

THE
SPANISH
ELECTRICITY
SYSTEM

2016

S U M M A R Y



RED
ELÉCTRICA
DE ESPAÑA

ELECTRICAL ENERGY BALANCE⁽¹⁾

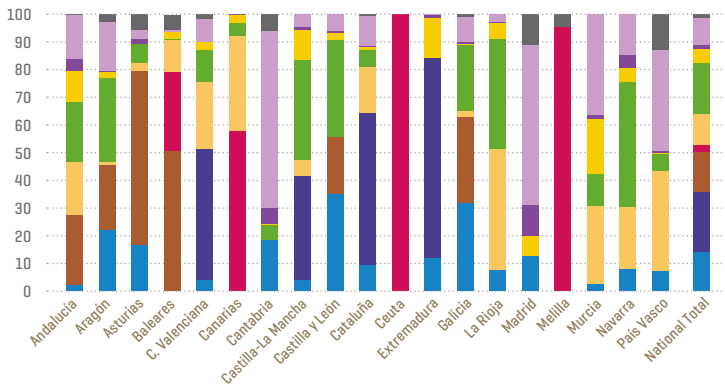
GWh

	Andalucía	Aragón	Asturias	Baleares	Comunidad Valenciana	Canarias	Cantabria	Castilla- La Mancha	Castilla y León	Cataluña
Hydro	956	3,333	1,986	-	1,994	3	667	874	11,570	4,179
Nuclear	-	-	-	-	9,178	-	-	8,003	-	23,743
Coal	8,273	3,318	7,573	2,304	-	-	-	0	6,554	-
Fuel/gas ⁽²⁾	-	-	-	1,312	-	5,043	-	-	-	-
Combined Cycle ⁽³⁾	6,186	176	355	543	4,695	3,032	-	1,266	-	6,990
Hydro-wind	-	-	-	-	-	18	-	-	-	-
Wind	7,060	4,226	798	5	2,225	394	71	7,678	10,940	2,684
Solar photovoltaic	1,524	295	1	120	513	277	2	1,622	828	413
Solar thermal	2,195	-	-	-	70	-	-	722	-	70
Other renewables ⁽⁴⁾	1,368	53	245	1	39	9	77	238	247	176
Cogeneration	5,102	2,499	370	35	1,580	0	831	989	1,858	4,689
Waste	182	367	708	262	345	-	78	-	-	271
Production	32,845	14,266	12,035	4,582	20,639	8,778	1,725	21,393	31,997	43,215
Pumped storage consumption	-371	-422	-39	-	-1,831	-	-612	-66	-920	-304
Energy exchange balance ⁽⁵⁾	6,875	-3,410	-1,465	1,251	8,177	-	3,105	-9,551	-16,923	3,643
Demand [b.c.-at power station busbars] 2016	39,349	10,435	10,532	5,832	26,985	8,778	4,219	11,776	14,154	46,554
Demanda [b.c.-at power station busbars] 2015	38,660	10,301	10,468	5,796	26,746	8,669	4,248	11,571	13,865	46,647
% 16/15	1.8	1.3	0.6	0.6	0.9	1.2	-0.7	1.8	2.1	-0.2
	Ceuta	Extremadura	Galicia	La Rioja	Madrid	Melilla	Murcia	Navarra	Pais Vasco	TOTAL
Hydro	-	2,519	9,842	174	153	-	101	450	371	39,171
Nuclear	-	15,175	-	-	-	-	-	-	-	56,099
Coal	-	-	9,469	-	-	-	-	-	-	37,491
Fuel/gas ⁽²⁾	211	-	-	-	-	199	-	-	-	6,765
Combined Cycle ⁽³⁾	-	-	670	1,016	-	-	1,115	1,288	1,930	29,260
Hydro-wind	-	-	-	-	-	-	-	-	-	18
Wind	-	-	7,311	934	-	-	465	2,572	332	47,695
Solar photovoltaic	-	1,061	20	131	88	0	745	294	30	7,965
Solar thermal	-	1,962	-	-	-	-	41	-	-	5,060
Other renewables ⁽⁴⁾	-	236	232	8	138	-	55	274	31	3,426
Cogeneration	-	51	2,802	66	707	-	1,446	846	1,948	25,817
Waste	-	-	338	-	136	10	-	-	698	3,392
Production	211	21,003	30,684	2,329	1,221	208	3,968	5,724	5,339	262,161
Pumped storage consumption	-	-84	-173	-	-	-	-	-	-	-4,819
Energy exchange balance ⁽⁵⁾	-	-15,962	-10,637	-584	27,862	-	5,137	-757	10,907	7,667
Demand [b.c.-at power station busbars] 2016	211	4,957	19,874	1,744	29,083	208	9,104	4,966	16,246	265,009
Demanda [b.c.-at power station busbars] 2015	205	4,836	19,718	1,725	28,874	213	8,920	4,843	16,977	263,283
% 16/15	2.6	2.5	0.8	1.1	0.7	-2.4	2.1	2.5	-4.3	0.7

[1] Allocation of generation units based on primary fuel. [2] Generation from auxiliary generation units is included in the Balearic Islands' electricity system. [3] Includes operation in open cycle mode. Fuel and gasoil are the primary fuels used in the electricity system of the Canary Islands. [4] Includes biogas, biomass, marine energy and geothermal. [5] Provisional value. Includes values corresponding to intra-national and international energy physical exchange balances.

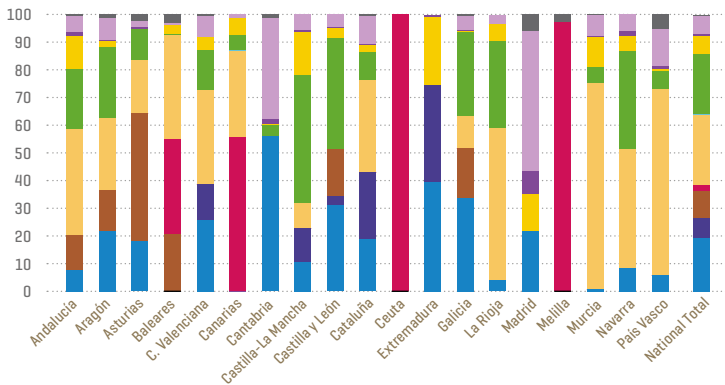
PRODUCTION STRUCTURE BY POWER STATION TYPE

%



INSTALLED POWER CAPACITY STRUCTURE

%



■ Hydro^[1]
■ Nuclear
 ■ Coal
 ■ Fuel/gas
 ■ Combined Cycle
 ■ Wind
 ■ Solar^[2]
■ Other renewables
 ■ Cogeneration
 ■ Waste

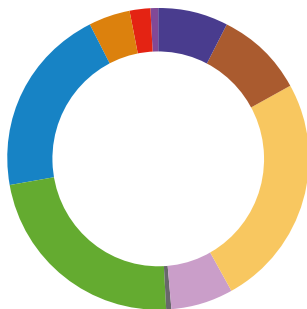
[1] Production structure does not include pumped storage generation. [2] Includes solar photovoltaic and thermal.

INSTALLED POWER CAPACITY AS AT 31.12.2016 PENINSULAR ELECTRICITY SYSTEM

%

100,059 MW

Nuclear	7.6
Coal	9.5
Combined cycle	24.9
Cogeneration	6.7
Waste	0.7
Wind	22.9
Hydro ^[1]	20.3
Solar photovoltaic	4.4
Solar thermal	2.3
Other renewables	0.7

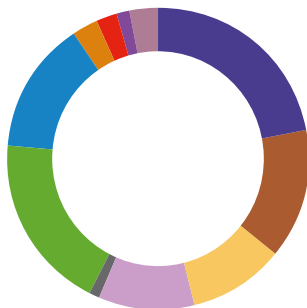


[1] Includes pure pumped storage.

ANNUAL DEMAND COVERAGE PENINSULAR ELECTRICITY SYSTEM

%

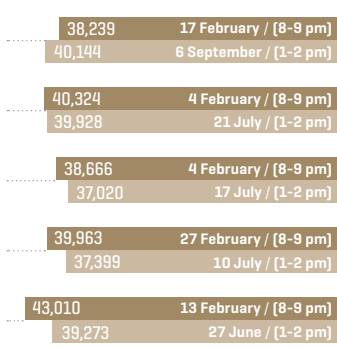
Nuclear	22.2
Coal	13.9
Combined cycle	10.2
Cogeneration	10.2
Waste	1.2
Wind	18.7
Hydro ^[1]	14.2
Solar photovoltaic	3.0
Solar thermal	2.0
Other renewables	1.4
Importer balance regarding international exchanges	3.0



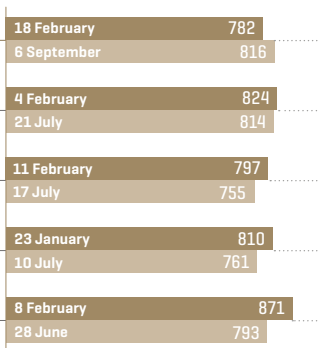
[1] Does not include pumped storage generation.

MAXIMUM HOURLY AND DAILY DEMAND PENINSULAR SYSTEM

Hourly demand [MWh]



Daily demand [GWh]



■ Winter (January-May / October-December) ■ Summer (June-September)

COVERAGE OF MAXIMUM HOURLY DEMAND PENINSULAR SYSTEM

%

40,144 MWh / 06 Sep 2016 [1-2 pm]

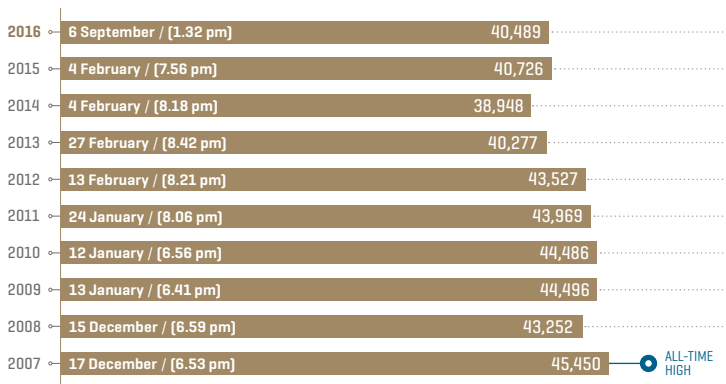
Nuclear	16.7
Coal	17.2
Combined cycle	18.6
Cogeneration	7.6
Waste	0.9
Wind	2.8
Hydro ^[1]	13.7
Solar photovoltaic	7.2
Solar thermal	4.7
Other renewables	1.1
Importer balance regarding international exchanges	9.5



[1] Does not include pumped storage generation.

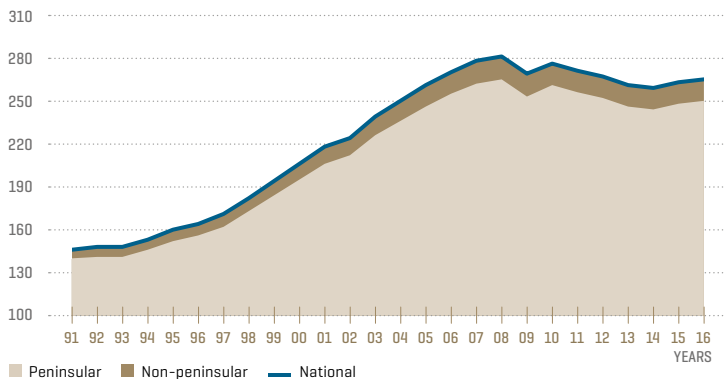
INSTANTANEOUS PEAK POWER DEMAND PENINSULAR SYSTEM

MW



EVOLUTION OF ELECTRICAL ENERGY DEMAND AT B.C. (POWER STATION BUSBARS)

TWh



ANNUAL EVOLUTION OF ELECTRICAL ENERGY DEMAND AND GDP PENINSULAR SYSTEM

	Demand			GDP [2]
	GWh	Δ [%]	Δ Corrected [%] [1]	
2012	252,014	-1.4	-1.8	-2.9
2013	246,368	-2.2	-2.2	-1.7
2014	243,544	-1.1	-0.1	1.4
2015	248,398	2.0	1.7	3.2
2016	249,980	0.6	-0.1	3.2

[Δ] Variation with respect to previous year. [1] After factoring in seasonal and working patterns. [2] Source: INE [Spanish Statistical Office].

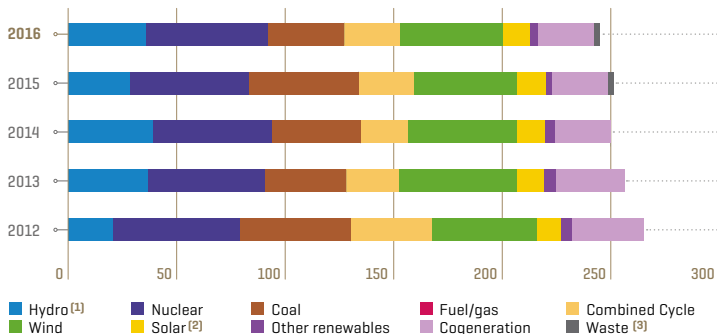
ANNUAL EVOLUTION OF ELECTRICAL ENERGY DEMAND NON-PENINSULAR SYSTEMS

	Balearic Islands		Canary Islands		Ceuta		Melilla	
	GWh	Δ [%]	GWh	Δ [%]	GWh	Δ [%]	GWh	Δ [%]
2012	5,823	1.4	8,893	0.3	212	4.5	217	1.1
2013	5,674	-2.6	8,624	-3.0	202	-4.8	210	-3.5
2014	5,585	-1.6	8,580	-0.5	212	5.1	210	0.1
2015	5,796	3.8	8,669	1.0	205	-3.2	213	1.7
2016	5,832	0.6	8,778	1.2	211	2.6	208	-2.4

[Δ] Variation with respect to previous year.

ANNUAL EVOLUTION ELECTRICAL ENERGY DEMAND AND GDP - PENINSULAR SYSTEM

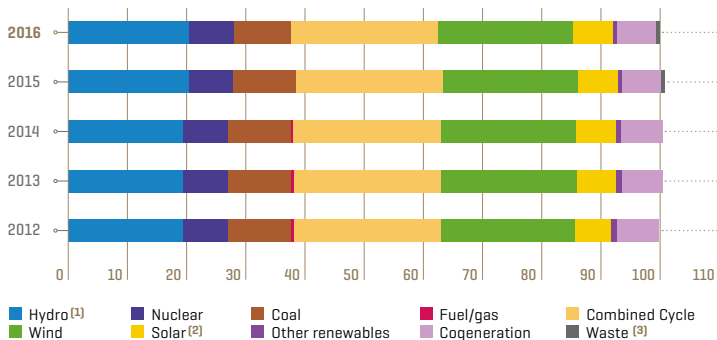
TWh



[1] Does not include pumped storage generation. [2] Includes solar photovoltaic and solar thermal. [3] Generation included in other renewables and cogeneration up to December 31, 2014. 50% of generation coming from urban solid waste is considered renewable.

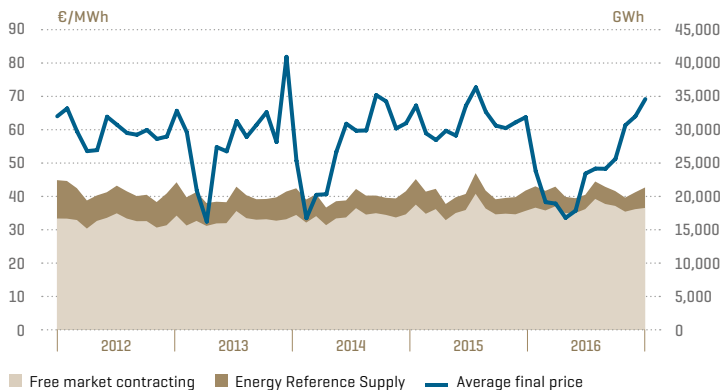
ANNUAL EVOLUTION INSTALLED POWER CAPACITY - PENINSULAR SYSTEM

GW



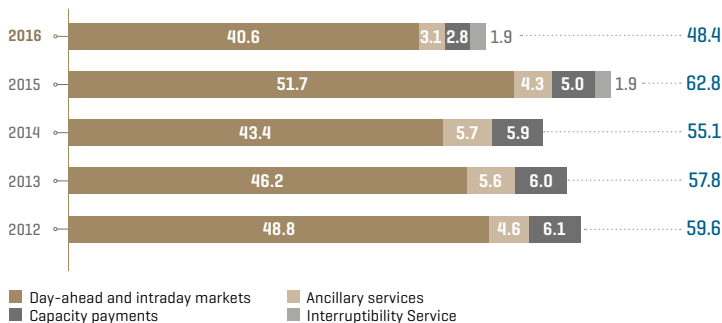
[1] Includes pure pumped storage. [2] Includes solar photovoltaic and solar thermal. [3] Capacity included in other renewables and cogeneration up to December 31, 2014. // Source: National Commission for Markets and Competition [CNMC] on data regarding: Non-Hydro Management Unit [HMC], wind, solar, other renewables, cogeneration and waste.

EVOLUTION OF MONTHLY ENERGY AND PRICES IN THE PENINSULAR ELECTRICITY MARKET



EVOLUTION OF THE COMPONENTS OF THE AVERAGE FINAL PRICE IN THE PENINSULAR ELECTRICITY MARKET

€/MWh



ENERGY MANAGED IN THE PENINSULAR SYSTEM ANCILLARY SERVICES ⁽¹⁾

GWh

	2015		2016		% 2016/15	
	Upward	Downward	Upward	Downward	Upward	Downward
Technical constraints (PDBF) ⁽²⁾	6,283	178	11,834	181	88.3	1.5
Secondary control	1,366	1,193	1,530	1,012	12.0	-15.1
Tertiary control	3,126	1,627	2,557	1,553	-18.2	-4.5
Deviation management	2,214	549	1,183	465	-46.6	-15.2
Real-time constraints ⁽³⁾	519	1,152	390	645	-24.7	-44.0
Total energy managed	18,206		21,351		17.3	

[1] Does not include additional upward power reserve, secondary control band, nor energies associated to cross-border balancing services. [2] Energy increased or decreased in phase I of the resolution of technical constraints of the PDBF (Daily Base Operating Schedule) – Operating Procedure 3.2. [3] Includes energy re-dispatching of the Spanish Peninsula-Balearic Islands link.

AVERAGE WEIGHTED PRICE IN THE PENINSULAR SYSTEM ANCILLARY SERVICES

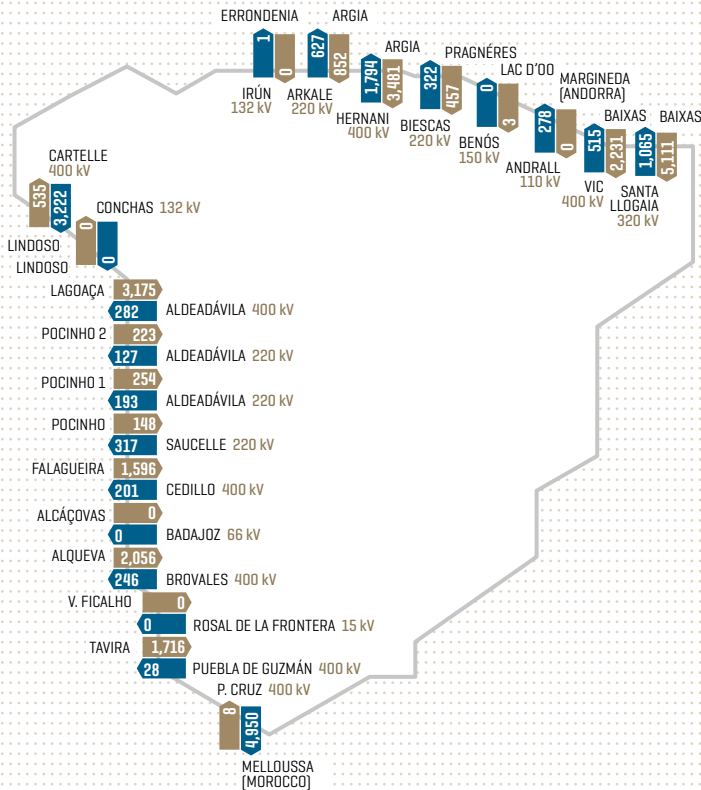
€/MWh

	2015		2016		% 2016/15	
	Upward	Downward	Upward	Downward	Upward	Downward
Technical constraints (PDBF) ⁽¹⁾	156.0	44.9	78.9	35.2	-49.4	-21.6
Secondary control	53.7	38.5	43.0	32.4	-19.9	-15.8
Tertiary control	63.7	24.8	50.2	19.4	-21.2	-21.9
Deviation management	62.3	33.5	47.8	26.3	-23.3	-21.4
Real-time constraints	104.1	19.4	94.7	16.2	-9.0	-16.7

[1] Weighted average price of energy increased or decreased in phase I of the resolution of technical constraints of the PDBF (Daily Base Operating Schedule) – Operating Procedure 3.2.

MAP OF INTERNATIONAL PHYSICAL ENERGY EXCHANGES

GWh



INTERNATIONAL PHYSICAL ENERGY EXCHANGES BY INTERCONNECTION

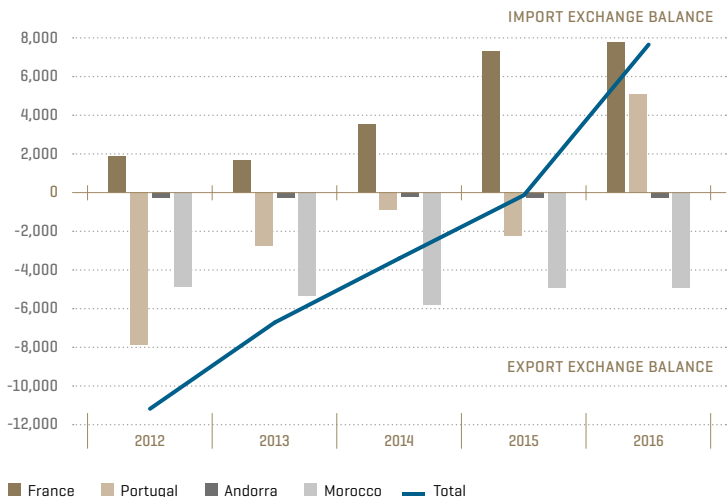
GWh

	Import		Export		Balance ⁽¹⁾	
	2015	2016	2015	2016	2015	2016
France	9,131	12,135	1,807	4,334	7,324	7,802
Portugal	5,811	9,702	8,077	4,616	-2,266	5,086
Andorra	0	0	264	278	-264	-278
Morocco	14	8	4,941	4,950	-4,927	-4,942
Total	14,956	21,845	15,089	14,178	-133	7,667

[1] Positive values indicate an import exchange balance and negative values indicate an export exchange balance.

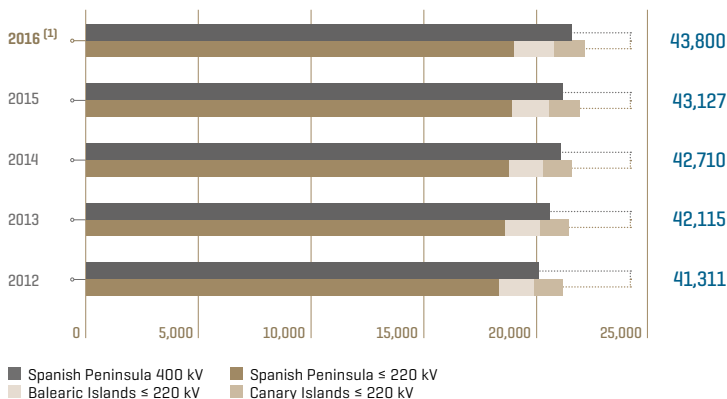
EVOLUTION OF THE INTERNATIONAL PHYSICAL ENERGY EXCHANGE BALANCE

GWh



EVOLUTION OF SPAIN'S ELECTRICITY TRANSMISSION GRID

km of circuit



[1] Provisional data pending audit [currently underway].

TRANSMISSION GRID FACILITIES IN SPAIN ^[1]

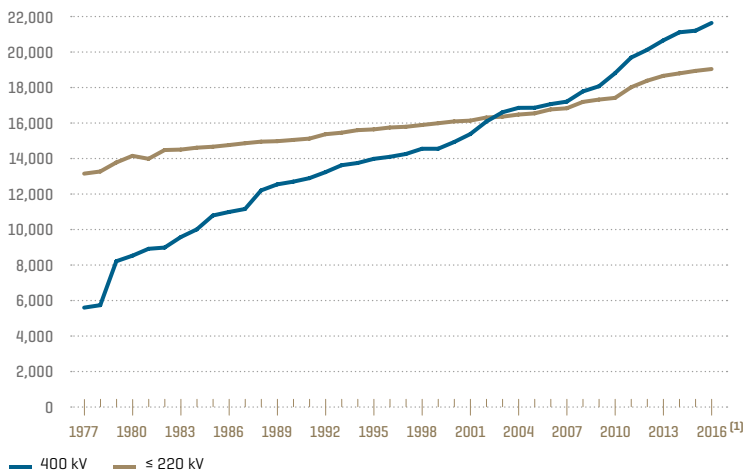
	400 kV		≤ 220 kV		Total
	Spanish Peninsula	Spanish Peninsula	Balearic Islands	Canary Islands	
Total lines (km)	21,620	19,026	1,800	1,354	43,800
Overhead lines (km)	21,503	18,259	1,089	1,080	41,931
Submarine lines (km)	29	236	540	30	835
Underground lines (km)	88	531	171	244	1,034
Transformer capacity (MVA)	79,808	63	3,273	2,000	85,144

[1] Provisional data pending audit [currently underway].

Cumulative data regarding km of circuit and transformer capacity as at 31 December 2016.

EVOLUTION OF THE PENINSULAR 400 KV AND ≤ 220 KV TRANSMISSION GRID

km of circuit



[1] Provisional data pending audit [currently underway].

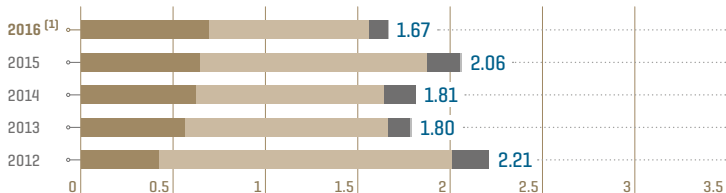
TRANSMISSION GRID QUALITY ENERGY NOT SUPPLIED (ENS) AND AVERAGE INTERRUPTION TIME (AIT)

	ENS (MWh)			AIT (minutes)		
	Spanish Peninsula	Balearic Islands	Canary Islands	Spanish Peninsula	Balearic Islands	Canary Islands
2012	133	7	224	0.28	0.68	13.25
2013	1,156	81	72	2.47	7.50	4.38
2014	204	13	148	0.44	1.21	9.04
2015	53	29	150	0.11	2.66	9.08
2016 ^[1]	78	0.3	457	0.16	0.03	27.45

Average interruption time [AIT] = Energy not supplied [ENS] / Average power of the system. The continuity of supply indicators shown include the assessment of the influence of incidents subject to administrative proceedings in progress. [1] Provisional data pending audit [currently underway].

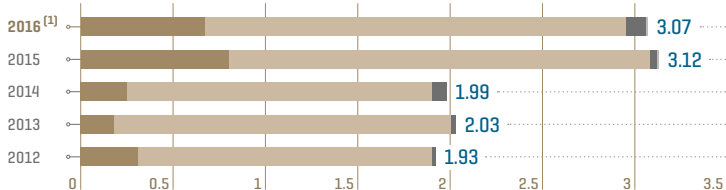
ANNUAL EVOLUTION OF THE NON-AVAILABILITY RATE PENINSULAR TRANSMISSION GRID

%



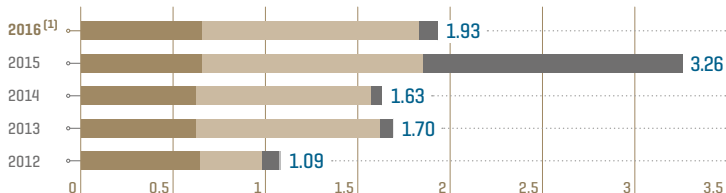
ANNUAL EVOLUTION OF THE NON-AVAILABILITY RATE BALEARIC ISLANDS' TRANSMISSION GRID

%



ANNUAL EVOLUTION OF THE NON-AVAILABILITY RATE CANARY ISLANDS' TRANSMISSION GRID

%



- Programmable for predictive and preventative maintenance.
- Programmable for causes not due to maintenance.
- Non-programmable due to corrective maintenance.
- Non-programmable due to fortuitous circumstances.

Note: Classification in accordance with RD 1955/2000. // The continuity of supply indicators presented include the assessment of the influence of incidents subject to administrative proceedings in progress.

[1] Provisional data pending audit [currently underway].

ELECTRICAL ENERGY DEMAND AND CONSUMPTION PER CAPITA OF ENTSO-E MEMBER COUNTRIES

	Demand [TWh]		Consumption per capita [kWh/hab.]	
	2016	% 16/15	2016	% 16/15
Germany	548.4	5.3	6,674	4.1
Austria	73.5	5.7	8,456	4.3
Belgium	84.2	-1.0	7,443	-1.6
Bosnia-Herzegovina ^[1]	12.3	2.7	3,216	2.7
Bulgaria	33.7	1.4	4,713	2.1
Chypre	4.7	6.5	5,530	6.3
Croatia	17.3	1.9	4,132	2.8
Denmark	34.5	6.4	6,048	5.5
Slovakia	27.7	1.8	5,101	1.8
Slovenia	13.8	1.2	6,690	1.1
Spain	265.0	0.7	5,706	0.7
Estonia	8.4	3.0	6,373	3.0
Finland	85.0	3.0	15,488	2.7
France ^[2]	483.1	1.6	7,236	1.2
FYROM	7.1	-4.4	3,417	-4.5
United kingdom ^[3]	334.0	-4.4	5,108	-5.2
Greece	51.3	0.2	4,755	0.9
Holland	114.5	1.8	6,745	1.3
Hungary	40.9	0.3	4,157	0.5
Ireland	27.6	2.2	5,832	0.1
Island	18.1	-1.5	54,341	-2.5
Italy	308.4	-1.9	5,084	-1.7
Latvia	7.3	1.6	3,719	2.5
Lithuania	11.4	5.3	3,959	6.5
Luxembourg	6.5	2.0	11,273	-0.3
Montenegro	3.2	-5.6	5,185	-5.6
Norway	133.2	3.9	25,571	3.0
Poland	155.3	1.8	4,090	1.9
Portugal	49.3	0.6	4,765	1.0
Czech Republic	64.7	2.1	6,134	1.9
Romania	55.4	1.1	2,803	1.7
Serbia	38.8	-1.3	5,485	-0.8
Sweden	139.8	2.8	14,190	1.8
Switzerland	63.1	-0.5	7,579	-1.5
Total	3,321.5	1.3	6,182	0.9

Consumption per capita = Total consumption / no. of inhabitants. // Population data: Eurostat; consumption data: ENTSO-E. Data Portal 24/5/2017, Spain REE. [1] Population data corresponding to 2012. [2] Population data includes overseas territories. [3] Population and demand data include Northern Ireland.



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