

The Spanish Electricity System

Preliminary Report 2021



Glossary of terms

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

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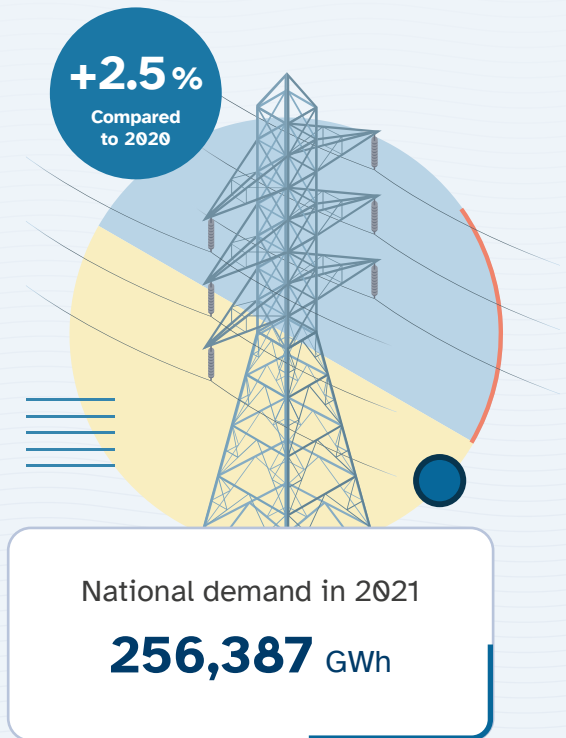
Electricity balance, installed power capacity and the transmission grid

In 2021, electricity demand in Spain recovered gradually after the impact of the pandemic and grew by 2.5% compared to 2020.

Renewable technologies produced 46.7% of all electricity generated in Spain in 2021, recording their highest share in the generation mix since records began.

Additionally, wind energy represented 23.3% of the total electricity production nationwide, and became the leading source of energy in Spain's generation mix for the first time since 2013.

For its part, generation coming from technologies which produce zero CO₂ equivalent emissions also set an all-time record and closed 2021 with a share of 68.2% of overall electricity production nationwide.

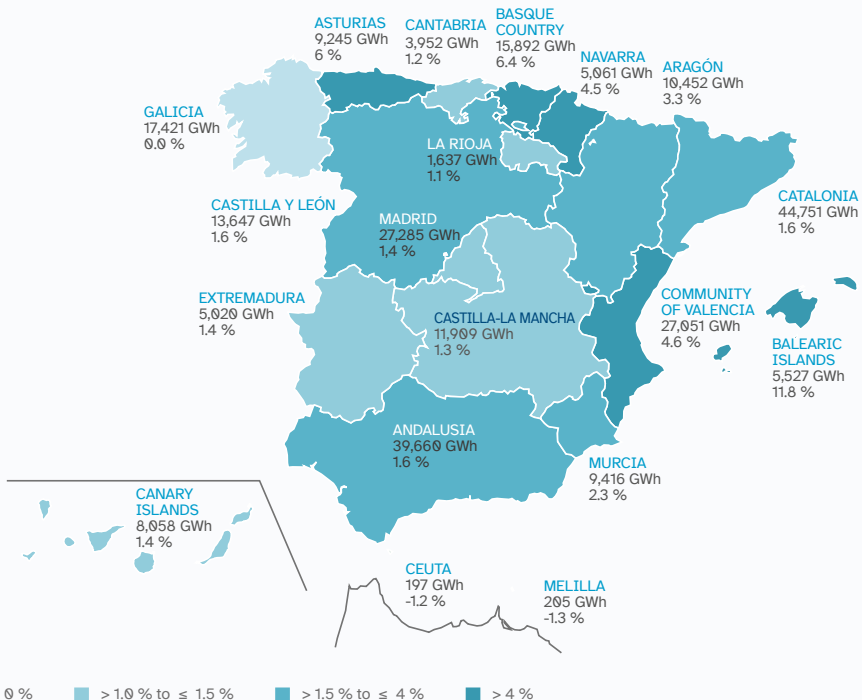


The **demand for electricity** in Spain is gradually recovering after the impact of the COVID-19 pandemic. Thus, in 2021, electricity demand reached 256,387 GWh, a value that is 2.5% higher than in the previous year. After having factored in the influence of seasonal and working patterns, the estimated annual variation in demand remains unchanged (+2.5%).

In terms of **generation**, noteworthy is the all-time record registered for renewable production, which reached a share of 46.7% in the overall electricity generation mix in 2020 (44% in 2020). In this regard, of note is that wind power is already the leading source of electricity generation in Spain, with a 23.3% share of total production nationwide. Additionally, in terms of installed power capacity, solar photovoltaic was the technology that grew the most in 2021, closing the year with a growth of 36.7%. Moreover, it also registered its annual all-time high in terms of production and contribution to the country's generation mix with a share of 8% of the total. As for international exchanges, for the sixth consecutive year they closed with an import balance, totalling 884 GWh in 2021.

Electricity demand by Autonomous Community and its variation with respect to the previous year

GWh and %



Final data: As at 28/02/2021

Provisional data: As at 31/10/2021

Estimated data: As at 31/12/2021



“ In 2021, coal-fired generation registered its lowest value ever and closed the year with an all-time low in the national generation mix (a 1.9% share of the total).

The complete set of generating facilities in Spain is increasingly renewable. In 2021, installed power capacity stood at 112,846 MW, of which 56.6% belonged to renewable energy technologies.

Installed power capacity by Autonomous Community

As at 31 December 2021

MW



The development of the **electricity transmission grid** in Spain during 2021 registered an increase of 206 km of new line circuit and 850 MVA of new transformer capacity, which together help bolster the reliability and security of a transmission grid that is smarter and more sustainable and has an increasingly more and more meshed.



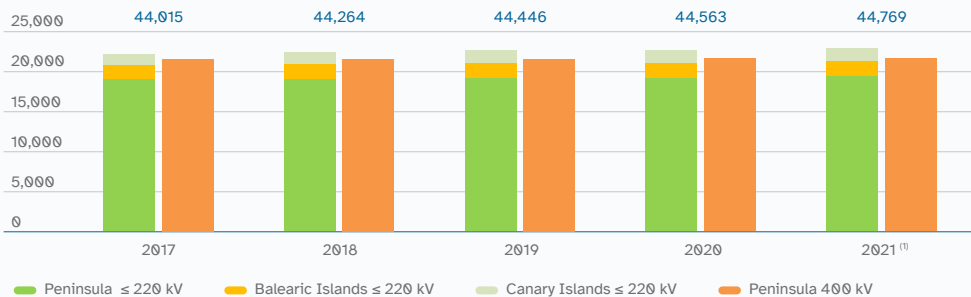
Transmission grid

44,769 km

of line circuit as at year-end 2021

Evolution of the electricity transmission grid in Spain

km of circuit



(1) Provisional data pending audit (currently in progress).

Cumulative figures regarding kilometres of line circuit as at 31 December of each year.

Includes the transmission grid assets of those utility companies whose electricity distribution facilities are considered as an integral part of the overall transmission grid infrastructure nationwide.

Electricity transmission grid facilities in Spain

	400 kV		≤ 220 kV		Total
	Peninsula	Peninsula	Balearic Islands	Canary Islands	
Total line circuit (km)	21,768	19,493	1,929	1,578	44,769
Overhead lines (km)	21,651	18,702	1,141	1,237	42,731
Submarine cable (km)	29	236	582	30	877
Underground cable (km)	88	556	206	311	1,161
Transformer capacity (MVA)	84,790	1,363	3,838	3,880	93,871

Provisional data pending audit (currently in progress).

Cumulative figures regarding kilometres of line circuit and transformer capacity as at 31 December of each year.

Includes the transmission grid assets of those utility companies whose electricity distribution facilities are considered as an integral part of the overall transmission grid infrastructure nationwide.



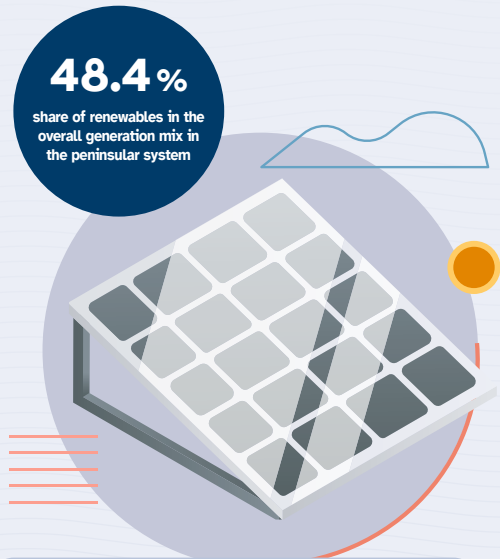
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Peninsular system

Electricity demand on the Spanish Peninsula also showed a growth of 2.4% in 2021. Clean electricity generation set all-time highs in 2021 compared to the data series available since records began.

With regard to electricity generation on the Spanish Peninsula, of note is that renewable energy increased by 9.6%, closing 2021 with a share of 48.4% in the generation mix. Also noteworthy was the increase in production coming from technologies which produce zero CO₂ equivalent emissions which closed 2021 with a share of 71% of overall electricity production nationwide. This fact has led to a 1.4% decrease in the CO₂ eq. emissions associated with electricity generation when compared to the previous year, reaching an all-time low in 2021 of 29.1 million tCO₂ eq.



Peninsular demanda in 2021

242,401 GWh

Evolution of electricity demand on the Spanish Peninsula

	Demand (measured at power station busbars)		Components (%)		
	GWh	Δ Annual (%)	Work calendar	Temperature	Adjusted
2017	252,506	1.1	-0.1	-0.2	1.4
2018	253,566	0.4	-0.3	0.2	0.5
2019	249,257	-1.7	0.7	0.2	-2.7
2020	236,755	-5.0	-0.1	0.1	-5.0
2021	242,401	2.4	0.1	-0.1	2.4

Monthly variation in peninsular electricity demand

2021

%

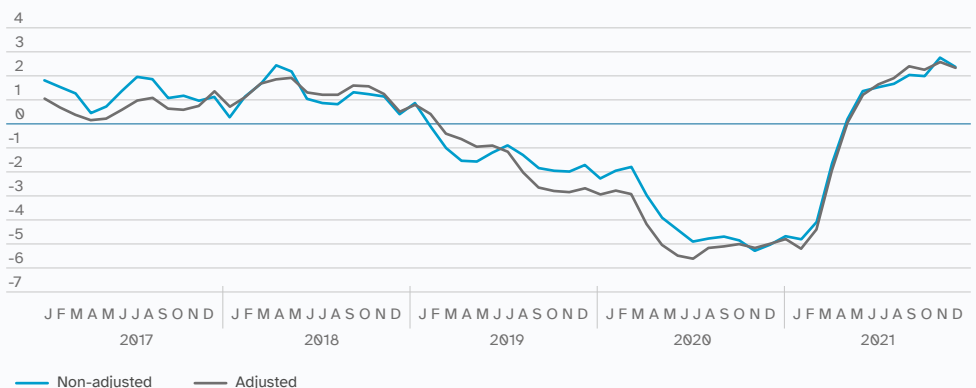
	Monthly	Cumulative		Monthly	Cumulative
January	0.8	0.8	July	-1.9	4.4
February	-3.2	-1.1	August	-0.5	3.7
March	4.7	0.8	September	1.6	3.5
April	17.0	4.1	October	-3.3	2.8
May	11.1	5.4	November	3.1	2.9
June	6.7	5.6	December	-2.4	2.4

Variation with respect to the same month the previous year.

Annual variation in peninsular electricity demand

Rolling year

%





According to provisional data, peninsular **electricity demand** closed 2021 at 242,401 GWh, an increase 2.4% compared to the previous year. After factoring in the influence of seasonal and working patterns, the estimated annual variation rate of the demand remains unchanged (+2.4%) with regard to 2020.

“ Temperatures have had an impact of -0.1% on the evolution of consumption while the work calendar had an influence of +0.1%.



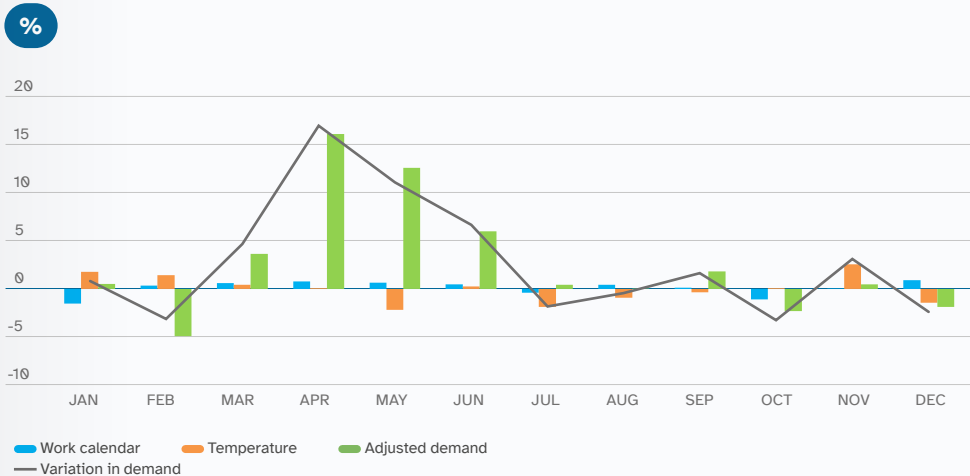
Peninsular demand in 2021

242,401 GWh

+2.4%
Compared to 2020

Components of the monthly variation in peninsular electricity demand

2021



The **Red Eléctrica Index (IRE)** is an electricity consumption indicator whose objective is to provide, in advance, the data regarding the evolution of the demand of large power consumers. In 2021, the IRE continued to show consumption levels below pre-COVID-19 pandemic levels. The composition of the work calendar during the year had a negative impact of 0.5 percentage points on the evolution of the IRE. Annual temperature levels also had a negative influence of 0.4% in the evolution of the IRE. After factoring in the influence of seasonal temperatures and the work calendar, the adjusted data of the general index showed a growth of 5.8% year-on-year.

By sector, the industrial sector showed an upward trend, closing the year with a growth of 6.0%, compared to the adjusted figure of -7.5% registered in 2020. For its part, the services sector also showed a growth of 6.4%, compared to the adjusted figure of -10.7 registered in 2020. However, in 2021, it is the services sector which was still lagging behind in its recovery with respect to pre-pandemic levels.

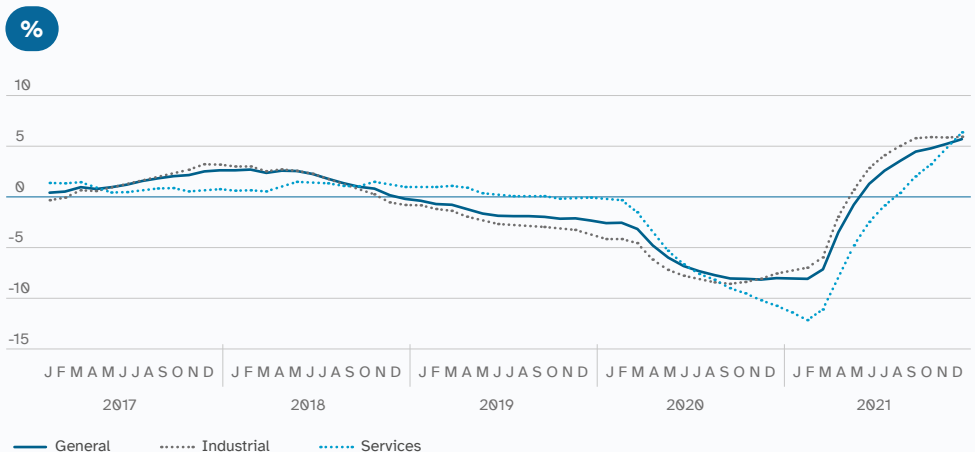
IRE: components of annual variation

2021

	Gross	Work calendar	Temperature	Adjusted
General	4.9	-0.5	-0.4	5.8
Industrial	5.3	-0.5	-0.2	6.0
Services	5.6	-0.2	-0.6	6.4
Other	1.2	-0.7	-0.7	2.6

Monthly evolution of the adjusted IRE

Rolling year





The **maximum instantaneous power demand** on the Spanish Peninsula was recorded on 8 January at 2:05 p.m. when it reached 42,225 MW, a value 4.5% higher than the previous year's maximum, but this figure still far from the all-time high of 45,450 MW set in December 2007. The maximum hourly demand was also registered on 8 January between 1:00 and 2:00 p.m., when it reached 41,483 MWh, a value that was 3.7% higher than the maximum registered in 2020.



Maximum instantaneous power demand

42,225 MW

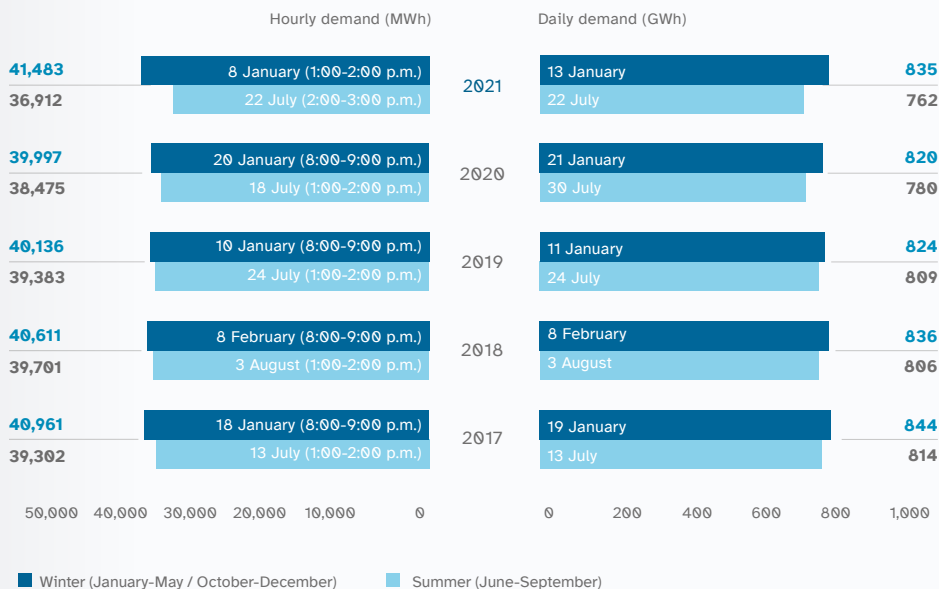
8 January

2.05 p.m.

+4.5%

Compared to 2020

Maximum annual peninsular demand values



In terms of **demand coverage**, the most noteworthy development has been the increase in the contribution of renewable energy technologies. In this respect, wind was the leading technology with a contribution of 23.9% (22.2% in 2020). Also noteworthy is the contribution of solar photovoltaic which reached a share of 8.3% in 2021.

“ 58.4% of the peninsular installed power capacity is based on technologies that use renewable sources.

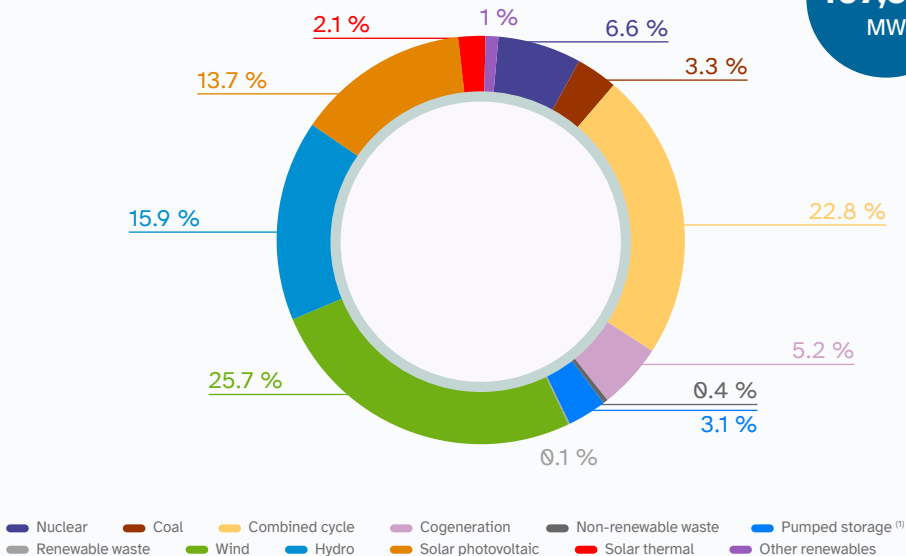
In terms of fossil-fuelled technologies, noteworthy is the decrease in the contribution of nuclear which reached a share of 21.8% (23% in 2020) and of combined cycle (15.2% coverage compared to 15.8% in 2020), while coal has grown slightly, although it maintains its 2% share in the coverage of demand.

Installed power capacity on the peninsula

as at 31 December 2021

%

107,505
MW

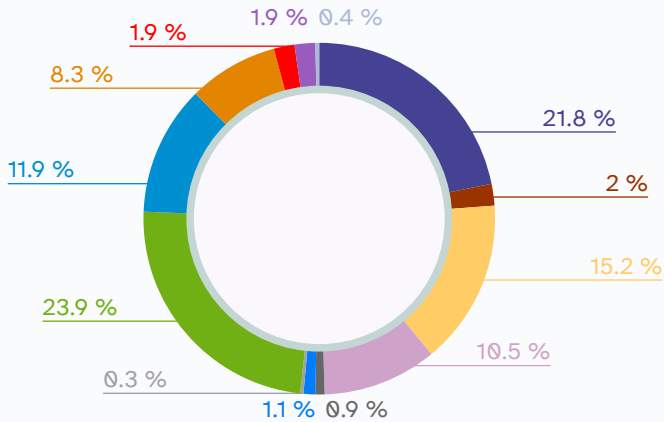




Electricity demand coverage on the peninsula

2021

%



- Nuclear
- Coal
- Combined cycle
- Cogeneration
- Non-renewable waste
- Pumped storage (1)
- Renewable waste
- Wind
- Hydro
- Solar photovoltaic
- Solar thermal
- Other renewables
- Import balance of international exchanges

(1) Pure pumped storage + estimated mixed pumped storage.

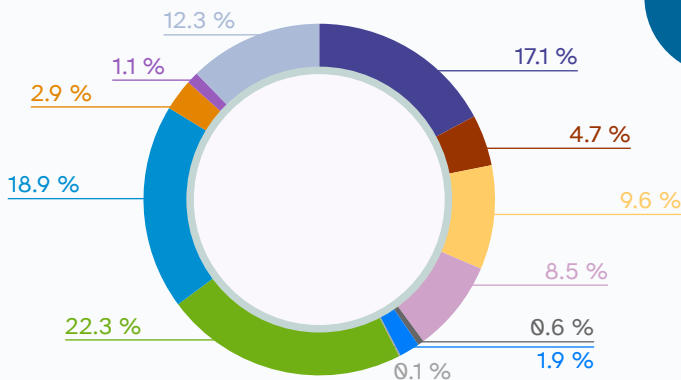
Electricity demand coverage

Maximum hourly demand coverage on the peninsula.

8 January 2021 (1:00-2:00 p.m.)

%

41,483
MWh



- Nuclear
- Coal
- Combined cycle
- Cogeneration
- Non-renewable waste
- Pumped storage (1)
- Renewable waste
- Wind
- Hydro
- Solar photovoltaic
- Solar thermal
- Other renewables
- Import balance of international exchanges

(1) Pure pumped storage + estimated mixed pumped storage.

Renewable energy has increased its share in the overall peninsular electricity generation mix, rising from 45.5% in 2020 to an all-time high of 48.4% in 2021. By technology, wind power stands out with 24% of total electricity production, followed by hydro and solar photovoltaic with 12% and 8.3%, respectively.



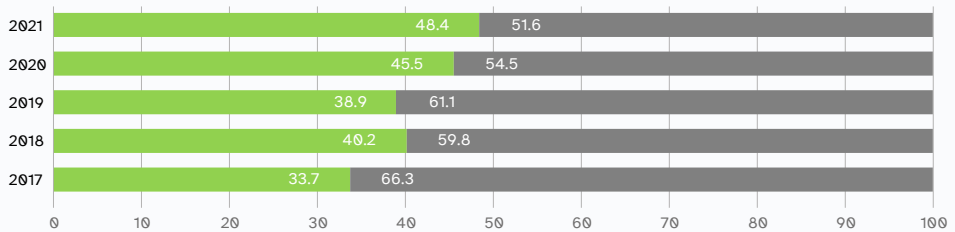
All-time high

48.4%

share of renewables in the overall peninsular electricity generation mix

Evolution of renewable and non-renewable peninsular electricity generation

%

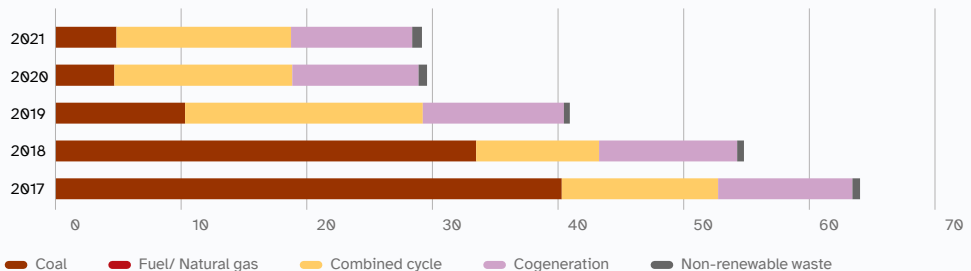


Renewable: hydro, wind, solar photovoltaic, solar thermal, other renewable and renewable waste.

Non-renewable: nuclear, coal, fuel/natural gas, combined cycle, cogeneration, non-renewable waste and pumped storage.

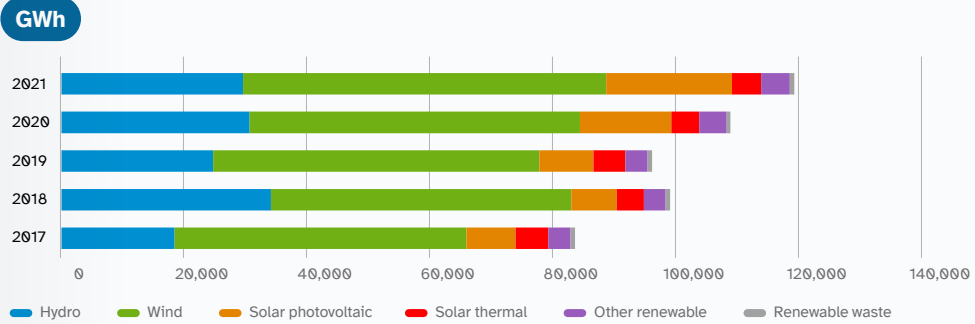
Evolution of CO₂ eq. emissions associated with electricity generation on the Spanish Peninsula

Million tCO₂ eq.

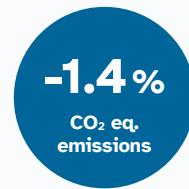




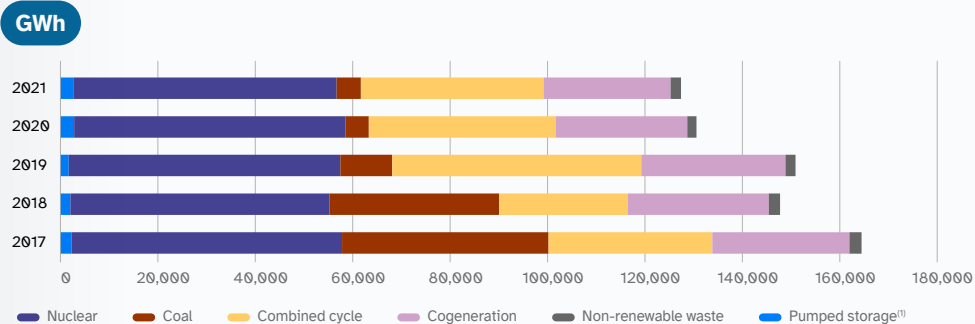
Evolution of renewable electricity generation on the peninsula



“ CO₂ eq. emissions derived from peninsular electricity generation registered a decrease of 1.4% due to the higher level of production from renewables.



Evolution of non-renewable electricity generation on the peninsula



(1) Pure pumped storage + estimated mixed pumped storage.

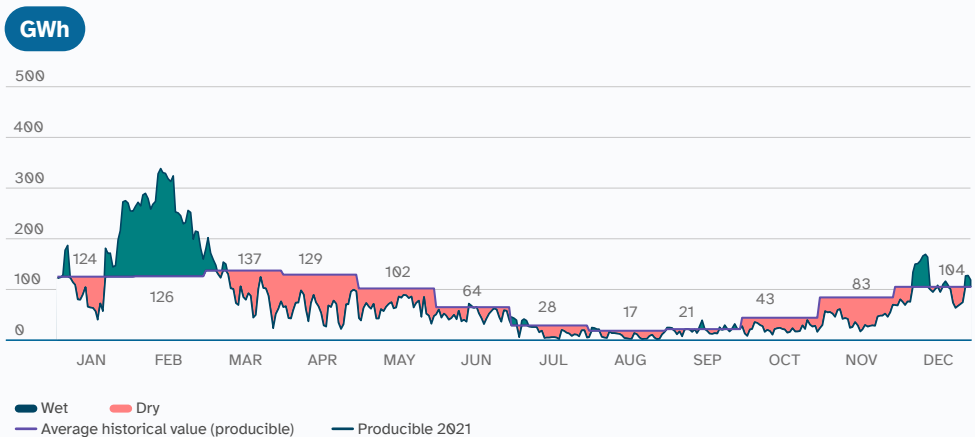
Producible hydroelectric registered a value of 26,839 GWh, a value slightly lower than the average historical value and 12.3% lower than that registered in 2020. Hydroelectric reserves of the complete set of reservoirs closed 2021 with a fill level of 36% of their total capacity (50.8% in 2020).

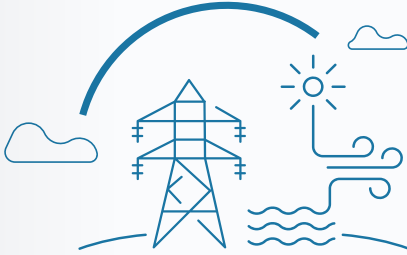
“ Producible hydroelectric was 12.3% lower than the value registered in 2020.

Producible hydroelectric energy on the Peninsula

	GWh	Index	Probability of being exceeded (%)
2017	15,972	0.5	99.3
2018	37,403	1.3	17.2
2019	25,995	0.9	63.7
2020	30,595	1.0	43.8
2021	26,839	0.9	60.1

Daily producible hydroelectric energy on the Peninsula in 2021 compared with the average historical value (producible)





Hydroelectric reserves
in 2021

36 %

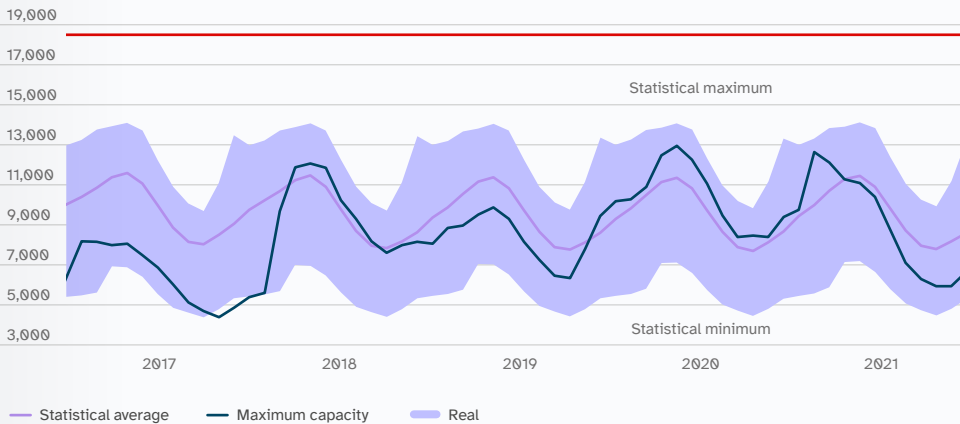
Peninsular hydroelectric reserves

as at 31 December 2021

	Capacity	2020		2021	
		GWh	% Fill Level	GWh	% Fill Level
Annual management regime	8,967	5,564	62.0	3,921	43.7
Hyper-annual management regime	9,571	3,855	40.3	2,758	28.8
Overall total	18,538	9,419	50.8	6,679	36.0

Evolution of peninsular hydroelectric reserves

GWh



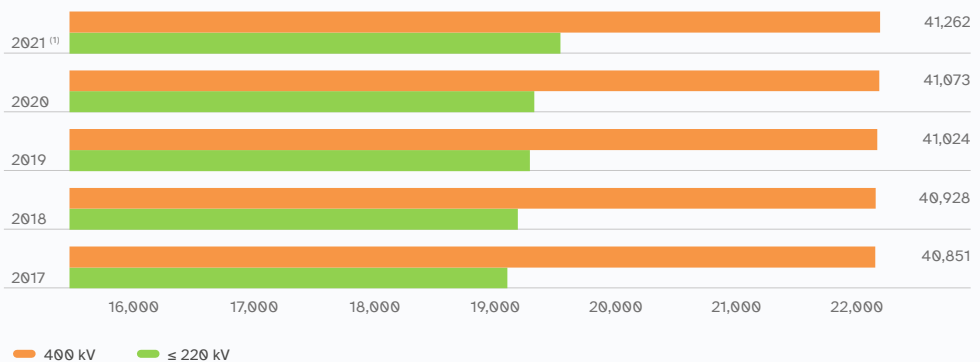
Statistical maximum and minimum: average of the maximum and minimum values of the last 20 years.

According to provisional data, the peninsular electricity **transmission grid** added an additional 188 km of line circuit during 2021 and increased its transformer capacity by 600 MVA, bringing the total km of line circuit in the peninsular transmission grid at year-end to 41,282 km.

“ New infrastructure to bolster grid meshing and shape a safer, more resilient and sustainable transmission grid.

Evolution of the peninsular transmission grid

km of line circuit



(1) Provisional data pending audit (currently in progress).

Cumulative figures regarding kilometres of line circuit as at 31 December of each year. Includes the transmission grid assets of those utility companies whose electricity distribution facilities are considered as an integral part of the overall transmission grid infrastructure on the Peninsula.

Evolution of the electricity transmission grid on the Peninsula

	2017	2018	2019	2020	2021 ⁽¹⁾
400 kV Circuit (km)	21,735	21,737	21,748	21,764	21,768
220 kV ≤ Circuit (km)	19,116	19,192	19,276	19,309	19,493
Transformer capacity (MVA)	82,471	84,853	84,283	85,553	86,153

(1) Provisional data pending audit (currently in progress).

Cumulative figures regarding kilometres of line circuit and transformer capacity as at 31 December of each year. Includes the transmission grid assets of those utility companies whose electricity distribution facilities are considered as an integral part of the overall transmission grid infrastructure on the Peninsula.



Balance of international physical electrical energy exchanges

GWh

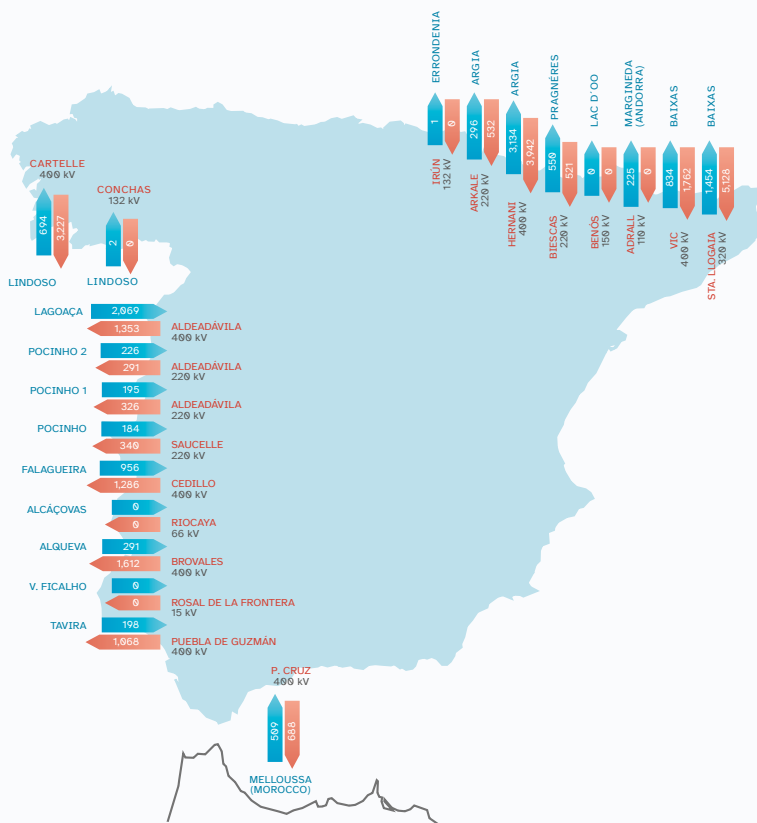
	France	Portugal	Andorra	Morocco	Total
2017	12,465	2,685	-233	-5,748	9,169
2018	12,047	2,655	-210	-3,389	11,102
2019	9,697	-3,399	-208	773	6,862
2020	5,229	-1,457	-196	-297	3,280
2021	5,617	-4,687	-225	179	884

Positive value: importer balance; Negative value: exporter balance.

International physical electrical energy exchanges

2021

GWh



3

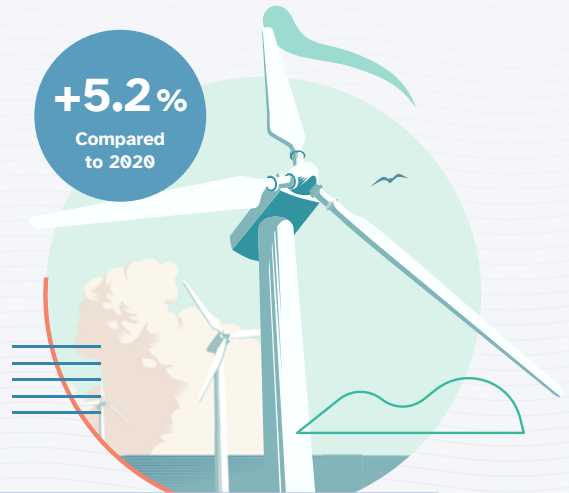


Non-peninsular systems

In 2021, electricity demand grew in the Balearic Islands and the Canary Islands, while in the case of Melilla and Ceuta it registered a decrease.

The Canary Islands electricity system covered more than 19.9% of its demand with renewables, registering a new all-time high, a remarkable value for an isolated electricity system.

In 2021, the energy transferred from the Spanish Peninsula, through the link with the Balearic Islands, has reached a total of 890 GWh, representing 16.1% of the annual electricity demand of the Balearic Islands.



Electricity demand in non-peninsular systems in 2021

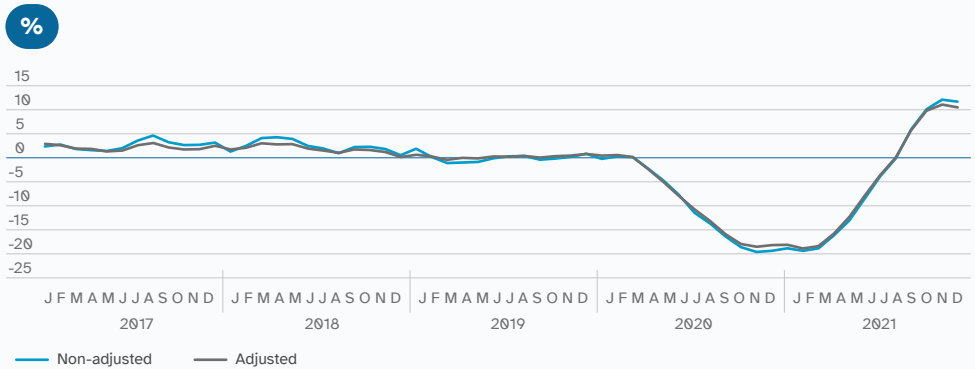
13,986 GWh

Evolution of non-peninsular electricity demand

	Balearic Islands		Canary Islands		Ceuta		Melilla	
	GWh	Δ Annual (%)	GWh	Δ Annual (%)	GWh	Δ Annual (%)	GWh	Δ Annual (%)
2017	6,016	3.3	8,931	2.1	203	-3.7	210	1.0
2018	6,057	0.7	8,842	-1.0	207	2.2	213	1.2
2019	6,115	1.0	8,875	0.4	206	-0.6	211	-1.0
2020	4,942	-19.2	7,947	-10.5	199	-3.3	208	-1.4
2021	5,527	11.8	8,058	1.4	197	-1.2	205	-1.3

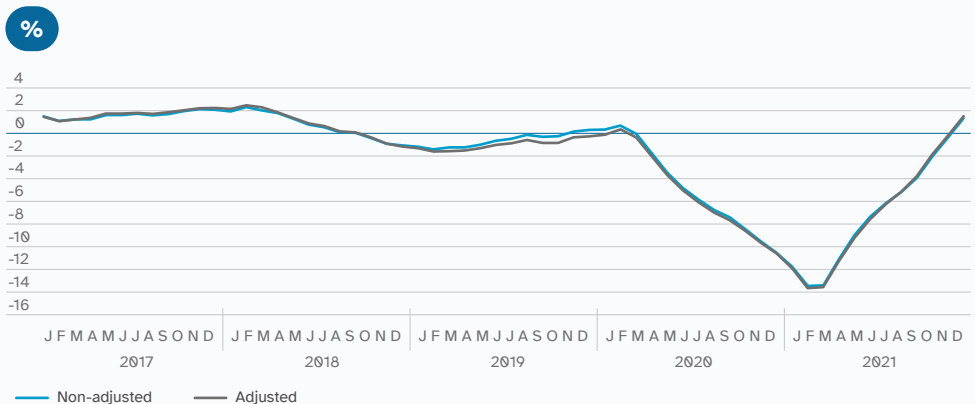
Annual variation of electricity demand. Balearic Islands

Rolling year



Annual variation of electricity demand. Canary Islands

Rolling year

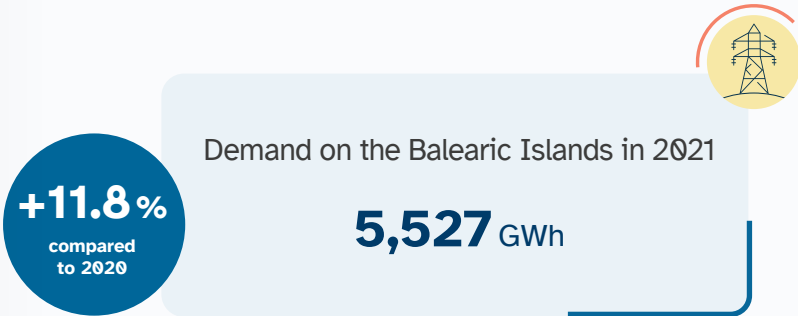




Electricity demand on the **Balearic Islands** closed 2021 at 5,527 GWh, representing an increase of 11.8% compared to the previous year.

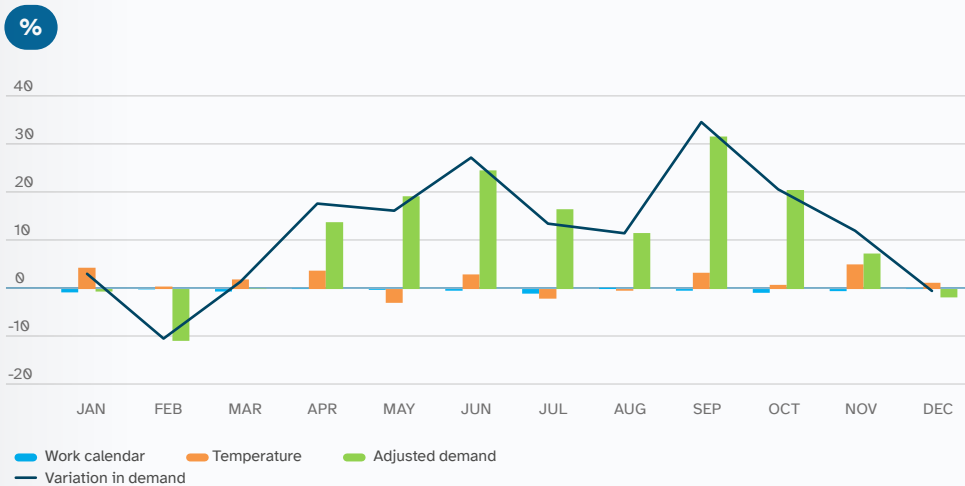
In 2021, the energy transferred from the Spanish Peninsula, through the submarine link with the Balearic Islands, contributed to covering 16.1% of the demand of the Balearic Islands.

“ 16.1% of the demand of the Balearic Islands was covered by energy transferred from the Spanish Peninsula.



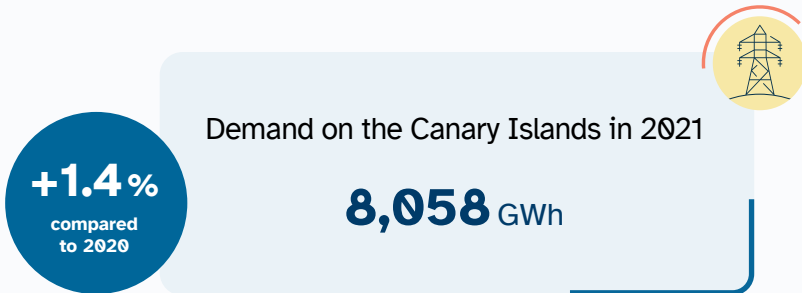
Components of the variation in monthly electricity demand

Balearic Islands. 2021



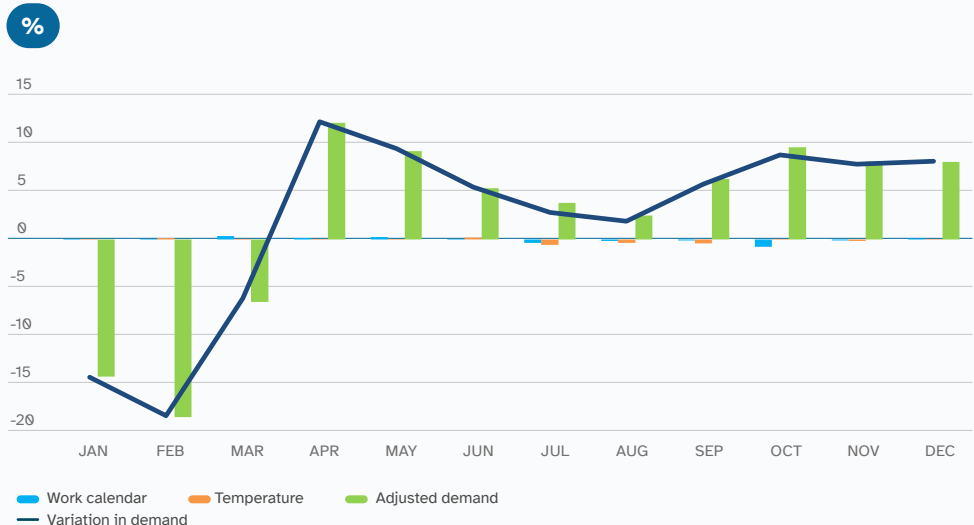
Electricity demand on the **Canary Islands** closed 2021 at 8,058 GWh, representing a growth of 1.4% with respect to 2020.

The decreases in demand in the electricity systems of Ceuta and Melilla were not as marked, registering negative variations of 1.2% and 1.3%, respectively.



Components of the variation in monthly electricity demand

Canary Islands. 2021





3 Non-peninsular system

The **maximum hourly demand** in the Balearic Islands occurred on 13 August, between 1:00 and 2:00 p.m., when it reached 1,169 MWh, a value 7.4% higher than the maximum recorded in 2020 on 31 July, between 1:00 and 2:00 p.m, when it registered a value of 1,088 MWh.

The **maximum hourly demand** in the Canary Islands was recorded on 31 December, between 7:00 and 8:00 p.m., when it reached 1,294 MWh, a value 4.2% lower than the than the maximum recorded in 2020 on 23 January, between 8:00 and 9:00 p.m., when it registered a value of 1,351 MWh.

Monthly variation of non-peninsular electricity demand

2021

	Balearic Islands	Canary Islands	Ceuta	Melilla
January	3.2	-14.4	3.9	2.9
February	-10.3	-18.3	-3.5	-4.8
March	1.6	-6.1	-7.6	3.6
April	17.7	12.2	-2.6	3.8
May	16.3	9.5	-2.0	5.0
June	27.4	5.5	-1.2	-0.6
July	13.6	2.8	-2.8	-6.0
August	11.6	1.9	-1.5	-9.0
September	34.7	5.7	0.5	-3.2
October	20.8	8.8	2.2	-0.5
November	12.1	7.8	1.5	0.8
December	-0.4	8.1	-1.2	-2.1

Variation with respect to the same period of the previous year.

Maximum annual demand values (Non-peninsular systems)

2021

Hourly demand (MWh)		Daily demand (MWh)	
991	7 January (7:00-8:00 p.m.)	Balearic Islands	8 January 18,301
1,169	13 August (1:00-2:00 p.m.)	Balearic Islands	13 August 23,364
1,294	31 December (7:00-8:00 p.m.)	Canary Islands	1 October 24,947
1,292	17 August (8:00-9:00 p.m.)	Canary Islands	18 August 26,047
39	11 January (9:00-10:00 p.m.)	Ceuta	11 January 682
32	17 August (1:00-2:00 p.m.)	Ceuta	17 August 619
36	13 January (9:00-10:00 p.m.)	Melilla	13 January 654
38	23 August (1:00-2:00 p.m.)	Melilla	23 August 729

Winter (January-May/October-December)

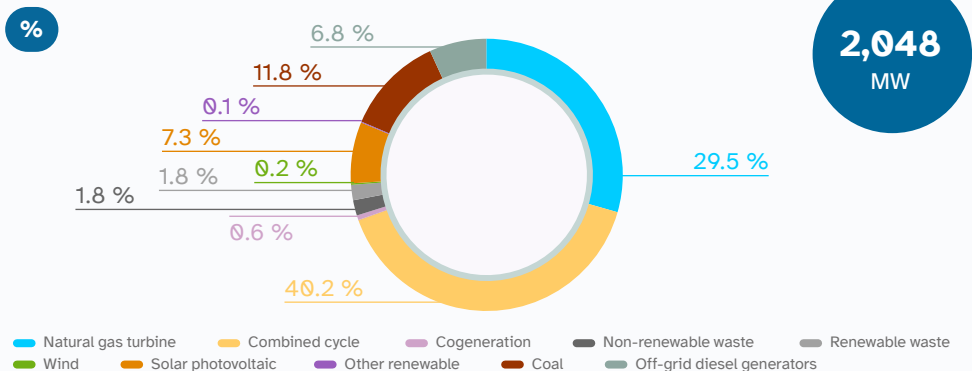
Summer (June-September)

Installed power capacity of non-peninsular systems increased 2.4%, due to an increase of 44.2% in installed solar photovoltaic capacity in the Balearic Islands and an increase of 14.7% in installed wind power capacity in the Canary Islands.

In terms of **demand coverage** in the electricity generation mix of the Balearic Islands, the share of coal-fired production continued to decrease, closing the year at only 0.8% (4.5% in 2020), and combined cycle continued to grow, reaching a share of 63% (48.8% in 2020). The decrease in the share of coal was due to the lack of generation from this technology during the first ten months of the year, motivated by the limitation of operating hours established for generating units 3 and 4 of the Alcudia power station. Regarding the Canary Islands, renewable energy covered 19.9% of annual demand, the highest value ever registered to date, a significant value for an isolated electricity system, and that in March 2021 contributed to covering up to 30.5% of the generation mix.

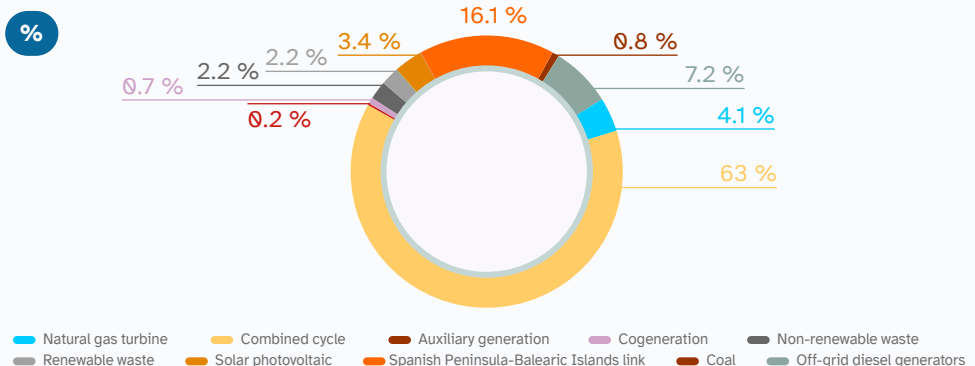
Installed power capacity in the Balearic Islands

as at 31 December 2021



Demand coverage in the Balearic Islands

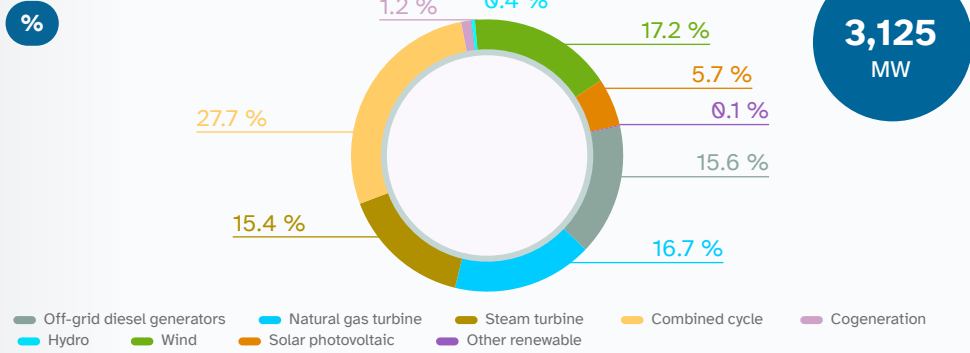
2021





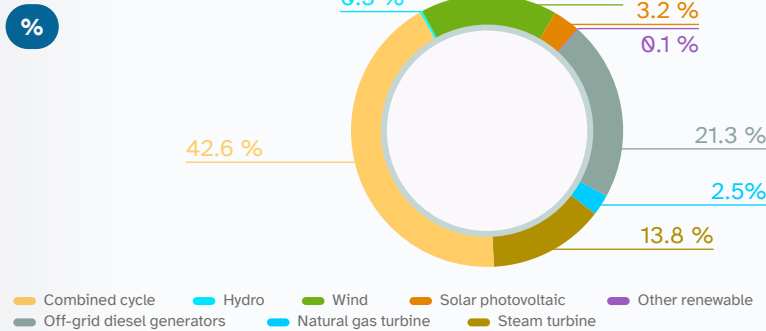
Installed power capacity in the Canary Islands

as at 31 December 2021



Demand coverage in the Canary Islands

Año 2021



Demand coverage in the Canary Islands

		2017	2018	2019	2020	2021 ⁽¹⁾
220 kV Circuit (km)	Balearic Islands	432	432	448	448	448
	Canary Islands	220	239	239	239	240
	Total	652	671	687	687	688
132 kV Circuit (km)	Balearic Islands	472	517	520	576	576
	Canary Islands	-	67	125	126	126
	Total	472	584	646	701	701
≤ 132 kV Circuit (km)	Balearic Islands	905	905	905	905	905
	Canary Islands	1,135	1,176	1,185	1,196	1,212
	Total	2,040	2,081	2,090	2,102	2,118
Transformer capacity (MVA)	Balearic Islands	3,463	3,463	3,838	3,838	3,838
	Canary Islands	2,810	3,310	3,470	3,630	3,880
	Total	6,273	6,773	7,308	7,468	7,718

(1) Provisional data pending audit (currently in progress).

Cumulative figures regarding kilometres of line circuit and transformer capacity as at 31 December of each year. Includes the transmission grid assets of those utility companies whose electricity distribution facilities are considered as an integral part of the overall transmission grid infrastructure nationwide.



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