



## **The Electric Power System**



(update 2017)





# **Basic facts**

- Area: 131 957 km<sup>2</sup>
- Population: 10.75 million (2016)
- Number of electricity consumers: 7.486.139 (2017)
- Number of TSOs: 1
- Number of DSOs: 1
- Peak load: 10 610 MW (in 2007)
- Average interruption of electricity of DSO customer:
  SAIDI: 98.5 min (2017)
  - > SAIFI: 1.5 (2017)





# Global map of the grid and of its interconnections

### Interconnectors with:

- > Turkey
- ➢ Bulgaria
- ≻ F.Y.R.O.M.
- > Albania
- > Italy







	Voltage Level	Total length (approx.)	Responsibility
Transmission Grid	400kV	3 054 km	TSO
High Voltage	150kV	8 565 km	TSO
High Voltage	66kV	54 km	TSO
Medium Voltage	0,4 kV to 20 kV	111.865 km	DSO
Low Voltage	220 V - 240 V	126.377 km	DSO





# Structure of electrical power system





# Map of the interconnected high voltage grid









# Information on TSO

- Name: Independent Power Transmission Operator (IPTO or ADMIE)
- Network length 11 673 (km)
- Served area 115 000 (km<sup>2</sup>)
- Annual transmitted energy 52.043 (TWh) (2017)
- website: <u>http://www.admie.gr</u>





Instructions to DSO in case that security is at risk mostly when curtailment is necessary



On-line and off-line info, short term forecasts to TSO for load and dispersed generation + measurements for market settlement





# Responsibilities of TSO

- System development, market rules implementation, dispatching and monitoring the overall system
- Responsibility for Security of Supply
- Operative contact to DSO
- Requests support by the DSO

## Responsibilities of DSO

- Monitoring own system
- Operative contact to generators on DSO-Level
- Support of TSO to operate the cascade







### Power structure of the country



Symbols for under operation

- Thermal Power Plant (Fossil fuel)
- Thermal Power Plant (Natural gas)
- Pump storage
- Everything hydro based
- ☑ Wind
- Biomass
- Solar



# RES Installed capacity and energy production 2017

		Installed	Generated	Capacity
	<b>.</b>	Capacity	Energy	Tactor
	OWNER	(MW)	(GWh)	(%)
Large Hydro	РРС	3018	3457	13,1
Small Cogeneration	IPPs	100	195	22,3
Wind	IPPs (mainly)	2302	4777	23,7
Small hydro	IPPs (mainly)	230	586	29,1
Biofuels - Biomass	IPPs (mainly)	61	278	52,0
PVs &	IDDs (mainly)	2094	3243	17,7
PVs on buildings	IPPS (IIIdilliy)	351	475	15,4
Total Renewables		5138	955/	
(Grid & Network)		3130	5554	
TOTAL		8156	13011	





# Conventional Installed Capacity and Energy production 2017

		Installed	Total	Capacity
		Capacity	Production	factor
	OWNERSHIP	(MW)	(GWh)	(%)
Lignite	PPC	3904	16387	47,9
OCGT	Heron Thermoelectric	148	19	1,5
CCGT	РРС	1821	7656	48,0
	ELPEDISON	810	2731	38,5
	Heron Thermoelectric	422	1168	31,6
	Korinthos Power	433	1731	45,6
	Mytilineos	433	2011	53 <i>,</i> 0
	Total	3919	15297	44,6
Large-scale CHP	Mytilineos	334	1163	39,7
TOTAL THERMAL		8305	32865	45,2



# Development of generation sources since 2004



2016











### Consuption per customer group

Electricity consumption on the interconnected system (GWh)								
Voltage	Year	Large Industrial customers	Household customers	usehold stomers Small Industrial and Commercial customers public, traction)		Total (GWh)		
	2010		16,477	12,257	2,805	31,539		
LV	2011		16,116	10,535	3,526	30,177		
	2012		16,714	10,123	3,734	30,571		
	2013		15,973	9,560	3,640	29,173		
	2010			9,674	1,447	11,121		
MIX	2011			9,125	1,397	10,522		
	2012			8,471	1,513	9,984		
	2013			8,904	1,487	10,391		
	2010	6,355			1,191	7,546		
ш./	2011	6,613			1,536	8,149		
ΠV	2012	6,507			1,361	7,868		
	2013	6,599			1,168	7,767		
Total	2010	6,355	16,477	21,931	5,443	50,206		
	2011	6,613	16,116	19,660	6,459	48,848		
	2012	6,507	16,714	18,594	6,608	48,423		
	2013	6,599	15,973	18,464	6,295	47,331		







Wind Farms in the Interconnected System





# Development of photovoltaic power







# RES installed capacity and aggregated RES production since 2004







### Price development for households and industry consumers

	Electricity prices						Gas prices					
	Households (1)				Industry (²)		Households (3)			Industry (*)		
	2012	2013	2014	2012	2013	2014	2012	2013	2014	2012	2013	2014
EU-28	0.195	0.202	0.208	0.116	0.118	0.120	0.070	0.071	0.072	0.038	0.040	0.037
Euro area (EA-17) (5)	0.205	0.215	0.221	0.122	0.126	0.128	0.077	0.079	0.079	0.039	0.041	0.038
Belgium	0.222	0.222	0.204	0.111	0.110	0.109	0.073	0.067	0.065	0.035	0.034	0.029
Bulgaria	0.096	0.088	0.090	0.078	0.073	0.084	0.056	0.052	0.047	0.040	0.035	0.034
Czech Republic	0.150	0.149	0.127	0.103	0.099	0.082	0.066	0.058	0.056	0.034	0.033	0.030
Denmark	0.297	0.294	0.304	0.099	0.100	0.088	0.096	0.098	0.088	0.042	0.044	0.036
Germany	0.268	0.292	0.297	0.130	0.144	0.152	0.065	0.069	0.068	0.038	0.048	0.040
Estonia	0.112	0.137	0.133	0.082	0.097	0.093	0.052	0.048	0.049	0.036	0.035	0.037
Ireland	0.229	0.241	0.254	0.140	0.137	0.131	0.067	0.072	0.075	0.042	0.047	0.042
Greece	0.142	0.170	0.179	0.122	0.124	0.130	0.102	0.089	0.080	0.058	0.051	0.047
Spain	0.228	0.227	0.237	0.120	0.120	0.117	0.086	0.089	0.096	0.038	0.038	0.037
France	0.145	0.159	0.175	0.079	0.085	0.091	0.068	0.073	0.076	0.040	0.039	0.038
Croatia	0.138	0.135	0.132	0.094	0.094	0.092	0.047	0.047	0.048	0.046	0.043	0.040
Italy	0.230	0.232	0.234	0.178	0.172	0.174	0.097	0.095	0.095	0.040	0.038	0.035
Cyprus	0.291	0.248	0.236	0.234	0.201	0.190	-	-	-	-	-	-
Latvia	0.137	0.136	0.130	0.111	0.115	0.118	0.056	0.050	0.049	0.040	0.037	0.036
Lithuania	0.127	0.139	0.132	0.114	0.123	0.117	0.061	0.061	0.050	0.046	0.041	0.037
Luxembourg	0.171	0.165	0.174	0.101	0.100	0.099	0.059	0.057	0.051	0.051	0.045	0.039
Hungary	0.162	0.133	0.115	0.100	0.098	0.090	0.052	0.042	0.035	0.047	0.048	0.039
Malta	0.168	0.169	0.125	0.186	0.186	0.186	-	-	-	-	-	-
Netherlands	0.190	0.192	0.173	0.097	0.094	0.089	0.084	0.085	0.082	0.037	0.036	0.033
Austria	0.202	0.202	0.199	0.112	0.111	0.106	0.076	0.075	0.073	0.043	0.043	0.040
Poland	0.153	0.144	0.141	0.096	0.088	0.083	0.058	0.051	0.050	0.038	0.036	0.036
Portugal	0.206	0.213	0.223	0.115	0.114	0.119	0.085	0.093	0.104	0.042	0.042	0.047
Romania	0.108	0.128	0.125	0.076	0.082	0.081	0.027	0.031	0.032	0.026	0.029	0.031
Slovenia	0.154	0.166	0.163	0.094	0.095	0.085	0.073	0.071	0.063	0.055	0.048	0.044
Slovakia	0.172	0.168	0.152	0.127	0.127	0.117	0.051	0.052	0.052	0.041	0.039	0.038
Finland	0.156	0.156	0.154	0.074	0.075	0.072	:	:	:	0.048	0.047	0.056
Sweden	0.208	0.205	0.187	0.078	0.075	0.067	0.127	0.122	0.114	0.055	0.055	0.044
United Kingdom	0.179	0.180	0.201	0.119	0.120	0.134	0.058	0.059	0.065	0.034	0.036	0.035
Iceland	0.116	0.107	0.116	:	:	:	-	-	-	-	-	-
Liechtenstein	:	:	0.155	:	:	0.140	:	:	0.086	:	:	0.056
Norway	0.178	0.178	0.166	0.086	0.087	0.081	:	:	:	:	:	:
Montenegro	0.095	0.099	0.099	0.072	0.075	0.075	-	-	-	-	-	-
FYR of Macedonia	0.079	0.078	0.082	:	0.075	0.078	:	:	:	0.050	0.039	0.042
Albania	0.117	0.115	0.116	:	:	:	-	-	-	-	-	-
Serbia	:	0.061	0.060	:	0.066	0.067	:	0.044	0.045	:	0.038	0.038
Turkey	0.147	0.131	0.131	0.096	0.081	0.081	0.041	0.037	0.037	0.030	0.027	0.027
Bosnia and Herzegovina	0.080	0.080	0.081	0.066	0.066	0.062	0.056	0.051	0.051	0.057	0.053	0.053
Kosovo	:	0.056	0.059	:	0.073	0.079	-	-	-	-	-	-

(1) Annual consumption: 2 500 kWh < consumption < 5 000 kWh.

(\*) Annual consumption: 500 MWh < consumption < 2 000 MWh; excluding VAT

(\*) Annual consumption: 20 GJ < consumption < 200 GJ.

(\*) Annual consumption: 10 000 GJ < consumption < 100 000 GJ; excluding VAT.

(5) 2014: EA-18.

Source: Eurostat (online data codes: nrg\_pc\_204, nrg\_pc\_205, nrg\_pc\_202 and nrg\_pc\_203)



### Electricity market organisation







# Power balance in 2017

- Generation (TWh): 45.8
- Consumption (TWh): 52.0
- Imports (TWh): 8.7
- Exports (TWh): 2.5

Losses of 1.1 TWh are included in the Consumption value.





# Energy exchanges







## Energy exchanges

### Physical flows 2017 (TWh)







### Specific aspects of the electricity market in 2017 and in future

- The Hellenic Electricity Market Model is a "physical market" based on a "day-ahead mandatory pool" with simultaneous co-optimization of the energy and reserves (primary and secondary) while respecting the constraints of transmission system and generation.
- There is no balancing market and in order to operate the day ahead scheduling (DAS), the generators submit offers for the entire available capacity of each power unit and the suppliers submit offers for the consumers' load that they represent in the market. The transmission congestion in the North to South corridor is reflected in the market model with a split in two operational market zones in cases of violation of certain power flow limits in this corridor.
- RES are remunerated with feed—in tariffs, but in the very close future auctions results will be taken into account.
- Mid 2019 a new market structure is foreseen to be implemented in order to comply with the European Target Model. In particular forward market, day-ahead market and intraday market will be operated by the Hellenic Energy Exchange and balancing market will be operated by IPTO (the Greek TSO).

