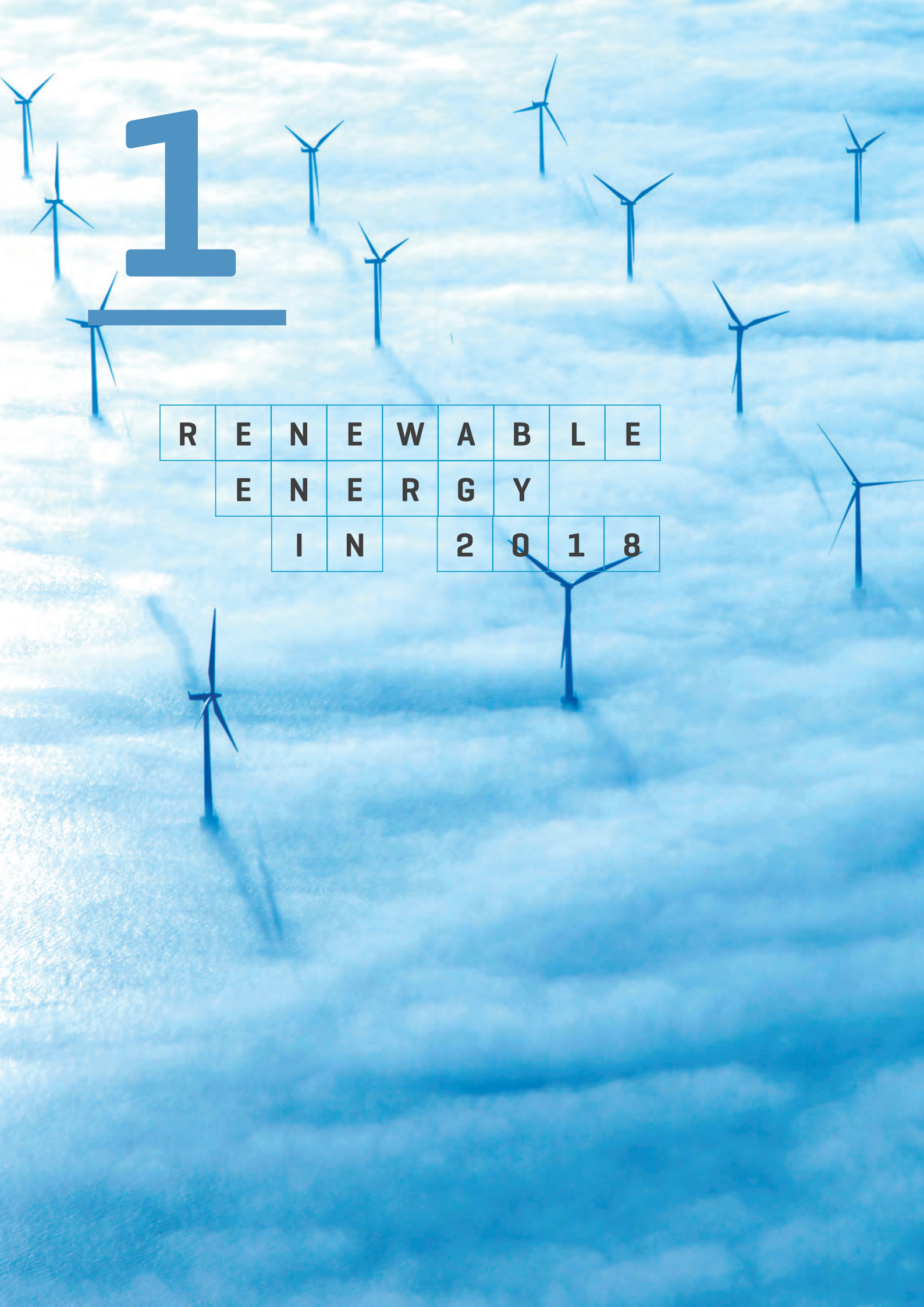
The success of this transition will be based on the connection of renewable resources to the transmission grid at the necessary pace. Storage and interconnections are also key instruments to ensure integration. To make it possible to safely operate an electricity system with such a high penetration of renewable energies, the control and supervision work carried out from the Renewable Energy Control Centre (CECRE) of Red Eléctrica is essential. In this sense, since its creation in 2006, the CECRE has been a pioneer and leading centre in the world, and is currently one of the most important tools in the transition.

The interest in the evolution of renewable generation and our commitment to be a benchmark regarding statistical information on electricity in Spain has prompted us, for the third consecutive year, to present this report on "Renewable energies in the Spanish electricity system", which presents a high-level overview of the behaviour of renewable energy in Spain in 2018, as well as how it has evolved over recent years.

The report begins with the chapter "Renewable energy in 2018", which consolidates the data on all renewables to give the reader a comprehensive view of their behaviour. This is followed by a breakdown of the data on energy from wind, water, sun and from earth and sea.

In addition, The report is also supplemented by data files that can be downloaded in different formats. This information is available in the REData section of the corporate website: www.ree.es, 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 email address redelectrica@ree.es is made available to the public, as a channel through which suggestions and observations may be submitted.



1

RENEWABLE ENERGY IN 2018

Production of renewable energy in the Spanish electricity system increased in the last year due to increased rainfall and wind power production.

100,314
GWh
RENEWABLE ENERGY GENERATION

+19 %
COMPARED TO 2017

38.4 %
OF TOTAL GENERATION

The generation facilities with renewable energy sources in Spain at the end of 2018 totalled 48,612 MW, producing just over 38 % of total generation, an increase from the 32 % for these energy sources in 2017.

This year, renewable installed power capacity increased by 0.9 % compared to the previous year, 427 MW more than in 2017. This increase was mainly due to wind technology, which contributed 88.4 % of the new power. Solar photovoltaic energy, although far behind wind power, was the second most important new renewable power source, with an additional 26 MW. The other renewable sources increased very little or not at all. In any case, it is important to note that since 2009, more than 8,500 MW of renewable energy have been installed in Spain.

The increase in the share of renewable generation over total generation is the result of the confluence of three factors: the increase in hydroelectric production due to higher water levels in 2018, the increase in wind production and the decrease in total energy production.

The increase in renewable generation, together with the decrease in total production, means that production by conventional thermal sources has been reduced, with the consequent decrease in CO_2 emissions, which were 13.8 % lower than the previous year, reaching slightly higher levels than in 2016.

Wind power continues to be the most important renewable technology in the national generation mix, accounting for 19 % of national production, 1.4 percentage points behind nuclear production, which is the technology that accounts for the largest part of the total generation.

Production from wind-powered sources has grown with respect to the previous year for the second consecutive year, increasing 3.5 % in comparison with 2017. In total, 49,570 GWh were produced with this technology, which is still 9.4 % lower than the maximum wind production achieved in 2013 with 2.1 % less installed power capacity.

In terms of geographical distribution of renewable power, five autonomous communities account for almost 70 % of the installed power capacity in Spain. These are, in decreasing order of installed renewable power capacity: Castilla y León, Galicia, Andalusia, Castilla-La Mancha and Extremadura.

Of all of the autonomous communities, Castilla y León and Castilla-La Mancha are the ones that stand out, with renewables accounting for more than 75 % of their installed power capacity. They are followed by Extremadura (65 %), Navarra (51 %) and, despite having only 231 MW of total capacity, Madrid (50 %).

Wind power showed the largest variation in renewable installed power capacity, growing by 1.6 % with respect to the previous year. By autonomous community, the greatest growth was recorded in the Canary Islands, which practically doubled the installed power capacity using this technology in one year. Other significant variations in wind power, although not of equal magnitude, occurred in Aragon and Galicia, which increased 4.7 % and 2.0 % respectively, which is important to note as these two communities are already among the top five autonomous communities with the largest installed wind power.

Generation with renewable energy sources by autonomous community is conditioned significantly by the distribution of installed power capacity among them and by the hydrological situation each year. In 2018, the production of five autonomous communities accounted for 46.7 % of total production. These were: Castilla y León, Galicia, Andalusia, Castilla-La Mancha and Catalonia.

In six autonomous communities, more than 50 % of the generation was from

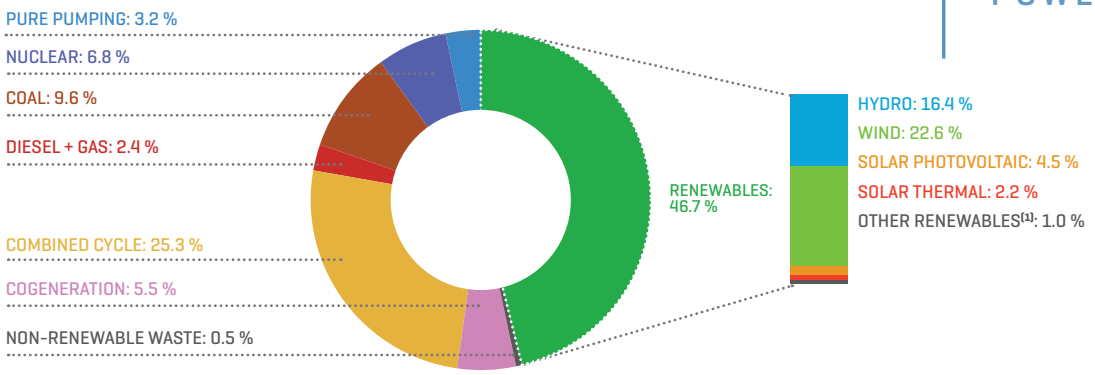
renewable sources: Castilla y León, Navarra, Aragón, Galicia, Castilla-La Mancha and La Rioja. Of these, Castilla y León stands out for the share of renewable generation of its total generation, with these sources of energy accounting for more than three-quarters of its total generation.

In comparison with the rest of the European countries, Spain climbed from sixth to the fifth position by volume of renewable generation. Regarding the share of renewable energy in total generation, Spain continues to present higher figures than the European average, with the particular circumstance that this year, coinciding with the high rainfall, the difference with respect to the average was 7 percentage points, as opposed to 3.5 points the previous year.

104,094 MW
INSTALLED POWER CAPACITY NATIONWIDE

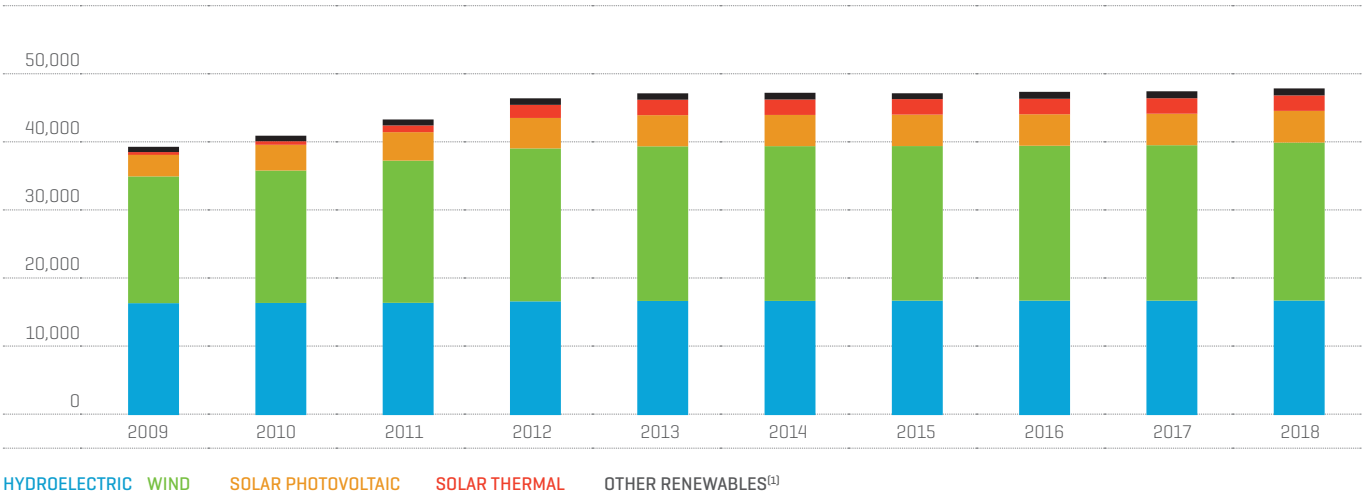
48,612 MW
INSTALLED RENEWABLE POWER CAPACITY

Breakdown of installed power capacity at 31.12.2018. National electricity system (%)



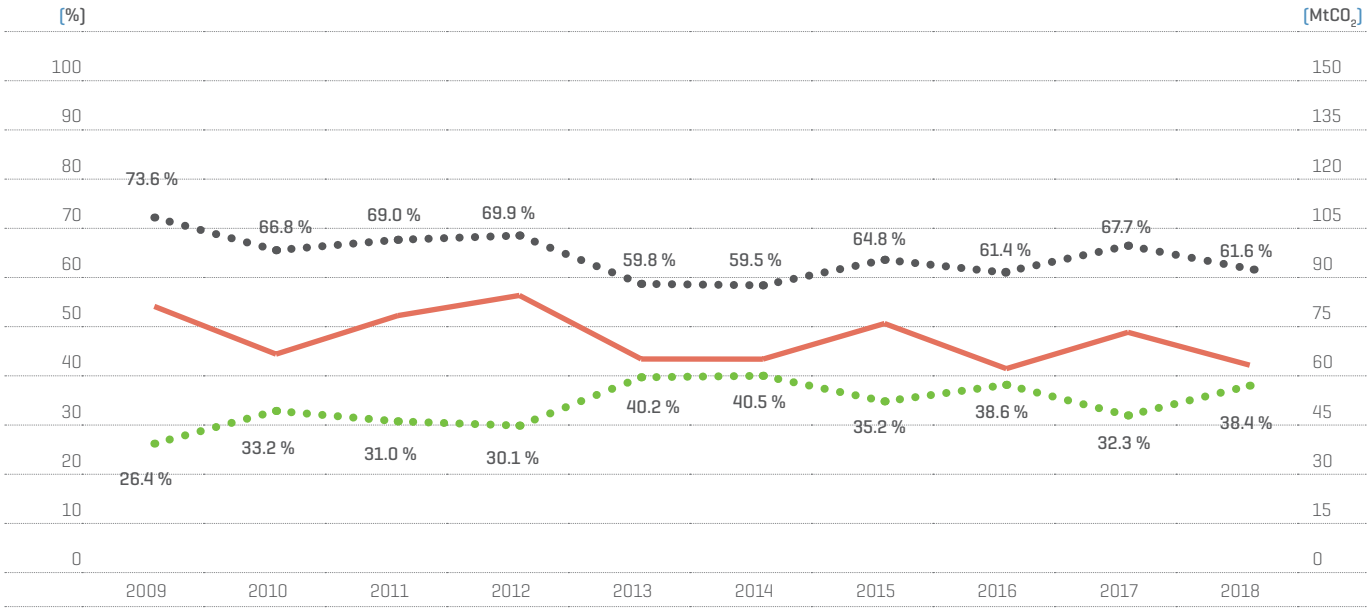
(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.

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



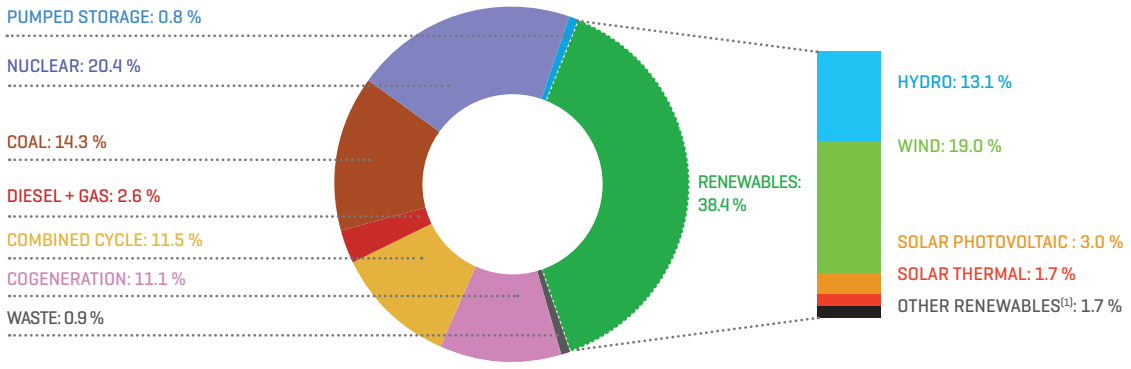
(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.
Source: National Commission of Markets and Competition (CNMC) until 2014.

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



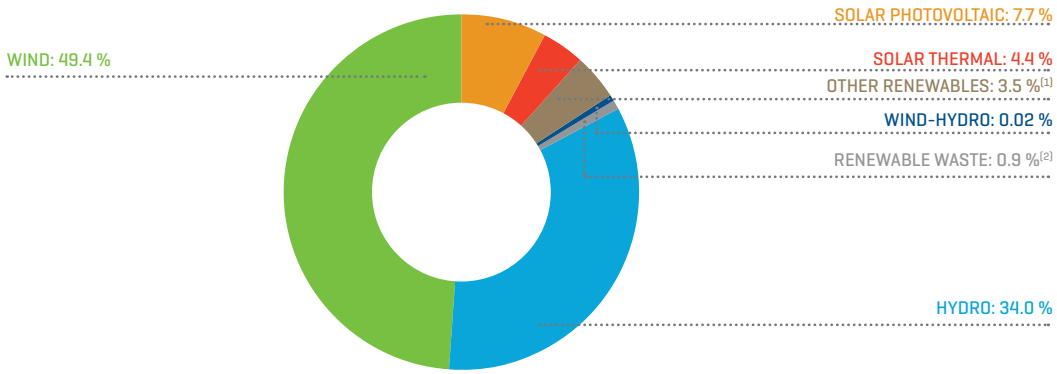
RENEWABLES: HYDROELECTRIC, WIND-HYDRO, WIND, SOLAR PHOTOVOLTAIC, SOLAR THERMAL, RENEWABLE WASTE AND OTHER RENEWABLES
NON-RENEWABLES: NUCLEAR, COAL, DIESEL/GAS, COMBINED CYCLE, COGENERATION, PUMPED STORAGE AND WASTE
EMISSIONS (MILLIONS tCO_2)

Renewable energy generation structure in 2018. National electricity system [%]



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

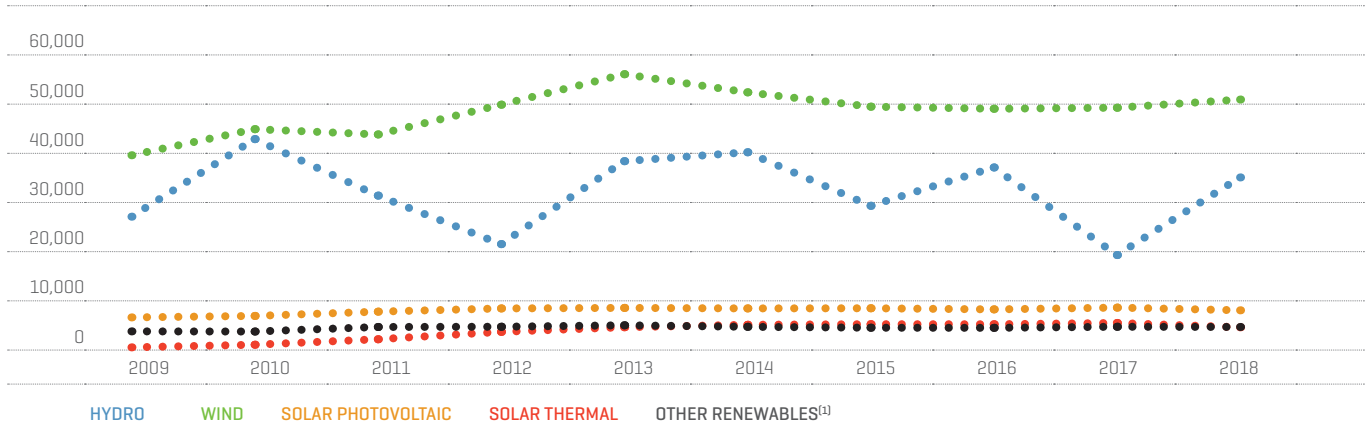
Annual renewable energy generation structure in 2018. National electricity system (%)



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

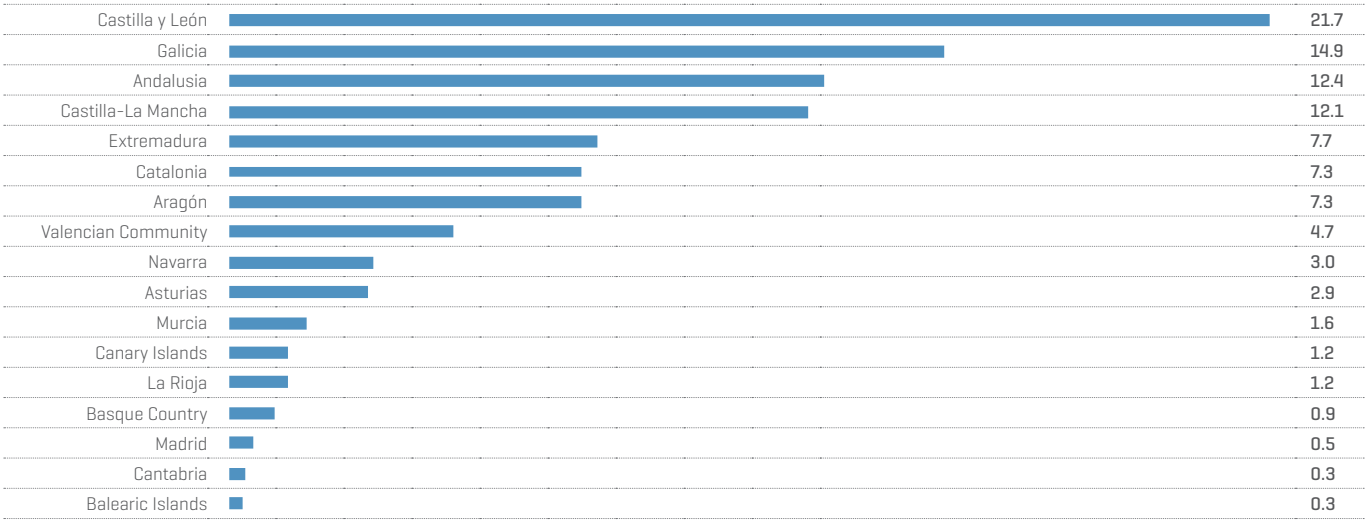
[2] 50% of generation obtained using urban solid waste is considered as renewable.

Evolution of renewable energy generation. National electricity system (GWh)

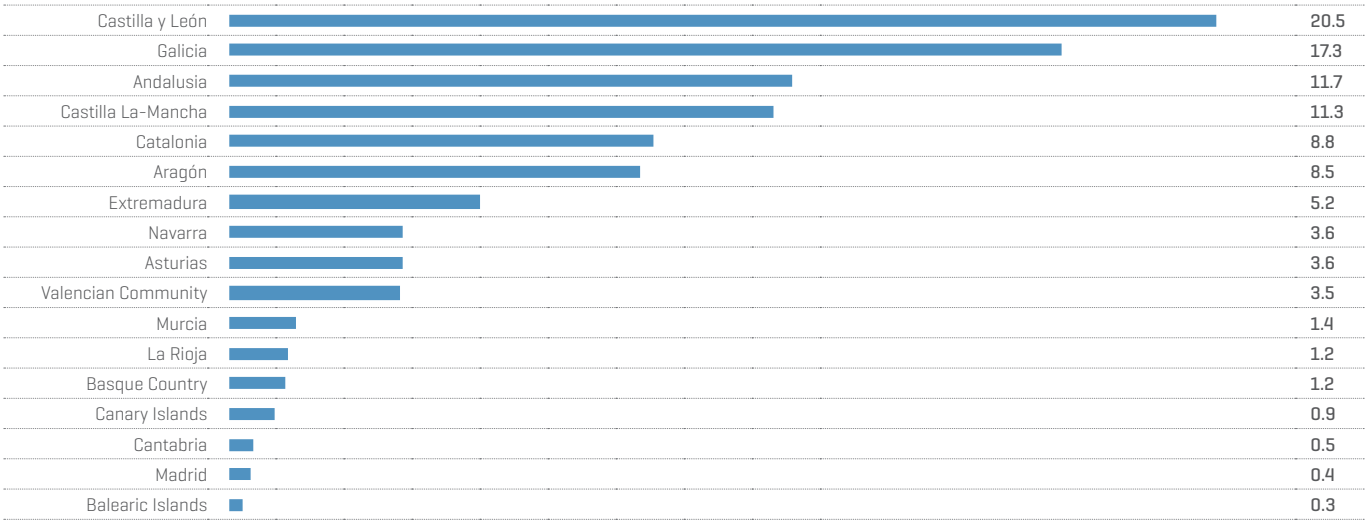


[1] Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste. Data for Balearic Islands and Canary Islands available since 2006 and Melilla since 2007. Data regarding the Balearic Islands and the Canary Islands available as of 2006 and Melilla since 2007.

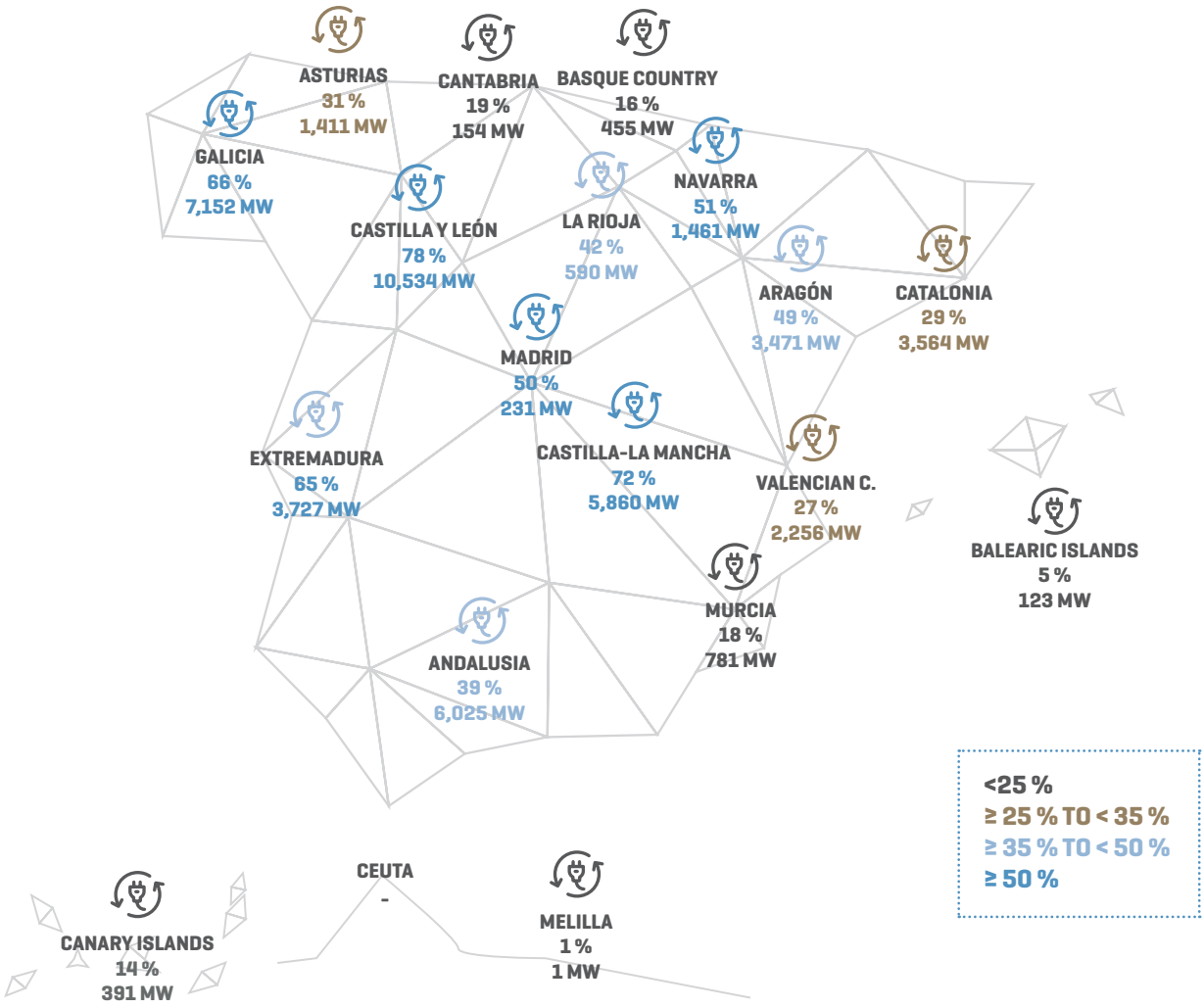
Share of installed renewable power capacity per autonomous community in relation to national renewable power capacity as at 31.12.2018 (%)



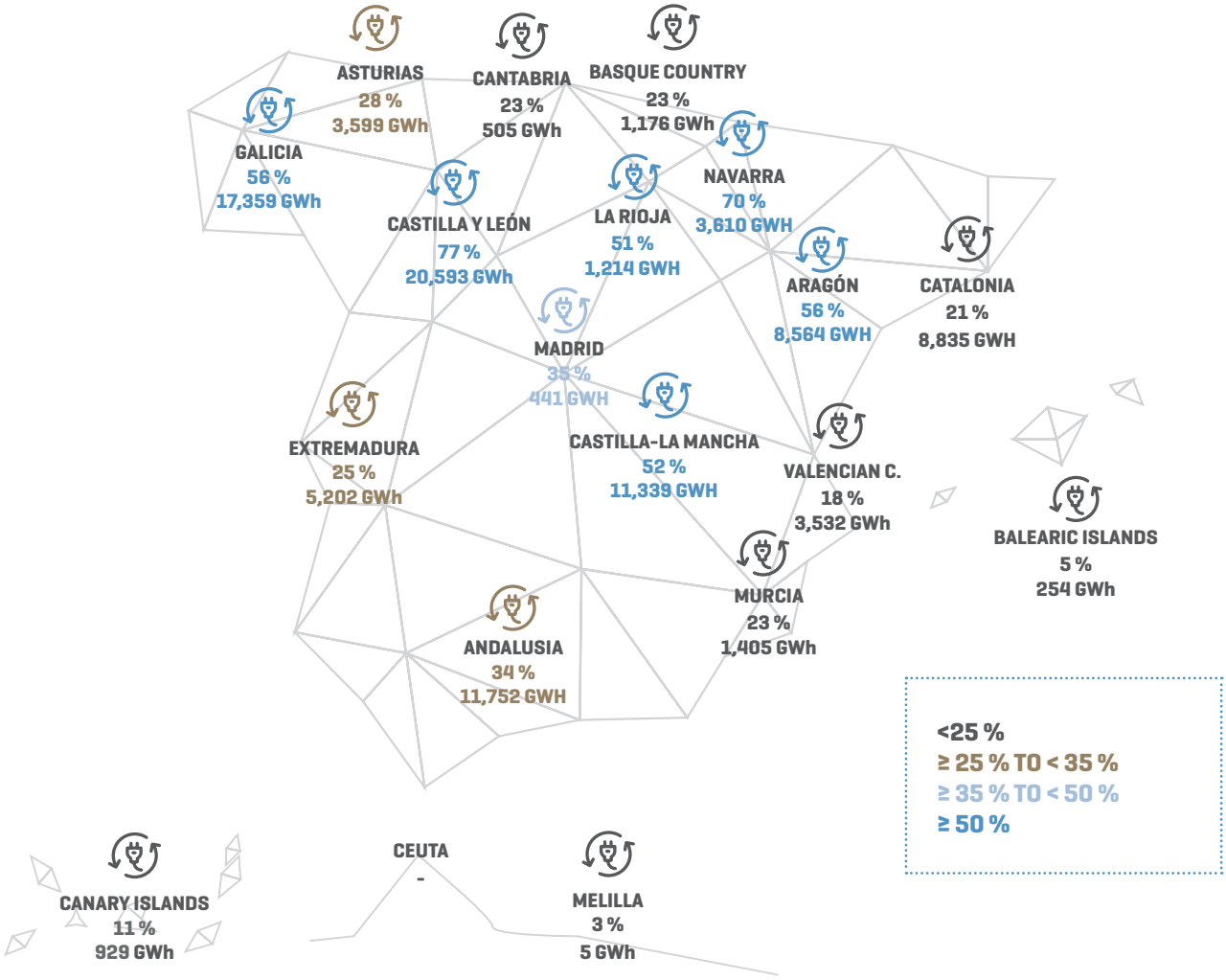
Share of renewable generation per autonomous community in relation to national renewable generation as at 31.12.2018 (%)



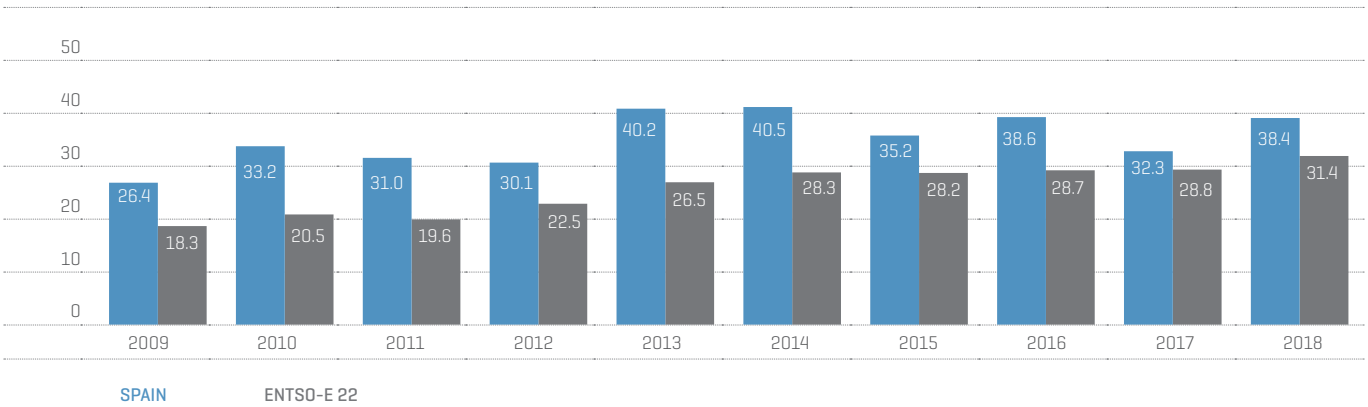
Renewable power installed as at 31.12.2018. National electricity system per autonomous community [MW]



Renewable generation in 2018. National electricity system per autonomous community [GWh]

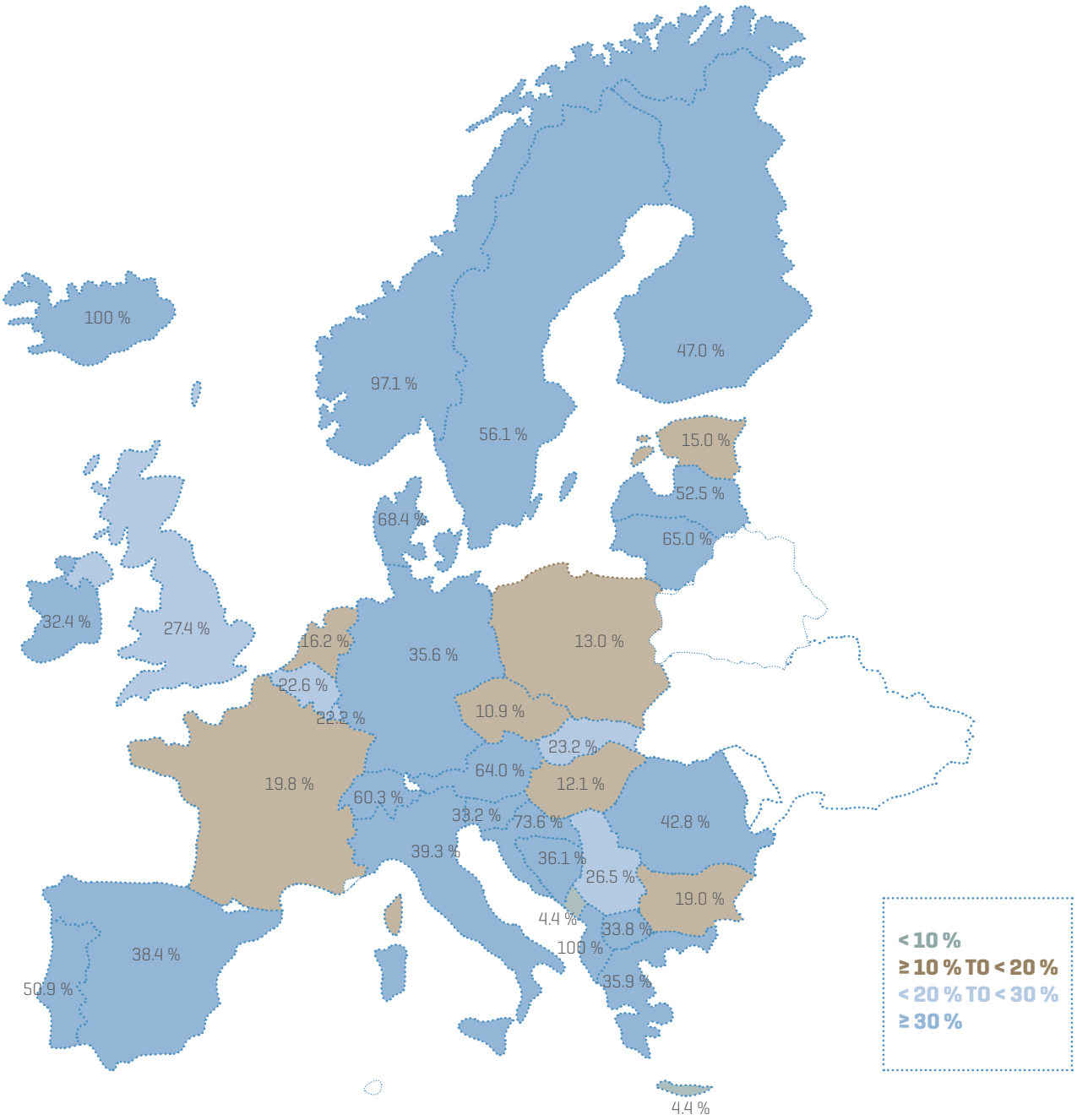


Renewable generation regarding total generation in Spain and the average of a selection of ENTSO-E 22 member countries[1] [%]



[1] Due to unavailability of data for the entire series of some countries, the evolution chart contains information on: Germany, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Denmark, Slovakia, Slovenia, Spain, France, North Macedonia, Greece, Holland, Hungary, Italy, Luxembourg, Poland, Portugal, Czech Republic, Romania and Switzerland.

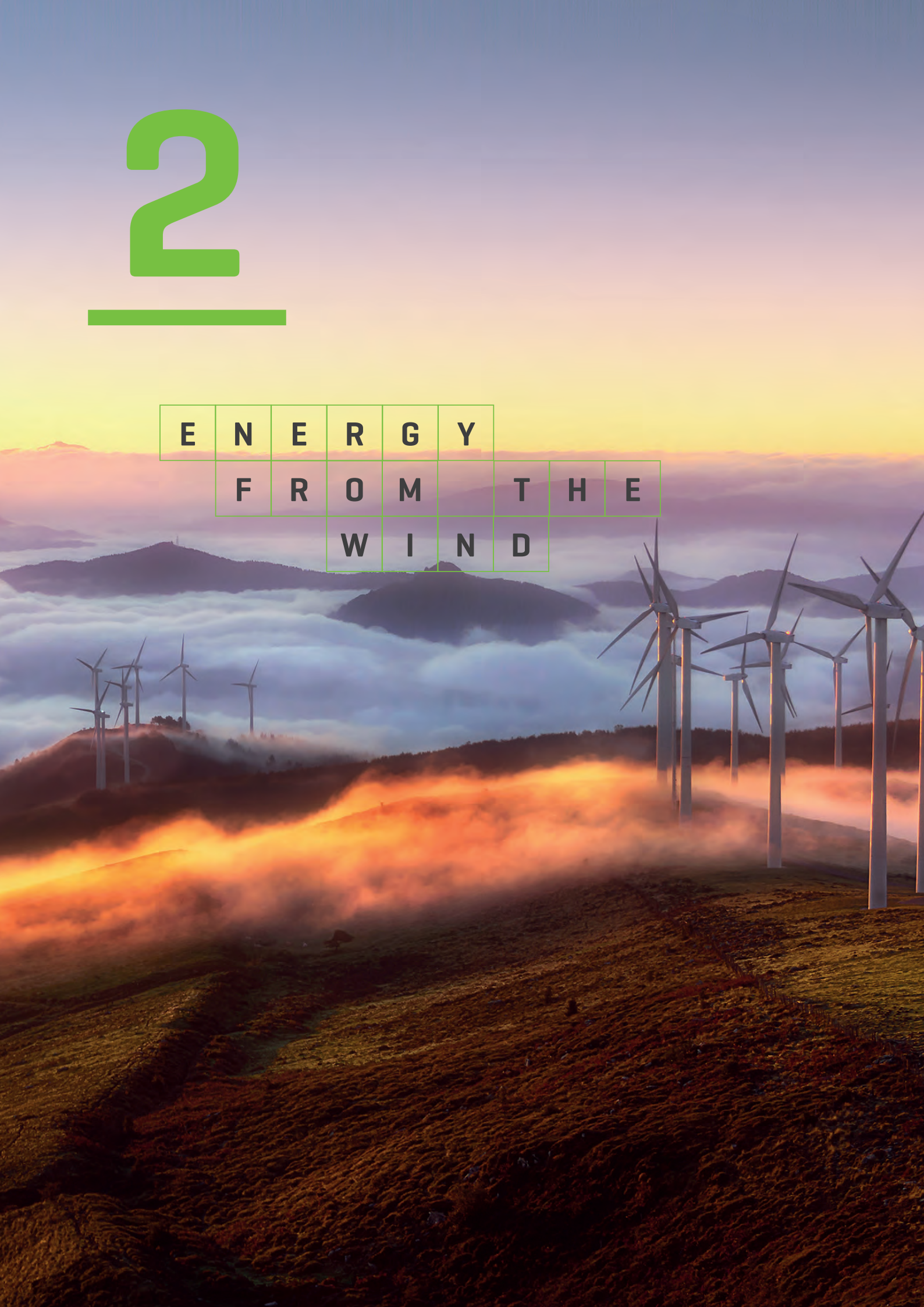
Share renewable generation over total generation within ENTSO-E in 2018 [%]



Source: ENTSO-E. Data portal 20/05/2019. Great Britain includes data for Northern Ireland.

2

ENERGY FROM THE WIND



Wind power is the main renewable source of electricity generation in Spain, with 49,750 GWh generated and 23,507 MW of installed power capacity.

+3.5 %

IN REGARD TO NATIONAL WIND ENERGY GENERATION IN 2017

19 %

WIND ENERGY GENERATION IN THE TOTAL GENERATION MIX

49.4 %
OF THE TOTAL RENEWABLE ENERGY GENERATED NATIONWIDE

22.6 %
OF THE TOTAL INSTALLED ELECTRICITY GENERATION CAPACITY IN SPAIN

With an installed power capacity of 23,507 MW, wind generation is the main renewable source in Spain. In total, it represents 22.6 % of the installed national power and is the second technology behind combined cycle.

The wind energy generated in 2018 increased in comparison with the figure for the previous year by almost 3.5 %, with significant growth in the Canary Islands, which has increased production by more than 56 %. Wind contributes 19 % of the total national generation, and is the second largest generation source after nuclear, maintaining high share levels, around the maximum value of 20 % that corresponded to 2013.

Of renewables as a whole, in 2018, wind continued to be a leader, accounting for just over 49 % of the total renewable energy generated at the national level, considerably less than the previous year due to the increase in hydroelectric generation.

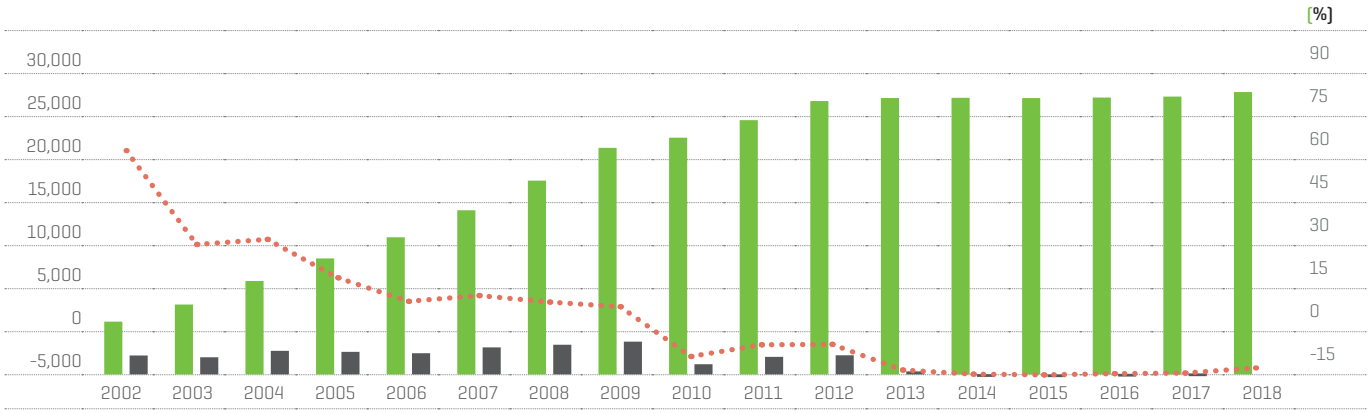
The maximum monthly wind generation was recorded in the month of March, which was also the maximum historic value. This value was 33.4 % higher than the monthly maximum of the previous year, which occurred in the month of December. In regard to the maximum share in generation, March was the month in which wind contributed more to the total electricity produced, accounting for almost 32 % of total generation during that month.

The high degree of variability that wind generation presents in hourly coverage of the demand means that its share over the course of 2018 ranged between minimum values of 0.9 % on October 17 at twelve o'clock in the morning, to 49.2 % on March 12 at 2 o'clock in the morning. The average contribution of wind generation to demand was higher in off-peak hours, with an average share of 23 %, while this share decreased during the daily peak hours to an average value of 17 %.

In regard to autonomous communities, Castilla y León is the autonomous community with the most installed wind power, with almost 24 % of the national power, followed by Castilla La Mancha, Galicia and Andalusia. These four communities alone account for almost 70 % of the installed wind power in our country. On the opposite side, the Balearic Islands, Cantabria and the Basque Country account for 1 % of installed power capacity compared to the national total. The power in the Canary Islands increased notably, doubling from 206.9 MW to 412.7 MW. There was a sharp increase in Tenerife, with just over 126 MW installed (more than 61 % of the new wind power installed in the Canary Islands). On Gran Canaria, 50 MW was installed, with the rest corresponding, almost equally, to Lanzarote and Fuerteventura.

In comparison with the rest of European countries, Spain remains the country with the second highest installed wind capacity, behind Germany, which is clearly the leader with more than 58 GW installed, followed by Great Britain in third place. In regard to the contribution of wind power with respect to total generation, the leader is Denmark, with slightly less than 50 % of its production coming from the wind, with Spain in fifth place. However, of the largest European countries, Spain remains the leader in wind contribution, followed by Germany with two points less.

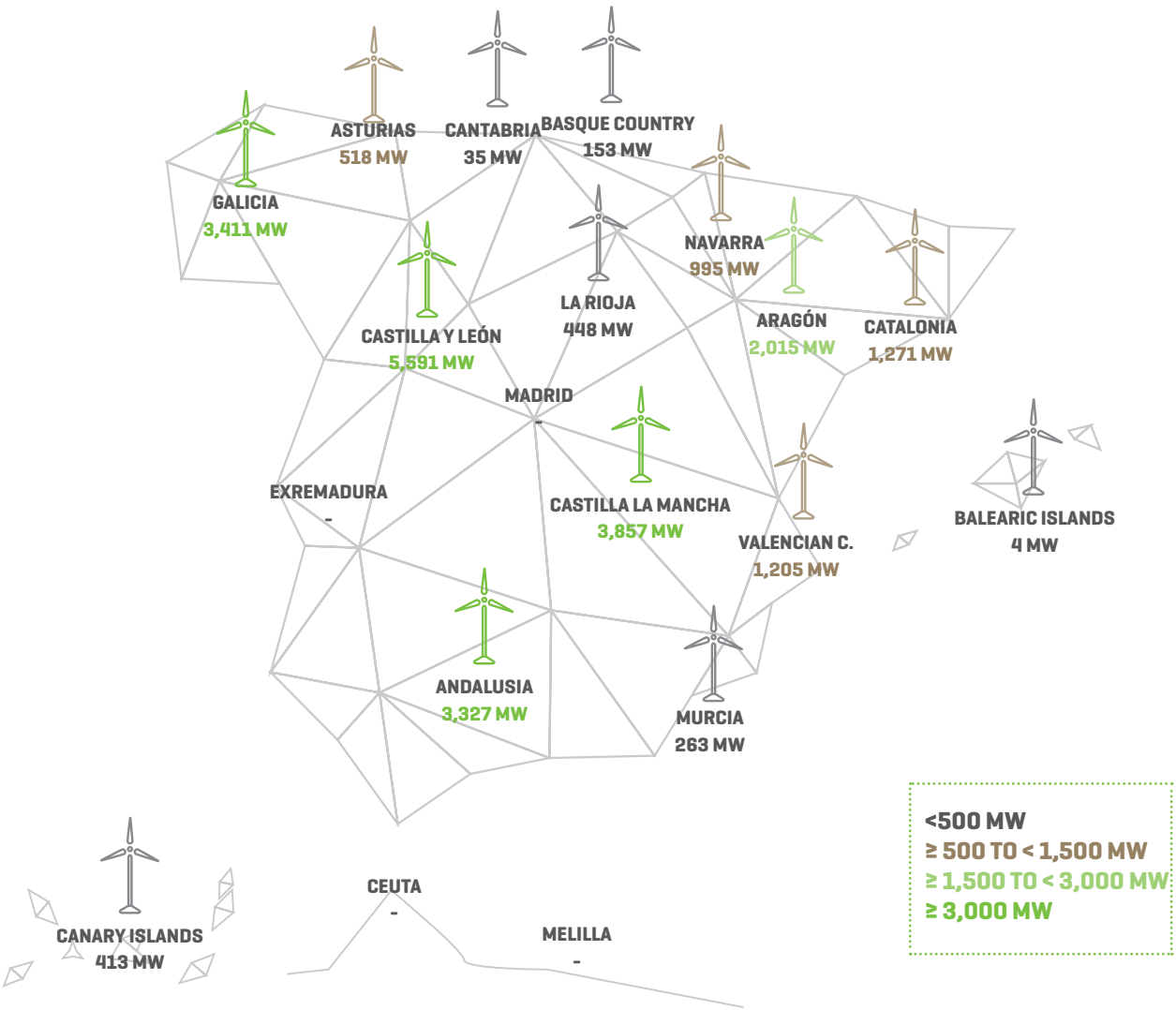
Installed wind power capacity. National electricity system [MW]



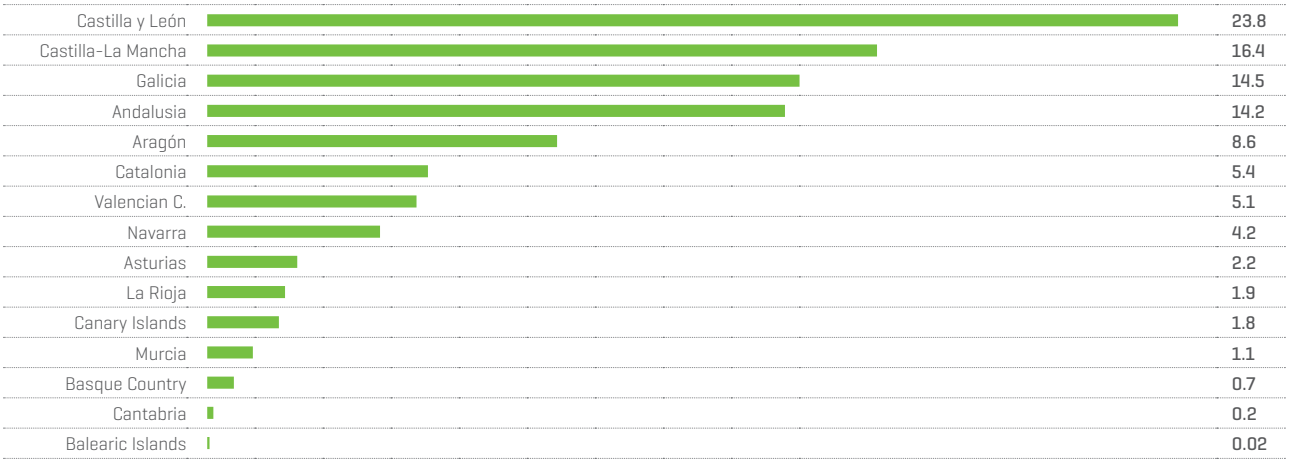
CUMULATIVE [MW] YEAR [MW] VARIATION [%]

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

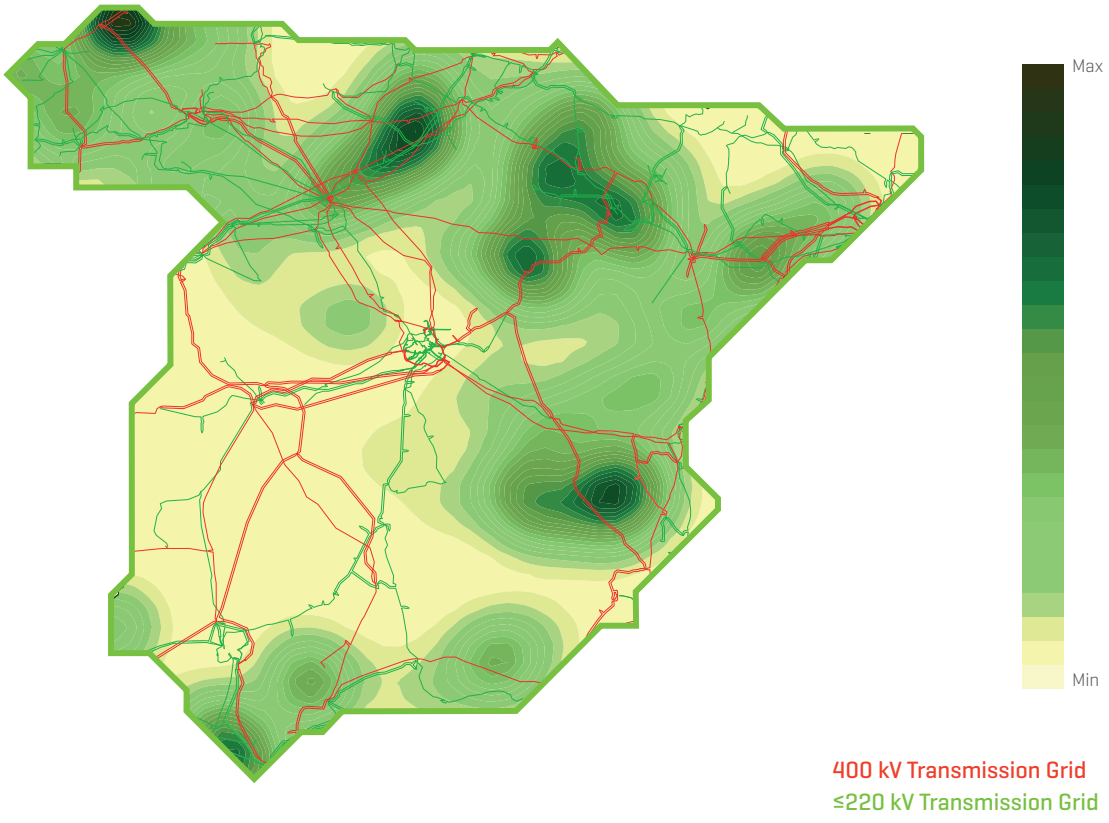
Installed wind power capacity as at 31.12.2018. National electricity system per autonomous community [MW]



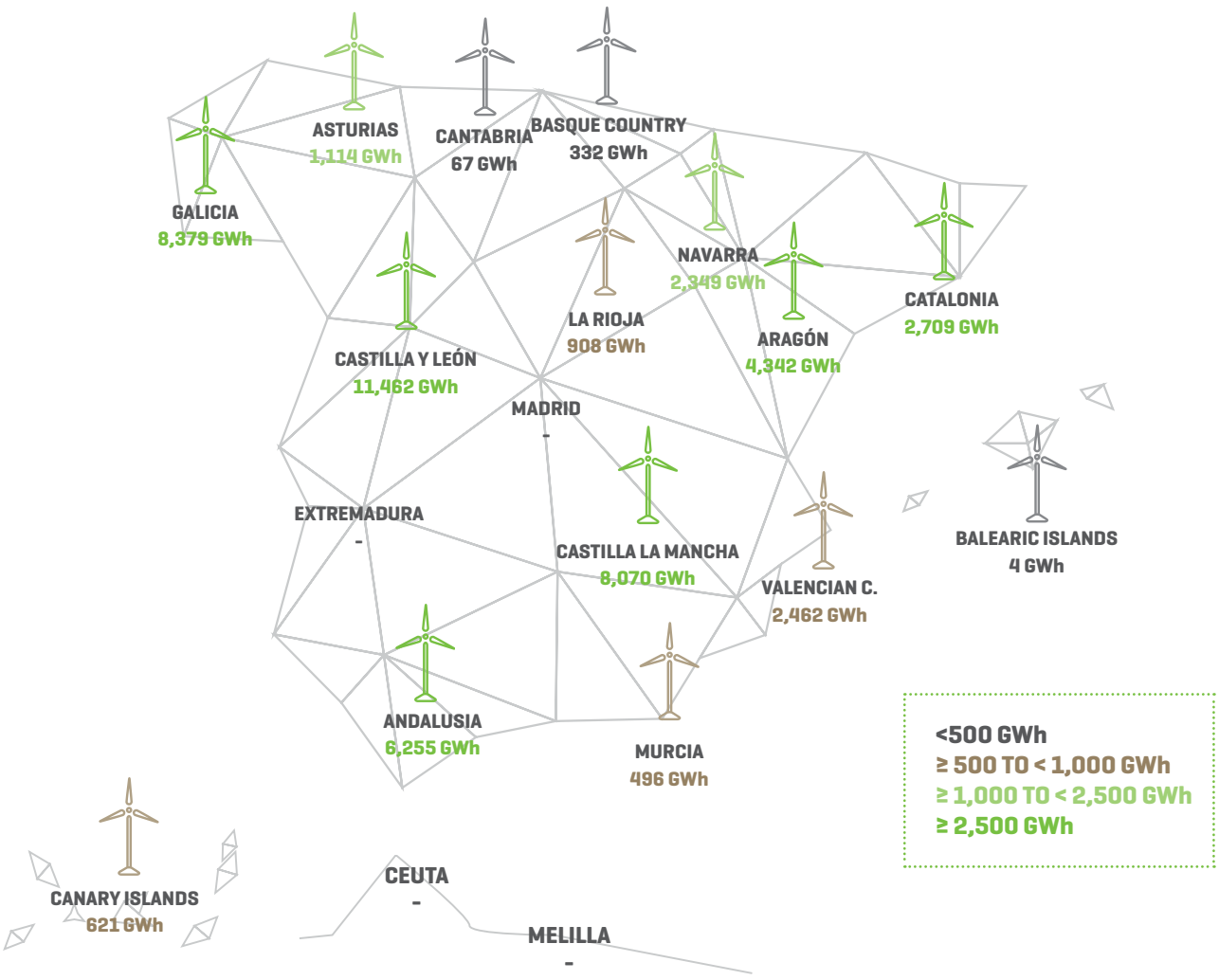
Share of installed wind power capacity in relation to the national total [%]



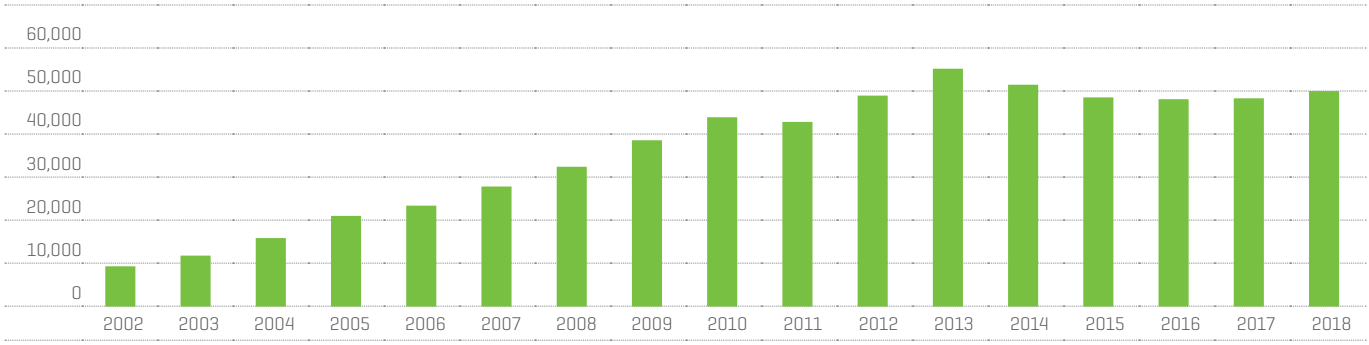
Geographical distribution of wind energy facilities on the Spanish peninsula as at 31.12.2018 [%]



Wind energy generation in 2018. National electricity system per autonomous community (GWh)

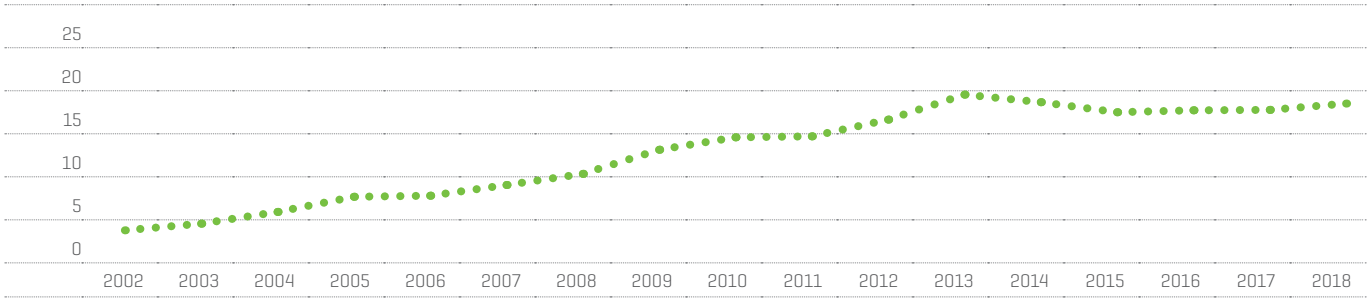


Wind energy generation. National electricity system (GWh)



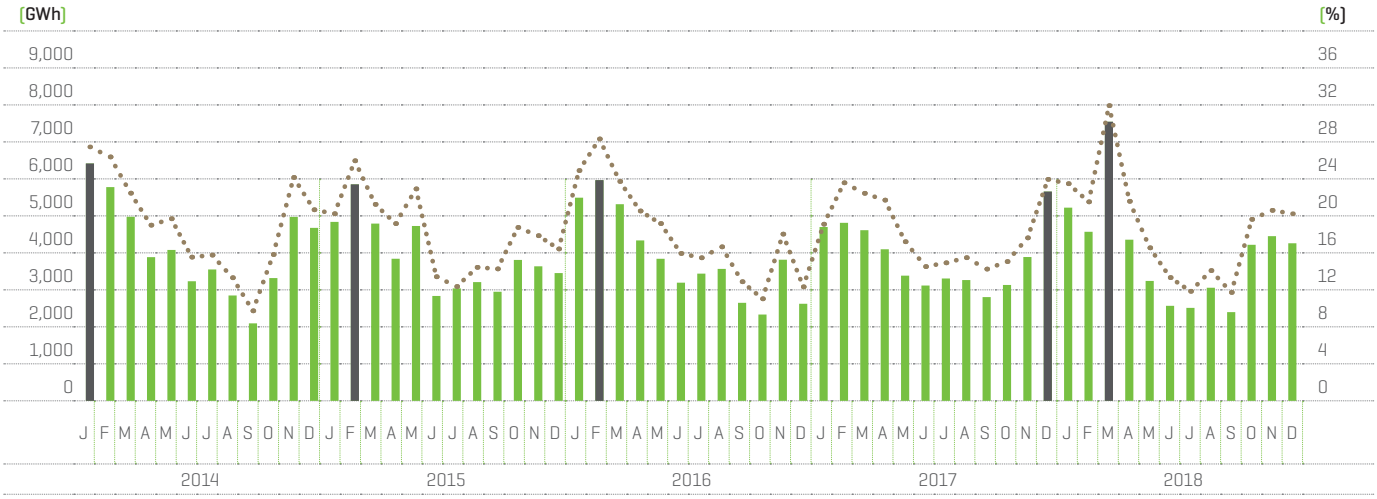
Data regarding the Balearic Islands and Canary islands available as of 2006 and Ceuta and Melilla as of 2007.

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



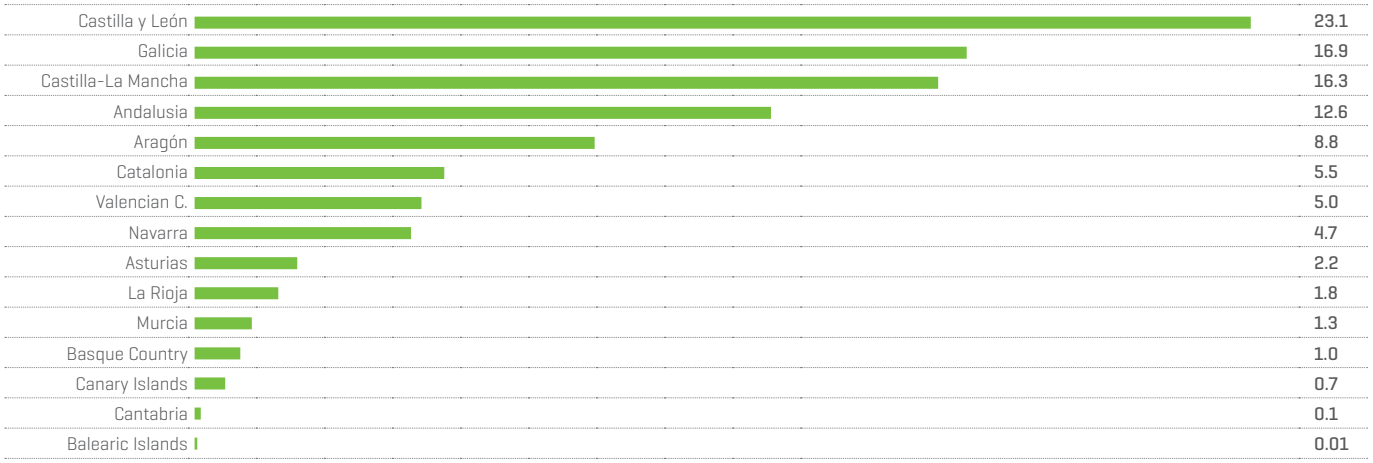
Data regarding the Balearic Islands and Canary islands available as of 2006 and Ceuta and Melilla as of 2007.

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

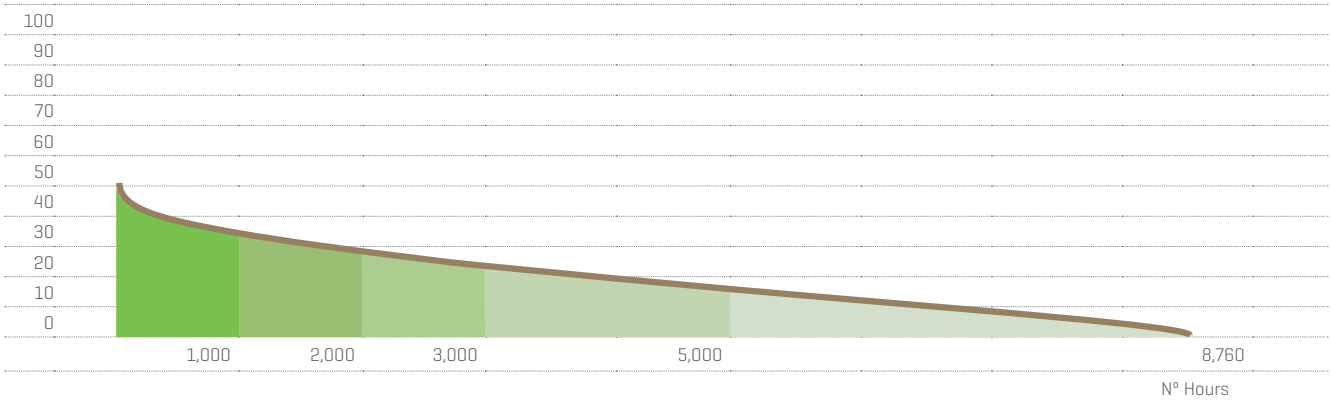


WIND GENERATION (GWh) MONTHLY MAXIMUM (GWh) WIND GENERATION/TOTAL GENERATION (%)
Data regarding the Balearic Islands and Canary islands available as of 2006 and Ceuta and Melilla as of 2007.

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

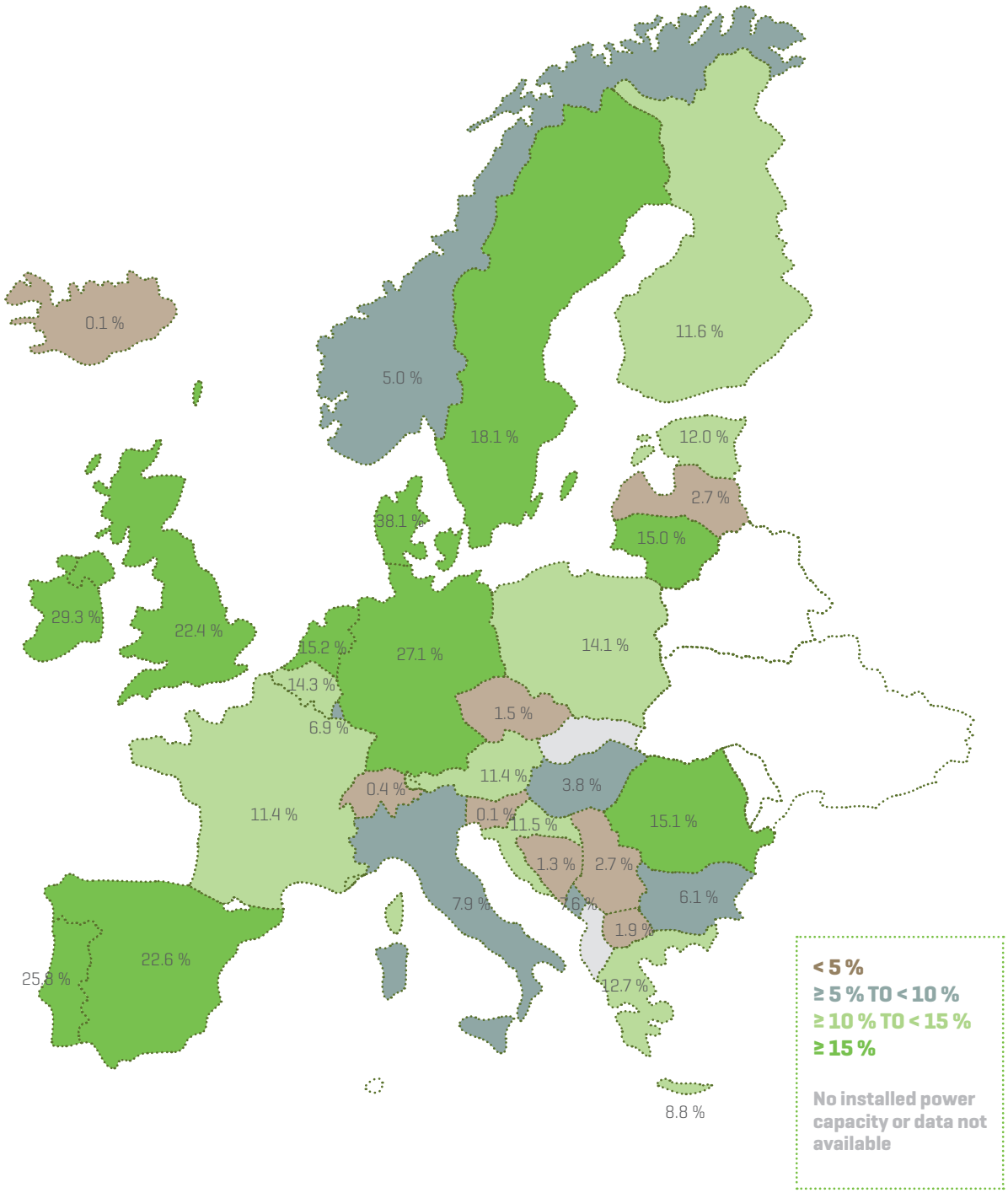


Monotonous curve [1] of the share of wind energy generation in demand coverage Spanish peninsular electricity system [%]



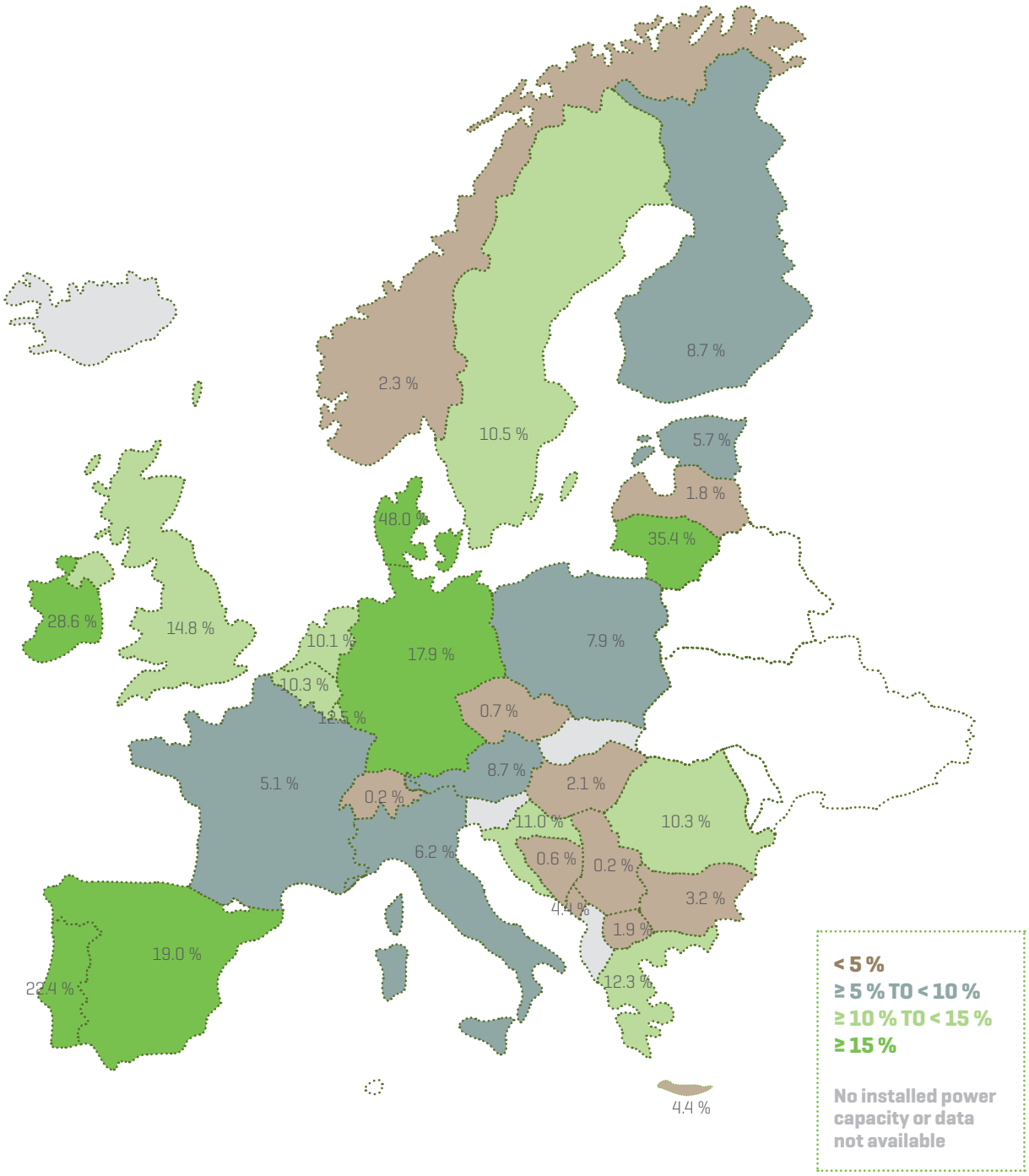
[1] Representation of the share of wind energy generation in demand coverage throughout the whole of the year divided in hourly periods and sorted by its greater to lesser share in the generation mix

Installed wind power capacity in relation to total power capacity in ENTSO-E member countries as at 31.12.2018 [%]



Source: ENTSO-E Data portal 20/05/2019. Great Britain includes data for Northern Ireland.

Share of wind generation over total generation within ENTSO-E in 2018 [%]



Source: ENTSO-E Data portal 20/05/2019. Great Britain includes data for Northern Ireland.

3

ENERGY FROM WATER

Hydroelectric power generation is 1.8 times higher than last year due to higher rainfall levels.

34,106
GWh
HYDROELECTRIC POWER GENERATION IN SPAIN

13.1 %
OF THE TOTAL NATIONAL PRODUCTION

17,049 MW

INSTALLED HYDROPOWER CAPACITY

16.4 %

OF OVERALL INSTALLED POWER CAPACITY NATIONWIDE

+85 %

HYDROELECTRIC POWER GENERATED COMPARED TO 2017

34 %

OF THE TOTAL RENEWABLE ENERGY GENERATED NATIONWIDE

Traditionally, hydroelectric power has been the main renewable source in Spain, until in 2009 when it was surpassed by wind power. Since then, it has clearly remained the second renewable source in terms of installed power capacity, with a total of 17,049 MW by the end of 2018 (not taking into account pure pumping capacity). Regarding the total installed national power (renewable and non-renewable), hydroelectric power represents 16.4 %, making it the third most important technology behind combined cycle and wind power.

Hydroelectric generation in Spain is highly variable, reaching 40,000 GWh in wet years, with that volume dropping by half in dry years. 2018 was a wet year, with production at 34,106 GWh, 85 % higher than 2017. This means that water power contributed 13.1 % to the total national production, ranking fourth among the generation technologies.

Regarding renewable energy as a whole, hydroelectric ranked second behind wind power with 34 % of the total renewable energy generated nationwide.

Historically, the final months of winter and the early months of spring are the periods with the greatest water contribution, mainly due to thawing and also to the higher rainfall in those months.

In 2018, April was the month with the highest hydroelectric generation, with just over 4,700 GWh (74.7 % higher than the maximum value of the previous year, which was the lowest maximum since January 2013). April is also the month with the greatest contribution of this technology to production as a whole, reaching almost 23 % of the total generation for that month.

One of the main advantages of this technology compared to the rest of renewable sources is its management, which becomes evident when observing the average daily curve of the share of hydroelectric out of the total generation, which demonstrates how the largest share of this technology coincides with demand peaks in the morning and evening.

In terms of hydroelectric reserves, 2018 ended with reserves slightly below the average, despite being a wet year in hydrological terms.

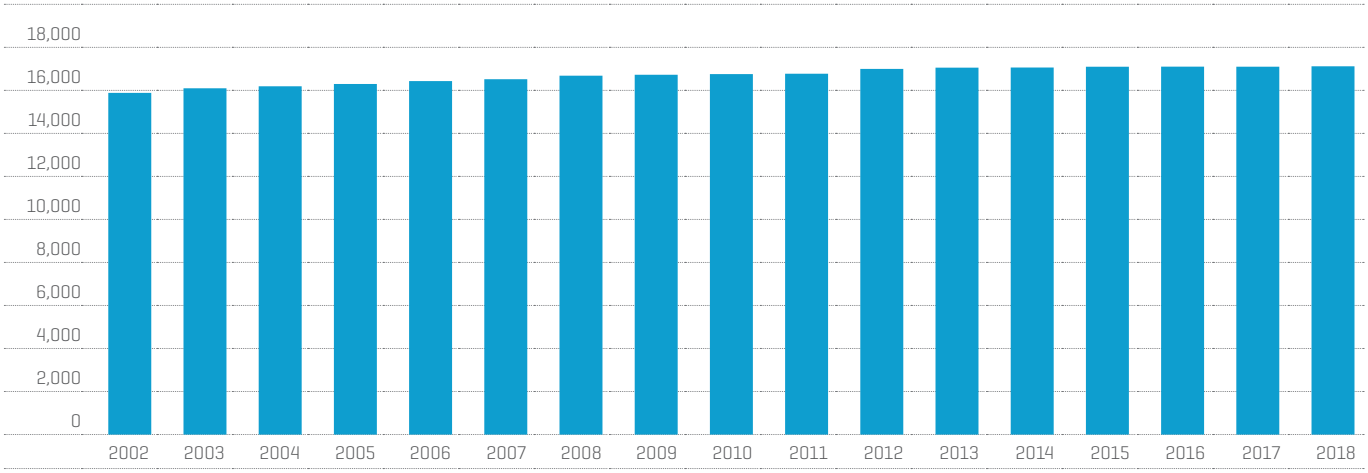
The reserves were above the statistical average in the middle six months of the year and below the statistical minimum during the first and last three months of the year, dropping below the statistical minimum in January. 2018 ended with a fill percentage of 44.1 %, which is almost 18 percentage points higher than at the end of 2017.

In 2018, the producible hydroelectric index reached a value of 1.28, much higher than the 0.53 of the previous year, which was the second lowest, after the value of 0.43 recorded in 1949.

By autonomous community, Castilla y León is the autonomous community with the most installed hydroelectric power (almost 26 % of the national total) because it contains the peninsula's second most important river basin the Duero, in its entirety. On the other hand, the Northern basin, the most important one that runs along the Cantabrian coast and a large part of Galicia, places the latter autonomous community in second position in terms of hydroelectric capacity, with almost 22 % of the total. Consequently, five autonomous communities account for 80 % of the total installed power capacity including, in addition to the ones mentioned above, Extremadura, Catalonia and Aragon.

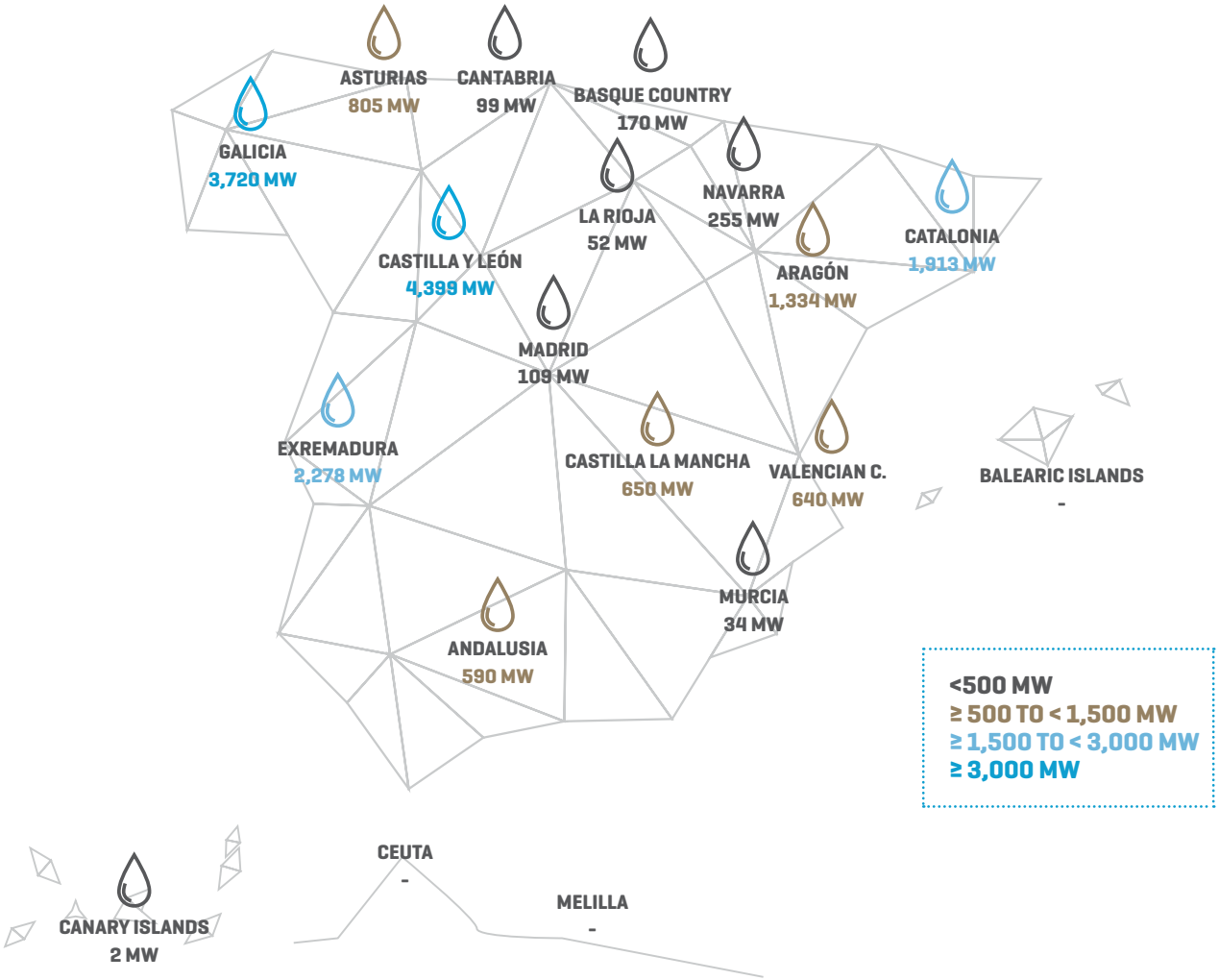
In comparison to the rest of European countries, in 2018 Spain was seventh in terms of energy generated with this technology. However, it is in the bottom half, in nineteenth position, in terms of the share of hydroelectric in comparison with total generation.

Installed hydropower capacity. National electricity system [MW]

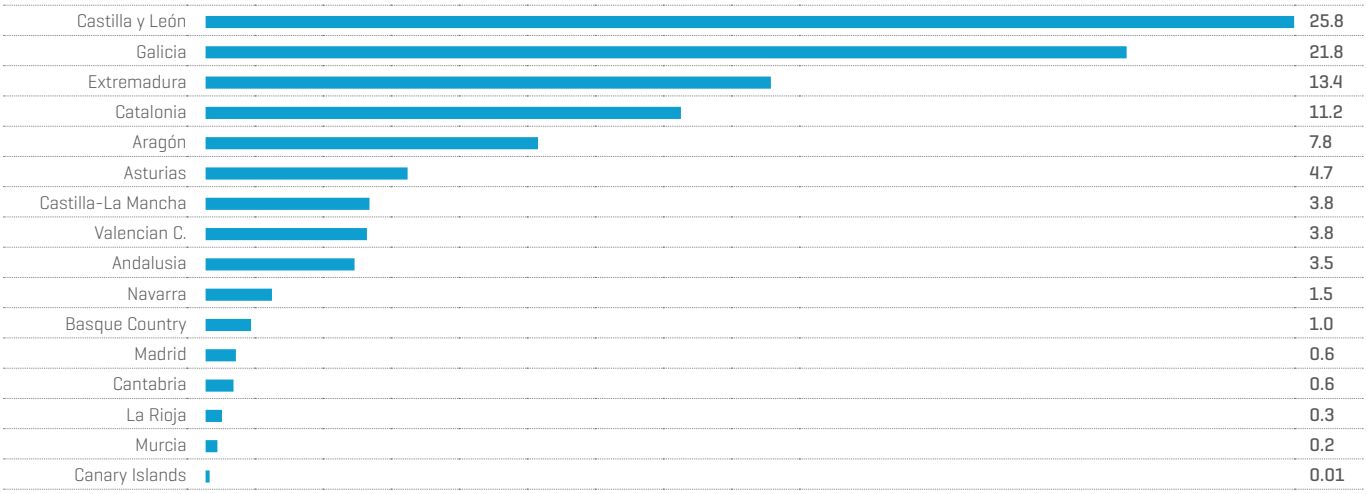


Source: Data National Commission of the Markets and the Competition (CNMC) until 2014 in non-HMU hydroelectric

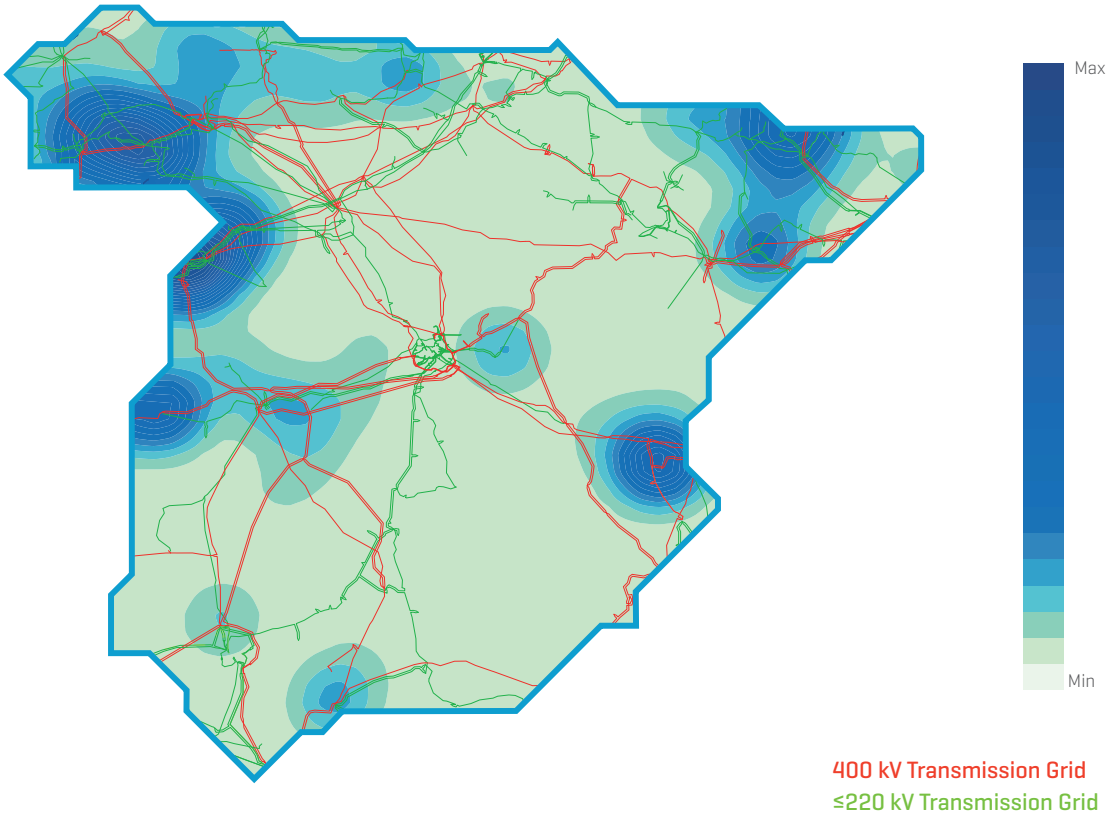
Installed hydropower capacity as at 31.12.2018. National electricity system per autonomous community



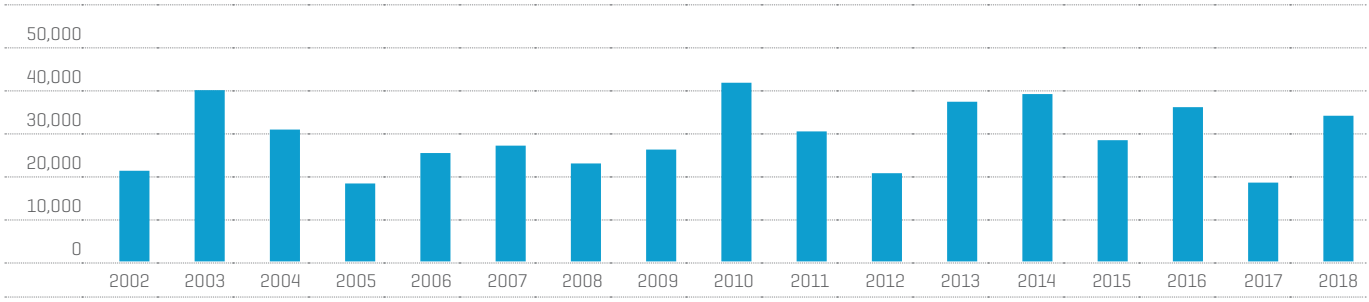
Share of installed hydropower capacity per autonomous community [%]



Geographical distribution of hydroelectric power stations on the peninsula as at 31.12.2018

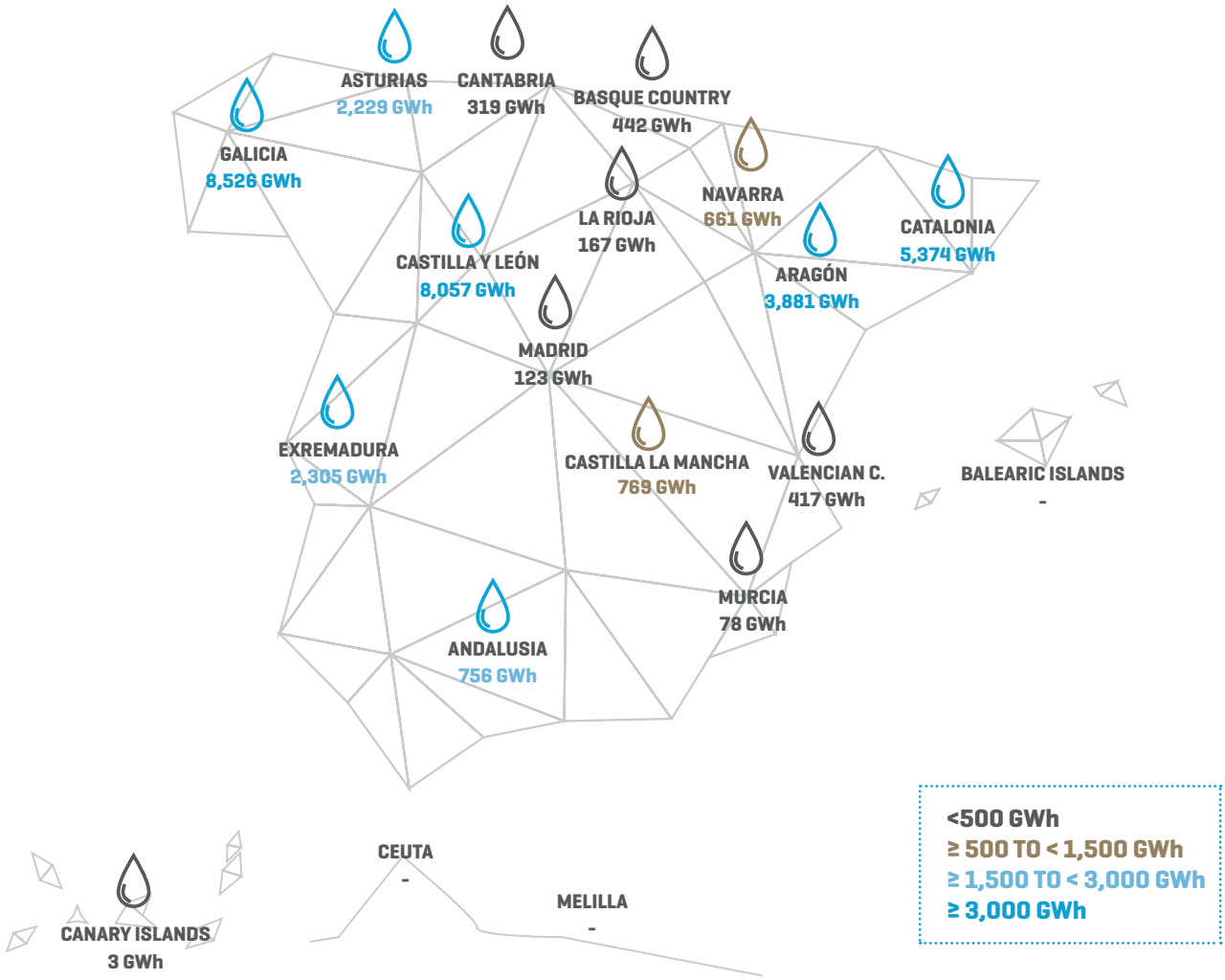


Hydroelectric power generation. National electricity system (GWh)

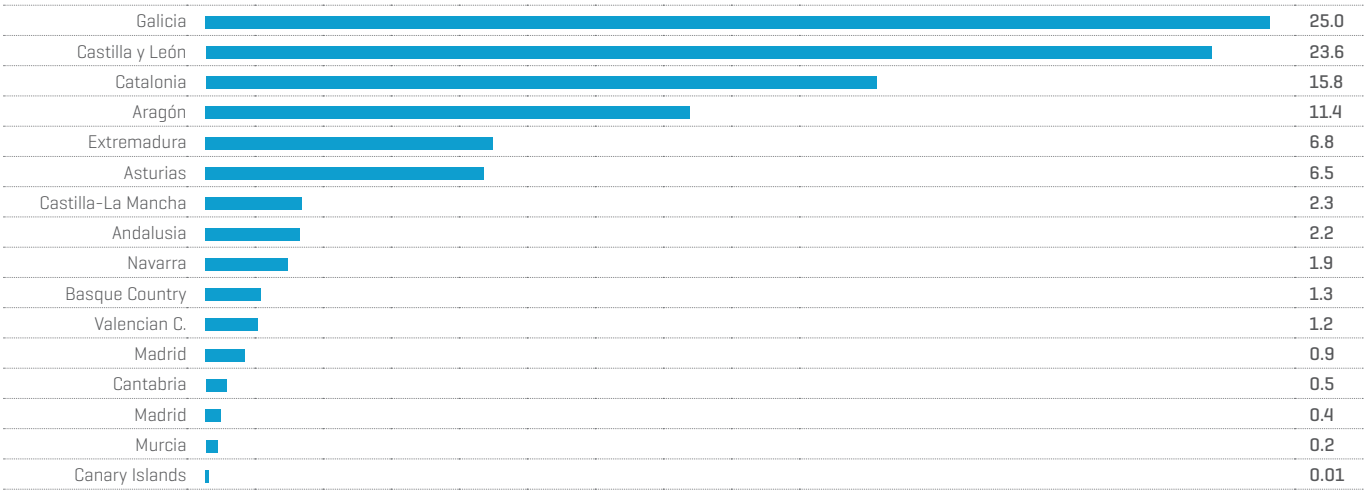


Data from the Canary Islands available since 2006.

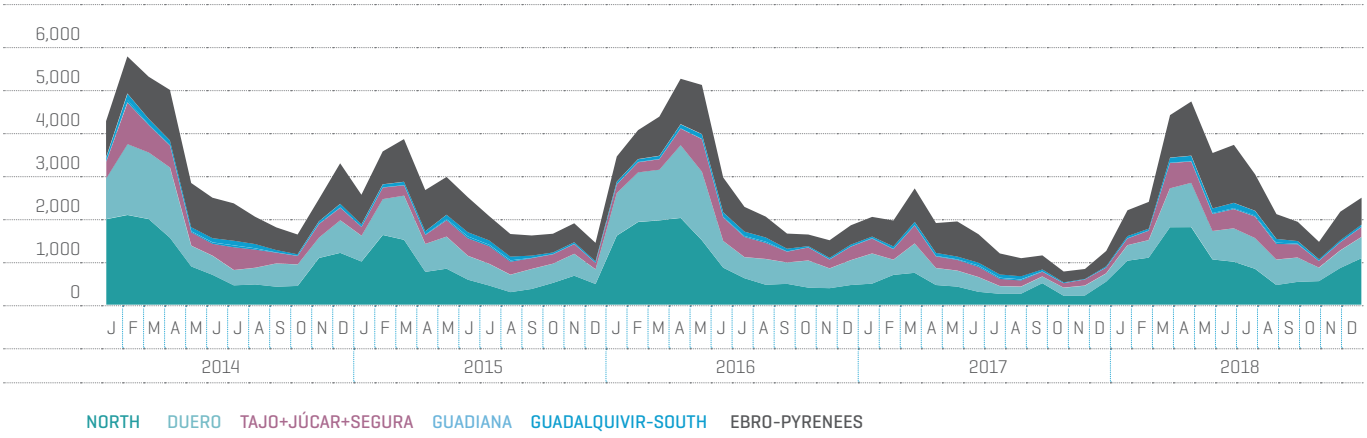
Hydroelectric power generation as at 2018. National electricity system per autonomous community



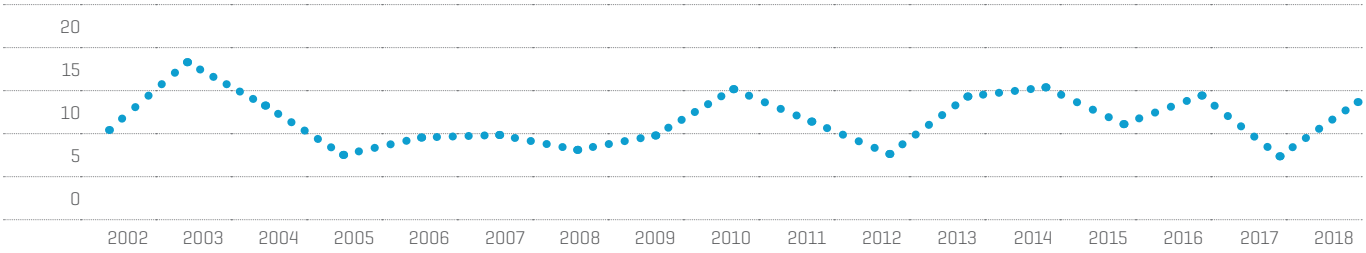
Hydroelectric power generation of each autonomous community over total national hydroelectric generation (%)



Hydroelectric power generation by hydrographic basin. Peninsular electricity system (GWh)

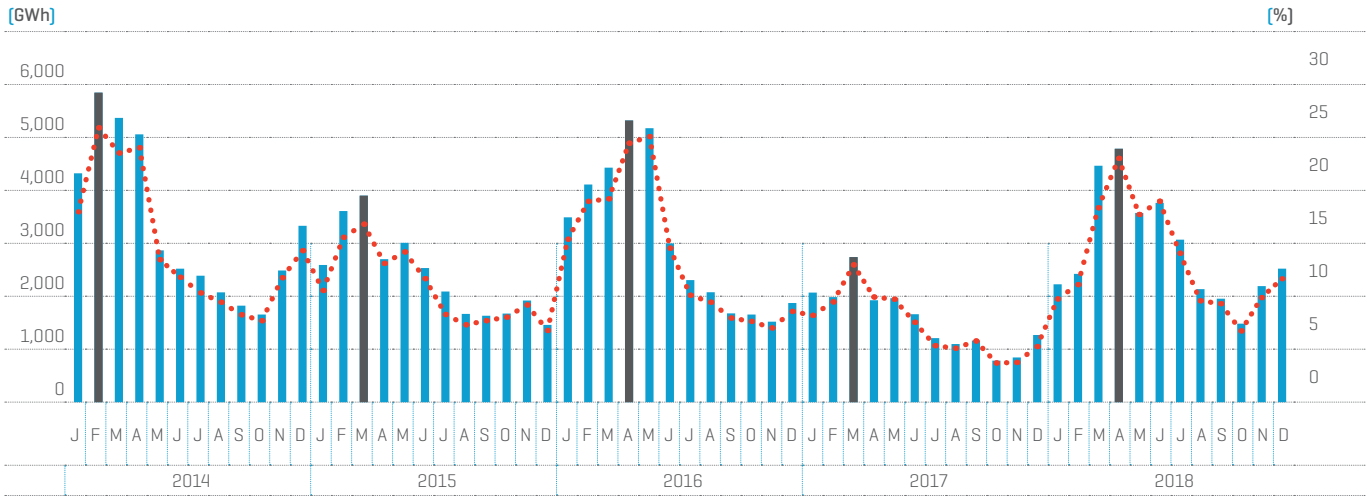


Share of hydro in the total generation mix. National electricity system (%)



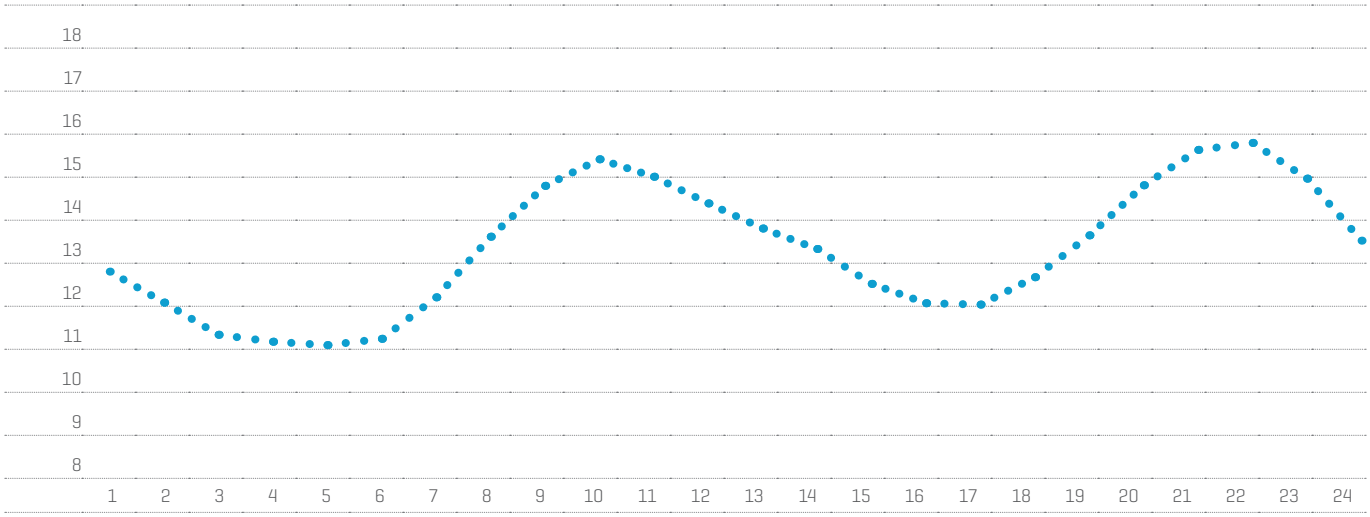
Data from the Canary Islands available since 2006.

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

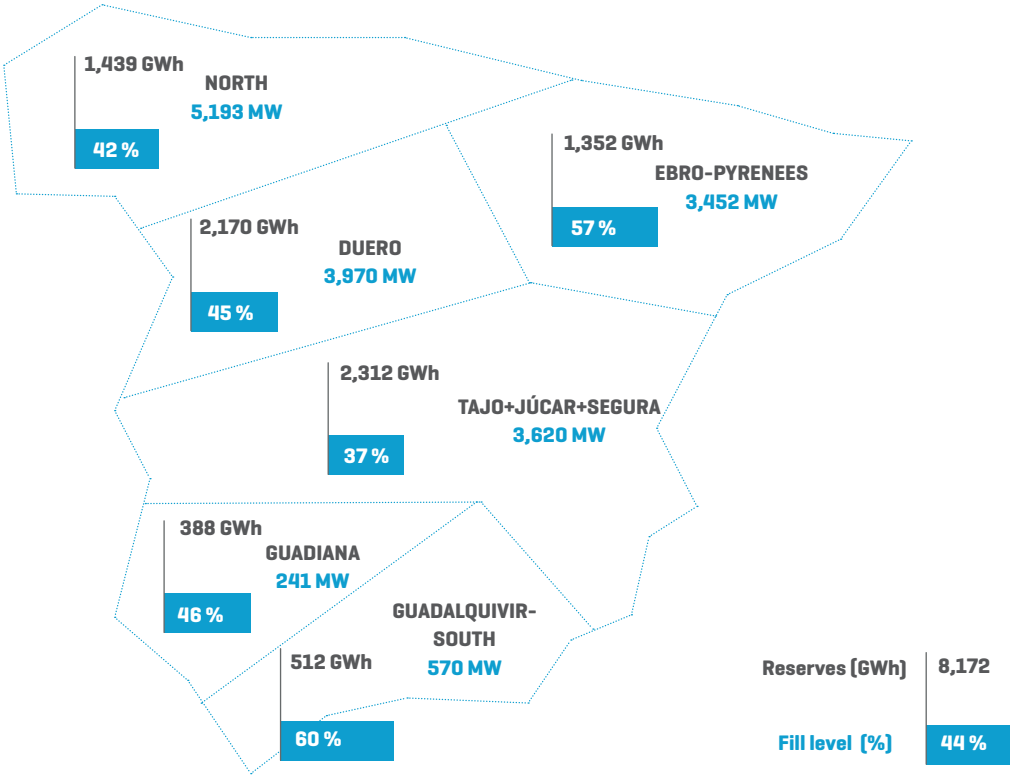


HYDROELECTRIC GENERATION (GWh) MONTHLY MAXIMUM HYDROELECTRIC (GWh) HYDROELECTRIC GENERATION/TOTAL GENERATION (%)
Data from the Canary Islands available since 2006.

Average hourly share of hydropower in total generation in 2018 (%) Peninsular electricity system



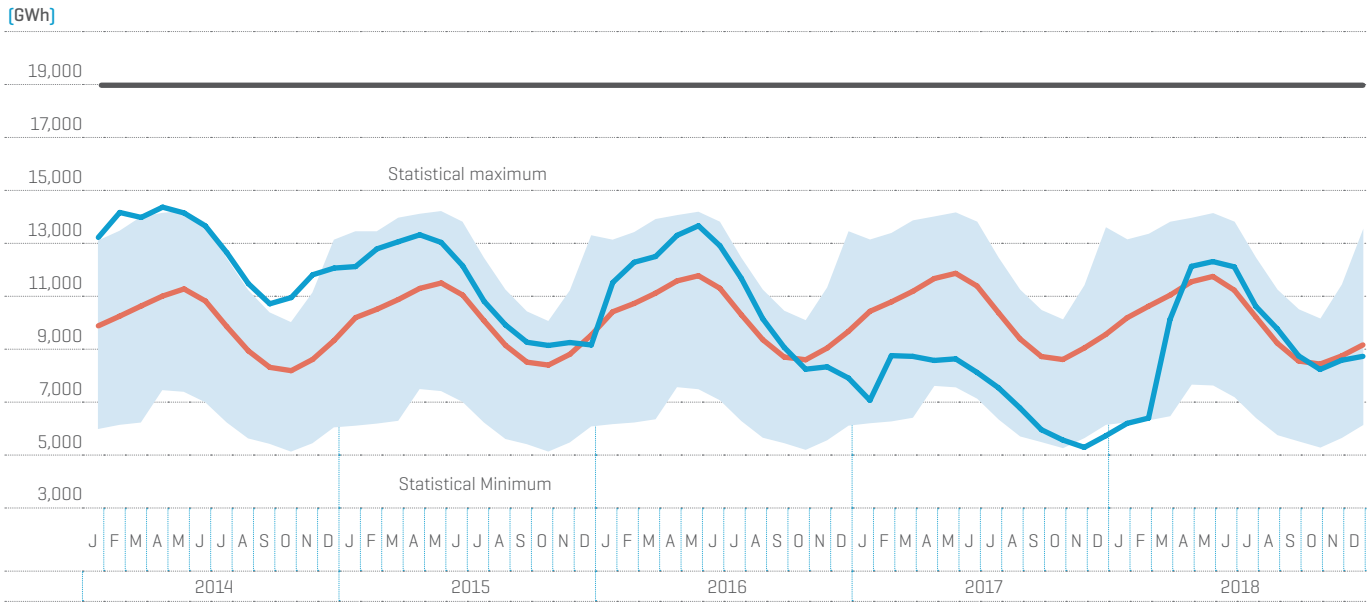
Installed hydropower capacity and hydroelectric reserves by hydrographic basin as at 31 december (GWh and %)



Extreme values of peninsular hydroelectric reserves

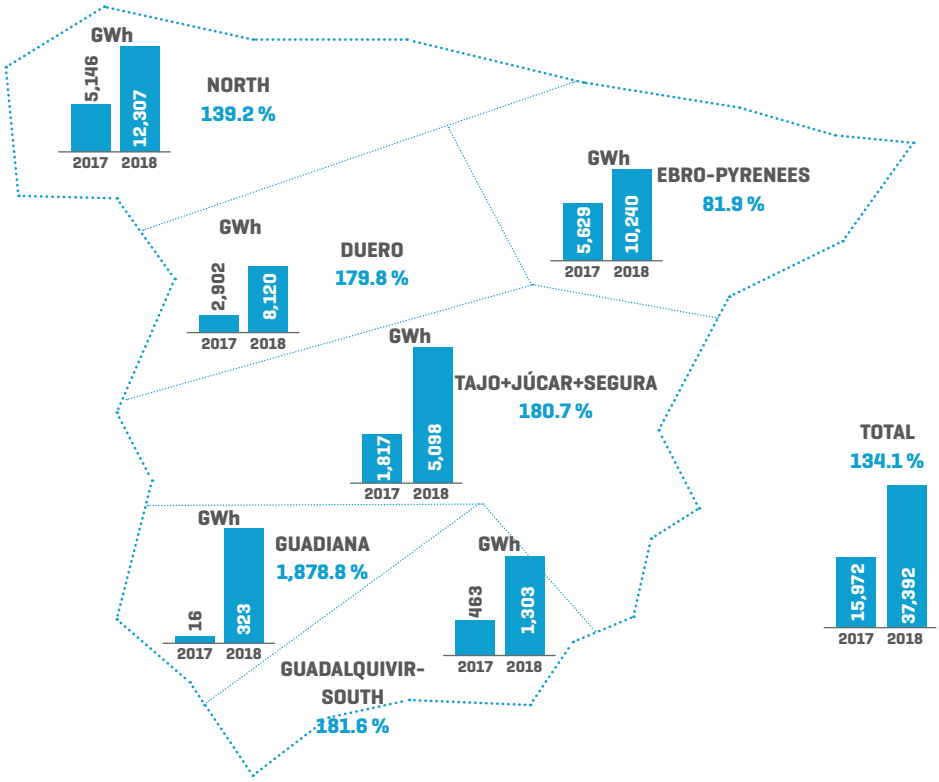
		2018			Historical Values	
		GWh	Date	%	Date	%
Max.	Annual	7,347	14-June	81.9	May 1969	92.0
	Hyperannual	5,076	18-June	53.0	April 1979	91.1
	All	**12,416**	**14-June**	**67.0**	**April 1979**	**86.6**
Min.	Annual	2,655	1-Jan.	29.6	December 2017	24.1
	Hyperannual	2,123	9-Feb.	22.2	November 1983	17.6
	All	**4,950**	**1-Jan.**	**26.7**	**December 2017**	**23.0**

Total hydroelectric reserves. Peninsular electricity system

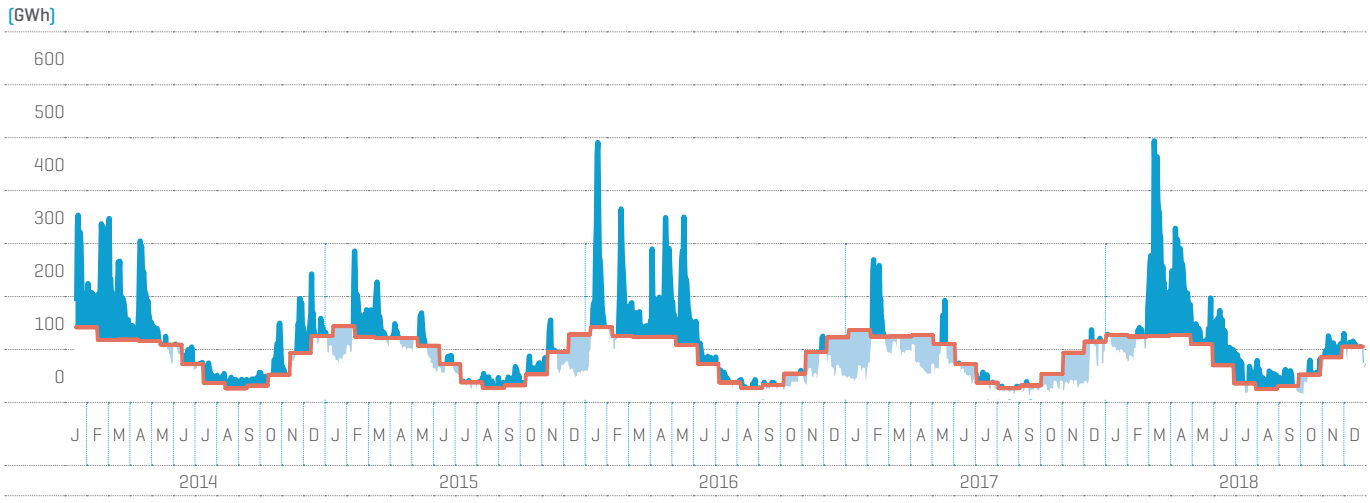


Statistical maximum and minimum: average of the maximum and minimum values of the last 20 years.

Producible hydroelectric power by hydrographic basin and annual variation

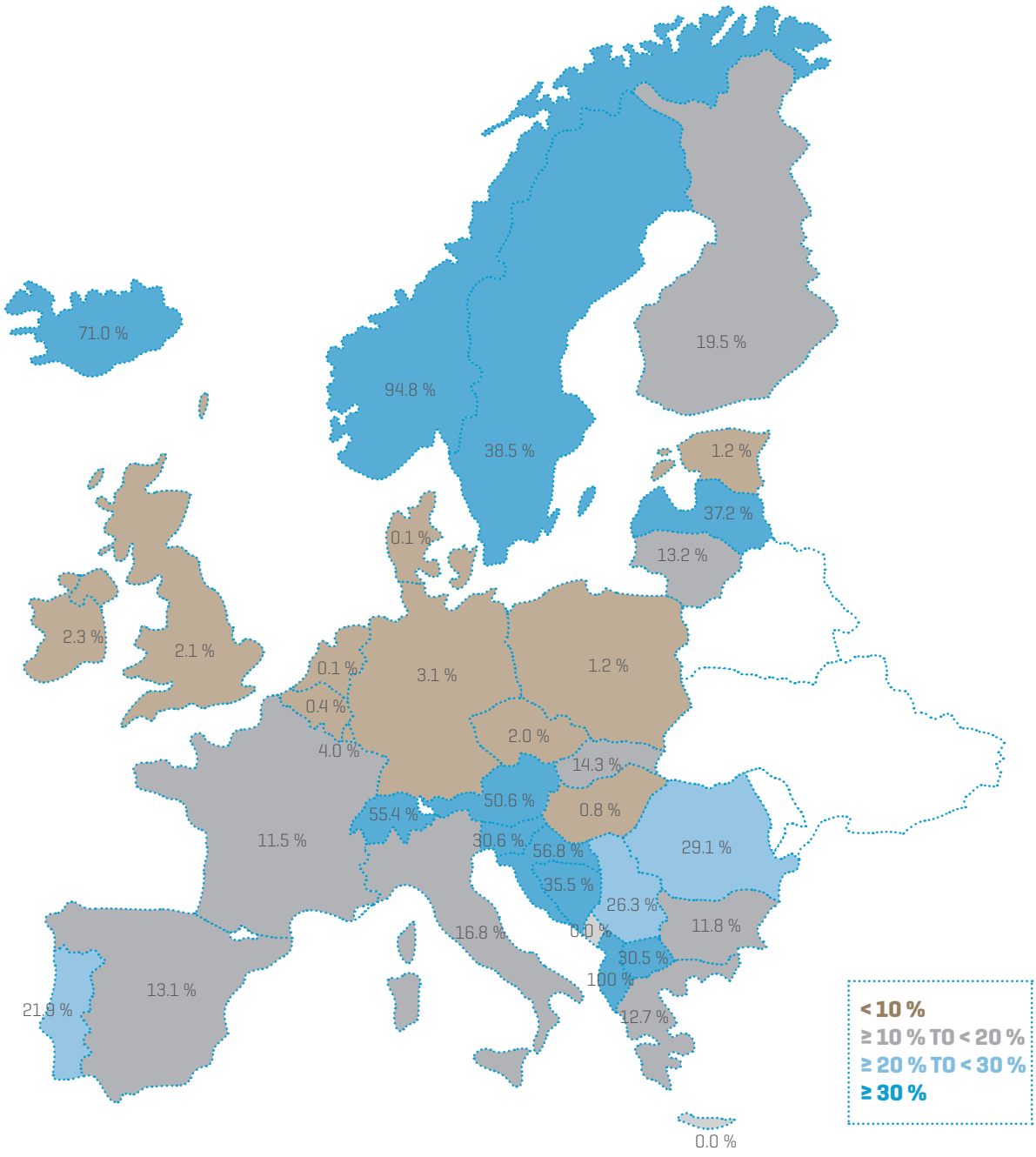


Daily producible hydroelectric energy compared with the historical average producible. Peninsular electricity system



WET DRY HISTORICAL AVERAGE PRODUCIBLE

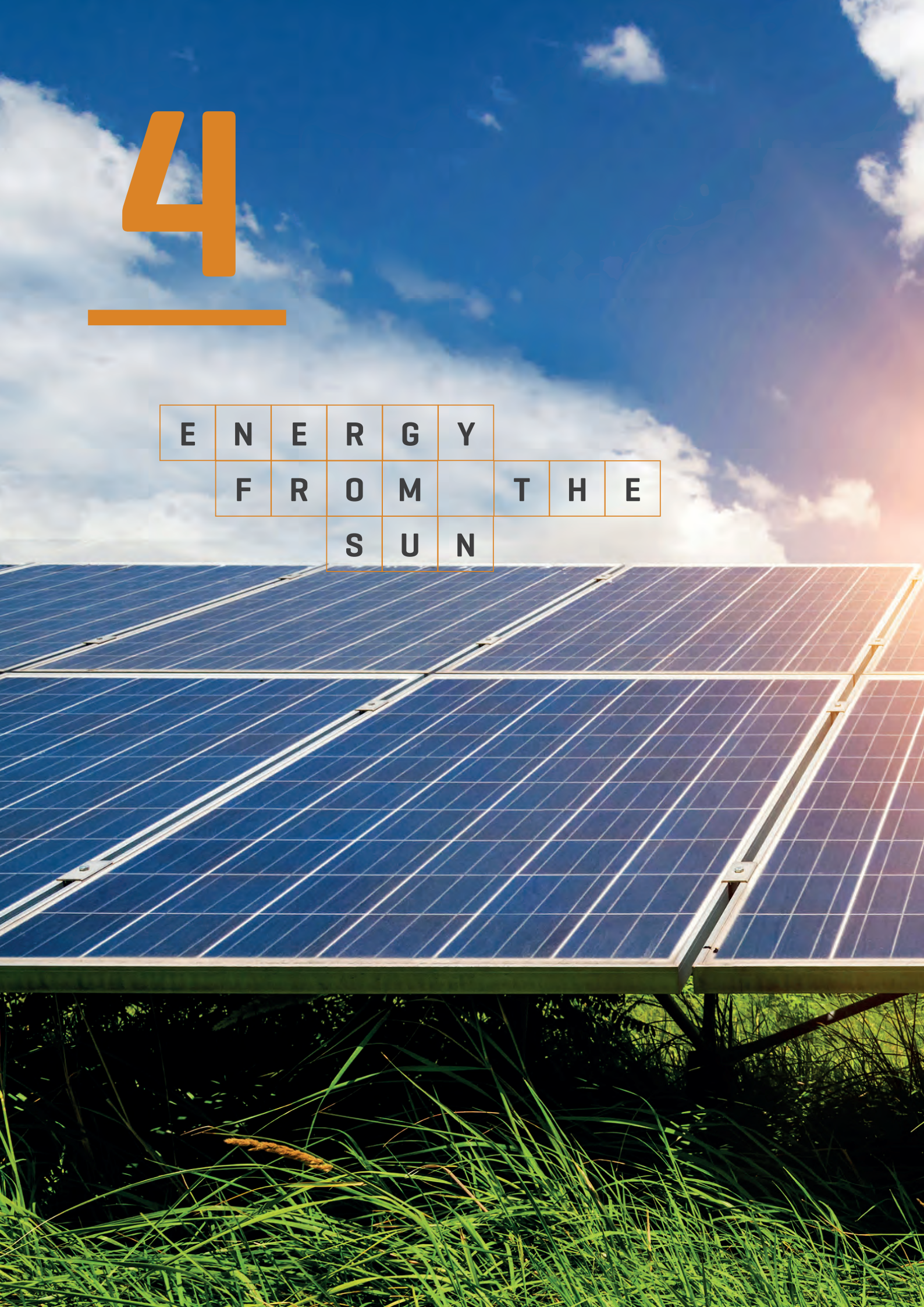
Share of hydraulic generation over total generation within ENTSO-E in 2018 [%]

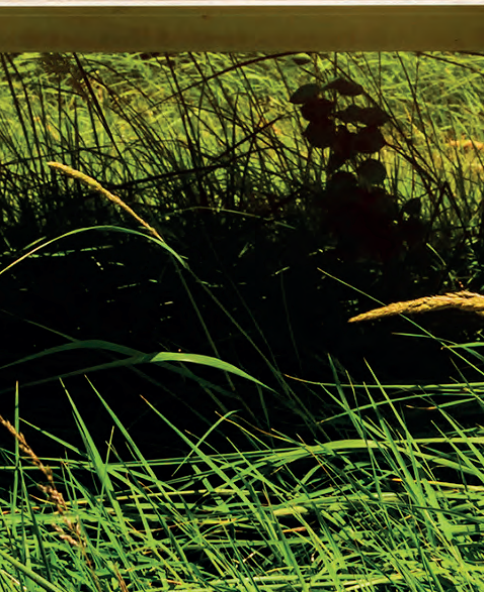


Source: ENTSO-E Data portal 20/05/2019. Great Britain includes data for Northern Ireland.

4

ENERGY FROM THE SUN





Solar energy is the third renewable source of electricity generation in Spain with 7,018 MW of installed power capacity and 12,183 GWh of generation in 2018.

6.7 %
OF OVERALL INSTALLED POWER CAPACITY NATIONWIDE

4.7 %
OF THE TOTAL ENERGY GENERATED IN SPAIN

12.1 %

SOLAR GENERATION WITH RESPECT TO THE TOTAL RENEWABLE ENERGIES

At the end of 2018, the installed power capacity of solar energy was 7,018 MW (4,714 MW corresponding to solar photovoltaic and 2,304 MW to solar thermal), which represents approximately 7 % of the total installed power capacity in Spain.

As is the case with wind, solar power has stabilised over the last five years after a long period of sustained growth.

The largest increases in photovoltaic power were recorded in 2007 and 2008, with the latter marking a record 2,733 new MW. This growth continued until 2013 with an average of more than 250 MW installed each year, and since then, it has remained relatively unchanged.

As for solar thermal, after the significant increase in 2012 with almost 1 GW of installed power capacity, power has remained stable since 2014, with a recorded value of 2,304 MW at the end of 2018.

Solar generation in Spain, as in the case of power, has slowed in recent years, dropping slightly in 2016 and, significantly, this last year. In 2018, 12,183 GWh were generated, down 11.4 % from the previous year and the lowest value since 2012 (11,650 GWh). This production represents 4.7 % of the total annual generation, 3 % for the photovoltaic and the remaining 1.7 % for the solar thermal.

The month of July is the month with the highest production for both technologies. In 2018, the maximum monthly production with photovoltaic was recorded in July, 1.9 % higher than the previous year, and the highest value of the previous three years. Seasonality is an important factor in this technology and greatly affects production over the course of the year; this means that from May to August, generation presents fairly similar values, but drops to almost half in the months of November to February.

The case was similar with solar thermal: July was also the month with the greatest generation, surpassing the 5.7 % recorded in 2017 with the highest value since 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.

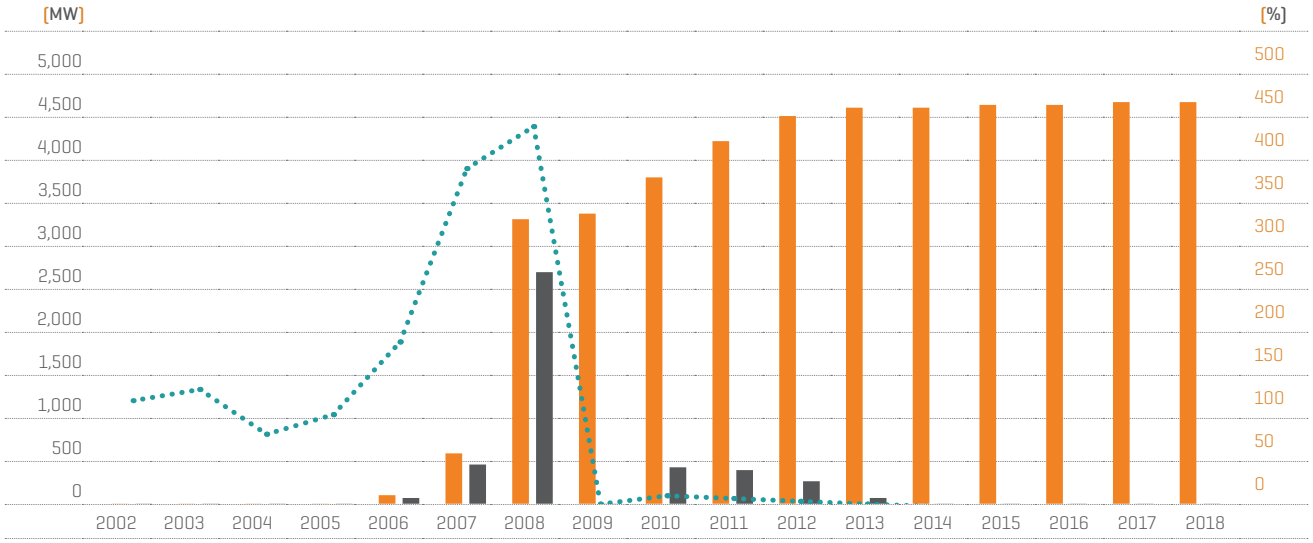
The distribution of the two solar technologies by autonomous community is very different. Castilla-La Mancha is the region with the greatest level of installed solar photovoltaic power capacity, with almost 20 % of all of the national power, followed very closely by Andalusia and somewhat further behind by Extremadura and Castilla y León. These four autonomous communities alone account for 61 % of the photovoltaic power installed in Spain. On the other hand, 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 fifth regarding installed solar power capacity, far behind Germany which is the undisputed leader with over 44 GW of installed capacity.

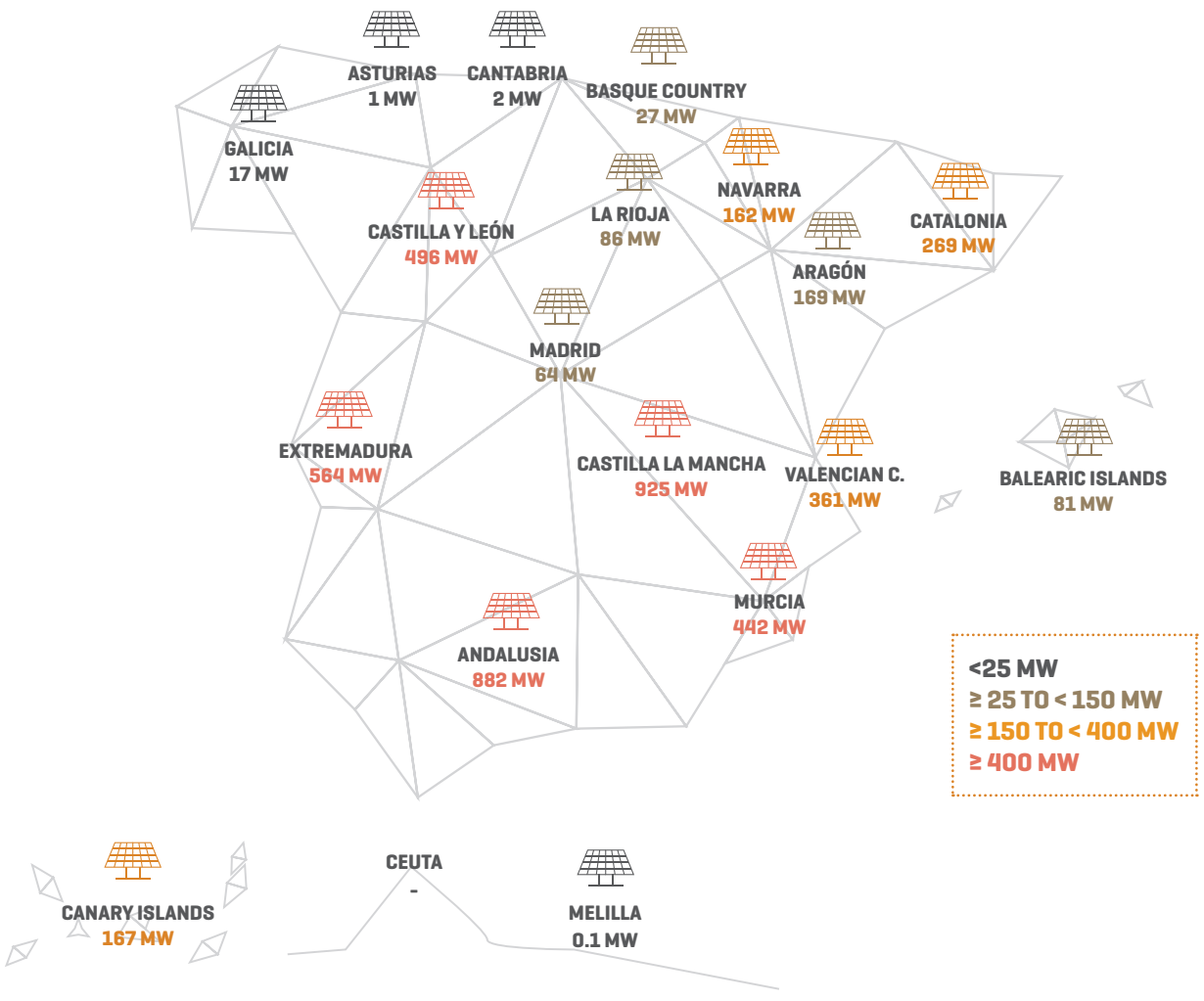
However, if the weight of this technology in the total installed power capacity were measured in each country, Spain would fall several positions to thirteenth place. Nevertheless, this year Spain is ranked third in production and fifth in the ranking of the contribution of solar energy to the total generation of each country, behind Italy, Greece, Germany and Belgium. If the ratio of generation to installed power capacity were compared, Spain would be in second place, after Estonia and trailed by Portugal.

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

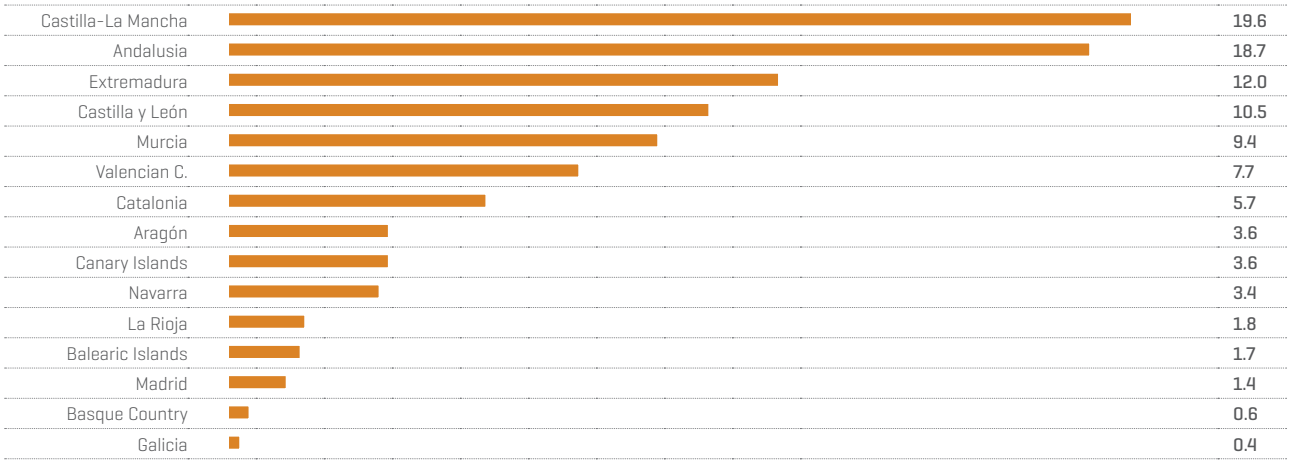


Source: National Commission of Markets and Competition (CNMC) until 2014. Data for Balearic Islands and Canary Islands available since 2006 and Melilla since 2007.

Installed solar photovoltaic (PV) power capacity as at 31.12.2018. National electricity system per autonomous community (MW)

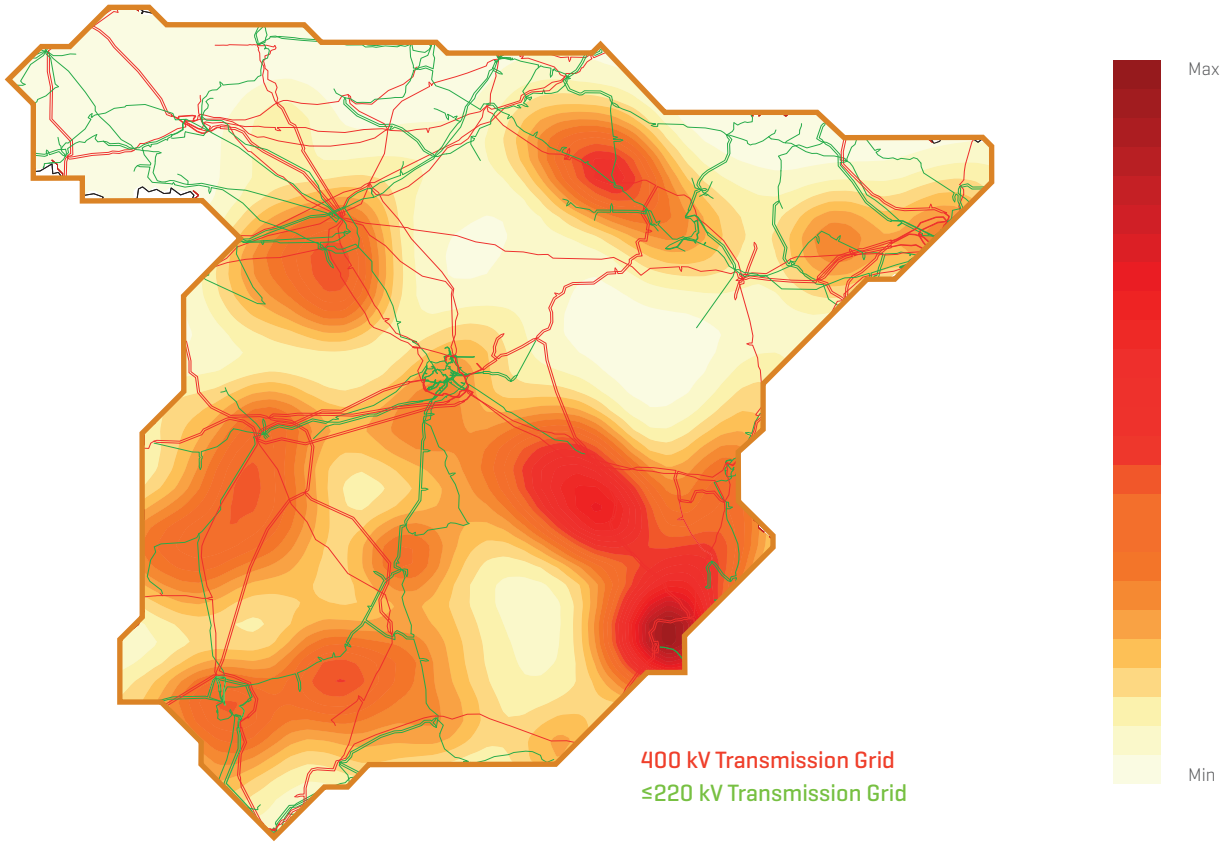


Share of solar PV power capacity per autonomous community in relation to the national total as at 31.12.2018 [%]

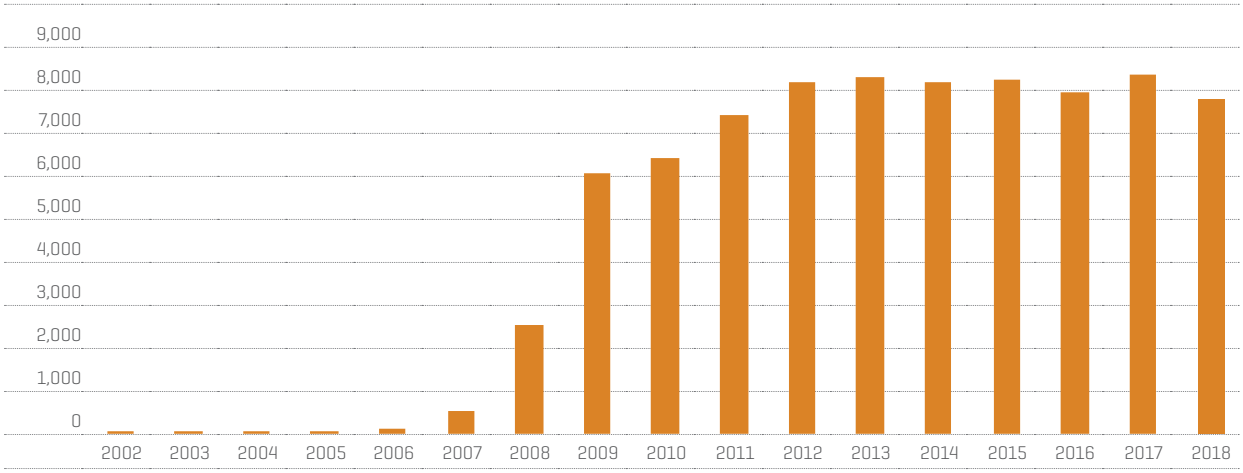


Does not include Cantabria, Asturias and Melilla, because their share in this technology is very small and negligible for the purposes of the graph.

Geographical distribution of solar photovoltaic facilities on the peninsula as at 31.12.2018

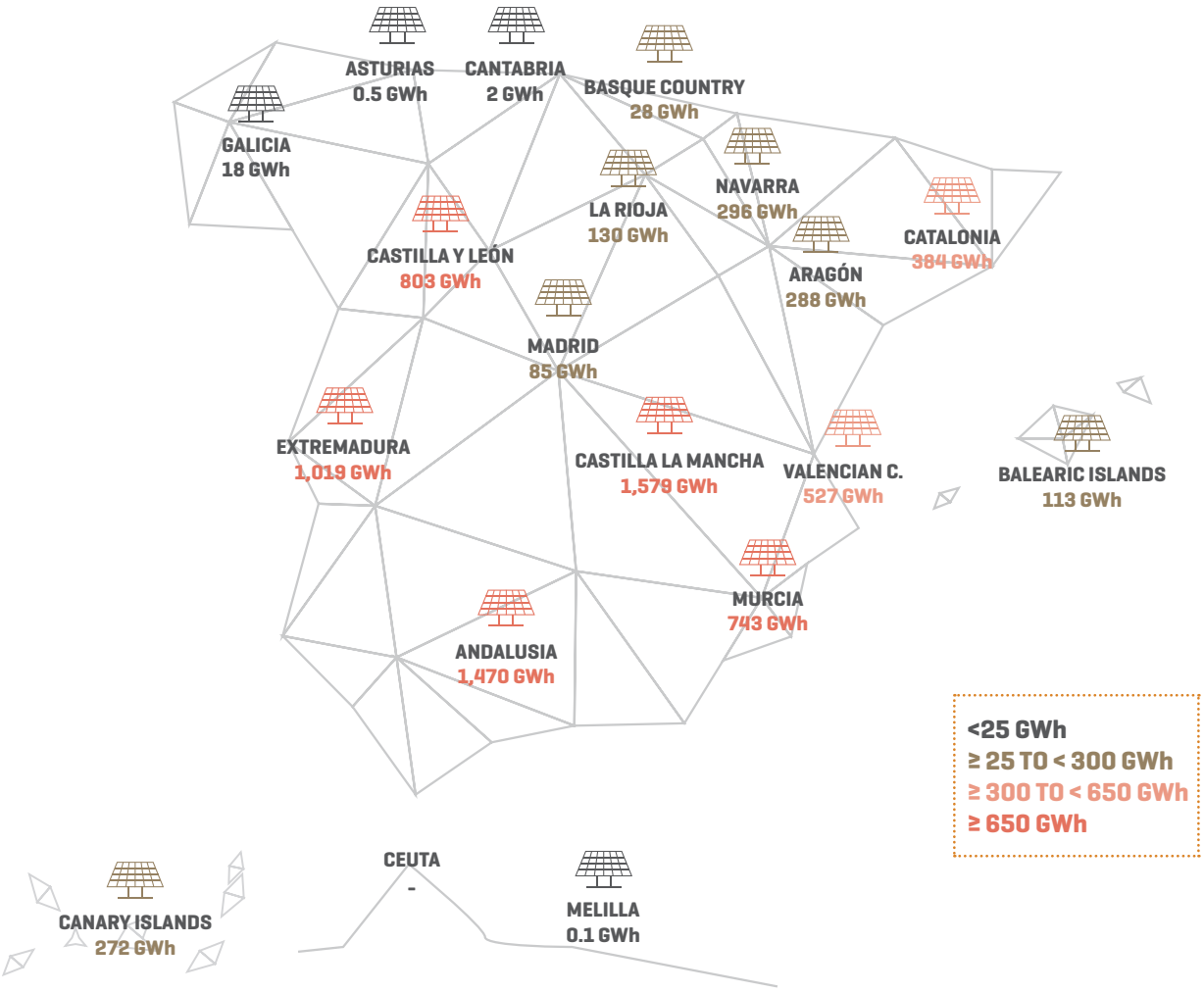


Solar PV energy generation. National electricity system (GWh)

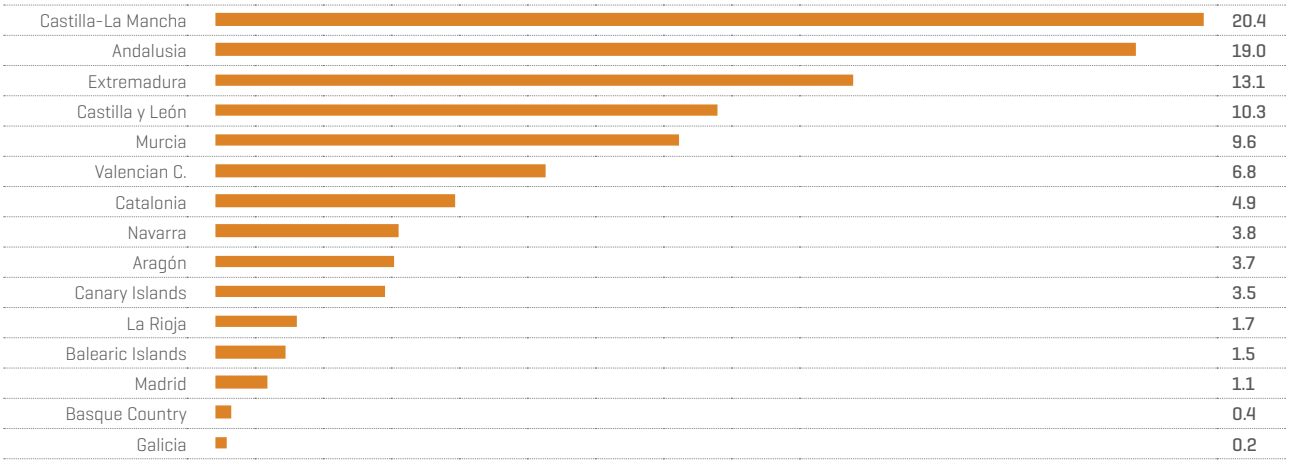


Data for Balearic Islands and Canary Islands available since 2006 and Melilla since 2007.

Solar PV energy generation in 2018. National electricity system per autonomous community (GWh)

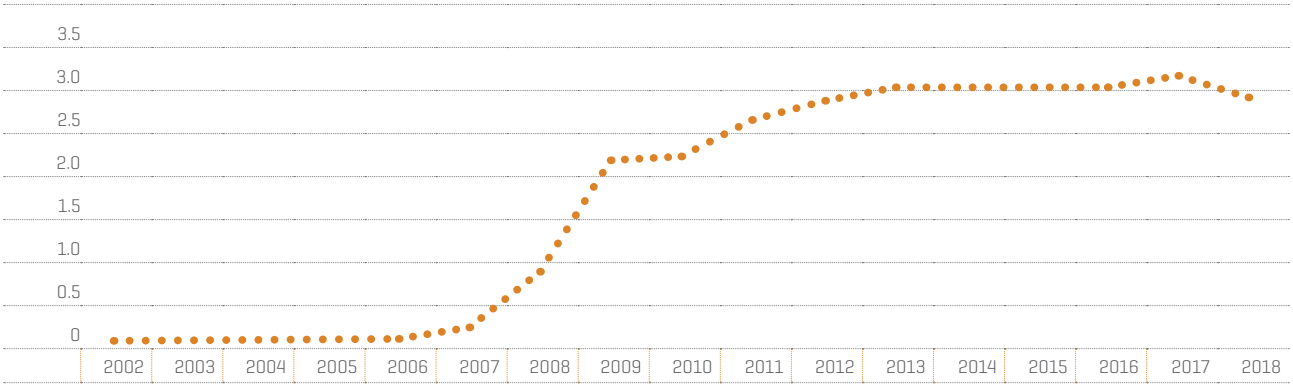


Share of solar PV energy generation per autonomous community in relation to the national total (%)



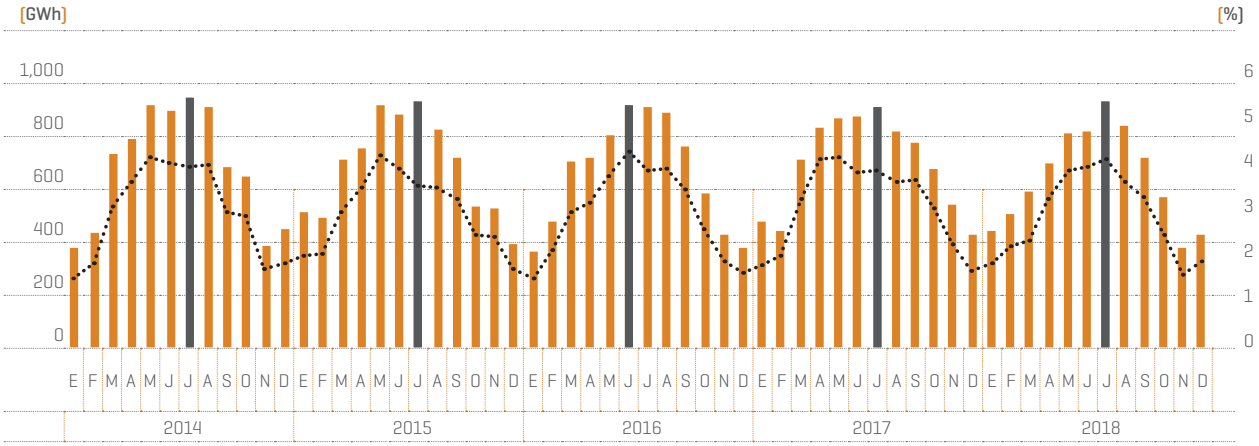
Does not include Cantabria, Asturias and Melilla, because their share in this technology is very small and negligible for the purposes of the graph.

Share of solar PV energy generation in the total generation mix. National electricity system (%)



Data for Balearic Islands and Canary Islands available since 2006 and Ceuta and Melilla since 2007.

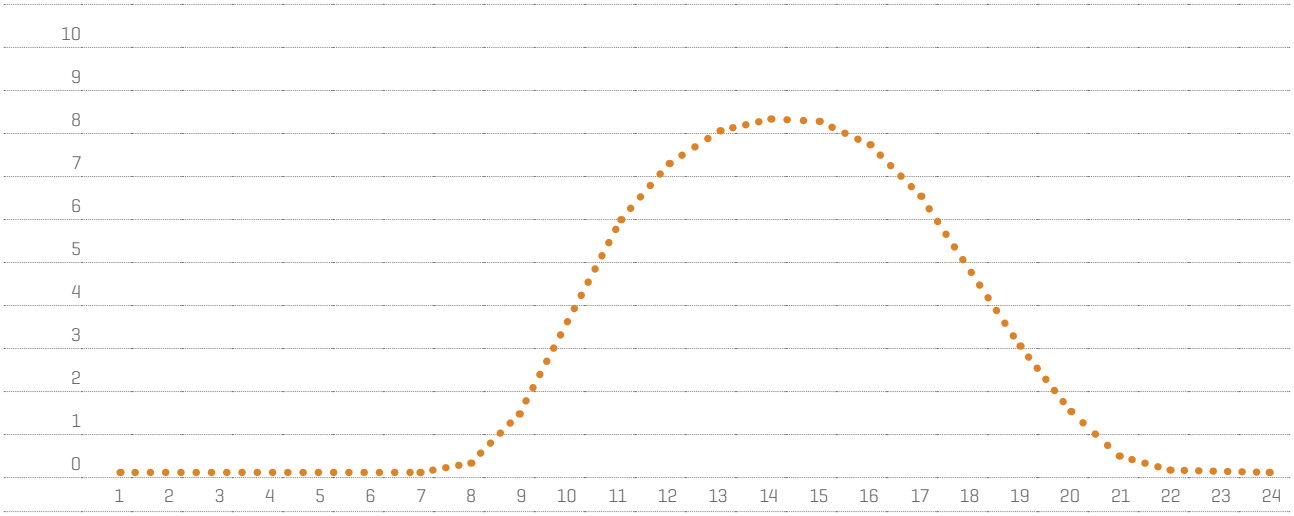
Solar PV energy generation, monthly maximum values and share in the total generation mix. National electricity system



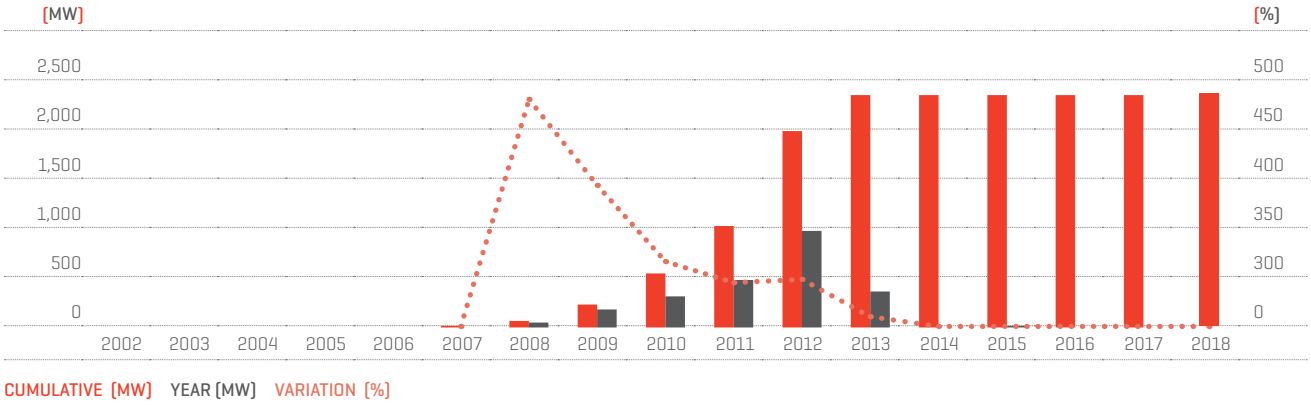
SOLAR PHOTOVOLTAIC GENERATION (GWh) MONTHLY MAXIMUM (GWh) SOLAR PHOTOVOLTAIC GENERATION / TOTAL GENERATION (%)

Data for Balearic Islands and Canary Islands available since 2006 and Ceuta and Melilla since 2007.

Average hourly share of solar PV in total generation in 2018 (%) Peninsular electricity system (%)

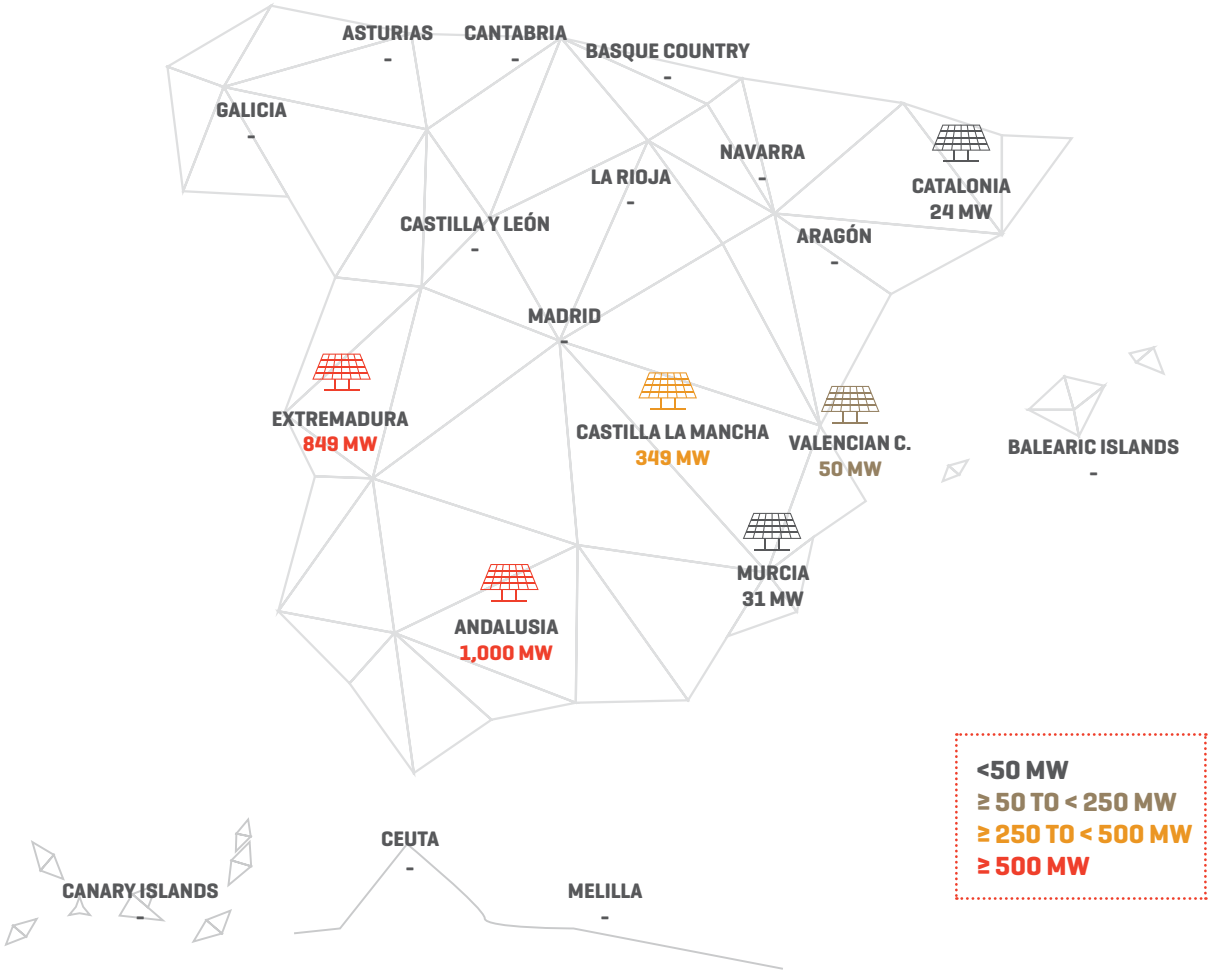


Installed solar thermal power capacity. National electricity system

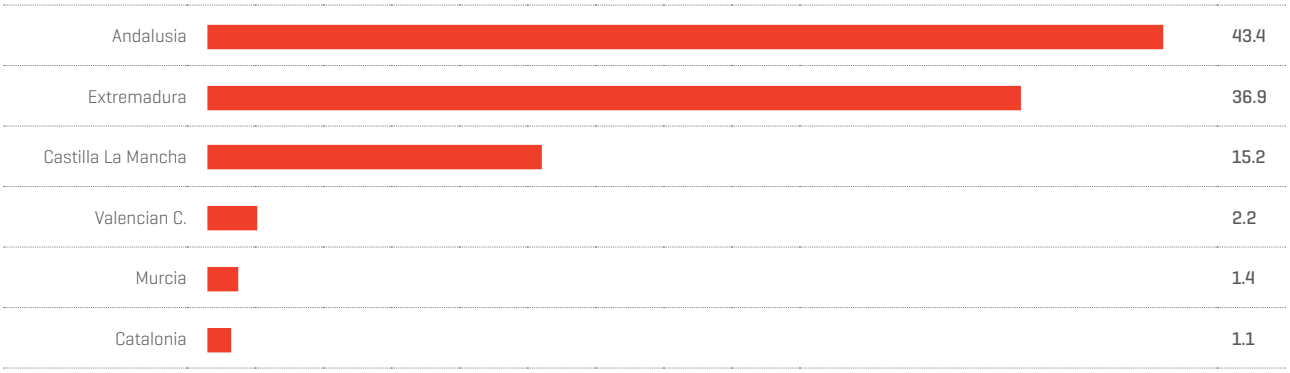


Source: National Commission of Markets and Competition (CNMC) until 2014.

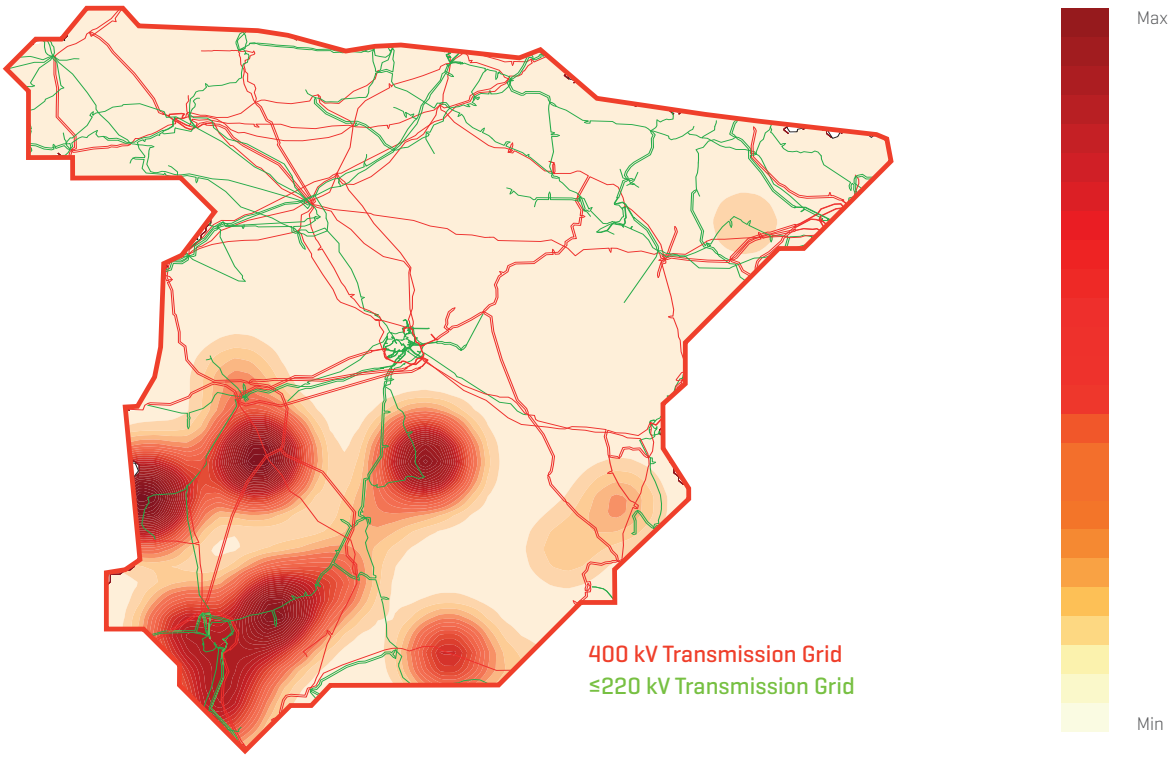
Installed solar thermal power capacity as at 31.12.2018. National electricity system per autonomous community [MW]



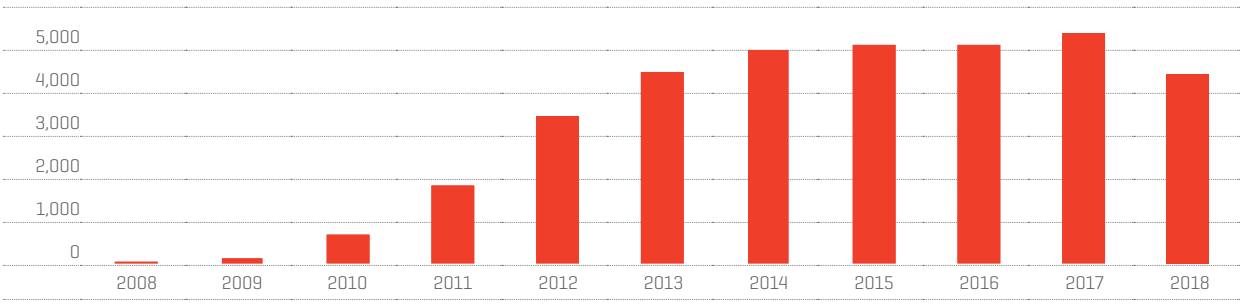
Share of solar thermal power capacity per autonomous community in relation to the national total [%]



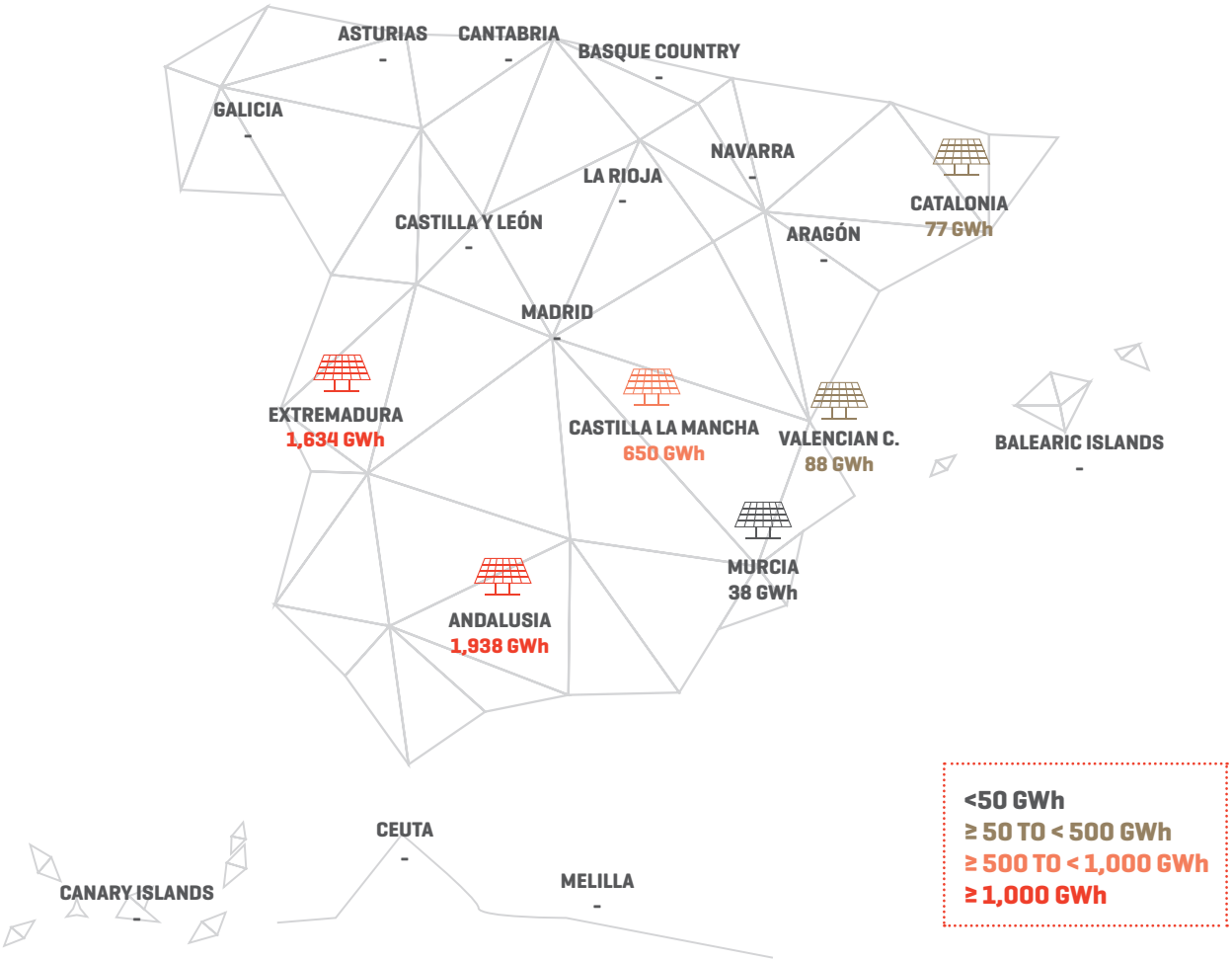
Geographical distribution of solar thermal facilities on the peninsula as at 31.12.2018



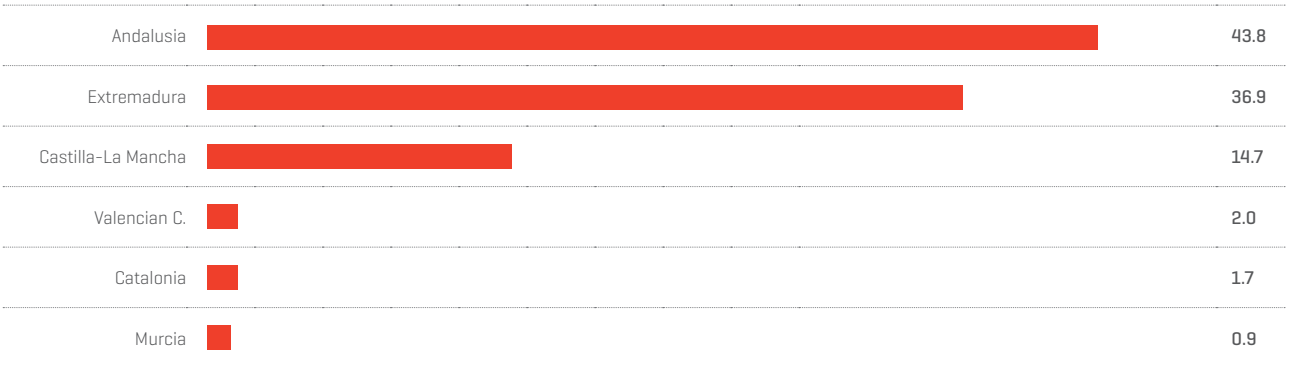
Solar thermal energy generation. National electricity system [GWh]



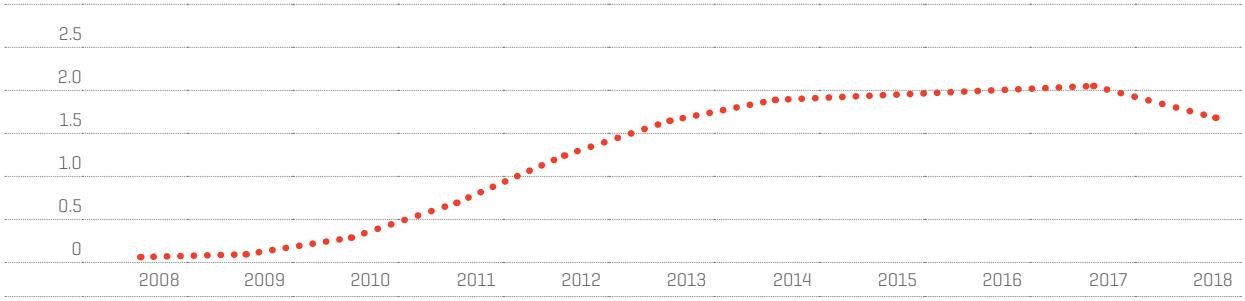
Solar thermal energy generation in 2018. National electricity system per autonomous community (GWh)



Share of thermal solar energy generation community in relation to the national total (%)

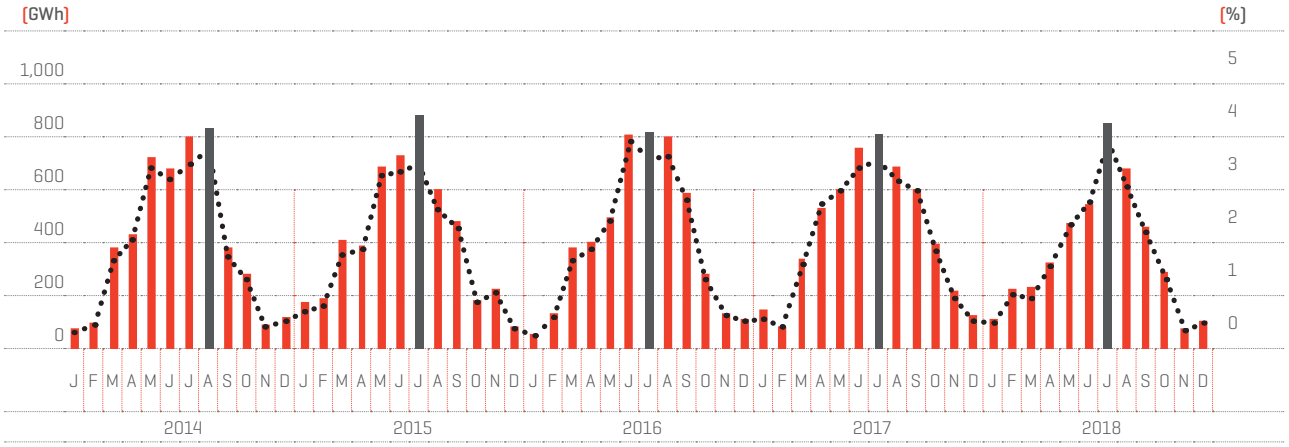


Share of solar thermal energy generation in the total generation mix. National electricity system [%]



Data for Balearic Islands and Canary Islands available since 2006 and Ceuta and Melilla since 2007.

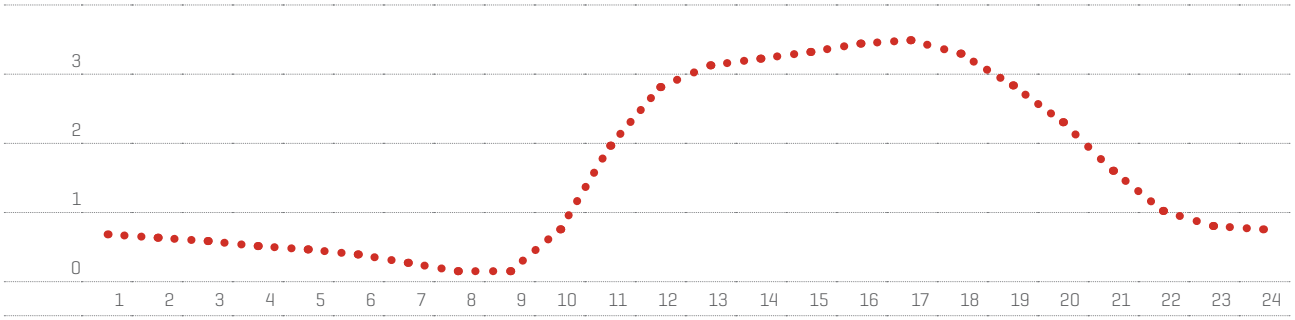
National solar thermal energy generation, monthly maximum values and share in the total generation mix. National electricity system



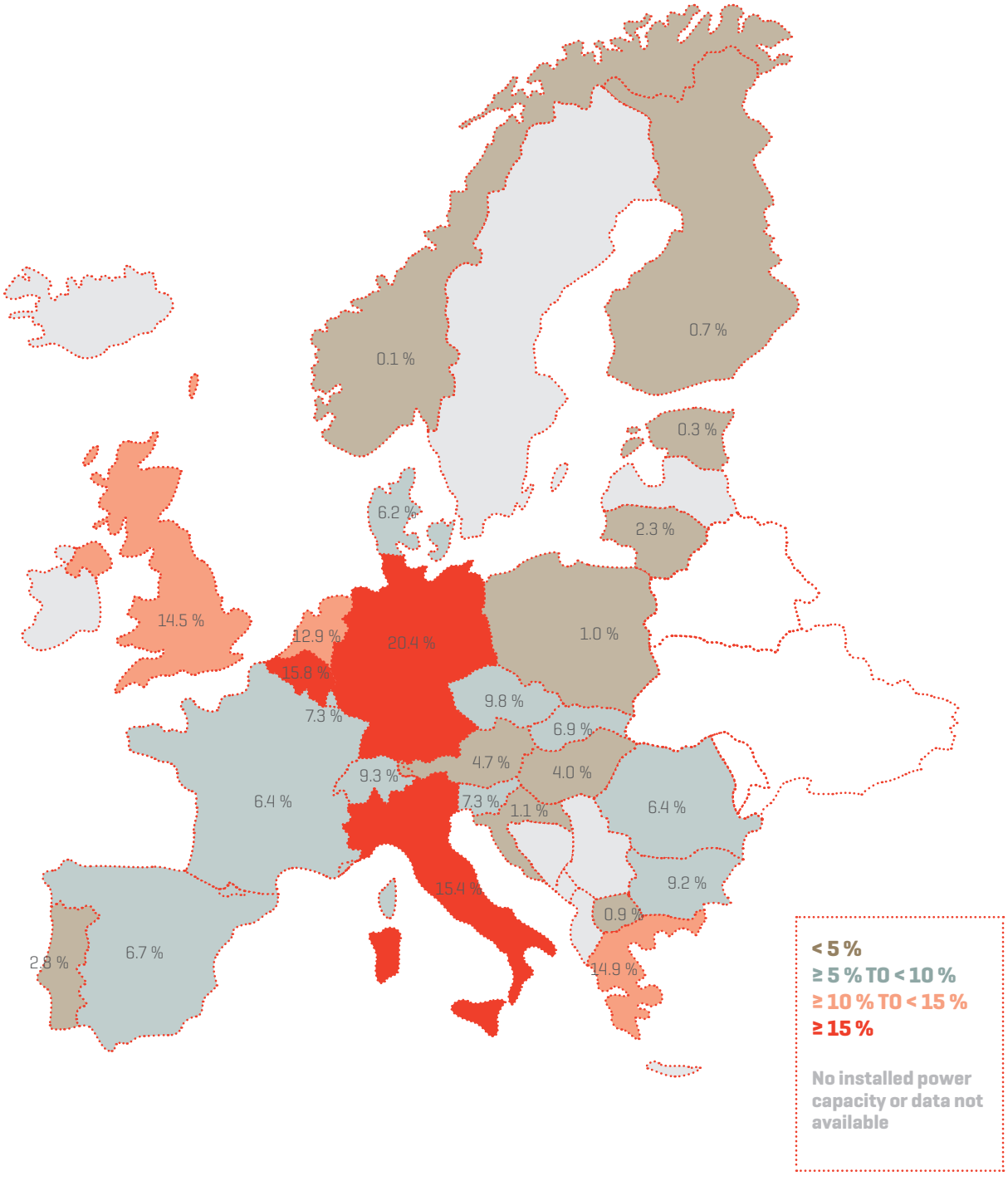
THERMAL SOLAR GENERATION [GWh] MAXIMUM MONTHLY [GWh] THERMAL SOLAR GENERATION / TOTAL GENERATION [%]

Data for Balearic Islands and Canary Islands available since 2006 and Ceuta and Melilla since 2007.

Average hourly share of solar thermal in total generation in 2018 [%] Peninsular electricity system

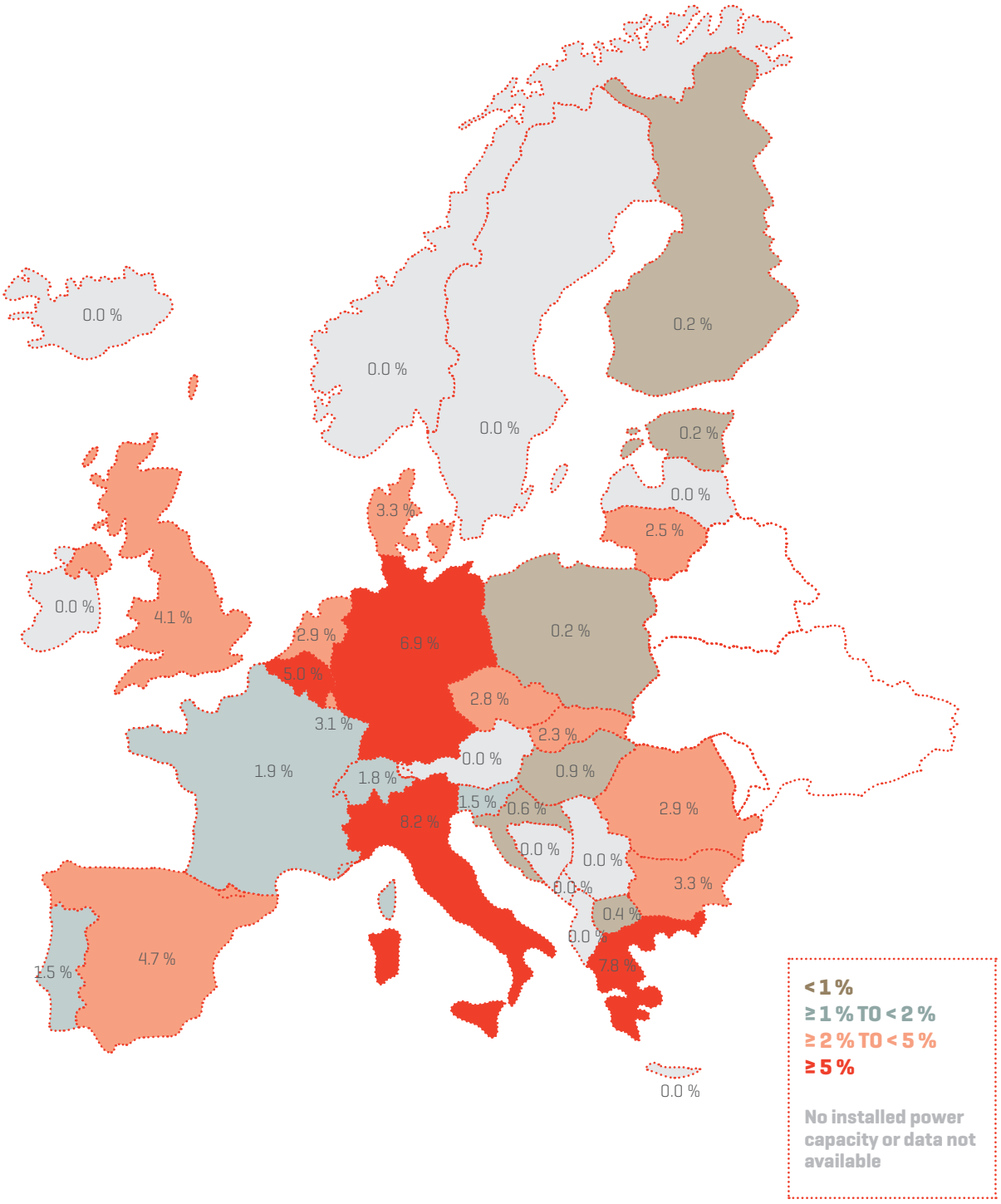


Solar power capacity in relation to total power capacity in ENTSO-E member countries in 2018 [%]



Source: ENTSO-E Data portal 20/05/2019. Great Britain includes data for Northern Ireland.

Share of solar generation over total generation within ENTSO-E in 2018 [%]



Source: ENTSO-E Data portal 20/05/2019. Great Britain includes data for Northern Ireland.

5

ENERGY FROM THE EARTH AND THE SEA

At the end of 2018, 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.

1,038
MW
INSTALLED POWER CAPACITY IN 2018

+0.5 %
COMPARED TO 2017

4,455
GWh
GENERATION FROM OTHER RENEWABLE TECHNOLOGIE

LESS THAN
2 %
OF THE TOTAL GENERATION NATIONWIDE

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 at the end of 2018. They can be divided into four blocks: biomass and biogas (860,5 MW); renewable waste, which considers 50% of municipal solid waste as a renewable source of energy (161,5 MW); the hydro-wind power station installed on the island of El Hierro (11,4 MW); and 4,8 MW of marine hydro.

It should be noted that the evolution of these aggregated energies has been constant for more than a decade, with their installed power capacity going from 379 MW in 2002 to 1,038 MW in 2018. However, their share in the Spanish electricity generation mix is still minor, not exceeding 2% in any year.

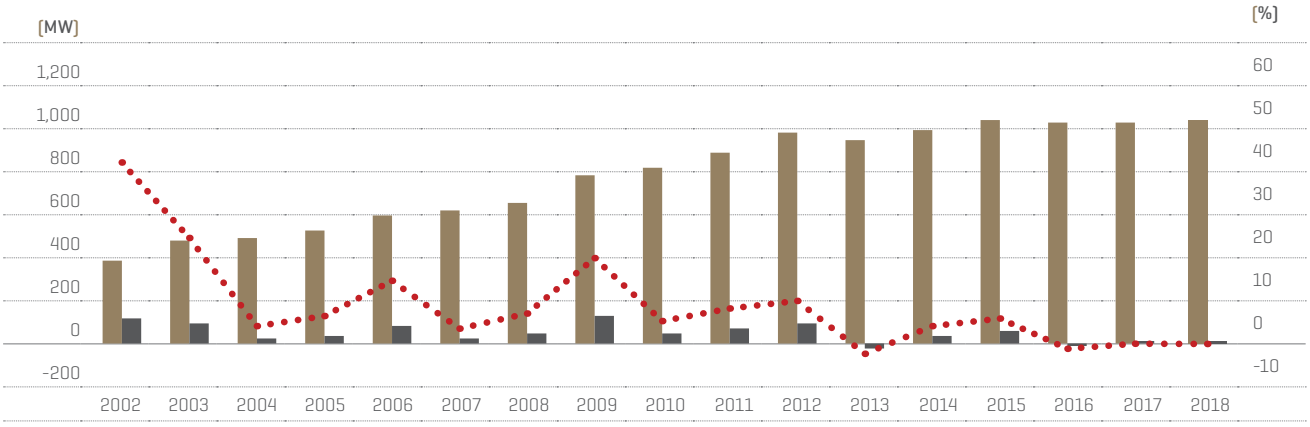
Because of its particularity, noteworthy is the hydro-wind power station of Gorona del Viento which in 2018 allowed renewable energy to cover 56 % of the annual generation of the island of El Hierro, reaching 100 % renewable on 28.2 % of days. New records for the integration of renewable energy were set, achieving 95.4 % supply with renewable generation in July.

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, with more than 22 % of all the installed power capacity of this group of renewables. It is followed, in this order, by the Basque Country, Catalonia and Asturias. In 2018, Asturias overtook Galicia, increasing its power by more than 5 %.

In comparison with the rest of European countries, Spain is ninth in terms of installed power capacity, but in terms of the percentage of this technology over total power, it falls to the 26th position, far behind the Scandinavian countries, which, with the exception of Norway, are the leaders in installed power capacity of this technology. Iceland tops this list with 27.4 % of its installed power capacity, followed by Denmark (14.9 %), Finland (11.9 %) and Sweden (7.9 %). However, in most European countries the installed power capacity of this type of energy is between 2 % and 4 %. The case is similar in terms of the contribution of these technologies to the total production, with Iceland, Finland and Denmark leading with 29 %, 18.6 % and 17.1 %, respectively.

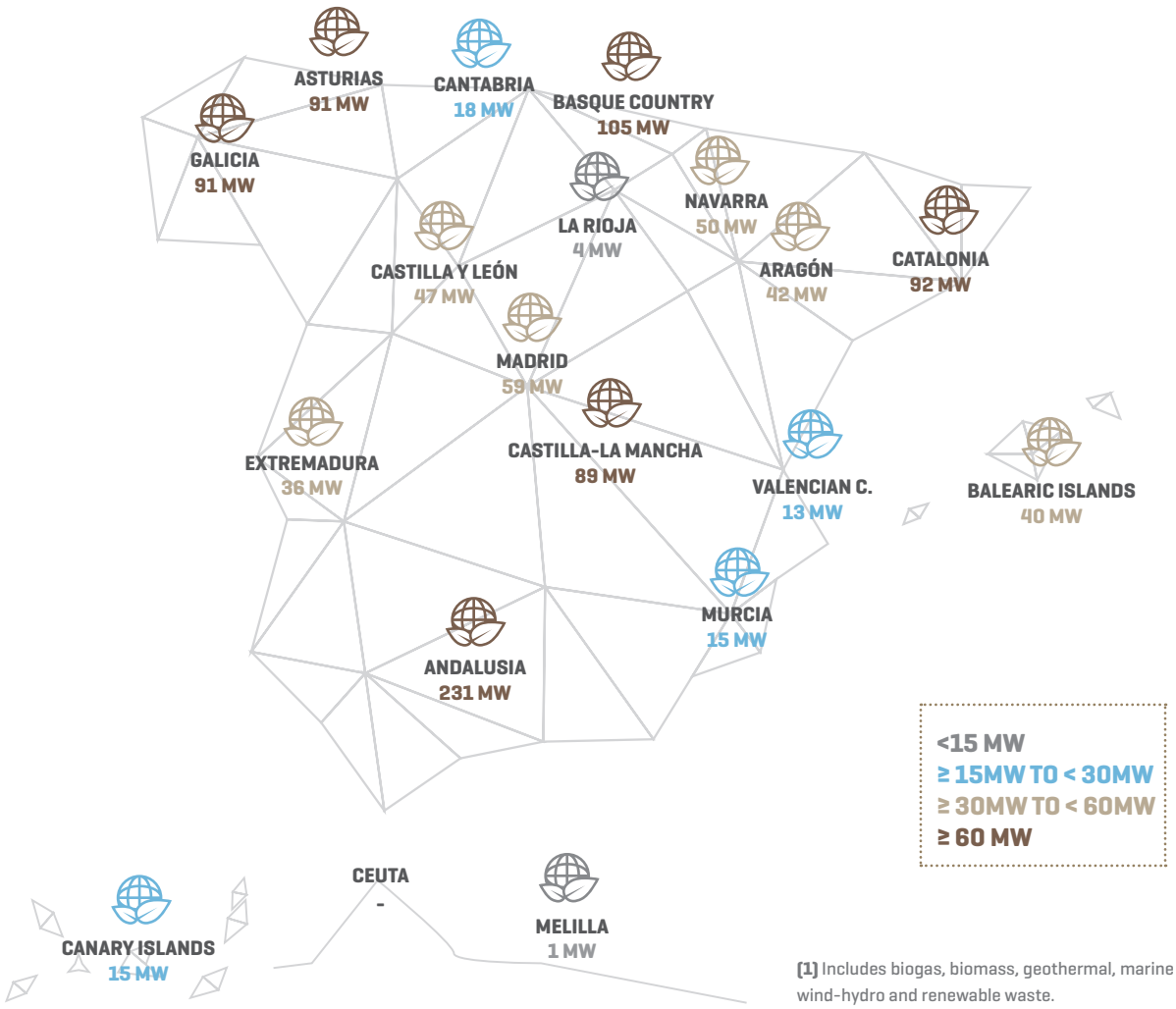
[1] The evolution over the years of these technologies has been affected by reorganisations due to regulatory changes as was the case in 2015 resulting from the coming into force of Royal Decree 413/2014 on electricity generation by means of Renewables, Cogeneration and Waste. This is the reason why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

Installed power capacity of other renewables[1]. National electricity system



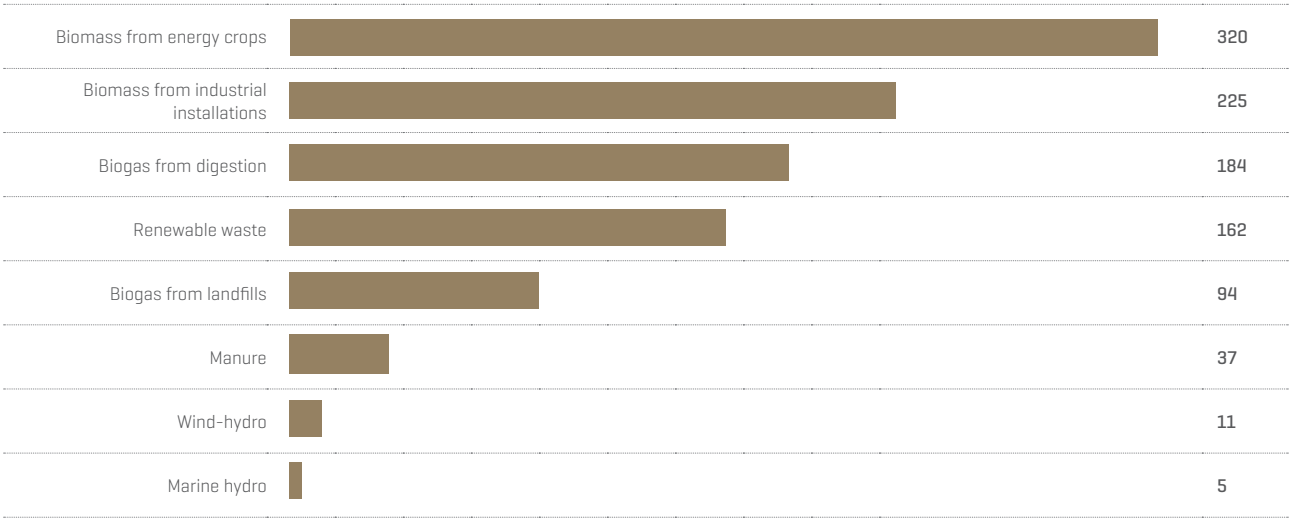
(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.
Source: National Commission of Markets and Competition (CNMC) until 2014. Data for Balearic Islands and Canary Islands available since 2006 and Melilla since 2007.

Installed power capacity of other renewables[1] as at 31/12/2018. National electricity system per autonomous community [MW]

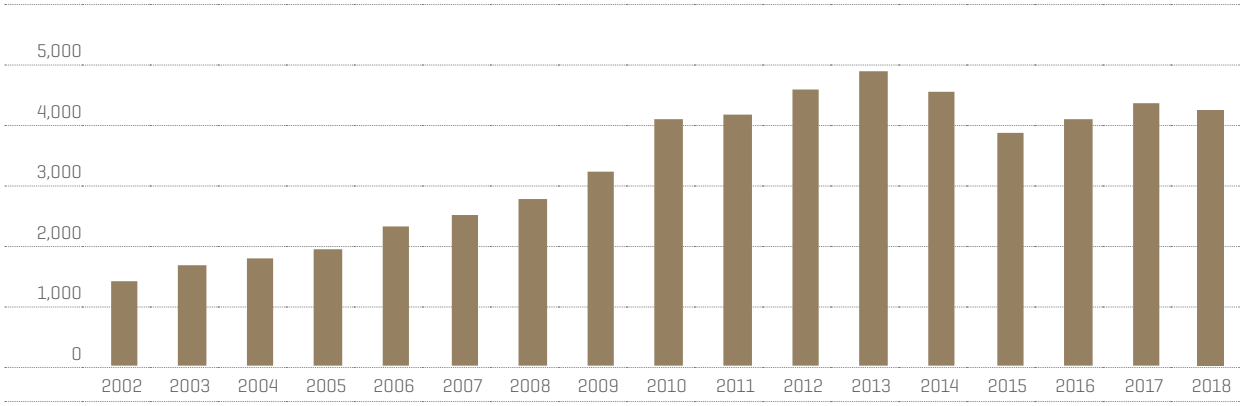


(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.

Power of other renewables per fuel type as at 31.12.2018. National electricity system (MW)

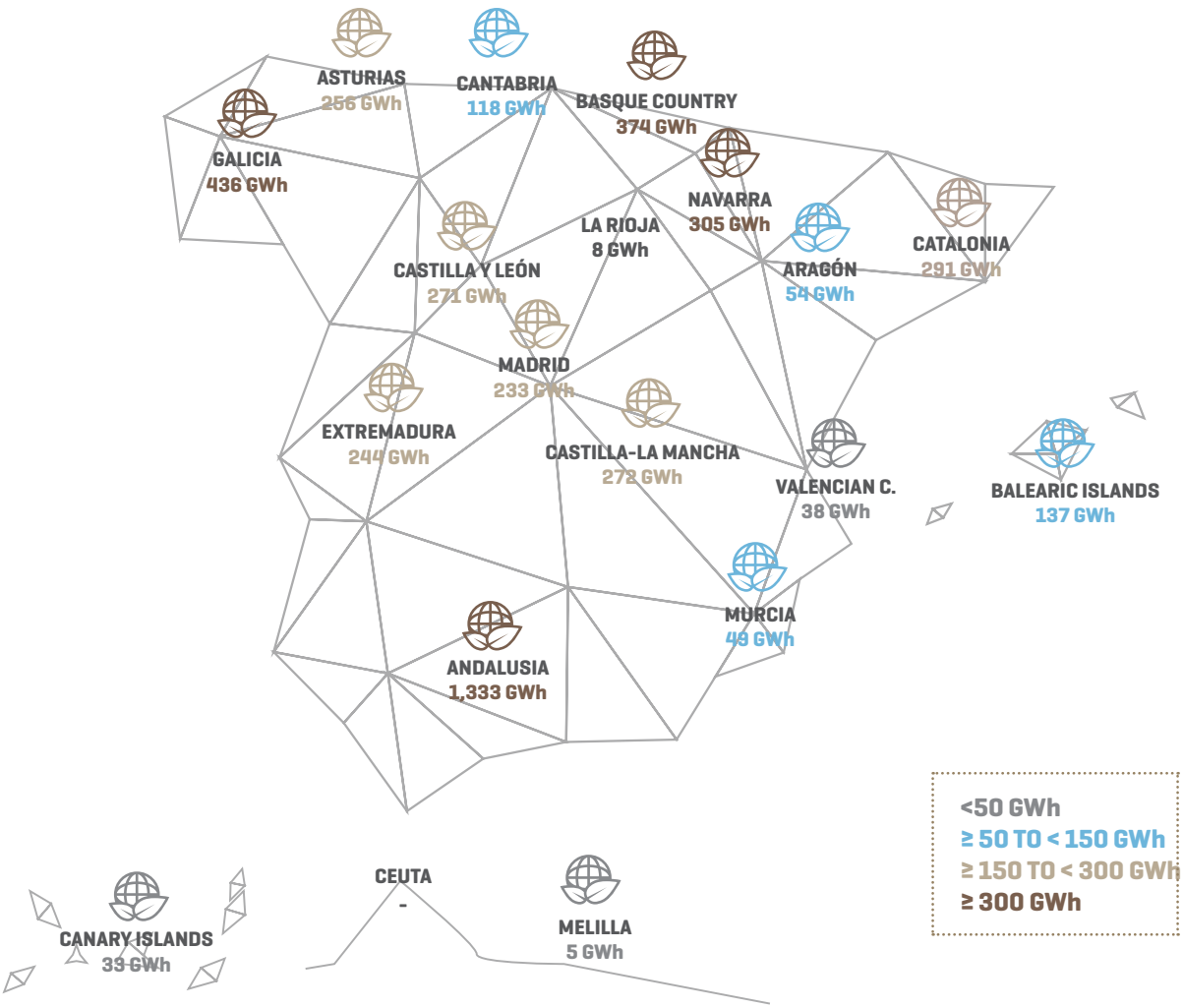


Generation from other renewables[1]. National electricity system (GWh)



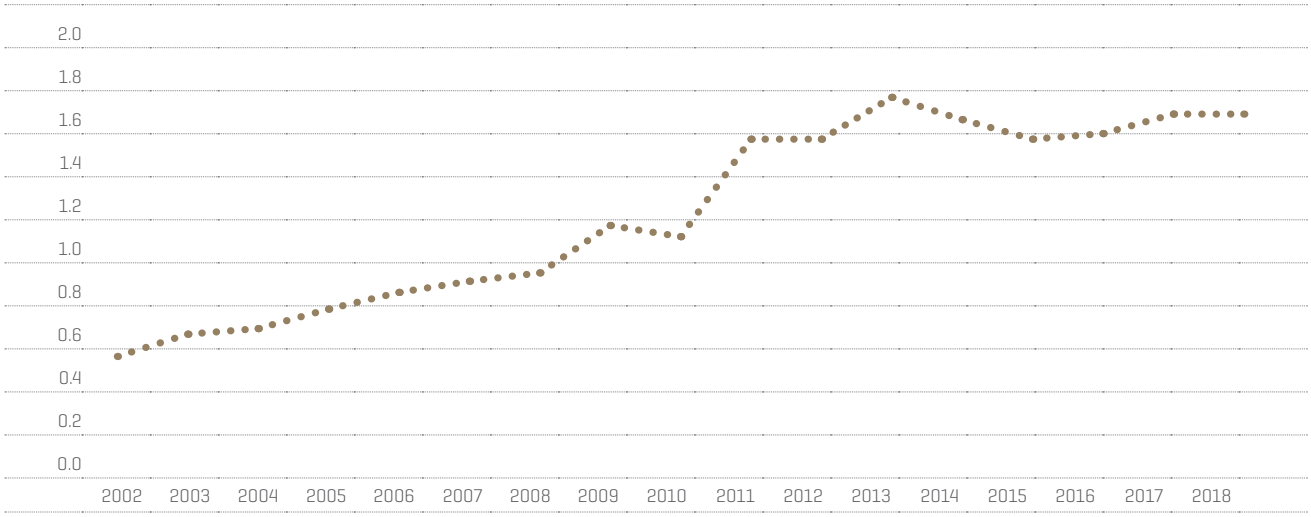
(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.
Data for Balearic Islands and Canary Islands available since 2006 and Melilla since 2007.

Generation from other renewables[1] in 2018. National electricity system per autonomous community (GWh)



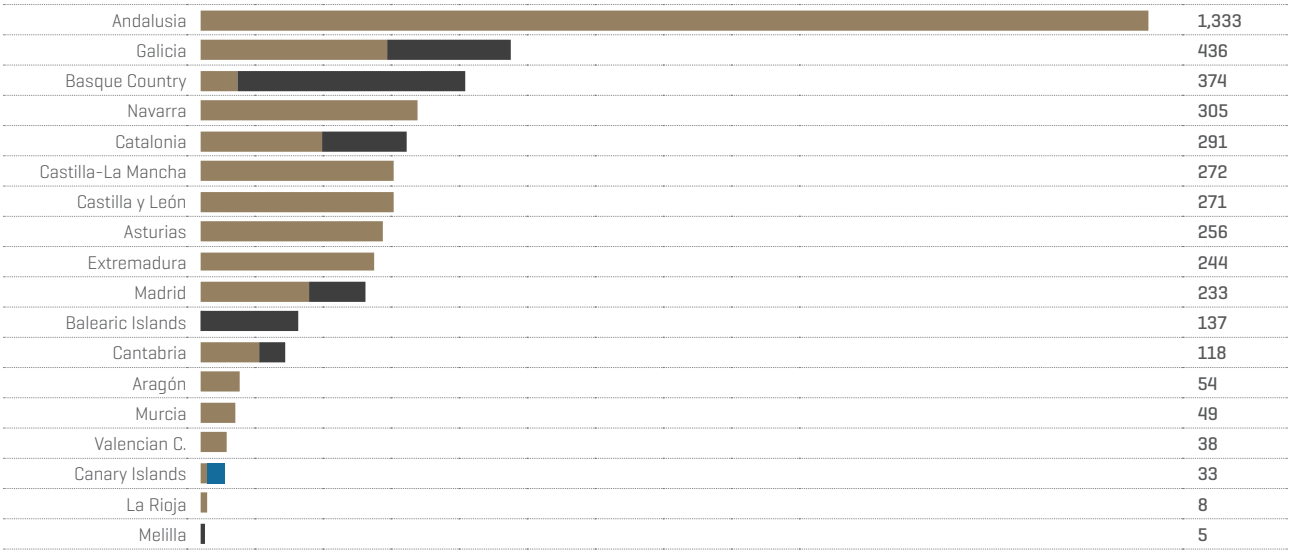
(1) Includes biogas, biomass, geothermal, marine hydro, wind-hydro and renewable waste.

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 for Balearic Islands and Canary Islands available since 2006 and Melilla since 2007.

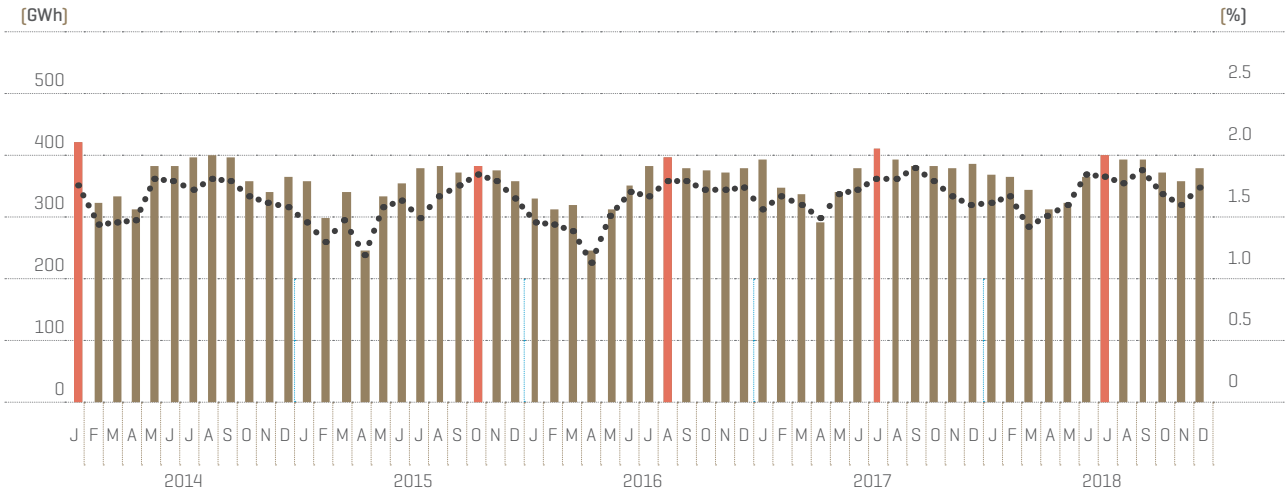
Generation from other renewables(1) per autonomous communnity and type of technology in 2018 (GWh)



OTHER RENEWABLES[1] RENEWABLE WASTE WIND-HYDRO

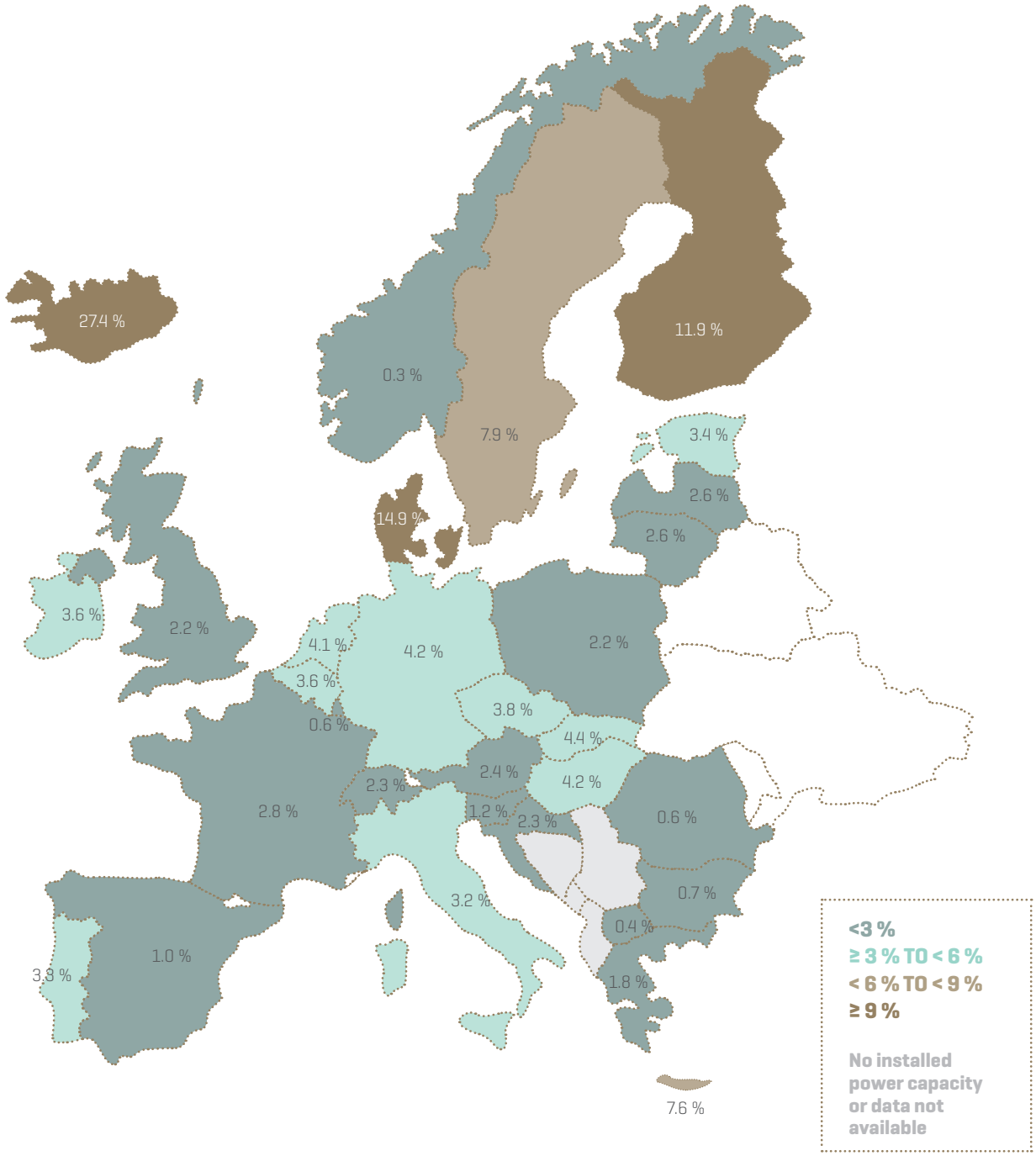
(1) Includes biogas, biomass, geothermal and marine hydro.

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 hydro, wind-hydro and renewable waste.
Data of Balearic Islands and Canary Islands available since 2006 and Melilla since 2007.

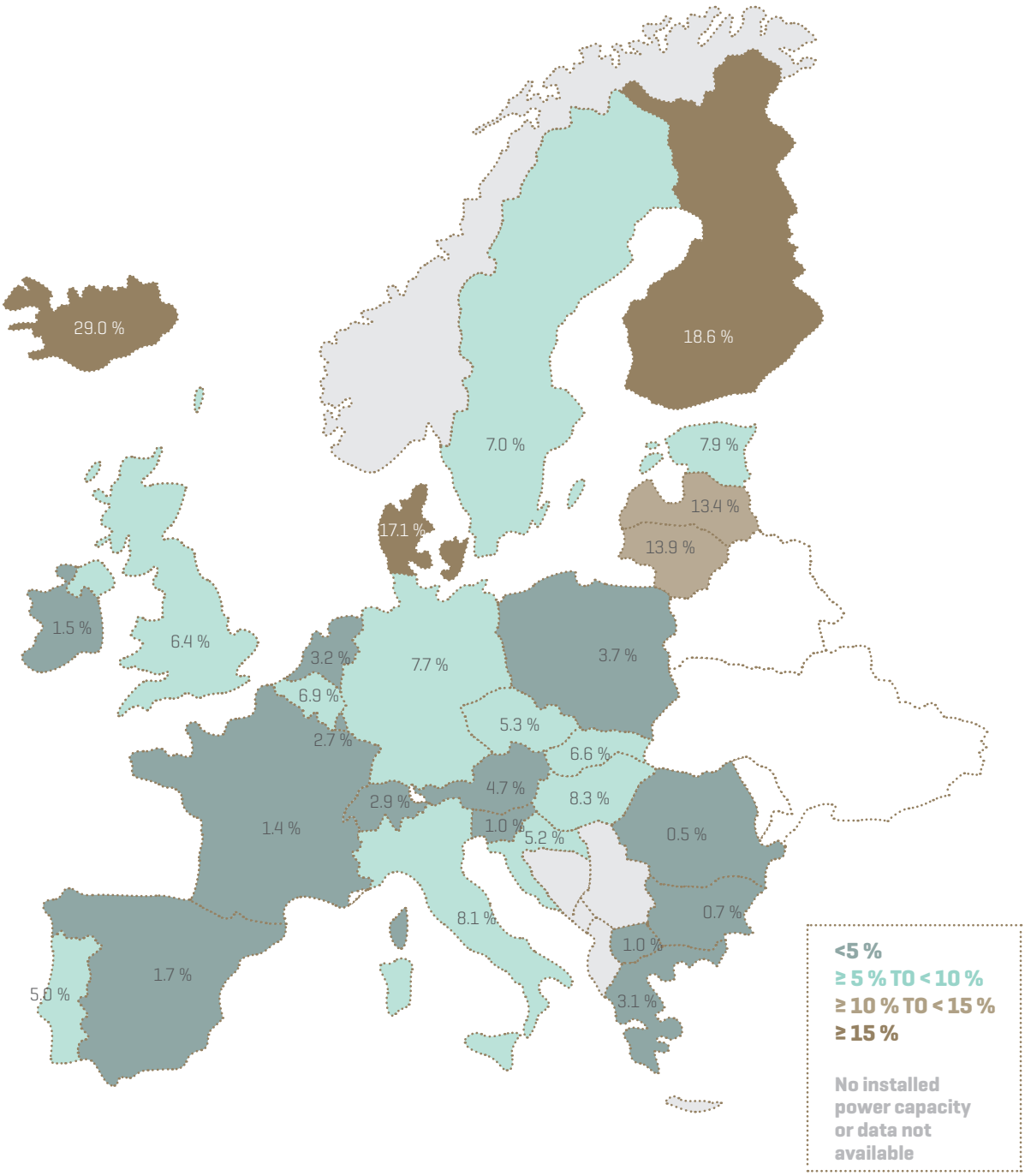
Power capacity of other renewables in relation to total capacity in ENTSO-E member countries in 2018[1] (%)



Source: ENTSO-E Data portal 20/05/2019. Great Britain includes data for Northern Ireland.

(1) For the ENTSO-E countries, biomass, biogas, geothermal, wind-hydro, marine hydro and renewable waste technologies are included.

Share of other renewables generation over total generation within ENTSO-E in 2018 [1] (%)



Source: Data ENTSO-E Data Portal 05/20/2019, Spain REE. Great Britain includes data for Northern Ireland.

(1) For the ENTSO-E countries, biomass, biogas, geothermal, wind-hydro, marine hydro and renewable waste technologies are included.

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.

NON-RENEWABLE ENERGIES
Energies obtained from fossil fuels (liquid or solid) and their derivatives. Includes pumped storage, nuclear, coal, fuel/gas, combined cycle, cogeneration and non-renewable waste.

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 ENERGIES
These are energies that are obtained from natural resources and waste, both industrial and urban. Includes hydroelectric, 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.
The hydroelectric power plant uses the stored potential energy, guaranteeing the electricity supply and the stability of the grid..

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