THE SPANISH ELECTRICITY SYSTEM

2019

2019

Committed To Intelligent Energy

RED ELÉCTRICA DE ESPAÑA

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PRESENTATION

Red Eléctrica de España (REE), as the sole transmission agent and operator of the Spanish electricity system, presents its latest edition of the Spanish Electricity System Report, which the Company has been publishing annually ever since it was established as Transmission System Operator (TSO) in 1985. This publication provides an overview of the main operational performance indicators and statistical ratios in 2019, as well as their evolution over recent years.

The information contained in this report is intended to be used as a management and reference tool in the current context of energy transition, in which the electricity system plays a fundamental role, making REE an agent to facilitate this transition.

In this regard, it should be noted that the efforts made by the Red Eléctrica Group in terms of innovation are focused on responding to the challenges of the energy transition. For this reason, this year we have decided to highlight the innovation applied to the electricity system by dedicating a chapter of this report to this topic.

The report is supplemented by Excel files that expand on the information and allow the data to be viewed online or downloaded, as well as by the publication 'Renewable Energy in the Spanish Electricity System', which provides a greater depth of information on the generation and consumption of renewable energies. This information is available in the REData section of the corporate website: www.ree.es/en, together with other publications and statistical series that Red Eléctrica periodically makes available to the general public for their consultation and use.

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

EXECUTIVE SUMMARY

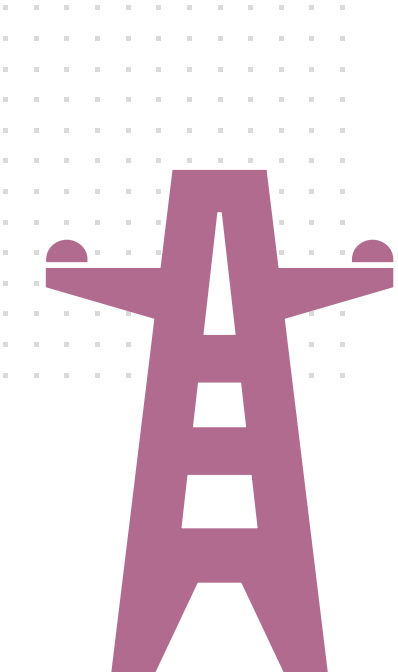
EXECUTIVE SUMMARY

In 2019, the demand for electricity in Spain suffered its first decrease since 2014.

Of the total installed power capacity nationwide, 50.1% corresponds to renewable energy facilities, which have overtaken non-renewable technologies for the first time since statistical records began.

264,635 GWh
DEMAND FOR ELECTRICITY IN SPAIN

-1.6 %
COMPARED TO 2018



249,228
GWh
DEMAND FOR ELECTRICITY ON THE SPANISH PENINSULA

- 1.7 %
COMPARED TO 2018

The **demand for electricity** in Spain during 2019 showed a decrease of 1.6% with respect to the previous year, reaching a demand total of 264,635 GWh, this being the first decrease in demand since 2014.

The evolution of the peninsular electricity system demand, which represents just over 94% of total Spanish demand, was 1.7% lower than the previous year, with a total of 249,228 GWh, 6% lower than the maximum demand reached in 2008, and at levels slightly higher than those recorded 15 years ago. After having factored in the effects of seasonal and working patterns, there is a negative variation of 2.7% compared to the previous year.

By **large sectors of activity,** according to the Red Eléctrica Index (IRE) that collects data on the electricity demand of large consumers, only the industrial sector has had a negative variation (-3.9%), but given its importance it has had a major influence on the evolution of the IRE as a whole. The services sector experienced a slight increase of 0.3%, although somewhat higher than that experienced in 2018 and the grouping of other sectors of activity grew by 2.5%, compared to figures that showed a decline in 2018.

The way in which the calendar fell last year had a very small impact on the evolution of the IRE, both in the general index and in its large sectoral groupings, and the colder temperatures had a positive impact on the evolution of the index, contributing to an increase of 0.4 percentage points. As a result, the decrease in the general IRE was -2.2% (-2.7% after having factored in the effects of seasonal and working patterns).

By **geographical area,** seven Autonomous Communities (regions in Spain) experienced positive variations, with Castilla-La Mancha standing out with 1.4%. The opposite case was Asturias with a negative variation of 11.5%.

The **maximum hourly demand on the Spanish peninsula** was recorded on 10 January between 8:00 and 9:00 p.m., with a total of 40,136 MWh, a decrease of 1.2% compared to the maximum recorded the previous year.

MAXIMUM HOURLY DEMAND ON THE SPANISH PENINSULA

10 JANUARY 2019

40,136
MWh

-1.2 %
LOWER THAN LAST YEAR'S MAXIMUM DEMAND WHICH WAS REGISTERED IN FEBRUARY.

The **installed power capacity** of the entire set of generating facilities in Spain increased by 6.0%, closing 2019 with 110,376 MW. Of the total installed power capacity, 50.1% corresponds to renewable energy facilities, which have overtaken non-renewable technologies for the first time since statistical records began.

With regard to **electricity generation,** the share of renewable generation on the Spanish peninsula in relation to total generation fell (38.9% compared to 40.2% in 2018) due to lower production by hydroelectric power stations (27.6% down on than the previous year).

Non-renewable generation reached 61.1% of the total on the Spanish peninsula, favoured by the increase in production from combined cycle, which almost doubled its share in the generation mix, rising from 10.7% in 2018 to 20.7% in 2019. On the other hand, there has been a fall in coal-fired generation, which has accounted for only 4.3% of the generation mix, the lowest value since statistical records began.

The drive towards decarbonisation has led to a fall in **in CO_2eq emissions** derived from electricity generation, which reached an all-time low since records began (1990): 50 million tonnes of CO_2, 23% less than in 2018.

The **volume of scheduled energy** exchanges between Spain and other countries registered a 10.4% decrease with respect to the previous year. Exports grew by 4.3% to 10,946 GWh, and imports dropped to 17,821 GWh (-17.5%). Therefore, for the fourth consecutive year the net balance of scheduled energy exchanges was an importer, with a value of 6,875 GWh, 38.0% lower than in 2018.

By interconnection, Spain was a net importer with France for yet another year and, for the first time since 2015, as an exporter with Portugal. The interconnection with France recorded an import balance of 9,705 GWh (12,042 GWh in 2018) and the balance with Portugal was an export balance of 3,395 GWh, compared to the import balance of 2,654 GWh in 2018. With Andorra the balance was once again as an exporter with 208 GWh and with Morocco for the first time in the history of this interconnection it was as an importer, with a value of 774 GWh, compared to the 3,395 GWh exported last year.

The **electricity transmission grid** continued to be bolstered in 2019 with the commissioning of 198 kilometres of line circuit and 168 substation bays, bringing the total length of circuits in the national grid to 44,453 kilometres and increasing substation bay to 6,086 by the end of the year. In turn, transformer capacity increased by 1,335 MVA, bringing the installed transformer capacity nationwide to 93,735 MVA.

In 2019, noteworthy was the commissioning of the 132 kV Ibiza-Torrent circuit in the Balearic Islands, the 220 kV Moncayo-Magaña circuit in Soria and the 132 kV La Oliva-Puerto del Rosario double circuit in the Lanzarote-Fuerteventura electricity subsystem.

The **service quality indicators** for 2019 improved compared to the previous year, with the exception of the Canary Islands system due to a one-off incident that occurred on the island of Tenerife.

110,376 MW
INSTALLED POWER CAPACITY IN SPAIN

50.1 %
CORRESPONDS TO RENEWABLE ENERGY FACILITIES

38.9 %
RENEWABLE ENERGY GENERATION IN THE PENINSULAR SYSTEM

-27.6 %
HYDROELECTRIC POWER GENERATION COMPARED TO 2018

53.4
€/MWh
AVERAGE FINAL PRICE OF ENERGY

- 17.0 %
COMPARED TO 2018

The Energy Not Supplied (ENS) in 2019 corresponding to the peninsular system was 47 MWh (250 MWh in 2018) and the Average Interruption Time (AIT) was 0.10 minutes (0.52 minutes in 2018).

In the Balearic Islands electricity system, these indicators showed improvement over the previous year. A single supply interruption was recorded, resulting in an ENS of 1 MWh (38 MWh in 2018) and an AIT of 0.09 minutes (3.27 minutes in 2018).

In the Canary Islands electricity system, the ENS was 2,626 MWh (corresponding to 3 supply interruptions) and the AIT was 155.52 minutes, largely due to the incident that occurred on 29 September when a 'zero-voltage' event occurred on the island of Tenerife and which originated at the 66 kV Granadilla substation.

In turn, the grid availability index (which measures the capacity or possibility of use of the different elements of the transmission grid by the system) corresponding to the peninsular system was 98.02%, slightly lower than the 98.14% recorded in 2018, and in the Balearic Islands and Canary Islands electricity systems, it was 96.91% (96.82% in 2018) and 98.90% (98.79% in 2018), respectively.

The **average final price of energy** in the electricity market was 53.4 euros/MWh, 17.0% lower than the price in 2018.

The combined price of the day-ahead and intraday market represented 90.9%, system ancillary services 2.7%, capacity payments 5.0% and the remaining 1.4% for the interruptibility service (also known as 'Interruptible Load Programme').

If the impact of the price on the net demand served is compared with that of last year, we can observe a reduction of 16.4% in the day-ahead and intraday market, 39.8% in the interruptibility service[1], 37.9% in ancillary services and 1.9% in capacity payments. The decrease in the price of the interruptibility service was due to the price reductions obtained in the two auctions held for 2019.

In the **area of innovation and technology,** the activity of Red Eléctrica de España in 2019 was strategically focused on the impact and technological verticals promoted by Red Eléctrica y de Telecomunicaciones, Innovación Tecnología (RETIT), the new company of the Red Eléctrica Group whose objective, in line with the provisions of the new 2018-2022 Strategic Plan, is to accelerate technological innovation, generate competitive advantages and create business opportunities to convert the Group into a technological benchmark. In total, 88 innovation projects have been undertaken.

(1) Demand-side management tool to ensure a quality electricity supply at all times. With this service, large electricity consumers (industries) commit to reducing their electricity consumption when the system requires it and they are remunerated for this service. The service is activated by REE in accordance with technical (system security) or economic (lower cost for the system) criteria.

ELECTRICITY DEMAND

Demand in the peninsular electricity system was 1.7% lower than the previous year, with a total of 249,228 GWh, a value 6% lower than the maximum demand reached in 2008, and at levels slightly higher than those recorded 15 years ago.

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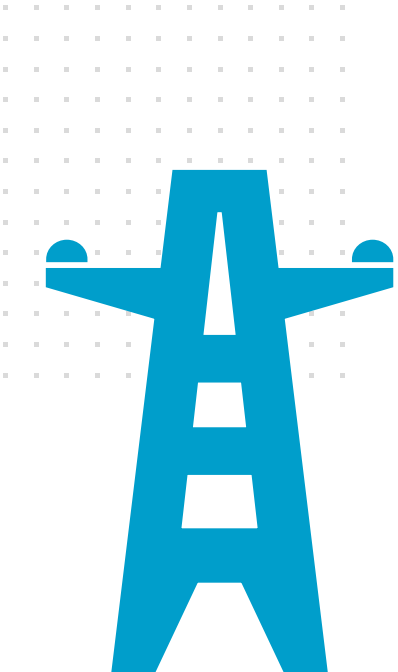
264,635 GWh
ELECTRICITY DEMAND IN SPAIN

-1.6 %
COMPARED TO 2018



DEMAND FOR ELECTRICITY ON THE SPANISH PENINSULA

249,228
GWh

-1.7 %
COMPARED TO 2018

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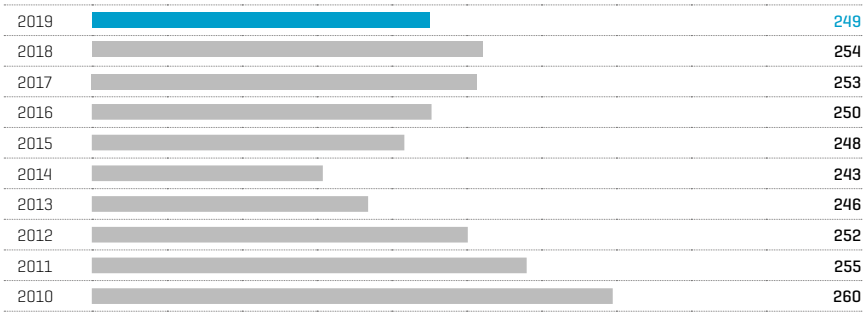
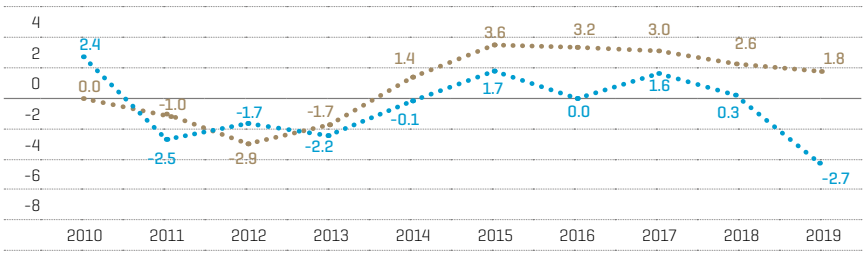
Evolution of the peninsular electricity demand over the last 10 years (TWh)



From the point of view of economic activity, there has been a variation in the Gross Domestic Product (GDP) of 1.8% with respect to the previous year, continuing the progressive slowdown in the growth rates of activity in recent years.

Annual variation of the peninsular electricity demand and Spanish GDP (%)



GDP [1] ADJUSTED PENINSULAR DEMAND

(1) Source: Spain's National Statistics Office (INE)

Regarding electricity demand, this lower growth in activity, and taking into account the low elasticity values that have been recorded since the beginning of the economic recovery, has given rise to a negative elasticity in the evolution between both magnitudes.

After having factored in the effects of seasonal and working patterns, the result is a negative variation with respect to the previous year of 2.7%, a slightly higher decrease than that recorded in 2011.

VARIATION IN PENINSULAR DEMAND

-2.7 %

AFTER HAVING FACTORED IN THE EFFECTS OF SEASONAL AND WORKING PATTERNS

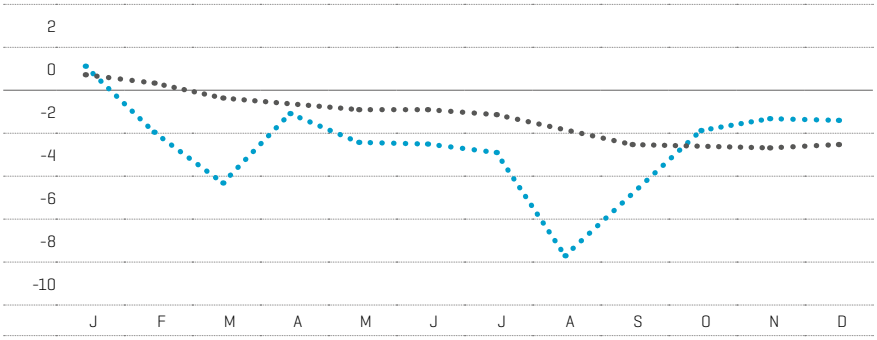
Components of the annual variation in peninsular electricity demand (%)

	Δ Demand at substation busbars.	Working Parterns	Temperature	Adjusted value
2010	3.0	0.2	0.4	2.4
2011	-2.0	1.4	-0.9	-2.5
2012	-1.3	-0.3	0.7	-1.7
2013	-2.3	0.2	-0.3	-2.2
2014	-1.1	0.0	-1.0	-0.1
2015	2.0	-0.1	0.4	1.7
2016	0.7	0.6	0.1	0.0
2017	1.1	-0.3	-0.2	1.6
2018	0.4	-0.3	0.2	0.5
2019	**-1.7**	**0.7**	**0.2**	**-2.7**

In 2019, the demand for electrical energy in the peninsular electricity system fell slightly breaking the upward trend that began in 2015.

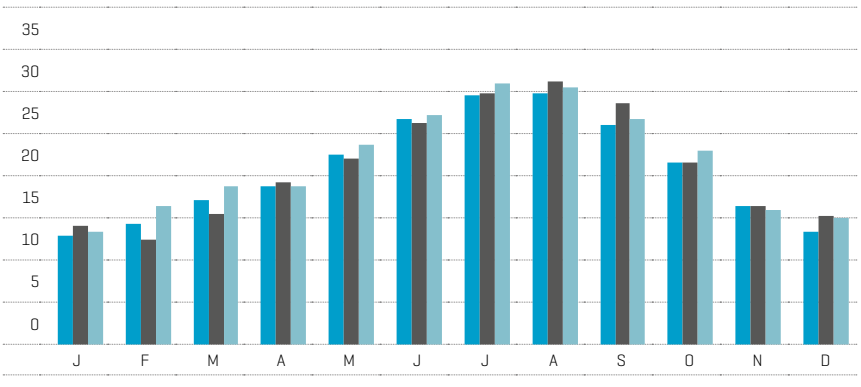
Adjusted demand showed a downward trend throughout the year. Thus, starting from the growth which ended in 2018, it showed negative values as of March during the year when compared with the trend of the previous year. The rest of the year continued with negative variation rates stabilising its fall in the last two months of 2019 and ended the year with the aforementioned decrease of 2.7%.

Monthly variation in the adjusted electricity demand on the Spanish peninsula in 2019 (%)



Colder temperatures had a positive impact on demand.

Monthly evolution of maximum temperatures (ºC)



(1) Average monthly temperature for the period 1989-2013. Source: Prepared by REE using data from the Spanish State Meteorological Agency (AEMET).

From the point of view of the influence of temperatures on demand, the whole of 2019 compared to the historical average[1], shows warmer temperatures in summer and milder temperatures in winter. The daytime temperatures[2] with a cooling effect (Cooling Degree Days) were 16.2% lower than the average values and the daytime temperatures with a heating effect (Heating Degree Days) were 27.3% higher than the average values for the period considered. In other words, over the year as a whole, the number of days with warmer than average temperatures was higher.

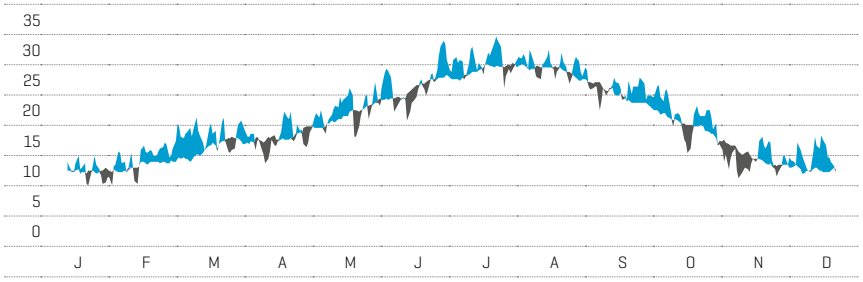
Thus, during 2019, temperatures were much higher than the historical average temperature on 27.9% of the days. These days were more concentrated in June and July for the summer months, and in February, March and December for the winter months. On the other hand, on days with temperatures below the historical average, this situation only occurred on 9.3% of the days in the year, with these days were concentrated mainly in January, October and November.

INFLUENCE OF TEMPERATURE ON THE DEMAND

27.9 %

OF THE DAYS REGISTERED ABOVE-AVERAGE TEMPERATURES

Evolution of the daily maximum temperatures compared to the average historical data (ºC)



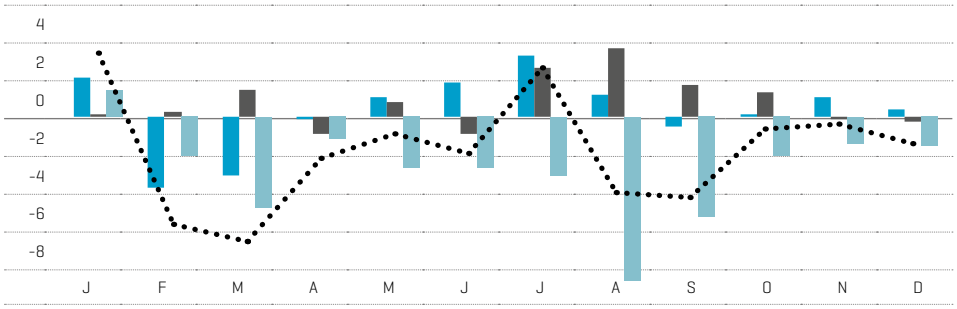
INFLUENCE OF TEMPERATURE ON THE DEMAND

+0.2 p.p.

Note: p.p. = percentage points

Compared to the previous year, 2019 was milder than 2018, with 22.7% fewer 'cold days' and 2.8% more 'hot days'. The combined impact of these effects, with a greater influence on consumption on hot days, results in a positive contribution of temperatures to the growth in demand of 0.2 percentage points.

Components associated to growth in monthly demand on the Spanish peninsula 2019 (%)



(1) Average maximum daily temperatures in the period 1989-2013.
(2) Cooling degree days are defined as those days registering temperatures below 19ºC, and heating degree days are defined as those above 23ºC.

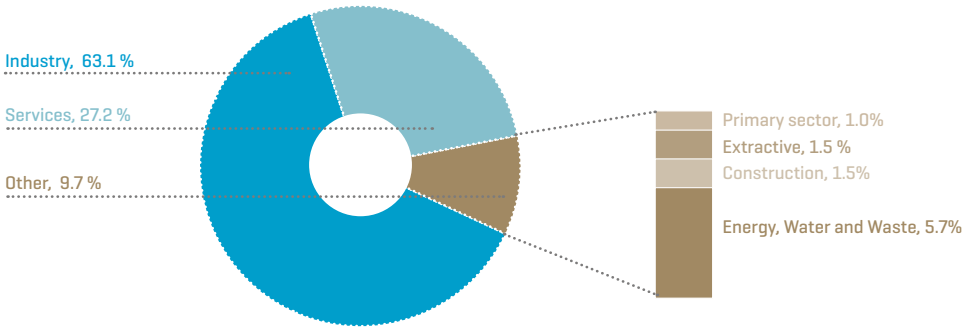
Decrease in the consumption of large consumers

RED ELÉCTRICA INDEX

– 2.2 %

COMPARED TO 2018

Composition of the General IRE (%)



In 2019, the IRE as a whole was 2.2% lower than the previous year, the second consecutive year in which this situation occurred. The index is equivalent to that of 2015, when activity was recovering after the crisis.

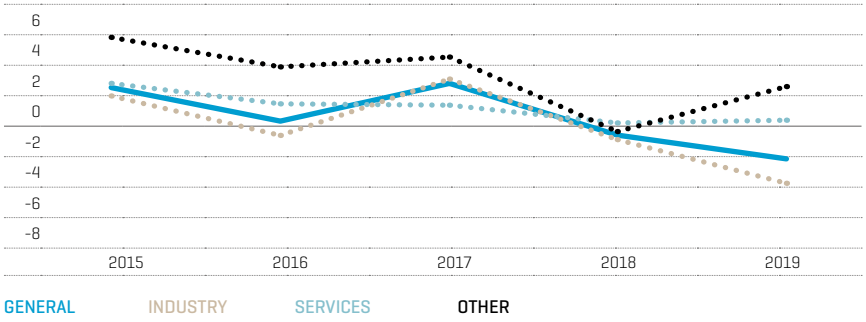
Of the main branches of activity that make up the IRE, industry, services sector and the grouping of other activities, only industry has had a negative variation, but given its share in the mix, it has had an influence on the evolution of the IRE as a whole:

— Industrial activities fell by 3.9%, showing an accelerated decline in consumption over the last two years.

— The services sector had a small growth of 0.3%, although somewhat higher than that experienced in 2018

— The grouping of other sectors of activity grew by 2.5%, compared to the decline registered in 2018.

Annual variation of the IRE (% year-on-year)



In 2019, the way in which the calendar fell had a very small impact on the evolution of the IRE, both in the general index and in its large sectoral groupings.

Temperatures also had a positive impact on the evolution of the index, contributing 0.4 percentage points, with the latter being more important in the second half of spring and early summer, as well as in the last quarter of the year. By large groupings, the most significant impact was on 'Other' groupings, where temperatures contributed 0.8 points to the evolution of the index, while in the industry and the services sectors, the positive contribution of temperatures was 0.2 percentage points in each.

IRE: Variation Breakdown in 2019 (%)

	Gross	Working patterns	Temperature	Adjusted value
General	**-2.2**	**0.1**	**0.4**	**-2.7**
Industry	-3.9	0.1	0.2	-4.2
Services	0.3	0.1	0.2	0.0
Other	2.6	0.0	0.8	1.7

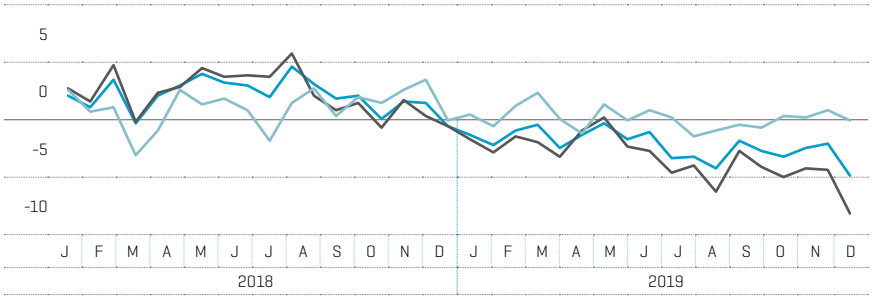
Temperatures had a positive impact on the evolution of the index, contributing 0.4 percentage points.

With regard to the monthly evolution of the adjusted index corresponding to the two large sectoral groupings (industry and services), industry, with negative variations throughout the year, had an effect on the evolution of the general index. The evolution of the services sector, on the contrary, showed strong fluctuations, alternating periods of negative and positive variations, which have led to the fact that, in certain months, the general index did not decrease so much as a result of the large decreases in industrial activity.

Throughout 2018, the evolution of the value for industry showed a progressive deterioration. This situation, far from being improved was actually accentuated in 2019, with the industrial index registering a decrease of 8.5% in December.

The evolution of the services sector showed a certain degree of volatility throughout the year, alternating periods that showed slight positive variations, with others that showed negative variations, although the former outweigh the latter, and the period between May and August had a big impact on the evolution of the index for the year as a whole.

Monthly evolution of the adjusted IRE (% previous year)



GENERAL INDUSTRY SERVICES

INDUSTRY ADJUSTED ANNUAL INDEX

-4.2 %

SERVICES ADJUSTED ANNUAL INDEX

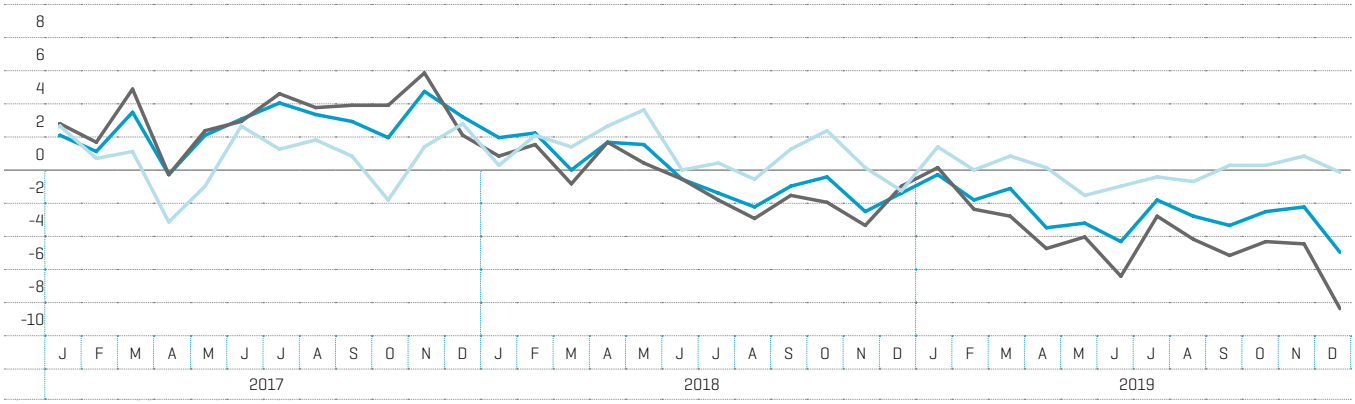
+0.0 %

As for the evolution of the IRE, in 2018 a process that showed a progressive reduction in the growth rates began, which shifted to negative variation rates as of December. This downward trend in the index continued apace during the first five months of the year, and from June onwards it continued to fall, although at a slower rate than in previous months, which could be signalling that the rate of decline in the index is stabilising.

The negative trend that the general index showed during the period 2018-2019 was a consequence of the even more negative evolution of the industrial sectors, whose variation defined the two periods of evolution of the trend that have marked the year.

Unlike the industrial sectors, the trend in the service sectors, although in the first five months of the year there was a gradual reduction in growth rates, from June onwards the evolution of the trend stabilised with values close to zero.

Monthly variation of the adjusted IRE (% rolling year)

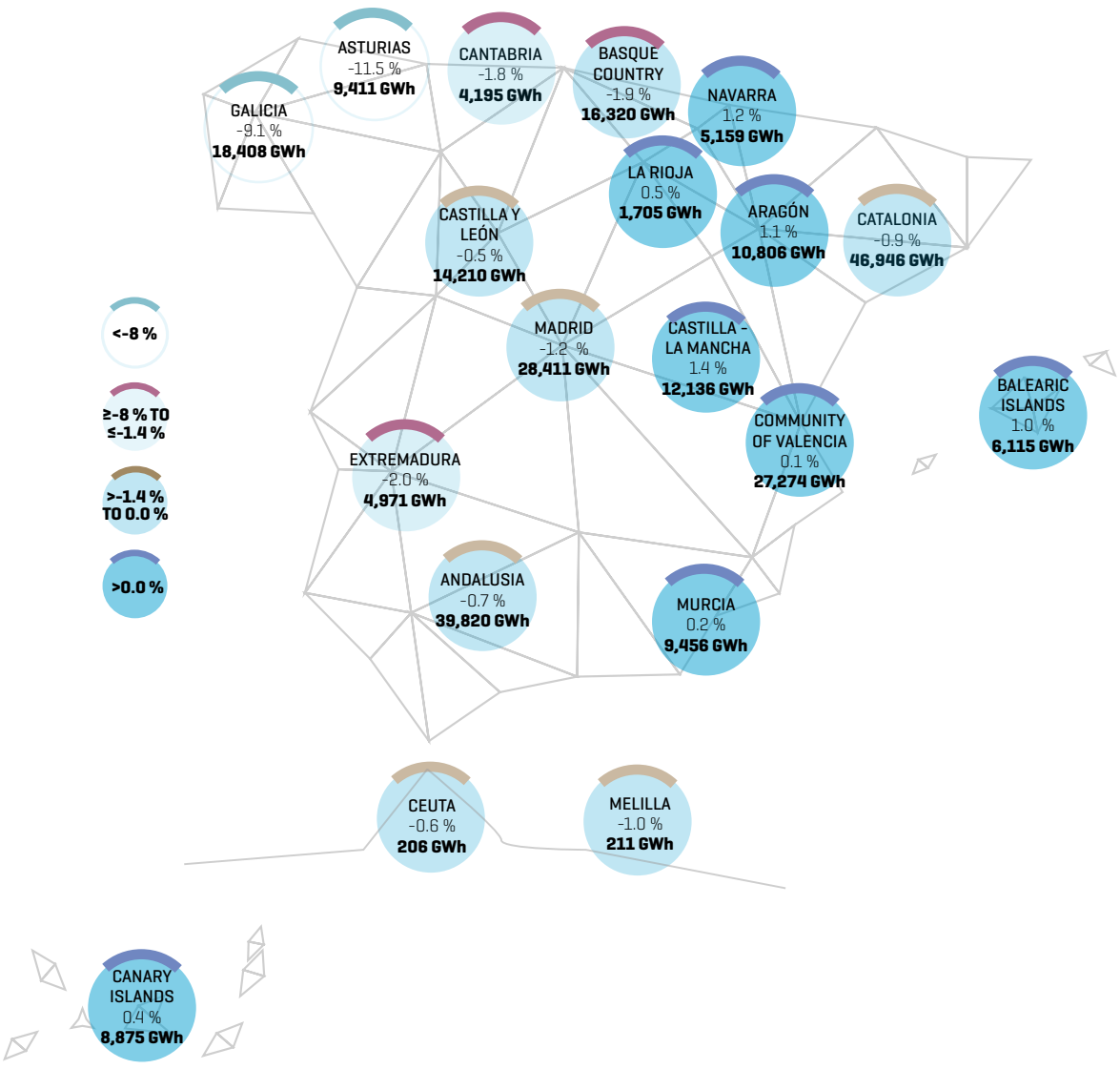


The negative trend that the overall index has shown during the period 2018-2019 was a consequence of the even more negative evolution of the industrial sectors.

Seven Autonomous Communities experience positive variations

Although demand in Spain as a whole fell by 1.6% in 2019, the geographical breakdown of demand evolution would have been very uneven, ranging from a maximum growth in Castilla-La Mancha of 1.4% to a fall of 11.5% in Asturias.
Up to seven Autonomous Communities experienced positive variations compared to the previous year. These are: Aragón, the Balearic Islands, the Community of Valencia, the Canary Islands, Castilla-La Mancha, Murcia and Navarra. On the negative side, the greatest decreases were recorded in Communities in the north of the Spanish peninsula where industrial consumption has a big influence on the demand.

Electricity demand per autonomous community and variation compared to the previous year (GWh and %)



Annual maximum below the figure for 2018

In 2019, both the winter hourly demand peaks (which correspond to the annual maximum), and the summer demand peaks, registered lower values than the previous year. The maximum for the year was recorded on 10 January between 8:00 and 9:00 p.m. with a total of 40,136 MWh, down 1.2% on the maximum value recorded the previous year.

In any event, these maximum values are long way from the all-time record of hourly demand registered in 2007, with the winter maximum being 4,740 MWh lower and the summer maximum being 1,557 MWh lower than its corresponding all-time highs.

WINTER MAXIMUM HOURLY DEMAND

40,136
MWh

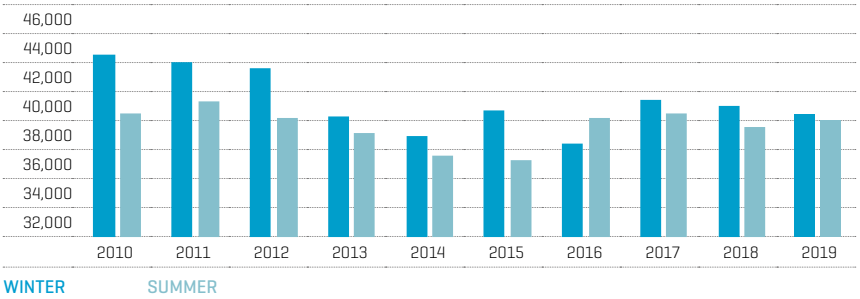
-1.2 %
COMPARED TO 2018

SUMMER MAXIMUM HOURLY DEMAND

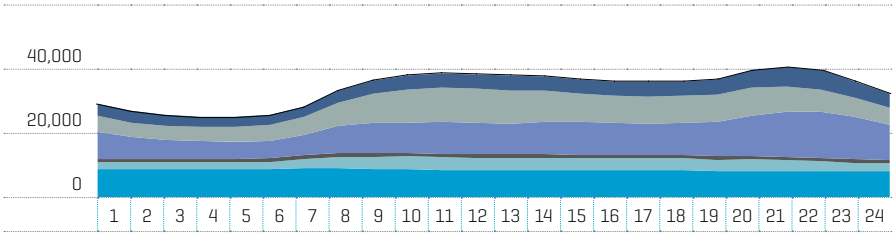
39,377
MWh

-0.8 %
COMPARED TO 2018

Maximum annual values for instantaneous demand on the Spanish peninsula (MW)



Breakdown of the demand on 10/01/2019



At the peak time of the day of the year when the maximum hourly demand[1] was registered, the residential sector[2] accounted for 34.5% of consumption, while industrial consumption of the IRE accounted for 20.9%, large services (IRE) 8.7% and small businesses and services 19.3%. Throughout the peak day, the greatest impact of the industrial sectors occured in the early hours of the morning, between 4:00 and 5:00 a.m. reaching total share of 35.7% of the demand (measured at the power station busbars), while for the large services, the hourly period with the greatest impact was between 7:00 a.m. and 6:00 p.m. with a share of slightly more than 10%.

[1] Includes transmission losses.
[2] Hourly profiles applied to the general low voltage electricity tariff with a contracted power equal to or less than 10 kW.

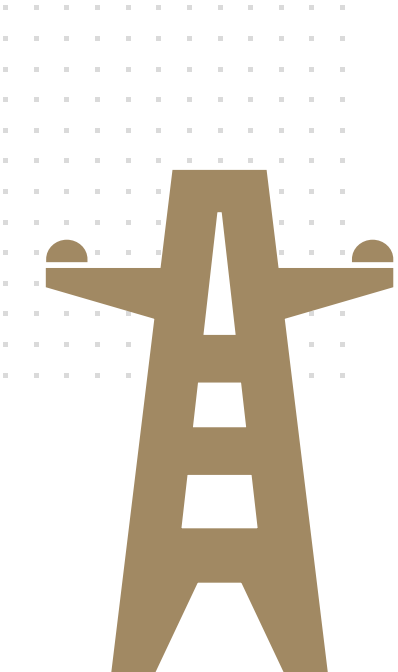
ELECTRICITY GENERATION

Non-renewable energy increased its share to 61.1% (59.8% in 2018).

In the overall electrical energy balance, broken down by the type of energy used, renewable energy reduced its share in the peninsular electricity generation mix, totalling 38.9% compared to 40.2% in 2018, due to lower hydroelectric generation.

247,086 GWh
ELECTRICITY GENERATION IN THE PENINSULAR SYSTEM

+0.1 %
COMPARED TO 2018



Renewable generation is declining due to lower production from hydroelectric power stations.

+93.7 %
COMBINED CYCLE

-27.6 %
HYDROELECTRIC GENERATION

-69.4 %
COAL-FIRED GENERATION

The generation of electricity in the peninsular system, which represents around 95% of total generation nationwide, increased by 0.1% in 2019, reaching 247,086 GWh. The most significant variations with respect to the previous year were recorded by combined cycle generation, which increased by 93.7%, while coal-fired and hydroelectric generation decreased their production by 69.4% and 27.6%, respectively.

The generation of electricity in the non-peninsular systems (13,712 GWh) fell by 2.7% with respect to the previous year, with a notable decrease of 16.5% for coal-fired generation and 14.8% for fuel/gas. On the other hand, wind power production increased by 82.9% over the previous year.

In the overall electrical energy balance, broken down by the type of energy used, renewable energy reduced its share in the peninsular electricity generation mix, totalling 38.9% compared to 40.2% in 2018, due to lower hydroelectric generation. But in contrast, non-renewable energy increased its share to 61.1% (59.8% in 2018).

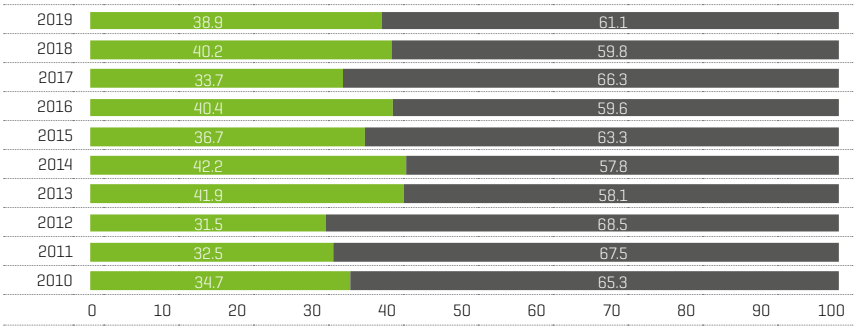
ELECTRICITY GENERATION IN NON-PENINSULAR SYSTEMS

13,712
GWh

-2.7 %

COMPARED TO 2018

Evolution of renewable and non-renewable electricity generation on the Spanish peninsula (%)



RENEWABLES: HYDROELECTRIC, WIND, SOLAR PHOTOVOLTAIC, SOLAR THERMAL, RENEWABLE WASTE AND OTHER RENEWABLES
NON-RENEWABLE: NUCLEAR, COAL, FUEL/GAS, COMBINED CYCLE, COGENERATION, PUMPED STORAGE (NET SUPPLY) AND NON-RENEWABLE WASTE

National electrical energy balance [1]

	Peninsular system		Non-peninsular systems		National total	
	GWh	%19/18	GWh	%19/18	GWh	%19/18
Hydro	24,709	-27.6	4	7.1	24,712	-27.6
Hydro-wind	-	-	23	-1.7	23	-1.7
Wind	53,094	8.5	1,144	82.9	54,238	9.4
Solar photovoltaic	8,841	19.8	400	3.7	9,240	19.0
Solar thermal	5,166	16.8	-	-	5,166	16.8
Other renewables [2]	3,607	1.7	11	6.3	3,617	1.7
Renewable waste	739	0.8	151	6.9	890	1.8
Renewable generation	**96,155**	**-3.0**	**1,733**	**45.6**	**97,888**	**-2.4**
Pumped storage (net supply) [3]	1,642	-17.6	-	-	1,642	-17.6
Nuclear	55,824	4.9	-	-	55,824	4.9
Coal	10,672	-69.4	2,000	-16.5	12,672	-66.0
Fuel/gas [4]	-	-	5,696	-14.8	5,696	-14.8
Combined cycle [5]	51,140	93.7	4,099	12.6	55,239	83.9
Cogeneration	29,580	2.1	34	-1.6	29,614	2.1
Non-renewable waste	2,072	-9.7	151	6.9	2,222	-8.7
Non-renewable generation	**150,931**	**2.2**	**11,979**	**-7.1**	**162,910**	**1.4**
Pumped storage consumption	-3,025	-5.4	-	-	-3,025	-5.4
Peninsula-Balearic Islands link [6]	-1,695	37.4	1,695	37.4	0	-
International exchange balance [7]	6,862	-38.2	-	-	6,862	-38.2
Demand (b,c,)	**249,228**	**-1.7**	**15,407**	**0.6**	**264,635**	**-1.6**

(1) Allocation of generation units based on primary fuel. The net production of non-renewable and non-Hydro Management Units (HMU) facilities have their own consumption discounted. In these types of production, negative generation indicates that the electricity consumed for the power station's uses exceeds its gross production. (2) Includes biogas, biomass, marine and geothermal. (3) Pure pumped storage (net supply) + estimate of mixed pumped storage (net supply). (4) The Balearic Islands electricity system includes generation with auxiliary generation units. (5) Includes operation in open-cycle mode. The Canary Islands electricity system uses diesel as its main fuel. (6) Positive value: energy input into the system; negative value: energy output from the system. (7) Positive value: importer balance; negative value: exporter balance. Increment values are not calculated when exchange balances have different signs

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

	Peninsular system		Non-peninsular systems		National total	
	MW	%19/18	MW	%19/18	MW	%19/18
Hydro	17,083	0.2	2	0.0	17,085	0.2
Hydro-wind	-	-	11	0.0	11	0.0
Wind	25,365	9.7	434	3.0	25,799	9.6
Solar photovoltaic	8,665	94.1	248	0.1	8,913	89.2
Solar thermal	2,304	0.0	-	-	2,304	0.0
Other renewables [1]	1,071	22.9	6	0.0	1,076	22.8
Renewable waste	122	0.0	38	0.0	160	0.0
Renewables	**54,609**	**13.9**	**740**	**1.8**	**55,349**	**13.8**
Pumped storage (net supply)	3,329	0.0	-	-	3,329	0.0
Nuclear	7,117	0.0	-	-	7,117	0.0
Coal	9,215	-3.6	468	0.0	9,683	-3.5
Fuel/gas	0	-	2,447	-1.7	2,447	-1.7
Combined cycle	24,562	0.0	1,722	0.0	26,284	0.0
Cogeneration	5,666	-0.9	10	0.0	5,677	-0.9
Non-renewable waste	451	0.0	38	0.0	490	0.0
Non-renewables	**50,341**	**-0.8**	**4,687**	**-0.9**	**55,028**	**-0.8**
Total	**104,950**	**6.4**	**5,427**	**-0.5**	**110,376**	**6.0**

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

National installed renewable power capacity overtakes non-renewable power capacity.

INSTALLED POWER CAPACITY IN THE NATIONAL ELECTRICITY SYSTEM

110,376
MW

50.1 %
INSTALLED RENEWABLE POWER CAPACITY NATIONWIDE

As at 31 December 2019, the complete set of electricity generating facilities in the peninsular system had increased with respect to the previous year, after five consecutive years of decreases; and had reached an all-time record with an installed power capacity of 104,950 MW, 6.4% more than at the end of 2018.

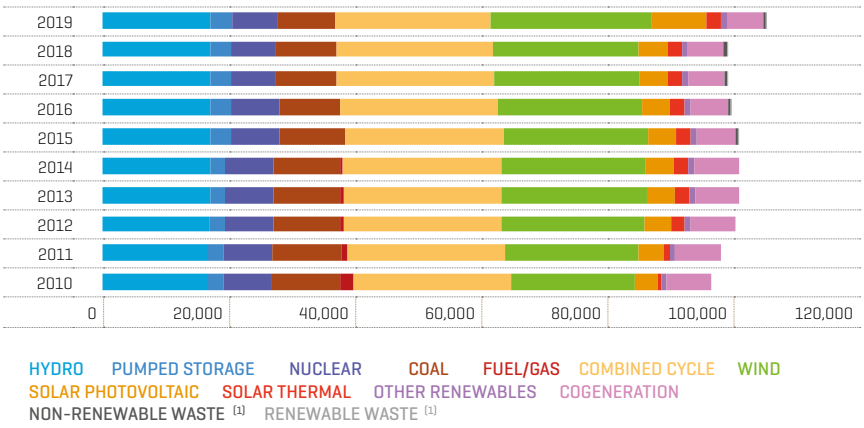
This complete set of electricity generating facilities is increasingly renewable and less dependent on polluting technologies, as a result of renewable power capacity on the Spanish peninsula increasing by 13.9%, while non-renewable power capacity decreased by 0.8%. In 2019, coal-fired generation was reduced by 3.6% compared to the previous year, due to the definitive closure of the Anllares thermal power station, with which 347 MW of installed non-renewable generation capacity has been subtracted from the total. Cogeneration capacity also fell by 0.9%.

On the other hand, more wind, solar photovoltaic and other renewable energy generation power plants have come into service, increasing their installed power capacity by 9.7%, 94.1% and 22.9%, respectively. Variations in the rest of the technologies have been zero or insignificant.

In non-peninsular systems, there was a 0.5% reduction in installed power capacity at the close of 2019. This decrease is mainly explained by the reduction of three generating units of the Ibiza thermal power station in the Balearic Islands for a total of 43 MW.

In Spain as a whole, which includes the peninsular and non-peninsular systems, installed power capacity increased by 6.0%, ending 2019 at 110,376 MW. Of the total installed power capacity, 50.1% corresponds to renewable energy facilities, which overtakes non-renewable technologies for the first time since statistical records began.

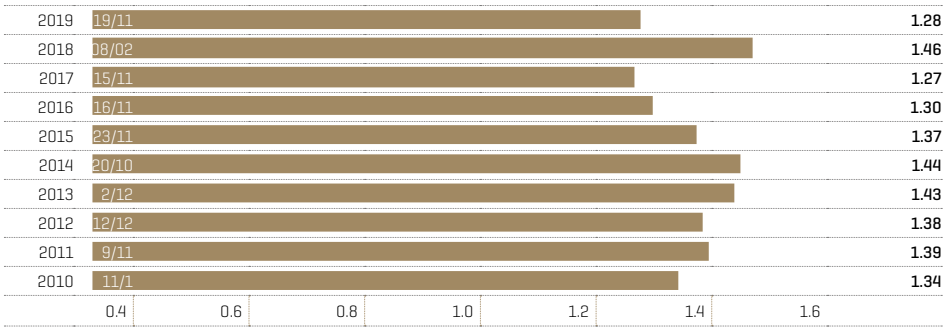
Evolution of the structure of installed power capacity on the Spanish peninsula (MW)



(1) Power capacity included in other renewables and cogeneration until 31/12/2014.
Source: National Commission of Markets and Competition (CNMC) until 2014 regarding: non-Hydro Management Units (HMU), wind, solar photovoltaic, solar thermal, other renewables, cogeneration and waste.

The minimum coverage index for the Spanish peninsula, defined as the minimum value of the ratio between the power available in the system and the peak power demanded from the system, stood at 1.28 in 2019.

Evolution of the minimum coverage index for the Spanish peninsula



ICmin = Min [Pd/Ps]
ICmin: Minimum Coverage Index.
Pd: Power available in the system.
Ps: Peak power demanded from the system.

Lower level of renewable generation in the peninsular system due to a decrease in the contribution of hydroelectric generation (-27.6%).

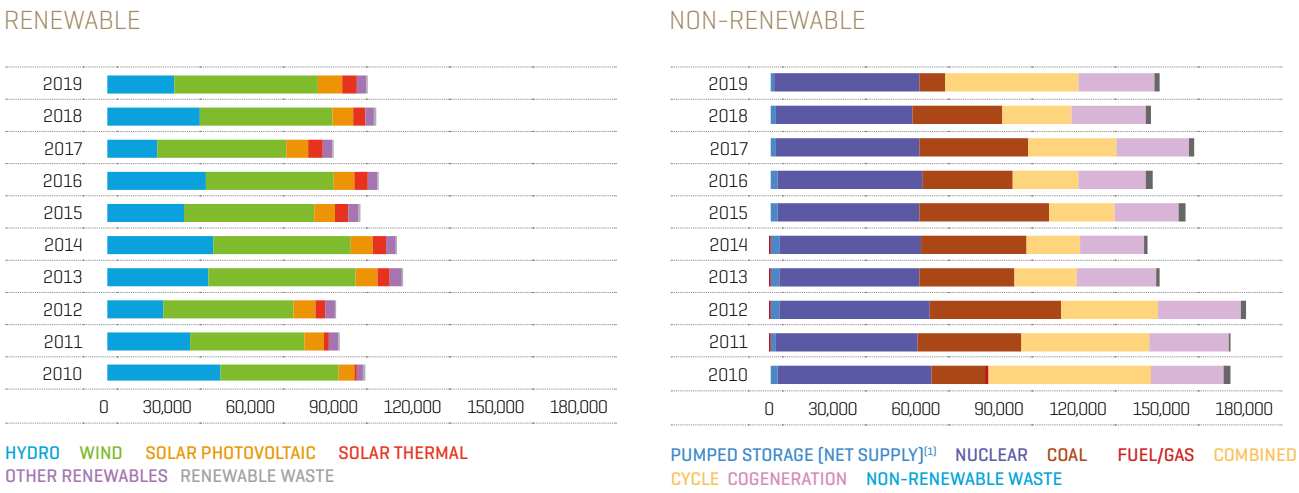
RENEWABLE ENERGY GENERATION IN THE PENINSULAR SYSTEM

38.9 %

The contribution of renewable energy to peninsular electricity generation in 2019 saw its share reduced in the electricity generation mix to 38.9%, compared to 40.2% in 2018. Despite this decrease, the important role played by renewable generation registered the fifth highest value in the entire historical series. The lower level of renewable generation is due to the decrease in hydroelectric generation, 27.6% lower than the previous year, as a result of 2019 being a year with less rainfall.

However, the most significant change in the peninsular generation mix was in the share of the different technologies that use fossil fuels as a primary energy source. Non-renewable generation reached 61.1% of the total on the Spanish peninsula, favoured by the increase in production of combined cycle, which almost doubled its share in the generation mix, increasing from 10.7% in 2018 to 20.7% in 2019. On the other hand, there was a drop in coal-fired generation, which accounted for only 4.3% of the mix, the lowest value since statistical records began.

Evolution of renewable and non-renewable electricity production on the Spanish peninsula (GWh)



The net production of non-renewable and non-Hydro Management Units (HMU) facilities have their own consumption discounted. In these types of production, negative generation indicates that the electricity consumed for the power station's uses exceeds its gross production. (1) Pure pumped storage (net supply) + estimate of mixed pumped storage (net supply).

The decrease in coal-fired generation meant that its share was just 4.3% of the mix, the lowest value since statistical records began.

Wind power remains the second largest source of electricity generation for the fourth consecutive year.

Renewable generation in the peninsular system in 2019 decreased by 3.0% compared to the previous year, closing the year at 96,155 GWh, a similar value to that recorded in 2015. This lower level of renewable generation in 2019 occurred mainly during the first months of the year, coinciding with the decrease in hydroelectric and wind power generation. However, towards the end of the year, renewable energy increased by 46.2% in November and by 42.6% in December, compared to the same months of the previous year, with all-time highs for renewable generation in November and December.

However, without taking into account hydroelectric generation, the rest of the renewable technologies in the peninsular electricity system increased by 9.8% in 2019, as all of them recorded increases when compared to the previous year.

Peninsular wind power production in 2019 stood at 53,094 GWh, 8.5% higher than the previous year. This increase occurred mainly in the final two quarters of the year, when this technology generated 23.3% and 25.2% more than in the same periods in 2018. In addition, wind power continues to be the most important renewable technology in the Spanish peninsular system, as in 2019 it accounted for more than half (55.2%) of all renewable generation.

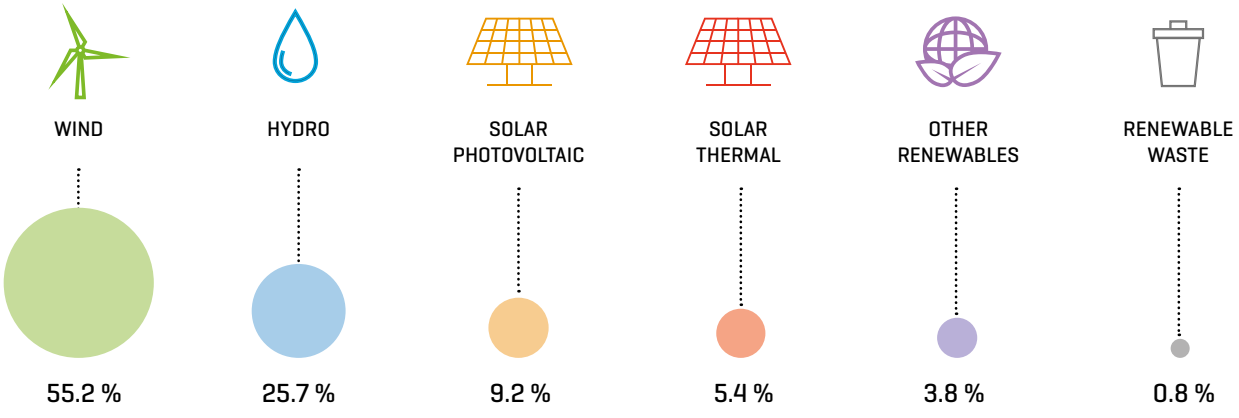
The 9.7% increase in installed wind power capacity in 2019 helped to break several all-time records. On Sunday 3 November 2019 at 5:20 a.m., a new historical record was reached in terms of instantaneous demand coverage with wind power generation in the peninsular electricity system, with a value of 75.97%. On Thursday 12 December 2019 at 4.21 p.m., a new all-time maximum record of wind power generation capacity was reached in the peninsular electricity system, with a value of 18,879 MW. On the same day between 4:00 and 5:00 p.m. hourly wind power energy broke the record with a value of 17,935 MWh.

On Friday 13 December, the maximum daily wind power energy was reached, totalling 397,541 MWh.

In line with previous years, it is worth highlighting the important contribution of wind power generation in the annual generation mix which, with a share of 21.5% of production, is in second place for the fourth consecutive year within the technologies of the complete set of generating facilities, second only to nuclear energy. Furthermore, the annual share of wind power in the peninsular generation mix in 2019 was the highest recorded to date.

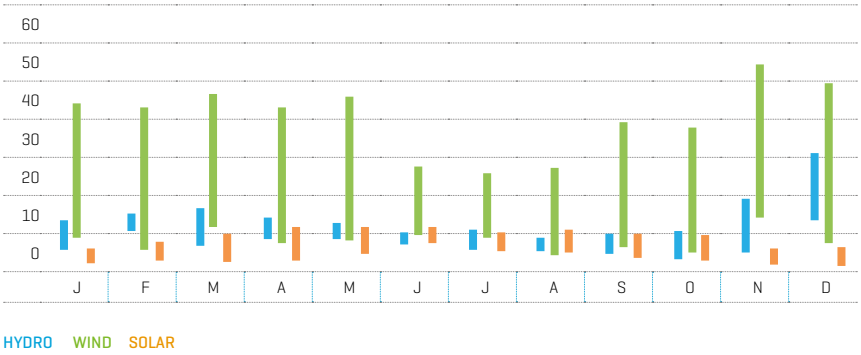
Wind power production was the leading technology in the peninsular generation mix in the months of January (25.5%), May (23.5%), November (34.0%) and December (25.4%). The share of wind power in the November 2019 mix also reached an all-time high, representing 34% of total peninsular generation.

Annual generation mix of renewable energy in the peninsular system in 2019 (%)



The enormous variability of wind power generation can be seen in the graph of maximum and minimum daily coverage of renewable hydro, wind and solar technologies. During 2019, daily wind power production had a share in the generation mix that ranged from a minimum of 2.7% on 28 August to a maximum of 53.5% on 3 November, which was the highest value recorded to date.

Maximum and minimum daily coverage on the peninsular in 2019 using hydro, wind and solar (%)



MAXIMUM AND MINIMUM

DAILY VALUES OF WIND POWER IN THE PENINSULAR GENERATION MIX

MAXIMUM

53.5 %

3 NOVEMBER

MINIMUM

2.7 %

28 AUGUST

In 2019, the hydroelectric power stations on the Spanish peninsula saw their production reduced compared to the previous year.

Peninsular hydroelectric generation in 2019 fell to 24,709 GWh, a 27.6% decrease compared to the previous year, as a result of it being a year with less rainfall. Its contribution to the peninsular generation mix was 10.0%, the same share that this technology had in the 2002 mix. In 2019, the total amount generated by hydroelectric power stations made this technology the fifth largest source of generation, whereas the previous year it was the fourth, with a 13.8% share of the total generation on the Spanish peninsula.

In the comparative graph of peninsular hydroelectric generation 2018-2019, it can be seen that during all the months of 2019, except November and December, hydroelectric generation was lower than both the generation in 2018 and the historical average, calculated with the productions of the last twenty years. In the months of May, April and June, peninsular hydroelectric generation was even reduced to more than half the amount produced in the same months of the previous year, and an all-time low for a month of May was registered with a share of just 9.9%. This situation contrasts with the 86.5% increase in hydroelectric generation in December 2019 and with what happened the previous year, when in the months of April and June hydro was the main source of production in the peninsular energy mix, with contributions of 24.0% and 19.9% respectively.

PENINSULAR HYDROELECTRIC GENERATION

24,709

GWh

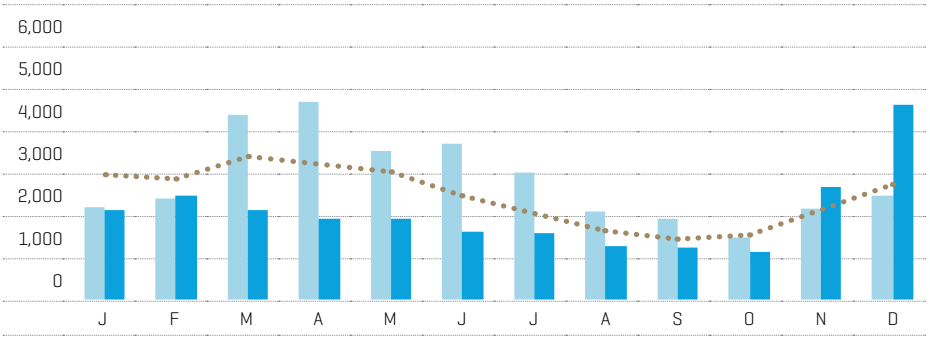
-27.6 %

COMPARED TO 2018

CONTRIBUTION TO THE PENINSULAR GENERATION MIX

10.0 %

Peninsular hydroelectric generation 2018-2019 compared to average generation (GWh)

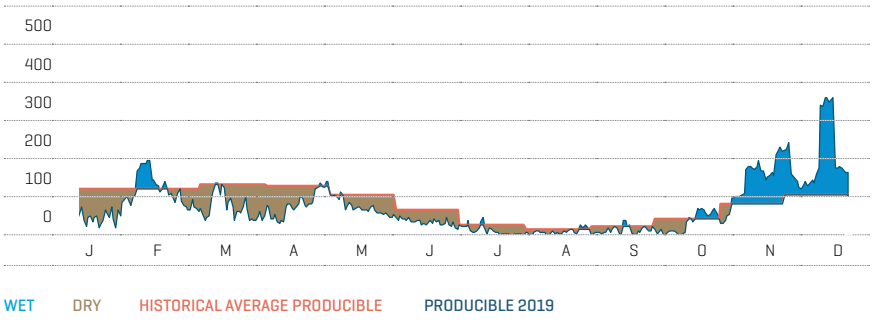


HYDROELECTRIC GENERATION IN 2018 HYDROELECTRIC GENERATION IN 2019 HISTORICAL AVERAGE [1]

[1] Average monthly hydroelectric generation for the last 20 years.

The decrease in hydroelectric generation was in line with the producible hydroelectric energy (maximum quantity of electricity that theoretically could be produced considering the water reserves available), which in 2019 fell to 25,989 GWh, 30.5% less than the value recorded in 2018 and 12.0% less than the annual historical average value. Therefore, we can consider that 2019 as a whole was a dry year as the producible hydroelectric index, defined as the quotient between producible energy and average producible energy, registered a value of 0.9.

Daily producible hydroelectric energy during 2019 compared to the historical average producible (GWh)



HYDROELECTRIC RESERVES IN THE COMPLETE SET OF RESERVOIRS

51.0 %

OF THEIR TOTAL CAPACITY AS AT 31/12/2019

Hydroelectric reserves recovered in December and ended 2019 above the statistical average

In terms of rainfall, after months of less rain 2019 ended as a normal year overall. After a very dry first period of the year from January to October, there was a very wet November and a wet December. As a result, hydroelectric reserves were below the statistical average (calculated with the values of the last twenty years) for almost the whole year. However, the increase in rainfall over the last two months allowed an increase in hydroelectric reserves bringing the volume of water in hydroelectric reservoirs in Spain as at 31 December 2019 to 51.0% of their fill capacity, i.e. 6.9 percentage points higher than the previous year.

Photovoltaic solar generation registered maximum production values.

In 2019, the solar photovoltaic power plants of the peninsular system almost doubled their installed power capacity and increased their production by 19.8%, reaching 8,841 GWh, which represents a new record of annual generation and share in the peninsular generation mix of 3.6%.

During every month of 2019, photovoltaic solar generation was higher than in the same period of the previous year. In addition, monthly production in August was the highest recorded to date with 973 GWh, and during May, June and August the share of this technology reached its maximum value with a contribution of 4.6% in the generation mix.

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

On Saturday 26 October between 1:00 and 2:00 p.m., the hourly solar photovoltaic energy set a record with a value of 4,227 MWh.

Lastly, on Wednesday 25 December 2019 at 1:36 p.m., a new historical maximum was reached in the coverage of demand using photovoltaic generation in the peninsular electricity system with a value of 17.9%.

With regard to solar thermal generation on the Spanish peninsula, in 2019, a total of 5,166 GWh was generated with this technology, 16.8% more than the previous year, and it contributed 2.1% to the total generation on the peninsula.

Similarly, other renewable energies (biogas, biomass, marine and geothermal) were 1.7% produced more than the previous year and accounted for 1.5% of the peninsula's generation mix.

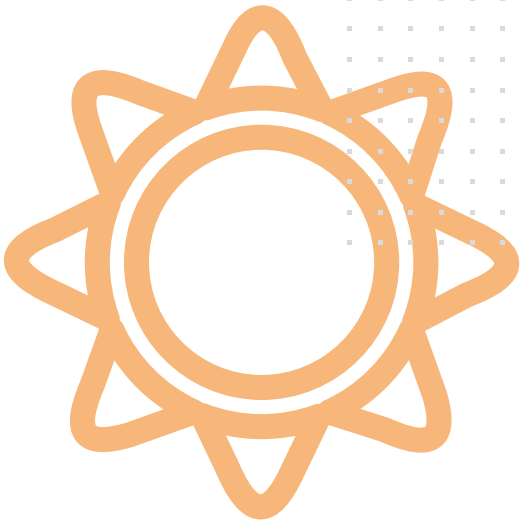
SOLAR PHOTOVOLTAIC POWER PLANTS

8,841
GWh

+19.8 %
COMPARED TO 2018

SHARE IN THE PENINSULAR GENERATION MIX

3.6 %



Non-renewable generation increased due to the higher production from combined cycle.

NUCLEAR POWER GENERATION

55,824
GWh

+4.9 %
COMPARED TO 2018

SHARE IN THE PENINSULAR GENERATION MIX

22.6 %

Non-renewable energy in the peninsular system registered an overall generation of 150,931 GWh in 2019, 2.2% more than in 2018. This increase contrasts with the 10.2% drop experienced last year and has resulted in an increase of 1.2 percentage points in its contribution to total peninsular generation, reaching a share of 61.1% in 2019, compared to 59.8% in 2018.

Among the non-renewable energies, nuclear energy generated a total of 55,824 GWh in 2019, 4.9% more than the previous year. This increase took place mainly during the second quarter of 2019, when nuclear power generation increased by 19.0%, producing 21.2% more in April and 29.4% more in June.

For the ninth consecutive year, nuclear power was the leading source of generation on the Spanish peninsula (in 2013 it shared the lead with wind power). In 2019, its share in the peninsula's generation mix stood at 22.6% (21.5% in 2018).

The utilisation ratio (ratio between actual production and what could have produced if the power stations had operated at their rated power during the entire time they were available) was 97.9%.

Nuclear power stations were the facilities that worked the highest number of hours, 8,040 hours out of the 8,760 hours in the year. Furthermore, 36.3% of the emission-free electricity generated in 2019 was produced thanks to nuclear power.

Annual peninsular electricity generation mix in 2018 and 2019 (%)

	2018	2019
PUMPED STORAGE (NET SUPPLY)	0.8	0.7
NUCLEAR	21.5	22.6
COAL	14.1	4.3
COMBINED CYCLE	10.7	20.7
COGENERATION	11.7	12.0
NON-RENEWABLE WASTE	0.9	0.8
RENEWABLE WASTE	0.3	0.3
WIND	19.8	21.5
HYDRO	13.8	10.0
SOLAR PHOTOVOLTAIC	3.0	3.6
SOLAR THERMAL	1.8	2.1
OTHER RENEWABLES	1.4	1.5

	2018	2019
RENEWABLES	40.2	38.9
NON-RENEWABLES	59.8	61.1

Generation from coal-fired power stations fell to all-time lows.

In the case of coal-fired power stations on the peninsula, their installed power capacity was reduced by 3.6% in 2019, due to the definitive closure in March of the 347 MW Anllares facility in León. At the end of the year, coal accounted for 8.8% of the Spanish peninsula's installed power capacity, compared to 9.7% in 2018.

In 2019, coal-fired power stations on the peninsula generated 10,672 GWh, the lowest value since records began, which represents 69.4% less than the previous year. This decrease was particularly significant in the second half of the year, when coal-fired generation was 85.6% lower than in the same half of 2018. In 2019, noteworthy was that August and September were 90.2% and 89.2% lower than the previous year, respectively.

In 2019, the energy mix showed that Spain is strongly committed to renewables but is also making progress in the decarbonisation process. In 2019, coal represented only 4.3% of the total generation mix, compared to 14.1% in 2018, and was the sixth largest source of generation in the mix. Furthermore, the year closed with an unprecedented event in the history of the peninsular electricity system: the so-called 'zero' coal generation, in other words, a whole day without generating one single MWh with this fossil fuel. This took place on 14 December and was repeated four more days during that month (December 21, 22, 24 and 25).

The coal utilisation coefficient has also decreased, as in 2019 it stood at 14.8%, compared to 45.3% in the previous year.

COAL-FIRED GENERATION

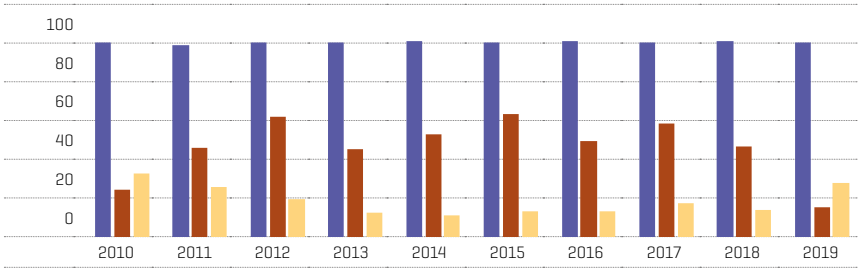
10,672
GWh

-69.4 %
COMPARED TO 2018

SHARE IN THE PENINSULAR GENERATION MIX

4.3 %

Utilisation coefficient of peninsular thermal power stations [1] (%)



[1] The utilisation coefficient is the quotient between actual production and the available production or maximum production that the power station could achieve by operating at its rated power during the entire time they are available.

COMBINED CYCLE GENERATION

51,140
GWh

+93.7 %
COMPARED TO 2018

In 2019, combined cycle power stations produced almost double the previous year's output.

Generation from combined cycle power stations almost doubled in 2019 as they generated 93.7% more than in the previous year. Their annual production was 51,140 GWh, which is similar to the amount produced in 2011. The greatest increases took place in the period from April to October, with production in July tripling that of the same month in 2018.

As a result of this higher production, combined cycle increased its share in the generation mix by 10 percentage points, reaching 20.7% in the peninsular generation mix in 2019 (10.7% in 2018), and was the third largest source of generation. The utilisation coefficient in 2019 stood at 27.1% (13.2% in 2018).

SHARE IN THE PENINSULAR GENERATION MIX

20.7 %

Electricity generation in non-peninsular systems decreased.

ANNUAL ELECTRICITY GENERATION IN THE COMPLETE SET OF NON-PENINSULAR SYSTEMS

13,712
GWh

-2.7 %
COMPARED TO 2018

Annual electricity production in the non-peninsular systems as a whole in 2019 stood at 13,712 GWh, 2.7% less than the previous year. By system, it grew by 0.4% in the Canary Islands, while in the Balearic Islands, Ceuta and Melilla it fell by 8.4%, 0.6% and 1.0%, respectively.

The electricity produced in the Balearic Islands system fell again for the second consecutive year, totalling 4,420 GWh in 2019, 8.4% less than the previous year. Coal-fired power stations reduced their production by 16.5% but continued to be the technology with the greatest share in the Balearic Islands' generation mix, representing 45.2% of the total generated in 2019 (49.7% in 2018).

Diesel generating units reduced their installed power capacity by 23.4% (43 MW) due to the closure of three units at the Ibiza thermal power station. This technology produced 27.0% less than the previous year.

However, due to the entry into commercial operation of the double link between Majorca and Ibiza as of 1 December 2018, the power stations that have reduced their production the most are gas turbine, which in 2019 generated 42.3% less than in 2018, becoming the fourth source of production in the generation mix with a 10.0% share compared to 15.9% in 2018.

On the other hand, combined cycle power stations in the Balearic Islands electricity system generated 77.0% more in 2019 than in 2018. This technology was the second largest source of generation in the Balearic Islands mix, as it increased its share in the generation mix of the Balearic Islands to 23.6%, which was 11.4 percentage points more than the previous year.

The energy transferred to the Balearic Islands from the Spanish peninsula in 2019 increased by 37.4%.

In application of Order TEC/1172/2018, of 5 November, which redefines the isolated electricity systems of the non-peninsular territory of the Balearic Islands and modifies the methodology for calculating the weekly purchase price and selling price of the energy in the dispatching of generation for non-peninsular territories. As of 1 December 2018, the two electricity subsystems of the Balearic Islands, Majorca-Minorca and Ibiza-Formentera, became one single system.

In 2019, this fact meant that the energy transferred from the Spanish peninsula to the Balearic Islands increased by 37.4%, the highest increase in the last five years.

This increase in incoming energy occurred mainly during the second quarter of the year, reaching an increase of 87.2% in April, compared to the same month in 2018.

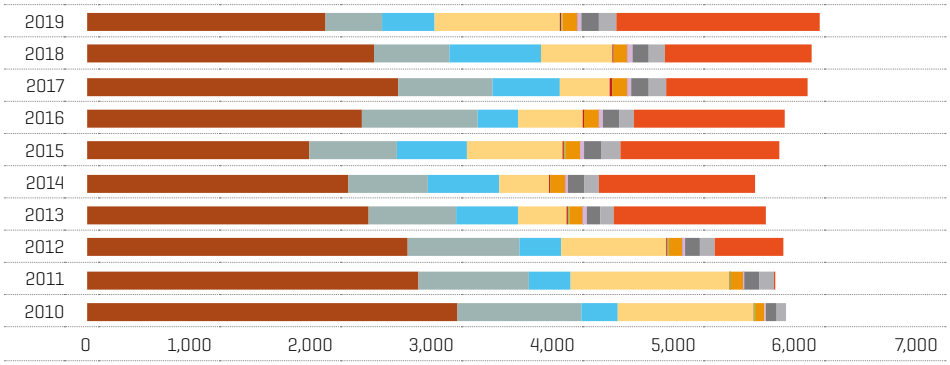
The energy transferred from the peninsular system covered 27.7% of the demand on the Balearic Islands in 2019 and reached peaks of 40% of hourly consumption, which meant savings of around 18% in the costs of covering the Balearic Islands electricity system.

ENERGY EXCHANGES BETWEEN THE SPANISH PENINSULA AND THE BALEARIC ISLANDS

+37.4 %

COMPARED TO 2018

Evolution of the electricity demand coverage on the Balearic Islands (GWh)



COAL DIESEL ENGINES GAS TURBINE COMBINED CYCLE [1] AUXILIARY GENERATION [2] WIND
SOLAR PHOTOVOLTAIC OTHER RENEWABLES COGENERATION NON-RENEWABLE WASTE
RENEWABLE WASTE PENINSULA-BALEARIC ISLANDS LINK [3]

The net production of non-renewable and non-Hydro Management Units (HMU) facilities have their own consumption discounted. In these types of production, negative generation indicates that the electricity consumed for the power station's uses exceeds its gross production.
(1) Includes operation in open cycle mode.
(2) Emergency generators installed temporarily in specific zones to cover a deficit in generation.
(3) Peninsula-Balearic Islands link working at minimum technical level until 31/08/2012.

In 2019, renewable generation on the Canary Islands grew 56.3%.

In 2019, generation in the Canary Islands electricity system grew 0.4% compared to the previous year, increasing to 8,875 GWh. The generation of the power stations that use fossil fuels was reduced by 6.2%, as all the non-renewable technologies, except combined cycle, have produced less during 2019. On the other hand, renewable energy produced in the Canary Islands during 2019 was 56.3% higher than the amount generated in 2018, reaching an all-time record of annual renewable production. As a result, in 2019 the share of renewables in the Canary Islands generation mix was 16.4% compared to 10.5% the previous year.

In July 2019, this generation from renewable sources achieved the highest monthly production recorded to date totalling 192,735 MWh and represented a quarter of the energy generated that month on the Canary Islands. On Saturday 5 October, renewable energy accounted for 43% of the generation mix on the Canary Islands.

The installed wind power generation capacity on the Canary Islands increased over the last year by 3.0%, so that as at 31 December 2019 it represented 70% of the renewable power capacity installed on the islands. In 2019, wind power produced 83% more than the previous year, reaching a maximum value in the generation mix of 12.8%, compared to 7.0% in 2018. The maximum share of this technology was recorded in July 2019, with 20.7% of the total generated on the Canary Islands, and on Saturday 5 October, wind power generation represented 37.9% of the mix.

The development of transmission infrastructure and wind power generation facilities led to new all-time highs in 2019, reaching a record in Tenerife on Sunday 9 June at 11:42 a.m., with 60.6% of the demand being covered by renewables. On Thursday, 31 October the maximum peak in wind power energy was registered in Tenerife with a value of 182.95 MW.

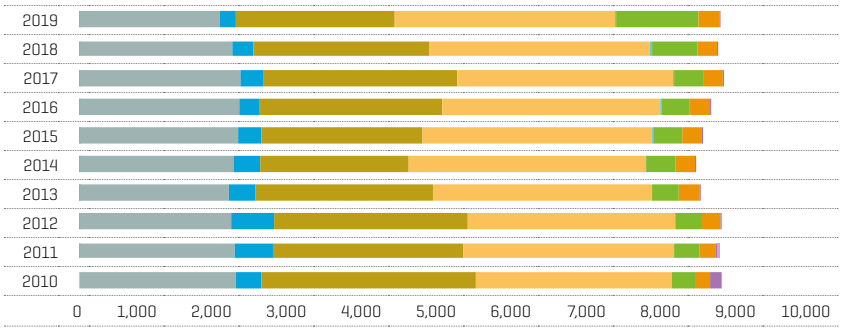
In Gran Canaria, a historical maximum of instantaneous renewable generation was registered on 9 June with a value of 167.79 MW and on Wednesday 17 July a maximum in peak for wind power energy was set with 142.41 MW.

ENERGY PRODUCTION IN THE CANARY ISLANDS ELECTRICITY SYSTEM

8,875
GWh

+0.4 %
COMPARED TO 2018

Evolution of the electricity generation mix on the Canary Islands (GWh)



The net production of non-renewable and non-Hydro Management Units (HMU) facilities have their own consumption discounted. In these types of production, negative generation indicates that the electricity consumed for the power station's uses exceeds its gross production.
(1) Includes operation in open cycle mode. Uses diesel as a primary fuel.
(2) Emergency generators installed temporarily in specific zones to cover a deficit in generation.

New monthly record for the integration of renewables on the island of El Hierro.

For the island of El Hierro, an electricity system that is especially relevant because it has the Gorona del Viento wind-hydro power station, the continuous review of its operating criteria made it possible to achieve even higher levels of renewable integration. Thus, in July, monthly renewable integration in this system reached 97%, achieving 54% for the year as a whole.

INTEGRATION OF RENEWABLE ENERGY ON THE ISLAND OF EL HIERRO

54 %

The electricity demand on the island of El Hierro was covered with 100% renewable energy for more than 24 consecutive days.

Wind enabled the Canary island of El Hierro to cover all of its electricity demand with renewable energy from 13 July to 7 August and thus it reached the milestone of supplying its electricity needs for more than 24 consecutive days with 100% clean generation, surpassing the previous record that was reached between 15 July and 2 August 2018.

During this uninterrupted period of 596.3 hours, the Gorona del Viento wind-hydro power station, with an installed wind power capacity of 11.5 MW, was the main source of electricity generation on the island.

Red Eléctrica de España, the operator of the island's electricity system, and the Gorona del Viento power station work closely together to include operational improvements that enable the maximum use of renewable resources, such as wind and water, and thus optimise its management.

Wind-hydro power plants combine wind generation with pumped-storage hydroelectricity, as they use part of the energy produced by wind to pump water that will later move hydroelectric turbines, in order to make the most of renewable sources of electricity generation. The Gorona del Viento power station is the only one of its kind installed in Spain and is a clear opportunity to reduce dependence on fossil fuels in small electricity systems such as that of El Hierro.

The design of the Chira-Soria pumped-storage hydroelectric power station has the following objectives: integration of renewables, system security and guarantee of supply.

Red Eléctrica de España is the company responsible for developing energy storage projects using pumped-storage hydroelectric power stations whose main purpose is to guarantee the supply, the security of the system and the integration of non-manageable renewable energy into isolated electricity systems.

The Chira-Soria Pumped-storage Hydroelectric Power Station project, designed by Red Eléctrica de España on the island of Gran Canaria, involves the construction of a facility capable of storing surplus renewable generation that cannot be managed in the electricity system, which will occur when the production of this type of energy is high, thus avoiding the curtailment of renewable energy. In this way, it will be possible to take advantage of the stored energy at times of reduced renewable production. The Chira-Soria Pumped-storage Hydroelectric Power Station project by Red Eléctrica also goes one step further. The facility, besides storing a large amount of energy, through its flexibility and control capacity, will be able to meet the objectives that drove its design: the integration of renewables, the security of the system and the guarantee of supply.

With an investment that will exceed 370 million euros, the Chira-Soria pumped-storage hydroelectric power station will have a turbine power rating of 200 megawatts, which represents around 36% of the current peak demand on Gran Canaria. The project includes the construction of a seawater desalination plant and the associated marine works, as well as the necessary facilities for its connection to the transmission grid so as to be able to evacuate this energy into the island's electricity system. During the total duration of the construction of this infrastructure it is estimated that more than 4,300 jobs will be generated, of which almost 1,650 are direct jobs and the rest indirect and induced. Of this total number of jobs, 80% will be generated in the Canary Islands.

With respect to the progress achieved in 2019 in the implementation of the project, it is worth noting that in February the Modified I project was processed, which arose from the need to adapt the original project to the geotechnical conditions obtained from the campaign carried out during 2018. Similarly, the drafting of the Modified I project has allowed changes to be incorporated in order to optimise the operation and functioning of the facility and to incorporate the needs and expectations of the project's stakeholders. In August, the public information and consultation process with organisations was completed, in which the suggestions, arguments and conditioning factors submitted by the project's stakeholders have been addressed. Also, in September the project dossier was presented to the General Directorate for the Fight against Climate Change and Environment of the Canary Islands Government for the beginning of the Environmental Impact Assessment process.

The design and modelling of the Chira-Soria pumped storage hydroelectric power station is carried out using Virtual Design & Construction (VDC) technology, which provides an evolutionary leap forward in the development of construction engineering and control. On the one hand, due to the virtual modelling technology used, adjustments can be made to the design taking into account the true on-site requirements, thus enabling the Company to reduce the volume of paper used for updated printed project documentation. Additionally, the use of virtual reality for the design process allows the optimal usage of construction site locations and enables the geometries of the site to be adjusted, integrating them into the landscape and minimising the visual impacts of the power station, reducing effects on the environment and on the archaeological and ethnographic heritage of the island of Gran Canaria.

The drive towards decarbonisation has led to a reduction in CO_2eq emissions.

One of the main consequences of the drive towards decarbonisation was the fall in CO_2eq emissions associated with national electricity generation, which fell to an all-time low since records began (1990): 50 million tonnes of CO_2eq, 23% less than in 2018. The biggest fall was seen in CO_2eq emissions associated with generation from coal-fired power stations, which in 2019 was 65.6% lower than the previous year. CO_2eq

ALL-TIME MINIMUM LEVEL OF CO_2eq EMISSIONS ASSOCIATED WITH ELECTRICITY GENERATION

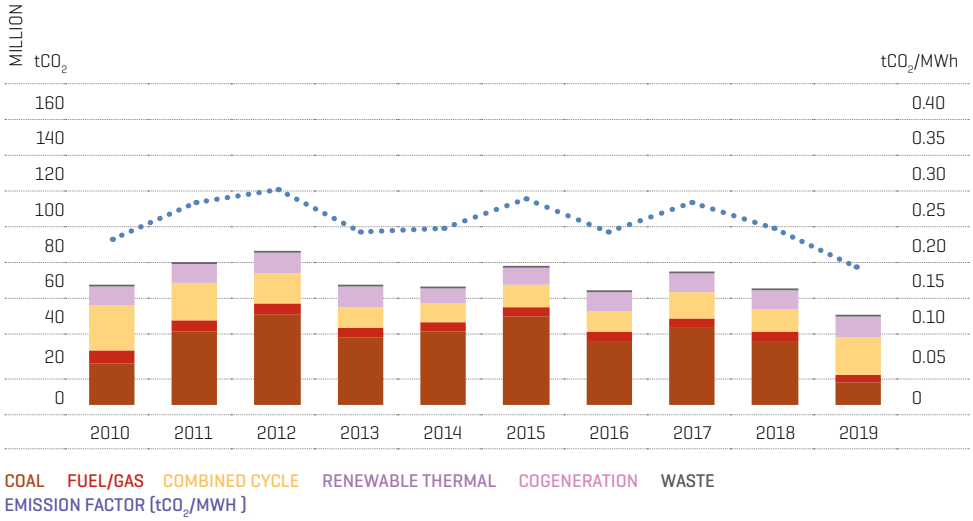
50

MILLION TONNES

-23 %

COMPARED TO 2018

Emissions and CO_2eq emission factor associated with national electricity generation [1]



[1] Includes the Spanish Peninsula, the Balearic Islands, the Canary Islands, Ceuta and Melilla.

GREATEST SHARE OF ELECTRICITY GENERATED NATIONWIDE

45,205

GWh

CATALONIA

BIGGEST INCREASE IN GENERATION

+71.9 %

COMPARED TO 2018

MURCIA

GREATEST SHARE IN RENEWABLE ENERGY GENERATION NATIONWIDE

19.5 %

OF THE NATIONAL TOTAL **CASTILLA Y LEÓN**

GENERATION WITH THE HIGHEST PERCENTAGE OF CO2-FREE GENERATION CO_2

99. 7 %

EXTREMADURA

Aragón registered the largest increase in installed wind power and solar photovoltaic power capacity.

Among the most relevant aspects of electricity generation per Autonomous Community during 2019, the following are noteworthy:

— Catalonia was the region that generated the most energy during 2019, a total of 45,205 GWh and registered an increase of 6.4% with respect to 2018. Most of this generation is without CO_2eq emissions, 68.4%.

— Murcia was the Autonomous Community with the greatest increase in generation in 2019, 71.9% more than in 2018. This growth was mainly due to the increase in combined cycle generation, which produced 132.3% more than last year and represented 65.1% in its generation mix.

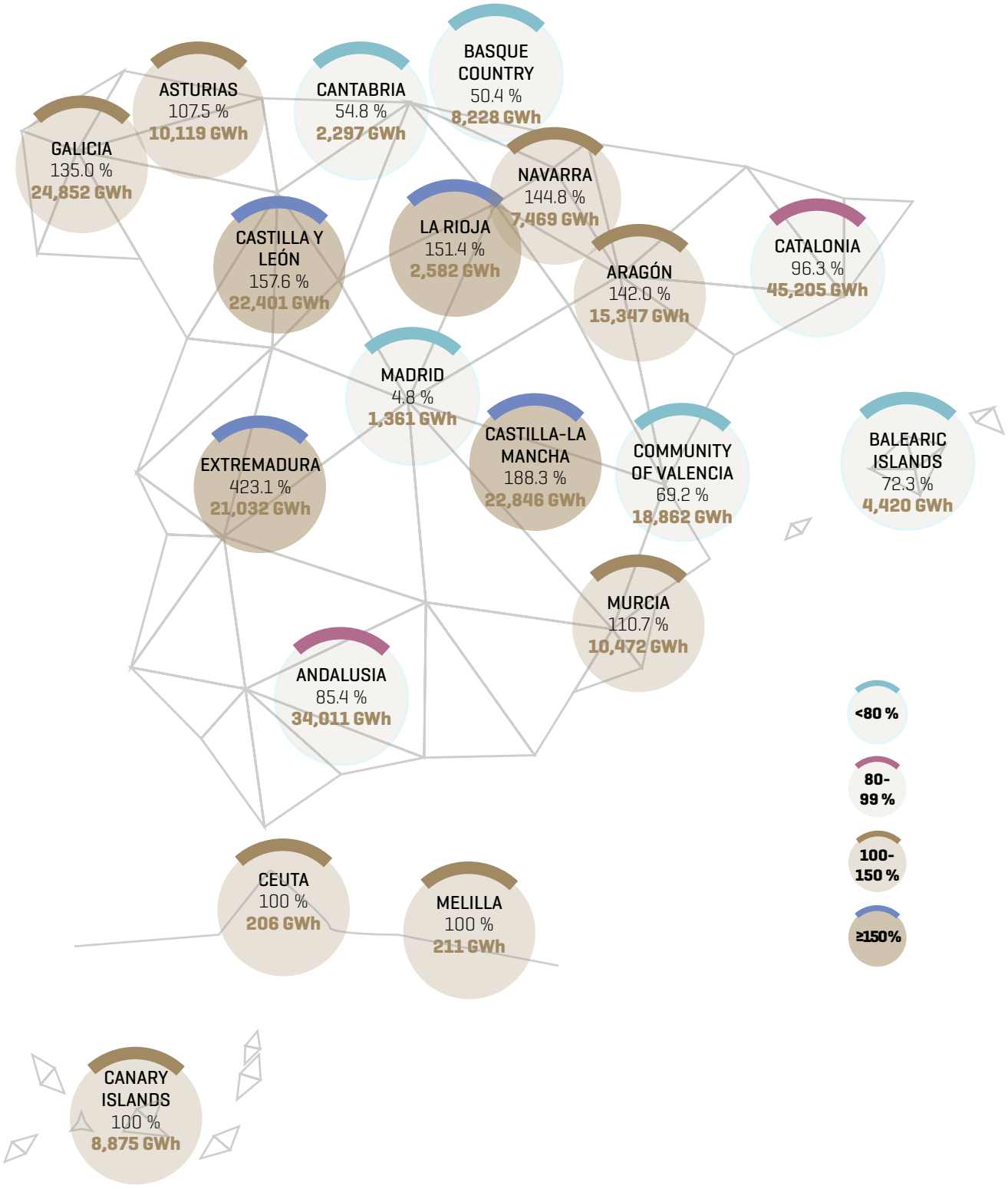
— Castilla y León continued to record the highest production of renewable energy, reaching 19,086 GWh in 2019, which represented 19.5% of the total national renewable generation. Similarly, it was the Community with the highest share of renewables in its generation mix, 85.2% in 2019. 65% of this renewable generation came from wind power. The generation mix was also mainly renewable in Galicia with a share of 65.2%, in Aragón with 54.0% and in Castilla-La Mancha with 53.0%.

— Extremadura had the energy mix with the highest percentage of generation without CO_2eq emissions, as 99.7% of its production comes from technologies free of CO_2 emissions.

— During 2019, nine Autonomous Communities generated more electricity than they consumed, among which noteworthy is Extremadura, where the energy generated was four times greater than its demand. It is followed by Castilla-La Mancha, which produced almost twice the amount needed to meet its demand.

—In relation to installed power capacity, the most significant variations in 2019 occurred in Castilla y León with a decrease in power capacity from coal-fired power stations due to the definitive closure of the 347 MW Anllares power station, and in the Balearic Islands where power capacity was reduced due to the closure of three generating units (with a total of 43 MW) at the Ibiza thermal power station. On the other hand, in Aragón, there were the largest increases in both installed wind power capacity, with an increase of 53.3%, and in solar photovoltaic power plants, which multiplied their installed power capacity by more than four times during 2019.

Electricity generation/demand ratio (%) and generation (GWh) in 2019 per Autonomous Community




3

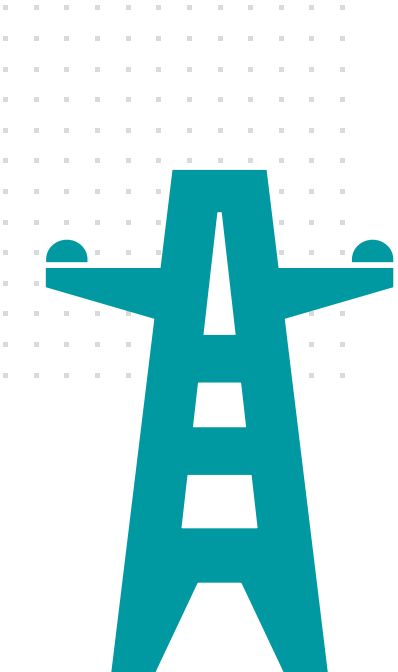
SCHEDULED INTERNATIONAL ELECTRICITY EXCHANGES

The energy import balance in Spain was 38% lower than in the previous year.

For the fourth consecutive year, Spain's electricity exchange programmes with other countries closed the year with an import balance.

6,875 GWh
IMPORT BALANCE 2019

-38 %
COMPARED TO 2018



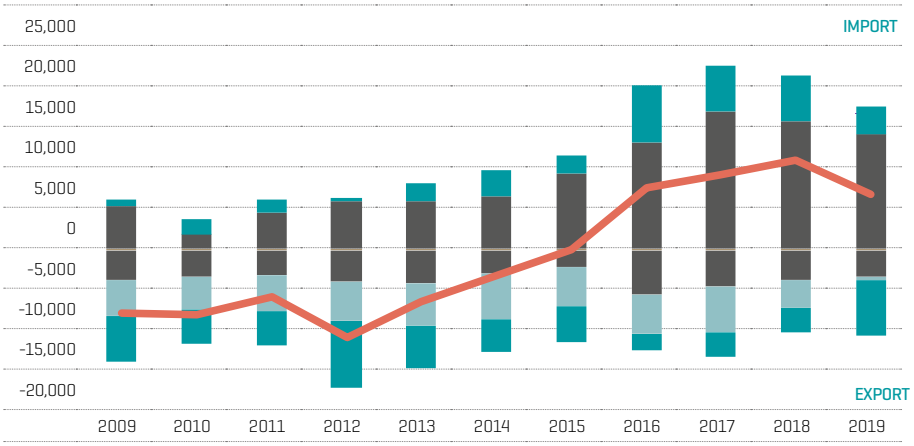
The volume of energy scheduled through the interconnections reached 28,767 GWh, 10.4% less than in 2018. A total of 10,946 GWh was scheduled for export, 4.3% more than the previous year, and a total of 17,821 GWh was scheduled for import, 17.5% less than in 2018.

As in the previous year, the net balance is again as an importer, with a value of 6,875 GWh, 38.0% less than in 2018.

10,946
GWh
IN EXPORT PROGRAMMES

+4.3 %
COMPARED TO 2018

Annual evolution of scheduled international energy exchanges (GWh)

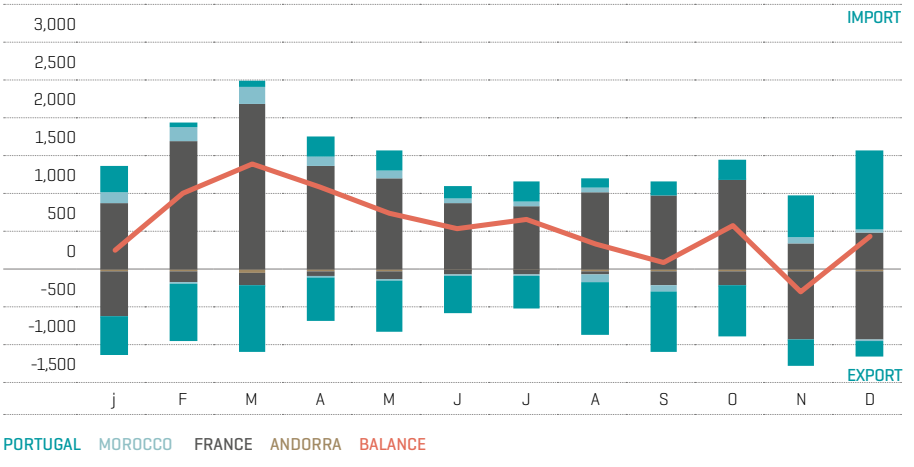


17,821
GWh
IN IMPORT PROGRAMMES

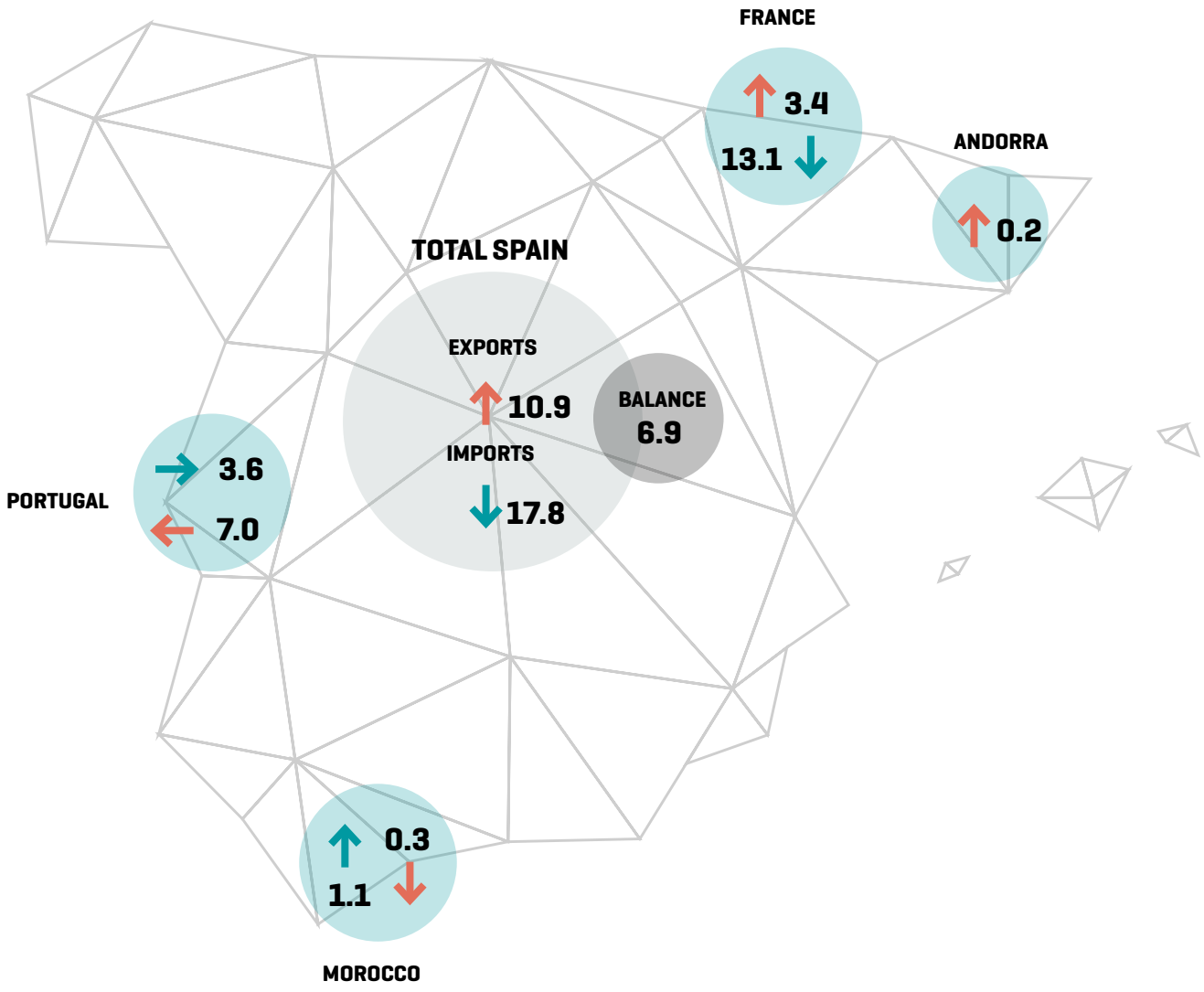
-17.5 %
COMPARED TO 2018

In 2019, the net monthly balance of energy exchanges scheduled in the Spanish interconnections was as an importer, except in the month of November, due to high hydroelectric and wind power generation that caused the balance with France to be as an exporter. The maximum net import balance was registered in March (1,413 GWh).

Monthly evolution of scheduled international energy exchanges in 2019 (GWh)



Scheduled International energy exchanges by interconnection in 2019 (TWh)



The balance of scheduled energy exchanges with Morocco was as an importer for the first time in the history of this interconnection.

FRANCE

9,705
GWh
ENERGY EXCHANGES WITH FRANCE IMPORT BALANCE

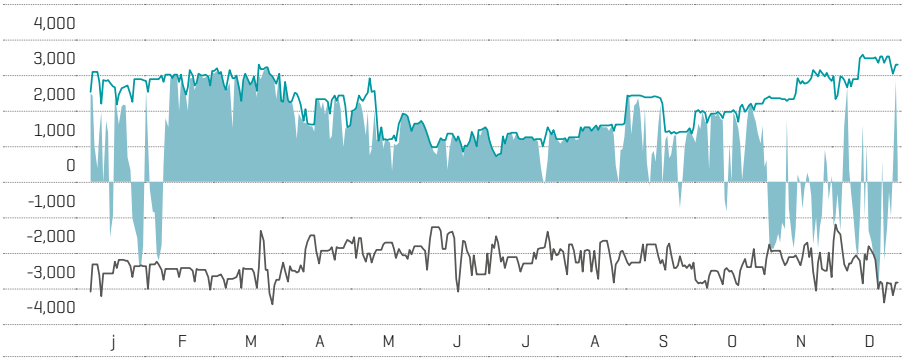
-19.4 %
COMPARED TO 2018

The annual balance of electricity exchanges through the interconnection with France was as an importer with 9,705 GWh, 19.4% less than in 2018. Import programmes totalled 13,119 GWh, 17.1% less than the previous year, and export programmes were 3,414 GWh, 9.6% less than last year. With the exception of November and December, the monthly net balances were as an importer every month.

During 2019, a high-level of utilisation of this interconnection was registered, mainly in the direction from France to Spain (80% of the hours).

Capacity was rather limited from April to October due to works being carried out in France.

Exchange capacity and net balance of scheduled exchanges at the interconnection with France 2019 (MW/MWh)



IMPORT CAPACITY (MW) EXPORT CAPACITY (MW) BALANCE FRANCE (MWH)

13,119
GWh
IN IMPORT PROGRAMMES

-17.1 %
COMPARED TO 2018

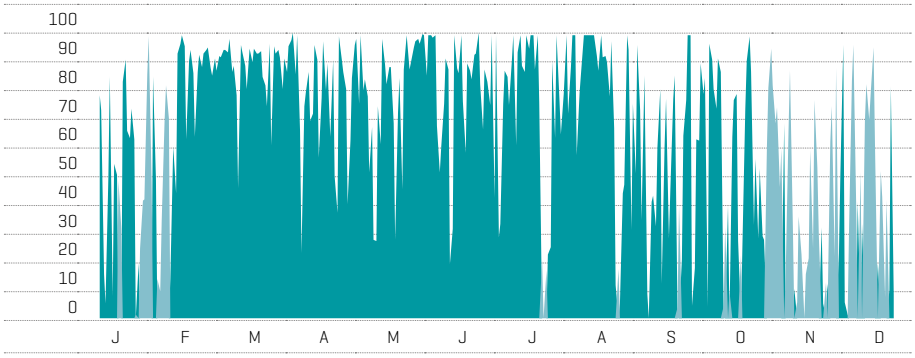
3,414
GWh
IN EXPORT PROGRAMMES

-9.6 %
COMPARED TO 2018

During 2019, a high-level of utilisation of this interconnection was registered, mainly in the direction from France to Spain (80% of the hours).

With regard to the daily use of the daily exchange capacity through the interconnection with France, from February to August it was mostly used in the import direction, and for 85% of the hours the exchange capacity utilisation rate was in excess of 90%. In November and December, utilisation was mainly in the export direction (70% of the hours), primarily due to the high level of hydroelectric and wind power generation in Spain.

Utilisation rate of exchange capacity in the interconnection with France 2019 (%)



UTILISATION OF THE INTERCONNECTION WITH FRANCE WAS IN THE IMPORT DIRECTION FOR A TOTAL OF 7 MONTHS

85 %

OF THE HOURS WITH A UTILISATION RATE IN EXCESS OF

90 %

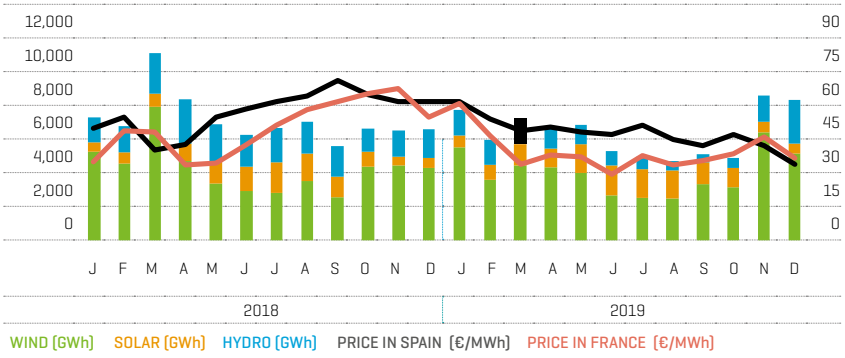
The high level of renewable generation in Spain, the cold spell and the non-availability of French nuclear power plants were determining factors that led to an exporter balance in the interconnection with France in mid-November.

Comparing the evolution of day-ahead market prices in France and Spain with the behaviour of renewable generation in Spain over the last two years, it can be seen that when the latter is high, the price differentials between the two countries are lower.

In November and December 2019, high levels of hydroelectric and wind power generation contributed to a greater share of renewable energy in the generation mix in Spain, resulting in day-ahead market prices in Spain being lower than those in France. In mid-November, a cold spell in France, combined with the high non-availability of French nuclear power, also helped to shift the exchanges to that of an exporter during those days.

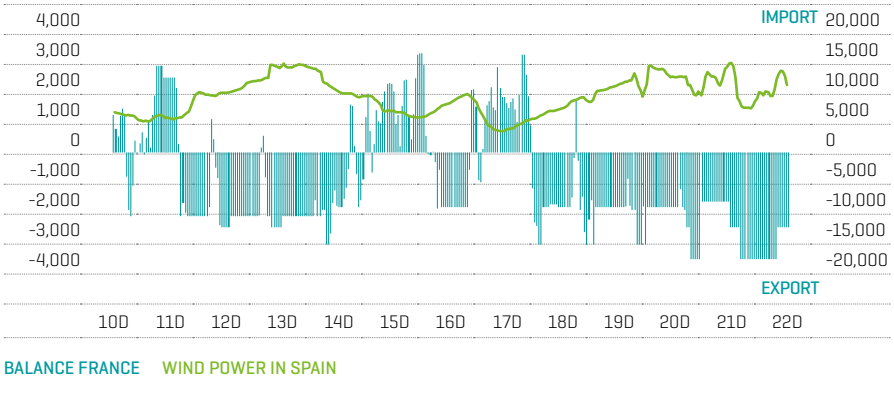
In November and December 2019, high levels of hydroelectric and wind power generation led to a greater share of renewable energy in the generation mix of the Spanish day-ahead market, resulting in prices in Spain being lower than those of France.

Renewable generation in Spain and day-ahead market prices (GWh/€/MWh)



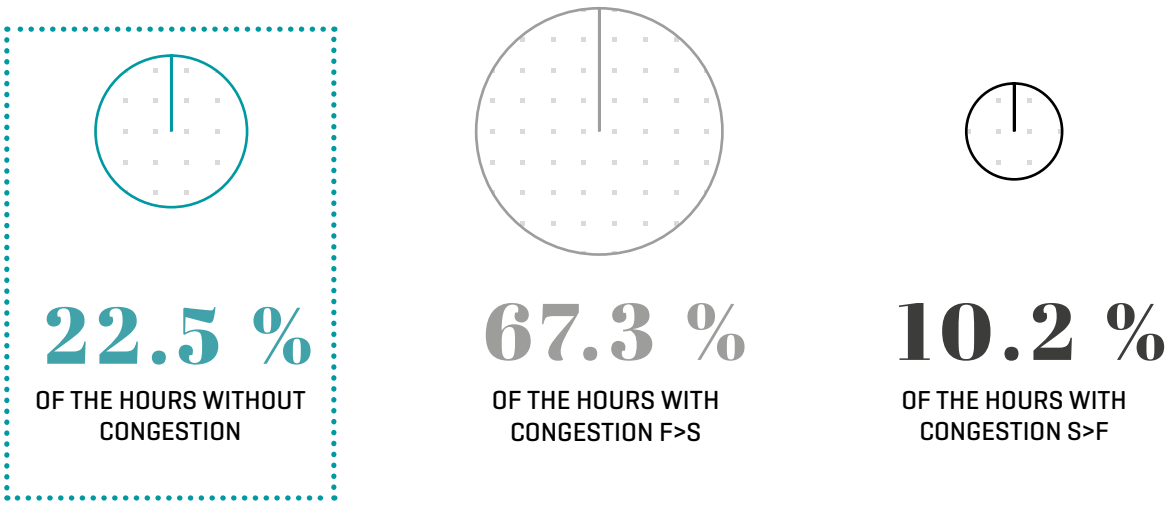
Wind power production influences day-ahead market prices and can have an impact on the direction of exchanges. Thus, in the month of December, the balance of the exchange schedules with France was as an importer when low levels of wind power production were recorded in Spain, while the balance became mostly as an exporter when there was high levels of wind power production.

Net balance of scheduled exchanges in the interconnection and wind power generation in the Spanish peninsular system (10 to 22 December 2019) (MWh)



With regard to the level of utilisation of exchange capacity in the daily horizon, a high rate of utilisation of this interconnection was recorded. Thus, in 4 out of every 6 hours it was congested in the direction from France to Spain, with an average price difference of 13.6 €/MWh; in 10.2% of the hours it was congested in the direction from Spain to France, with an average price difference of 9.3 €/MWh, and in the remaining 22.5% of the hours there was no congestion in this interconnection.

Hours without congestion and with congestion in the interconnection with France in 2019 (%)

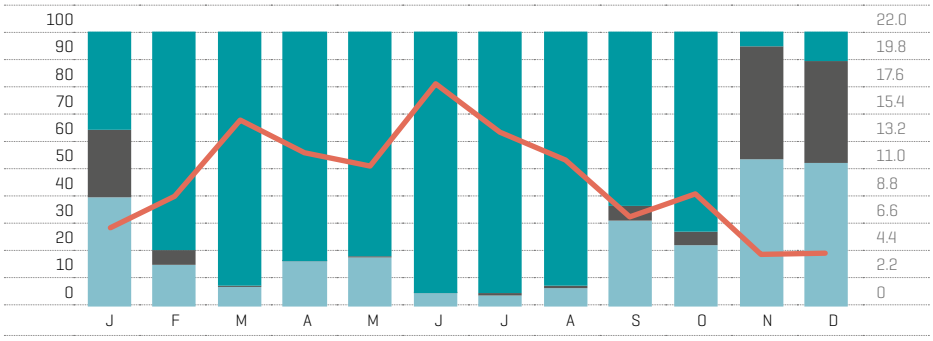


In 2019, only two full days without congestion on the daily horizon were recorded in the interconnection with France. On 81% of the days, congestion was registered for more than 12 hours.

Congestion levels of exchange capacity on the daily horizon were higher in the direction from France to Spain every month, except in November and December when prices in Spain were lower than in France. In January, the price in Spain was slightly higher than in France, but in the second half of the month there were a significant number of days when prices in Spain were lower than in France (high levels of generation with renewables).

The average price differential in absolute terms in 2019 was equal to 10.1 €/MWh.

Hours with and without congestion in the interconnection with France and the average difference in prices of the day-ahead market in 2019 (% and €/MWh)



178.3
MILLION EUROS
IN CONGESTION RENTS FOR THE SPAIN – FRANCE INTERCONNECTION

133.6
MILLION EUROS IN THE IMPORT DIRECTION

44.7
MILLION EUROS IN THE EXPORT DIRECTION

Congestion rents generated in 2019 in cross-border trade through this interconnection totalled 178.3 million euros (133.6 million in the import direction and 44.7 million in the export direction), with 50% of this total corresponding to the Spanish electricity system. This is 20.6% less than the revenue generated in 2018.

With regard to the prices resulting from the exchange capacity auctions, the marginal price of the annual capacity auction for 2019 in the direction Spain → France was equal to 4.36 €/MW, a value which is almost double the price of the capacity in the annual auction for 2018 (2.25 €/MW). In the direction France → Spain, the resulting marginal price was equal to 7.51 €/MW, which is almost 27% lower than the price in that direction in the annual auction for 2018 (10.25 €/MW).

The maximum price of allocated capacity in the monthly auctions was registered in May, in the direction France → Spain with a value of 14.05 €/MW. In the direction Spain → France the maximum price was reached in January with 12.49 €/MW.

Cross-border balancing services, managed via the BALIT platform, have enabled 27 GWh of balancing energy to be scheduled for import and 136 GWh for export via the interconnections with France.

In 2019, coordinated counter-trading actions (exchange programmes, in a counter direction, in order to guarantee already established commercial programmes when faced with reductions in capacity) were required by the operators of the electricity systems in Spain and France, for a total value of 551 GWh, much higher than the 195 GWh scheduled the previous year. This is the maximum value recorded to date.

In 2019, coordinated counter-trading actions were required by the operators of the electricity systems in Spain and France, for a total value of 551 GWh, much higher than the 195 GWh scheduled the previous year. This is the maximum value recorded to date.

PORTUGAL

The annual balance of scheduled energy exchanges in the interconnection with Portugal was as an exporter, reaching 3,395 GWh, compared to the import balance of 2,654 GWh in 2018. The balance had not been as an exporter since 2015. The import programmes totalled 3,640 GWh, a reduction of 35.6% with respect to the previous year, while those for export rose to 7,035 GWh, more than double the figure for 2018 (+134.7%).

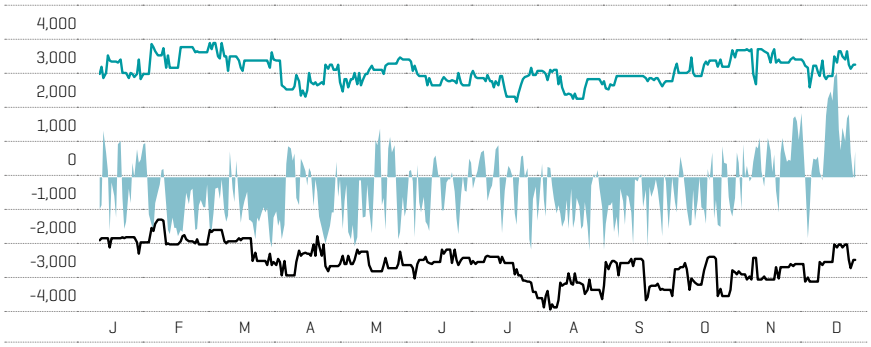
3,395 GWh
ENERGY EXCHANGES WITH PORTUGAL EXPORT BALANCE

3,640 GWh
IN IMPORT PROGRAMMES

7,035 GWh
IN EXPORT PROGRAMMES

+134.7 %
COMPARED TO 2018

Exchange capacity and net balance of scheduled exchanges in the interconnection with Portugal in 2019 (MW/MWh)

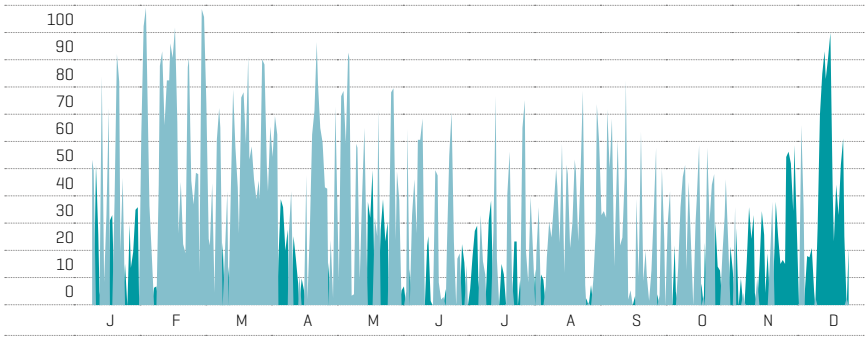


IMPORT CAPACITY (MW) EXPORT CAPACITY (MW) BALANCE PORTUGAL (MWH)

The net balance of programmes was as an exporter every month except November and December. In year as a whole 64% of the hours registered an export balance, with March being the month with the highest number of hours (644 hours). Portugal reduced, by a significant number of hours, the energy import capacity from Spain (Spain → Portugal) in order to integrate the maximum amount of wind power generated in Portugal into its system. December was the month with the most hours of import balance (578 hours).

Regarding the daily utilisation rate of the exchange capacity, in this interconnection there were no days when there was congestion throughout the whole 24-hour period.

Utilisation rate of exchange capacity in the interconnection with Portugal in 2019



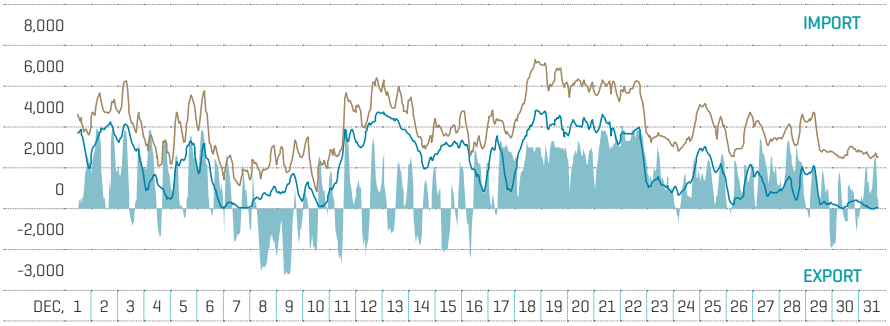
IMPORT EXPORT

Hydroelectric and wind power generation significantly influenced the scheduled balances in the interconnection with Portugal.

The import balances are largely due to high hydroelectric and wind power generation in Portugal. This year the producible hydroelectric power index was 0.81 and the wind power index was 1.07[1]. December was the month with the highest import balance and also the month with the highest producible hydroelectric power index in the Portuguese system (1.77). November, the other month with an import balance, had the highest producible wind power index of the year (1.54) and a high hydroelectric power index (1.15) in the Portuguese system. March was the month with the highest export balance and coincides with low wind power and hydroelectric power indexes.

Both hydroelectric and wind power generation in the Portuguese system significantly influenced the scheduled balances in the interconnection with Portugal. As an example, it can be seen how in a month with high wind and hydroelectric power production in Portugal (such as December), the balance is as an importer, while in months with low production it is as an exporter, or a with low importer balance.

Balance of scheduled exchanges in the interconnection and wind power & hydroelectric generation in Portugal in 2019 (MWh)



In the daily horizon, the coupling rates (or without congestion) registered in the interconnection with Portugal in 2019 were high, resulting in a percentage of hours with congestion of less than 6% in the day-ahead market. Consequently, prices in both systems were very similar, with the average price differential in absolute terms being 0.23 €/MWh.

LESS THAN 6 % OF THE HOURS WITH CONGESTION

[1] Source: REN (http://www.centrodeinformacao.ren.pt/PT/InformacaoExploracao/Paginas/EstatisticaMensal.aspx)

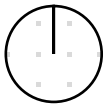
Hours without congestion and with congestion in the interconnection with Portugal in 2019 (%)

94.8 %

OF THE HOURS WITHOUT CONGESTION

1.0 %

OF THE HOURS WITH CONGESTION P>S

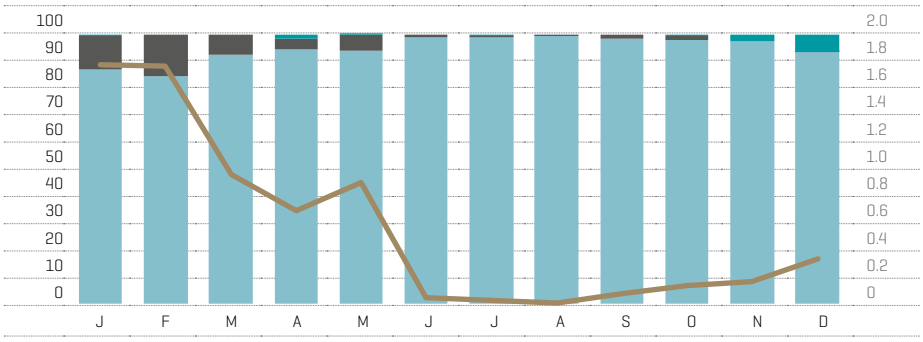


4.2 %

OF THE HOURS WITH CONGESTION S>P

The monthly evolution shows that August was the month with the highest coupling rate, while February saw the highest percentage of hours with congestion, with almost 16% of the hours and an average price differential in absolute terms of 0.7 €/MWh.

Monthly congestion levels and average difference in prices in the interconnection with Portugal in 2019 (% and €/MWh)



Congestion rents in cross-border trade through this interconnection reached almost 4.4 million euros, with 61% coming from the day-ahead market, 3% from the intraday market and 12% from each of the auctions (annual, quarterly and monthly). 50% of this amount corresponds to the Spanish electricity system.

2019 was the first year in which financial capacity rights were assigned in the three long-term horizons (annual, quarterly and monthly). In addition, capacity auctions were carried out through the European platform, in compliance with the 'Forward Capacity Allocation' Directive.

The management of cross-border balancing services have enabled 66 GWh of balancing energy to be scheduled for import and 70 GWh for export through this interconnection.

In 2019, it was necessary to apply coordinated counter-trading actions for a total value of 4,838 MWh, 65% were scheduled in the import direction and the remaining 35% in the export direction.

4.4

MILLION EUROS

IN CONGESTION RENTS IN THE SPAIN - PORTUGAL INTERCONNECTION

61 %

DAY-AHEAD MARKET

MOROCCO

774
GWh
ENERGY EXCHANGES WITH MOROCCO IMPORT BALANCE

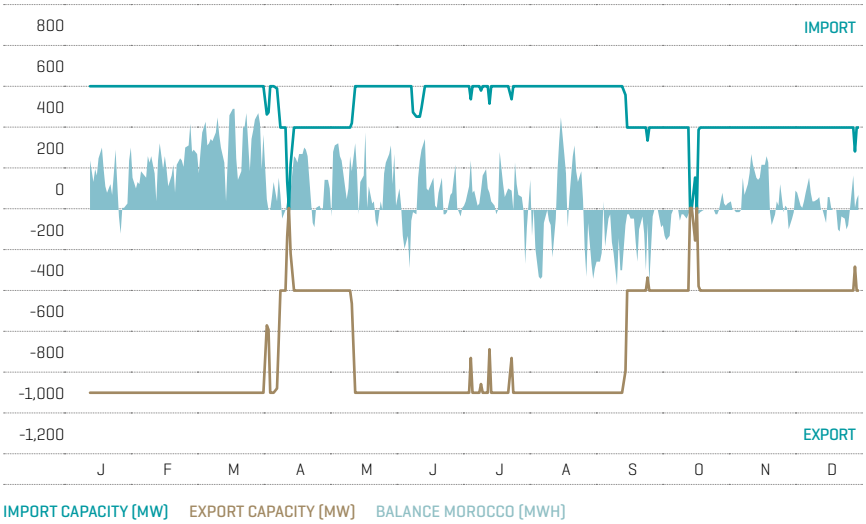
1,351
GWh
VOLUME OF ENERGY

The annual balance of the scheduled exchanges with Morocco was as an importer for the first time in the history of this interconnection, with a value of 774 GWh, compared to 3,395 GWh in exports last year. The months of August to October are the only ones with a net balance as an exporter, while the rest of the months the net balance is as an importer. The volume of energy was 1,351 GWh, 62.9% less than last year and the lowest since the two interconnection circuits were commissioned.

The average utilisation rate of the exchange capacity of this interconnection changed with respect to previous years, registering exports of just 5%, a value significantly lower than the 45% registered the previous year. As an importer, its utilisation rate was 22%, much higher than 2% rate in 2018.

The reductions in the exchange capacity through this interconnection were due to the non-availability of one of the two links that make up this interconnection or a direct line of influence. As of mid-September, the capacity of this interconnection was limited to 400 MW in both directions, as circuit 2 was rendered inoperative. In April and the first few days of May, capacity was also reduced to 400 MW due to works that needed to be carried out. On 5 April and on 12, 13 and 15 October, there was no capacity due to the non-availability of both interconnection circuits.

Exchange capacity and net balance of scheduled exchanges in the interconnection with Morocco in 2019 (MW/MWh)



ANDORRA

The annual balance of the electricity exchanges scheduled in the interconnection with Andorra was as an exporter, with a value of 208 GWh, which represented a reduction of 1.0% with respect to 2018. The average utilisation rate of the exchange capacity of this interconnection in the export direction was 20%.

208
GWh
ENERGY EXCHANGES WITH ANDORRA EXPORT BALANCE

-1 %
COMPARED TO 2018

Exchange capacity and net balance of scheduled exchanges in the interconnection with Andorra in 2019 (MW/MWh)

IMPORT CAPACITY (MW) EXPORT CAPACITY (MW) BALANCE ANDORRA (MWH)

ELECTRICITY TRANSMISSION

The development of more robust, smart and interconnected grids will help to integrate the largest possible amount of renewable generation, guarantee security of supply and ensure quality of service.

During 2019, the transmission grid was bolstered due to the commissioning of facilities that contribute efficiently to the decarbonisation of the economy and the energy transition.

44,453
KM
TOTAL LENGTH OF LINE CIRCUIT IN THE NATIONAL GRID

93,735
MVA
INSTALLED TRANSFORMER CAPACITY NATIONWIDE

DRIVING THE ENERGY TRANSITION

TRANSMISSION GRID

198

KM

NEW LINE CIRCUIT COMMISSIONED IN 2019

INCREASE IN TRANSFORMER CAPACITY

1,335

MVA

IN 2019

During 2019, the transmission grid was bolstered due to the commissioning of facilities that contribute efficiently to the decarbonisation of the economy and the energy transition, the aim of which is to integrate the largest possible amount of renewable generation, guarantee the security of supply and ensure the quality of the service, through the development of more robust, smart and interconnected grids.

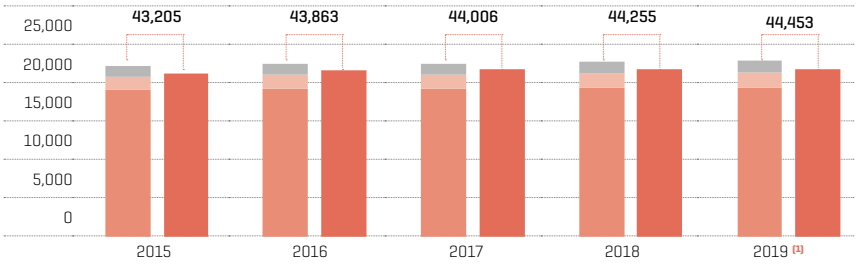
198 kilometres of line circuit and 168 substation bays were commissioned, bringing the total circuit length of the national grid to 44,453 kilometres and there were 6,086 substation bays by the close of the year. Regarding transformer capacity, this increased by 1,335 MVA, bringing the total installed transformer capacity nationwide to 93,735 MVA.

Facilities in the electricity transmission grid in Spain

	400 kV	≤220 kV			Total
	Peninsula	Peninsula	Balearic Islands	Canary Islands	
Total lines (km)	**21,736**	**19,295**	**1,873**	**1,549**	**44,453**
Overhead lines (km)	21,619	18,545	1,141	1,235	42,541
Submarine cable (km)	29	236	540	30	835
Underground cable (km)	88	513	192	283	1,077
Transformer capacity (MVA)	**84,864**	**1,563**	**3,838**	**3,470**	**93,735**

Provisional data pending audit (currently underway).
Accumulated data for kilometres of line circuit and for transformer capacity as at 31 December 2019

Evolution of the electricity transmission grid in Spain (km of circuit)



(1) Provisional data pending audit (currently underway).

Among the projects carried out in 2019, the following are noteworthy and are listed according to the geographical area in which the work was carried out:

Andalusia: The 220 kV Don Rodrigo substation was enlarged to connect and evacuate generation coming from renewable sources. In addition, the 220 kV Santa Elvira substation and the 220 kV Santa Elvira-Alcores double circuit were commissioned to support the distribution network in the area. Also noteworthy was the incorporation of the 220 kV Gazules-Parralejo overhead line into the transmission grid, which will improve the security of supply, assist in the evacuation of renewable energy and boost support for the area's distribution network. Lastly, a new 400/220 kV transformer unit was commissioned at the 400 kV Palos substation to resolve technical constraints in the area.

Aragón: the 220 kV Mezquita and 220 kV Muniesa substations were both enlarged. The aim of these enlargement works was to increase the possibilities of evacuating generation coming from renewable sources.

Balearic Islands: to improve the security of supply in the Palma de Mallorca area, the following were commissioned; the 220/66 kV Son Moix substation and its connection through the incoming-outgoing feeder lines to the 220 kV Son Reus-Valldurgent circuit and via a double underground circuit to the 66 kV Rafal substation. The 66 kV Rafal-Coliseo and Falca circuits were also relocated to the 66 kV Son Moix substation. Lastly, in Ibiza, the 132 kV Ibiza-Torrent circuit was commissioned to improve the security of supply on this island.

Canary Islands: Noteworthy was the strengthening of the interconnection of the Lanzarote-Fuerteventura electricity subsystem with the commissioning of the 132 kV La Oliva-Puerto del Rosario double circuit, as well as the incorporation of two 132/66 kV transformers and a 132 kV reactor at the Playa Blanca substation.

Castilla-La Mancha: A substation bay was commissioned in the 220 kV Villares del Saz substation to support distribution. Similarly, progress was made in terms of the administrative permitting procedures and works regarding the change of configuration of the 220 kV Talavera substation, as well as in the rest of the actions proposed in the 2015-2020 Planning.

Castilla y León: Construction work continued on the 400 kV Tordesillas-Galapagar-San Sebastián de los Reyes (SUMA) axis to improve grid meshing between Castilla y León and Madrid. Enlargement of the 220 kV Tordesillas and the 400 kV Mudarra substations for the connection and evacuation of renewable generation were brought into service. Security of supply in the Soria area was improved with the commissioning of the 220 kV Magaña substation (Incoming/Outgoing feeder lines for the 220 kV Oncala-Trévago line) and the new 220 kV Magaña-Moncayo line. Lastly, to improve voltage-level control, the second 400 kV reactor was commissioned in the Aldeadávila substation.

Catalonia: Progress continued to be made in strengthening the transmission grid around the Barcelona metropolitan area, with the completion of the planned development of the 220 kV Gramanet dual-node and its 220 kV Rubí and Sant Just connections. On the other hand, progress was made in strengthening the transmission grid of Gerona with the adaptation of the 220 kV Mas Figueres substation.

Extremadura: A substation bay was commissioned in the 220 kV Trujillo substation for the evacuation of renewable energy. At the same time, progress continued to be made in terms of the administrative permitting procedures and works for two new substations: the 400 kV Cañaveral and the 400 kV Carmonita facilities, to provide power for the high-speed train.

Levante: The 220 kV La Eliana B dual-node was commissioned to improve the reliability of the system, as well as the commissioning of the 220 kV La Eliana B-Feria de Muestras circuit, a reactor in the 400 kV La Eliana substation and another in the 400 kV Torrente substation. The 220 kV El Palmeral-Torrellano line (change of topology) and the 220 kV Saladas-Torrellano double circuit were also commissioned to improve the reliability of the system and provide power for main railway lines.

Central area: The 400 kV Morata, the 400 kV San Sebastian de los Reyes and the 220 kV Arroyo de la Vega reactors were commissioned as part of the plan to install new reactors to control electrical voltage in the Community of Madrid. The relocation of substation bays from the 220 kV Villaverde substation to the 220 kV Villaverde Bajo substation also continued. Construction work also continued on the 400 kV Tordesillas-Galapagar-San Sebastian de los Reyes (SUMA) axis to improve grid meshing between Castilla y León and Madrid. Similarly, of the administrative permitting procedures continued for those actions (support for distribution, dual-nodes, bypasses), that help increase system reliability in the area, by providing support for demand coverage, in addition to controlling short-circuit power. Lastly, progress continued to be made on the administrative permitting procedures and work related to the remaining actions planned in the 2015-2020 Planning.

Northern area: Construction of the 400 kV Güeñes-Ichaso double circuit continued in the Basque Country. This action forms part of the axis that, passing through Ichaso, will connect the west of the Basque Country (Abanto-Güeñes axis) with the 400 kV grid of Navarra (Muruarte-Castejón axis). This strengthening will enable an increase in energy evacuation capacity and greater integration of renewable energies, as well as ensuring the agreed levels of exchange capacity between Spain and France. In Galicia, in order to increase the connection and evacuation of renewable energy generation, the enlargement of the 220 kV Regoelle, the 220 kV Mesón Do Vento and 400 kV Ludrio substations were brought into service.

COMMISSIONING OF THE
132 kV
IBIZA-TORRENT
LINE CIRCUIT

NEW
220 kV
MONCAYO-MAGAÑA
LINE CIRCUIT

COMMISSIONING OF THE
132 kV
LA OLIVA-PUERTO DEL ROSARIO
DOUBLE-CIRCUIT IN THE LANZAROTE-FUERTEVENTURA ELECTRICITY SUBSYSTEM

INTERNATIONAL INTERCONNECTIONS

Interconnections are key elements in the energy transition. Their role is key to achieving greater integration of renewable energy and advancing along the road to decarbonisation, so the strengthening of interconnections has been and is a priority in the development of the transmission grid for the coming years.

The last interconnection commissioned between Spain and France (Baixas-Santa Llogaia) doubled the electricity exchange capacity between Spain and France (from 1,400 MW to 2,800 MW), which has contributed to strengthening the security of the two electricity systems and to boosting the integration of a greater volume of renewable energy, especially wind power generated within the Iberian system. However, and despite this increase, the degree of interconnection of our country is still far below the targets set by the European Union of 10% and 15%, for 2020 and 2030, respectively.

The Spanish Integrated National Energy and Climate Plan (NECP) makes this clear and proposes increasing the exchange capacity by exceeding 3,000 MW with Portugal and reaching up to 8,000 MW with France, by means of three new electricity interconnections. The interconnection between Gatika (Spain) and Cubnezais (France) will basically be the first submarine interconnection between Spain and France ('Bay of Biscay' project); and there are two further projects via the Pyrenees[1],

(1) The three projects were endorsed by the Heads of State and Government of Portugal, Spain and France, as well as by representatives of the European Commission (EC) and the European Investment Bank (EIB) within the framework of the two Summits on interconnections held in 2015 (Madrid Declarations) and in Lisbon in 2018 (Lisbon Declarations). The three projects have been classified as Projects of Common Interest (PCI) approved by Commission Delegated Regulation (EU) 2020/389 of 31 October 2019 amending Regulation (EU) No 347/2013 of the European Parliament and of the Council as regards the Union's list of Projects of Common Interest. Published in Spain's Official State Gazette (BOE) on 11 March 2020.

EUROPEAN UNION TARGET OF

15 %

REGARDING INTERCONNECTION CAPACITY FOR 2030

The Spanish Integrated National Energy and Climate Plan (NECP) proposes increasing the exchange capacity by exceeding 3,000 MW with Portugal and reaching up to 8,000 MW with France, by means of three new electricity interconnections.

SERVICE QUALITY

PENINSULAR ELECTRICITY SYSTEM

-50 %

ELECTRICITY SUPPLY INTERRUPTIONS COMPARED TO 2018

0.10
MINUTES

AIT VALUE IN 2019

Service quality indicators for 2019 improved with respect to the previous year, with the exception of the Canary Islands system where a specific incident occurred on the island of Tenerife, which had a particular impact on the corresponding indicators.

The key indicators of global quality according to Royal Decree 1955/2000 are Average Interruption Time (AIT) and Non-Supplied Energy (ENS).

In 2019 only 7 supply interruptions were recorded in the peninsular electricity system, 50% less than in 2018. This was reflected in the ENS, which showed a significant improvement compared to the previous year (47 MWh in 2019 compared to 250 MWh in 2018). Similarly, the AIT, with a value of 0.10 minutes (0.52 minutes in 2018), is well below the reference value of 15 minutes established by Article 26.2 of Royal Decree 1955/2000. The main incident occurred in the 220 kV La Canonja facility with an ENS of 19 MWh.

Energy not supplied (ENS) and average interruption time (AIT) of the transmission grid

	ENS (MWh)			AIT (minutes)		
	Peninsula	**Balearic Islands**	**Canary Islands**	**Peninsula**	**Balearic Islands**	**Canary Islands**
2015	53	29	150	0.11	2.66	9.08
2016	78	0.3	457	0.16	0.03	27.45
2017	60	33	47	0.13	2.88	2.75
2018	250	38	63	0.52	3.27	3.77
2019[1]	**47**	**1**	**2,626**	**0.10**	**0.09**	**155.52**

ENS: Energy not supplied. AIT: Average interruption time.
Average Interruption Time (AIT) = Energy Not Supplied (ENS) / Average System Power.
(1) Provisional data pending audit (currently underway).

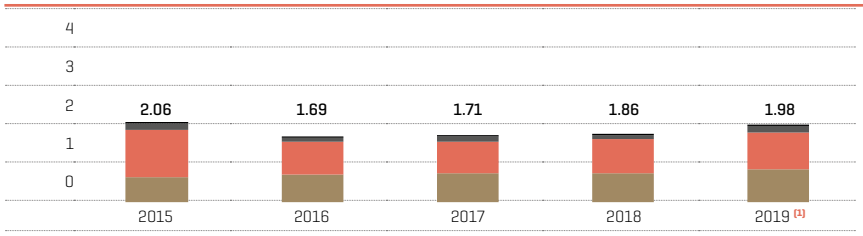
In the Balearic Islands electricity system, the continuity of supply indicators for 2019 also showed a clear improvement over the previous year. A single supply interruption was recorded, resulting in an ENS of 1 MWh (38 MWh in 2018) and an AIT of 0.09 minutes (3.27 minutes in 2018). The opposite occurred in the Canary Islands electricity system, with an ENS of 2,626 MWh (corresponding to 3 supply interruptions) and an AIT of 155.52 minutes, largely due to the incident that occurred on 29 September when there was a zero voltage event on the island of Tenerife, originating in the 66 kV Granadilla substation.

The quality of the transmission grid is also assessed on the basis of the availability of its facilities. Availability measures the capacity or possibility of use by the system of the different elements of the transmission grid, these being the electricity line circuits, transformers and active or reactive power control elements (reactors and capacitors). The availability rate is calculated as the difference between 100 and the non-availability rate of the transmission grid.

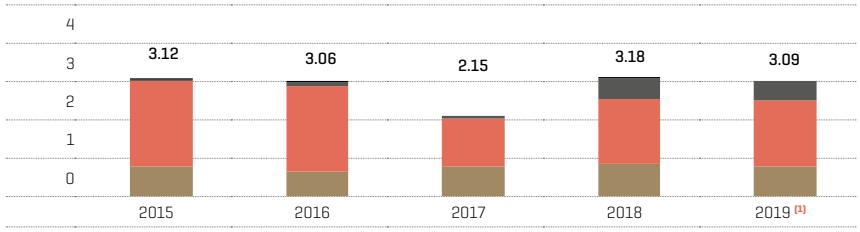
The following graphs show the evolution of the non-availability rate indicator over the last five years. The availability rate

of the peninsular transmission grid in 2019 reached a value of 98.02%, slightly lower than the 98.14% in 2018. In the Balearic Islands and the Canary Islands systems, the grid availability rate was 96.91% (96.82% in 2018) and 98.90% (98.79 % in 2018) respectively. Although the accumulated availability rate of the Balearic Islands system improved with respect to the previous year, it ended the year below 97%, due mainly to the non-availability of the Majorca-Menorca link and other scheduled non-availabilities as a result of actions to improve grid assets.

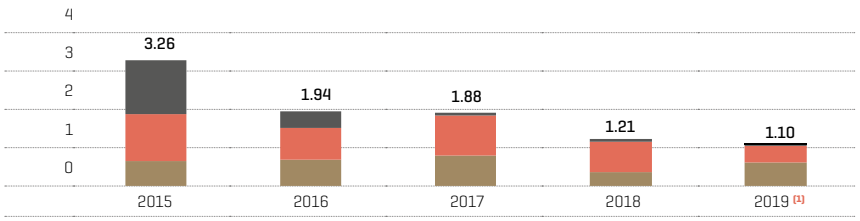
Annual evolution of the non-availability rate of the peninsular transmission grid (%)



Annual evolution of the non-availability rate of the Balearic Islands transmission grid (%)



Annual evolution of the non-availability rate of the Canary Islands transmission grid (%)



PROGRAMMED FOR PREDICTIVE AND PREVENTATIVE MAINTENANCE
PROGRAMMED FOR CAUSES NOT DUE TO MAINTENANCE
NON-PROGRAMMED DUE TO CORRECTIVE MAINTENANCE
NON-PROGRAMMED DUE TO FORTUITOUS CIRCUMSTANCES

Note: Classification according to RD 1955/2000. The total non-availability rate of the transmission grid does not include non-availabilities due to force-majeure or third-party actions.
(1) Provisional data pending audit (currently underway).

TRANSMISSION GRID AVAILABILITY RATE IN 2019

PENINSULAR

98.02 %

BALEARIC ISLANDS

96.91 %

CANARY ISLANDS

98.90 %

ELECTRICITY MARKETS

The impact of ancillary services on the average final price of energy was 1.46 €/MWh, 37.9% less than in 2018 and the second lowest price since the electricity markets began (after 1999).

The average final price of energy in the electricity markets in 2019 was 17.0% lower than the price in 2018, the fourth lowest price in the last twelve years.

TOTAL ENERGY MANAGED IN THE ELECTRICITY MARKET

-1.8 %

COMPARED TO 2018

IMPACT OF THE DAY-AHEAD AND INTRADAY MARKET IN THE COMPOSITION OF THE FINAL PRICE OF ENERGY COMPARED TO 2018

- 16.4 %

AVERAGE FINAL PRICE OF ENERGY IN THE ELECTRICITY MARKET

53.4

€/MWh

-17.0 %

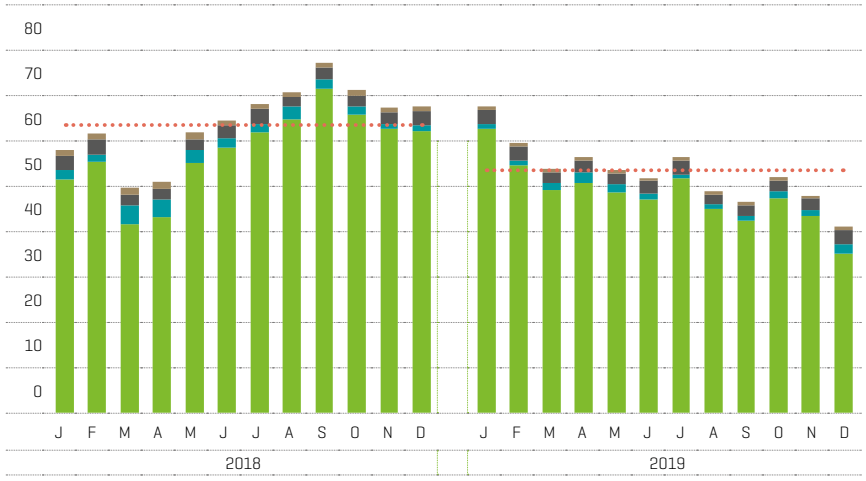
COMPARED TO 2018

During 2019, the total energy managed in the electricity market (reference supply plus free contracting) was 1.8% lower than the previous year.

The average final price of energy in the electricity market stood at 53.4 €/MWh in 2019, 17.0% lower than the price in 2018. It is lower than in the previous two years and the fourth lowest of the last twelve years, but it is far from the all-time minimums recorded in the first years of the market (1998 and 1999) and 2004 (around 35 €/MWh).

Comparing month by month, it can be seen how, in February and from May to December, the final prices were lower than in the same months of the previous year. Noteworthy was the fall that occurred in the last five months, with an average reduction of 33%.

Components of the average final price of energy in the electricity market (€/MWh)

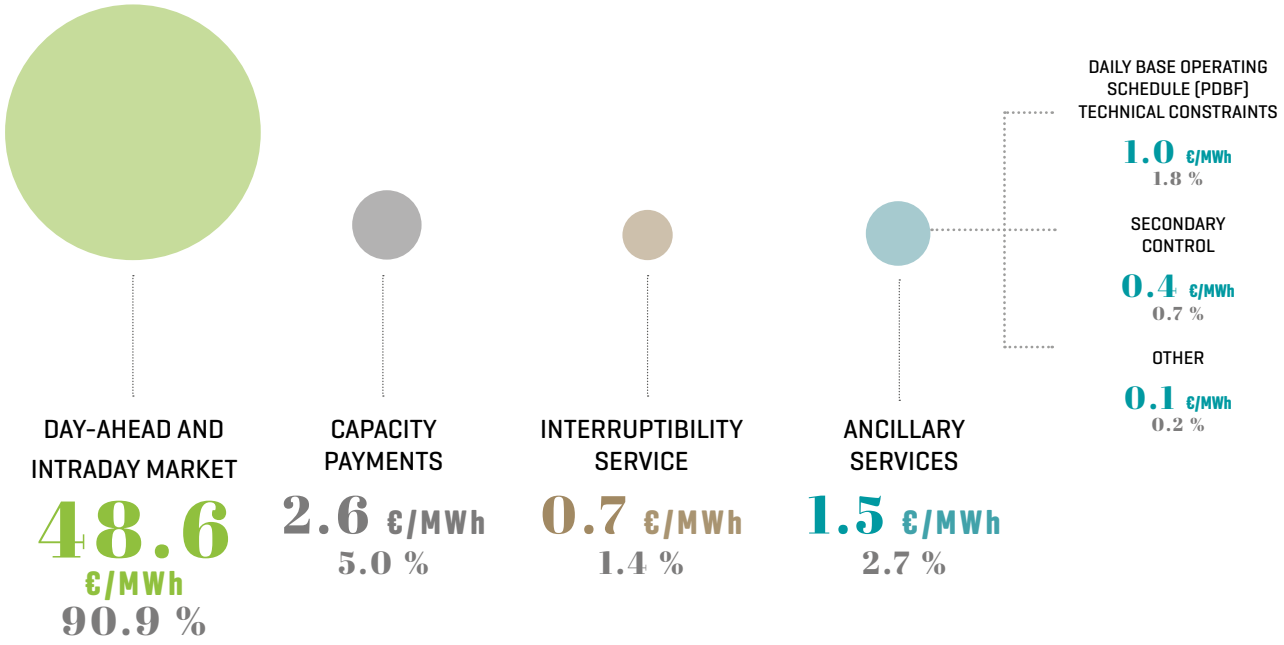


In February and from May to December, final prices were lower than in the same months of the previous year. Noteworthy was the fall that occurred in the last five months, with an average reduction of 33%.

During 2019, the components that made up the price of energy were the following: day-ahead and intraday market price 90.9%, ancillary services 2.7%, capacity payments 5.0% and the remaining 1.4% was the interruptibility service.

A comparison of the impact of the price on the demand served with that of last year shows a reduction of 16.4% in the day-ahead and intraday market, 39.8% in the interruptibility service [1], 37.9% in the ancillary services and 1.9% in the capacity payments. The decrease in the price for the interruptibility service was due to the price reductions obtained in the two annual auctions in 2019.

Components of the average final price of energy in the electricity market in 2019



During 2019, the day-ahead and intraday market price component represented 90.9%, system ancillary services 2.7%, capacity payments 5.0% and the remaining 1.4% the interruptibility service.

[1] Demand-side management tool to ensure a quality electricity supply at all times. With this service, large electricity consumers (industries) commit to reducing their electricity consumption when the system requires it and they are remunerated for this service. The service is activated by REE in accordance with technical (system security) or economic (lower cost for the system) criteria.

DAY-AHEAD MARKET

Energy in the day-ahead market stood at 244 TWh in 2019 (175 TWh in the spot market without bilateral contracts), a fall of 1.6% compared to 2018. 71.8% of energy was traded in the spot market (73.6% in 2018) and the remaining 28.2% through bilateral contracts, compared to 26.4% the previous year. These percentages have remained quite similar since 2010, with an average of 73% for the spot market and 27% for bilateral contracts, increasing the percentage of bilateral trading this year to the values recorded before 2016.

Energy supplied by market traders who are not classified as reference suppliers continued to increase reaching a market share of 88.8% in 2019, compared to 88.5% in the previous year.

ENERGY IN THE DAY-AHEAD MARKET

244
TWh

-1.6 %

COMPARED TO 2018

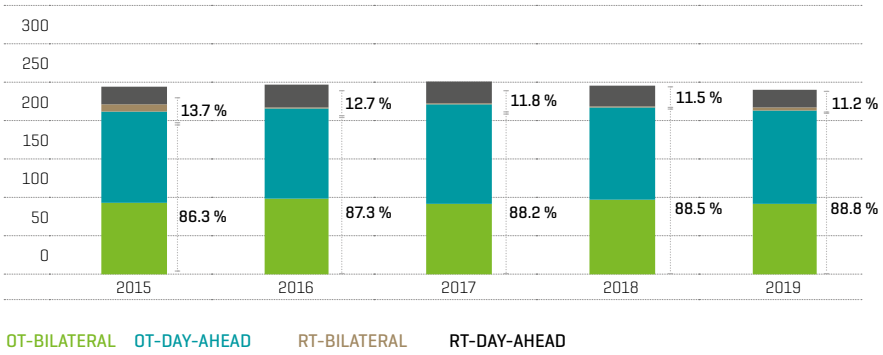
Energy supplied by market traders who are not classified as reference traders continued to increase reaching a market share of 88.8% in 2019, compared to 88.5% in the previous year.

Percentage of energy purchased in the day-ahead market and through bilateral contracts

SPOT MARKET
71.8 %

BILATERAL CONTRACTS
28.2 %

Evolution of purchases in PDBF from Reference Traders (RT) and other traders (OT) (TWh)



The arithmetic average price in the day-ahead market in Spain was 47.68 €/MWh, 16.8% lower than the previous year (57.29 €/MWh) and slightly lower than that of Portugal (47.87 €/MWh). It is lower than the last two years, although it is the eighth highest since the market started in 1998.

If compared to the previous year, the first months of the year the average prices were equal to or higher than last year, whereas as of May they were lower. The December price was the lowest of the year, as well as the lowest in that month since 2009 and the seventh lowest since the market began (1998). Prices from January to March were the third highest values ever recorded for those months. April's prices were the second highest and prices for May and July were the fifth highest for those months.

The day-ahead market price in 2019 showed a downward trend, except for April, July and October. The year was characterised by lower production with renewables and a slight increase in the CO_2 emissions price. This would suggest an increase in prices with respect to the previous year, which was not the case due to the fall in the price of fossil fuels.

If we take into account the generation mix in the day-ahead market, an important factor in the calculation of the price, it can be seen that the months of January and February, when the share of coal in the mix was higher, were the months with the highest prices, despite the fact that renewables represented approximately half of the generation mix.

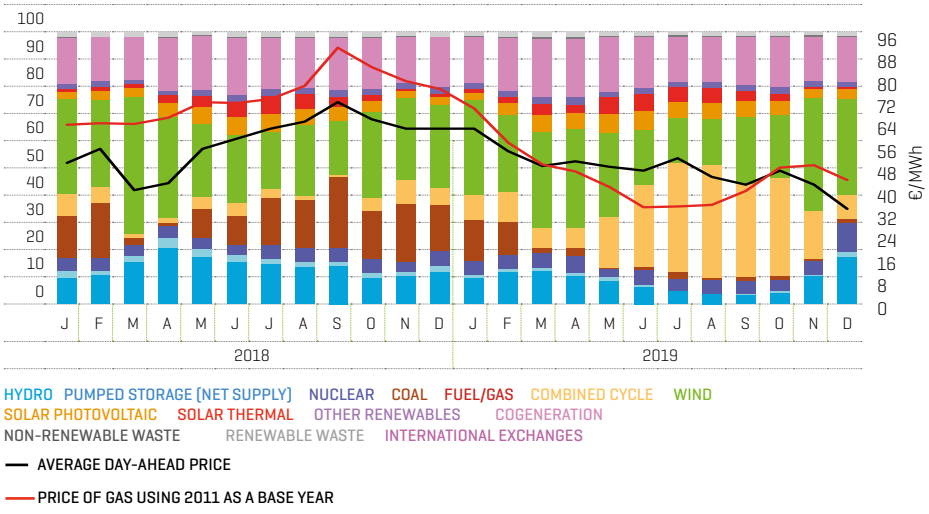
ARITHMETIC AVERAGE PRICE IN THE DAY-AHEAD MARKET

47.68
€/MWh

-16.8 %

COMPARED TO 2018

Percentage of energy sales by technology in the spot market



The fall in fuel prices, especially gas, led to a greater share of combined cycle in the generation mix, to the detriment of coal, which also has a greater CO_2 emission factor, whereby the influence on the final price was less.

Another factor that has an influence on the price is the hydroelectric reserves. Until October, these were below historical averages, and in November they reached the average level and in December they were at their highest level in 20 years. As a result, those last two months of the year saw a fall in the day-ahead market price.

The decrease in fuel prices, especially gas, led to a greater share of combined cycle in the generation mix, to the detriment of coal, which also has a greater CO_2 emission factor, whereby the influence on the final price was less.

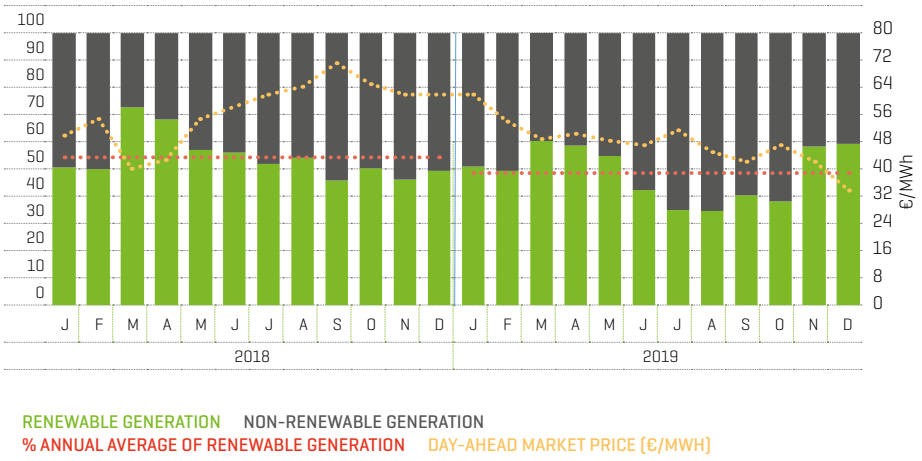
From June to October 2019, it can be seen that combined cycle is matched in a higher percentage than the rest of the technologies. A correlation can be seen between the price of gas and the day-ahead market price.

In annual terms, hydro reduced its share in the generation mix matching process by 5 percentage points compared to the previous year, wind by just over 2 points and coal by 11 percentage points, while combined cycle increased its share by almost 18 percentage points.

In general, a high presence of renewables in the matching process, mainly wind and hydro, cause a decrease in the average day-ahead market price.

In the generation mix in the day-ahead market, it can be seen that production with renewable energy in 2019 was, except for the last two months of the year, lower or similar to those values of the previous year. The graph for 2019 shows that prices, as of May, were lower every month compared to 2018, despite the fact that renewable generation was only higher in November and December, when prices fell. There is therefore a certain decoupling between electricity production from renewable energy and day-ahead market prices.

Generation in Spain and prices in the day-ahead market (% and €/MWh)



Changes in the market price do not necessarily respond to changes in the generation mix, but also reflect changes in the cost of generating electricity in the power stations. Thus, in the current electricity market, a decrease in costs in the most expensive technologies translates into reductions in the remuneration of all technologies, affecting the price of energy in the electricity market.

If the energy matching process of the generation mix is represented in a graph showing the times of the day in which the day-ahead market price set the annual minimum and maximum values, we can see how these are very different.

At the time in which the minimum price was set, it can be seen how hydro is the technology that has an impact on the marginal price (with a percentage of 34.5%), with renewable energy matched in that hour being in excess of 60%. If we look at the mix at the time in which the maximum price was registered, we can see that it is also hydro that determined the marginal price, although it is combined cycle and coal that have the highest percentage in the mix (23 and 22%). In that hour, renewables represented just 30% of the generation mix. On that day, the greatest energy matched with prices close to the marginal price corresponds to combined cycle followed by hydro.

MINIMUM PRICE IN THE DAY-AHEAD MARKET

60 %

RENEWABLE GENERATION

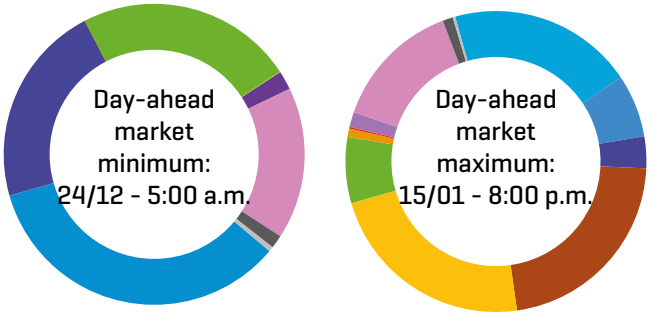
MAXIMUM PRICE IN THE DAY-AHEAD MARKET

70 %

RENEWABLE GENERATION

Generation mix in the hours of minimum and maximum price in the day-ahead market 2019 (%)

	Minimum price	Maximum price
	December 24	**January 15**
HYDRO	34.5 %	19.9 %
PUMPED STORAGE (NET SUPPLY)	0 %	6.8 %
NUCLEAR	21.8 %	3.4 %
COAL	0 %	22.0 %
COMBINED CYCLE	0 %	23.8 %
WIND	23.4 %	7.1 %
SOLAR PHOTOVOLTAIC	0.1 %	0.9 %
SOLAR THERMAL	0 %	0.2 %
OTHER RENEWABLES	2.0 %	1.6 %
COGENERATION	16.3 %	13.9 %
NON-RENEWABLE WASTE	1.4 %	1.1 %
RENEWABLE WASTE	0.5 %	0.3 %



MAXIMUM DAILY PRICE

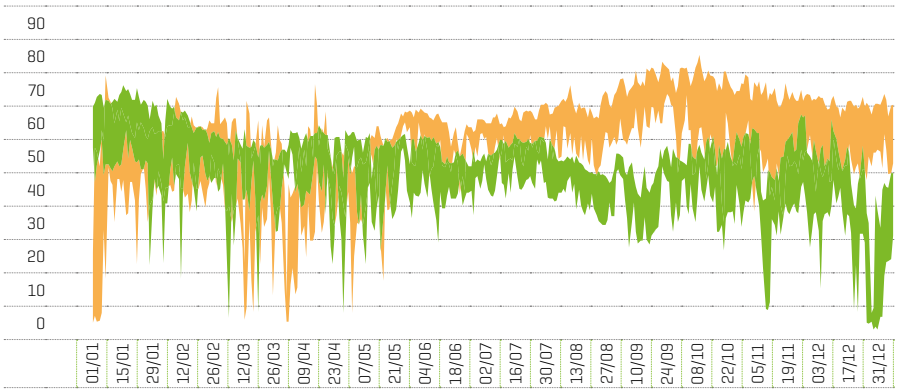
74.74
€/MWh
JANUARY

MINIMUM DAILY PRICE

0.03
€/MWh
DECEMBER

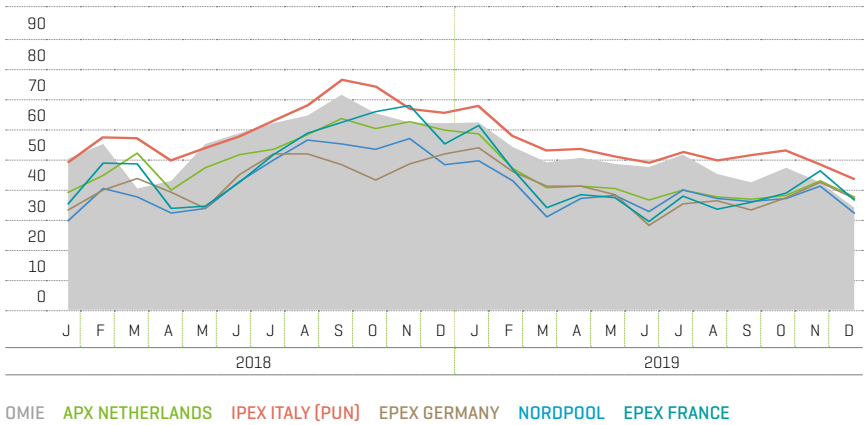
In the last few days of December, with high renewable production, minimum prices were recorded that were very close to 0 €/MWh. The maximum daily price was recorded in January (74.74 €/MWh) and the minimum was recorded in December (0.03 €/MWh), with such low prices not having been recorded since 2014, when energy was matched at 0 €/MWh.

Evolution of the maximum and minimum prices in the day-ahead market (€/MWh)



Comparing the price of the Spanish day-ahead market with the prices of the European markets, it can be seen that prices in Italy (PUN or National Single Price) and Spain (OMIE) are, in general, the highest in Europe. In March and April 2018 and in December 2019, the Spanish price was one of the lowest in Europe, coinciding with high renewable production in Spain.

European market prices (€/MWh)



INTRADAY MARKET

Energy sales in the intraday market auctions were 30.2 TWh, 9.7% less than in 2018, with 30% of sales corresponding to a net increase in demand and/or pumped-storage consumption.

The arithmetic average price of the intraday market in 2019 stood at 47.99 €/MWh, higher than the 47.68 €/MWh in the day-ahead market.

Energy sales in the continuous intraday market stood at 12.4 TWh, compared to 7.0 TWh the previous year (started in June 2018).

The arithmetic average price in Spain stood at 48.32 euros, ranging from 32.53 €/MWh in December to 62.87 €/MWh in January.

ENERGY SALES IN THE INTRADAY MARKET

30.2
TWh

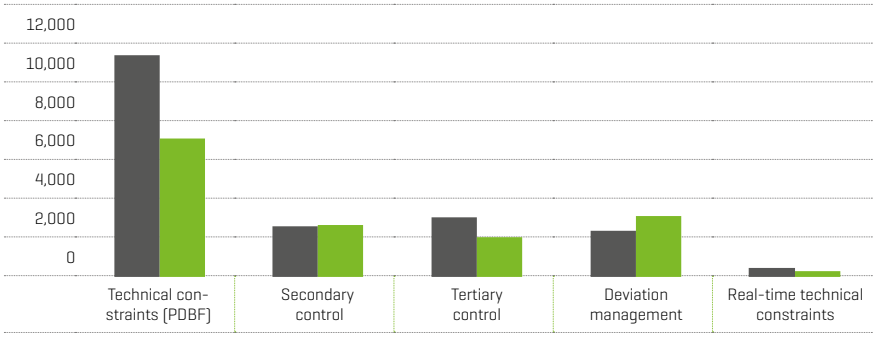
-9.7 %

COMPARED TO 2018

ANCILLARY SERVICES[2]

The volume of energy managed through system ancillary services in 2019 was 15,126 GWh, 23.5% less than the previous year, as a result of a decrease in the volume of energy scheduled due to technical constraints and tertiary control. On the other hand, secondary control energy and deviation management increased slightly. The volume of energy scheduled for resolving technical constraints through the Daily Base Operating Schedule (PDBF) fell by almost 38%, with the volume of energy in this market representing 47% of the total.

Energy managed in the system ancillary services (GWh)



(2) Does not include additional upward power reserve, secondary control, or energies associated with cross-border balancing services.

During 2019, the cost of ancillary services was 363 million euros, 39% lower than the previous year.

Cost of ancillary services (M€)

	2018	2019
Daily base operating schedule (PDBF) technical constraints	372	239
Real-time technical constraints	18	10
Technical constraints	390	249
Secondary control	139	92
Additional upward power reserve	58	15
Deviations	41	42
Other(*)	-18	-20
Power control factor	-15	-15
Total Ancillary services	**595**	**363**
2019/2018		-39.0 %

(*) Includes non-fulfilment of balancing energy, deviation balancing and deviations between systems.

The impact of ancillary services on the average final price of energy was 1.46 €/MWh, 37.9% less than in 2018 and the second lowest value since the market began in 1999 when the all-time low was registered. The highest prices were recorded in April and December, and in the latter month the lowest price was recorded in the day-ahead market. This is due to the fact that, when matching high levels of renewables, thermal generation is not matched and, to ensure system security, thermal is scheduled as part of the technical constraints linked to PDBF.

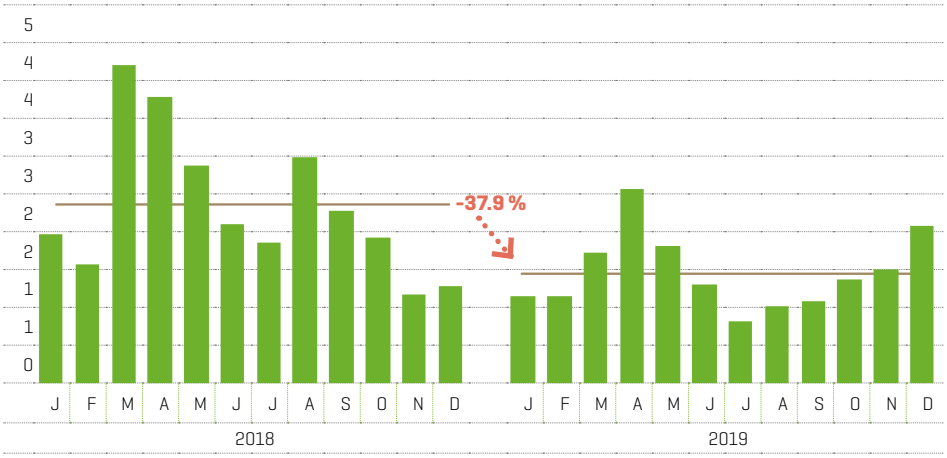
IMPACT OF THE ANCILLARY SERVICES ON THE AVERAGE FINAL PRICE OF ENERGY

1.46 €/MWh

-37.9 %

COMPARED TO 2018

Impact of the ancillary services on the average final price of energy (€/MWh)



Constraints of the Daily Base Operating Schedule

The energy scheduled to resolve technical constraints of the Daily Base Operating Schedule (PDBF) was 6,801 GWh of upward energy (38% lower than the previous year) and 257 GWh of downward energy. The average value of the price of upward energy was 81.4 €/MWh, 8.0% lower than last year, and that of the price of downward energy was 46.1 €/MWh, 15.1% lower than in 2018. The impact on the average final price of energy was 0.96 €/MWh compared to 1.47 €/MWh the previous year.

Upward energy in phase I

COMBINED CYCLE
62.99 %

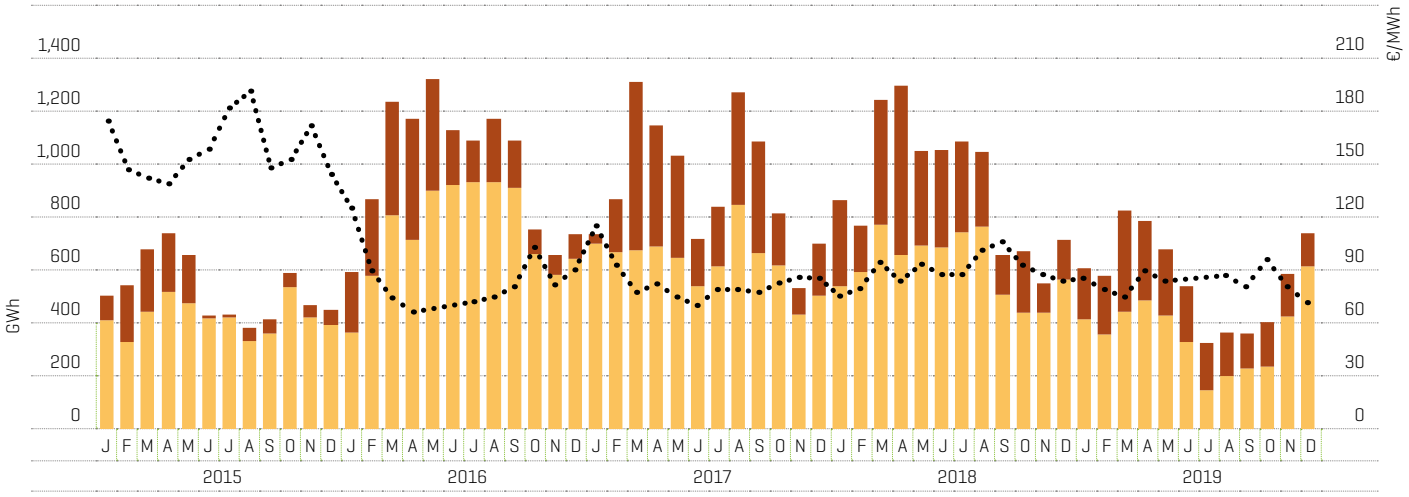
COAL
36.28 %

HYDRO	0.69 %
PUMPED STORAGE CONSUMPTION	0.02 %
OTHER RENEWABLES	0.03 %

The energy scheduled in phase I for resolving technical constraints of the Daily Base Operating Schedule corresponded mainly to combined cycle and coal-fired technologies. The downward energy in phase I was all but negligible.

The bar chart below shows the evolution over the last five years of the upward energy scheduled in phase I for resolving technical constraints of the Daily Base Operating Schedule.

Upward energy scheduled in phase I from coal and combined cycle and upward energy price (GWh and €/MWh)



It can be observed how in 2019 a lot of combined cycle energy was matched from June to October, therefore energy scheduled for resolving constraints in phase I was less, while in the rest of the months, which matched less combined cycle, more energy was scheduled through this mechanism.

Other ancillary services

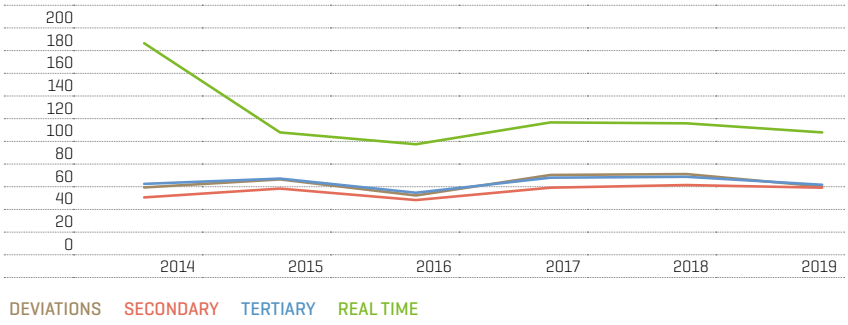
In the markets for secondary control, tertiary control, deviation management and the resolution of technical constraints in real time, 2,650 GWh, 2,302 GWh, 3,091 GWh and 295 GWh were managed, respectively. Of this total, 57.6% corresponded to upward energy managed and the remaining 42.4% to downward energy managed.

Regarding power reserves, the volume of additional upward power reserve that needed to be allocated was 1,433 GW, a value that was much lower than the previous year (5,333 GW); with an impact of 0.06 €/MWh on the demand served. This complementary service disappeared in November with the advanced opening of the continuous intra-day market at 3:00 p.m.

The average hourly secondary control allocated was 1,091 MW, with an impact of 0.37 €/MWh on the demand served, 32.7% lower than the previous year.

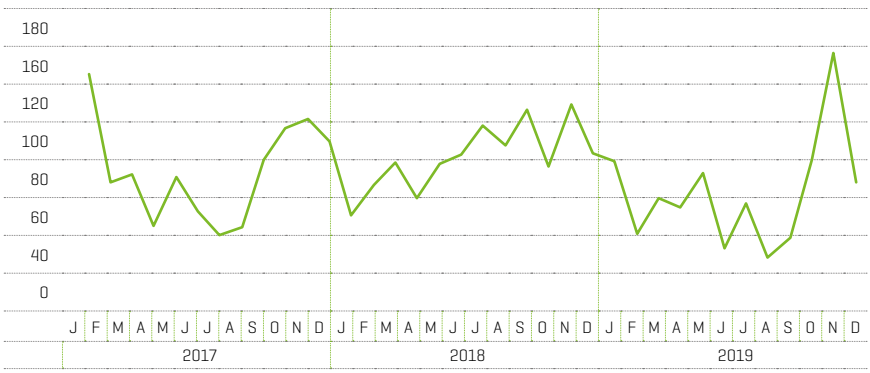
The weighted price of upward energy of secondary and tertiary control remained fairly constant, while the upward energy prices for real-time re-dispatches due to security of supply measures registered high values in 2014 and the following years' values have fluctuated between 95€ and 114 €/MWh.

Annual evolution of the weighted average price of ancillary services (€/MWh)



The graph below shows the evolution of the weighted average prices of the upward energy scheduled for the resolution of technical constraints in real time, at a monthly level.

Annual evolution of the weighted average price of ancillary services (€/MWh)



Voluntary price for the small consumer (VPSC)

The voluntary price for the small consumer was 10.4% below that of the previous year.

The VPSC is conditioned by the day-ahead market, and for this reason, the highest VPSC value was registered in January, 130.2 €/MWh, while the lowest value was registered in December, 97.6 €/MWh.

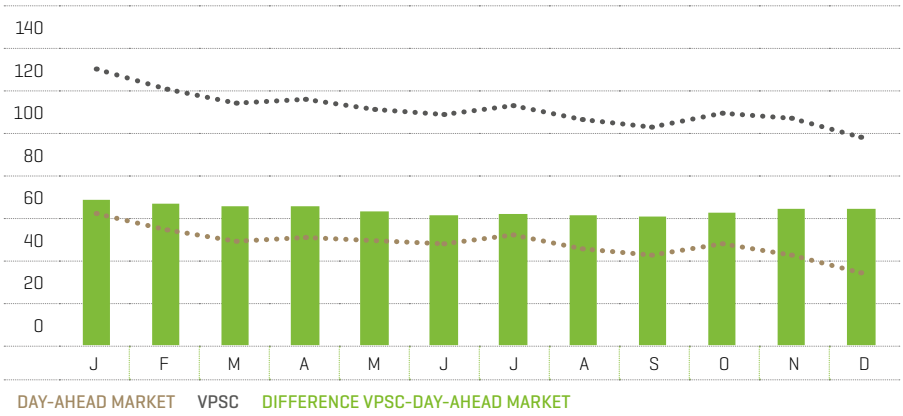
HIGHEST PRICE

130.2
€/MWh
JANUARY

LOWEST PRICE

97.6
€/MWh
DECEMBER

Evolution of the VPSC (general tariff 2.0 A) compared to the day-ahead market price (€/MWh)



Customers who opt for this tariff pay tolls and charges for regulated costs, which are set by the Government at the beginning of each year and have not increased since 2014, and an amount for the energy consumed, which is based on prices in the electricity market during the billing period.

Therefore, in the case of an average household consumer using the regulated tariff 2.0 A with a contracted power of 4.6 kW and a consumption of 3,900 kWh/year, the cost of the bill for all of 2019 would have been 793 euros, 7.6% less than they would have paid for the same consumption in 2018, that is to say, 56 euros less per year.

Of the 793 euros that this customer would have paid for their electricity consumption in 2019, 282 euros would correspond to the purchase of energy in the market (33% of the bill), 361 euros (42%) to the regulated part of tolls and system charges and the rest, 169 euros would correspond to taxes (21%).

Therefore, even though the cost of energy purchased in the electricity market would have been reduced by 16.4% compared to 2018 (compared to a 17.0% decrease in the average final price of energy), since the rest of the costs had not increased with respect to the previous year, the total bill would only have fallen by 7.6%, a decrease which in real terms, discounting the inflation forecast for 2019 (0.8%), would have been 8.4%.

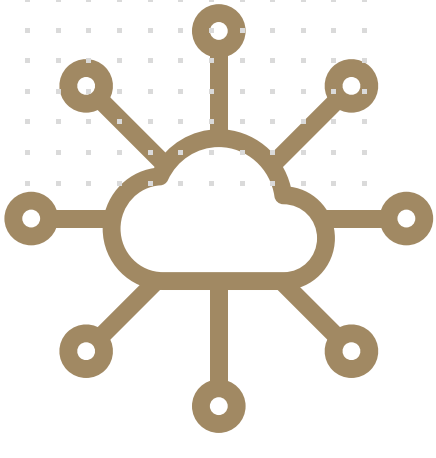
INNOVATION APPLIED TO THE ELECTRICITY SYSTEM

Innovation efforts are focused on meeting the challenges of the energy transition by increasing the availability of transmission grid elements, improving the efficiency of transmission and system operation activities, and maximising the safe integration of renewables, among others.

Red Eléctrica de España relies on innovation and technology as key elements for its present and future contribution to the energy transition.

88 INNOVATION PROJECTS

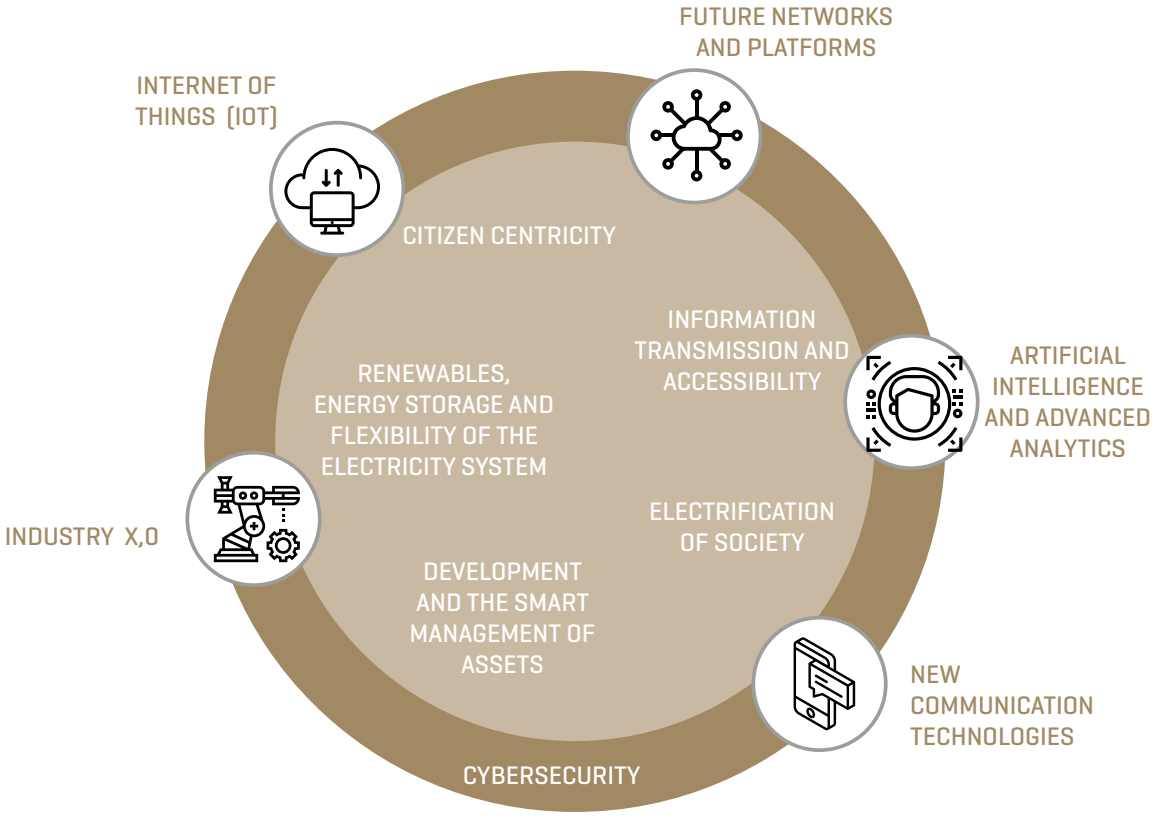
WERE MANAGED IN 2019



In the field of innovation and technology, the activity of Red Eléctrica de España in 2019 was strategically focused around the areas of impact and technological verticals promoted by **Red Eléctrica y de Telecomunicaciones. Innovación y Tecnología (RETIT)**, the new company of the Red Eléctrica Group whose objective, in line with that established in the new 2018-2022 Strategic Plan, is to accelerate technological innovation, generate competitive advantages and create business opportunities to help the Group become a benchmark in terms of technology.

The **technological verticals** of interest are the following: Internet of Things (IoT), industry X.0, networks and platforms of the future, artificial intelligence and advanced analytics, and new communication technologies. Cybersecurity is also a key technological area.

The **areas of impact** are the following: citizen centricity; transmission and accessibility of information; renewables, energy storage and flexibility of the electricity system; electrification of society; development and the smart management of assets.



Among the projects completed in 2019, below is a brief description of the 16 most relevant projects classified according to their objective:

INCREASE THE AVAILABILITY OF TRANSMISSION GRID ELEMENTS

Analysis of generator damping systems, FACTS and HVDC: extension of the capabilities of a simulation platform for dynamic models of generation, loads, FACTS (Flexible AC Transmission Systems) and HVDC (High-Voltage Direct Current) to enable adjustments to be made to the different power oscillation damping systems with which generators and FACTS and HVDC systems are equipped.

Overhead Transmission Line Capacity in Real Time: development and implementation of methodologies and tools that determine the transmission capacity of overhead lines in real time, as well as improvements associated with forecasts based on a 36-hour horizon.

Chargers with a battery management system (BMS): development and testing of new battery chargers with control units capable of individually managing the operating variables of the accumulators: current, voltage and temperature elements.

Partial discharge monitoring in gas insulated substations: evaluation and practical validation of the results obtained in the laboratory tests carried out on the GIS (Gas Insulated Switchgear) substation system - power transformers - interconnection cables.

Special solutions for the corrosion of electricity towers in critical areas: evaluation of different types of organic coatings for the protection of high-voltage electricity towers under conditions of extreme corrosiveness, as well as the establishment of an appropriate testing system to study the most suitable anti-corrosion coating systems for the future. Similarly, development of experimental methodologies in the laboratory to simulate field exposure conditions.

Optical current sensors: design of a system that allows the improvement of the operation of mixed lines in the transmission grid (overhead section + underground section), by means of a system of optical current sensors that help to discriminate the faults that occur in the overhead section from those that occur in the underground section. This introduces the concept of replacing analogue measurements with sampled or digital ones.

IMPROVEMENT IN EFFICIENCY

Fast capture of geographic information with a Remotely Piloted Aircraft System (RPAS): the capture of data regarding the terrain using a RPAS which makes it possible to generate three-dimensional geographical models of the environment overflown by the aircraft. The development of technologies related to RPAS offers the possibility of evaluating and identifying whether it is possible to optimise and/or obtain new methods for the procedures that REE currently carries out in engineering and maintenance of facilities, the natural environment, etc.

Development of predictive indicators for the decision-making process: development and implementation of algorithms and predictive indicators regarding different areas of interest, which allow the management of the Company's investment activity and decision-making processes to be improved.

3D modelling on a HVDC converter transformer - phase 2: application of 3D laser technologies and 3D mechanical design software that allows for more information on a singular facility (HVDC converter transformer in Santa Llogaia), thus improving both the maintenance of the facilities and the training of specialist technicians.

Risk management model for investment projects in the transmission grid: development of a management model that provides information on the risks to which the projects are subject and their quantification in time, costs and the actions derived from this risk management. The information was made available in an aggregate form for the entire portfolio of projects and dashboards were developed and risk monitoring process was carried out with a focus on the decision-making process. These included predictive indicators on the variability of project budgets/costs, their completion dates (commissioning), financial margins, the main stakeholders affected by these risks, the cost/benefit of preventive/corrective actions and the evolution of all of them over time.

Model for estimating the useful life of metal structures: definition of a model to analyse and determine the needs for the application of corrosion inhibitors on electricity towers, especially those subject to high atmospheric corrosion. A tool has been created to evaluate the convenience of applying anticorrosive treatments to the towers in a certain period of time, according to their environmental characteristics, so as to optimise the resources dedicated to this type of work.

DEPLA Project. Automatic production of technical drawings in accordance with construction specifications: development of a tool to automatically prepare the technical design and drawings in accordance with the construction specifications/parameters of the substation plans. This development will improve efficiency in the Company's key processes, digitalise the business and reduce the carbon footprint.

INTEGRATION OF RENEWABLES

Gravitational energy storage using solid bodies: pilot test with a very small scale model to check the system's performance, the operation of the motor/generator controller in the rise/fall of a certain mass and to make comprehensive measurements of the energy consumed and generated in one complete cycle.

Nowcasting solar phase II: new phase of the 'Solar nowcasting model to forecast direct and global solar irradiation' project, which evaluates the results obtained in the previous phase, which have been materialised in a new meteorology forecast based on the analysis of satellite images. The aim of this new phase is to adapt the tools and use & test REE's models to evaluate how the improvement in irradiation forecasts provided by AEMET (Spain's State Meteorological Agency) translates into improved forecasts of photovoltaic and solar thermal production in the first four hours of any given forecast generated by the systems.

IMPROVEMENT IN THE SUSTAINABLE MANAGEMENT OF OUR ASSETS

Furan Analysis and Degree of Polymerisation ratio: detailed study on the correlation of furanic compounds, degree of polymerisation in the insulation system and the thermal modelling of in-service transformers.

HEALTH AND SAFETY

Acured: development of a system for the reduction of noise generated by high voltage substations.

REGULATORY FRAMEWORK

2019 stood out for being a year of enormous importance in terms of regulations regarding the electricity sector, both in terms of the regulations approved at European level and at national level.

At European level, 2019 saw the completion of the 'Clean Energy for all Europeans' Package, a legislative package made up of four directives and four regulations with which the European institutions lay the regulatory and energy policy foundations for the European Union for the coming decade. Specifically, the aforementioned Package establishes the European regulatory framework necessary to achieve compliance with the emission reduction targets of the Paris Agreement, through the development of renewable energies and the strengthening of the Internal Energy Market.

Of the eight provisions that make up the package, four had already been published during 2018: The Directive on the Energy Performance of Buildings, the Energy Efficiency Directive, the Renewable Energy Directive and the Regulation on the Governance of the Energy Union. The other four provisions of the Package, which had not progressed at the same pace in terms of approval, were finally published in the Official Journal of the European Union on 14 June 2019:

- **Regulation (EU) 2019/941** of the European Parliament and of the Council of 5 June 2019 on risk preparedness in the electricity sector and repealing Directive 2005/89/EC.

- **Regulation (EU) 2019/942** of the European Parliament and of the Council of 5 June 2019 establishing a European Union Agency for the Cooperation of Energy Regulators.

- **Regulation (EU) 2019/943** of the European Parliament and of the Council of 5 June 2019 concerning the internal market for electricity.

- **Directive (EU) 2019/944** of the European Parliament and of the Council of 5 June 2019 concerning common rules for the internal market for electricity and amending Directive 2012/27/EU.

Within these four regulatory provisions, the last two are particularly relevant for the electricity sector, as they shape the design of the European electricity markets for the coming years. It is also important to note that European directives must be transposed into a rule with the status of a national law, while regulations are directly applicable.

The 'Clean Energy for all Europeans' Package establishes the European regulatory framework needed to achieve the emission reduction targets of the Paris Agreement.

However, the concern of the European institutions with regard to the fight against climate change and the energy transition was not limited only to completing the 'Clean Energy for all Europeans' Package: on 11 December the new President of the European Commission Ms. Ursula von der Leyen and her team presented Communication 2019/640 of the European Green Deal that aims to make Europe the first climate neutral continent in terms of emissions by 2050. In order to achieve this ambitious objective, the Communication included a roadmap in the Annex section, with a series of measures and proposals that will be developed during her next five years in office.

At a national level, 2019 was also a relevant year in terms of regulation regarding the electricity sector. In spite of the legislative paralysis caused by the twice-repeated elections, the publication, in January, of Royal Decree-Law 1/2019, of 11 January, which brings the powers of the National Commission of Markets and Competition (CNMC) in line with those established in Directives 2009/72/EC and 2009/73/EC of the European Parliament and of the Council, of 13 July 2009, that govern the internal market on electricity and natural gas and this led to intense regulatory activity by the CNMC throughout the year. As its name suggests, the Royal Decree Law transferred a number of competences in the field of electricity and gas from the Ministry of Ecological Transition (MITECO) to the CNMC, thus complying with the EU mandate, which meant that the latter body submitted fourteen draft regulatory circulars during the year.

Of the fourteen proposals, eight were approved in 2019, including:

- **Circular 2/2019**, of 12 November, establishing the methodology for calculating the remuneration rate of regulated activities in the electricity and natural gas sectors.
- **Circular 3/2019**, of 20 November, establishing the methodologies that regulate the operation of the wholesale electricity market and the management of the system's operation.
- **Circular 4/2019**, of 27 November, establishing the methodology for the remuneration of the electricity system operator.
- **Circular 5/2019**, of 5 December, which establishes the methodology for calculating the remuneration of the electricity transmission activity.
- **Circular 6/2019**, of 5 December, establishing the methodology for calculating the remuneration of the electricity distribution activity.
- **Circular 7/2019**, of 5 December, which approves reference values for benchmark facilities and operation and maintenance costs per fixed asset to be used in the calculation of the remuneration of the companies that own electricity transmission facilities.

Royal Decree-Law 1/2019 transferred a series of powers in the field of electricity and gas from the Ministry of Ecological Transition (MITECO) to the CNMC, thus fulfilling the EU mandate, which meant that the latter body submitted fourteen draft regulatory circulars during the year.

Despite being an 'acting' Ministry for a significant part of the year, MITECO also developed important new regulations and energy policies, most notably the presentation, in February 2019, of the draft of the 2021-2030 Integrated National Energy and Climate Plan (NECP). The drafting of the NECP is mandatory as per Regulation 2018/1999, of the Governance of the Energy Union, and is the main energy policy instrument of the Member States to carry out an effective energy transition and meet the European climate targets for 2030. After a first version of the NECP was sent to the European Commission, at the beginning of 2020, MITECO presented a second version where it included the following targets to 2030: 23% reduction of greenhouse gas emissions with respect to 1990, 42% of renewables in the final energy consumption, 39.5% improvement in energy efficiency and 74% of renewable energy in electricity generation mix.

From a purely regulatory standpoint, it is worth highlighting the boost to self-consumption that the publication of Royal Decree 244/2019, of 5 April, which regulates the administrative, technical and economic conditions for the self-consumption of electricity. It defines a simplified compensation mechanism between deficits and surpluses of self-consumption facilities that generate surpluses, it enables collective self-consumption and reduces administrative procedures, among other measures. The launch of the new planning of the electricity transmission grid for the period 2021-2026, with the publication of Order TEC/212/2019, is also another important regulatory milestone for the sector in 2019.

With regard to the regulations currently being processed, important steps were taken in 2019 to ensure that Spain has a complete regulatory framework for climate action: the preliminary draft of the Climate Change and Energy Transition Law was presented by MITECO in February 2019 and submitted for public consultation until April.

Lastly, with respect to 2020, it is expected that both European and national institutions will continue moving forward with the energy transition and the decarbonisation of the economy; the former by developing the regulatory proposals derived from the European Green Deal, and the latter by approving the Climate Change and Energy Transition Law, as well as transposing Directive 2019/944 on common rules for the internal electricity market into national legislation.

Glossary of terms:
https://www.ree.es/en/glossary

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