

THE
SPANISH
ELECTRICITY
SYSTEM
2017

SUMMARY



RED
ELÉCTRICA
DE ESPAÑA

Electrical Energy Balance 2017 ^[1] [GWh]

	Andalucía	Aragón	Asturias	Baleares	Comunidad Valenciana	Canarias	Cantabria	Castilla-La Mancha	Castilla y León	Cataluña
Hydro	560	2,412	981	-	378	3	161	409	4,138	3,720
Pumped storage ^[2]	147	149	13	-	1,011	-	400	42	332	114
Nuclear	-	-	-	-	7,050	-	-	7,981	-	24,233
Coal	10,550	4,711	10,104	2,603	-	-	-	-	6,410	-
Fuel/gas ^[3]	-	-	-	1,368	-	5,240	-	-	-	-
Combined cycle ^[4]	7,768	1,100	685	426	4,174	3,016	-	1,667	-	7,893
Hydro-wind	-	-	-	-	-	20	-	-	-	-
Wind	7,190	4,478	827	3	2,176	396	66	7,504	10,989	2,825
Solar photovoltaic	1,580	311	1	123	543	274	2	1,742	895	420
Solar thermal	2,320	-	-	-	99	-	-	743	-	87
Other renewables ^[5]	1,388	58	271	2	32	10	83	266	263	191
Cogeneration	5,275	2,968	392	36	1,591	-	1,165	1,088	2,333	5,082
Non-renewable waste	299	413	734	144	54	-	37	-	-	145
Renewable waste	-	-	-	144	-	-	37	-	-	141
Production	37,076	16,600	14,008	4,849	17,107	8,958	1,951	21,441	25,360	44,852
Pumped storage consumption	-224	-206	-22	-	-1,346	-	-667	-68	-748	-165
Energy exchange balance ^[6]	3,420	-5,783	-3,403	1,179	11,262	-	3,084	-9,660	-10,502	2,966
Demand [b.c.] 2017	40,272	10,612	10,583	6,028	27,023	8,958	4,368	11,713	14,110	47,652
% 17/16	1.7	1.7	0.7	3.4	0.6	2.1	3.9	0.0	0.6	1.6
	Ceuta	Extremadura	Galicia	La Rioja	Madrid	Melilla	Murcia	Navarra	País Vasco	TOTAL
Hydro	-	1,359	3,308	101	136	-	72	340	286	18,364
Pumped storage ^[2]	-	20	23	-	-	-	-	-	-	2,249
Nuclear	-	16,345	-	-	-	-	-	-	-	55,609
Coal	-	-	10,817	-	-	-	-	-	-	45,196
Fuel/gas ^[3]	203	-	-	-	-	201	-	-	-	7,011
Combined Cycle ^[4]	-	-	1,763	1,690	-	-	3,447	1,405	2,265	37,296
Hydro-wind	-	-	-	-	-	-	-	-	-	20
Wind	-	-	7,002	977	-	-	435	2,703	328	47,897
Solar photovoltaic	-	1,119	21	139	92	0	773	318	31	8,385
Solar thermal	-	2,056	-	-	-	-	43	-	-	5,348
Other renewables ^[5]	-	234	253	9	150	-	54	305	45	3,614
Cogeneration	-	53	2,826	75	704	-	1,688	903	1,991	28,170
Non-renewable waste	-	-	178	-	71	5	-	-	528	2,608
Renewable waste	-	-	178	-	71	5	-	-	301	877
Production	203	21,185	26,369	2,991	1,223	211	6,513	5,975	5,773	262,645
Pumped storage consumption	-	-36	-195	-	-	-	-	-	-	-3,675
Energy exchange balance ^[6]	-	-16,082	-6,316	-1,277	27,544	-	2,887	-918	10,770	9,171
Demand [b.c.] 2017	203	5,068	19,858	1,714	28,768	211	9,400	5,057	16,543	268,140
% 17/16	-3.7	2.0	-0.5	-1.0	-0.7	1.1	3.8	2.2	2.1	1.1

[1] Allocation of generation units based on primary fuel.

[2] Pure pumped storage + estimate of mixed pumped storage

[3] Generation from auxiliary generation units is included in the Balearic Islands' electricity system.

[4] Includes operation in open cycle mode. Gas-oil is the primary fuel used in the electricity system of the Canary Islands.

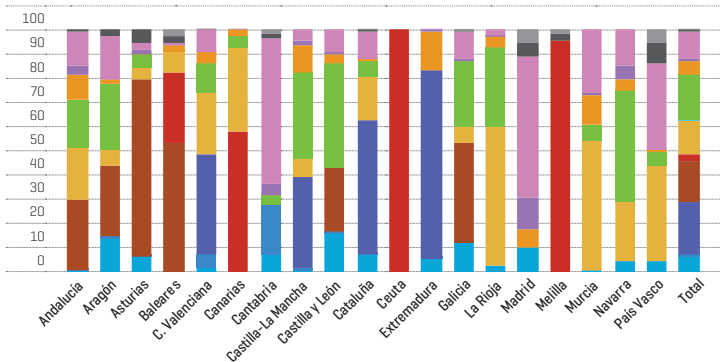
[5] Includes biogas, biomass, marine energy and geothermal.

[6] Includes values corresponding to intra-national and international energy physical exchange balances.

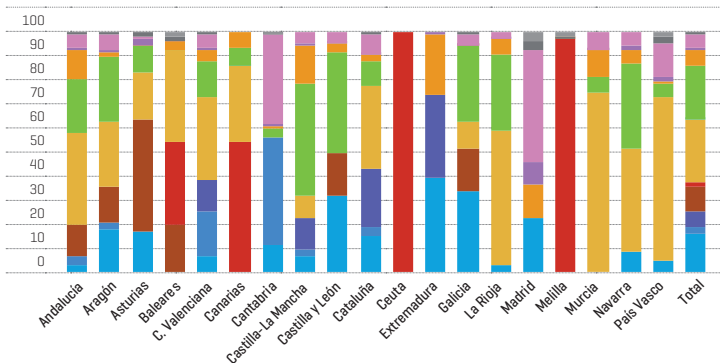
Positive values indicate an import exchange balance and negative values indicate an export exchange balance.

Note: b.c. = power station busbars

Production structure by power station type [%]



Installed power capacity structure [%]



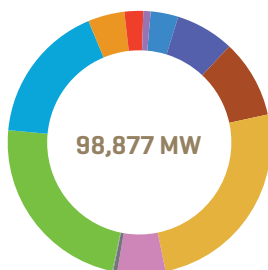
HYDRO
PUMPED STORAGE
NUCLEAR
COAL
FUEL/GAS
COMBINED CYCLE
WIND
SOLAR^[1]
OTHER RENEWABLES
COGENERATION
NON-RENEWABLE WASTE
RENEWABLE WASTE

[1] Includes solar photovoltaic and solar thermal.

Installed power capacity as at 31.12.2017 [%]

Peninsular electricity system

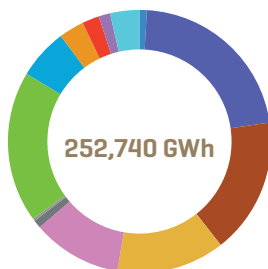
PUMPED STORAGE	3.4
NUCLEAR	7.2
COAL	9.6
COMBINED CYCLE	25.2
COGENERATION	5.9
NON-RENEWABLE WASTE	0.5
RENEWABLE WASTE	0.1
WIND	23.2
HYDRO	17.2
SOLAR PHOTOVOLTAIC	4.5
SOLAR THERMAL	2.3
OTHER RENEWABLES	0.9



Annual demand coverage 2017 [%]

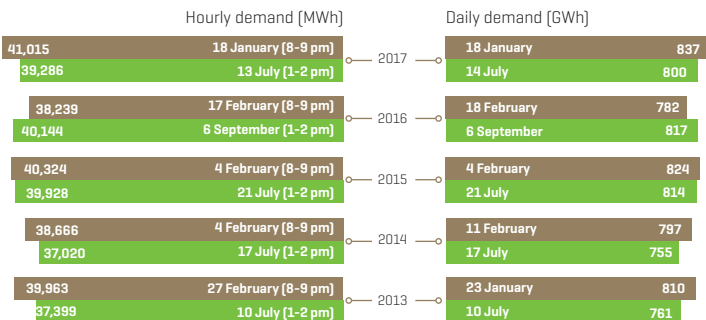
Peninsular electricity system

PUMPED STORAGE	0.9
NUCLEAR	21.6
COAL	16.5
COMBINED CYCLE	13.1
COGENERATION	10.9
NON-RENEWABLE WASTE	1.0
RENEWABLE WASTE	0.3
WIND	18.4
HYDRO	7.1
SOLAR PHOTOVOLTAIC	3.1
SOLAR THERMAL	2.1
OTHER RENEWABLES	1.4
IMPORTER BALANCE REGARDING INTERNATIONAL EXCHANGES	3.6



[1] Pure pumped storage + estimate of mixed pumped storage.

Maximum hourly and daily demand Peninsular electricity system

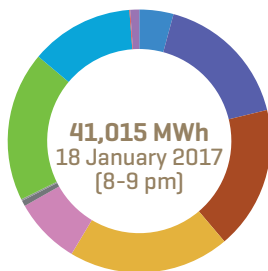


WINTER (JANUARY-MAY / OCTOBER-DECEMBER)

SUMMER (JUNE-SEPTEMBER)

Coverage of maximum hourly demand 2017 [%] Peninsular electricity system

PUMPED STORAGE	4.2
NUCLEAR	17.0
COAL	17.6
COMBINED CYCLE	19.8
COGENERATION	8.2
NON-RENEWABLE WASTE	0.7
RENEWABLE WASTE	0.2
WIND	18.4
HYDRO	12.7
SOLAR THERMAL	0.1
OTHER RENEWABLES	1.1



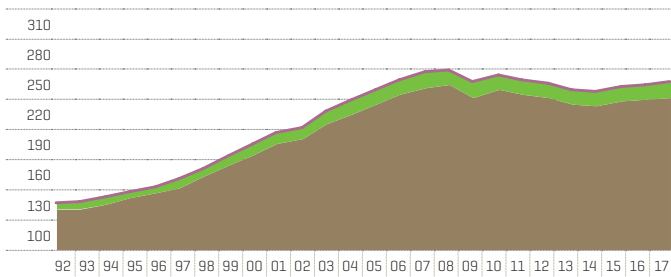
Maximum peak load demand ^[1] [MW]

Peninsular electricity system

2017	18 January (7.50 pm)	41,381
2016	6 September (1.32 pm)	40,489
2015	4 February (7.56 pm)	40,726
2014	4 February (8.18 pm)	38,948
2013	27 February (8.42 pm)	40,277
2012	13 February (8.21 pm)	43,527
2011	24 January (8.06 pm)	43,969
2010	12 January (6.56 pm)	44,486
2009	13 January (6.41 pm)	44,496
2008	15 December (6.59 pm)	43,252

[1] All-time high 45,450 MW. 17 December 2007 at 6.53 pm.

Evolution of electrical energy demand at B.C. [power station busbars] [TWh]



PENINSULAR

NON-PENINSULAR

NATIONAL

Annual evolution of electrical energy demand and GDP Peninsular system

	Demand			GDP ⁽²⁾
	GWh	Δ [%]	Δ Corrected ⁽¹⁾ [%]	
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	3.4
2016	250,099	0.7	0.0	3.3
2017	252,740	1.1	1.6	3.1

[Δ] Variation with respect to previous year.

[1] After factoring in seasonal and working patterns.

[2] Source: INE

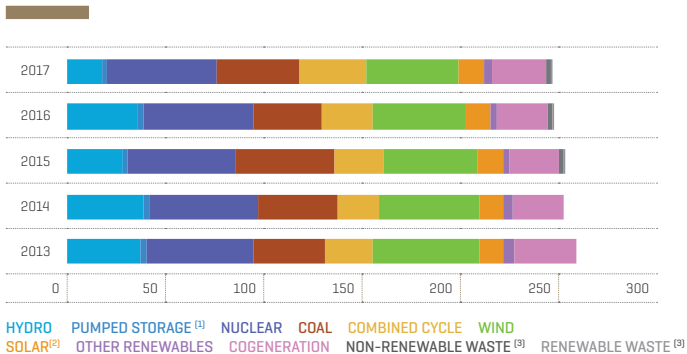
Annual evolution of electrical energy demand Non-peninsular systems

	Balearic Islands		Canary Islands		Ceuta		Melilla	
	GWh	Δ [%]	GWh	Δ [%]	GWh	Δ [%]	GWh	Δ [%]
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	8,777	1.2	211	2.6	208	-2.4
2017	6,028	3.4	8,958	2.1	203	-3.7	211	1.1

[Δ] Variation with respect to previous year.

Annual evolution of the generation structure [TWh]

Peninsular electricity system



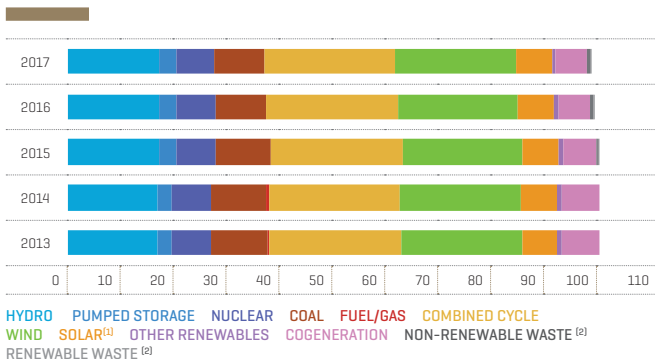
[1] Pure pumped storage + estimate of mixed pumped storage

[2] Includes solar photovoltaic and solar thermal

[3] Generation included in other renewables and cogeneration up to December 31, 2014

Annual evolution of installed power [GW]

Peninsular electricity system

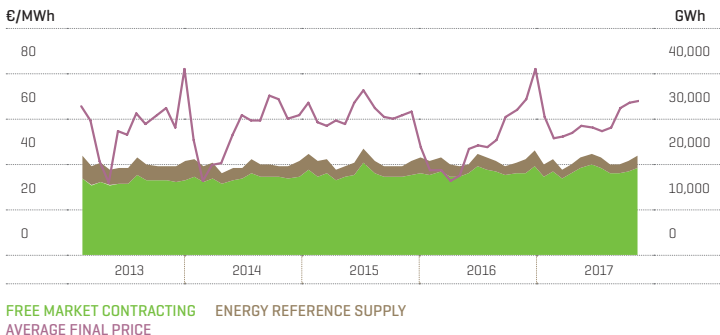


[1] Includes solar photovoltaic and solar thermal

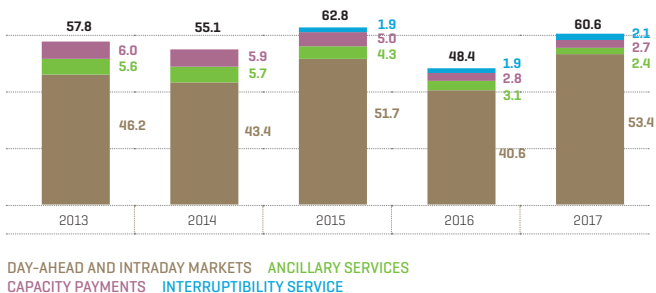
[2] Capacity included in other renewables and cogeneration up to December 31, 2014.

Source: National Commission for Markets and Competition [CNMC] until 2014 on data regarding: Non-Hydro Management Unit (HMU), 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 [GWh] ⁽¹⁾

	2016		2017		% 17/16	
	Upward	Downward	Upward	Downward	Upward	Downward
Technical constraints (PDBF) ⁽²⁾	11,834	181	11,035	740	-6.8	308.8
Secondary control	1,530	1,012	1,203	1,212	-21.3	19.7
Tertiary control	2,557	1,553	2,348	1,806	-8.2	16.3
Deviation management	1,183	465	1,006	760	-15.0	63.3
Real-time constraints ⁽³⁾	391	645	207	434	-46.9	-32.7
Total energy managed	21,351		20,751		-2.8	

(1) Does not include energy 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.

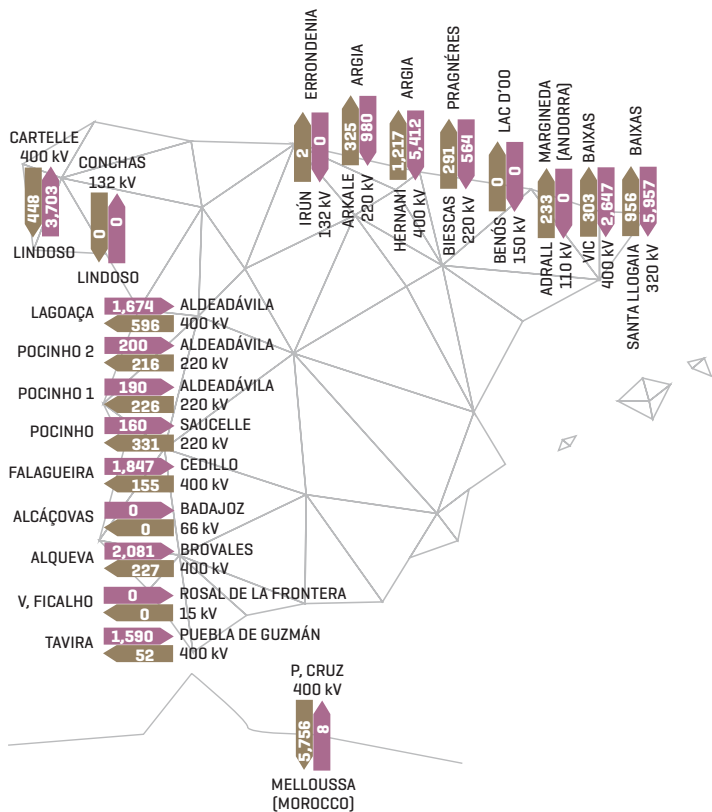
(3) Includes energy re-dispatching of the Spanish Peninsula-Balearic Islands link.

Average weighted price in the peninsular system ancillary services [€/MWh]

	2016		2017		% 17/16	
	Upward	Downward	Upward	Downward	Upward	Downward
Technical constraints (PDBF)	78.9	35.2	81.5	48.2	3.3	37.0
Secondary control	43.0	32.4	54.8	45.0	27.3	38.9
Tertiary control	50.2	19.4	64.3	32.8	28.1	69.5
Deviation management	47.8	26.3	66.5	38.2	39.3	45.3
Real-time constraints ⁽¹⁾	101.3	22.0	119.1	27.9	17.6	26.7

(1) Includes the Spanish Peninsula-Balearic Islands link. It takes into account only re-dispatched energy.

Map of international physical energy exchanges [GWh]

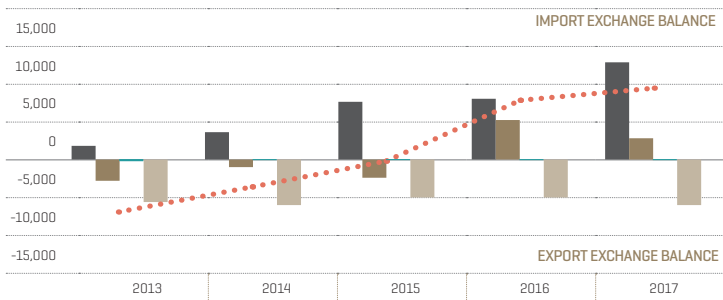


International physical energy exchanges by interconnection [GWh]

	Import		Export		Balance ^[1]	
	2016	2017	2016	2017	2016	2017
France	12,135	15,561	4,334	3,094	7,802	12,467
Portugal	9,702	8,190	4,616	5,505	5,086	2,685
Andorra	0	0	278	233	-278	-233
Morocco	8	8	4,950	5,756	-4,942	-5,748
Total	21,845	23,759	14,178	14,588	7,667	9,171

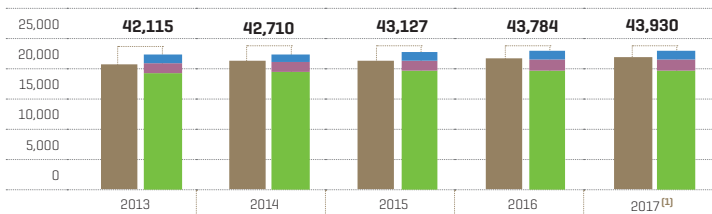
[1] Positive values indicate an import exchange balance and negative values indicate an export exchange balance.

Evolution of the international physical energy exchange balance [GWh]



FRANCE PORTUGAL ANDORRA MOROCCO TOTAL

Evolution of Spain's electricity transmission grid (km of circuit)



SPANISH PENINSULA 400 kV SPANISH PENINSULA ≤220 kV
 BALEARIC ISLANDS ≤220 kV CANARY ISLANDS ≤220 kV

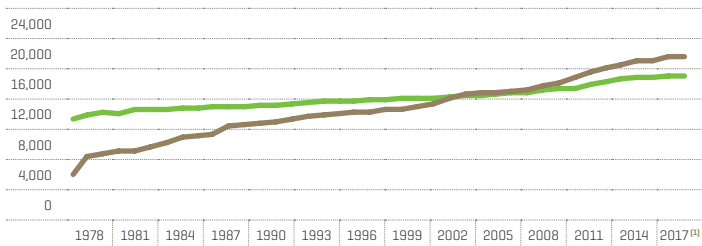
[1] Provisional data pending audit (currently underway).
 Cumulative data regarding kilometre of circuit as at year end.

Transmission grid facilities in Spain 2017^[1]

	400 kV		≤ 220 kV		Total
	Spanish Peninsula	Spanish Peninsula	Balearic Islands	Canary Islands	
Total lines (km)	21,728	19,039	1,808	1,355	43,930
Overhead lines (km)	21,611	18,264	1,089	1,080	42,045
Submarine lines (km)	29	236	540	30	835
Underground lines (km)	88	539	179	245	1,051
Transformer capacity (MVA)	80,208	613	3,273	2,560	86,654

[1] Provisional data pending audit (currently underway).
 Cumulative data regarding kilometre of circuit and transformer capacity as at 31 December 2017.

Evolution of transmission grid 400 y \leq 220 kV [km of circuit] Peninsular electricity system



400 kV \leq 220 kV

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

Transmission grid quality Energy Not Supplied (ENS) and Average Interruption Time (AIT)

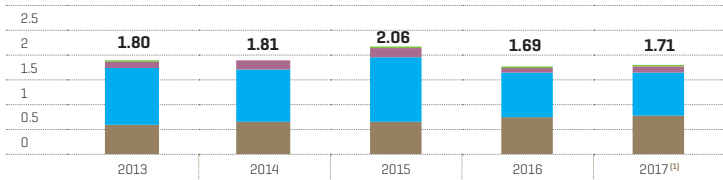
	ENS (MWh)			AIT (minutes)		
	Spanish Peninsula	Balearic Islands	Canary Islands	Spanish Peninsula	Balearic Islands	Canary Islands
2013	1,156	81	72	2.47	7.50	4.38
2014	204	13	148	0.44	1.21	9.04
2015	53	29	150	0.11	2.66	9.08
2016	78	0.3	457	0.16	0.03	27.45
2017⁽¹⁾	60	33	47	0.13	2.88	2.75

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

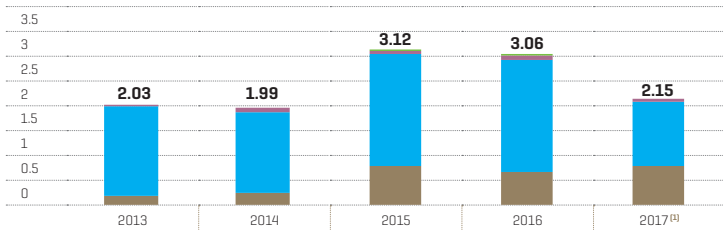
Average interruption time (AIT) = Energy not supplied (ENS) / Average power of the system.

Annual evolution of the transmission grid non-availability rate [%]

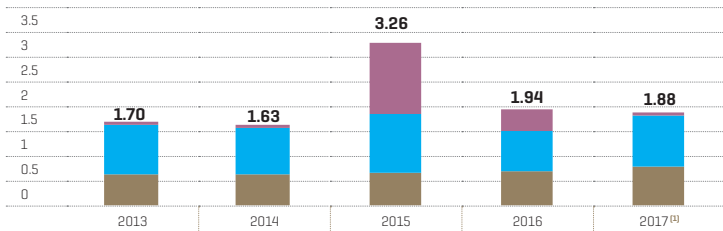
Spanish Peninsula



Balearic Islands



Canary Islands



NON-PROGRAMMABLE DUE TO FORTUITOUS CIRCUMSTANCES

NON-PROGRAMMABLE DUE TO CORRECTIVE MAINTENANCE

PROGRAMMABLE FOR CAUSES NOT DUE TO MAINTENANCE.

PROGRAMMABLE FOR PREDICTIVE AND PREVENTATIVE MAINTENANCE.

Note: Classification in accordance with RD 1955/2000. The total transmission grid non-availability rate does not include non-availabilities due to force majeure or actions to third parties.

(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.)	
	2017	% 17/16	2017	% 17/16
Albania ^[1]	7	-	2,478	-
Austria	72	-1.6	8,244	-2.4
Belgium	85	0.8	7,474	0.4
Bosnia-Herzegovina	13	2.2	3,595	2.3
Bulgaria	34	1.7	4,839	2.5
Croatia	18	1.8	4,244	2.7
Cyprus	5	1.6	5,575	0.8
Czech Republic	66	2.5	6,271	2.3
Denmark	34	-1.6	5,941	-2.4
Estonia	9	1.5	6,466	1.5
Finland	85	0.5	15,536	0.2
France ^[2]	482	-0.3	7,201	-0.7
Germany	539	0.0	6,528	-0.4
Greece	52	1.2	4,819	1.3
Hungary	42	2.6	4,281	3.0
Iceland	19	3.2	55,110	1.4
Ireland	28	0.9	5,815	-0.3
Italy	320	3.9	5,289	4.0
Latvia	7	-0.7	3,733	0.3
Lithuania	12	2.6	4,119	4.0
Luxembourg	6	0.0	10,998	-2.4
Macedonia	7	1.0	3,463	0.9
Montenegro	3	5.6	5,472	5.6
Netherlands	115	0.4	6,750	-0.2
Norway	134	0.7	25,450	-0.2
Poland	159	2.6	4,196	2.6
Portugal	50	0.7	4,815	1.1
Romania	57	2.5	2,890	3.1
Serbia	40	2.1	5,630	2.7
Slovakia	29	3.1	5,253	3.0
Slovenia	14	2.8	6,872	2.7
Spain	268	1.1	5,763	0.9
Sweden	140	0.1	14,000	-1.3
Switzerland	63	0.4	7,527	-0.7
United Kingdom ^[3]	325	-3.1	4,935	-3.7
Total	3,339	0.8	6,204	0.5

Consumption per capita = Total consumption / no. of inhabitants.

Population data: Eurostat; consumption data: ENTSO-E. Data Portal 19/4/2018, Spain REE.

[1] Information corresponding to Albania is included as of 2017.

[2] Population data includes overseas territories.

[3] Population and demand data include Northern Ireland.

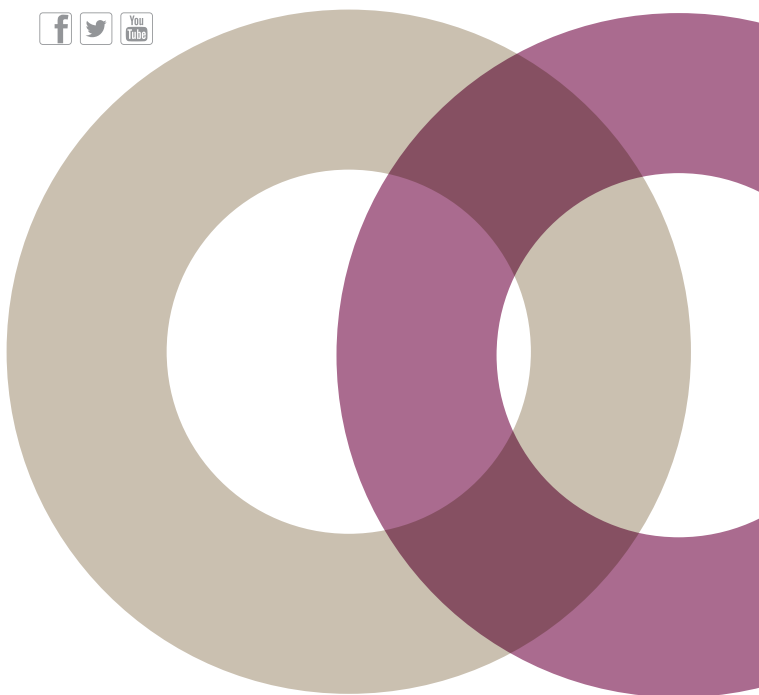


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