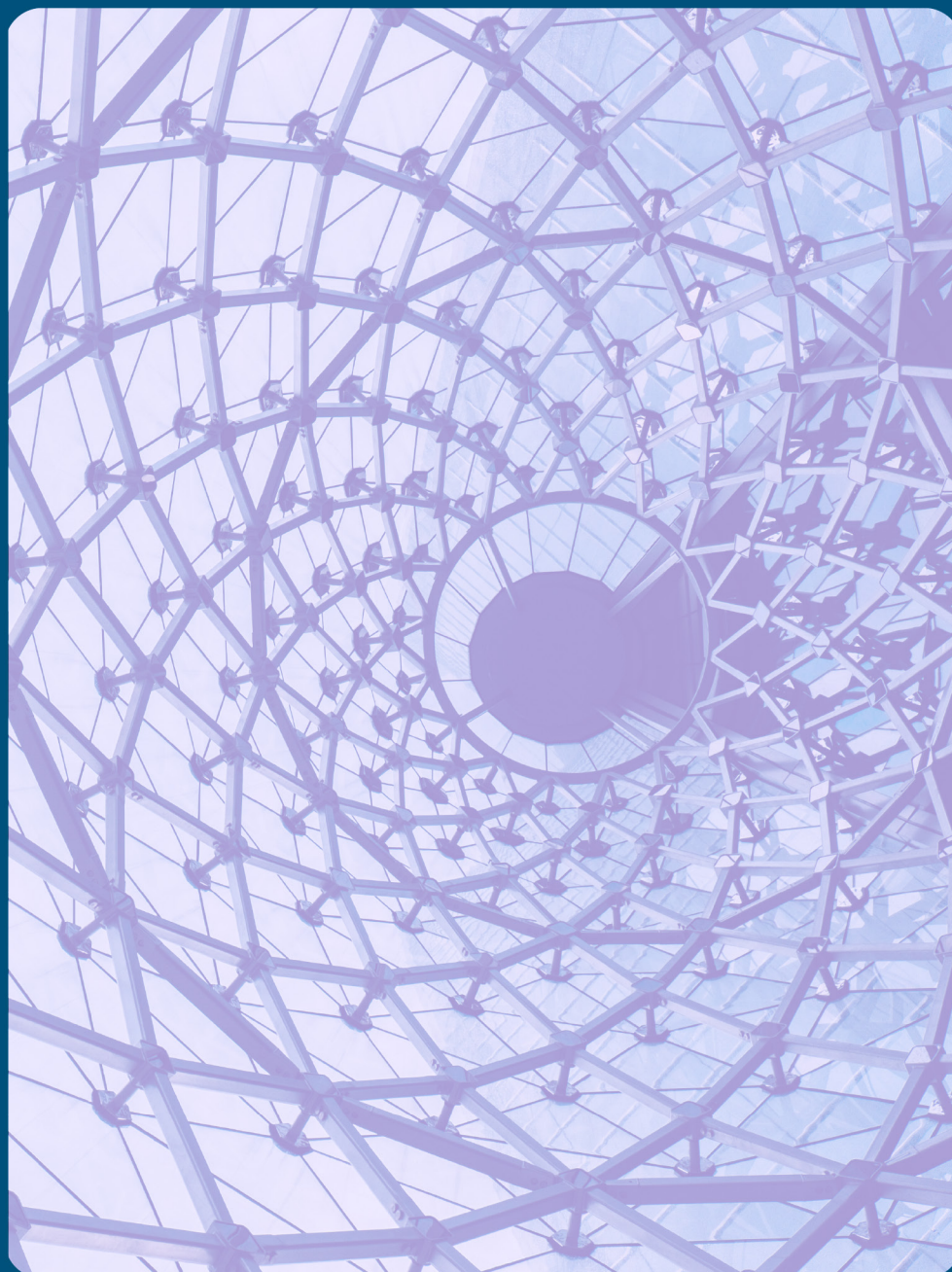




MEDREG

REGIONAL INTEGRATION: SUB-REGIONAL REGULATORY CONVERGENCE



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Electricity
Working group
(ELE WG)

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DISCLAIMER

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ABOUT MEDREG

MEDREG stands for the Association of Mediterranean Energy Regulators which gathers 27 energy regulators from 22 countries, spanning the European Union (EU), the Balkans and the MENA region.

Mediterranean regulators work together to promote greater harmonization 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 to foster consumers' rights, energy efficiency and infrastructure investment and development based on secure, safe, cost-effective and environmentally sustainable energy systems. MEDREG serves as a platform allowing information exchange and providing assistance to its members as well as offering capacity development activities through webinars, training sessions and workshops.

The MEDREG Secretariat is located in Milan, Italy.

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<http://www.medreg-regulators.org/>

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EXECUTIVE SUMMARY

Improving the level of interconnections between Mediterranean countries and enabling them to move toward greater integration is one of the objectives of MEDREG. This objective, shared at the level of the Union for the Mediterranean, has made the creation of a regional electricity market one of its energy priorities. In this context, the European model places interconnections at the service of a collective objective: the completion of the internal electricity market. It serves as a model for the Mediterranean region while the specific geographical, economic and development characteristics of the electricity systems of southern and eastern Mediterranean countries make them a special case. MEDREG has, therefore, chosen to focus on two sub-regions: the Maghreb and the Mashreq, which have to find their own logic due to their distance from the European system.

In the West, the Maghreb is connected to the Spanish network via the Strait of Gibraltar. The synchronization of its electricity system with the EU and the Morocco–Spain interconnection is an important factor in stabilizing supplies. The issue of integration in the Maghreb is mainly a question of developing the use of interconnections at the high voltage transmission network level with the possibility of shifting from use focused on security of supply to a more commercial use. In the East, the situation is different with no possibility to rely on the European system. Furthermore, the interconnection issues include the structural problem of supply in Lebanon and the challenge of connecting the Palestinian distribution networks to an integrated network on a territorial scale. In both cases, the integration of renewable energies is becoming increasingly important with questions about the role of cross-border integration for reinforcing the stability of the networks and benefitting of complementarities between countries.

Two strategic orientations have to be followed for the improvement of cross-border integration: in the short term, the focus will be on regulatory convergence and, in the long term, investment and interconnection development aspects will be included.

Short term strategy: Regulatory convergence

The options for short term improvements and regulatory convergence are given below:

- In most countries, a regulator has been created, which facilitates the promotion of cross-border coordination through the bilateral assessment of required regulatory adaptations.
- At each border, the situation is distinct. If the focus is on HV transmission lines with similar issues at interconnections in the Maghreb, in the eastern part of the region, there is a large range of situations from HV interconnections to distribution levels. Regulatory convergence should be addressed specifically according to technical and commercial requirements.
- Standards' and norms' convergence on the relevant aspects is the first requirement, including operational security aspects such as the N-1 rule.

In this respect, MEDREG allots complementary roles for regulators and transmission system operators. The first step should be to clarify technical standards for network management.

The regulators shoulder the responsibility for framing Transmission System Operators (TSOs)' activities along the following lines: identification of needs and gaps, drafting transparency requirements for the regulator or relevant administration and stakeholders, and creating a framework for the provision of associated services (ancillary services, operating reserves) with a view to cross-border participation.

Where interconnection aspects also involve distribution system operators, as in the East of the region, it is important to develop a high-quality dialog between all the involved parties, meaning that regulators of each country should be aware of the relations between operators to ensure that agreements are properly balanced and well designed.

Long term strategy: Interconnection development

Regional integration has been considered an objective within the two regions for a long time with projects creating regional interconnected

electricity systems among Arab countries such as the Maghreb electricity market project and, in the East of the Mediterranean region, the eight-country block project (EJLLPST).

Interconnection project development is a multiple-year process that starts with the identification of a need. This need can come from the inclusion of the new generation, internal problems of congestion, demand growth or significant changes in the network's topology. Going ahead with further cross-border integration requires a high level of coordination among different parties, namely TSOs, regulators and administrations. The development of cross-border interconnections and integrated regional market is a long process that requires stability in terms of its regulatory framework and a well-designed long-term plan; as the first step, regulators and governments need to assess the benefits from the development of cross-border interconnections and decide on the priorities of usage, either for the security of supply and better stability of national electricity system or for a better market integration that fosters the Renewable Energy Sources' (RES) integration and reduces the price of electricity by importing from the neighbors. Ideally, developing integration should be a shared process.

Thus, MEDREG's recommendation is to foster network planning at regional levels with joint assessments of power market dynamics and a thorough assessment of projects through cost and benefit analyses along the following lines:

- In-depth assessment of long-term energy dynamics at national and regional levels;
- Assess the physical role of new interconnection lines in terms of energy flows and systems' complementarity;
- From a national perspective, Cost-Benefit Analyses (CBAs) should be adapted to the business models, including the characteristics of the interconnected system (stability and resilience, market depth and liquidity when relevant);
- Sources of financing, including international support schemes, should be included in the analyses, particularly regarding the RES valuation;

- Assess interconnection against alternative options.

Recommendation in terms of governance

In terms of governance, MEDREG recommends the creation of regional bodies gathering regulators, transmission system operators and, when relevant, stakeholders. A three-level regional organization could thus be arranged on the model of EU's regional initiatives structured around regional coordination committees (RCC), regional implementation groups (RIG) and regional stakeholder groups (RSG). In this respect, the RIG would frame the cooperation between regulators and TSOs, while the RCC would gather regulators and the RSG would serve consulting market players.

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INTRODUCTION

The two previous MEDREG reports on electricity have focused on the development of infrastructures and assessment of the organization of electricity markets in the Mediterranean region. This work intends to serve as a basis for further reflection on the cross-border integration of electricity systems in the Mediterranean. In the North, the European Union proposed a successful example of cross-border integration which inspired the rest of the region. However, the specific geographical, economic and developmental characteristics of the electricity systems set it apart from the rest. MEDREG has, therefore, chosen to focus on two sub-regions: the Maghreb and the Mashreq, which are tasked with finding their own methods due to their differences from the European system.

In the west, the Maghreb is connected to the Spanish network via the Strait of Gibraltar. The synchronization of its electricity system with the Union for the Coordination of the Transmission of Electricity (UCTE) and the Morocco–Spain interconnection is an important factor in stabilizing supplies. However, recent evolutions have shown an inversion of flows, Morocco being a net exporter of electricity to the North since 2019. This subject remains, however, predominantly limited to one country; there is, therefore, a strong stake in the improvement of exchanges between the countries on the southern shore in order to create a common dynamic bringing security and efficiency. It should be noted that with the interconnection project between Tunisia and Italy, Elmed would reinforce integration with the European market and enable Tunisia to play a new role within the Maghreb system. In short, the problem of integration in the Maghreb is fairly classic since it is a question of developing the use of interconnections at the high voltage transport network level with the possibility of moving from use focused on security of supply to a more commercial use. The problems associated with the integration of renewable energies are becoming increasingly important but are still, in the short term, relatively marginal in terms of cross-border integration.

In the East, the situation is very different for several reasons: geographically, except Egypt – which is a large system – the other countries are

smaller and seldom enjoy sufficient stability to be propelled toward the rapid development of their electrical systems, which needs first a significant national electricity infrastructure development. The region's isolation eliminates the possibility of relying on the European Union but enables interconnections with the Arab system. Interconnection issues include a structural problem of supply in Lebanon and the challenge of connecting the Palestinian distribution networks to an integrated network on a territorial scale. The integration of renewable energies is an important subject here, especially for Jordan, and the aim is to reinforce the stability of the networks and ensure good management of intermittence. The current state of the infrastructures does not allow the benefit of complementarities between countries, especially between Jordan and Lebanon. The Mashreq is, therefore, subject to greater heterogeneity in the organization of the systems and to issues that primarily concern the security of supply.

In this report, the issues of regional integration of electricity systems are approached from two angles: the short-term improvement in the fundamentals of the electricity systems in place and, in the longer term, the prospects for strengthening relations between countries through the development of infrastructures. This report proposes, in the annex, two case studies on the development of the network in Palestine aimed at setting up an integrated structure at the territorial level and the role of the regulator in approving the investment decisions of the Egyptian TSO.

1

**CROSS-BORDER INTEGRATION,
RATIONALE AND STATE OF PLAY**

1

CROSS-BORDER INTEGRATION, RATIONALE AND STATE OF PLAY

1.1 Interconnection development and market integration

Advancing the level of interconnections between Mediterranean countries and enabling them to move toward greater integration is one MEDREG objectives. This objective, shared at the level of the Union for the Mediterranean, has made the creation of a regional electricity market one of its energy priorities. MED-TSO works toward this objective as well by analyzing the gaps that exist between national frameworks on a number of technical parameters.

The European model, based on a set of precise rules laid down in legislative texts adopted by all member states, is particularly well developed and places interconnections at the service of a collective objective: the completion of the internal electricity market. The European doctrine has been built up over a long period of time and is part of the gradual development of a large electricity system based on local or national logic. Recent history shows that interconnections have evolved from the initial approach consisting of linking national networks through the convergence of technical standards and the synchronization of production means. The objective, then, was to improve the resilience of the systems through mutual back-up procedures and thus enhance the supply security. In particular, the aim was to better manage frequency by sharing primary reserves.

Commercial logics have emerged subsequently through the development of transactions between integrated, often public, operators. The competitive issue only came into play in the third phase. The free market then constitutes a sophisticated organization which consists of several players. In this sense, it requires a sufficiently robust framework. Another notable point is that electricity

exchanges imply the existence of surpluses, either structural or momentary. The robustness of the national systems is, therefore, a favorable factor for the development of cross-border exchanges since they are based on the capacity of certain systems to support their neighbors.

Thus, in the MEDREG analyses, we constructed an approach underlining the “maturity” of electrical systems by pointing out three development stages:

- Electrification and development of supply for all potential users;
- Strengthening the supply security: achieving a high level of reliability by reducing interruptions and improving its quality;
- Development of commercial transactions based on robust systems.

In the Mediterranean, outside the European Union, energy systems’ development level lies between stages 1 and 2, with an evolution toward stage 3 in some cases.

From the lessons learned, it is necessary to treat electrical systems as a whole, combining production, network and consumption. It is not enough to have physical links between electrical systems that enable them to be truly interconnected; there must also be sufficient visibility in the availability of production means, specifically to provide guarantees regarding the possibility of mobilizing them if necessary. Interconnection leads to the development of interdependencies, and the harmonization of rules in Europe aims, in particular, to provide sufficient legal and technical security.

Outside the European Union, we have identified two approaches in this report: short and long

term. In the short term, the aim is to improve matters through greater convergence of the rules applied at the national level. In this respect, beyond the bilateral agreements between historical operators, for example, in the Maghreb, it is a question of going beyond this singular relationship to objectify the parameters of convergence and allow, if necessary, the broad participation of third-party actors.

For the years to come, MEDREG has developed a strategy in four phases, summarized in the following figure. First, it is a question of creating conditions for exchange through the creation of robust infrastructures and the diversification of the means of production. The progression of renewable energies, in this respect, could lead to the emergence of new opportunities but in a new framework where it would be a question of exchanging temporary surpluses and playing on the complementarities of the load curves.

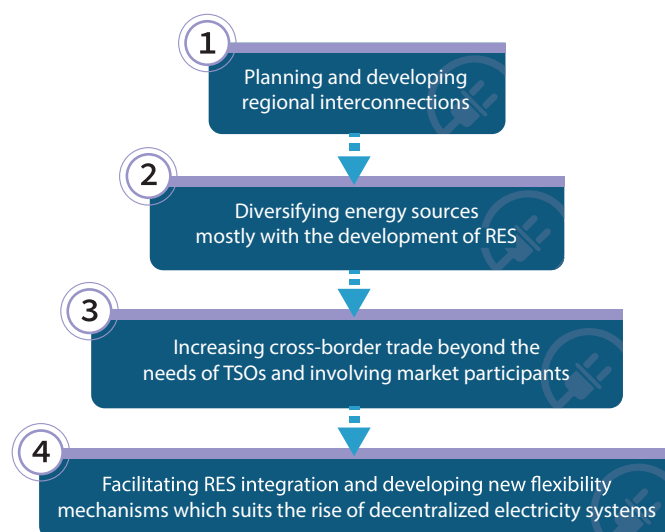
1.2 Electricity market trends in the Mediterranean

The development of electricity systems is part of the economic dynamics of countries and is strongly influenced by the level of development, geographical characteristics and the availability

of primary energy sources. Beyond industrial issues, the organization 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 centralized production means and vertically integrated organizations. 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 organized competitively or with a plurality of suppliers.

However, this history is not linear and organizations 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 neighboring markets or the purchasing power of consumers. Economic stability, the establishment of institutions capable of supervising the functioning of the market and the electricity mix to be addressed in the light of energy policy objectives, industrial history and the availability of primary energy sources are other important parameters. The competitive organization

Figure 1 . Steps toward market integration



of electricity systems is indeed complex and regulation must take all these parameters into account to propose measures adaptable to market fundamentals.

In such a context, the Mediterranean region is characterized by wide demographic disparities, with a few large countries and a group of countries with smaller populations. Four of the countries account for about 60% of the total population: Egypt (98.42 million), Turkey (82.32 million), France (66.99 million) and Italy (60.43 million). The overall population grew from 281 million in 1970 to 419 million in 2000 and 517 million in 2018. It is even predicted to reach 572 million by 2030. While the population increase in the North is almost stagnant, it is still strong in the Southern shore countries, which translates into the overall increased 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 a very rich region with the GNI per capita at above 20,000 USD in 2018. A second group of countries, including some Balkan states and Turkey, are at around 10,000 dollars per year. Others are below 5000 dollars per capita,

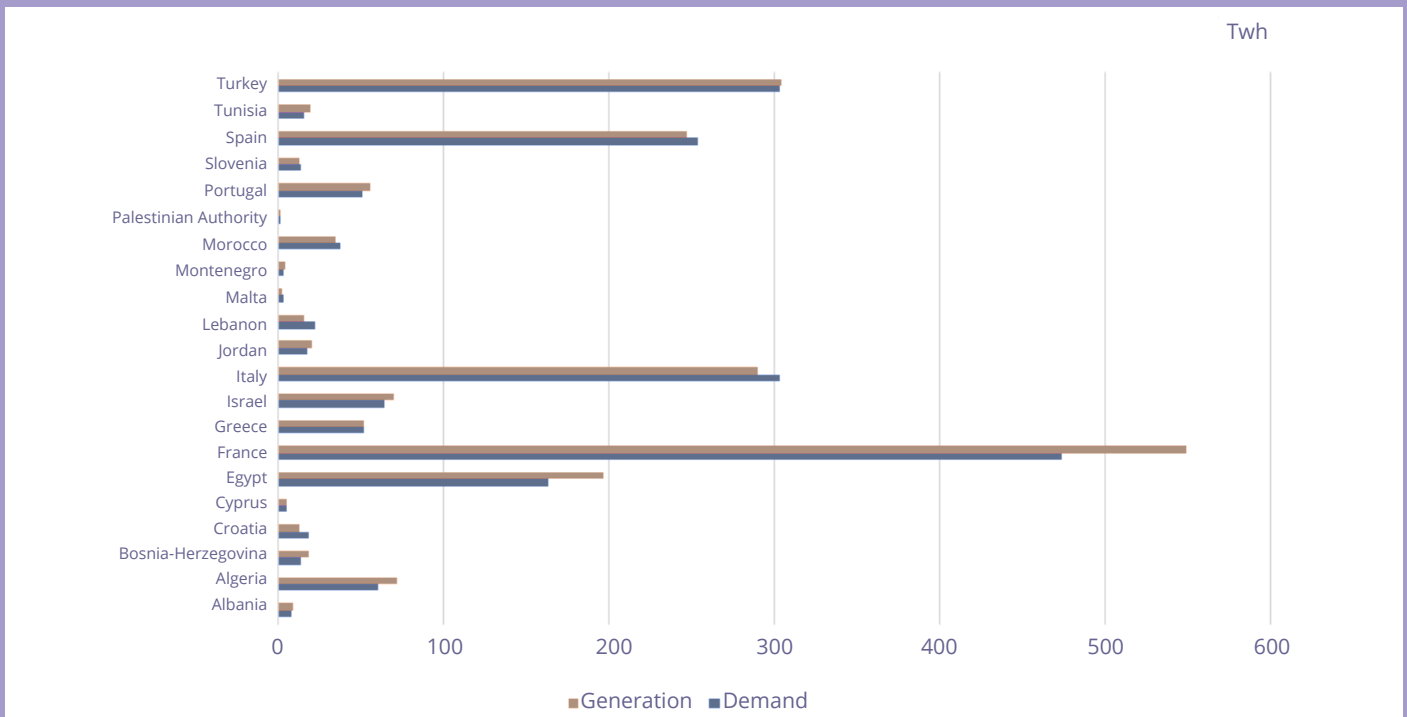
especially in North Africa, for instance, the Maghreb and Egypt.

A considerable contrast can also be found in regard to power infrastructures. In the Northern countries, especially the EU, existing supply infrastructures were completed decades ago. Therefore, most of them can be qualified as “mature” and investments termed as “marginal” when compared to the asset basis of the operators. Besides, financing the modernization and maintenance of the networks is relatively easy, resulting from a secure investment environment. It is particularly visible in the context of more politically integrated markets, such as the recent Energy Union that was approved in 2019¹. The power demand in the EU is stagnant owing to its relatively slow economic growth, steady or declining populations and ambitious energy efficiency policies.

In Southern and Eastern Mediterranean Countries (SEMCs), existing infrastructures are not mature and the lack of access to energy supplies and transformation systems is a constraint to human and economic development. In the context of

1. https://ec.europa.eu/commission/priorities/energy-union-and-climate_en

Figure 2 . Electricity generation vs. demand in MEDREG countries



such rapid demographic and economic growth, system planning is becoming even more challenging due to the fast-growing electricity demands. Consumption has increased ten-fold since 1980. This surge can be attributed to several factors including urbanization, industrialization and electricity prices set artificially low through government subsidies. Although growth rates have slowed in the last few years owing to weaker economic activity and increases in electricity prices as subsidies were reduced, most countries are still struggling to meet the increasing electricity demand, creating the need for significant investment in the electricity infrastructures.

In this framework, this chapter provides an overview of the power market trends in the Mediterranean region with a specific focus on southern and eastern Mediterranean countries; a detailed analysis can be found on MEDREG’s report “Mediterranean Electricity Market Observatory (MEMO) 2019²”.

1.3 Power generation vs. consumption

Several mechanisms are available to ensure the national security of supply, with the most evident one being the increase of local power generation

² [Link to the report](#)

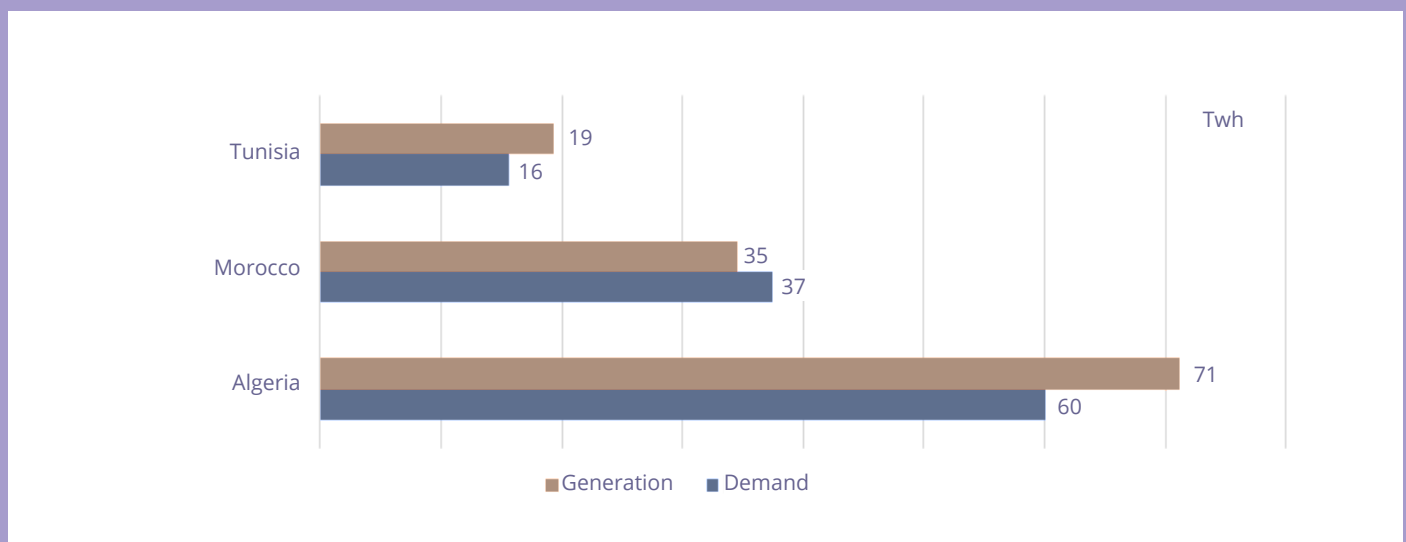
to meet the level of predicted consumption for both short- and long-term perspectives.

From 2016 to 2018, the total generation and consumption increased by 71 TWh and 51 TWh respectively to reach approximately 1891 TWh in terms of total generation and 1802 TWh in consumption.

In 2018, most of the Mediterranean countries had arrived at this balance (Figure 2) but, in some countries, the consumption was above the power generation, which does not necessarily lead to a lack of power generation but to the use of different energy supply sources; for instance, importing from neighboring countries to maintain the balance between the electricity generation and consumption.

As far as electricity generation is concerned, marked differences exist between the Southern shore countries depending on the local availability of energy resources. In the Maghreb, gas is the main source of electricity generation due to Algeria’s gas resources and Tunisia being a gas transit country. The two countries have generated more electricity than their internal consumption (Figure 3); therefore, they may have the means to export electricity. On the other hand, Morocco bases its power generation on coal and renewable sources as wind and solar power production reached 13.4% of the overall electricity generation in 2018.

Figure 3. Electricity generation VS demand in North Africa sub-region



In Morocco, power generation used not to fulfill electricity demand, which was covered, in part, by imports from neighboring countries, particularly from Spain. It must be noted, however, that Morocco has become a net exporter on a yearly basis since 2019.

The same differentiated situation can be also observed in the eastern Mediterranean sub-region as shown in the next figure.

Egypt and Israel generate more electricity than what they consume on account of their gas resources, providing them the option of increasing their export share. The same applies to Jordan, where wind and solar power generation represented 7.8% of the total in 2018. On the opposite, Lebanon is not self-sufficient, and the most important generation source is fuel oil.

On the other hand, the electricity mix in the EU and some countries in the Balkans have low-carbon generations or even a very high proportion of renewables. For instance, electricity coming from hydroelectric plants is extremely efficient in the Balkans (proving to be the main energy resource in Albania, Slovenia, Croatia and Montenegro), while it is the second source of energy in France, Italy and Portugal.

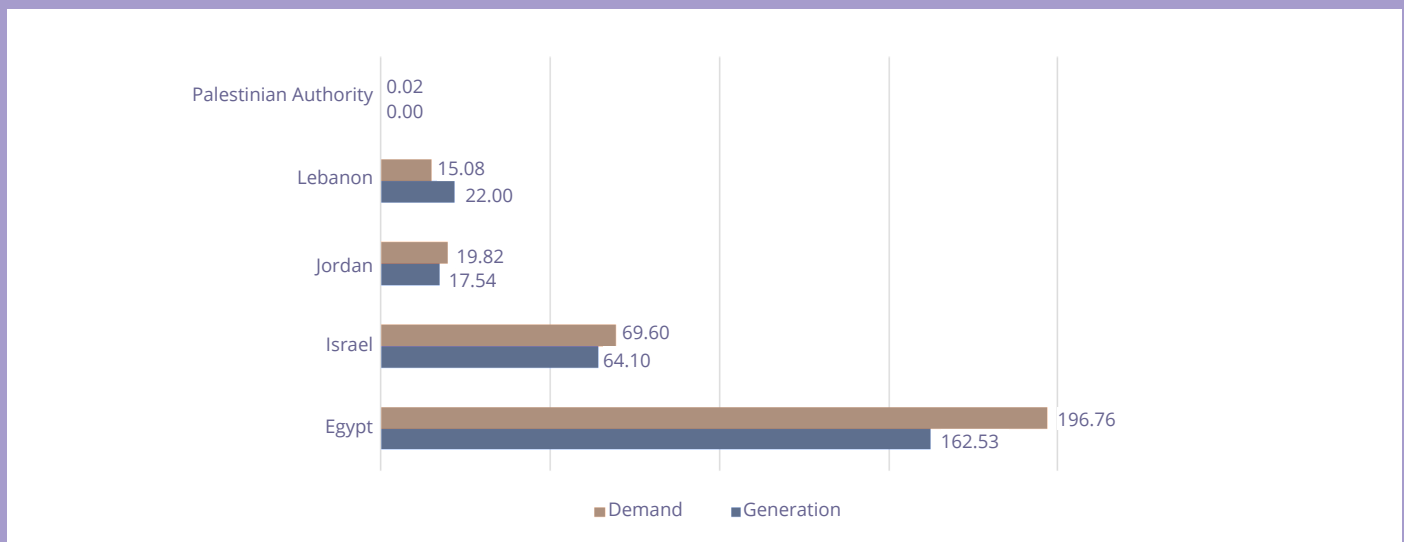
1.4 Cross-border interconnections

In the Mediterranean region, the development of

power interconnections is extremely differentiated (see the figure below). In the EU, a complex power market has been set up as the result of a long integration process where European countries shared common standards in terms of the reliability of electricity systems. The market model put in place enables achieving high levels of exchange from the 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 assigns transmission capacity at interconnection points to cross-border transactions concluded on spot markets. Interconnections make it possible to take advantage of the complementarities between national systems, with surpluses from one country offsetting deficits from another. However, this model cannot be generalized and replicated as it requires significant infrastructure and sophisticated mechanisms that are unique to the EU system.

Outside the EU, the Balkans, Turkey and Maghreb belong to the European synchronous zone. On the other hand, in both North Africa and the East Mediterranean sub-regions, there is no organization comparable to the European model, cross-border interconnections are not well developed and the existing ones do not operate at full potential. Therefore, cross-border trade is immensely limited and the interconnection lines are mainly used for security purposes.

Figure 4 . Electricity generation VS demand in the Eastern Mediterranean sub-region



This use for the cross-border interconnections is mainly due to the orientation of the electricity market, most countries focus on maintaining the balance between electricity generation and demand by domestic production. Additionally, the absence or the dismal quality of regional markets in these sub-regions can be attributed to the lack of harmonization in terms of legislation and the regulation framework.

Factors that increase power exchanges include an increase in power generation and interconnection capacities in addition to better regulatory convergence, which facilitates the exploitation of complementarities between national systems. However, the European experience reveals that the road to cross-border integration could be a long one.

1.4.1 Zoom in the MEDREG region by country

The Mediterranean region has regrouped diverse electricity systems; therefore, the use and the development of cross-border interconnections is

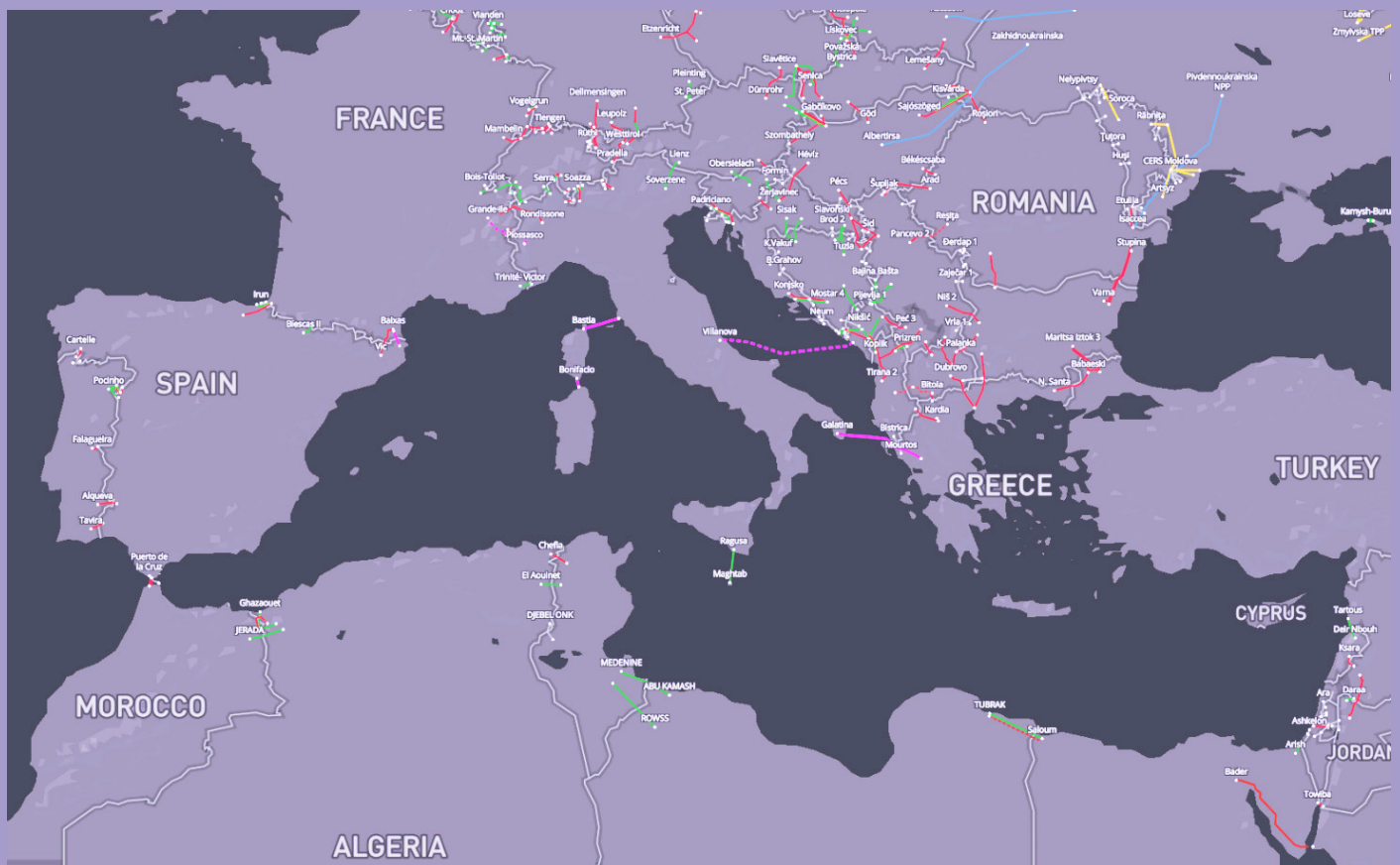
divided into three subregions;

- EU countries: well-developed cross-border interconnections with a mature electricity market;
- Balkans & Turkey: the infrastructure is almost well developed but with reduced use and
- East Mediterranean and North Africa: both infrastructure and regional markets need to be developed.

For the purpose of understanding the current situation in the MEDREG countries better, a questionnaire was circulated among the members to assess the existing infrastructure, the role of the regulators and short and long-term perspectives in terms of the expectations of the members from the cross border interconnection. The following paragraph will describe the first two points³.

³ Nine countries replied to the questionnaire.

Figure 5. Cross-border electricity transmission grid¹



¹ The grid map can be found on ENTSO-E website: <https://www.entsoe.eu/data/map/>

In **Turkey**, there are 11 cross-border interconnection lines with a capacity of around 9600 MW; however, four lines are not in operation (2100 MW) and only three lines operate in synchronous modes with Bulgaria and Greece (4000 MW); the remaining interconnections are either in isolated island mode or for emergencies.

Greece has seven high voltage lines (Bulgaria, Albania, North Macedonia, Italy and Turkey) with a total theoretical capacity of 7400 MW operating only at a total capacity of 2500 MW⁴.

Cyprus doesn't have any interconnections with its neighboring countries.

The interconnection lines in **Slovenia** are more developed with Croatia (8 HV lines) with an operating capacity of 1500 MW from 4700 MW theoretical capacity. Moreover, Slovenia has five other interconnections with Austria and Italy with a theoretical capacity of 4300 MW but operating at an average of 2400 MW.

In the eastern Mediterranean region, **Jordan** has three interconnection lines with Palestine, Egypt and Syria, with the last-mentioned ceasing operations in 2011. The other two run at 100% of their theoretical capacity, which is around 430 MW.

Egypt, on the other hand, has only two interconnection lines with Libya and Jordan and three more under the construction/negotiation phase with Sudan, the Kingdom of Saudi Arabia, Cyprus and a reinforcement of the interconnection with Jordan.

In **Palestine**, the state's communities are already connected with the Israel Electricity Company (IEC) as customers in most areas buy medium and low voltage with a total import of 1100 MVA. Furthermore, as mentioned in the Jordanian case, Palestine is connected to Jordan with a capacity of 80 MW and an existing line with Egypt which is not in operation.

In **Lebanon**, Lebanese electrical grid is connected only to Syria through three interconnections. The first one is a single circuit 400 kV level line via Ksara

(Lebanon)–Dimas (Syria). The line is in double circuit in the Lebanese territories and single circuit in the Syrian territories. Currently, this line is used to import power only from Syria without synchronization. The second is a double circuit 220 kV tie line via Deir Nbouh (Lebanon)–Samaria (Syria) which is not frequently used to import power due to technical restrictions from the Syrian side (after the Syrian crises). Finally, there are two 66 kV overhead tie lines via Ksara–Dimas which are used from time to time.

In the North African region, **Algeria** has nine interconnections with its neighbors, five with Tunisia and four with Morocco; for security purposes, the capacities of these lines are limited to 600 MW exportation and 300 MW importation with Morocco and 275 MW with Tunisia. The electricity grid in the border regions is not developed enough to operate at more capacity.

Lastly, in Europe, **Italy** has 26 interconnection lines with France, Switzerland, Austria, Slovenia, Greece, Malta and Montenegro. The operation capacity of these lines depends on the seasons, with the average winter capacity being around 9700 MW and, in the summer, the average oscillation being around 8200 MW.

France has many interconnections with all its neighboring countries. The current exchange capacity of the electrical interconnections between France and its neighbors is approximately 15 GW, with an estimated export capacity of 17 GW and an estimated import capacity of 11 GW. This difference can be explained by the internal network constraints in certain neighboring countries. The assessment of capacities on a commercial basis is, however, complex on some borders due to the implementation of flow-based market coupling (FBMC) in the Central West European market zone (borders with Germany and Belgium).

The following table provides the details by country.

In terms of the types of agreements, depending on the sub-region and maturity of the regional market, the agreements employed change. For instance, in the EU countries, contracts are established between traders and are part of a liberalized market. On the other hand, where the market is not wholly liberalized, long-term contracts are used, such as in Algeria, Egypt, Palestine and Jordan.

⁴ **Theoretical capacity** represents the physical capacity of the line regardless of the operation circumstances (Agreements, limitations etc). **Operation capacity** represents the average capacity taking in account the system limitations, agreements etc.

Table 1. Cross-border interconnection in the MEDREG region

	Qte	Country	Voltage (kV)	Operation capacity (MW) or operation Mode	Theoretical capacity (MW)
Turkey	11	Bulgaria	400	Synchronous	995
		Bulgaria	400	Synchronous	1510
		Greece	400	Synchronous	1510
		Georgia	220	Emergency	287
		Georgia	400	700 HVDC Back-to-Back	1510
		Armenia	220	Not in operation	574
		Azerbaijan	154	Not in operation	132
		Iran	154	Isolated island mode	204
		Iran	400	Isolated island mode	1510
		Iraq	400	Not in operation	408
		Syria	400	Not in operation	1005
Greece	7	Bulgaria	400	500	1260
		2xNorth Macedonia	400	1100	2520
		Albania	400	250	1260
		Albania	150	0	125
		Italy	400	500	500
		Turkey	400	218	1800
Jordan	3	Egypt	400	550	550
		Syria	400	Not in operation	300-800
		Palestine	33	80	80
Palestine	3	Egypt	22		
		Jordan	33		
		Israel ¹	33	1100 MVA	
			22		
		0,4			
Cyprus	0				
Slovenia	13	Austria	2x400	950	2860
			220		
		Italy	400	680	1488
			220	800	
		Croatia	3x400	1500	4716
			2x220		
3x110					

¹ Palestinian communities are already connected with the Israeli Electricity Company (IEC) as customers in most areas buy medium and low voltage.

	Qte	Country	Voltage (kV)	Operation capacity (MW) or operation Mode	Theoretical capacity (MW)
Algeria ²	9	Morocco	400	600	N/A
			220		
		Tunisia	400	275	N/A
			220		
			150		
Egypt	2	Libya	220		
		Jordan	400	450	N/A
France		Belgium	400	N/A (flow based)	
		Germany	400	N/A (flow based)	
		Great Britain	400 (DC)	2000	
		Italy	HV	2700	
		Spain	400	2800	
		Switzerland	400	2680 (exp)/1160 (imp)	
Italy ³	26	France	3150	2700	
		Switzerland	HV	4240	3420
		Austria	HV	315	270
		Slovenia	HV	730	515
		Greece	HV	500	500
		Malta	HV	200	200
		Montenegro	HV	600	600
Lebanon	1	Syria	400		
	2		220		
	3		66		

² The capacities given in the table correspond to the limitations of the transit threshold, set for security purposes, on cross-border interconnections.

³ The capacities shown in the table represents the winter period (instead of operation capacity) and summer period (instead of theoretical capacity).

In Turkey, the exchanges are ruled by bilateral contracts and an intergovernmental agreement with Georgia on energy trade. In the case of Slovenia, all the lines are included in the cross-border capacity allocation in the long term (LT), day-ahead (DA) and intraday (ID) markets.

The details on the import/export and the types of agreements are given in the table below.

1.4.2 Role of the TSO in the cross-border interconnections

From all the active operators in the cross-border interconnections' development and operation, TSOs play a crucial role in the process of elaborating the needs for new cross borders and operating the existing ones at their maximum potential.

Therefore, the cooperation between the National Regulatory Authorities (NRAs) and TSOs is an important aspect. In that regard, MEDREG has been coordinating with MED-TSO to improve and enhance the relations between the TSOs and NRAs. Furthermore, several projects have been elaborated to analyze the cross-border interconnections issue from a holistic perspective (technical and regulatory aspects).

The main challenge in cross-border interconnections is to understand how the Cross-Border Cost Allocation (CBCA) mechanism should be assessed in the Mediterranean region. During the previous years, MEDREG and MED-TSO have, at least, enabled the members of the association to tackle the issue of the CBCA and ensured a transfer of knowledge from the countries of the northern shore of the Mediterranean, where the reflection on this issue

Table 2 . Export/import and types of agreements in the MEDREG region

	To	Export capacity (MW)	Import capacity (MW)	Type of agreements
Turkey	Bulgaria	100–250	100–434	<ul style="list-style-type: none"> • Bilateral contracts with neighboring countries • Intergovernmental agreement between Turkey and Georgia on energy trade
	Greece	50–120	0–166	
	Georgia	700	150 - 700	
Greece	Bulgaria	400	600	<ul style="list-style-type: none"> • Capacity allocation for commercial purposes at the borders with other member states through JAO and with three countries of southeast Europe through SEECAO¹ • Emergency imports by Greek TSO in extraordinary situations are also possible
	North Macedonia	1100	850	
	Albania	250	250	
	Italy	500	500	
	Turkey	218	166	
Jordan	Egypt	0	213 GWh/year	<ul style="list-style-type: none"> • Long-term contracts
	Syria	0	0	
	Palestine	90GWh/ year	0	
Palestine	Egypt	0		<ul style="list-style-type: none"> • Jordan side, long-term contract between the Jordanian transmission company and the Palestinian electricity distributor • IEC, connections point by emergency contract • IEC side with Palestinian transmission company, short-term contract
	Jordan	0	90GWh/ year	
	Israel	0	1100 MVA	

¹ JAO = Joint operating agreements | SEECAO = Coordinated Auction Office in South East Europe

	To	Export capacity (MW)	Import capacity (MW)	Type of agreements
Cyprus				
Slovenia	Austria	950	950	<ul style="list-style-type: none"> All the lines on all borders are included in the cross border allocation process on LT, DA and ID markets For LT (yearly and monthly) cross-border allocation, the harmonized (explicit) auction rules are used In the DA and ID timeframe, there are implicit auctions provided by NEMO (Nominated Electricity Market Operator) – company BSP Southpool
	Italy	800	680	
Croatia	1500	1500		
Algeria	Morocco	600	300	<ul style="list-style-type: none"> Bilateral contracts to ensure the security of supply with both neighboring countries
	Tunisia	275	275	
Egypt	Libya	327 GWh	0.3 GWh	<ul style="list-style-type: none"> Long-term power purchase agreements (PPA)
	Jordan	314 GWh	69.7 GWh	
France	Belgium	N/A (flow based)		<ul style="list-style-type: none"> EU rules: market coupling (flow-based) for short-term time frames and FCA guidelines for the long term. Trading operated either on power exchanges or on an ITC basis
	Germany	N/A (flow based)		
	Great Britain	2000		<ul style="list-style-type: none"> Market coupling (day-ahead) and FCA regulation for long-term time frames (physical transmission rights)
	Italy	2400	1000	
	Spain	2800	2800	
	Switzerland	2680	1160	<ul style="list-style-type: none"> Long-term contracts (historical) and short-term transactions (ITC) via explicit capacity subscriptions
Italy	France	995	870	<ul style="list-style-type: none"> As for energy flows, contracts are established between traders and part of the liberalized energy market As a rule, import-export operations on the so-called “North Border”² occur based on the day-ahead market coupling mechanisms; the interconnection capacity may also be (partly) reserved to non-regulated “merchant” exchange, for which parties can arrange long-term contracts
	Switzerland	1810	1440	
	Austria	100	80	
	Slovenia	660	620	
	Greece	500	500	
	Malta	200	200	
	Montenegro	600	600	<ul style="list-style-type: none"> Emergency contracts exist in particular circumstances, namely for security-of-supply arrangements with Malta and between Italy and the Vatican State and the Republic of San Marino

² France, Switzerland, Austria and Slovenia

is already underway and has made great progress, toward the countries of the southern shore for which this issue is relatively new; the next figure summarizes the MED-TSO approach to the CBCA.

Even though the involvement and responsibility of the TSOs differ from one country to another, among the MEDREG countries, the TSO in Turkey is responsible for the interconnection usage agreements between other neighboring TSOs and making investments for the new cross-border interconnections after determining the necessary feasibility.

In Greece, the TSO (IPTO) participates in the South East Europe Coordinated Auction Office (SEECAO) where the explicit allocation of cross-border transmission capacity takes place between Control Areas. Additionally, IPTO also participates in the Joint Allocation Office (JAO) which performs long- and short-term auctions of transmission capacity for the Greece-Bulgaria and Greece-Italy lines.

The role of the Jordanian TSO is defined by law, and it stipulates that the TSO is responsible for the maintenance and operation of the transmission systems network and signing the contract and agreements with other transmission system operators in the neighboring countries where the responsibility of each part (each TSO) is determined in the agreements.

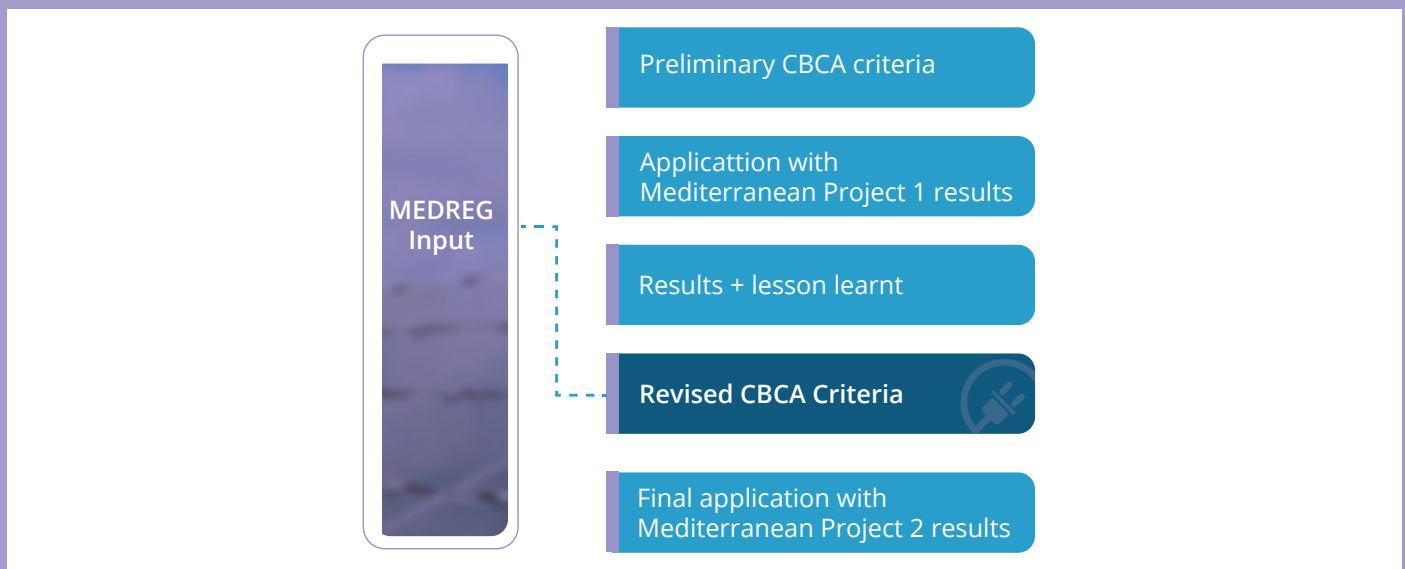
ELES is a certified TSO by the Slovenian regulator (AGEN-RS) according to Directive (EU) 2019/944 and is the owner of all interconnectors in the country. They operate in accordance with the cross-border rules valid for two EU Capacity Calculation Regions: CORE (Central EU region) and IN (Italy North). Allocation and operational rules are in line with all valid network codes adopted by the European Parliament or European Commission.

The Algerian System Operator holds the responsibility to monitor and operate the interconnections, communicate and exchange information with neighboring TSOs regarding the planning and monitoring of energy exchanges and compensation for involuntary exchanges. Moreover, the System Operator establishes operation instructions and defense plans in case of emergency situations.

In Egypt, the TSO implements interconnectors when approved by the ministry and coordinates its commercial operations and electricity transactions.

In the case of Italy, as far as designing and building an interconnection infrastructure is concerned, the national TSO (TERNA, a floated public company of which the national institutions own a blocking share of around 30%) is responsible by law for projecting and building interconnections, based on a long-term comprehensive infrastructure plan that has to be

Figure 6 . MED-TSO approach to CBCA¹



¹ Common Med-TSO and MEDREG webinar on Cross-Border Cost Allocation, October 7, 2020.

approved by the regulator and is consistent with the long-term EU planning put forward by the European Network of Transmission System Operators (electricity network) ENTSO-E. TERNA is expected to elaborate and present (for approval) proposals on the balance and congestion management methodologies in strict coordination with other involved TSOs.

1.5 Internal Market structure

Internal market structure is another relevant point to be taken into consideration when analyzing the potentialities of market integration. The organization 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.

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, some countries have maintained a vertically integrated organization, where free-market principles are applied only at the margin. Furthermore, 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, in most cases, a way to attract investors by taking on economic risks.

Internal market structure in the North African countries (Figure 7) is completely different: in Algeria, the electricity market corresponds to a limited single buyer model with the possibility of establishing bilateral contracts between producers and large consumers; however, the regulatory framework plans a total liberalization of the market by introducing competition in the wholesale and retail trades.

In Morocco, the market structure maintains a public monopoly at both wholesale and retail levels.

In Tunisia, the structure of the electricity market is based on the combination of monopoly and the limited single buyer model. Tunisia's 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 Independent Power Producers (IPPs) in 1996, which involves a limited single buyer model for IPPs and self-producers through PPAs under regulated tariffs. However, their contribution is limited to production for either self-consumption or for selling electricity to STEG.

Figure 7. Market Structure in Maghreb



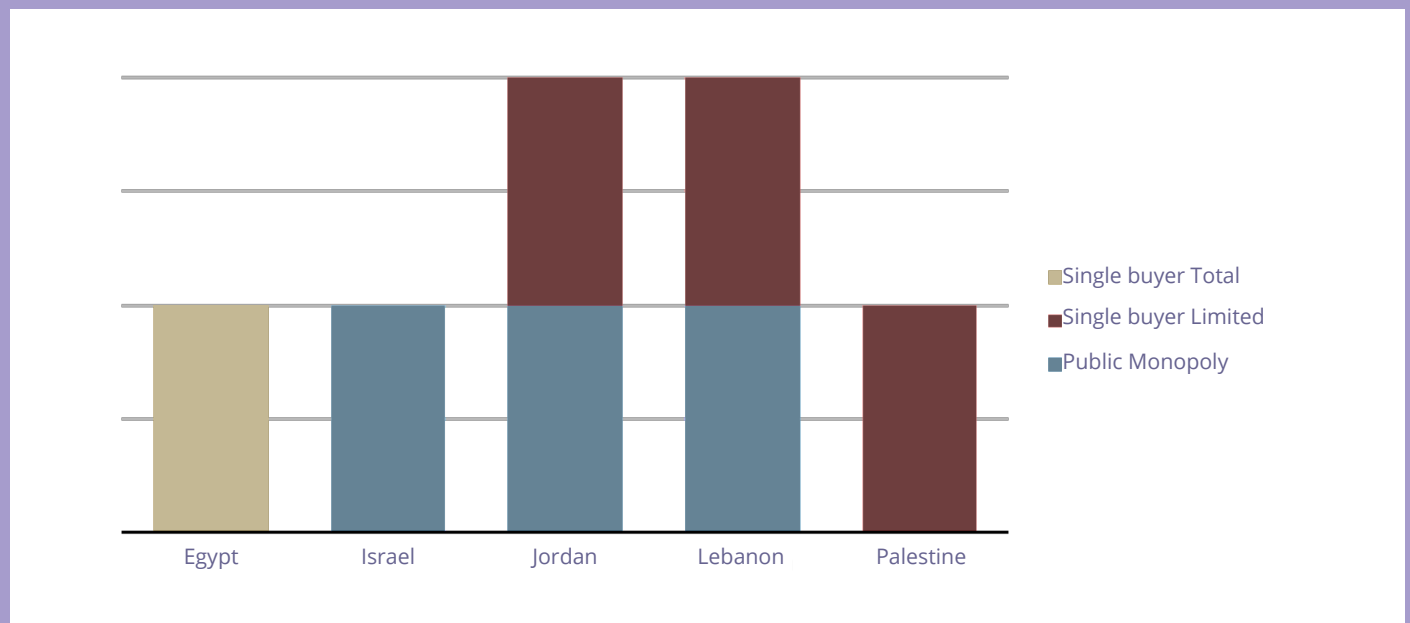
In the Eastern Mediterranean region (Figure 8), wholesale and retail trade markets have not opened yet. There is still a public monopoly in three states (Israel, Jordan and Lebanon). Single buyers are very active: a single buyer can be found in Egypt (total); Jordan and Lebanon (limited, there are also 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 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 would 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 from 3rd December 2019 and continuing in the coming years. Moreover, only in Israel is there a partial retail market competition limited to 20% of the market, i.e., users consuming more than 40,000 kWh.

The overview of the electricity system in North Africa and the eastern Mediterranean region shows that the potential of developing cross-border interconnection is high. However, the lack

of harmonization in terms of market structure and regulation can prove to be a challenge. Looking for an efficient and coordinated development at a regional level clearly makes sense. Undeniably, strengthening the institutional cooperation and regulatory coherence could stimulate cross-border exchanges, which should be seen as a supplement to generation capacity additions, avoiding costly redundancies and promoting the more efficient utilization of existing interconnectors.

Figure 8 . Market Structure in Eastern Mediterranean



2

SHORT-TERM SCENARIO

2

SHORT-TERM SCENARIO

2.1 The state of play of power market integration⁵

2.1.1 Overview of the South-Mediterranean sub-region

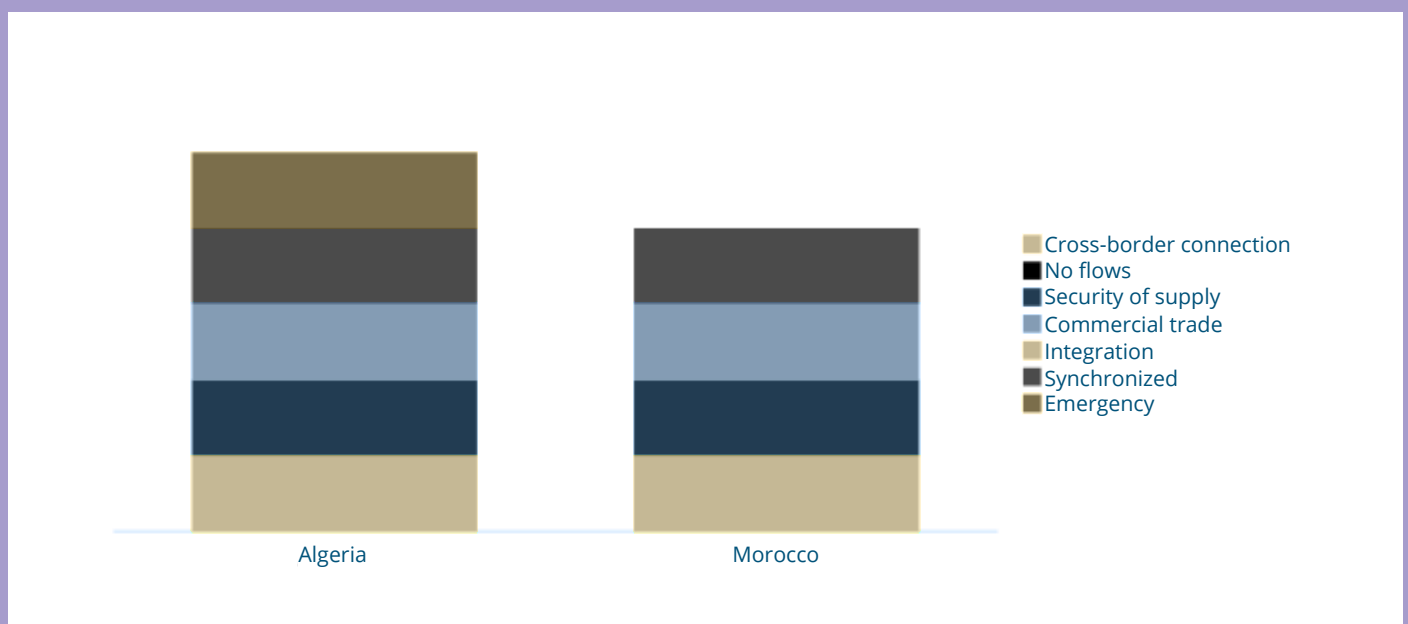
Cross-border interconnections in the Maghreb block (Algeria, Morocco and Tunisia) started in the 1950s and subsequently evolved into multiple high-voltage transmission interconnections between the three countries. Morocco was also connected to Spain in the late 1990s, thus, facilitating the synchronization of the Maghreb countries with the European high-voltage transmission network. With the Algiers Declaration stipulated in 2010, the three countries

⁵ The overview presented in this chapter is mainly extracted from the Mediterranean Electricity Markets Observatory (MEMO) published in January 2020.

agreed to standardize their laws and frameworks in line with each other to create a competitive electricity market and potentially integrate with the EU. The plan included transparent network access for cross-border electricity trading. However, progress has been slow and intra-regional trade limited. Currently, the sub-regional energy interconnections are well developed but are mainly used for supply security and not for commercial transactions nor the integration of the RES as shown below:

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 sub-regional integrated electricity market. Energy exchanges would involve not only TSOs but also market participants (generators, big consumers and suppliers).

Figure 9 . Role of cross-border interconnections: North Africa



Even though cross-border interconnections are advanced in both countries, the exchange of electricity is highly limited and has been used for mutual aid and annual trade contracts with the European Union. It is worth noting that the export is close to zero in Algeria and Morocco.

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As a consequence, receiving further benefits from the existing infrastructure is a key factor; however, developing a market and simulating

the system with intermittent generation appears tremendously difficult. The problem of technical and non-technical losses is also crucial and should be addressed by a specific framework. Ergo, the current existing cross-border electricity interconnections of the Maghreb block are shortly described Figure 10.

In Algeria, the electricity cross-border interconnections have already developed in the South-South route, thereby connecting Algeria with Morocco on its western border and with Tunisia on its north-eastern border.

Morocco is interconnected at the cross-border level with Spain and Algeria. As the other Maghreb countries, the Moroccan grid evolved over the years and is now synchronized with the European high-voltage transmission network.

Similar to Morocco and Algeria, the Tunisian network is synchronized with the European high-voltage transmission network, thus facilitating potential cross-border lines on the North-South route. However, Tunisia's electricity network is currently connected only with its North African

Table 3 . Export percentage of North Africa

Country	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 4 . Import percentage of North Africa

Country	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

neighbors: there are five transmission lines that connect Tunisia to Algeria, while there is just one connecting Tunisia to Libya.

2.1.2. Overview of eastern Mediterranean sub-region

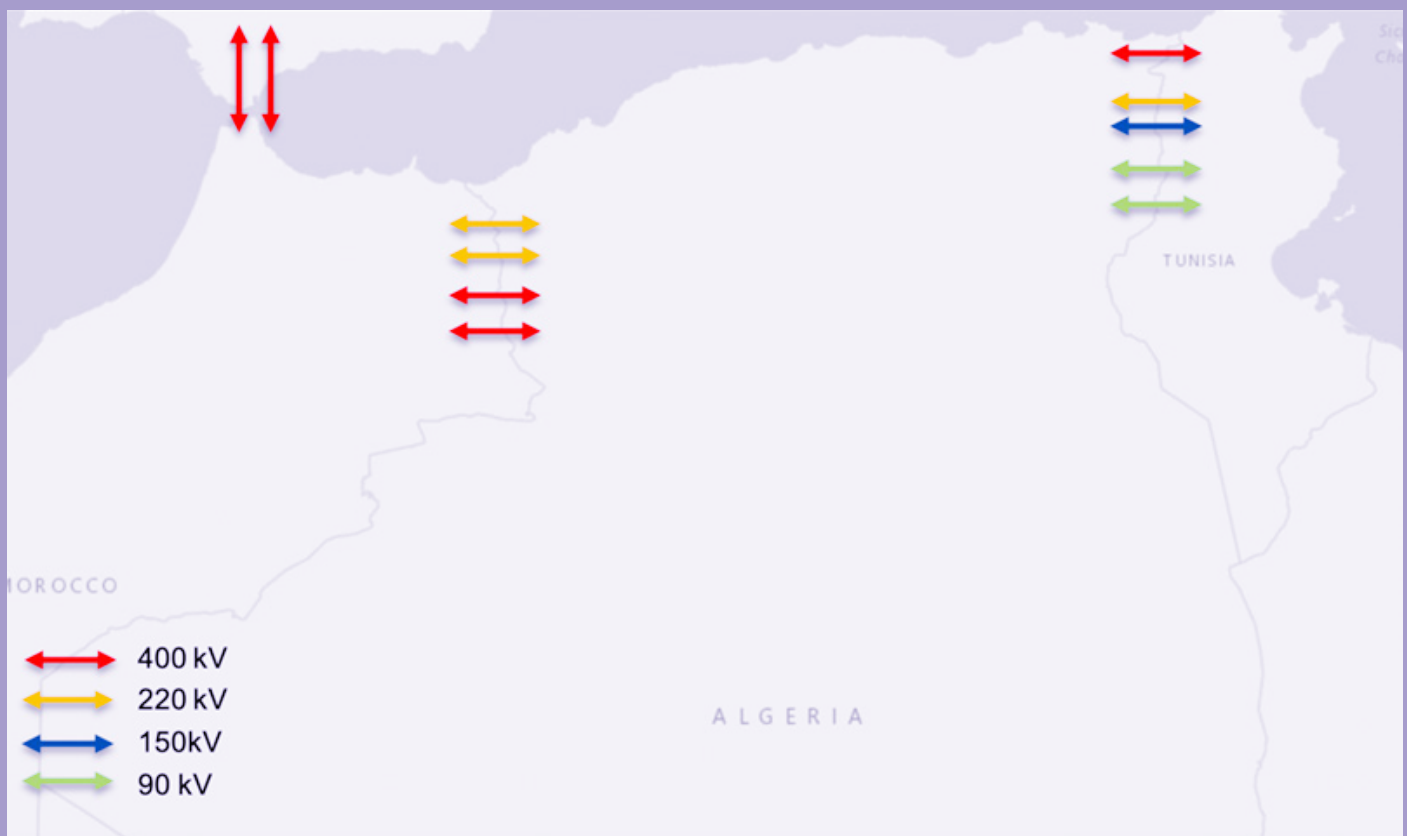
In the eastern Mediterranean, the main cross-border project is the eight-country block project (EIJLLPST)⁶ which was initiated in 1998 by Egypt, Iraq, Jordan, Syria and Turkey to upgrade their electricity systems to a regional standard. Lebanon, Libya and Palestine later joined the group. In 1992, the original five countries signed a general trading agreement for mutual assistance through the exchange of surplus power. A general energy interconnection agreement followed in 1996, outlining the terms and conditions for the use of the energy interconnection. The National Electric Power Company of Jordan (NEPCO) was nominated by the other parties as the coordinating body of the EIJLLPST and two committees on

⁶ The eight-country block interconnection project (Egypt, Iraq, Jordan, Lebanon, Libya, Palestine, Syria, and Turkey).

operation and planning were established in its interconnection program. The program planned to yield great economical and technical benefits for interconnected countries, reducing investments in constructing new power stations and exchanging energy among the networks in normal and emergency cases, thereby improving their financial standing, exchanging knowledge and experience in power system planning and operation. However, this has not been the case as the EIJLLPST has not been employed due to the continuous political issues between the countries in the region.

As a consequence, interconnections are quite low in the eastern Mediterranean, even if the recent gas fields discovered by Israel and Egypt might open up a very strong development potential for the sub-region. Better interconnections with neighboring countries and with the rest of the Mediterranean could indeed be helpful to fully exploit these resources. In this regard, it can be observed that cross-border interconnections in the eastern Mediterranean are mainly used for security of supply, as detailed in the Figure 11.

Figure 10 . Electricity cross-border interconnections in North Africa



In this context, 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. It is to be noted 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.

Exports are also similarly scarce, which highlights the

potential 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. Whereas 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 neighboring countries. Working as an isolated network, there are neither power import nor export figures available for Israel.

Figure 11 . Role of cross-border interconnections: Eastern Mediterranean

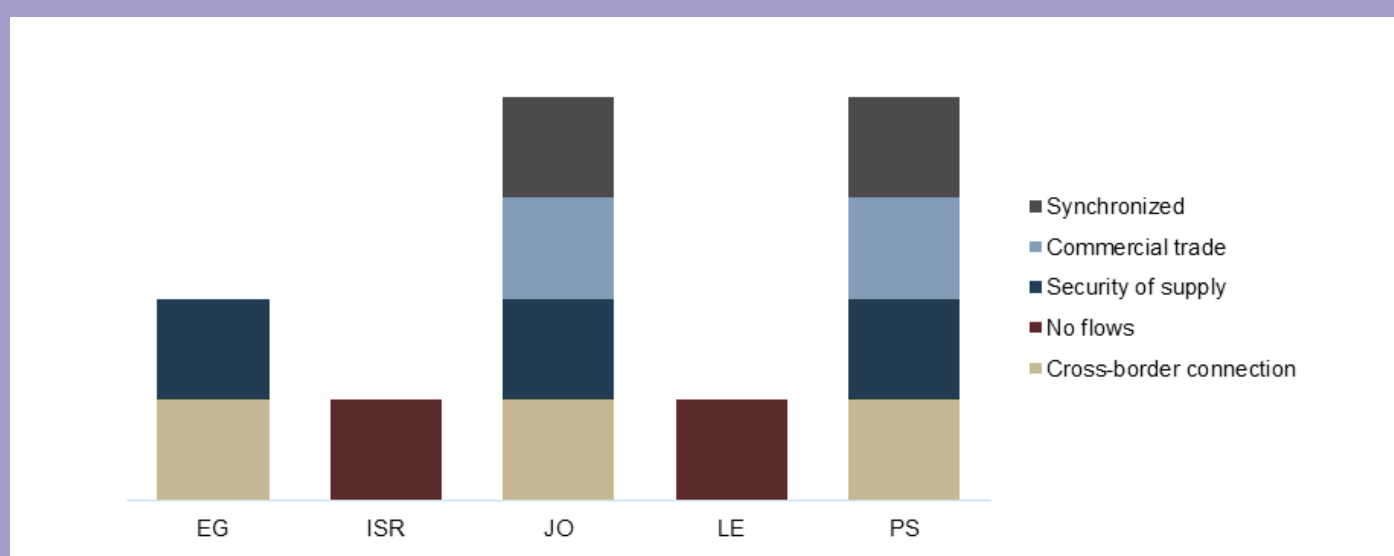


Table 5 . Import East Mediterranean (Israel has not answered)

Country	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 6 . Exports in the East Mediterranean (Israel, Lebanon and Palestine have not replied)

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

In order to better outline the status of sub-regional electricity market integration, the figure below provides an overview of the existing electricity cross-border interconnectors.

In Egypt, the existing electricity cross-border infrastructures connect Egypt with Libya on its western border and with Jordan and Palestine on its eastern border. Existing Egyptian cross-border interconnections are part of the so-called “Eight Country Interconnection Project.” Interconnectors from Egypt to Libya and Jordan have not been completely exploited and, in 2016, no electricity exchange took place through the Egyptian–Libyan electrical interconnection due to the current prevailing conditions in the region⁷. Moreover, the Egyptian–Jordanian Electrical Interconnection witnessed a decline in electricity trade as only 314 GWh were exported from the Egyptian network

⁷ National Electric Power Corporation, Annual Report 2016, p. 29, 2016.

to the Jordanian one, less than the average of the previous years⁸. Electricity trade is relevant only in the interconnection with Palestine.

In Israel, the electric system works autonomously as an island that must be self-sufficient and capable of fully meeting its own demands in all circumstances due to its geographical location and its complex relationships with its neighboring countries. The Israel electrical grid is connected only with Palestine and supplies the electricity demand in the West Bank and Gaza. Israel has always been dependent on imports to meet its energy needs. However, the recent significant natural gas discoveries exceed Israel’s projected demands and, as such, it has become a net exporter of electricity generated from gas.

In Jordan, existing electricity cross-border

⁸ National Electric Power Corporation, Annual Report 2016, p. 29, 2016.

Figure 12 . Electricity cross-border interconnections in Eastern Mediterranean region



infrastructures connect the country with Egypt, Palestine and Syria. Similar to Egypt, Jordan was among the five countries that started the so-called “Eight Country Interconnection Project.” However, not all these infrastructures are availed to their full potential; for instance, in 2016, no energy was exported from Jordan to Egypt⁹. In contrast, the interconnection that links Jordan to Palestine usually provides a satisfactory level of electricity trade. The West Bank started importing 20 MW of power from the Jordanian grid through a 33 kV feeder to Jericho in 2008. However, a decline to 424 GWh was registered in 2016, reducing Jordanian exports compared to the level of the previous years. Additionally, since the Palestinian power demand is not integrated into the expansion plans of the Jordanian power sector, Palestine will only be able to rely on the residual Jordanian power surplus for its growing demands.

Due to its geographical position, the Lebanese electrical grid is connected only to Syria through three interconnections. The first one is a single circuit 400 kV level line via 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 synchronization regime (a part of the Lebanese grid was set to operate as an electrical island with Egypt). Currently, this line is used to import power only from Syria without synchronization. The second is a double circuit 220 kV tie line via Deir Nbouh (Lebanon)–Samaria (Syria) which is not frequently used to import power due to technical restrictions from the Syrian side (after the Syrian crises). Finally, there are two 66 kV overhead tie lines via Ksara–Dimas which are used from time to time.

Since the start of the war in Syria in 2011, Lebanon’s electrical grid became more like an energy island; electricity imports were disrupted and a substantial new demand for electricity estimated at 500 MW was provoked by the influx of more than 1.5 million Syrian refugees to Lebanon, which led to a wider gap between the electrical demand and supply. Moreover, no electrical energy exchange took place between Syria and Jordan during 2016 due to the current prevailing conditions in the region¹⁰.

⁹ National Electric Power Corporation, Annual Report 2016, p. 29, 2016.

¹⁰ National Electric Power Corporation, Annual Report 2016,

In Palestine, the power system is interconnected with Israel, Jordan and Egypt and the imported electricity from the cross-border interconnections are unique sources of supply, making them vital to satisfy the electricity supply since there is no power. The Palestinian territories depended on the IEC for 90% of their electricity supply in 2015, ranging from 64% in Gaza to 99% in the West Bank. The only slight exception to this is the transmission lines from Jordan and Egypt to the West Bank and Gaza respectively.

In 2008, the West Bank started importing 20 MW of power from the Jordanian grid through a 33 kV feeder to Jericho¹¹. Since the Palestinian power demand is not integrated into the Jordanian power sector expansion plans, only the Jordanian power surplus was available for export. Therefore, no electricity was exported from Palestine to Jordan. In 2008, Gaza also started to import 20–30 MW of power from Egypt during a limited number of hours per day which provides 14% of Gaza’s energy supply through three feeder lines¹². This restricted service is frequently interrupted due to the lack of line maintenance and security in the Sinai Peninsula.

2.1.3. Current status of market integration and steps forward

As observed in the above description, on cross-border interconnections, the rate of utilization of the existing capacity is low for almost all cross-border interconnections between the Southern Mediterranean countries. In principle, electricity trading should improve the region’s energy security, especially in countries that suffer recurring power outages. Currently, most electricity exchanges on existing interconnections take place on an emergency basis to cover either unexpected outages or scheduled ones due to maintenance. The fact that intra-regional interconnections are not properly exploited shows that interconnections in the SEMCs are mainly driven by considerations related to the security of supply rather than the development of a regional market, which is why countries continue to focus on meeting their own demands through investing in local power generation.

p. 29, 2016.

¹¹ World Bank Group, Securing Energy for Development in West Bank and Gaza, p. 62, 2017.

¹² World Bank Group, Securing Energy for Development in West Bank and Gaza, p. 64, 2017.

Improving the cross-border integration of electrical systems is one way of reinforcing the security of supply and overall efficiency of the electricity chain by relying on the complementarities of networks and means of production. Indeed, the sharing of resources (power generation, technical requirements and know-how) could improve sub-regional electricity integration with benefits for the final consumer and the national electricity system to:

- Facilitate RES integration in the Mediterranean Region in general and North-South RES exchange and encourage cost-effective RES exchanges;
- Increase energy efficiency as a result of electricity transmission network integration;
- Increase energy security and reliability;
- Generate economies of scale in investments with a better allocation of costs and risks.

Three “ingredients” (RES, sharing and interconnectors) appear to be instrumental for supporting significant infrastructural, economic and social developments in both the Mediterranean shores and this is even more relevant for development in the Southern shore countries. The sharing of ancillary services is essential to facilitate RES development, while cross-border interconnections are necessary for achieving such sharing since interconnectors are intended for capacity and energy exchanges as well as for providing capacity reserve security support between facing TSOs.

Sharing services can be enhanced by market mechanisms, where they exist, making Balancing Service Providers (BSPs) more effective. However, sharing services can be also achieved by specific TSOs’ agreements (protocols) even where there is no market. In this case, TSOs may assume the role of the Balance Responsible Party (BRPs) and be instrumental in setting up BSPs’ organizations. Flexibility is a prized characteristic in power systems with significant RES. How this flexibility is procured is strongly shaped by the regulatory context. Vertically integrated utilities typically can use contractual or policy mechanisms to extract flexibility from generators. In contrast, in partially or wholly restructured power markets, system operators use market tools with clear definitions

of performance requirements to incentivize the provision of power system flexibility. Interconnected countries can pool flexible resources by coupling markets, if they exist, and cooperating on reserve/balancing, pooling response, ramping capabilities and system services.

However, it should be noted that certain conditions may be necessary for the interconnections to operate effectively, i.e., ensuring a sufficient level of reliability of the interconnected systems.

In the Mediterranean, cross-border interconnection development is an important objective, but it is also a long and demanding process requiring the proper assessment of the needs and locations on technical aspects and ensuring a proper level of coordination. That means linking together countries with strong synergies at the geographical and energy levels, which in the process should share, to some extent, a common vision of the electricity developments and confidence in the reliability of the neighboring system.

In this regard, it is clearly fundamental to look at what NRAs are currently competent on, what powers they are granted with regard to the management of cross-border interconnections and what the existing regulatory barriers for increasing power exchange are in order to better understand what points are already common and what is missing.

2.2. The current role of regulators and existing barriers to cross-border interconnections

The regulators are involved in every step of the electricity system chain, either directly by setting the rules or indirectly by monitoring the operators and interacting when needed. Regarding the cross-border interconnections, many regulators are involved in terms of approval of the development plans of the TSO and, therefore, approval of the new interconnection lines. Furthermore, some regulators monitor the operation of the TSO and cross-border interconnections.

In the case of cross-border interconnections, the role of the regulator differs from one country to another. For instance, **EMRA (Turkey)** is not involved in the planning of the new cross-border interconnection except in terms of economic aspects, when the regulator either approves or rejects the investment.

RAE (Greece) approved the Ten-Year Transmission Network Development Plans after being submitted by the TSO. Similarly, in **CREG (Algeria)**, the regulator approves the development plan of the electric transmission system, including international interconnections.

In the case of **CERA (Cyprus)**, the regulator is responsible for the approval of the investment, the monitoring and ensuring that the investment is carried out and the granting of relevant licenses.

In Egypt, the interconnection projects are approved by the ministry, not the regulator. However, **EgyptERA** reviews the transmission investment plans. In addition, the regulator approves the conditions that should be fulfilled by the contracts concluded by the Electricity Utility Parties to use a transmission and/or distribution network.

ARERA (Italy) is involved either as a member of Agency for the Cooperation of Energy Regulators (ACER) for decisions relevant to the EU regulations on cross-border exchanges and/or as a national regulator whereas the application for a new interconnection requires regulatory approval/appraisal. When it comes to regulated new interconnections, i.e., those fully covered by tariffs for construction/operating costs, the regulator is indirectly involved as they approve the short- and long-term TSO strategic plan, which in turn contains regulated interconnection

projects. ARERA is responsible for the entire TSO planning approval, which includes projects connecting the national HV grid with neighboring countries.

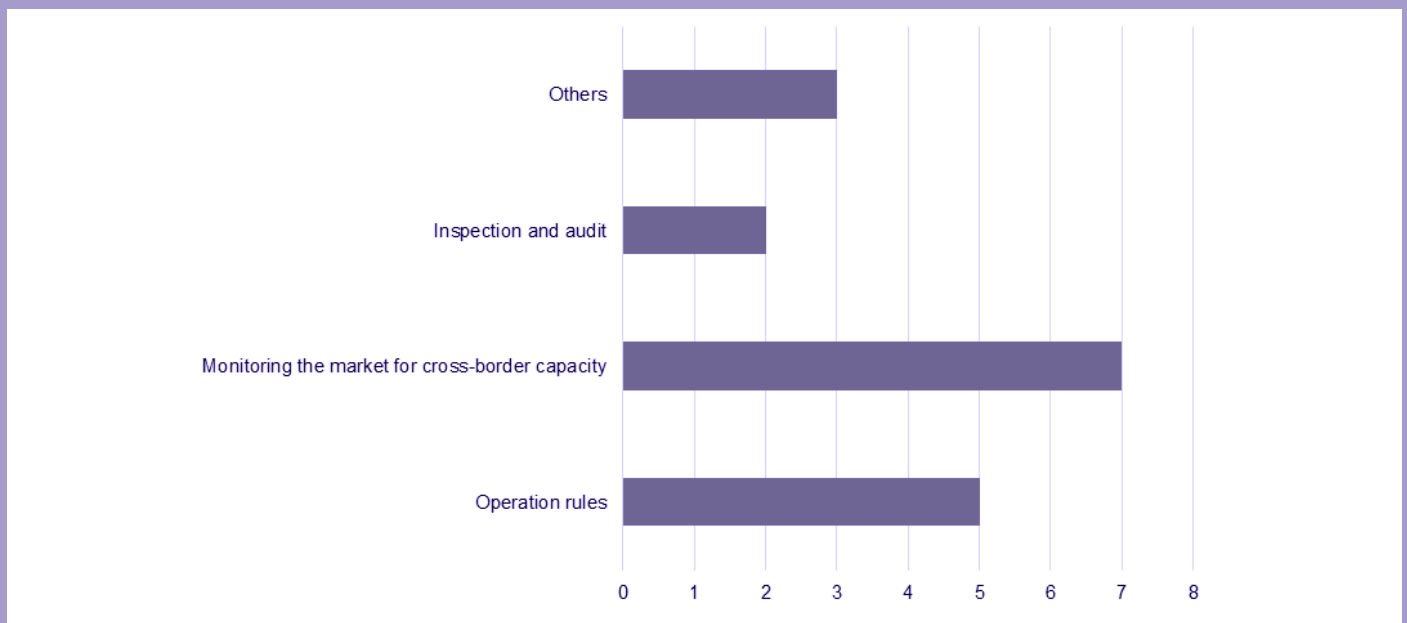
In France, the duties of CRE are similar to the ones of other EU member states, which, however, play a large role in the interconnection developments and tariff settings. The CRE is responsible for validating TSOs' investments, including on interconnections, assessing their investment plans every year. In the case of cross-border projects accompanied by a CBCA, it controls the cost and benefit analyses from project promoters and concludes final agreements with neighboring NRAs.

In **Jordan** and **Slovenia**, the regulators are not involved in the process, as the approval of the development plans is under the ministry responsible for energy roles. In **Palestine**, **PERC** is also not involved in the process.

The competences of the regulators are presented in the next figure, including the replies of nine MEDREG countries.

In case the legislation related to the cross-border interconnection is not respected, fines or sanctions can be imposed on the concerned operator. Only three countries stated that there are neither fines nor sanctions; however, it has been imposed in the six remaining countries.

Figure 13. Electricity cross-border interconnections in the Eastern Mediterranean region



In Turkey, fines/sanctions are imposed on the operators. For Greece, the RAE can impose a fine of up to 10% of the non-compliant organization's annual turnover. The fine is proportional to the gravity of the infringement. The imposition of a fine does not impede the RAE from proceeding to any further sanction for the same infringement. In cases of repeated non-compliance with the rules, the RAE can revoke the license of the organization in question.

In Palestine, the sanctions and fines are imposed by license on the licensee entities in the same way that sanctions are applied to all CERA's licensees, including cross-border interconnectors.

In Slovenia, fines/sanctions are imposed in the case of discriminatory allocations of the cross-border capacities or the non-provision of information according to Article 15 and behavior not in line with general principles of congestion management according to Article 16 of Directive 714/2009.

ARERA is responsible according to the EU regulations; the usual regulatory framework rules hold, inter alia, the possibility for the regulator to run inspections and audit and, whenever an operator is found guilty of misconduct, to fine and ask the operator to re-establish the situation and provide for the conduct regulation. In France, CRE has the power to ensure that the rules are respected by operators and can run inquiries and audits in this respect. The CRE also carries out market monitoring activities under the Regulation on Wholesale Energy Market Integrity and Transparency (REMIT) legislation.

Fines nor sanctions are imposed only in Jordan, Egypt and Algeria. However, In Algeria, fines and sanctions could be provided in the secondary legislation on the import and export of electricity once established.

In terms of barriers, two main types of obstacles need to be overcome by the regulators and operators; the first one, related to the technical and economic aspects, is the development of new cross-border interconnection needs and important funds and the determination of the shares of each country representing a major barrier in the eastern Mediterranean and North African regions. Moreover, in these regions, there

is also a need to include the transmission lines in the development plans—a reinforcement of the national grid close to the borders; otherwise, the cross-border lines can't be used at their optimal load as in Algeria where the interconnections are limited.

The second type of barriers refer to the development of the regional markets to facilitate energy trades between the neighboring countries; both countries should have the same rules and a more harmonized regulatory framework.

2.3. Quick wins in terms of regulatory gap reduction and interoperability to integrate power markets at sub-regional levels

In the previous chapters, the overview of the sub-regions' cross-border interconnections shows the differences in terms of development on infrastructure, the maturity of the regional market and the regulatory gaps. These particulars can be seen as an opportunity to foster intra-region cooperation to reduce the regulatory gaps and benefit from the interoperability of the electrical systems.

In all the countries studied in this report, the more optimized use and development of new interconnection lines are evident; however, many barriers slow the establishment and development of the sub-regional market. The economic aspect needs further studies and cooperation between the concerned countries. However, the regulators should work toward a more harmonized regulatory framework in the same sub-regions to foster the integration of power markets.

Furthermore, the characteristics of the power systems in the South and North shore countries are complementary in both energy production (more RES potential in the south shore) and peak load and seasonal demands; the winter period is more constraining for the north shore while, on the other side, the summer calls for high demands.

In terms of the two sub-regions in focus in this report, the options for short term improvements and regulatory convergence are the following:

- In most countries, a regulator has been created, enabling the promotion of the development of cross-border coordination through bilateral assessment of required adaptations.
- At each border, the situation is particular. If, in the Maghreb, the focus is on HV transmission lines with similar issues at interconnections, in the eastern part of the region, there is a large range of situations from HV interconnections to distribution levels. Regulatory convergence has to be addressed specifically as the technical and commercial requirements are different.
- Standards and norms' convergence on relevant aspects is the first requirement, including operational security aspects such as the N-1 rule.

In the Maghreb electricity market, the dominant issue is improving flows on interconnections. As a result, the first step is a clarification of technical standards for network management: system operation and operational planning. MED-TSO has carried out in-depth work on these aspects with a view to improve the overall understanding of requirements for TSOs. In terms of responsibilities, regulators' role is complementary to TSOs by, on that basis, elaborating on rules for:

- Identification of needs and gaps;
- Transparency requirements toward the regulator or relevant administration and to stakeholders;
- Framework for the provision of associated services (ancillary services, operating reserves) with a view to cross-border participation.

In the eastern region, the design of interconnections is different. On HV lines, issues are similar to the Maghreb with a stronger focus on RES integration, especially in Jordan. Egypt can play a role in terms of the stabilization of supply tanks to its generation surplus. However, the topology for the system reduces connections to the North-East boundaries with Israel and a link with Jordan. As a result, the region is open to systems in the East but can hardly rely on

a support comparable to the EU. The other important aspect is the connection of Palestinian distribution systems with Egypt, Israel and Jordan. In this respect, distributors play a major role as a single interface between foreign production and consumers. Each situation would require a specific assessment; in this respect, quick wins first relate to the quality of the dialog between all involved parties, meaning that the regulators of each country should be aware of the relations between operators to ensure that agreements are properly balanced and well designed.

3

INTERCONNECTION DEVELOPMENT IN THE LONG TERM

3

INTERCONNECTION DEVELOPMENT IN THE LONG TERM

3.1. MEDREG analysis of cross-border investment processes

In the report on the stimulation of infrastructure investments, MEDREG had identified a series of priorities and recommendations.

The first aspect to be retained is that several investment types have to be distinguished in terms of geographical scope (national vs international projects) and different levels of voltage or characteristics. Infrastructure projects are of a regulated nature; thus, the involvement of regulatory authorities is crucial as new assets have to be covered via tariff regimes. Commercial arrangements may be foreseen for interconnections, but these projects are complex and have a risk structure that may not be compatible with the specific context of Mediterranean countries.

From the overall logic identified in the investment report, we have to retain that project development is a multiple-year process that starts with the identification of a need. This need can come from the inclusion of a new generation, internal problems of congestion, demand growth or significant changes in the network's topology. Among the consecutive steps of an investment process, permitting and financial closure are important aspects that impact both the timing and the technical choices. The analysis of the likely evolution of market trends is crucial, they are meant to be summarized in the investment plans.

In summary, going ahead with further cross-border integration requires a high level of coordination among different parties, namely TSOs, regulators and administrations. Ideally, developing integration should be a shared process.

In terms of project assessment, MEDREG calls for the conception of Cost-Benefit Analyses (CBAs) based on a case-by-case approach that includes qualitative aspects and (appropriate comparison) arbitrages between interconnections and other measures, on top of economical evaluations. Regarding the Mediterranean region, the following aspects were underlined:

- Technical: reliability of the electricity systems, level of controllable/intermittent generation, resilience, internal congestions and weaknesses of networks. Analysis of the integration of interconnections in the load curve management;
- Economic and commercial: development and operational costs, services to be provided and possible transactions; capacity utilization, electricity flows and selling;
- Financing: level of available equity, bank loans, institutional loans, possible grants, need for government support, financial risk assessment;
- Regulation: rules have to be compatible on both sides of interconnection in order to allow for the technical and commercial exploitation of the line.

More generally, several aspects have to be addressed. The first is that by connecting two power systems, an interconnection can modify their respective dynamics. The long-term effects of further integration need to be properly assessed, particularly in terms of the evolution of generating facilities and the effective resilience of power systems. The short-term reduction in the use of certain means of generation may certainly lead to savings, but it may also weaken them economically, even though they are still necessary

for system security. The economic parameters used in CBAs must therefore refer to the underlying factors in terms of the energy delivered to users in price and volume. Risk and uncertainty have to be properly assessed, especially in the absence of a uniform legal framework. In this respect, the regulatory framework should provide guarantees in terms of stability of the rules and clarity upon the long-term energy strategy.

MEDREG recommends including the following elements when carrying out cost and benefit analyses:

- In-depth assessment of long-term energy dynamics at national and regional levels;
- Assessment of the physical role of new interconnection lines in terms of energy flows and systems' complementarity;
- From a national perspective, CBAs should be adapted to the business models, including the characteristics of the interconnected system (stability and resilience, market deepness and liquidity when relevant);
- Sources of financing, including international support schemes, could be included in the analyses, particularly regarding the valuation of RES;
- Assess interconnection against alternative options.

In any case, at a regional level, it is necessary to organize a common understanding of the value of infrastructure projects. This concerns not only the technical aspects but also the socio-economic aspects. The purpose of the project assessment is to establish the contribution that the host countries are prepared to make in terms of financing. This must be set against the general objectives of developing electricity supplies, security and quality of supply, which actually have a political dimension.

3.2. Perspectives in the Maghreb and Mashreq sub-regions

Regional integration has been considered an objective within the two regions for a long time. More generally, projects for creating regional

interconnected electricity systems among Arab countries have been at stake for the past decades (see Figure 12).

In the West side of the Mediterranean region, the concept of the Maghreb electricity market has been promoted for a long time. The interconnection of the Maghreb countries (Algeria, Morocco and Tunisia) started in the 1950s and translated into multiple high-voltage cross-border transmission lines. Morocco was connected to Spain in the late 1990s, thus facilitating the synchronization of the Maghreb countries with the European high-voltage transmission network. The Algiers Declaration in 2010 stipulates that Maghreb countries will aim to align their laws and frameworks to create a competitive electricity market and potentially integrate with the EU. The plan includes transparent network access for cross-border electricity trading. However, progress has been slow and intra-regional trade limited. Currently, the regional energy interconnections are well developed but, for the time being, the electricity exchanges are limited. As a result, the focus falls on regulatory harmonization than interconnection development, except with the EU, with projects of connection between Morocco and Portugal and between Tunisia and Italy. In this context, the business model of such developments is twofold: securing power supplies in the South and supporting the development of RES, opening new opportunities for exports of green electricity.

In the Mashreq, regional integration has also been promoted in the past decades, particularly under the eight-country block project (EIJLLPST)¹³ which was initiated in 1998 by Egypt, Iraq, Jordan, Syria and Turkey to upgrade their electrical systems to a regional standard. Lebanon, Libya, and Palestine later joined the group. In 1992, the original five countries signed a general trading agreement for mutual assistance through the exchange of surplus power. A general energy interconnection agreement followed in 1996 outlining the terms and conditions for the use of the energy interconnection. The National Electric Power Company of Jordan (NEPCO) has been nominated by the other parties as the coordinating body of the EIJLLPST and two committees on

¹³ The eight-country block interconnection project (Egypt, Iraq, Jordan, Lebanon, Libya, Palestine, Syria, and Turkey).

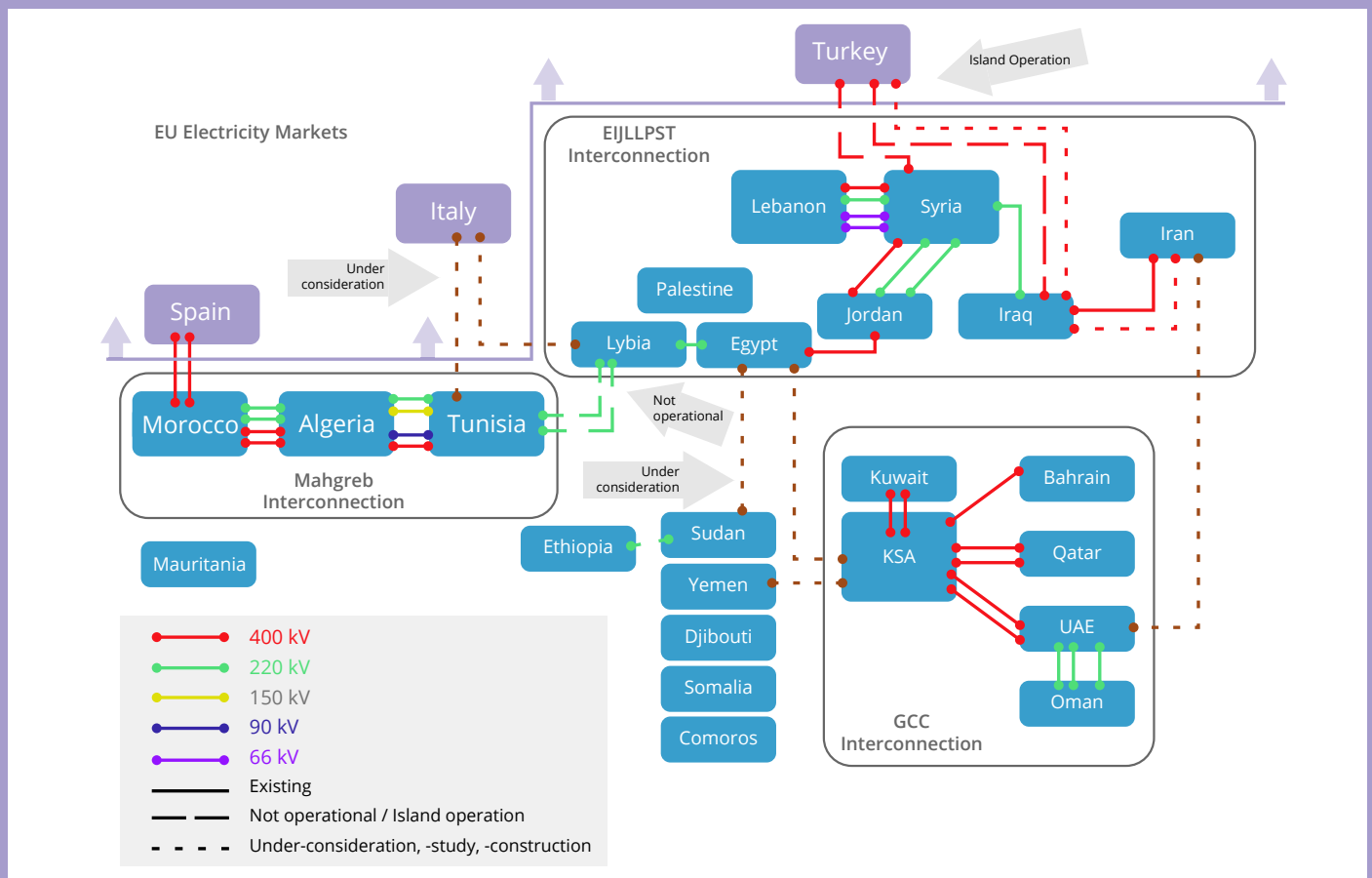
operation and planning were established in the EIJLLPST interconnection program. The program was expected to yield important economic and technical benefits by reducing the need for investments in power stations and exchanges of energy in normal and emergency cases. The political context has slowed down the process but the need for further interconnection still exists, exacerbated by the large-scale development of RES.

Regarding the development of cross-border capacity in the future, many projects are either under construction or in the negotiation/planning phase. In Turkey, there are some projections to strengthen connections with its neighbors. The aim is to maximize the net transfer capacity and improve energy trade. Unfortunately, due to social, economic and geopolitical problems, these projects have been postponed.

In Jordan, a project has been proposed that aims to increase the capacity of the interconnection line with Egypt to reach 1100 MW by 2025. Additionally, in 2020, the capacity of the interconnection line with Palestine increased from 40 MW to 80 MW. In the same year, the Jordan and Iraq governments signed an agreement for a project aiming to supply the Iraq side with 1000 GWh/year. The first phase of the project will start with a capacity of 150 MW to be operational in 2022. Finally, actions have been taken to improve the interconnection between Jordan–Gulf countries and Egypt by 2025.

In Egypt, the planned projects are as follows: one with Sudan (220 kV), one with the Kingdom of Saudi Arabia (500 kV-HVDC) and one with Cyprus (2000 MW); another is planned to reinforce the interconnector with Jordan to increase its capacity from 450 MW to 2000 MW.

Figure 14. Projects of interconnected regions among Arab countries¹



¹ Source: World Bank, 2013

3.3. Regulatory requirements for new cross-border interconnections

The development of cross-border interconnections and integrated regional market is a long process that requires stability in terms of the regulatory framework and well-designed long-term planning; as the first step, regulators and governments need to assess the benefits from the development of cross-border interconnections and decide on the priorities of usage, either for the security of supply and better stability of national electricity system or for better market integration that fosters RES integration and reduces the price of electricity by importing from neighbors. Furthermore, the use of the interconnection will enhance the competition among electricity companies for the benefit of the domestic electricity market and national economy.

In this regard, legislative arrangements for improving energy trading and facilitating market integration with countries a key element. A harmonized regulatory framework will facilitate such market integration and the development of sub-regional markets.

MEDREG has been very active in promoting and enhancing the development of regional markets and sub-regional markets. In cooperation with MED-TSO, several training events, workshops and webinars have been undertaken to study and analyze the many aspects of the development of cross-border interconnections. Furthermore, these activities have reinforced the relation between TSOs and regulators; the outcome of this cooperation is available on both institutions' websites¹⁴.

Mainly, the lesson learned from the past years has shown that the effectiveness in regulation requires a good diagnosis of the needs and the benefits from the cross-border interconnections, to create a specific solution reflecting the objectives and needs of the countries, a solution that fits a specific country or region may not be adapted to another.

In addition, reaching an exceptional level of

mutual understanding is a key element and, to achieve that, the MEDREG members need to share their expertise and knowledge to determine the standards and rules of governance with concrete situations and issues. This can be achieved through projects and studies or twinning activities between regulators.

In terms of project assessments, the cost-benefit analysis represents a key element in the analysis of cross-border interconnections' feasibility studies. Usually, the TSOs are more competent in carrying out the CBA analysis and, in some countries, the regulators approve the proposal of the TSO such as in Turkey, Greece, Algeria and Italy.

In the case of Slovenia, the cross-border interconnectors are subjects of ENTSO-E's Ten-Year Network Development Plan (TYNDP) and also a subject of the CBA according to the ENTSO-E methodology.

In Egypt, depending on the current legal and regulatory framework, interconnection projects are approved by the ministry. However, the ministry may appoint bodies to carry out the necessary studies. On the other side, the regulator reviews the transmission investment plans. Moreover, the regulator approves the conditions that should be fulfilled by the contracts concluded by Electricity Utility Parties to use a transmission and/or distribution network.

Due to its geographical location in South-East Europe, Greece is planning to develop interconnections and transmission corridors in the region from generation areas toward big energy consumption centers of Europe. Investing in RES (overtaking the goals for 2020 and 2030) is highly related to the willingness of the country to export energy to other countries of the European continent. The RAE assesses the requests of all interested parties and approves or rejects the relevant projects.

The main actors in the development of the new cross-border interconnection are the TSOs and the regulators. For the Italian projects, TERNA, Italy's TSO is responsible for overseeing project activities, building and technical development of both the Third-Party Access (TPA) and merchant interconnections. On the other hand, the role

¹⁴ MEDREG: <http://www.medreg-regulators.org>
MED-TSO: <https://www.med-tso.com>

of the NRA is mainly to approve TSO's planning when it comes to interconnections that will be built and managed under the TPA regime. The NRA also has to approve the CBA carried out by the merchant interconnections' proponents, but it does not approve the project itself (merchant lines are authorized and "approved" by the Energy Ministry).

For Algeria, CREG and the TSO are members of regional organizations and associations dealing with energy exchange issues (MEDREG, MED-TSO, AFUR, AERF, COMELEC, etc.), to acquire the expertise and support to examine the possibilities of export/import capacity building, pre-feasibility and feasibility studies for the extension and development of interconnection links with neighboring countries and countries of the north-western shore of the Mediterranean are carried out.

In Cyprus, the regulator has the responsibility of evaluating the project, including the CBA, the CBCA and the technical studies, monitoring the implementation of the project and setting the rules.

In the case of Slovenia, the regulator shall examine whether the TYNDP covers the investment needs identified in the consultation process and whether the network development plan is in line with the non-binding ten-year network development plan for the European Union referred to in Article 8 (3) (b) of the EU Regulation 715/2009. If there are doubts about compliance with the network development plan for the European Union, the regulator shall consult the ACER.

4

RECOMMENDATIONS

4

RECOMMENDATIONS

While the integration of power systems on a Mediterranean scale is the long-term objective of MEDREG, it must be recognized that the diversity of situations call for the definition of specific trajectories according to the countries and their locations. Willing to implement a pragmatic approach, MEDREG, therefore, proposes approaching integration via regional logics and more specifically addressing the Maghreb and Mashreq. The prospects are indeed different there, particularly in their relationship with the European market, since the East of the region does not have the opportunity to rely on the European system as the Maghreb can, owing to the existing interconnections between Morocco and Spain and the future interconnections between Tunisia and Italy. However, this report makes it possible to identify common recommendations on governance for the short and long term.

4.1. Recommendations in terms of regulatory convergence

In terms of the two sub-regions in focus in this report, the options for short-term improvements and regulatory convergence are the following:

- At each border, the situation is particular. Regulatory convergence has to be addressed specifically as the technical and commercial requirements are different.
- Standards and norms convergence on relevant aspects are a first requirement, including operational security aspects such as the N-1 rule.

In terms of responsibilities, regulators' role is complementary to the infrastructure operators' for elaborating on rules for:

- Identification of needs and gaps;

- Transparency requirements toward the regulator or relevant administration and to stakeholders;
- Framework for the provision of associated services (ancillary services, operating reserves) with a view to cross-border participation.

4.2. Recommendations in terms of the development of interconnections

In terms of project assessment, MEDREG calls for the conception of Cost-Benefit Analyses (CBAs) based on a case-by-case approach that includes qualitative aspects and (appropriate comparison) arbitrages between interconnections and other measures. Cost and benefit analyses should include:

- In-depth assessment of long-term energy dynamics at national and regional levels;
- Assess the physical role of new interconnection lines in terms of energy flows and systems' complementarity;
- From a national perspective, CBAs should be adapted to the business models, including the characteristics of the interconnected system (stability and resilience, market deepness and liquidity when relevant);
- Sources of financing, including international support schemes could be included in the analyses, in particular regarding the valuation of RES.

4.3. Recommendations in terms of governance

In terms of governance, MEDREG concludes that it is necessary to deepen the dialog at a regional

level, between regulatory institutions and also between institutions and network operators. This is necessary in terms of regulatory convergence, network planning and interconnection project realization.

MEDREG recommends creating regional bodies gathering regulators, transmission system operators and, when relevant, stakeholders. A three-level regional organization could thus be arranged on the model of EU's regional initiatives structured around regional coordination committees (RCC), regional implementation groups (RIG) and regional stakeholder groups (RSG). In this respect, the RIG would frame the cooperation between regulators and TSOs, while the RCC would gather regulators and the RSG would serve the dialogue with stakeholders.



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