Empowering Mediterranean regulators for a common energy future.

Electricity Working Group

Mediterranean Electricity Markets Observatory

National electricity systems and regional overview

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MEDREG – Association of Mediterranean Regulators
Corso di Porta Vittoria 27 - 20122 Milan, Italy
Tel + 39 02 655 65 537 - Fax +39 02 655 65 562
info@medreg-regulators.org – www.medreg-regulators.org

Abstract

Since 2007, the Mediterranean Electricity Market Observatory (MEMO) aims to monitor the evolution of national, sub-regional and regional electricity markets. The MEMO is a periodic assessment, with a time span of three years each; it mainly relies on the responses and clarifications received from MEDREG members.

This edition focusses on national data and regional integration. It includes indicators aimed at assessing national priorities in Mediterranean countries and their potential for being a part of the integrated sub-regional and regional electricity markets.

The report highlights that around the Mediterranean Sea, there is a considerable contrast between the northern, southern and eastern shores. In the northern and western sides of the Mediterranean (mostly European Union members), infrastructures and supply have reached very high standards, resulting from development processes over the past decades. Outside the EU, networks, generation and regional integration are progressing at different speeds in different areas.

In particular, the dynamics of demand, following demography and the evolution of living standards, has introduced some pressure on supplying systems, making the security of supply and diversification of energy sources a further priority. The development of renewable energy sources adds to the changes in power systems, particularly in terms of network reinforcement and flexibility.

In this context, regional cooperation appears to be a privileged option for mutual strengthening of national systems. Cross-border integration offers opportunities for building upon complementarities of systems and providing broader outlets to RES generation. However, challenges are important, and the EU model may not be fully applicable to the rest of the region but provides interesting learnings on how to connect and jointly operate markets. In this respect, transmission system operators and regulators play a crucial role. Even though most non-EU countries are not part of a regional market, they are interconnected with their neighbours.

The northern and southern shores of the Mediterranean show different characteristics, potentialities and complementarities. Countries on both banks can use these synergies to exchange energy and meet the targets of the energy transition in the next decades. Therefore, well-designed, integrated and efficient electricity infrastructures, through the shared use of energy, can contribute to paving the way towards the achievement of development and security goals in the Mediterranean region.

About MEDREG

MEDREG is the association of Mediterranean energy regulators, bringing together 27 regulators from 22 countries, spanning the European Union (EU), the Balkans and North Africa. MEDREG acts as a platform for providing information exchange and assistance to its members as well as capacity development activities through webinars, training sessions and workshops.

Mediterranean regulators work together to promote greater harmonisation of the regional energy markets and legislations, seeking progressive market integration in the Euro-Mediterranean basin.

Through constant cooperation and information exchange among members, MEDREG aims at fostering consumers' rights, energy efficiency, infrastructure investment and development, based on secure, safe, cost-effective and environmentally sustainable energy systems.

The MEDREG Secretariat is located in Milan, Italy.

For more information, visit www.medreg-regulators.org

If you have any queries relating to this paper, please contact:

MEDREG Secretariat

Telephone: +39 02 65565 524

Email: vlenzi@medreg-regulators.org

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EXECUTIVE SUMMARY

The development of electricity systems is part of the economic dynamics of countries; it is strongly influenced by the level of development, geographical characteristics and the availability of primary energy. The history of electrical systems generally highlights that principles of unbundling and third-party access to the network come as a reform of centralised governance regimes. Organisations separating production and transport can be set up in developing markets, however, the operating rules must then be adapted to the specifics of the systems and, in particular, account for the indicators on the size of the market, the number of existing or potentially present players, the proximity of neighbouring markets or the purchasing power of consumers.

In all cases, a common objective across the entire region is to make energy supplies more secure and sustainable. Regional market integration is a means of improving the security of supply through better use of national complementarities. They can support flexibility provisions and commercial transactions, which can help integrate renewable energy sources. This is particularly important as all around the Mediterranean, renewable energy source integration poses new questions in terms of grid management.

This report aims to assess the status and recent developments regarding national power systems characteristics and the international integration potential. Three sub-regions have been identified: the EU, the Balkans and Turkey, North Africa and the Eastern Mediterranean countries.

The basis of this report is a questionnaire circulated among MEDREG members to get updated information on national situations. The MEDREG members provided information on the following aspects:

- Volume of demand, generation, import, and export
- Data related to Transmission system operators (TSOs) and Distribution system operators (DSOs) including governance and unbundling regime
- Internal structure of the electricity market
- Interconnections and regional electricity markets.

In northern Mediterranean countries (the EU, the Balkans and Turkey), economic development is more mature, the population is ageing and sometimes declining. Besides, the almost complete liberalisation of wholesale and retail markets and the active policies promoting wind generation and solar power, have strong influences on the evolution of the electricity sector. Peak demand in many European countries is likely to shift from winter to summer, as air conditioning usage rises.

On the other hand, southern and eastern Mediterranean countries (SEMCs) are experiencing demographic and economic growth, requiring significant investment in the electricity sector to meet the resulting increase in demand. Although growth rates have slowed in the last few years, owing to weaker economic activity and increases in electricity prices and reduced subsidies, most countries are still struggling to meet the growing electricity demand. Looking forward, governments are likely to continue to face this challenge by expediting new projects and upgrading their infrastructure, investing heavily as partners and financiers, while trying to increase the role of the private sector in power generation.

Since energy security is at the forefront of political agendas, in some countries, this has extended to efforts in diversifying the national energy mixes, thanks also to the decreasing costs of renewable energy. It has also driven countries to diversify their energy import sources.

Regional integration is progressing at different speeds in different areas of the Mediterranean (EU, the Balkans and Turkey, Eastern, North Africa). On the northern shore, the leadership of international projects and institutions, such as the Energy Union (in the EU and its member states), explains why

cross-border interconnections have been up and running for decades. On the other hand, due to the lack of any supranational guidance in the southern and eastern Mediterranean regions, sub-regional cooperation is much weaker. Currently, most electricity exchanges on existing interconnections take place on an emergency basis, to cover either unexpected or scheduled outages due to maintenance. However, it seems that countries continue to focus on meeting their own demands through investing in local power generation.

Diverse forms of governance and unbundling regimes exist in MEDREG countries. The primary objective of the unbundling rules is ensuring independence of transmission services from generation, production and supply, in order to allow competition. The internal structures of the electricity markets vary greatly between MEDREG's members and regions. In the EU, the Balkans and Turkey, wholesale and retail competitions are almost fully open, but it's rarely the case in other countries.

The northern and southern Mediterranean energy markets show different characteristics, potentialities and complementarities. Countries on both banks can use these synergies to exchange energy and meet the targets of the energy transition in the next decades. Therefore, well-designed, integrated and efficient electricity infrastructures, through the shared use of energy, can pave the way towards the achievement of development and security goals in the Mediterranean regions.

Related Documents

MEDREG documents

- MEDREG Electricity Working Group report - Regulatory options for the stimulation of infrastructure investments, 2018, Ref. 18-25GA-5.1.2, http://www.MEDREG-regulators.org/Portals/_default/Skede/Allegati/Skeda4506-323-2018.12.28/Regulatory_options_for_stimulation_investments_final.pdf?IDUNI=3craytmdtgo2fuiv4p22fkee5902
- Joint Report Electricity Working Group (ELE WG) & Renewable Energy & Energy Efficiency Working Group (RES WG) Smart Grids in the Mediterranean Countries, 2018, MED18-26GA-4.4.1 http://www.medreg-regulators.org/Portals/_default/Skede/Allegati/Skeda4506-321-2018.12.14/Smart%20Grids%20in%20the%20Mediterranean%20Countries.pdf?IDUNI=c5j4e1hkffnhlmxb4sx2pugw1092
- Electricity Working Groups: Towards a MEDREG Electricity Market Observatory Part One - National Market Observatory - 2017 Update REF: MED17-ELE-24-5.2.2
- Mediterranean Electricity Markets Observatory (MEMO) Part 2 – Regional electricity markets – Comparison of responses from 2010 and 2015 Final version – Electricity Working Group - May 2015
- Report on Interconnection Rules and Practices for MEDREG Countries, November 2008
- Summary assessment: survey on the legal framework for management of electricity interconnection in the Mediterranean region, December 2011

External documents

- Status Review on Implementation of TSO and DSO Unbundling Provisions, CEER, 2019, C18-LAC-02-08 https://www.ceer.eu/documents/104400/-/-/f69775aa-613c-78a5-4d96-8fd57e6b77d4
- Mediterranean Energy perspectives 2018, OME, 2018, http://www.ome.org/event/mediterranean-energy-perspectives-2018/
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List of abbreviations

Term	Definition
CEER	Council of European Energy Regulators
DSO	Distribution System Operator
ENTSO-E	European Network of Transmission System Operators
EU	European Union
GNI	Growth National Index
IPP	Independent power producer
MEDREG	Mediterranean Energy Regulators
MED-TSO	Mediterranean Energy Transmission System Operators
MEMEE	Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement
OME	Observatoire Méditerranéen de l'Énergie
ONEE	National Office for Electricity and Potable Water
OTC	Over the Counter
PPA	Power Purchase Agreement
PCI	Project of Common Interest
RES	Renewable Energy Sources
RTE	Réseau de Transport d'Electricité
SDG	Sustainable Development Goals
SEE	South East Europe
SEMCs	Southern and Eastern Mediterranean Countries
STEG	Société Tunisienne de l'Electricité et du Gaz
TSO	Transmission System Operator
UN	United Nations

1. Introduction

MEDREG's role is to promote cooperation between regulatory authorities in the Mediterranean, with the objective of contributing to the improvement of the governance of the energy sector. In this regard, the electricity sector is very relevant, since access to electricity represents an important aspect of economic progress and is crucial in improving living conditions. As such, the situations are very diverse among MEDREG members, particularly with regard to the significant differences in terms of economic development. In the European Union (EU), the Mediterranean has a range of counties from highly industrialised and intermediate countries to countries where the standard of living remains much lower, with much more marked problems of poverty.

To be effective, regulations must answer concrete questions and be adapted to the problems encountered by the countries implementing them. In the past, MEMO reports have focused on the reforms implemented in the different countries, with particular attention to the comparison with the European model. Regulations in Europe refer to a specific framework enshrined in the European legislation. It serves for the creation of an integrated competitive market among countries that have achieved a high level of convergence in terms of economic, institutional and energy organisation. Outside the EU, political commitments are not of the same nature and, although there is a desire to develop the integration of national energy systems, there are still several obstacles and difficulties to be overcome.

In this new edition of the MEMO, Mediterranean regulators have proposed an overview of electricity markets that aims to highlight national specificities, in order to improve the understanding of the actions to be considered for better integration. The aim is not only to establish what complementarities exist between countries but also to provide useful information for improving the integration of renewable energies. This report, which complements the one on "*Regulatory Options for the Stimulation of Infrastructure Investments*", published in January 2019, should serve as a basis for future work on the Union for the Mediterranean Regional Electricity Market Platform and, more generally, for understanding the needs of Mediterranean countries.

This study aims at mapping the power systems of the Mediterranean region and to feed the work on regulatory convergence and interconnection development. Specifically, the 2019 MEMO report provides an overview of Mediterranean electricity markets, focussing on seven leading indicators which partly repeat or reformulate the items requested for previous editions, since 2010. The seven "new" indicators are interpreted in Annex 2 of the current report, and they provide information on the volume of demand, generation, import and export, base load and peak load, average and maximum import bases and loads on a daily basis, generation capacities per TSOs and DSOs, the governance and unbundling regime, the generation plants, and the internal structure of the electricity market and the comparison among countries and the regional electricity market system. The comparison involves purpose, status and role of cross-border interconnections.

In order to analyse the framework and interconnections, MEDREG members have been grouped into three zones. These areas are for information purposes only and do not imply any political or economic bias on the part of MEDREG. The three areas are as follows:

- The EU, the Balkans and Turkey: Albania, Bosnia-Herzegovina, Croatia, Cyprus, France, Greece, Italy, Malta, Montenegro, Portugal, Spain, Slovenia, Turkey
- North Africa: Algeria, Libya, Morocco, Tunisia[1]
- East Mediterranean: Egypt, Israel, Jordan, Lebanon, Palestinian Authority

2. Overview of Electricity Systems

The development of electricity systems is part of the economic dynamics of countries, it is strongly influenced by the level of development, geographical characteristics and the availability of primary energy sources. Beyond industrial issues, the organisation of electricity markets refers to demographic changes as well as the needs of populations and public service cultures. The history of electrical systems generally highlights several stages with, at least initially, the construction of large-scale networks and means of production and centralised, vertically integrated organisations. The principles of unbundling and third-party access to the network generally come into play at a later stage, with the aim of enabling the sector to be organised competitively or with a plurality of suppliers.

However, this history is not linear, and organisations separating production and transport can be set-up in developing markets. The operating rules must then be adapted to the specificities of the systems and, in particular, take into account specific indicators regarding the size of the market, the number of existing or potentially present players, the proximity of neighbouring markets or the purchasing power of consumers. Economic stability and the institutions able to supervise the functioning of the market are also two important parameters. The competitive organisation of electricity systems is indeed complex – it must be sufficiently confident to attract private actors.

The electricity mix is also an important point and must be seen in the light of energy policy objectives. As such, the development of renewable energy is a priority in many countries, both in the EU and in the south or east of the region. On the one hand, this development raises questions relating to their competitiveness, as compared to conventional controllable production means, and, on the other hand, to their integration into the networks, since it is necessary to put in place means to compensate for the possible unavailability of production.

More generally, the production mix is strongly influenced by industrial history and the availability of primary energy sources. Regulation must take all these parameters into account, since it must promote efficient organisation, i.e., propose measures adaptable to market fundamentals. As far as the organisation of the sector is concerned, this is true for the short term, but in the long run, it is essential to think about the evolution of the industrial organisation and support investment decisions.

2.1. Macro-economic context

The Mediterranean is characterised by wide demographic disparities, with a few large countries and a group of countries with smaller populations. Four countries account for about

[1]Only Algeria and Morocco replied to the questionnaire, in order to have a complete overview of the North African region, data from the STEG 2018 annual report and ENERDATA have been used for Tunisia and Libya.

60% of the total population: Egypt (98.42 million), Turkey (82.32 million), France (66.99 million) and Italy (60.43 million).

The total population of the Mediterranean countries grew from 281 million in 1970 to 419 million in 2000 and to 517 million in 2018. The population is even predicted to reach 572 million by 2030. While population development in the north is almost stagnant, it is still strong in many countries on the southern shore, translating in increasing needs and challenges in terms of access to various services such as energy.

In terms of economic development, the region also shows important differences. In the north, the EU is amongst the richest regions in the world, with the GNI per capita at above 20,000 dollars in 2018. A second group of countries, including some Balkan states and Turkey, are at around 10,000 dollars per year. Other countries are below 5000 dollars per capita, especially in North Africa (except Libya), grouping Maghreb and Egypt with populations of 90 and 98 million inhabitants, respectively.

Country profiles	Total population (million) – 2018	GNI per capita (USD) atlas method – 2018	Growth level (% per year) – 2018	Population growth (annual %) – 2018
Albania	2.87	4860	4	-0.2
Algeria	42.23	4060	2.1	2
Bosnia-Herzegovina	3.32	5690	3.1	-0.8
Croatia	4.09	13830	2.6	-0.9
Cyprus	1.19	26300	3.9	0.8
Egypt	98.42	2800	5.3	2
France	66.99	41080	1.7	0.2
Greece	10.73	19600	1.9	-0.3
Israel	8.88	40850	3.3	1.9
Italy	60.43	33540	0.9	-0.2
Jordan	9.96	4210	1.9	1.8
Lebanon	6.85	6790	0.2	0.5
Libya	6.68	6330	7.8	1.5
Malta	0.48	26220	6.6	3.3
Montenegro	0.62	8400	4.9	0
Morocco	36.03	3090	3	1.3
Palestinian Authority	4.57	3710	0.9	2.5
Portugal	10.28	21680	2.1	-0.2
Slovenia	2.07	24840	4.5	0
Spain	46.72	29450	2.6	0.3
Tunisia	11.57	3500	2.5	1.1
Turkey	82.32	10380	2.6	1.5

Table 1: Country profiles[2]

[2]Source: World Bank

In the context of fast demographic growth, Southern and Eastern Mediterranean countries (SEMCs) face a series of pressing socio-economic challenges, including problems of poverty and large structural unemployment. Energy is an essential commodity enabling socio-economic development. With the populations' rapidly growing needs, system planning is becoming even more challenging in terms of fast-growing electricity demands. Consumption has increased ten-fold since 1980 on the southern shore of the Mediterranean. This surge can be attributed to several factors including urbanisation, industrialisation and electricity prices set artificially low through government subsidies.

2.2. Electricity demand trends

Around the Mediterranean Sea, there is a considerable contrast between the northern, southern and eastern shores. In the northern and western sides of the Mediterranean (mostly EU members), infrastructures and supply development were completed decades ago. Therefore, most of the current infrastructures can be qualified as "mature", and investments "marginal" when compared to the asset basis of the operators. Besides, financing the modernisation and maintenance of the networks is relatively easy, resulting from a secure investment environment. It is particularly visible in the context of politically more integrated markets, for example, the recent Energy Union that was approved during the previous European Commission term[3].

The evolution of demand in EU countries can be explained with mature economies, relatively slow economic growth, steady or declining populations but also by ambitious energy efficiency policies. In 2012, under the Energy Efficiency Directive 2012/27/EU, the EU set a 20% energy savings target by 2020 (when compared to the projected use of energy in 2020).

In SEMCs, the lack of access to energy supplies and transformation systems is a constraint to human and economic development. Energy plays a vital role for the security of the Mediterranean countries, and no significant economy progress can be foreseen without the support of reliable energy. Except in Libya, all populations in MEDREG member countries have full access to electricity. Such a positive statement must not hide that, first, there are remaining issues in terms of security and quality of supply in numerous countries, and that access to clean energy at an affordable cost [7th United Nation Sustainable Development Goal (SDG[4])] represents another key challenge. Thus, SEMCs require significant investment in the electricity sector to meet the resulting increase in electricity demands, while a common objective across the entire region is to make energy supplies more secure and sustainable.

In general, there are very large differences in terms of the level of electricity consumption. France and Israel, with more than 7 MWh/inhabitant, are the countries with the highest consumption rate, which is explained by their standard of living and consumption habits (in France, for example, part of the consumption is dedicated to heating buildings). In the EU, the consumption levels are around 5 MWh/inhabitant annually, as compared to less than 2 MWh/inhabitant annually in most SEMCs, with the exception of Turkey and Lebanon (3.7 and 3.2).

[3] https://ec.europa.eu/commission/priorities/energy-union-and-climate_en
[4] https://www.seforall.org

2.3. Power generation

As far as electricity production is concerned, fossil fuel-based thermal technologies remain largely dominant, with a few exceptions, such as France – where nuclear power is highly dominant, Spain – whose electricity mix is highly diversified, with nuclear and wind power leading the way in 2018 and Portugal – where renewable energy sources are dominant. Depending on the region, there are quite marked differences, due to the local availability of energy resources. In the EU, production from petroleum products is now marginal, and the dominant thermal production method is gas for Mediterranean countries. In the Balkan region, it should be noted that hydropower plays a particularly important role, it dominates in all MEDREG member countries except Bosnia and Herzegovina.

In the SEMCs, depending on the country, gas or coal dominate. Gas is the main source of production in gas producing countries (Algeria, Egypt) or transit countries such as Tunisia; elsewhere, coal is often the main source of production (in Turkey and Morocco in particular). In most cases, fuel oil is a marginal source (except Lebanon).

With regards to renewable energy, it is now one of the major sources of production in several countries. In Portugal, renewable energy production (hydro, wind, photovoltaic) accounted for 65% of electricity production in 2018. Then there is Spain, where installed wind power is equivalent to the CCGTs for 85% more production and are particularly at the top of RES penetration (in total, RES accounted for 37% of the Spanish electricity production in 2018). While all European countries have major programmes for the development of renewable energies, their production shares remain low. Among the SEMCs, the situation is also mixed; some countries have major development programmes, such as Jordan or Morocco, where wind and solar power production are reaching significant levels. In Jordan, they represent 7.8% of the total power generation, and up to 13.4% in Morocco. In other countries, RESs are generally marginal.

2.4. Interconnections

A fully integrated energy market between Europe and the rest of the Mediterranean basin could facilitate the harmonious development of the RESs of the South, at least cost. Countries on the Southern shore have large RES potential (solar in particular) and have a comparative advantage; the resources are sufficient to meet national needs as well as those of European countries that are prepared to pay a premium for “zero-carbon” electricity.

However, the level of interconnection between Mediterranean countries is very uneven. In the EU, the capacity among countries is high – the basis for building the internal market. The market model put in place also makes it possible to achieve high levels of use of interconnections. With market coupling, the functioning of interconnections is associated with price differentials between national markets. This requires the establishment of power exchanges and an “implicit” allocation principle that allocates transmission capacity at interconnection points to cross-border transactions concluded on spot markets. However, this model cannot be generalised as it requires significant infrastructure and involves sophisticated mechanisms. In addition, European countries share common standards in terms of the reliability of electricity systems; interconnections make it possible to take advantage of the complementarities between national systems, with surpluses from one country offsetting

deficits from another. It should be noted that some countries, such as France and Portugal, have a trend of surplus, while Italy or Spain are rather dependent on imports.

Outside the EU, the Balkans, Turkey and Maghreb belong to the European synchronous zone. For the countries belonging to the Energy Community, the European organisation is being set up. On the other hand, among the SEMCs, there is no organisation comparable to the European model, and cross-border trade is very limited. Some, such as Morocco, make significant use of imports but, in general, markets are poorly connected and interconnection lines are mainly used for security purposes. Factors that increase trade include an increase in production and interconnection capacities but also better regulatory convergence, which facilitates the exploitation of complementarities between national systems. However, European history shows that the road to cross-border integration can be a long one.

2.5. Institutional organisation

The organisation of electricity systems covers two main aspects: the status of operators and market rules. The two are generally linked since TSOs have a central role in the establishment of markets that are more or less open to competition. The question of the maturity of the systems, i.e., the level of infrastructure development, the size of the potential market in terms of producers and consumers, access to sources of flexibility or interconnections with neighbouring countries, are parameters that strongly influence what can actually be put in place.

While the principle of setting up an independent regulator is generally shared in the Mediterranean region, industrial structures show a high degree of diversity between the markets of the EU, where unbundling, third-party network access and competition rules are applied at all levels. As a counterpoint, there are countries that have maintained a vertically integrated organisation, where free market principles are applied only at the margin. In the SEMCs, some countries could foresee that most consumers can be subject to the regulated regime. When this is the case (Algeria, Israel, Turkey), consumers are eligible for going above a certain annual consumption threshold. However, outside the EU and the Balkans, only Algeria and Turkey have a wholesale market.

In other countries, the public incumbent operator also acts as a single buyer for private producers, who operate under power purchase agreements (PPAs). This PPA model is found in most cases as a way to attract investors by taking on economic risks.

A number of reforms are underway, aiming to move towards unbundling rules in order to improve transparency and allowing for the integration of new producers without going through the IPP model. It also offers opportunities for the development of cross-border transactions via interconnections.

3. Demand and Supply

3.1. Electricity demand and generation

Electricity demands continue to grow rapidly in the Southern shore of the Mediterranean. Although growth rates have slowed in the last few years, owing to weaker economic activity and increases in electricity prices and reduced subsidies, most countries are still struggling to meet this increasing demand. Looking forward, governments are likely to continue to face this challenge by expediting new projects and upgrading their infrastructure, investing heavily while trying to increase the role of the private sector in power generation, as partners and financiers.

3.2. North Africa

For North Africa, only two members replied to the questionnaire – Algeria and Morocco – therefore, the data from the STEG annual report and Enerdata[5] has been used for Tunisia and Libya in order to have a complete overview on the North African sub-region.

Although the countries are not comparable in terms of surface and population, they all have to deal with steady population growth and constant economic development, which may explain the rising demands for electricity being a direct consequence of the change in consumer habits as well as the impetus given to the economic and industrial sectors. The next figure provides a global view on the evolution of this demand in the last three years.

The volume of demand in North African countries is growing and it is expected to continue through the next five years. In Algeria, demand grew by 6% over the past five years, while in Morocco the rate was 3.2%, on average, for the same period and an average of 2% in Tunisia. On the other hand, Libya's consumption decreased by an average of 6%.

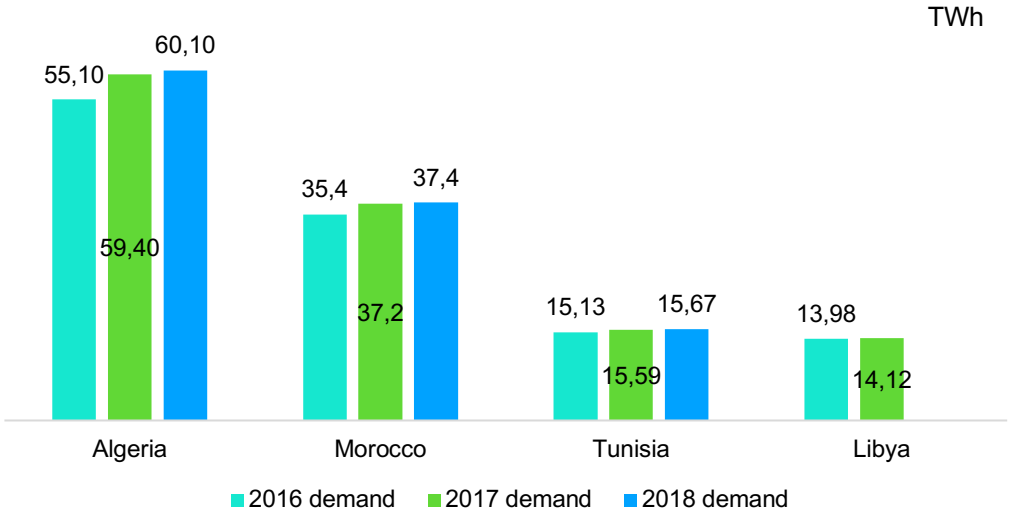


Figure 1 – Evolution of demand in North Africa (TWh)

[5]2018 STEG annual report:
https://www.steg.com.tn/fr/institutionnel/publication/rapport_act2018/Rapport_Annuel_steg_2018_fr.pdf
For Libya, Enerdata was used, the 2018 data is not available, so the 2017 data was taken into consideration.

In 2018, Algeria experienced a peak load on the main grid at 13.676 GW, while the daily average load was 9.6 GW. The peak load in Morocco was 6.31 GW, while the daily average load was 5.5 GW. In Morocco, the average daily import load was 0.6 GW and the maximum load on a daily basis reached 0.875 GW. Algeria did not answer this question.

	Peak load (GW)	Average import load on a daily basis (GW)	Maximum import load on a daily basis (GW)	Daily average load (GW)
Algeria	13.676	n/a	n/a	9.6
Morocco	6.31	0.6	0.875	5.5
Tunisia	3.91[6]	n/a	n/a	n/a
Libya	7.017[7]	n/a	n/a	n/a

Table 2: Baseload, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis: North Africa

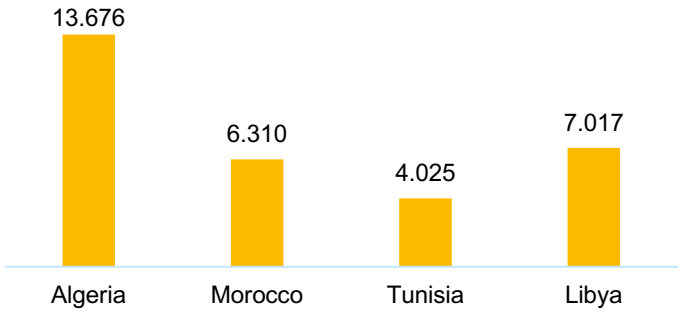


Figure 2 – Peak load (MW) North Africa

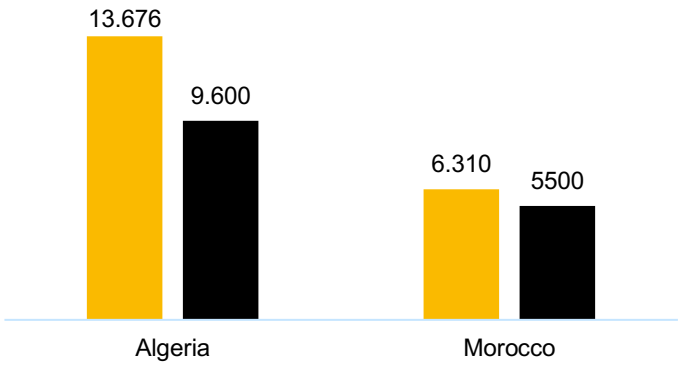


Figure 3 – Peak and daily average load: North Africa[8]

The gap between the peak load and the average load in both countries (4 GW for Algeria) can be explained by the hot weather condition during the summer. The smaller gap in the Moroccan case (0.8 GW) was due particularly to the economic and industrial development and lifestyle modernisation (greater use of air conditioning in the summer, etc.).

[6]STEG 2018 annual report: https://www.steg.com.tn/fr/institutionnel/publication/rapport_act2018/Rapport_Annuel_steg_2018_fr.pdf
[7]2016 data
[8]Daily average load for Tunisia and Libya not available

In addition, the management of this type of network is more difficult in terms of planning generation and from an economic point of view (the new investments are focussed on the peak load, therefore, some power plants have a low load factor during the year).

3.3. The European Union, The Balkans and Turkey

The evolution of demand in the EU countries can be explained through mature economies, slow economic growth, steady or declining populations and a deindustrialisation process, but also, and perhaps more importantly, by ambitious energy efficiency policies. In 2012, under the Energy Efficiency Directive 2012/27/EU, the EU set a 20% energy savings target by 2020 (when compared to the projected use of energy in 2020). These policy choices have a direct impact on the EU's closer neighbours and partners.

In 2018, the volume of demand in the countries examined ranged from under 8 TWh in Albania, Cyprus, Malta and Montenegro (countries with a limited population and surface) and between 50–64 TWh (Greece and Portugal) up to and above 250 TWh in Spain (253.6 TWh), Turkey (303 TWh), Italy (303.4 TWh) and France (474 TWh). It is not surprising that these last four countries are the most electricity-intensive, they are also the most active economies with the largest number of inhabitants. The electrification policies of the residential stock in France also influence overall demand.

EU, the Balkans and Turkey	Demand 2016 (TWh)	Demand 2017 (TWh)	Demand 2018 (TWh)	Average volume growth over the past 5 years
Albania	-	7.4	7.64	-
Bosnia-Herzegovina	12.87	13.37	13.29	2.2%
Croatia	17.67	18.20	18.35	1.23%
Cyprus	4.34	4.55	4.54	3.3%
France	473.00	474.00	474.00	-0.5%
Greece	51.21	51.93	51.46	0.62%
Italy	295.5	301.9	303.4	2.05%
Malta	2.27	2.40	2.48	+ 115.649 GWh
Montenegro	2.79	2.95	2.99	+ 67 GWh
Portugal	49.27	49.37	50.90	0.71%
Slovenia	13.30	13.67	13.74	1.95%
Spain	249.68	252.51	253.56	0.84%
Turkey	279.29	293.87	303.05	+ 9.17 TWh

Table 3: Evolution of demand: EU, The Balkans and Turkey

Croatia, as a small EU country and located in the Balkan area, is a good example. In 2018, the volume of demand was 18.35 TWh, with an average growth of 1.23% over the past five years. Croatia expects a small reduction of growth in the next five years due to energy efficiency measures. The amount of total generation was 12.19 TWh, with a negative growth rate of

0.25% over the last five years. The total generation fluctuates due to a large part of the generation coming from hydro power.

Given these circumstances, demand growth in this area should overall remain stable (maximum +2.2%) in the next five years. Moreover, after a contraction of 0.5% between 2013 and 2018, demand is expected to remain stable in France. Demand is expected to increase in Italy, although no figure was provided; it has increased by 2.05% over the past five years. Malta's demand should increase by 3.3 TWh, with it increasing by 0.115 TWh in the past five years. Portugal expects a 0.8% growth per year, following an increase of 0.71% in the last five years. Slovenia expects a maximum of 2% growth per year, which is stable compared to the 1.95% increase over the past five years. Spain's electricity demand has increased by 0.84% in the past five years, and in Montenegro it increased by 0.067 TWh in the past five years. The regulator has planned an increase to 3.08 TWh in 2020, 3.14 TWh in 2021 and 3.17 TWh in 2022. In Bosnia and Herzegovina, demand has increased by 2.2% over the last five years. In case of Turkey, the demand increased by 9.16 TWh during the last five years, and it's expected to continue increasing by 0.38 TWh in the next five. In Greece, demand has increased by 0.62% in the past five years.

According to the last 10-year transmission system development plan approved by the regulator RAE[9], for the period 2018-2027, there are three different scenarios for the demand evolution from 2018 up to 2028. It should be noted that, starting from 2018, the demand forecast in Greece includes the demand of the Cyclades that are about to be interconnected. From mid-2020, the demand forecast includes the demand of Crete that will be satisfied by the AC interconnection. Last, but not least, starting from 2024, the demand forecast includes the total demand of Crete, since the DC interconnection is expected to be established by the end of 2023.

3.4. East Mediterranean countries

In 2018, the volume of demand in the countries examined ranged from under 5 TWh in Palestine to between 17 and 64 TWh (17.54 TWh in Jordan, 22.81 TWh in Lebanon in 2017, more than 64.10 TWh in Israel) to 162.53 TWh in Egypt.[10] These differences are mainly due to the size of the countries, their economic dynamism and the evolution of their populations. In Egypt, electrification programmes are also one of the key reasons for the important rise in the past years (+4.2% over the past five years).[11] This upward trend is visible in other countries of the region. In Jordan, the volume of demand was 17.5 TWh in 2018, having increased by 4%, on average, over the past five years. In 2018, the volume of demand in Lebanon was 22.81 TWh, up by 5.28% in the last five years. In 2018, the volume of demand in Palestine was 3.8 TWh, up by 4% in the past five years. In 2018, the volume of demand in Israel was 64.1 TWh, up by 2.5% in the last five years. Demand should increase by 2.7% in Israel, and 3% per year in Lebanon until 2030. Jordan plans an increase to 18.72 TWh.

[9]Source http://www.admie.gr/fileadmin/user_upload/Files/masm/2018_2027/DPA_2018_2027.pdf
[10]According to Enerdata, energy demand was 160 TWh in 2018. The regulator indicates that in 2018, the peak load in Egypt was 30.8 GW, with an average growth of 4.2% over the past five years.
[11]Source Enerdata

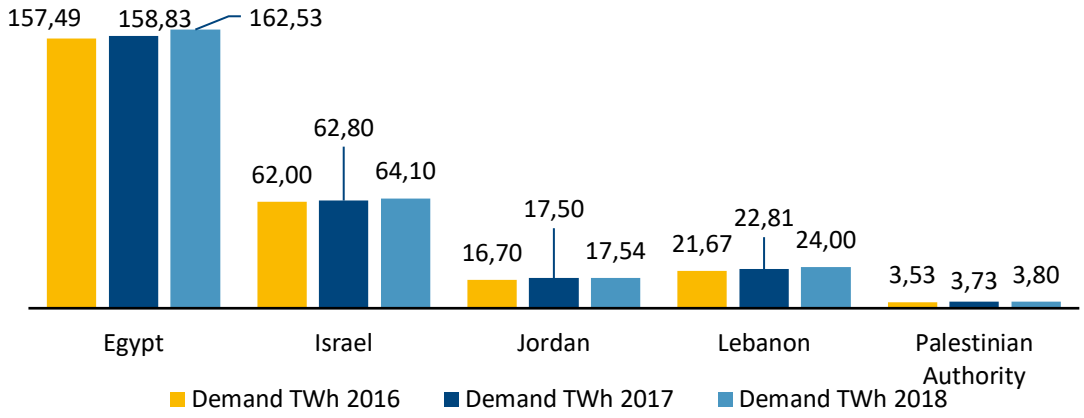


Figure 4 – Evolution of demand: East Mediterranean[12].

4. Power Generation

The sources of electricity around the Mediterranean are very diverse. Many countries mainly rely on fossil fuels, while others have seen an increase in renewable energies in recent years. Today, most of the region's renewable energy supply is to the North Mediterranean countries, including Turkey. EU members, the Balkans and Turkey are expected to maintain the lion's share of renewables, as a result of favourably evolving regulatory frameworks and the introduction of stronger policy support measures. Solar and wind energy continue to cover less than 1% of the SEMCs' electricity generation mix – a figure that strongly collides with the region's abundant solar and wind resources. Key barriers to the development of renewable energy in the region are the extensive use of energy subsidies and the lack of adequate electricity infrastructures, energy regulatory frameworks and financing mechanisms.

To power rising electricity needs, coupling variable RES deployment and grid upgrades is essential and assumes different aspects in terms of integration effects and system adaptation, according to the sub-region. It is mainly because of different economic situations and national energy mixes but also market designs, legal frameworks and sector-based country policies.

Since, in some countries, energy security is at the forefront of political agendas, this has implied efforts to diversify the national energy mix, due to the decreasing costs of renewable energy. It has also driven countries to diversify the sources of their energy imports. This is mainly the case for countries relying on gas imported via pipelines.

4.1. North Africa

In terms of power generation, the first priority for all countries is to provide supply security. Therefore, the evolution of total generation during the three last years, shows a continual growth. This trend is expected to remain for the next five years.

In 2018, the amounts of total generation in Algeria was 71.2 TWh and 34.5 TWh in Morocco. In these two countries, the growth rate is important, with 4.2% for Algeria and 5.1% in Morocco. The growth was more moderate in Tunisia at 2%, while generation decreased in Libya (-1%)

[12]Latest data for demand in Egypt extracted from Enerdata.

over the last five years. However, as it stands, all the countries have to regularly build new power plants to keep up with the continuous growth of demand and peak load. These developments reinforce the rationale for having more interconnection capacity, for example, to avoid duplicating costly peak shaving capacities.

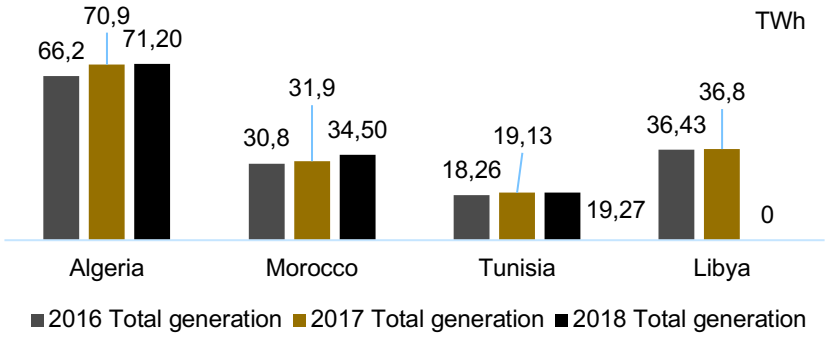


Figure 5 – Evolution of generation in North Africa (TWh)

Fossil fuels largely dominate electricity generation in North Africa, despite important potential for renewables, in particular, solar generation. Some of the reasons behind the slow development of RESs in the region include the compared costs of technologies and a preference for controllable power generation means. In Algeria and Libya, this is even exacerbated by the fact that they are important oil and gas producers.

In terms of governance, electricity is mostly generated by public utility in Tunisia. The picture is more balanced in Algeria, with a combination of public and private ownership of assets and, in Morocco, the IPP-PPA (power purchase agreements) model is dominant.

In Algeria, most of the electricity power plants are powered by natural gas using different technologies such as thermal power plants (CCGT + steam turbines), with 10 power plants (6.809 GW installed capacities) producing 39.33 TWh in 2018. Gas turbines come second, with 30.39 TWh generated in 2018 with 40 power plants (11.543 GW installed capacities). Public generation (39.16 TWh) is superior to PPA (32.040 TWh). The share of the dominant producer is 51%, while the remaining generation is split between eight other producers, with shares between 2 and 10%.

In Morocco, most of the electricity comes from coal power plants, with 21.261 TWh generated in six power plants (4.281 GW installed capacities), in 2018. Gas plants come second with 5.198 TWh generated in 2018, in two power plants (0.834 GW installed capacities). More electricity comes from IPP–PPA (23.335 TWh) than public generation by ONEE (10.992 TWh); the dominant producer is JLEC (43.4%). The remaining 56.6% is split between other producers (32.3% ONEE, 6.5 % SAFIEC, 6.6% EET, 4.5% EEM, 3.6% TAREC, 2.8% MASEN and 0.4% CED).

After the first liberalisation strategy (1995), the Moroccan government adopted a strategy where the regulated sector represents the bulk of the generation, while the free market is limited to renewables, allowing private producers to conclude contracts with some consumers.[13]

In the case of Tunisia, natural gas is the main source for electricity generation, with 2770 MW thermal power plants (steam and combined) and 2004 MW gas turbines. Oil has been kept for

[13]MEDREG, 2018: Regulatory options for the stimulation of infrastructure investments

a small part of generation as back-up and in isolated areas (422MW installed capacity). In fact, gas represents more than 97% of production[14].

In Libya, electricity is exclusively generated from gas and oil; installed capacities amount to 3300 MW for oil and 14 000 MW for gas (gas turbines, steam and combined power plants).

In terms of renewable energies, Algeria has chosen to prioritise developing solar while, in Morocco, wind is dominant and accounts for the third-largest generation source, but this picture could change thanks to important solar farms under development. In 2030, renewables should represent 52% of the total installed capacity, according to official objectives. Tunisia has opted for a balanced renewable energy mix (solar and wind).

In the Maghreb, Morocco is highly dominant in terms of renewables, with 1.22 GW wind capacity generating 3.69 TWh in 2018. Algeria has installed 0.344 GW PV which generates 0.603 GWh. In Tunisia, the total production of renewables power plants is 0.02 TWh, produced by two power plants of wind energy at 245 MW, 55MW PV solar and 62 MW hydro power.

	Electricity generation source* 1	Electricity generation source* 2	Electricity generation source* 3	Mostly IPP-PPA or Public generation?	Market share of dominant producer (% of power generation)
Algeria	Natural gas	Oil	Solar PV	Public generation	51%
Morocco	Coal	Natural gas	Wind	IPP-PPA	43.4%
Tunisia	Natural gas	Wind	Oil	Public generation	93%
Libya	Natural gas	Oil	Solar PV	Public generation	N/A

Table 4: Main generation sources: North Africa

**Electricity generation source include: Natural gas, coal, oil, hydro, solar pv, solar thermal, wind.*

4.2. The European Union, The Balkans and Turkey

For the majority of the countries in this area, generation is relatively stable. The volume of generation in the countries studied range from less than 9 TWh (Albania, Malta, Montenegro and Cyprus), between 45 and 55 TWh in Greece and Portugal, respectively, to more than 245 TWh in Spain (246.9 TWh), Italy (289.7 TWh), Turkey (303.66 TWh) and France (548.6 TWh).

Changes in electricity generation do not directly reflect changes in consumption as they are also affected by changes in the different products used for energy production and by changes in electricity imports and exports. For example, electricity production decreased in Malta due to the closure of an electricity plant and, as a consequence, imports from Italy increased[15].

[14] Enerdata

[15] Source: Eurostat, Electricity production, consumption and market overview https://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_production,_consumption_and_market_overview#Electricity_generation

Likewise, in 2018, the volume of demand in Spain was 253.6 TWh, slightly up from the last five years (0.84%). The amount of total generation was 246.9 TWh, slightly lower than in the previous five years (-0.51%). In 2018, the volume of demand in Turkey was 303 TWh, up by 9.2 TWh over the last five years. The amount of total generation was 303.7 TWh, up by 10.3 TWh in the last five years.

In the coming five years, generation is expected to increase by 0.9% in Cyprus. Montenegro envisages an increase to 3.82 TWh in 2022.

EU, Balkans and Turkey	Generation 2016 (TWh)	Generation 2017 (TWh)	Generation 2018 (TWh)	Average volume growth over the past five years
Albania	7.14	4.53	8.55	13.2%
Bosnia-Herzegovina	16.51	15.15	17.87	5%
Croatia	11.33	10.82	12.19	-0.25%
Cyprus	4.86	5.01	5.23	+ 1.02 TWh
France	531.3	529.4	548.60	-0.4%
Greece	42.45	45.81	45.21	N/A
Italy	289.8	295.8	289.7	-0.03%
Malta	2.36	1.60	1.91	N/A
Montenegro	3.02	2.44	3.74	0.176 TWh
Portugal	55.873	54.545	55.14	3.09%
Slovenia	12.52	12.00	12.26	N/A
Spain	248.1	248.12	246.90	-0.51%
Turkey	274.41	297.28	303.65	+ 10.34 TWh

Table 5: Evolution of Generation: EU, Balkans and Turkey

In Greece, concerning the evolution of generation, the national power adequacy study of the TSO ADMIE[16] considered two scenarios, i.e., a lower and a higher degree of RES penetration. Additionally, during the next years, a fair number of lignite units is expected to stop operating.

The sources of electricity in the Northern Mediterranean are very diverse. Some countries have low-carbon generations or even a very high proportion of renewables. For instance, electricity coming from hydroelectric plants is very strong in the Balkans (main energy resource in Albania, Slovenia, Croatia and Montenegro), while it's the second source of energy in France, Italy and Portugal.

Nuclear energy is highly dominant in France and strong in Spain, however, recent political decisions have called into question the preponderance of this energy. The Spanish government has decided not to build a new reactor. In France, the future role of nuclear power is under debate; its share is supposed to decrease but the magnitude and horizon remain open, after the decision to reach a 50% share by 2025 was questioned by the government. France generated 393.2 TWh in 2018, in 58 nuclear power plants (63.130 GW installed capacities). In Croatia, nuclear energy is the second source after hydroelectric. It also owns

[16] Source: http://www.ypeka.gr/LinkClick.aspx?fileticket=W%2FLndQ4wluo%3D&tabid=232&language=el-GR

50% of the Krško nuclear powerplant, located in Slovenia, which explains its not usually being counted within the Croatian generation capacity.

In other countries, fossil fuels continue to play an important role. In Cyprus and Greece, most of the electricity comes from thermal plants, where Cyprus saw 4.575 TWh generated electricity in 2018, in three power plants (1.478 GW installed capacities) and 29.03 TWh by 28 thermal power plants (8.804 GW installed capacities) in Greece.

In Bosnia and Herzegovina and Turkey, most of the electricity comes from coal plants (1.097 TWh generated electricity in 2018, in five power plants (2.156 GW installed capacities) in Bosnia-Herzegovina; 111 TWh generated electricity in 2018 in 42 power plants (19.152 GW installed capacities) in Turkey), while it comes second in Montenegro and Slovenia. In Italy, Malta and Portugal, most of the electricity comes from gas plants, while coming second in Greece and Turkey.

	Electricity generation source* 1	Electricity generation source* 2	Electricity generation source* 3	Mostly IPP-PPA or Public generation?	Market share of dominant producer (% of power generation)
Albania	Hydro	-	-	Public	68.31
Bosnia-Herzegovina	Coal	Hydro	Wind	Public	40.5
Croatia	Hydro	Nuclear	Wind	n/a	83
Cyprus	Oil & diesel	Wind	Solar PV	n/a	91
France	Nuclear	Hydro	Gas	n/a	80–85
Greece	Coal	Natural gas	Wind	n/a	74.19[17]
Italy	Natural gas	Hydro	Solar PV	n/a	19–20
Malta	Natural gas	Solar	Oil	n/a	52.67
Montenegro	Hydro	Coal	Wind	n/a	93
Portugal	Natural gas	Hydro	Wind	n/a	51
Slovenia	Hydro	Coal	Nuclear	n/a	56.6
Spain	Nuclear	Wind	Coal	n/a	23.08
Turkey	Coal	Natural gas	Hydro	IPP-PPA	15.49

Table 6: Main generation sources: The EU, The Balkans and Turkey

**Electricity generation source include: Natural gas, Coal, Oil, Hydro, Solar PV, Solar thermal, Wind.*

It is worth noting that in Spain, wind energy is close to nuclear in terms of generation. Even though nuclear was dominant in 2018, at 53.198 TWh generated in seven power plants (7.12GW installed capacities), wind plants come second with 48.946 TWh (23.091 GW

[17]This may represent approximately the market share of PPC in the interconnected system if RES is totally excluded – otherwise PPC's market share amounts to approximately 64% (always excluding imports).

installed capacities). In Malta, PV power plants come second with 0.172 TWh generated electricity in 2018, in 24672 power plants (131.3 MWp installed capacities).

In most of the countries, the share of the dominant producer is largely superior to its competitors' (more than 80% in Montenegro, Cyprus, Croatia and France). This is explained by the original market structure and the fact that, for example, in France, nuclear energy is still in the hands of the historical utility EDF, which accounts for 80–85% of the production. The remaining 15–20% is split between the other producers (mainly Engie, Total – Direct Energie, Uniper and decentralised renewable production). In the case of Albania, the total production was 8.5 TWh, the highest since 1985, with 68.31% public power generation. In Bosnia-Herzegovina, the dominant producer share is 40.5%. Public generation (3.902GW) is superior to PPA (0.560 GW). In Turkey, there is more IPP-PPA (256.56 TWh) than public power generation (47.09 TWh). In Montenegro, 3.744 TWh was generated by IPPs under PPA.

4.3. East Mediterranean countries

The volume of generation in the countries examined range from less than 0.024 TWh (Palestine), between 15 and 70 TWh (15.363 TWh in Lebanon, 19.82 TWh in Jordan, 69.6 TWh Israel) to close to 196.8 TWh in Egypt. Despite the low figures, it is proportionally in Palestine that the generation has increased the most (+342%), from 0.007 TWh to 0.024 TWh. This upward trend is visible in other Eastern Mediterranean countries (Israel: +2.5%, Jordan: +3%, Egypt: +4%, Lebanon: +5.6%) as well. In the near future, generation is expected increase by 2.7% annually in Israel (mainly due to major gas discoveries). Jordan plans to increase to 21.11 TWh in the next five years. However, as it stands, most countries will continue to struggle to meet the rising demand with their generation assets. Interconnections could interestingly help ensuring the balance between supply and demand at a regional level.

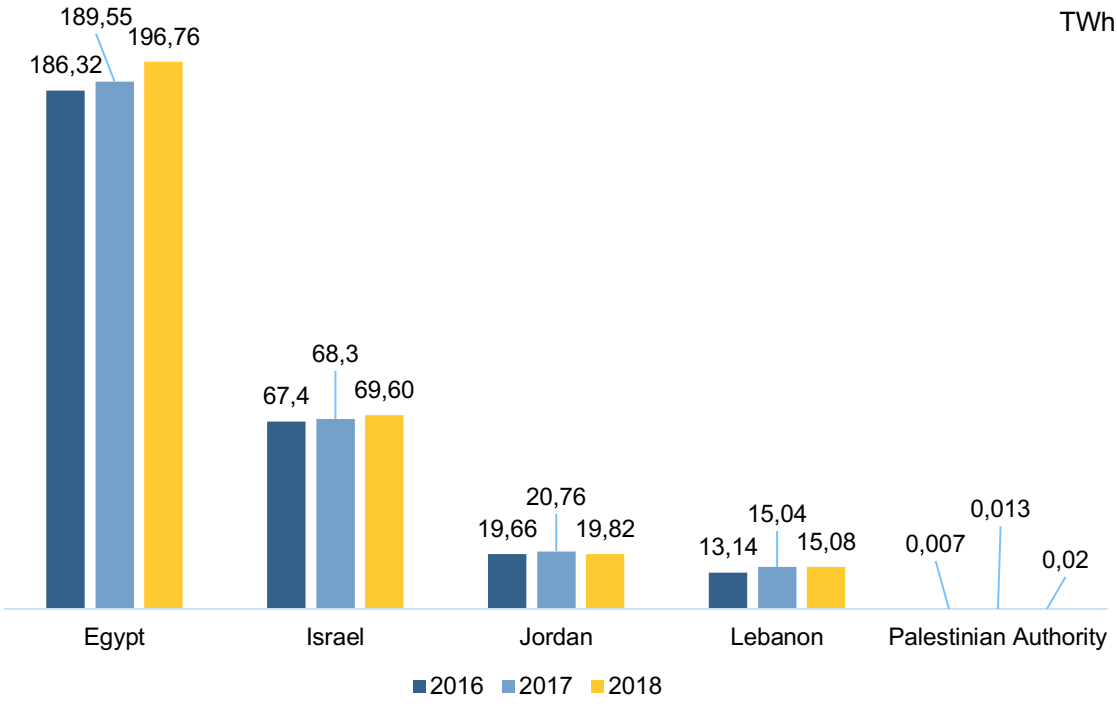


Figure 6 – Evolution of generation: East Mediterranean (TWh)

Fossil fuels dominate energy generation in East Mediterranean countries. This trend could be further exacerbated by the discovery of gas reserves in the region. Gas comes first in Israel and in Egypt because they have large reserves. In the last 20 years, the discovery and development of gas fields off the coast of Israel has resulted in an abundance of gas. In Israel, the share of indigenous natural gas production is expected to increase, following the recent discovery of the Leviathan gas field, where production is expected to start in 2020. Better interconnections with neighbouring countries, and with the rest of the Mediterranean, will therefore be essential to fully exploit these resources.

Electricity comes mostly from thermal sources in Egypt and Lebanon (first source and second source of generation, respectively). Natural gas is the main energy resource of electricity in Jordan and second in Israel and oil generation dominates in Lebanon. Solar comes first in Palestine, second in Jordan, along with wind, and third in Israel. Hydro-electric generation comes third in the Egyptian and Lebanese energy mixes.

In Egypt, most of the electricity comes from thermal plants (combined and steam turbines), with 148.59 TWh generated electricity in 2018 in 41 power plants (47.527 GW installed capacities). Gas turbines come second with 32.41 TWh generated electricity in 2018, in 25 power plants (5.745 GW installed capacities). Most of the electricity comes from gas and oil power plants in Jordan, with 17.69 TWh generated electricity in 2018 in 87 power plants (4.261 GW installed capacities). Wind and PV generated 1.54 TWh electricity in 2018 (0.986 GW installed capacities).

Coal also comes second in Israel, after gas plants, with 46.28 TWh generated electricity in 2018 in 58 power plants (10.888 GW installed capacities). In Lebanon, most of the electricity comes from oil-based power plants. The total generation from oil and thermal plants in 2018 was 14.87TWh, with 2764 MW nominal installed capacity and other landfill electricity production in Naameh, at 0.064TWh in 2018.

Solar and wind, i.e., RESs, rarely make it to the top two in Jordan and Palestine. In Palestine, apart from the interconnections, the electricity comes from PV plants, with 0.0244 TWh generated electricity in 2018 (0.018 GW installed capacities). In Jordan, solar and PV accounted for 1.54 TWh generated electricity in 2018 (0.986 GW installed capacities). In Egypt and Israel, there is more public generation (0.193 TWh in Egypt, 13.335 GW in Israel) than PPAs (0.044 TWh in Egypt, 4.839 GW in Israel). In Egypt, the dominant producer generates 176.8 TWh electricity. In Lebanon and Israel, dominant producers generate between 69–80% electricity (69% in Israel, 80% for EDL in Lebanon). In Jordan, the government is the dominant producer (about 40% of the production).

	Electricity generation source* 1	Electricity generation source* 2	Electricity generation source* 3	Mostly IPP-PPA or Public generation?	Market share of dominant producer (% of power generation)
Egypt	Natural gas	Hydro	Wind and solar PV	Public generation	90
Israel	Natural gas	Coal	Solar PV	Public generation	69

	Electricity generation source* 1	Electricity generation source* 2	Electricity generation source* 3	Mostly IPP-PPA or Public generation?	Market share of dominant producer (% of power generation)
Jordan	Natural gas	Wind and Solar PV	n/a	Public generation	40
Lebanon	Oil	Natural gas	Hydro	Public generation	80
Palestinian Authority	Solar PV	n/a	n/a	n/a	n/a

Table 7: Main generation sources: East Mediterranean

**Electricity generation source include: Natural gas, coal, oil, hydro, solar pv, solar thermal, wind.*

5. Governance and Unbundling Regime

Network operators are at the centre of the organisation of electricity markets. They manage an essential resource on which relations between producers and consumers are built. The competitive organisation of markets requires independent network management to ensure fair access for all users, and the regulator is then responsible for regulating operators' activities in terms of access rules and tariffs. In the Mediterranean, there are still organisations with a high level of vertical integration, in which, the network belongs to the incumbent operators. This concerns, in particular, countries that have entrusted a significant part of their production to private actors under IPP regimes.

This chapter aims to describe the situation of the Mediterranean countries in relation to the legal regime to which infrastructure operators are subjected.

5.1. North Africa

In the Maghreb, governance and unbundling regimes remain different between countries. On the one hand, Algeria started reforming its market in 2002, adopting a new regulatory framework based on turning the incumbent Sonelgaz, into a holding gathering subsidiaries in charge of the activities which used to be integrated. Thus, competition has been gradually introduced in generation. In Algeria, there is one TSO which is legally unbundled, called Opérateur du système électrique (OS). The transmission system operation is performed by two companies: ISO (the system operator) and the grid owner (GRTE, Gestionnaire du Réseau de Transport de l'Electricité). The only DSO is called Société de distribution de l'électricité et du gaz (SDC).

On the other hand, Morocco, Tunisia and Libya still have their transmission network operated by the historical utility. In Morocco, the ONEE/CTR operates the transmission network and, as the regulatory authority has been created, the unbundling process will be carried out in the next few years. Distribution is split between the ONEE and local companies (namely four delegated distributors and seven distribution regions). In Morocco, the process of energy sector liberalisation has been limited to RESs, where independent producers are expected to contribute to reaching the national objectives in terms of installed capacity. The private sector

is also present in generation, under the framework of IPPs with long term PPAs. In Tunisia, the Société Tunisienne de l'Electricité et du Gaz (STEG) holds a dominant position on generation (5005 MW out of 5476 MW, 91% of the total capacity), and a monopoly on transmission and distribution. Tunisia has one IPP (Carthage Power Company), operating a 471 MW station selling all its production to STEG, which operates as a single buyer.

	Number of integrated utilities	Number of TSOs	Number of DSOs	Accounting unbundling for TSOs	Legal unbundling for TSOs	Ownership unbundling for TSOs
Algeria	0	1	1	yes	yes	n/a
Morocco	1	1	n/a	no	no	no
Tunisia	1	1	1	no	no	no
Libya	1	n/a	n/a	n/a	n/a	n/a

Table 8: Governance and unbundling regime: North Africa

5.2. The European Union, the Balkans and Turkey

With the adoption of the "Third Energy Package" in 2009 (Directive 2009/72/EC on Electricity and Directive 2009/73/EC on Gas), new rules have been introduced on unbundling for TSOs and, to a lesser extent, DSOs. Under this package, energy networks are subject to unbundling requirements which oblige member states to ensure the separation of vertically integrated energy companies, resulting in the separation of the various stages of energy supply (generation, distribution, transmission and supply). This explains why the situation is relatively homogeneous in the EU, Balkans and Turkey regions. Apart from Malta, which does not have a TSO, all countries have DSOs and TSOs operating on their territories.

Eight EU member states, also part of the MEDREG (Croatia, Cyprus, France, Greece, Italy, Portugal, Slovenia and Spain), have accounting, legal and/or ownership unbundling of the TSO.[18] Bosnia and Herzegovina, Montenegro and Turkey also apply those rules.

In Albania, electricity transmission is performed by the TSO company, a public company with 100% of the shares owned by the state. The TSO was established on 2004, and it currently in charge of the transmission network operation, system operation and market operator activities.

Four countries have at least one integrated utility: Bosnia and Herzegovina, Cyprus, France (with EDF S.A.) and Malta. In those cases, utilities own power plants, networks and supply to the customer as well. In Malta, there is one integrated utility, the Enemalta plc. Enemalta plc is active in terms of generation and carries out DSO functions and is a supplier of electricity to final customers. Unbundling is required at management accounts level only.

There are four integrated utilities in Bosnia and Herzegovina (JP Elektroprivreda Bosne i Hercegovine, Sarajevo; MH Elektroprivreda Republike Srpske, Trebinje; JP Elektroprivreda Hrvatske zajednice Herceg Bosne, Mostar; JP Komunalno Brčko). There is one TSO, although split in two for different activities: Elektroprijenos Bosnia and Herzegovina – operation and maintenance of the transmission network and Independent System Operator (NOSBIH) – control of the power system.

[18] Malta does not have a TSO

In Cyprus, there is one integrated utility, the Electricity Authority of Cyprus (EAC), active in the distribution segment, and one TSO – the Cyprus Transmission System Operator (TSOC). In Croatia, there is one TSO (Hrvatski operator prijenosnog sustava d.o.o) and one DSO (HEP-Operator distribucijskog sustava d.o.o.).

	Number of integrated utilities	Number of TSOs	Number of DSOs	Accounting unbundling for TSOs	Legal unbundling for TSOs	Ownership unbundling for TSOs
Albania	1	1	1	yes	yes	yes
Bosnia-Herzegovina	4	1	8	yes	yes	yes
Croatia	0	1	1	yes	yes	yes
Cyprus	1	1	1	yes	yes	n/a
France	1	1	144	yes	yes	yes
Greece	0	1	2	yes	yes	yes
Italy	0	1	130	yes	yes	yes
Malta	1	0	1	n/a	n/a	n/a
Montenegro	0	1	1	yes	yes	yes
Portugal	0	1	11	yes	yes	yes
Slovenia	0	1	1	yes	yes	yes
Spain	0	1	333	yes	yes	yes
Turkey	0	1	21	yes	yes	yes

Table 9: Governance and unbundling regime: EU, Balkans, Turkey

All the countries in the zone have one or more DSOs operating in given territories. In Europe, DSOs are fully regulated companies. Their allowed revenue is determined by national regulatory authorities. DSOs that are part of a vertically integrated company and are obliged to comply with conditions of legal, functional and accounting unbundling, as laid down in the European legislation.[19] DSOs serving less than 100,000 connected customers can be exempted from the requirements of both legal and functional unbundling.

This diversity is due to the historical organisation of distribution and differences in the role of local/national authorities. Most DSOs own the network and are granted an operation licence by local or national public authorities. In certain countries, such as France, DSOs are granted concession contracts to operate the network for a certain amount of time, while the public authorities remain the owner in the long-term. In these cases, DSOs are in charge of operation and maintenance as well as capital investments.

In Albania, electricity distribution is performed by the DSO, licensed by the ERE, according to the provisions of the Power Sector Law. The DSO owns the electricity distribution system at the high, medium and low voltage levels.

[19]Since the Third Energy Package was adopted in 2009

There are eight DSOs in Bosnia-and-Herzegovina, 11 in Portugal, 21 in Turkey, 130 in Italy, 144 in France and 333 in Spain. In Greece, there are two DSOs [Hellenic Electricity Distribution Network Operator (HEDNO) or DEDDIE (in Greek) and the closed distribution system of the Athens airport].

In Italy, among the 130 DSOs, the majority manage very few points of delivery (> 500000 points of delivery: e-distribuzione, Unareti, Areti, Ireti; > 100000 points of delivery: Inrete Distribuzione Energia, Megareti, Edyna, Set Distribuzione, Deval, AcegasApsAmga).

In Portugal, only one DSO works at the high, medium and low voltage levels (EDP Distribuição), while 10 distribution network operators are involved exclusively in low voltage. The largest DSO in terms of volumes in Spain is Endesa Distribución Eléctrica, S.A.U). Moreover, there are 327 small DSOs there (< 100000 customers).

In France, among the 144 DSOs, only six of them have more than 100,000 clients: Enedis (36.5 million clients – by far the most important French DSO), Strasbourg Electricité Réseaux, Gérédis (SRD) and URM GreenAlp. Malta still benefits from the exemption from the requirements of the 2009 Electricity Directive 2009/72/EC1; the Maltese electricity market regulations require unbundling at an internal accounting level only.[20]

5.3. East Mediterranean countries

There are similarities in the East Mediterranean area. In 2018, Egypt is the only country in the region on the way to unbundling yet without an integrated utility. The electricity market is still largely under the strict control of the states in the other countries. “Vertically integrated” utilities, is where utilities’ own generation, transmission, distribution and supply to the customer are still largely present: Israel, Jordan and Lebanon have at least one integrated utility. In Jordan, there are four integrated utilities, NEPCO, JEPCO, EDCO and IDECO. In Lebanon and Israel, there is one integrated utility. The Israel Electric Corporation (IEC) is a public and government-owned company, generating and supplying electricity to all sectors in the economy.

Responding countries have not achieved accounting or legal unbundling for their TSOs. Egypt has stipulated that the ownership unbundling for the TSO has not yet been achieved. To increase the attractiveness of these countries and attract private capital, national objectives and the institutional architecture have to be clear in order to properly design the rules and set up incentives for each category of actors.

There is one TSO active for each of the four studied markets (apart from Israel). All countries have more than one DSO (apart from Israel which has not provided details). There are nine DSOs in Egypt: North Cairo, South Cairo, North Delta, South Delta, Alexandria, Behera, Canal, Upper Egypt and Middle Egypt. There are three DSOs in Jordan (Jordanian Electric Power Co.; Irbid District Electricity Co. and Electricity Distribution Co.). There is one TSO in Palestine [Palestinian Electricity Transmission company ltd (PETL)] and five DSOs (JDECO, TEDCO, NEDCO, HEPCO, SELCO). In Lebanon, there are three DSOs (Dabas, BUS and KVA).

[20]CEER Status Review on Implementation of TSO and DSO Unbundling Provisions, 2019

	Number of integrated utilities	Number of TSOs	Number of DSOs	Accounting unbundling for TSOs	Legal unbundling for TSOs	Ownership unbundling for TSOs
Egypt	0	1	9	n/a	n/a	not yet achieved
Israel	1	n/a	n/a	n/a	n/a	n/a
Jordan	4	1	3	n/a	n/a	n/a
Lebanon	1	1	3[21]	n/a	n/a	n/a
Palestinian Authority	n/a	1	5	n/a	n/a	n/a

Table 10: Governance and unbundling regime: East Mediterranean

6. Internal Structure of the Electricity Market

The internal structures of the electricity markets vary greatly between the MEDREG members and regions. In the EU, Balkans and Turkey, wholesale and retail competitions are almost fully open, but it's rarely the case in other countries.

6.1. North Africa

The situation in the North African countries is completely different. In Algeria, electricity markets include wholesale as well as retail trade, while Morocco retains a public monopoly on both markets. In Tunisia, the structure of the electricity market is based on the combination of monopoly and a limited single buyer model.

In Morocco, the ONEE is in charge of the public service of producing, transporting and distributing electricity. ONEE is the main player in the Moroccan electricity sector and is fully owned by the government of Morocco. ONEE is also the only purchaser of power from generators, except for renewables generation, where Law 13-09 has opened up the production of electricity from renewable energy to competition[22].

On the other hand, Algeria is moving closer to the European model, in order to stimulate investments and create closer ties. Wholesale market competition with over the counter (OTC) markets is present in Algeria. The retail market competition is also open in Algeria; consumers can participate directly in the retail market if their annual electricity consumption is equal to or above 4 GWh.

Finally, in Tunisia, the national electricity market is still dominated by STEG which, under the supervision of the Ministry of Industry, performs production, transmission, distribution and supply activities. On the generation side, STEG's monopoly status ended with the opening of the market to IPPs in 1996, which involves a limited single buyer model for IPPs and self-

[21] DSPs: Data Service Providers
[22] Source: https://uk.practicallaw.thomsonreuters.com/Document/Id8323ba03e7f11e9adfea82903531a62/View/FullText.html?contextData=(sc.Default)&transitionType=Default&firstPage=true&bhcp=1

producers, through the PPA under regulated tariffs. However, their contribution is limited to production for either self-consumption or for selling electricity to STEG.

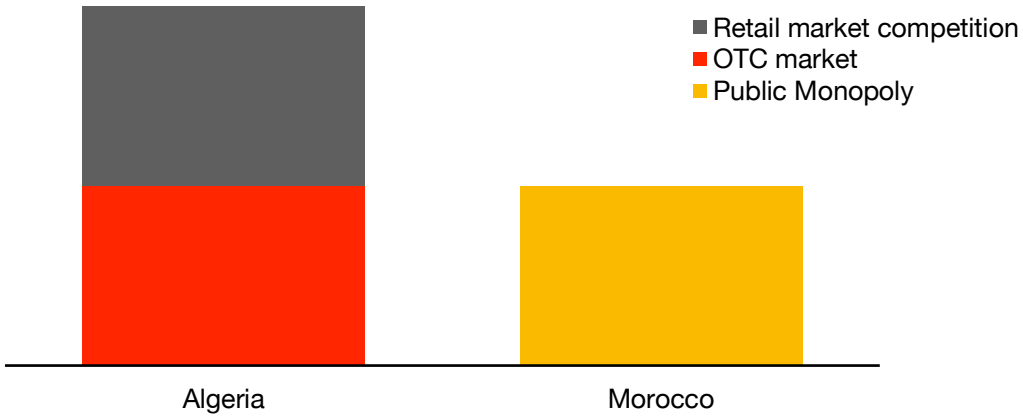


Figure 7 – Internal structure of the energy market: North Africa

6.2. The European Union, Balkans and Turkey

In almost all EU member states, the Balkans and Turkey, there is trade on wholesale and retail electricity markets. There is a combination of OTC and power exchange, although in Montenegro, the power exchange is not active yet, and in Greece, there is only power exchange. Wholesale market competition with OTC markets is present only in Bosnia and Herzegovina. A single buyer (total) can be found only in Malta. Malta is one of the least connected countries in the entire EU and relies on LNG imports and a single electricity cable linking it to Italy for its external power supplies.

The European single market in electricity has been promoted vigorously by the European Commission since 1996. The liberalisation of power markets has led to substantial changes in the way electricity is generated and used. Furthermore, it has created competition in a traditionally monopolistic and conservative industry, allowing new business models to emerge and new players to challenge incumbent utilities. Among other procedures, the EU sets rules on wholesale energy, trading to foster competition in the energy market.

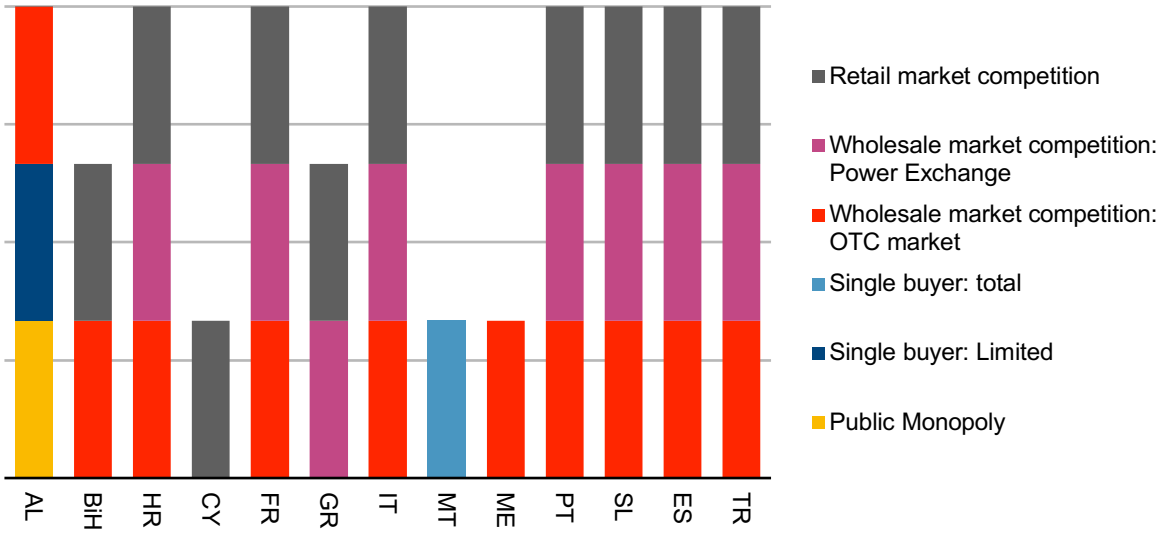


Figure 8 – Internal structure of the energy market: EU, the Balkans, Turkey

European electricity retail markets are characterised by differences in their structures. However, retail market competition is now fully open in almost all EU member states, western Balkans and Turkey, with some exceptions. In Turkey, users consuming more than 1,400 kWh/year and connected directly to the transmission grid as well as organised industrial zones are all eligible consumers.

In Malta, the retail market is not open to competition. However, electricity generation is open to competition, but generators have to sell to a single buyer (Enemalta plc, also the only supplier of electricity to final customers) except for self-consumption. In Bosnia and Herzegovina, households and small consumers can use universal service supplies.

Cyprus makes a clear difference between household, commercial and industrial consumers, including the category of household vulnerable consumers. “Eligible consumers” in Cyprus are any consumer able to conclude agreements for the purchase of electricity with any person holding a licence for the supply of electricity. “Non-eligible consumer” means any consumer not designated as an eligible consumer, and who is supplied with electricity by the Electricity Authority of Cyprus (EAC). The Minister of Energy may, following consultation with the CERA, issue a decree concerning eligible consumers, which sets out the manner of and criteria by which the consumption of electricity is to be calculated, and sets the electricity consumption threshold, measured over a twelve-month period, defining whether a consumer is an eligible consumer. On 27 December 2013, the Minister of Energy issued a decree, by which he defined that all consumers from the 1st January 2014 are eligible to choose their electricity supplier.

6.3. East Mediterranean countries

In the Eastern Mediterranean, wholesale and retail trade markets have not opened yet. There is still a public monopoly in two states (Israel and Jordan). Single buyers are very active and can be found in Egypt (total), Jordan (limited, there are also independent producers), and Palestine (limited). The single buyer model preserves a key role for the public sector in decisions on investments in generation capacity, and for the state-owned electricity company in the sector’s day-to-day financial affairs. A clear readability of the system, transparency and safeguards as well as a gradual opening will make it possible to attract foreign capital.

Israel and Jordan have retained a public monopoly. However, in 2018, the Israeli Government decided to reform the electricity market and change its structure. Several generation sites were sold to private generators, starting from 3rd December 2019 and it is to continue in the coming years. In addition, only in Israel there is a partial retail market competition, it is limited to 20% of the market, i.e., users consuming more than 40,000 kWh.

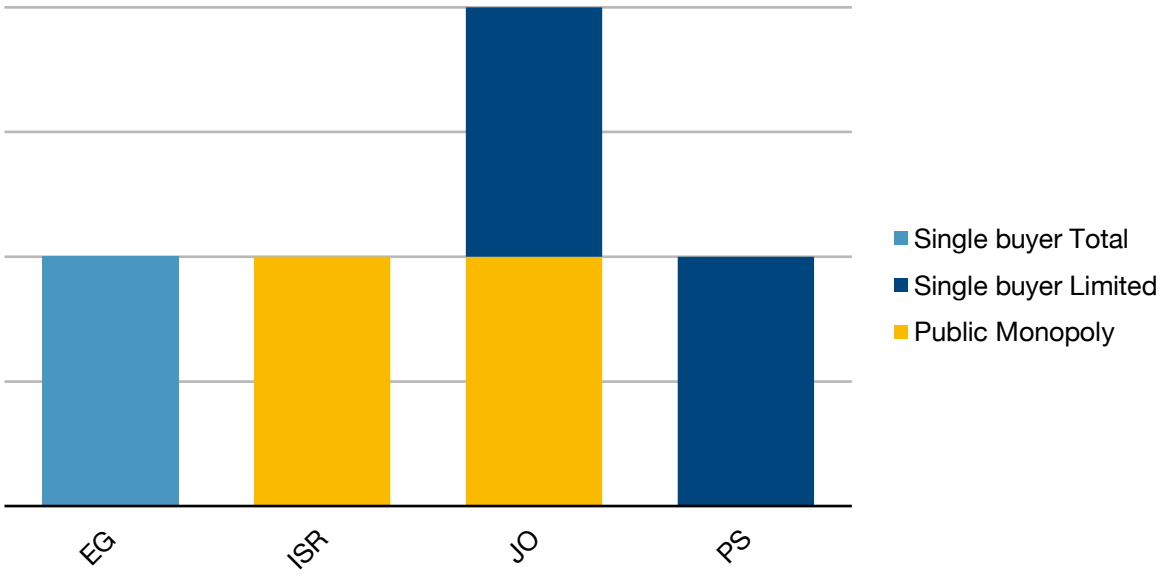


Figure 9 – Internal structure of the energy market: Eastern Mediterranean

7. Regional electricity market system: Purpose, status and role of cross-border interconnections

Developing cross-border electricity trade is the natural supplement to generation capacity additions, enabling avoidance of costly redundancies. A coherent strategy for regional cooperation and stimulating intra-regional trade could provide important benefits, notably by promoting a more efficient use of existing capacity. This is why looking at imports and exports gives a clear picture and understanding of the opportunities for MEDREG members. In this document, imports are the quantities of energy products imported from abroad into the national territory, with deductions being made for quantities simply in transit, destined for other countries. These quantities are processed within the national boundaries, on behalf of another country.

In 2018, nearly all respondents declared that the roles of regional interconnections and integration are commercial purposes and to increase the security of supply. Only the Palestinian regulator underlined the importance of diversifying the energy sources, in order to get cheaper prices. In principle, electricity trading should improve the region's energy security, especially in countries that suffer recurring power outages.

Currently, most electricity trade on existing interconnections take place on an emergency basis, to cover either unexpected outages or scheduled ones due to maintenance, but countries still continue to focus on meeting their own demand through investing in local power generation.

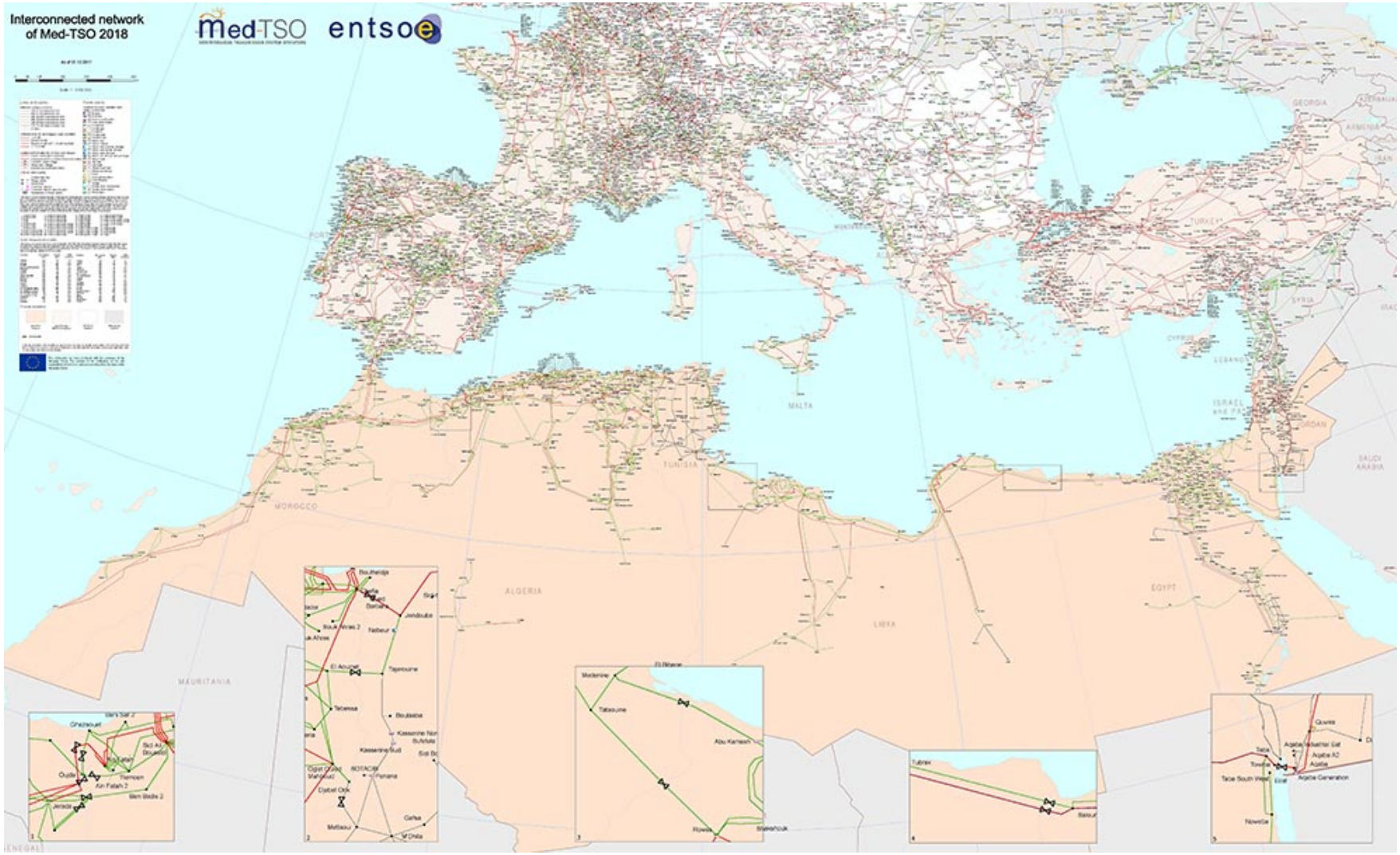


Figure 10 – Mediterranean electricity interconnections (Source: Med-TSO)

7.1. North Africa

Morocco has interconnections with Spain and Algeria and Algeria has connections with Morocco and Tunisia. Currently, in the Maghreb region (Algeria, Morocco and Tunisia), electricity interconnections are well developed but electricity exchanges are limited. Interconnections are mainly used for security of supply, but neither for commercial transactions nor the integration of RESs.

As underlined by the Algerian regulator, facilitating cross-border trade (beyond the needs of TSOs) could be an intermediate step to evolve from the current situation (security of supply) to a regionally integrated electricity market. Energy exchanges would involve not only TSOs but also market participants (generators, big consumers and suppliers).

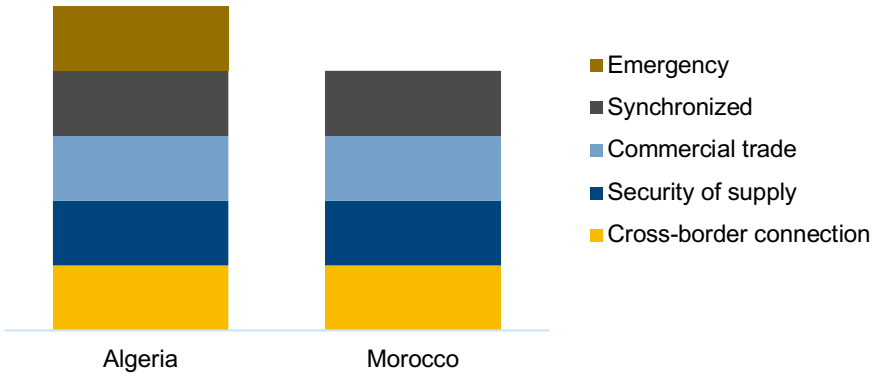


Figure 11 – Role of cross-border interconnections: North Africa

Even though cross-border interconnections are well developed in both countries, the exchange of electricity is very limited. It is worth noting that export is close to zero in Algeria and Morocco.

	Export % 2016	Export % 2017	Export % 2018	Average volume growth over the past 5 years	Foreseeable demand evolution in the next five years
Algeria	0.3	0.4	0.1	23%	Expected to increase
Morocco	0.4	0.5	1	26%	n/a
Tunisia	1.2	2.1	n/a	n/a	n/a
Libya	0	0	0	n/a	n/a

Table 11: Export % of North Africa

The interconnection between Algeria, Morocco and Tunisia started in the 1950s, and subsequently evolved into multiple high-voltage transmission interconnections between the three countries. The Algiers Declaration in 2010 stipulated that the three countries will aim to bring their laws and frameworks in line with each other, to create a competitive electricity

market and potentially integrate with the EU. The plan includes transparent network access for cross-border electricity trading.[23]

Algeria does not report any imports but expects to increase the exportation in the coming years, given that exports have already grown by 23% in the past five years. Morocco only exported 1% (0.35 TWh) of its electricity in 2018, although exportations have grown by 26% in the past five years. Morocco imported 9.9% (3.72 TWh) – a diminution by 5.3% of the volume growth – over the past five years. Morocco imports about 15% of its energy load from Spain. The country has been connected to its European neighbour since the late 1990s, thus facilitating the synchronisation of Maghreb countries with the European high-voltage transmission network. Considering that the Algerian grid is also already synchronised with the European high voltage transmission network, it could be possible to directly interconnect its network with the European grid, thus facilitating electricity exchanges on a north-south route.

	Import % 2016	Import % 2017	Import % 2018	Average volume growth over the past five years
Algeria	0	0	0	0%
Morocco	14.9	16.3	9.9	-5.3%
Tunisia	0.7	2.3	n/a	n/a
Libya	1.0	0.8	n/a	n/a

Table 12: Imports % North Africa

As a consequence, getting more benefits from the existing infrastructure is a key question, however, developing a market and simulating the system with intermittent generation appears very difficult. The problem of technical and non-technical losses is also crucial and should be addressed by a specific framework.

7.2. The European Union, Balkans and Turkey

EU countries have committed to improving cross-border electricity interconnections, so as to achieve their climate and energy goals. Connecting Europe's electricity systems should allow the EU to boost its security of electricity supply and integrate more renewables into energy markets. Further investments are planned between EU members in order to reinforce interconnections, develop competitive national markets and ensure security for national energy systems.

France, for instance, is well connected to Italy and Spain, and two additional interconnections between those countries will enter into service in the coming years with Italy (Savoie-Piémont) and Spain (Golfe de Gascogne). French interconnections are considered well-used and allow France to develop a competitive national market to support the neighbouring countries, thanks to the complementarity of its power station park with theirs as well as to benefit from flexibility sources. Interconnections also play a key role in the security of the French energy system.

Italy also has interconnections with Slovenia and Greece, while an interconnection with Italy – Montenegro (HVDC) – is scheduled to enter into service by the end of the year, to will allow a bi-directional exchange of electricity between the two countries – initially for 600 MW of power

[23] https://ec.europa.eu/commission/presscorner/detail/en/IP_10_763

which will then become 1,200 MW when the second cable is laid, scheduled for the near future[24]. Malta also has interconnections with Italy.

Spain and Portugal are interconnected and are expected to reach 3 GW of available capacity for commercial purposes in both directions (import and export), in the near future. A new OHL 400kV interconnection between Fontefría (Spain) and Ponte de Lima (Portugal) is commissioned for 2021 (delayed). There will be an internal reinforcement complementing the cross border section, such as the axis in Spain between Fontefría and Beariz, in order to connect the cross border project to the existing network, and in Portugal to Ponte de Lima (previously Viana do Castelo).

Between Spain and France, projects concern the Biscay Gulf (370 km HVDC-VSC, linking two bipoles of 1000 MW each), mainly the subsea in the Biscay Gulf, between Gatica (Basque Country, ES) and Cubnezais (Aquitaine, FR) – commissioning date 2025. The transformer Gatica (new transformer 400/220 kV) in the existing Gatica sub-station can have a potential impact in cross border values – commissioning date: 2025. Furthermore, there is a scheduled upgrade of the following 400kV lines that reach Gatica sub-station: Gatica-Gueñes, Gatica-Amorebieta-Ichaso and Gatica-Azpeitia. This internal project has influence in the exchange capacity values between France and Spain, and it is directly related to the Biscay Gulf project (commissioning date 2025). Other project are the Navarra-Landes (new HVDC interconnection between France and Spain in the Western part of the Pyrenees between Pamplona area in Spain and Cantegrit in France – commissioning date: 2027) and Aragón-Atlantic Pyrenees (new HVDC interconnection between France and Spain located in the Central part of the Pyrenees between Aragón region in Spain and Marsillon in France – commissioning date 2027).

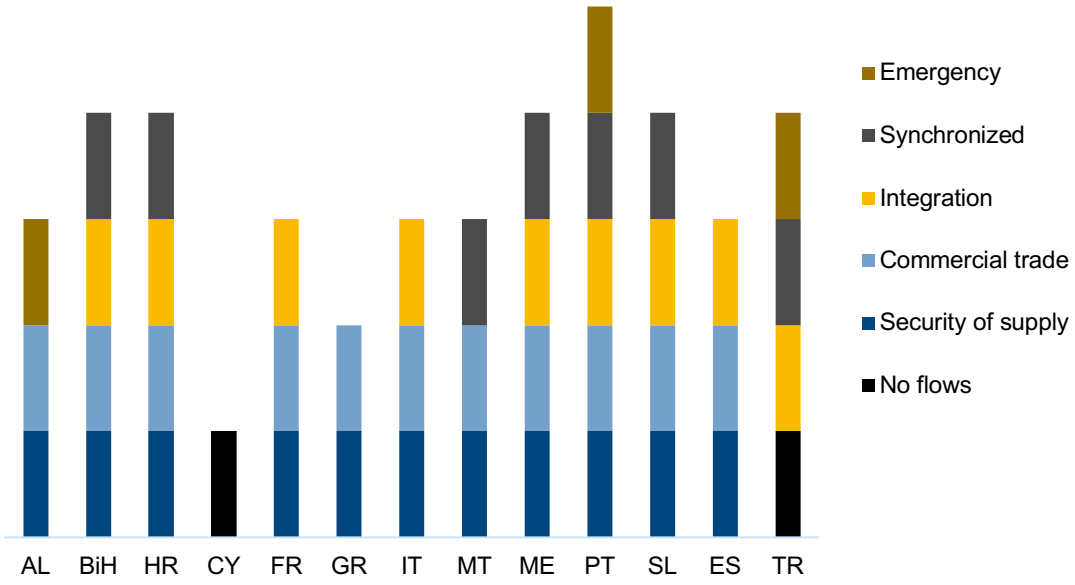


Figure 12 – Role of cross-border interconnections: EU, Balkans, Turkey

[24] TERNA's press release dated 15/11/2019

Electricity trade in Southeast Europe is intense, and the regional wholesale market is functional with seven existing electricity exchanges. HUPEX in Budapest is the largest electricity exchange in the Western Balkans in terms of trade volume and price. This exchange is reference for the region and Bosnia and Herzegovina. Bosnia and Herzegovina do not have established electricity exchanges. Establishment of the electricity exchange is an obligation that Bosnia and Herzegovina has to fulfil in accordance with the Energy Community requirements.

Six cross-border interconnections exist in Albania, two lines with each neighbouring countries (Kosovo, Greece and Monte Negro). For each interconnection, two levels of voltage operate at 400kV and 220kV, only for the second interconnection with Greece involves a 150 kV transmission line.

In Bosnia-Herzegovina, there are in total 37 cross-border interconnections. Among them, four lines are 400 kV, 10 are 220 kV and 23 are 110 kV. Most cross-border lines are on the border with Croatia (27 in total), while five lines are at the border, both with Serbia and Montenegro.

Croatia has strong interconnections with neighbouring countries (Slovenia, Hungary, Serbia and Bosnia-Herzegovina), which contribute to high levels of security of supply and promote an integrated regional electricity market. In 2018, Croatia finalised a day-ahead market coupling of Croatia and Slovenia. There are also regular improvements in cross-border trade with its neighbouring countries. Slovenia is interconnected with Italy, Austria and Croatia. There is a PCI project for the HV line, Cirkovce (Slovenia) – Pince (Hungary) (2 x 400 kV) – which is to join the interconnector between Slovenia and Hungary, currently under construction.

Currently, Montenegro has interconnections with Serbia, Albania and Bosnia-Herzegovina. Major changes at the regional market are expected after entry into operation submarine cable (HVDC). Actually, the first line of the cable (600 MW) is scheduled to operate by the end of 2019[25]. This cable will enable the access to not just regional but European markets, bringing about a competitive electricity market and optimal use of available resources.

Greece has currently interconnections with North Macedonia, Albania, Bulgaria, Italy and Turkey. It has put in place a very ambitious plan regarding the interconnections with neighbour countries, with a view to achieving the Union's 15% target until 2030 and, in this context, participating actively in the integration of the regional market, ending the isolation of Greek and Cyprus islands and increasing the penetration of RES units in the area. To that end, the second interconnection to Bulgaria (namely PCI Interconnector Maritsa East, Bulgaria – Nea Santa UHV substation, Greece) at 400kV AC has received the CBCA decision by the RAE and EWRC, and it is currently under implementation in order to become operational by the end of 2023.

In addition, a CBCA decision has been issued by RAE and CERA over the Greece-Cyprus (Attica-Crete) interconnector (part of Euroasia Interconnector PCI with code 3.10 connecting Greece-Cyprus-Israel) with a HVDC capacity of 1 GW. The Greek part is being implemented in pursuing RAE decisions no. 816/2018, 838/2018,1190/2018 and 150/2019 by the SPV Ariadne Interconnector S.A., with the aim to be installed by the end of 2022.

Moreover, Greece has been evaluating the development of similar projects in the area and, more specifically, the upgrading of the Greece-North Macedonia interconnector to increase its

[25] As mentioned in the paragraph 7.2

transfer capacity and the LEG1 project, which is based on the interconnection of Greece (mainland) to Libya through Crete with the simultaneous development of RES projects (solar) in Africa.

Cyprus has currently no interconnections with neighbouring countries. There is one project of common interest (PCI) for electricity which concerns Cyprus, known as the "Euro-Asia Interconnector", and has been included in the EU list. The cluster of Israel-Cyprus-Greece between Hadera (Israel) and the Attica regions (Greece) include the following PCIs: Interconnection between Hadera (Israel) and Kofinou (Cyprus), interconnection between Kofinou (Cyprus) and Korakia (Crete, Greece) and the internal electric line between Korakia-Crete-Attica regions (EL).

The implementing body of the EuroAsia Interconnector project submitted an investment request to the regulatory authorities of Cyprus and Greece, on 5 September 2017 for the first stage of project 3.10.2 – "Interconnection between Kofinou (CY) and Korakia, Crete (EL)", with a total capacity of 1 GW, and for the first phase of the project 3.10.3 – "Internal line between Korakia, Crete and Attica region (EL)", with a total capacity of 1 GW. Following consultations between CERA and RAE, an agreement was reached on 10th October 2017, on the cross-border sharing of investment costs.

Turkey has currently interconnections with Bulgaria, Greece, Georgia, Armenia, Azerbaijan, Iraq, Syria and Iran. The Turkish electricity network has a good quality of service and a reliability that is in line with the European standards. In order to take part in European electricity markets, a contractual agreement between ENTSO-E and TEIAS was signed by the end of 2009, and the Turkish power system was synchronised with the interconnected power systems of Continental Europe. Turkey has been an observing member of the ENTSO-E since 2016.

In the EU, national electricity markets are well integrated, highlighting the merit of interconnections in terms of complementarity between member states. France, Portugal and Slovenia are big exporters while Greece, Italy and Spain import large amounts of power.

Assuming no technical constraints, power import in Turkey is very low (around or less than 1%), moderate in France, Italy, Slovenia and Spain (between 6 and 17%), and higher in Albania (20.7%), Bosnia and Herzegovina (23.4%), Malta (24.43%), Montenegro (25%) and Croatia (69.16%). Even if the share of import is important in European countries, during the past year, the trends is for a decrease of this amount, except Italy where it is growing (+15.6%).

	Import 2016	Import 2017	Import 2018	Average volume growth over the past five years	Foreseeable demand evolution in the next five years
Albania	25.6%	75.2%	20.7%	5%	*
Bosnia and Herzegovina	24.4%	25.6%	23,4%	-1.3%	n/a
Croatia	70.14%	66.81%	69,16%	2.84%	*
France	6.9%	7.6%	5,5%	-4.4% (2014–2018)	n/a
Greece	18.81%	15.96%	n/a	-4.12%	n/a
Italy	24.6%	14.2%	15,6%	15.6%	Stable
Malta	65.34%	36.03%	24,43%	n/a	n/a

	Import 2016	Import 2017	Import 2018	Average volume growth over the past five years	Foreseeable demand evolution in the next five years
Montenegro	44%	52%	25%[26]	n/a	2020: 0 TWh 2021:0,153 TWh 2022: 0 TWh
Portugal	4%	6.22%	5.88%	12.63%	10.55%
Slovenia	6%	14%	12%	n/a	n/a
Spain	8.75%	9.41%	9.47%	-3.85%	n/a
Turkey	2.27%	0.93%	0.81%	-1.1 TWh	n/a

Table 13: Imports % EU, Balkans and Turkey[27]
**Import fluctuates as they depend on generation from hydro*

Cyprus doesn't have any cross-border interconnections. Export is very low in Italy, Croatia, Malta and Turkey (less than 1.5%). In Albania and Bosnia-Herzegovina, the export also fluctuates as they depend on generation from hydro plants. France and Montenegro exported between 15% and 30% of power generation. Portugal exported 10.25% of its electricity in 2018, and Spain exported 5.23% of its electricity in 2018. In the last five years, exportations have increased mostly in Greece (+73.24%), Spain (+14.30%) and France (8.7%), in particular, thanks to the better integration of the systems under the guidance of ENTSO-E, and the needs of some countries to meet their electricity needs.

	Export % 2016	Export % 2017	Export % 2018	Average volume growth over the past five years	Foreseeable demand evolution in the next five years
Albania	26.2	10.8	31.4	-	*
Bosnia-Herzegovina	41.1	34.4	43	2.9	*
Croatia	53.43	44.17	53.58	1.17	n/a
France	13.5	14.0	15.7	-6.6 (2014-2018)	n/a
Greece	1.99	4.52	n/a	73.24	n/a
Italy	2.1	1.7	1.14	1.14	Stable
Malta	0	0	0.42	n/a	n/a
Montenegro	30	17	26[13]	n/a	2020:0.424 TWh 2021:0.336 TWh 2022: 0.737 TWh
Portugal	10.25	n/a	n/a	n/a	n/a
Spain	5.72	5.88	5.23%	14.30	n/a
Turkey	0.53	1.11	1.01	0.076 TWh	n/a

Table 14 - Exports % EU, Balkans and Turkey[28]
**Import fluctuates as they depend on generation from hydro*

[26]Assessment
[27]Cyprus does not have any cross-border interconnection, therefore, there are not electricity imports or exports
[28]Slovenia has not provided an answer on this question

7.3. East Mediterranean countries

Interconnections are quite low in this region[29], however, as we have seen previously, the gas fields discovered by Israel and Egypt open up a very strong development potential for the sub-region. Better interconnections with neighbouring countries, and with the rest of the Mediterranean, will therefore be essential to fully exploit these resources.

Jordan has interconnections with Egypt, Syria and Palestine-Jericho. The interconnections are very important for the security of the national grid, and they provide the possibility of selling electricity to new customers, by being more competitive with the price of electricity.

Palestine has interconnections with Israel, Jordan and Egypt and the imported electricity from cross-border interconnections are unique sources of supply, making them vital to satisfy the electricity supply, since there is no power generation sector. Incoming generation projects need cross-border interconnections to meet the regional integration and are important for commercial purposes.

Lebanon is interconnected with Syria on a 400 kV-level via line Ksara (Lebanon)-Dimas (Syria). The line is in double circuit in the Lebanese territories and single circuit in the Syrian territories. This line was used (before the Syrian crises) to import power mainly from Egypt but not in a synchronisation regime (a part of the Lebanese grid was set to operate as an electrical island with Egypt). Now this line is used to import power only from Syria without synchronisation.

The other interconnection lines are:

- Deir Nbouh (Lebanon)–Samarian (Syria), a 220 kV tie line with the Syrian grid. It's not frequently used to import power due to technical restriction from the Syrian side (after the Syrian crises)
- Ksara–Dimas, two 66 kV lines are used from time to time.

There is a plan to add another transformer of 400/220 kV in the Ksara substation to increase the power import on the 400 kV line, and there is a discussion with the Syrian side to construct another 400 kV line in the Syrian territories in order to meet the double circuit line in Lebanon.

Offshore generators are connected to the grid, but their contracts are to end in 2021. Historically, there has been an interconnection agreement with Syria, Jordan and Egypt. However, political problems lead to a reduction in these electricity imports, specifically from Syria, where they collapsed from 529 GWh per year in 2013 to 68 GWh per year in 2016 and 11.93 GWh in 2018. The main lesson is that interconnections are not a panacea, and one should pay due attention to the rationale behind developing interconnections[30].

[29] Only Jordan, Lebanon and the Palestinian Authority have provided an answer to this question.
[30] MEDREG, 2018: Regulatory options for the stimulation of infrastructure investments

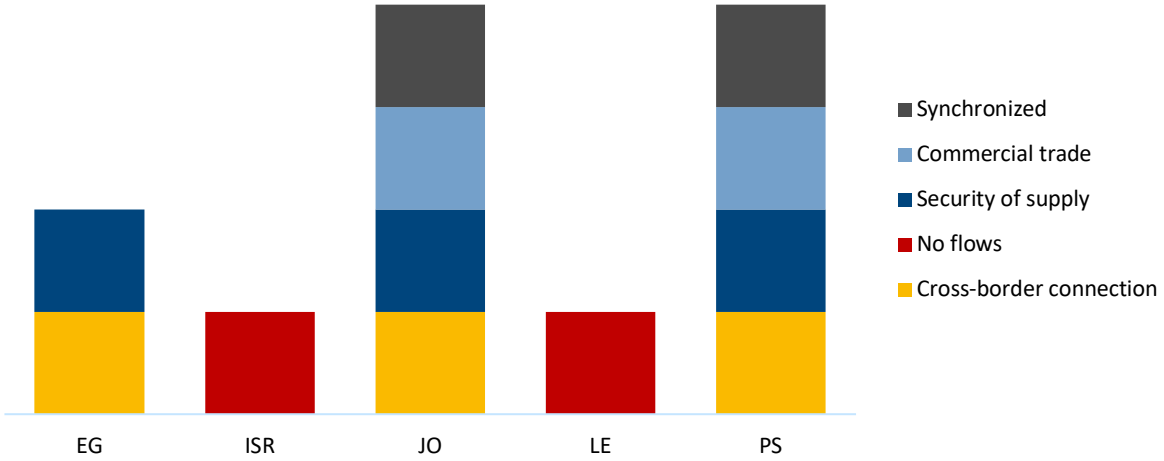


Figure 13 – Role of cross-border interconnections: Eastern Mediterranean

Assuming no technical constraints, power import in Lebanon, Jordan and Egypt is very low (around or less than 1%) and very high in Palestine (99.36%). As it stands, Palestine cannot provide for its electricity needs and depends on imports from Israel. To be noted is that the importing of energy from Israel is still not regulated by the PPA; this means that there are 300 connection points supplied to the Palestinian market with individual contracts.

	Import % 2016	Import % 2017	Import % 2018	Average volume growth over the past five years
Egypt	54 GWh	65 GWh	81 GWh	0.26%
Jordan	2	0.29	1.07	1.93%
Lebanon	0.59	3.61	0.078	n/a
Palestinian Authority	99.81	99.65	99.36	n/a

Table 15: Import East Mediterranean (Israel has not answered)

Exports are also very low, which underlines a potential for the development of interconnections. They are very low in Egypt and Jordan (less than 1.5%). Egypt imported 0.081 TWh of its electricity and reports 0.425 TWh in exports. Jordan imported 1.07% and exported 0.47% of its electricity in 2018. Lebanon imported 0.078% of its electricity from Syria in 2018 (against 3.61% in 2017 and 0.59% in 2016). Palestine did not export any energy to neighbouring countries. Working as an isolated network, there are neither power import nor export figures available for Israel.

*	Export % 2016	Export % 2017	Export % 2018	Average volume growth over the past 5 years
Egypt	747 GWh	333 GWh	425 GWh	0.2%
Jordan	0.22	0.274	0.47	0.31%

Table 16: Exports in East Mediterranean
**Israel, Lebanon and have not replied*

Investments will be needed to meet the increasing electricity demand. The MENA region will need to install a 88GW generation capacity over the period 2019–2023, which is expected to

translate into $142 billion for generation, and $68 billion for transmission and distribution (T&D)[31]. To be noted is that the APICORP estimates include countries beyond the Mediterranean region such as Saudi Arabia, Iraq, Iran, UAE and Qatar. In such a context, looking for an efficient and coordinated development at a regional level clearly makes sense. On the other hand, it should be noted that exploring the complementarities of the national power systems is, therefore, particularly relevant in Eastern Mediterranean countries to promote a better use of existing interconnections and identifying where new interconnections would be relevant.

In addition, the ongoing project of the EuroAfrica interconnector, and the complementarity of seasonal high peak load of the EU and non-EU countries, will allow a better integration of renewable energy into the European, Arab and African networks.

[31]Source: APICORP Energy Research – July 2019 – MENA Power Investment Outlook 2019-2023

8. Conclusions

The analysis of the evolution of the national and regional electricity markets in the Mediterranean area provides a clear picture and insights regarding where and how the region is heading. Furthermore, it can help in opening a discussion on how Mediterranean electricity markets could be improved in the future to hasten the way towards more integrated and competitive national and regional electricity markets.

Electricity demands are inclining at a high pace in the Southern and Eastern Mediterranean countries and, although cross-border interconnections exist, even if in a minimum number and with limited operating capacities, regional integration is not progressing, keeping their role minimal. Currently, most electricity exchanges on existing interconnections take place on an emergency basis, to cover either unexpected outages or scheduled ones due to maintenance. It can be assumed that this is not because of the Mediterranean region's lack of potential, but rather because of the lack of opportunities, adequate infrastructures and harmonised regulatory frameworks. Besides, electricity systems' management is often centralised, with a single company operating national systems from production to distribution. This organisation looks similar to the one that used to exist in Europe in the past, whose rationale derived from the steady increase of demand and the resulting priority to significant investments. It is therefore crucial for non-EU-Mediterranean countries to elaborate a coherent analysis of expected energy developments, to assess and prioritise where investment efforts should be developed.

Economic development, increase in population and the affirmation of a growing middle class, and hotter summers due to climate change, will continue to increase electricity needs and pressure on the networks in SEMCs, leading to a struggle to increase generation to match the rising demands, with a direct impact on the evolution of energy prices (at wholesale and retail levels) and import needs.

In this regard, SEMCs should keep looking and further focus on meeting the internal demands through investing in power generation internally, keeping the usage of cross-border interconnections only for security of supply purposes, or, alternately, look at the benefits that a difficult process such as market integration could bring to their energy system.

Such process can be started around two main axes: the diversification of energy sources, mostly with the development of RESs, and better regional interconnections. Facilitating cross-border trade (beyond the needs of TSOs) could be an intermediate step for SEMCs to evolve from a focus on only the security of supply to a regionally integrated electricity market. Thus, energy exchanges would involve not only TSOs but also market participants (generators, big consumers and suppliers).

Security of supply and diversification of energy sources will be all the more important as the share of renewable energy use increases under the spur of international agreements. The development of more decentralised electricity generation through RESs could make international interconnections less critical, especially when configuring in smarter and micro-grids. However, intra-SEMCs and SEMCs-EU electricity interconnections will be more essential to create broader, integrated and more efficient, regional energy markets.

In this framework, Southern Mediterranean countries have a substantial potential for their Northern neighbours, which, within the EU, have committed to improving cross-border

electricity interconnections to achieve their climate and energy goals. On top of that, Northern and Southern shores of the Mediterranean show different characteristics, potentialities and complementarities, and they can use these synergies to exchange energy and meet the targets of the energy transition in the next decades. A stronger commitment from Mediterranean countries toward cross-border interconnections could facilitate the integration of electricity system on north-south and south-south routes, supporting the EU in boosting its security of supply and integrating more renewables into energy markets. This will pave the way for the achievement of development and security goals in the Mediterranean region through the shared use of energy.

Implementing the conditions for sharing resources can determine significant cost reductions and more limited risks of investments in infrastructures. Besides, the possibility to combine and operate in a more integrated way of power systems that have complementarities of generation mix and load profiles, is another benefit with direct impact on increasing energy efficiency.

Electricity systems will have to adapt to the ongoing energy transition, articulated around three main trends: decarbonisation, decentralisation and digitalisation. Regulators and transmission system operators are at the perfect place to rewrite the script, in close cooperation with DSOs and governments. In this context, new models for customer energy management, grid infrastructure and electricity market design are emerging. They are forcing utilities and regulators to rethink how the grid works and explore ways to improve grid operations. For instance, smart grids and the aggregation of distributed resources, using a combination of power electronics, communications tools and analytics software, will be more and more common.

The integration of RESs raises the question of grid management all around the Mediterranean. In the EU, the Balkans and Turkey, the electricity distribution business varies in the number and size of operational areas, the number of customers, network characteristics as well as ownership structure. Infrastructure development now mainly consists of reducing congestions and developing cross-border transmission capacities, in order to achieve the EU single electricity market and allow the large-scale integration of renewable energies. DSOs must accompany the integration of rising shares of decentralised and variable generations and new loads, such as electric vehicles, into their networks. Therefore, appropriate investments in distribution networks, including smart grids and smart meters, will be needed to accommodate these challenges and replace the current ageing infrastructure, while maintaining the high quality of service.

Annex 1: MEMO Evolution History

The Mediterranean electricity market observatory (MEMO) was initiated in 2007. It aims at monitoring the overall evolution of national, sub-regional and regional electricity markets in the Mediterranean region. It is a periodic assessment, with a timespan of three years. It mainly relies on a questionnaire sent to the members. Consequently, the results are worked out using member responses, since they are encouraged to provide an evaluation of their country's situation and status.

A summary of the published reports under the MEMO initiative with their publication dates is listed in Figure 14:

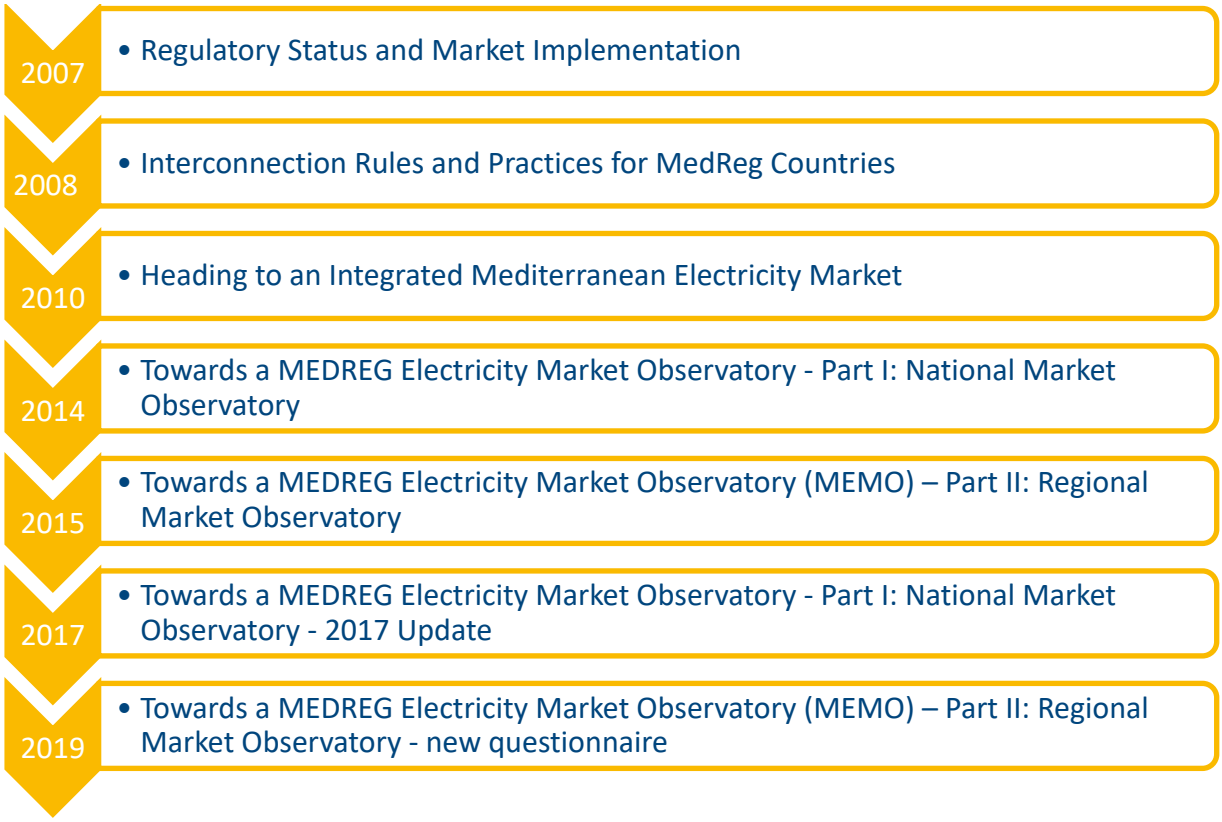


Figure 14 – MEMO evolution history

The first version of the MEMO, in 2008[32], revealed that cross-border trade in the Mediterranean region still had potential to grow. Two survey forms were circulated among the MEDREG participants for this report: the first survey questioned the present and future infrastructure facilities, the second survey investigated the practices that govern cross-border exchanges in the MEDREG regions. In 2010, MEDREG carried out the third survey of the MEMO. With the positive outcomes of the answers provided in the report[33], the questionnaire became the benchmark for the analysis of the regulatory and market status/development in MEDREG countries.

[32]Report on interconnection rules and practices for MEDREG Countries, November 2008
[33]Summary assessment: Survey on the legal framework for management of electricity interconnection in the Mediterranean region, December 2011

Since 2010, the MEMO initiative has been split in two different observatory directions, related to either the national (part 1) or the regional market (part 2). Each report was developed based on of the associated survey's replies from MEDREG members to map and study the current status of the region. The indicators used to assess the regulatory frameworks, market status and the obtained results from the published reports[34] were harmonised to map the development of the MEDREG members' electricity markets, at the national and regional levels. Replies received on the survey's indicators were used without questioning the efficiency of the regulatory frameworks and networks in place, for example, the level of each indicator's implementation.

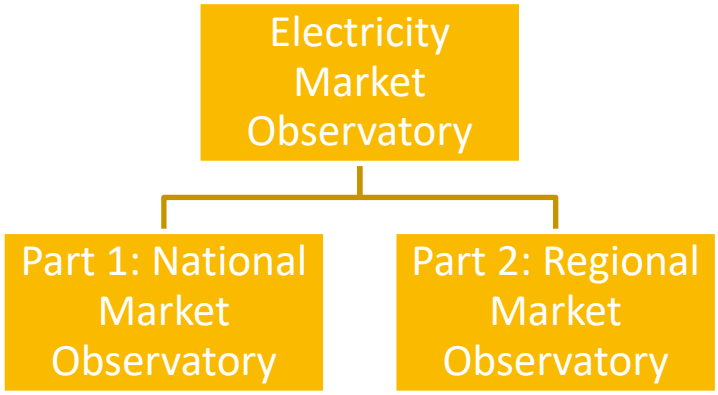


Figure 15 – MEMO Structure

The 2018 national report, based on 2017 data, provided an update of the previous work performed in the 2014 report towards a MEDREG electricity market observatory – Part I: National Market Observatory.

[34]Four reports analysed national electricity market replies (published in 2007, 2010, 2014 and 2018), and two reports looked at regional electricity market replies (published in 2010 and 2015).

Annex 2: List of Indicators

Question 1: Volume of demand, generation, import and export

Members are to express in the table the total energy volume that they would expect to import, assuming no technical constraint in interconnections. Import (%) should be calculated as a percentage of the total demand, and export (%) should be calculated as a percentage of the total amount of generation.

Question 2: Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

Members are invited to express the amount of daily average load, peak load, average and maximum import base on a daily basis and average and maximum import load on a daily basis.

Question 3: TSOs and DSOs

Members are invited to express in the table the amount of the requested data on transmission system operators and distribution system operators.

Question 4: Governance and unbundling regime

Members are invited to check and insert data related to governance and unbundling regimes.

Question 5: Generation plants

Members are invited to express in the table the requested data.

Question 6: Internal structure of the electricity market

Members are invited to check and insert data related to the internal structure of the electricity market.

Question 7: Regional electricity market system: Purpose, status and role of cross-border interconnections

Members are required to check and comment the following characteristics of their cross-border interconnections.

Annex 3: Overview of the Responses Received

Table 17 shows that the responses to the circulated surveys varied during the last decade. Out of 22 MEDREG member countries, replies were received from 14, 11, 12 and 14, 20 countries in the circulated 2007, 2010, 2014, 2017, 2019 surveys, respectively.[35]

Country	Acronyms	Regulators	2007	2010	2014	2017	2019
Albania	AL	ERE	✓		✓	✓	✓
Algeria	DZ	CREG	✓	✓	✓	✓	✓
Bosnia-Herzegovina	BiH	SERC	✓	✓	✓	✓	✓
Croatia	HR	HERA					✓
Cyprus	CY	CERA	✓			✓	✓
Egypt	EG	Egypt ERA	✓	✓	✓	✓	✓
France	FR	CRE		✓	✓	✓	✓
Greece	GR	RAE		✓	✓	✓	✓
Israel	ISR	PUA	✓				✓
Italy	IT	ARERA	✓	✓	✓	✓	✓
Jordan	JO	EMRC	✓	✓	✓	✓	✓
Lebanon	LE	LCEC[36]					✓
Libya	LY	ME					
Malta	MT	REWS	✓	✓	✓	✓	✓
Montenegro	ME	REGAGEN				✓	✓
Morocco	MO	MEMEE					✓
Palestinian Authority	PS	PERC	✓				✓
Portugal	PT	ERSE		✓	✓	✓	✓
Slovenia	SL	AGEN-SR	✓				✓
Spain	ES	CNMC	✓	✓	✓	✓	✓
Tunisia	TN	MIT	✓				
Turkey	TR	EMRA	✓	✓	✓	✓	✓
Total number of answers received			14	11	12	14	19

Table 17: Answered MEMO questionnaires per country

Several questions were developed to find out more about each indicator. Figure 16 shows the share of answers to each question concerning the total number of items listed in the survey.

[35]All regulators but three joined in 2007: Libya's ME joined MEDREG in 2013, and Lebanon's LCEC in 2018. In Morocco, the regulator ANRE joined MEDREG on 2018. Before 2018, the MEMEE represented Morocco in MEDREG

[36]LCEC assists the Ministry of Energy and Water in regulations related to renewable energy.

Under the current methodology used, the answer to each question can be either “yes” or “no”, without weighting the specific responses provided.

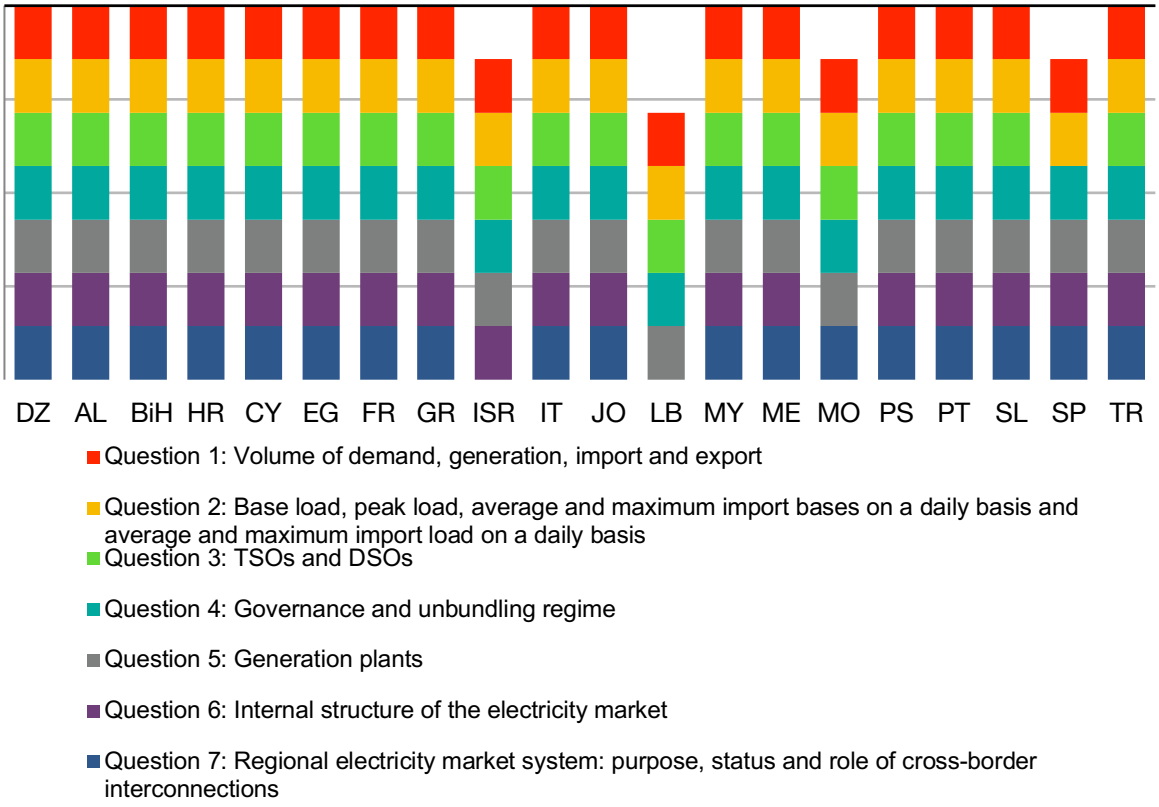


Figure 16 – Answered questions per country

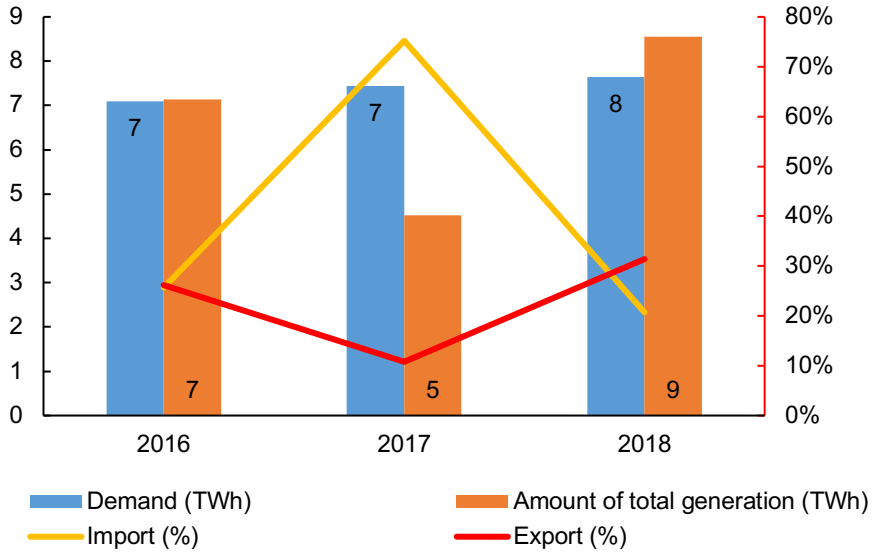
Annex 4: Country Profiles (Data by Country)

In this annex, the data received from the members are illustrated through tables and figures. This will cover only the data on the electricity system, without the unbundling and the cross-border situations data, which are analysed in the report.

Albania

1. Volume of demand, generation, import and export

The electricity demand in Albania increased by 2.7% in 2018, compared to 2017, reaching values of over 7.6 TWh. Total electricity demand for 2018 in Albania reached 7 639 GWh.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

	Unit	2018
Peak load (MW)	MW	1.480
Average import load on daily basis	MW	N/A
Maximum import load on a daily basis	MW	N/A
Daily average load (MW)	MW	N/A

3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	9.85	5.96
Length of High Voltage	km	3388.1	/
Length of Medium Voltage	km	/	/
Length of Low voltage	km	/	/
Consumption of High Voltage	TWh	0.957	/
Consumption of Medium Voltage	TWh	/	5.96
Consumption of Low voltage	TWh	/	
Generation capacity	MW	1 964	240
Amount of losses	%	2.46	/

4. Generation plants

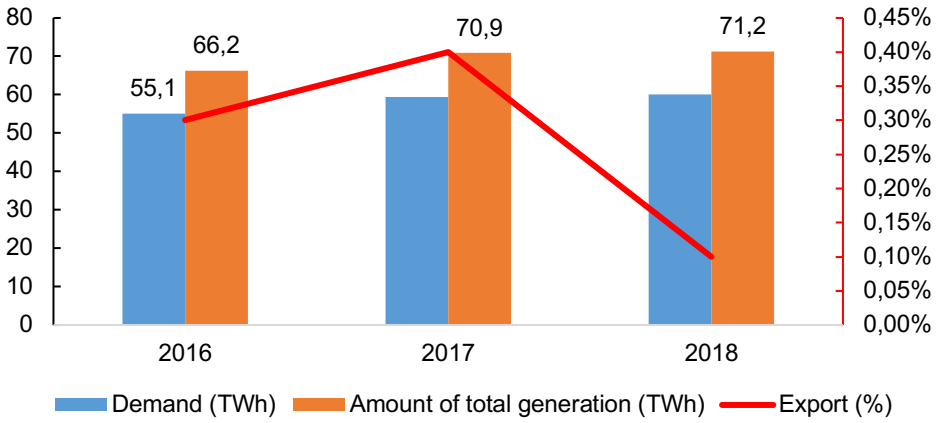
Albania is almost totally dependent on hydropower for electricity generation; nearly 100% of the country's domestically produced electricity comes from hydropower. During the last year, all the energy production was provided by hydro power plants (8.552 TWh).

In addition, 68.31% of the generated energy was produced by public company KESH spa, the rest (31.69%) was produced by private companies.

Algeria

5. Volume of demand, generation, import and export

The amount of total generation is expected to increase by 6% in the next 5 years.



6. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

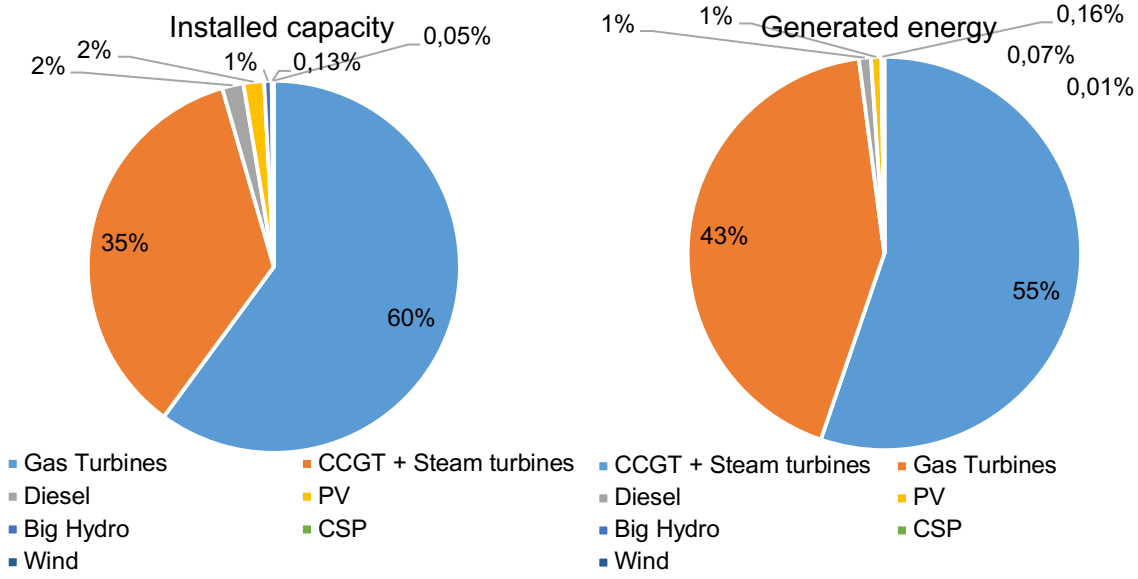
	Unit	2018
Peak load (MW)	MW	13.676 (main grid)
Average import load on daily basis	MW	N/A
Maximum import load on a daily basis	MW	N/A
Daily average load (MW)	MW	9 600

7. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	11.8	49.1
Length of High Voltage	km	29.461	/
Length of Medium Voltage	km	/	153.105
Length of Low voltage	km	/	185.874
Consumption of High Voltage	TWh	11.8	/
Consumption of Medium Voltage	TWh	/	16.1
Consumption of Low voltage	TWh	/	33
Generation capacity	MW	18.250	935
Amount of losses	%	3.4	14.2

8. Generation plants

In both installed capacity and generated energy, conventional power plants dominate the power production in the Algerian electrical system, with more than 95% in the installed capacity and 98% in generated energy.



In terms of number of plants, 106 power plants are in service.

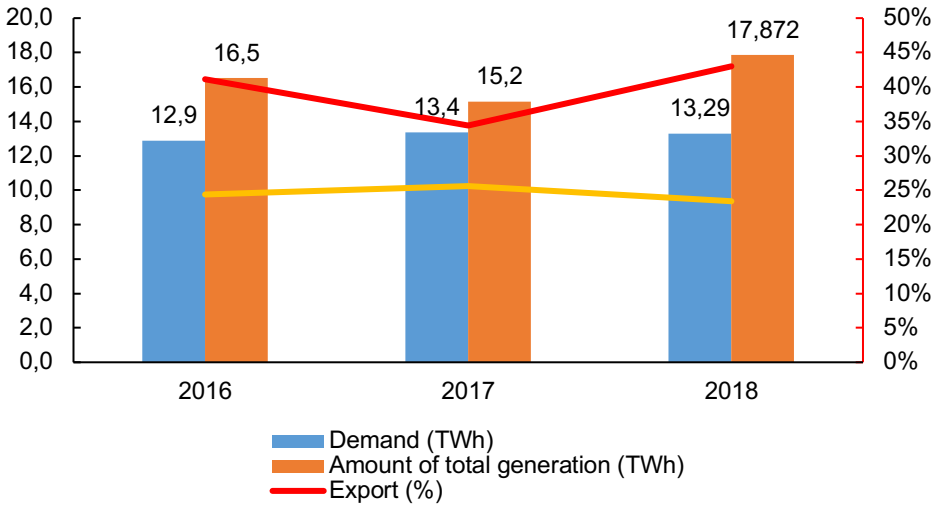
Type	Number of plants	Installed capacity (MW)
Gas Turbines	40	11.543
Diesel	30	357
PV	22	344
CCGT + Steam turbines	10	6.809
Big Hydro	2	125
Wind	1	10.2
CSP	1	25

In addition, 55% of the generated energy is produced by public utilities and 45% is produced by IPP or through PPA. The share of the dominant producer is 51% of the total generated energy.

Bosnia and Herzegovina

1. Volume of demand, generation, import and export

The amount of total generation is expected to increase by 5% in the next five years at a 2.2% increase in demand.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

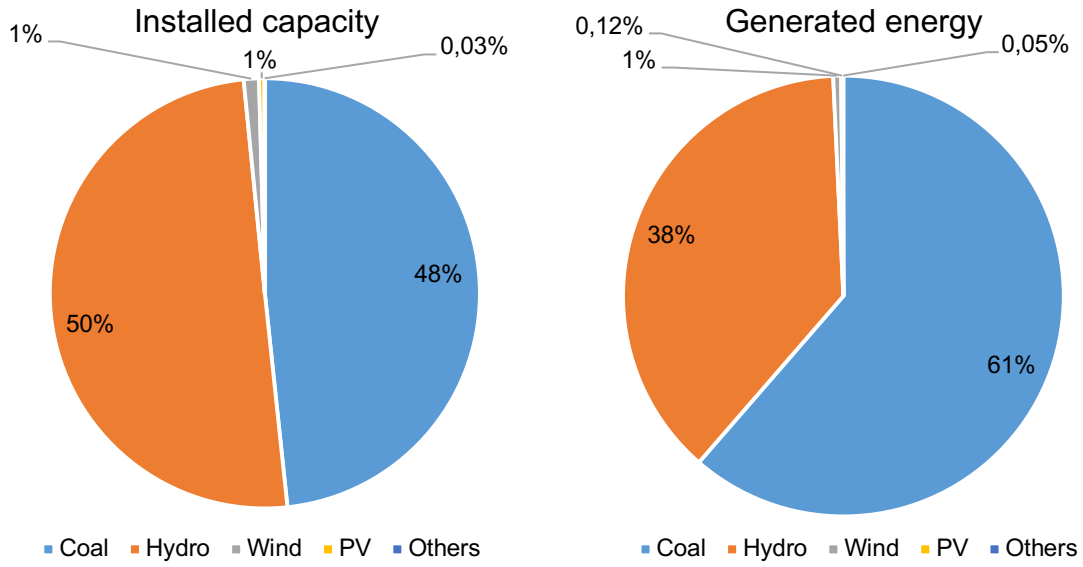
	Unit	2018
Peak load	MW	1 994
Average import load on daily basis	MW	158.3
Maximum import load on a daily basis	MW	N/A
Daily average load	MW	1 517.5

3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	12.23	10.14
Length of High Voltage	km	6.402.10	/
Length of Medium Voltage	km	/	25.251
Length of Low voltage	km	0	68.714
Consumption of High Voltage	TWh	2.76	/
Consumption of Medium Voltage	TWh	0	2.48
Consumption of Low voltage	TWh	0	6.71
Generation capacity	MW	4.192.6	270.6
Amount of losses	%	3.26	9.37

4. Generation plants

In both installed capacity and generated energy, hydro and coal power plants dominate the power production in Bosnia and Herzegovina electrical system, with more than 50% in the installed capacity for hydro and 61% in generated energy for coal.



In terms of number of plants, 299 power plants are in service.

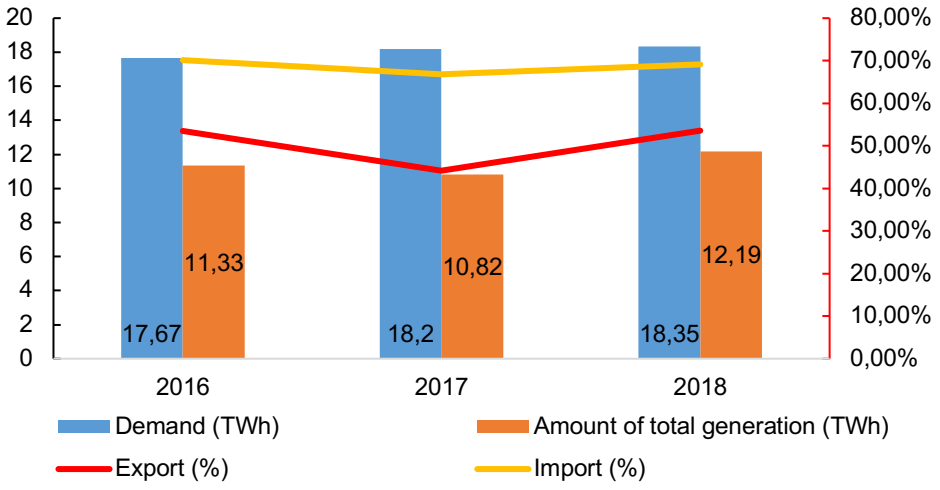
Type	Number of plants	Installed capacity (MW)
Coal	5	2156.23
Hydro	100	2235.6
Wind	1	51
PV	190	18.15
Others	3	1.25

In addition, the public generation owns 87% of installed capacity and 13% by IPP or through PPA. The dominant share producer is 83% of the total generated energy.

Croatia

1. Volume of demand, generation, import and export

The amount of total generation is expected to slightly decrease by -0.25% in the next five years, due to the fluctuation of hydro energy. On the other hand, the demand will increase by 1.23%



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

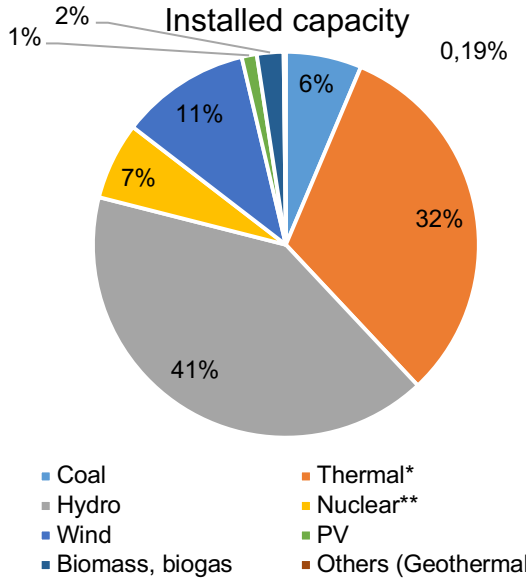
	Unit	2018
Peak load	MW	3.168
Average import load on daily basis	MW	N/A
Maximum import load on a daily basis	MW	N/A
Daily average load	MW	N/A

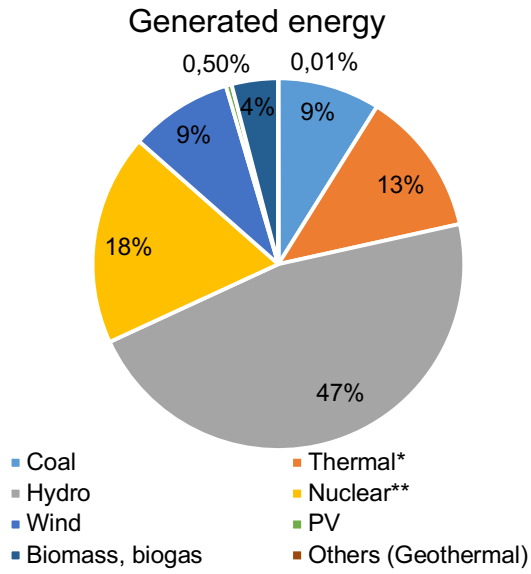
3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	1.59	16.76
Length of High Voltage	km	7.791	
Length of Medium Voltage	km		41.731
Length of Low voltage	km		97.058
Consumption of High Voltage	TWh	1.59	
Consumption of Medium Voltage	TWh		16.76
Consumption of Low voltage	TWh		
Generation capacity	MW	4 670	350
Amount of losses	TWh	0.53	1.29

4. Generation plants

In both installed capacity and generated energy, the mix is more dominated by hydro power plants, with 41% in the installed capacity and 47% in generated energy. Thermal power plant (using gas and oil as fuel) is in second place in terms of installed capacity and third in generation.





In terms of number of plants, 1885 power plants are in service.

Type	Number of plants	Installed Capacity (MW)
Coal	2	342
Thermal*	18	1702
Hydro	65	2202
Nuclear**	1	348
Wind	24	585
PV	1701	68
Biomass, biogas	73	120
Others (Geothermal)	1	10

In addition, the share of the dominant producer is 83% of the total generated energy.

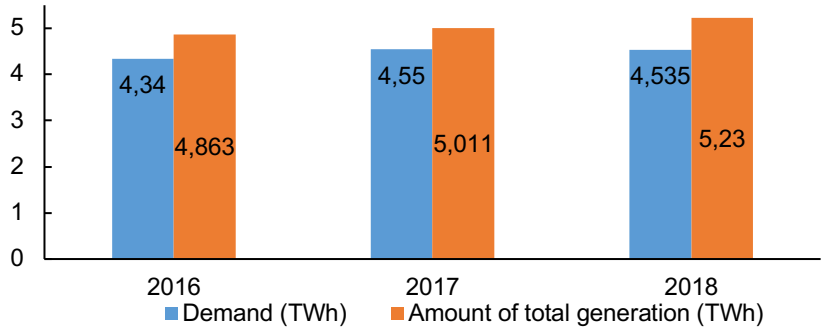
*Thermal includes all the thermal power plants (gas, oil and steam), the data is merged since both gas and oil are used as fuel for these power plants.

**Croatia owns 50% of nuclear power plants of Krško, which is located in Slovenia. We don't usually count it as a Croatian powerplant since it's not located on our territory (energy produced from that powerplant has to be imported).

Cyprus

1. Volume of demand, generation, import and export

The amount of total generation is expected to increase by almost 1 TWh in the next five years. Cyprus doesn't have any cross-border interconnection, therefore, there is no import or export.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

	Unit	2018
Peak load	MW	1 074
Average import load on daily basis	MW	N/A
Maximum import load on a daily basis	MW	N/A
Daily average load	MW	571

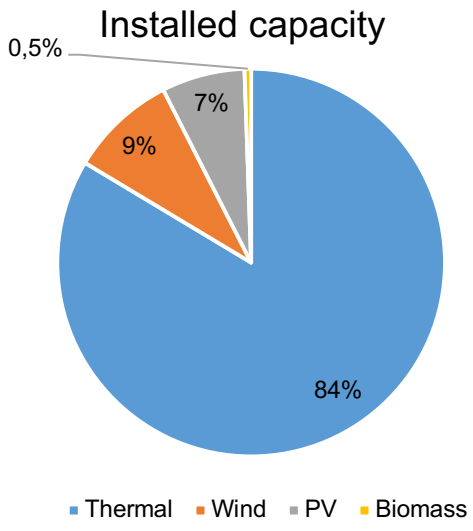
3. TSOs and DSOs

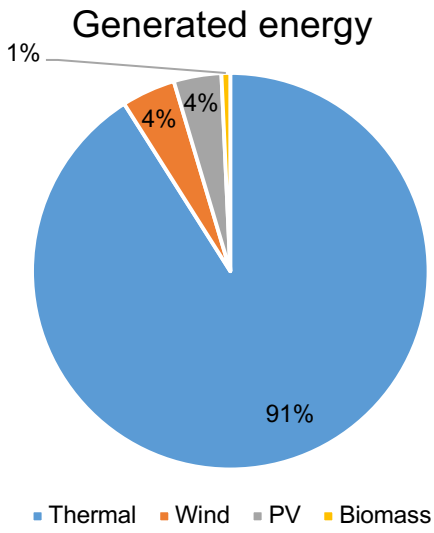
	Unit	TSOs	DSOs
Consumption	TWh	0.147	4.399
Length of High Voltage (2017 data)	km	1320	-
Length of Medium Voltage (2017 data)	km	-	24.875
Length of Low voltage	km	-	

Consumption of High Voltage	TWh	0.147	-
Consumption of Medium Voltage	TWh	-	1.263
Consumption of Low voltage	TWh	-	3.136
Generation capacity	MW	1635.5	89
Amount of losses	%	1.35	2.1

4. Generation plants

In both installed capacity and generated energy, thermal power plants dominate the power production in Cyprus, with more than 84% in the installed capacity and 91% in generated energy.





In terms of number of plants, 13,688 power plants are in service.

Type	Number of plants	Installed Capacity (MW)
Thermal	3	1478
Wind	5	157.5
PV	13,667	122.7
Biomass	13	9.7

In addition, the share of the dominant producer is 91% of the total generated energy.

Egypt

1. Volume of demand, generation, import and export

For both demand and energy generation, the average annual growth over the past 5 years is 4%.

In terms of import and export, the volume varies from a year to another.

	Unit	2016	2017	2018	Average volume growth over the past 5 years
Demand	MW	29,200	29 400	30,800	4%
Generation	TWh	1,86,320	1,89,550	1,96,760	4%
Import	%	54	65	81	0.26%
Export	%	747	333	425	0.20%

2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

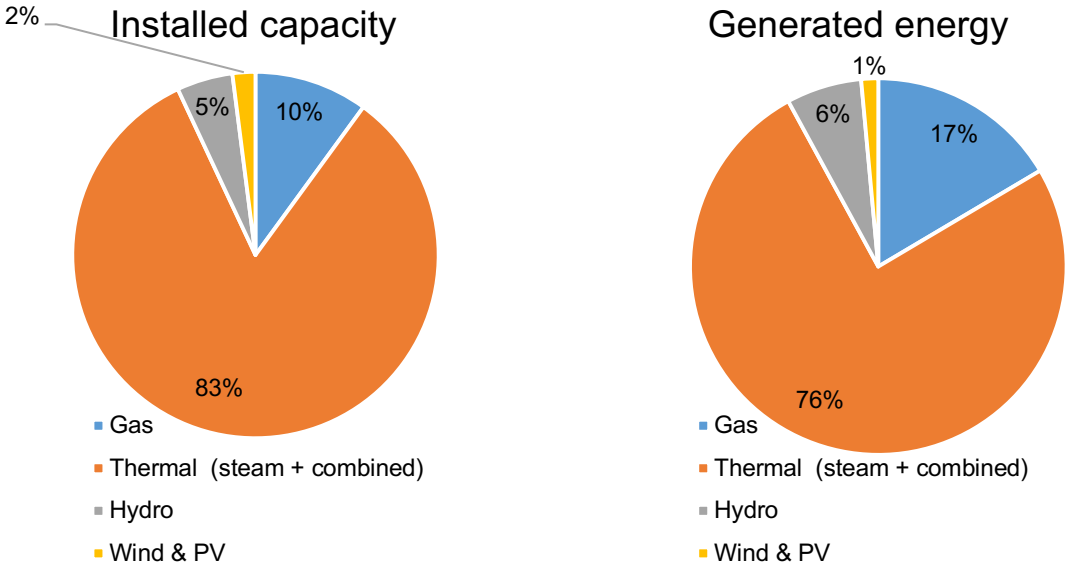
	Unit	2018
Peak load	MW	30,800
Average import load on daily basis	MW	N/A
Maximum import load on a daily basis	MW	N/A
Daily average load	MW	N/A

3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	189.5	155.97
Length of High Voltage	km	45,079	-
Length of Medium Voltage	km	1811	197.741
Length of Low voltage	km	-	288.867
Consumption of High Voltage	TWh		
Consumption of Medium Voltage	TWh		131.15
Consumption of Low voltage	TWh		
Generation capacity	MW		
Amount of losses	%		15.9

4. Generation plants

In both installed capacity and generated energy, thermal power plants (steam + combined) dominate the power production in Egypt, with more than 83% in the installed capacity and 76% in generated energy.



In terms of number of plants, 77 power plants are in service.

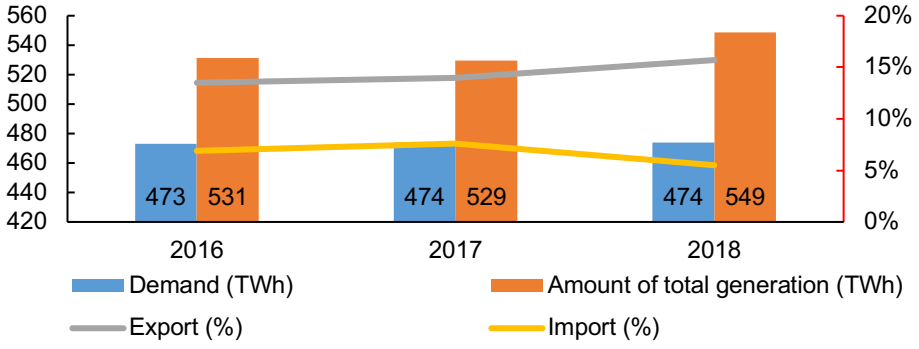
Type	Number of plants	Installed Capacity (MW)
Gas	25	5.745
Thermal (steam + combined)	41	47.527
Hydro	6	2.832
Wind and PV	5	1.157

In addition, the share of the dominant producer is 90% of the total generated energy.

France

1. Volume of demand, generation, import and export

Demand in the last five years.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

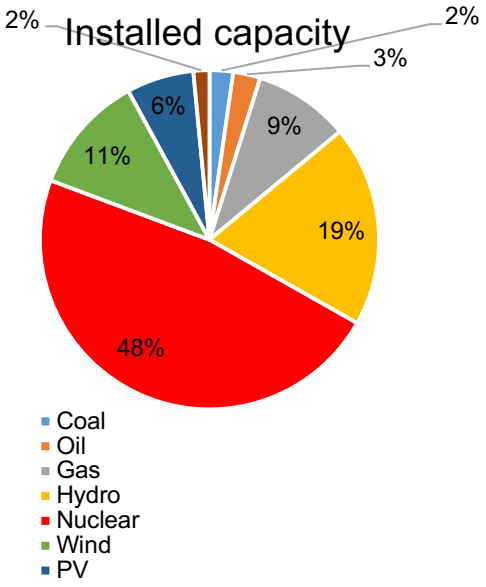
	Unit	2018
Peak load	MW	96,600
Average import load on daily basis	MWh	+/- 71.507
Maximum import load on a daily basis	MW	10,000
Daily average load	MWh	+/- 1,298.630

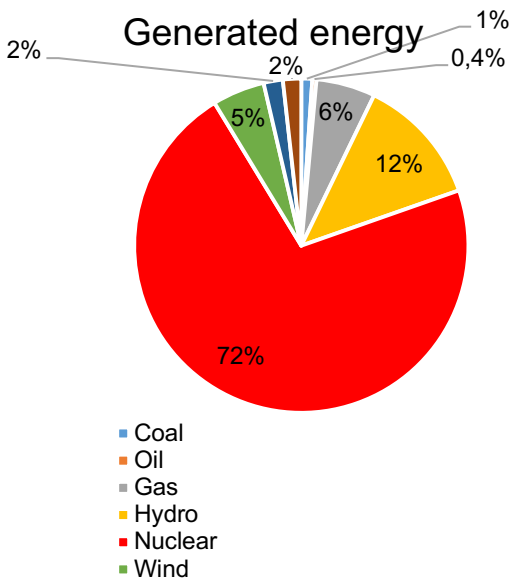
3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	66.2	407.8
Length of High Voltage	km	105.857	N/A
Length of Medium Voltage	km	N/A	1.4 million
Length of Low voltage	km	N/A	
Consumption of High Voltage	TWh	66.2	N/A
Consumption of Medium Voltage	TWh	N/A	407.8
Consumption of Low voltage	TWh	N/A	
Production injected on the network	TWh	493.5	55.1
Generation capacity	GW	106.6	26.3
Amount of losses	TWh	11.1	23.3

4. Generation plants

In both installed capacity and generated energy, the mix includes diverse technologies and different sources. In terms of installed capacity, 48% of the generation plants are nuclear power plants and in terms of generated energy 72% of the total is generated by also nuclear power plants.





In terms of number of plants, 77 power plants are in service.

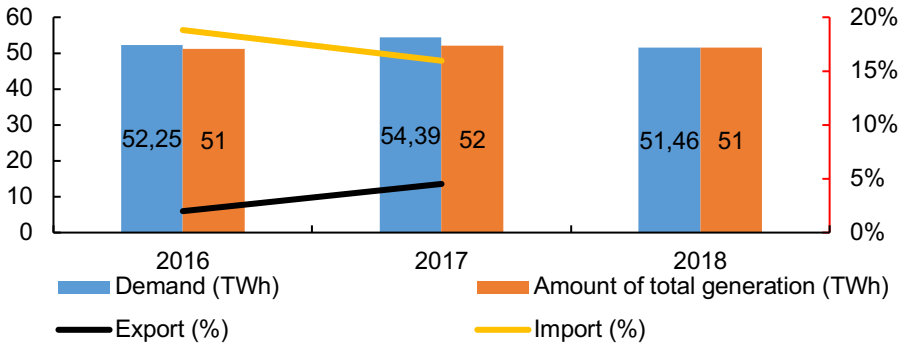
Type	Number of plants	Installed Capacity (MW)
Coal	5	2.997
Oil	12	3.440
Gas	16	12.151
Hydro	57	25.510
Nuclear	58	63.130
Wind	Multiple	15.108
PV	Multiple	8.527
Bioenergy (biogas, biomass...)	1	2.026

In addition, the share of the dominant producer is between 80–85% of the total generated energy.

Greece

1. Volume of demand, generation, import and export

The evolution of the demand has been more or less stable during the last five years, with an average growth of 0.62%. On the contrary, the generation increased by 2.5%. For the foreseeable evolution, three scenarios are taken in consideration (low demand, reference and high demand).



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

	Unit	2018
Peak load	MW	9,062
Average import load on daily basis	MW	N/A
Maximum import load on a daily basis	MW	N/A
Daily average load	MW	5,956

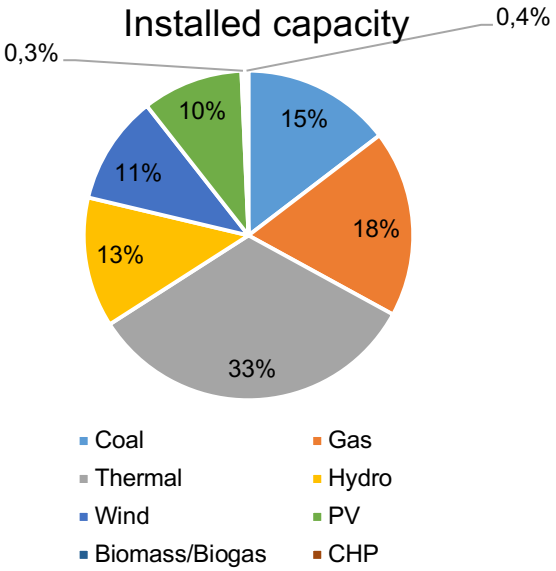
3. TSOs and DSOs

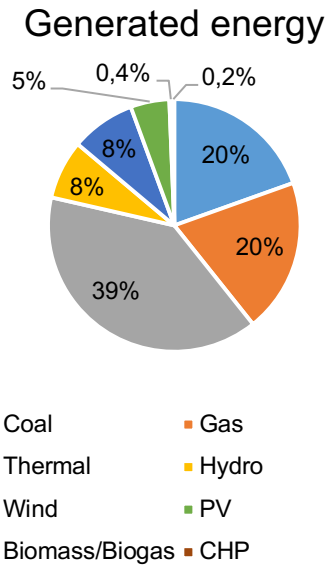
	Unit	TSOs	DSOs
Consumption	TWh	9.5	
Length of High Voltage	km	11.670	-
Length of Medium Voltage	km	-	112.295
Length of Low voltage	km	-	126.941
Consumption of High Voltage	TWh	9.5	
Consumption of Medium Voltage	TWh		11.755
Consumption of Low voltage	TWh		31.439

Generation capacity	MW	18 032	
Amount of losses (monthly)	GWh	1 234	N/A

4. Generation plants

The electricity power generation mix in the Greece electrical system is diversified using multiple technologies and different resources. In both installed and generation capacity, thermal comes first at, respectively, 33% and 39%. In the second place, gas and coal power plants represent 18% and 15%, respectively, in terms of installed capacity, and 20% for both in generated energy.





In terms of number of plants, more than 73 power plants are in service.

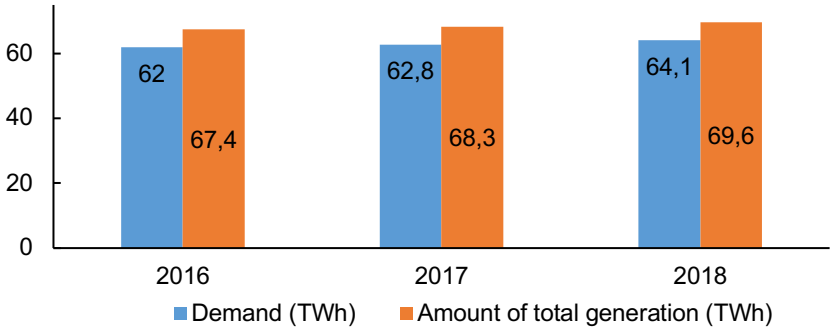
Type	Number of plants	Installed Capacity (MW)
Coal	14	3,903.9
Gas	14	4,900.3
Thermal	28	8,804.2
Hydro	16	3,410.5
Wind	N/A	2,860.53
PV	N/A	2,643.01
Biomass/Biogas	N/A	83.2
CHP	1	100.8

In addition, the share of the dominant producer is 64% of the total generated energy.

Israel

1. Volume of demand, generation, import and export

During the last three years, the demand increased from 62 TWh in 2016 to 64.1 TWh in 2018. The evolution of the power generation followed the same trend as the demand, with an increase from 67 TWh in 2016 to 70 TWh in 2018.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

	Unit	2018
Peak load	MW	12.921
Average import load on daily basis	MW	N/A
Maximum import load on a daily basis	MW	N/A
Hourly average load	MW	7.938

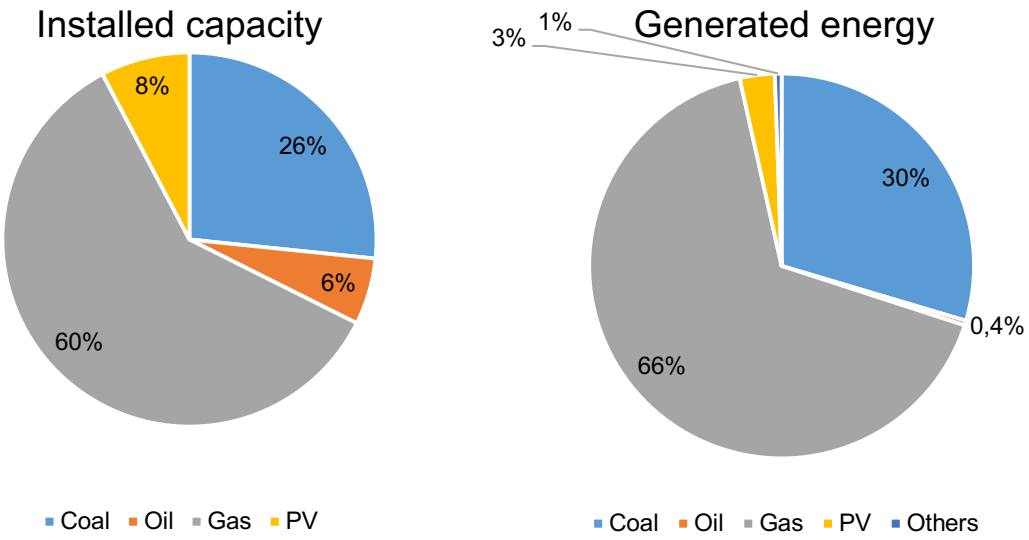
3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	/	/
Length of High Voltage	km	5.586	/
Length of Medium Voltage	km	/	28.340
Length of Low voltage	km	/	35.924
Consumption of High Voltage	TWh	9.98*	/
Consumption of Medium Voltage	TWh	/	23.7**
Consumption of Low voltage	TWh	/	18.5***
Generation capacity	MW	18.200	/
Amount of losses	GWh	N/A	N/A

*Only high industry
** Include Public Commercial, Water Pumping, Agriculture, East Jerusalem and Palestinian Authority
***Low Voltage Consumers Only

4. Generation plants

In the case of Israel, the mix is dominated by conventional power plants, with more than 60% gas turbines in terms of installed capacity and more than 66% in terms of generated energy.



In terms of number of plants, more than 91 power plants are in service.

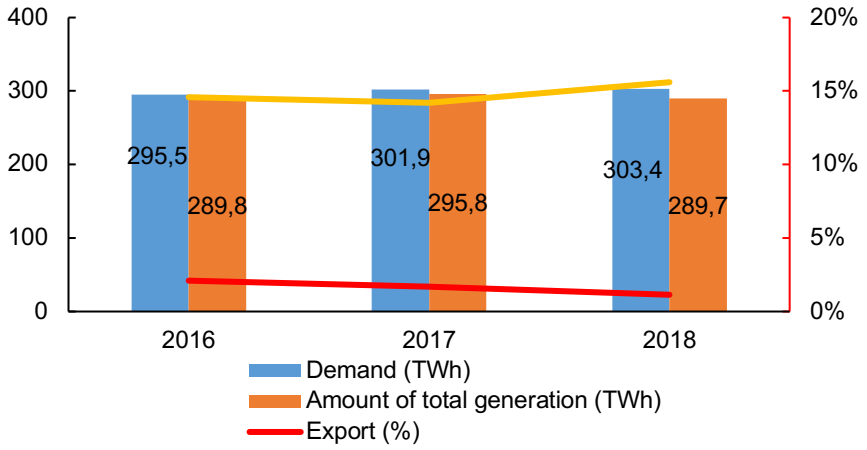
Type	Number of plants	Installed Capacity (MW)
Coal	10	4.840
Oil	23	1.046
Gas	58	10.888
PV	N/A	1.400

In addition, the share of the dominant producer is 69% of the total generated energy.

Italy

1. Volume of demand, generation, import and export

The demand in Italy has known an average growth of 2% during the last five years and it's expected to increase during the next five years. On the other hand, the volume of generation has slightly decreased by 0.03% during the last five years.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

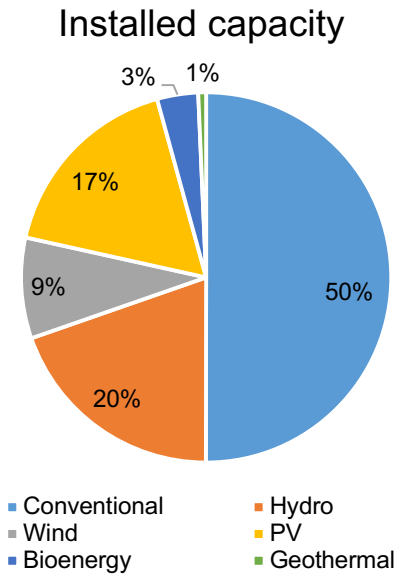
	Unit	2018
Peak load	GW	52.7
Average import load on daily basis (import-export balance)	GW	5.9
Maximum import load on a daily basis	GW	8.9
Hourly average load	GW	41.6

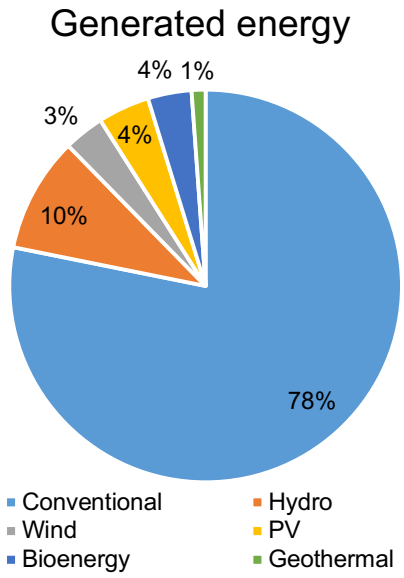
3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	35.46	267.9
Length of High Voltage	km	72 856	963
Length of Medium Voltage	km		873.034
Length of Low voltage	km		393.990
Consumption of High Voltage	TWh		38.9
Consumption of Medium Voltage	TWh		96.6
Consumption of Low voltage	TWh		132.3
Generation capacity	GW	86.9	31.3
Amount of losses	TWh	18.6	

4. Generation plants

Half of the installed capacity comes from the conventional power plants (using coal, oil, gas), which generate more than 78% of the total energy, the rest is divided by renewable energy power plants.





In terms of number of plants, more than 841,214 power plants are in service.

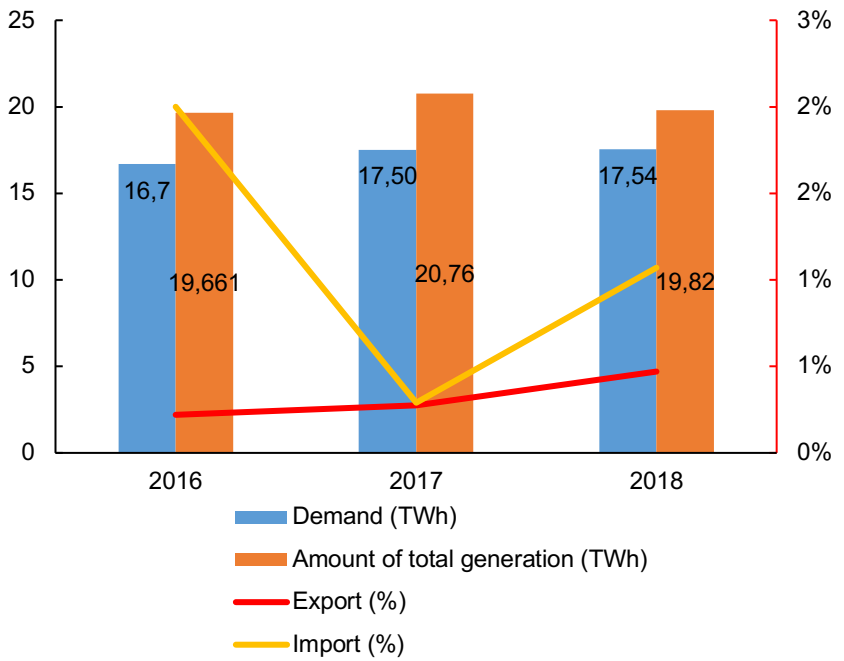
Type	Number of plants	Installed Capacity
Conventional	5 976	58.3
Hydro	4 337	22.9
Wind	5 642	10.26
PV	822 301	20.11
Bioenergy	34	4.18
Geothermal	2 924	0.8

In addition, the share of the dominant producer is 20% of the total generated energy.

Jordan

1. Volume of demand, generation, import and export

In Jordan, the demand and generation has known an average growth of 4% and 3% during the last five years, respectively, and it is expected to reach 21 TWh during the next five years[37], while the demand will reach 18.7 TWh[35].



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

	Unit	2018
Peak load	MW	3 380
Average import load on daily basis (import-export balance)	%	0.9%
Maximum import load on a daily basis	%	0.95%
Hourly average load	MW	2500

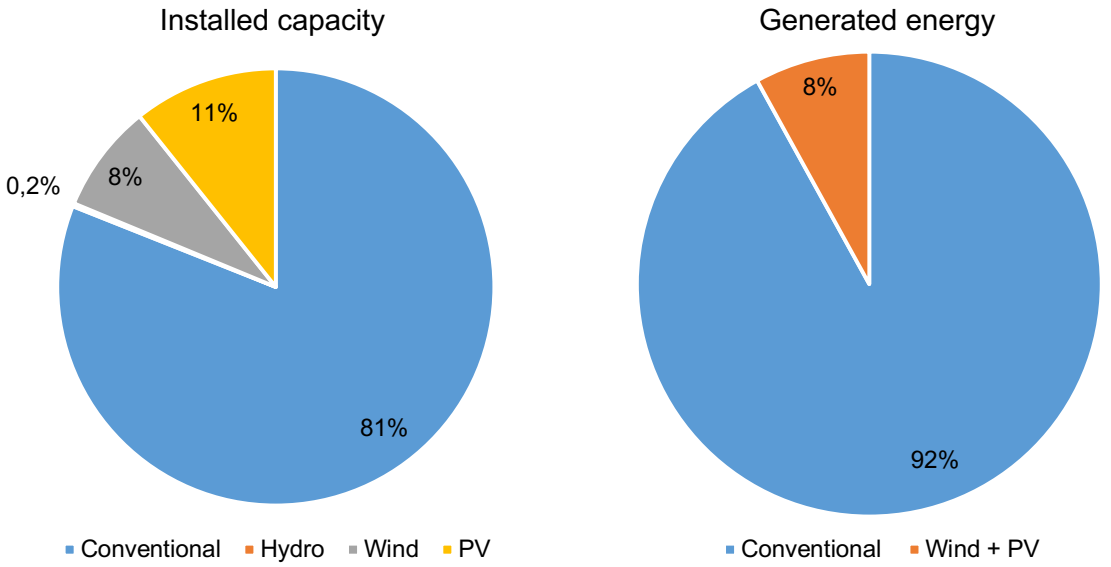
[37] Average for between 2022 and 2018 low growth assumption

3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	0.462	17.079
Length of High Voltage	km	4 714	0
Length of Medium Voltage	km	0	21 963
Length of Low voltage	km	0	50 834
Consumption of High Voltage	TWh	0.462	0
Consumption of Medium Voltage	TWh	0	17.079
Consumption of Low voltage	TWh	0	
Generation capacity	MW	4879	380
Amount of losses	%	2%	12.5

4. Generation plants

The conventional power plants represent more than 80% of the installed capacity and 92% in the power generation, the rest is divided between wind and solar PV.



In terms of number of plants, more than 841 214 power plants are in service.

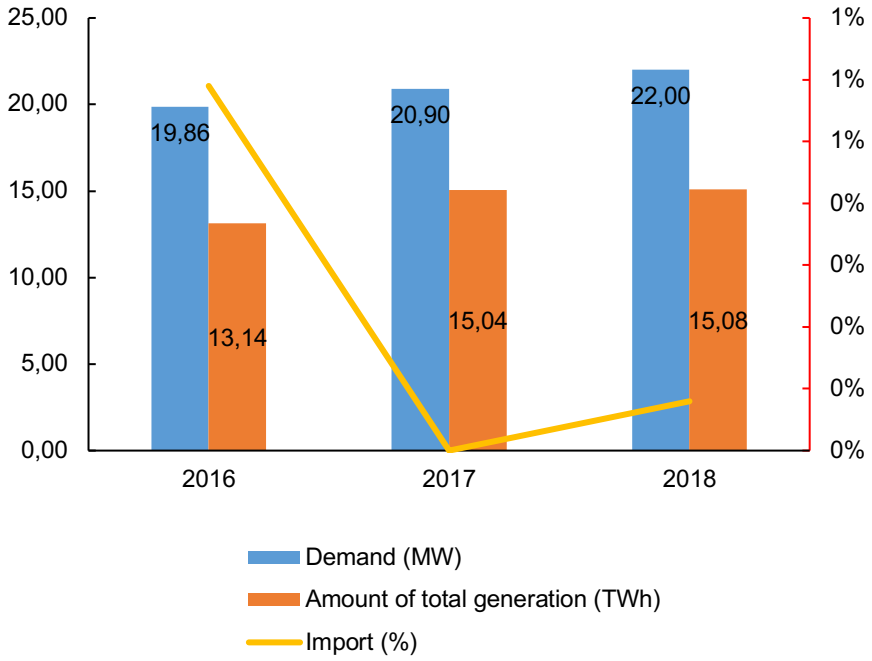
Type	Number of plants	Installed Capacity
Conventional	87	4261
Hydro	4	12
Wind	-	422
PV	-	564

In addition, the share of the dominant producer is 40% of the total generated energy.

Lebanon

1. Volume of demand, generation, import and export

During the last five years, the average growth of demand and generation was around 5%. The forecast for the next years state an increase of demand by 3%.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

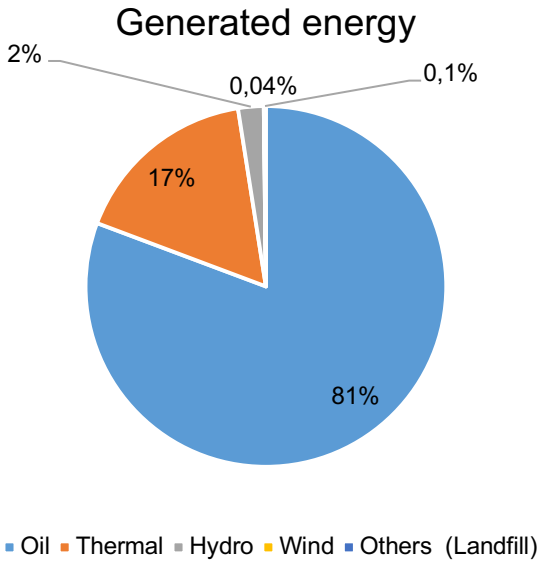
	Unit	2018
Peak load	MW	3 471
Average import load on daily basis	MW	1 745
Maximum import load on a daily basis	MW	2 214
Hourly average load	MW	2 591

3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh		
Length of High Voltage	km	2 198	N/A
Length of Medium Voltage	km	N/A	
Length of Low voltage	km	N/A	
Consumption of High Voltage	TWh	N/A	
Consumption of Medium Voltage	TWh	N/A	
Consumption of Low voltage	TWh	N/A	
Generation capacity	GW	2.2	
Amount of losses	%	1.8	

4. Generation plants

The electricity production comes mostly from conventional power plant using oil with more than 81% of the total electricity produced.

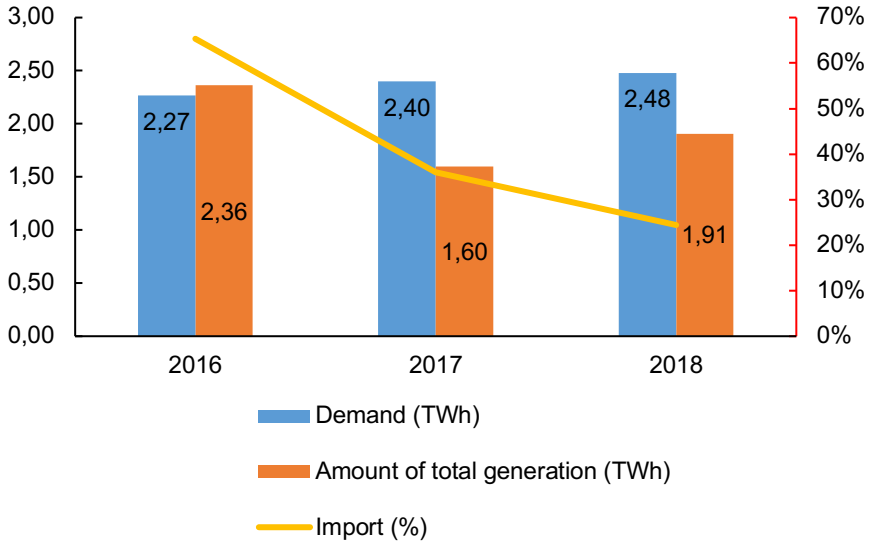


In addition, the share of the dominant producer is 80% of the total generated energy.

Malta

1. Volume of demand, generation, import and export

During the last five years, the demand has gain 4%. The forecast for the next five years anticipates an increase of demand to 3.34 TWh.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

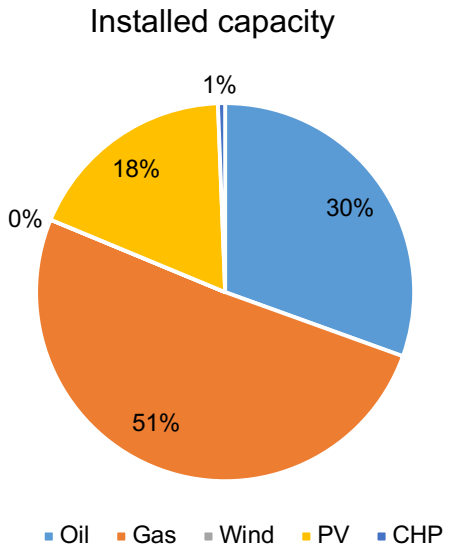
	Unit	2018
Peak load	MW	465
Average import load on daily basis	MW	72.1
Maximum import load on a daily basis	MW	250.6
Hourly average load	MW	289.21

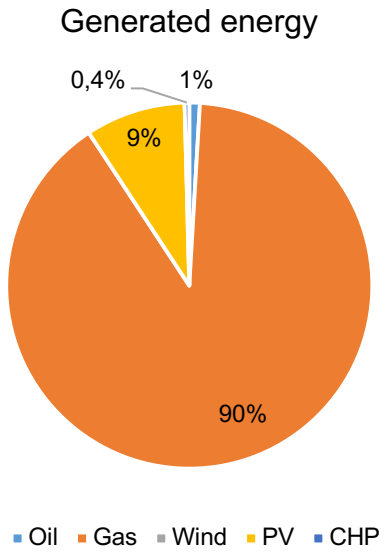
3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	No TSO in Malta	
Length of High Voltage	km		90.8
Length of Medium Voltage	km		1 505
Length of Low voltage	km		1 275
Consumption of High Voltage	TWh		
Consumption of Medium Voltage	TWh		
Consumption of Low voltage	TWh		
Generation capacity	GW		0.788
Amount of losses	TWh		Technical losses = 83.059GWh Lost in distribution = 32.935GWh

4. Generation plants

The electricity production comes mostly from conventional power plants (using oil and gas), representing more than 51% of the installed capacity and 90% of the generated energy.





In terms of number of plants, more than 24,693 power plants are in service.

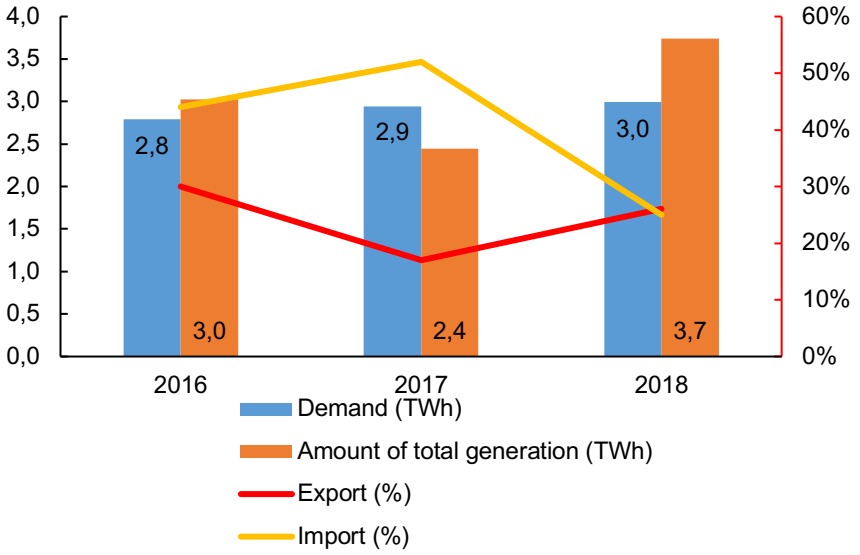
Type	Number of plants	Installed Capacity
Oil	2	221
Gas	2	367.6
Wind	12	0.0698
PV	24,672	131.3
CHP	5	4.419

In addition, the share of the dominant producer is 52.67% of the total generated energy.

Montenegro

1. Volume of demand, generation, import and export

For the next five years, the volume of both demand and generation is expected to grow and reach 3.17 TWh for the demand and 3.82 TWh for generation.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

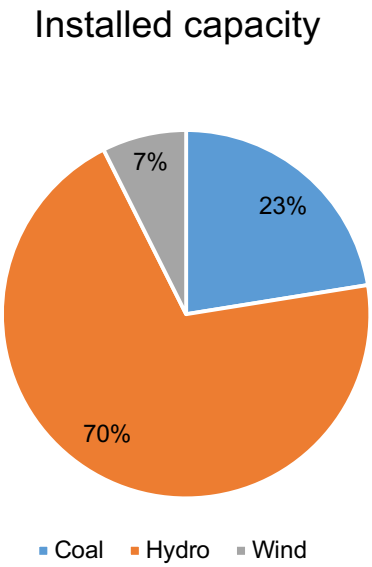
	Unit	2018
Peak load	MW	567.21
Average import load on daily basis	MW	n/a
Maximum import load on a daily basis	MW	n/a
Hourly average load	MW	372.52

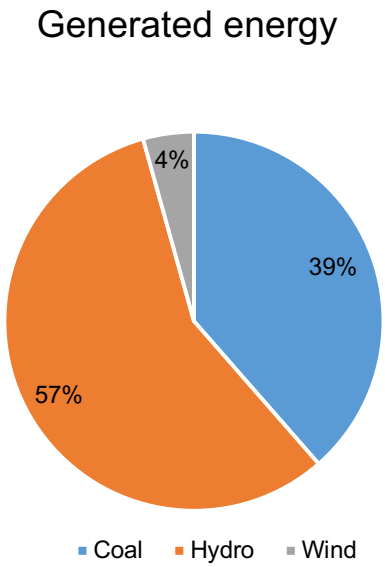
3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	GWh	676.74	2,314.55
Length of High Voltage	km	1,305.86	
Length of Medium Voltage	km		1,043.06
Length of Low voltage	km		5,180.66
Consumption of High Voltage	GWh	676.74	
Consumption of Medium Voltage	GWh		479.74
Consumption of Low voltage	GWh		1,834.81
Generation capacity	GW	939.50	33.02
Amount of losses	GWh	142.18	371.61

4. Generation plants

The electricity production comes mostly from hydro power plants, representing more than 71% of the installed capacity and 57% of the generated energy.





In terms of number of plants, 4 power plants are in service.

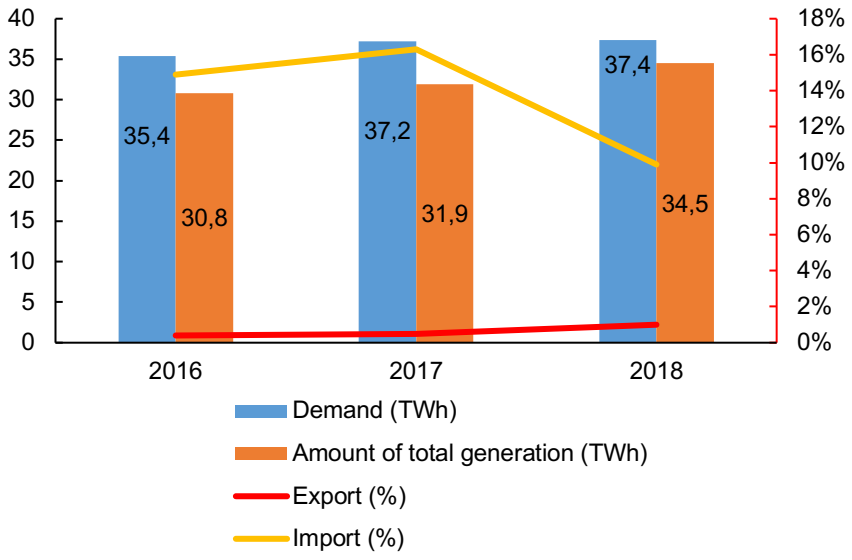
Type	Number of plants	Installed capacity
Coal	1	218.5
Hydro	2	682.02
Wind	1	72

In addition, the share of the dominant producer is 93% of the total generated energy.

Morocco

1. Volume of demand, generation, import and export

During the last five years, the demand has gained 3.2%, and 5.1% for the generation. The forecast for the next five years anticipates an increase of demand between 3 and 4%.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

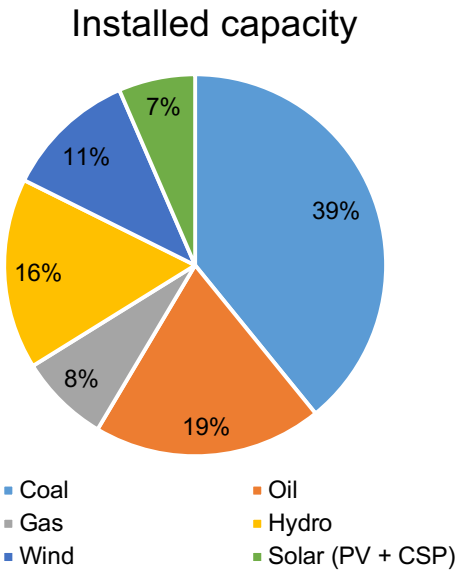
	Unit	2018
Peak load	MW	6 310
Average import load on daily basis	MW	600
Maximum import load on a daily basis	MW	875
Hourly average load	MW	5 500

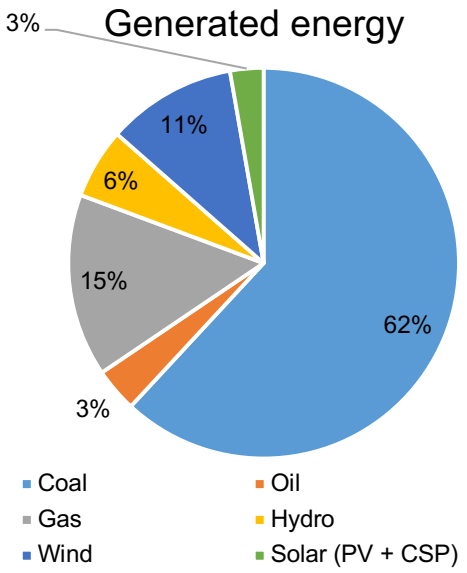
3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	7.4	30
Length of High Voltage	km	26,651.5	N/A
Length of Medium Voltage	km	N/A	
Length of Low voltage	km	N/A	
Consumption of High Voltage	TWh	7.4	
Consumption of Medium Voltage	TWh	N/A	
Consumption of Low voltage	TWh	N/A	
Generation capacity	GW	10.9	
Amount of losses	TWh	1.9	

4. Generation plants

The electricity production comes mostly from conventional power plant (coal, oil and gas), representing more than 66% of the installed capacity and 80% of the generated energy.





In terms of number of plants, 89 power plants are in service.

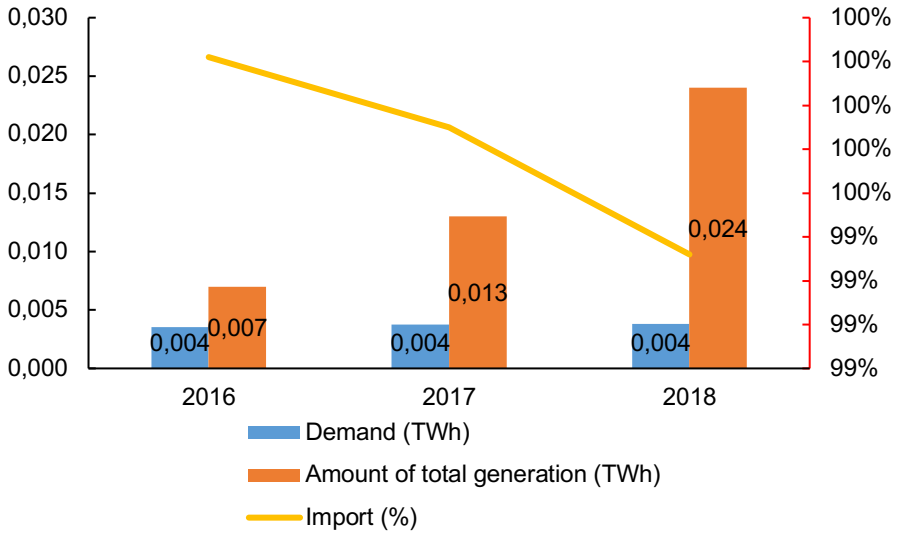
Type	Number of plants	Installed Capacity
Coal	6	4.281
Oil	32	2.122
Gas	2	834
Hydro	31	1.770
Wind	11	1.220
Solar (PV + CSP)	7	711

In addition, the share of the dominant producer is 43.4% of the total generated energy.

Palestine

1. Volume of demand, generation, import and export

During the last five years, the demand gained 4%, and 85% for the generation.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

	Unit	2018
Peak load	MW	805
Average import load on daily basis	%	99.97
Maximum import load on a daily basis	%	100
Hourly average load	MW	663

3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	GWh	159	3 797
Length of High Voltage	km	-	
Length of Medium Voltage	km	86	3 154
Length of Low voltage	km	-	42 556
Consumption of High Voltage	GWh	-	-
Consumption of Medium Voltage	GWh	159	3 744
Consumption of Low voltage	GWh	-	53
Generation capacity	MW	6	11.8
Amount of losses	%	2	22

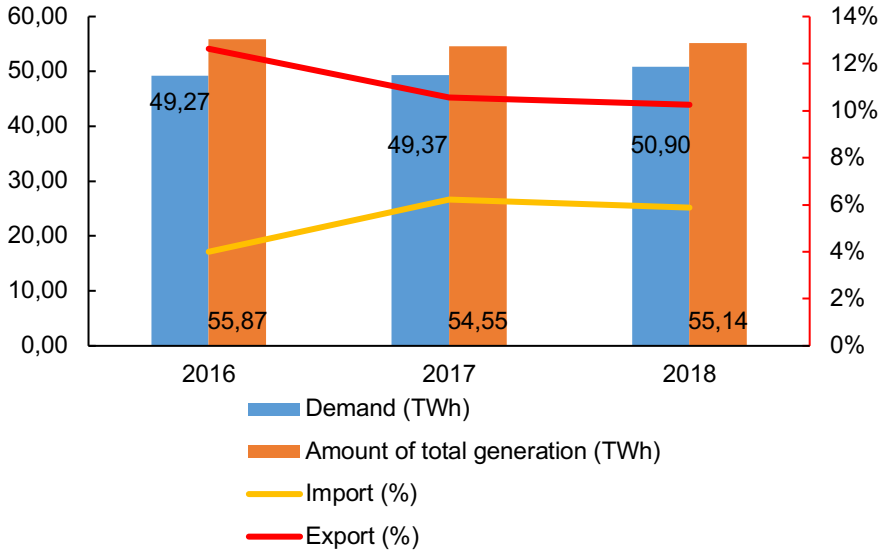
4. Generation plants

In the case of Palestine, only solar PV is used with an installed capacity of 18 MW with a production of 24.409 GWh.

Portugal

1. Volume of demand, generation, import and export

During the last five years, the demand growth by 0.71% and 3.09% for the generation. The forecast for the next five years anticipates an increase of demand of 0.8%/year.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

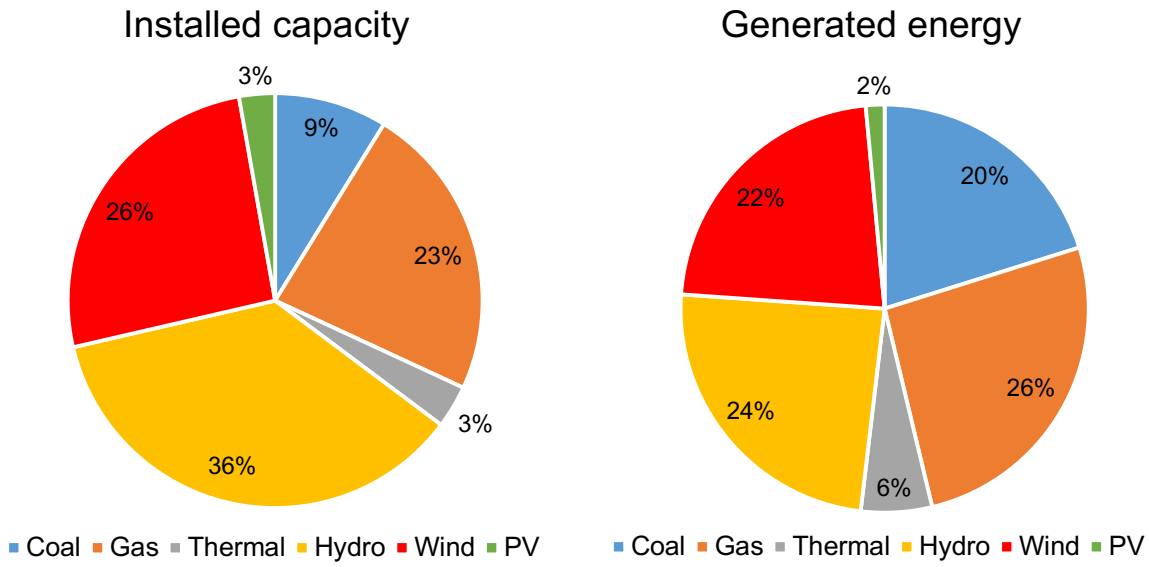
	Unit	2018
Peak load	MW	8794
Average import load on daily basis (hourly value)	MW	333
Maximum import load on a daily basis (hourly value)	MW	2704
Hourly average load (hourly value)	MW	5810

3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	**44.57**	**43.71**
Length of High Voltage	km	8 907 (VHV)	9 543 (HV)
Length of Medium Voltage	km	-	73 547
Length of Low voltage	km	-	143 440
Consumption of High Voltage	TWh	-	7.04
Consumption of Medium Voltage	TWh	-	14.98
Consumption of Low voltage	TWh	-	21.69
Generation	TWh	45.32	47.90
Amount of losses	TWh	0.744	4.19

4. Generation plants

The electricity production mix in Portugal is balanced in both installed capacity and generation. In terms of installed capacity, Hydro power plants comes first with 36%, followed by wind (26%), gas (23%) and 9% (coal). For the generated energy, the shares are similar for the three power plants with 26% (gas), 24% (hydro), 22% (wind) and 20% (coal).



In terms of number of plants, 1,068 power plants are in service.

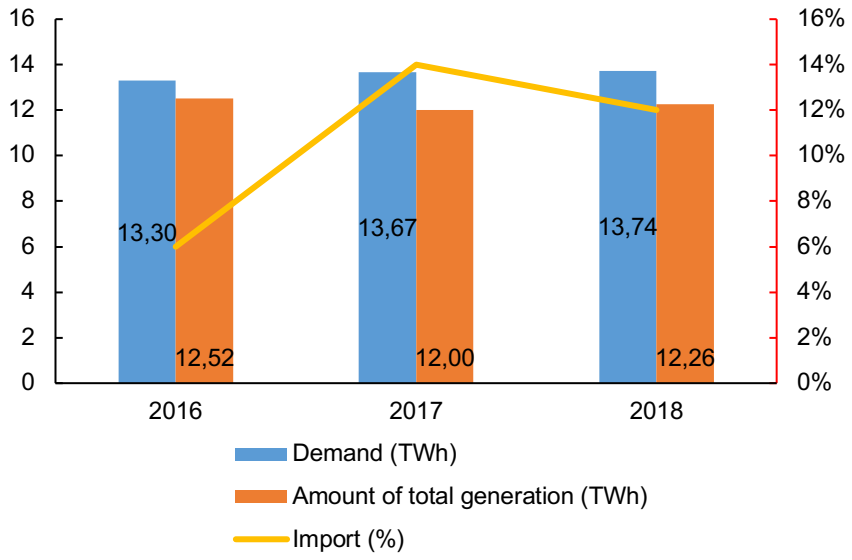
Type	Number of plants	Installed Capacity
Coal	2	1756
Gas	4	4609
Thermal	308	664
Hydro	31	7215
Wind	250	5150
PV	473	559

In addition, the share of the dominant producer is 51% of the total generated energy.

Slovenia

1. Volume of demand, generation, import and export

During the last five years, the demand growth was by 1.95%. The forecast for the next five years anticipates a maximum increase of demand of 2%.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

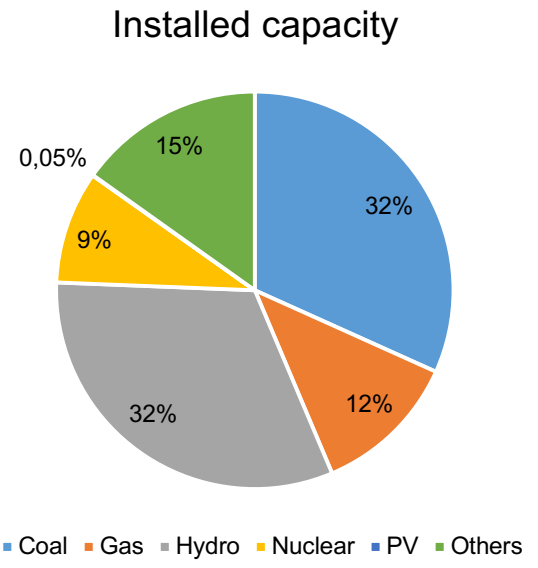
	Unit	2018
Peak load	MW	2 228
Average import load on daily basis	MWh	25 565
Maximum import load on a daily basis	MWh	6 936
Hourly average load	MW	1 518

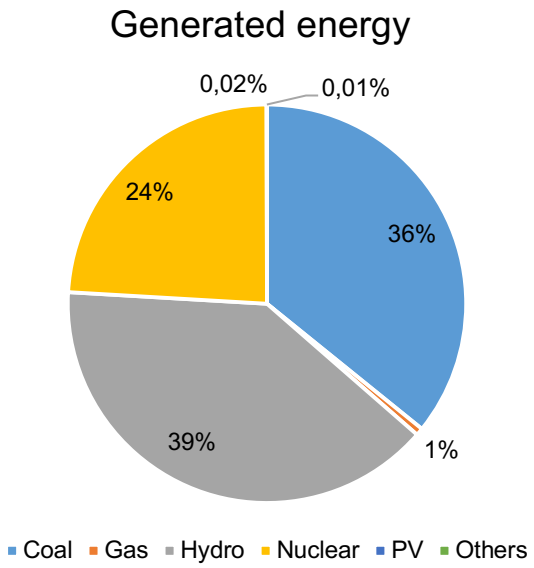
3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	GWh	222	13 281
Length of High Voltage	km	2 888	932
Length of Medium Voltage	km	-	18 009
Length of Low voltage	km	-	45 009
Consumption of High Voltage	GWh	222	1 670
Consumption of Medium Voltage	GWh	-	5 405
Consumption of Low voltage	GWh	-	6 205
Generation capacity	MW	3 220	575
Amount of losses	GWh	362	517

4. Generation plants

The electricity production mix is balanced in both installed capacity and generation. In terms of installed capacity, Hydro and coal power plants come first with 32% each, followed by a mixed generation on distribution system (15%), gas (12%) and nuclear (9%). For the generated energy, the shares are similar for the two power plants with 39% (hydro), 36% (coal) and 24% (nuclear).





In terms of number of plants, more than 77 powerplants are in service.

Type	Number of plants	Installed Capacity
Coal	4	1204
Gas	7	452
Hydro	54	1214

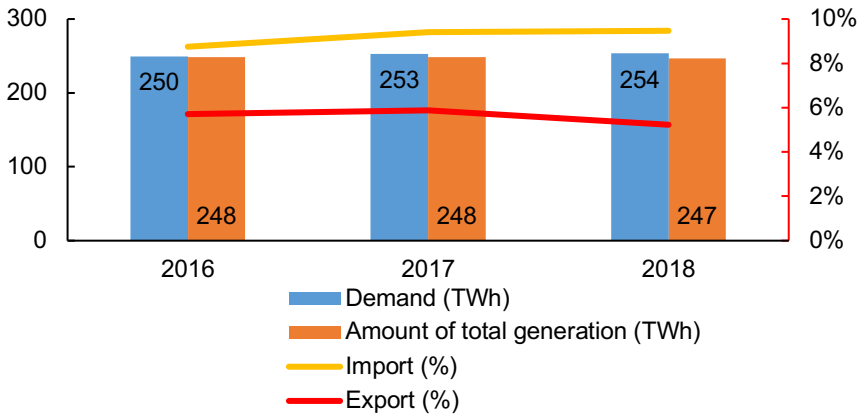
Nuclear	1	348
PV	11	1.76
Others	N/A	575

In addition, the share of the dominant producer is 57% of the total generated energy.

Spain

1. Volume of demand, generation, import and export

During the last five years, the demand growth by 0.84% and the generation decreased by 0.51%.

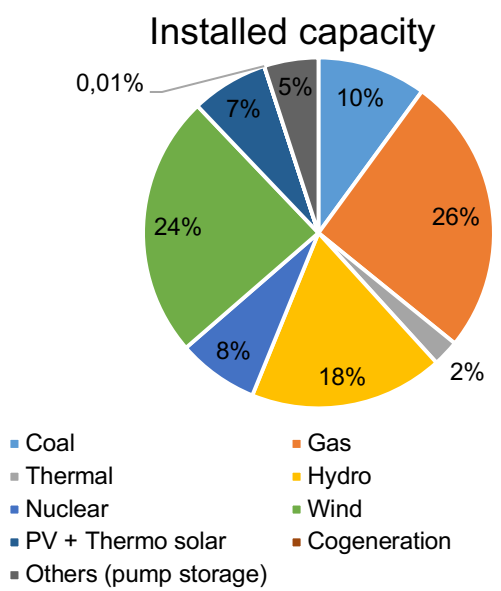


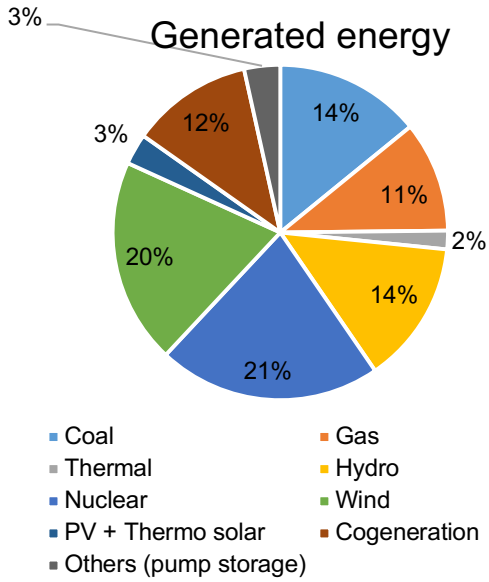
2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

	Unit	2018
Peak load	MW	**40 947**
Average import load on daily basis	MW	**2 348**
Maximum import load on a daily basis	MW	**1 071**
Hourly average load	MW	**29 288**

3. Generation plants

The electricity production mix in is balanced in both installed capacity and generation. In terms of installed capacity, gas power plants come first with 26%, followed by wind (24%), hydro (18%) and 10% (coal). For the generated energy, the shares are similar for the two power plants with 21% (nuclear), 20% (wind), and 14% (coal and hydro).





In terms of number of plants, 1176 power plants are in service.

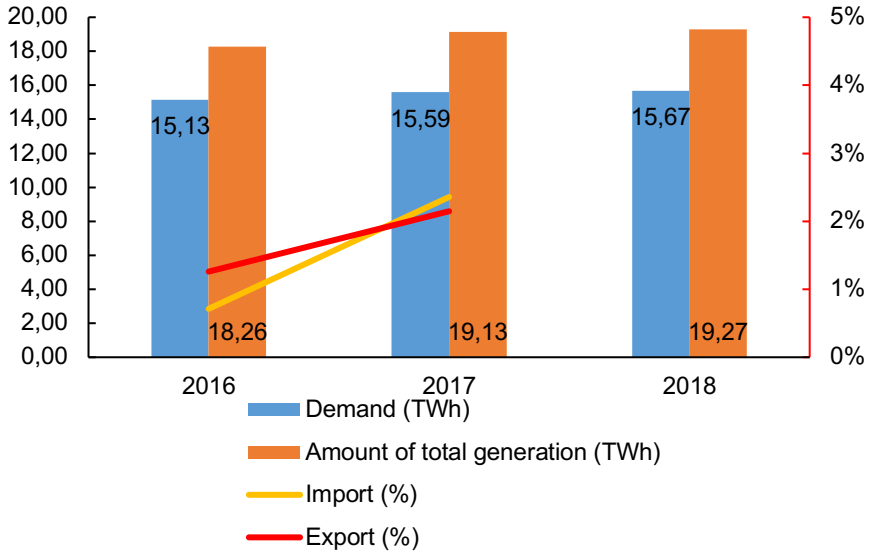
Type	Number of plants	Installed Capacity
Coal	26	9.562
Gas	50	24.562
Thermal	1	2.304
Hydro	214	17.047
Nuclear	7	7.117
Wind	229	23.091
PV + Thermo solar	190	6.770
Cogeneration	437	5.73
Others (pump storage)	22	4.764

In addition, the share of the dominant producer is 23% of the total generated energy.

Tunisia

1. Volume of demand, generation, import and export

During the last five years, the demand continues to grow to reach 15.67 TWh, in the same trend, the generation reached 19.27 TWh in the same year.



2. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

	Unit	2018
Peak load	MW	3 916
Average import load on daily basis	MWh	N/A
Maximum import load on a daily basis	MWh	N/A
Hourly average load	MWh	N/A

3. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	19.27	15.67
Length of High Voltage	km	6 906	175 389
Length of Medium Voltage	km		
Length of Low voltage	km		
Consumption of High Voltage	TWh		
Consumption of Medium Voltage	TWh		
Consumption of Low voltage	TWh	/	/
Generation capacity	TWh	/	/
Amount of losses	%	2.3	15

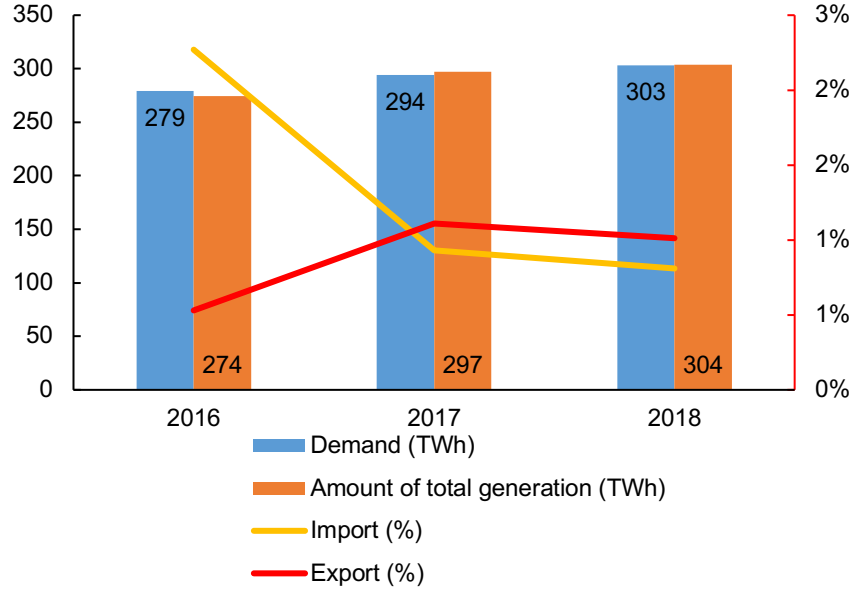
4. Generation plants

The electricity production mix is dominated by thermal power plant, with more that 97% of the total generated energy. In terms of installed capacity, 68% represented by combined cycle, 15% for each thermal and gas turbines, and the remaining 2% is Wind and solar energy.

Turkey

5. Volume of demand, generation, import and export

During the last five years, the demand growth by 9.1TWh and 10.3TWh for the generation. The forecast for the next five years anticipates an increase of demand to reach 381 TWh.



6. Base load, peak load, average and maximum import bases on a daily basis and average and maximum import load on a daily basis

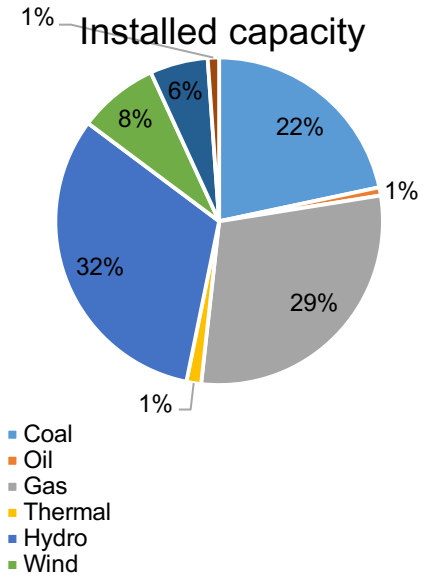
	Unit	2018
Peak load	MW	46 159.55
Average import load on daily basis	MWh	1 516
Maximum import load on a daily basis	MWh	11 210
Hourly average load	MWh	800 469

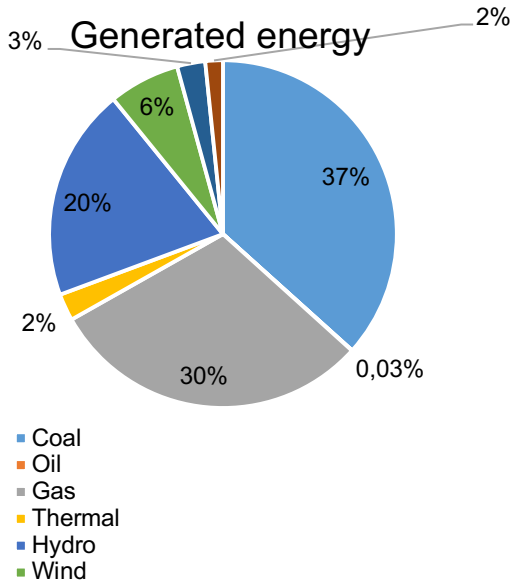
7. TSOs and DSOs

	Unit	TSOs	DSOs
Consumption	TWh	296.70	233.61
Length of High Voltage	km	66 285	1 164 170
Length of Medium Voltage	km		
Length of Low voltage	km		
Consumption of High Voltage	TWh		55.699
Consumption of Medium Voltage	TWh		177.91
Consumption of Low voltage	TWh	/	/
Generation capacity	TWh	/	/
Amount of losses	%	Around 2 %	Around 12 %

8. Generation plants

The electricity production mix is balanced in both installed capacity and generation. In terms of installed capacity, gas power plants come first with 29%, followed by solar PV (32%), coal (22%) and 8% (wind). For the generated energy, the shares are as follow, coal power plants with 37%, 30% (gas), 20% (solar pv) and 6% (wind).





In terms of number of plants, 7 426 power plants are in service.

Type	Number of plants	Installed Capacity
Coal	42	19 152.12
Oil	3	710.25
Gas	320	25 880.2
Thermal	48	1 282.52
Hydro	653	28 292.61
Wind	249	7 005.4
PV	5 868	5 062.9
Others (Biomass, naptha, asphaltites)	243	990.91

In addition, the share of the dominant producer is 15.49% of the total generated energy.