TeasiMed

TOWARDS AN EFFICIENT, ADEQUATE, SUSTAINABLE AND INTERCONNECTED MEDITERRANEAN POWER SYSTEM

FEASIBILITY OF MED-TSO MID-TERM ADEQUACY ASSESSMENT

APPLICATION: 2025/2027

Final Report

Med-TSO

MEDITERRANEAN TRANSMISSION SYSTEM OPERATORS

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TASK 4 *Optimized planning capacities and operation procedures*

Activity 4.3 *Medium-term Adequacy Forecast*

Deliverable 4.3 – *Medium-term Adequacy Feasibility Report, based either on statistical or deterministic approach.*

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Abbreviations

CCGT	–	Combine Cycle Gas Turbine
EKC	–	Electricity Coordinating Center
EU	–	European Union
FCR	-	Frequency Containment Reserve
FRR	-	Frequency Restoration Reserve
NTC	–	Net Transfer Capacity
OCGT	–	Open Cycle Gas Turbine
O&M	–	Operation and Maintenance
PEMDB	–	Pan-European Market Database (developed by ENTSO-E)
RES	–	Renewable Energy Sources that in general include wind, solar and hydro capacities, but in this Study, RES refers only to wind and solar as VRES (Variable RES) capacities
ROR	–	Run-of-River
TSO	–	Transmission System Operator
TYNDP	–	Ten-year Network Development Plan (Europe's Network Development Plan prepared bi-annually by ENTSO-E)

Market areas/countries:

Med-TSO	-	Association of the Mediterranean Transmission System Operators (TSOs) for electricity
DZ	-	Algeria
EG	-	Egypt
IL	-	Israel
JO	-	Jordan
LY	-	Libya
MA	-	Morocco
PS	-	Palestine
TN	-	Tunisia
PS	-	Palestine
LB	-	Lebanon
ES	-	Spain

Executive Summary

The main objective of this activity is to establish a harmonized guidelines for implementing Mid-term Adequacy Assessment (MAA) for the Mediterranean electricity systems to have a clearer view on time horizons beyond short term and before Master Plans.

To this end, a survey has been conducted, to collect the current practices of each member country, as well as their expectations regarding this type of assessment at Med-TSO level.

Based on the results of this survey, and with respect to the expectation of the members in terms of methodology and implementation guideline for those assessments, an application of adequacy assessment among non-EU Med-TSO members during 2025 and 2027 is reported. These investigations consider the security of electricity supply to consumers through a detailed power system adequacy assessment, using probabilistic criteria. This approach is inevitable due to the stochastic nature of renewable energy systems (RES), their intermittency, and the power system operation based on open electricity market conditions.

This Mid-term adequacy assessment provides information about potential adequacy issues in 2025 and 2027 in the 5 MED-TSO members: Morocco, Algeria, Tunisia, Egypt and Jordan.

Main adequacy indicators that have been assessed are:

- **Loss of Load Expectation (LOLE)** in a given geographical zone for a given year is the expected number of hours per year when there is a lack of resources to cover the demand needs, within a sufficient transmission grid operational security limit.
- **Expected Energy Not Served (EENS)** in a given geographical zone for a given year, is the expected value of energy not to be supplied due to lack of resources while complying with transmission grid operational security limit.
- **Relative EENS:** is a more suitable indicator to compare adequacy across geographical scope as it represents the percentage of annual demand which is expected to be not supplied.

The adequacy situation is assessed using a two-step approach. In the first step, adequacy under isolated system operation is evaluated. In the second, adequacy under interconnected system operation is assessed to quantify the importance of Med-TSO interconnections.

The application showed in the case of a theoretical isolated scenario, adequacy risks are observed in all countries except Egypt, although they could be considered as small or marginal in Morocco and Algeria, especially in 2025. In case of Jordan and Tunisia, adequacy risks are very high under isolated system operating mode, with somewhat better situation in 2027 than in 2025. Expected generation development between 2025 and 2027 in these two countries provides additional capacity and reduces adequacy risks. In case of Morocco and Algeria expected consumption increase is similar or even higher than increase in generation capacities and adequacy risks increase between 2025 and 2027.

In the case of interconnected operation, adequacy risks are observed in all countries except Egypt and Morocco. In case of Jordan and Tunisia, adequacy risks are high, but they drop between 2025 and 2027 which is the opposite to Algeria where adequacy risks increase in the same period. Increase of consumption in Algeria is not followed by corresponding generating capacity increase and adequacy risks are increasing after 2025.

1. Background and Benchmark on MAA

1.1. Why a Mid-Term Adequacy Assessment?

System adequacy is the capability of a power system to balance power injections and withdrawals in/from the grid at all timeframes, especially referred to mid & long-term horizons. Power injections include generation and supply from storage/conversion plants, and conversely withdrawals include final demand and energy being stored or converted. Performing periodic adequacy assessments is therefore a crucial exercise in order to assess the security of supply of a power system, identifying and characterizing potential risks, namely by anticipating where and under which circumstances the security of supply may be at risk. Such risk can be due to supply deficit and/or to grid constraints.

The time horizon of these assessments may range from short-term to long-term. The time horizon on which the study is based leads to different certainty levels of the conclusions. Shorter-term adequacy studies are based on more certain assumptions (i.e., load forecast, generation availability) and therefore provide more deterministic conclusions. Conversely, longer-term assessments are based on scenarios with higher uncertainty on the assumptions; also, in short term horizon the asset base is a given, while in long term horizon there is possibility of having new assets in operation. The conclusions of these different assessments, according to their time horizon, may be used to support different decisions and actions. A shorter time horizon assessment is used to support system operation decisions, whereas a longer time horizon assessment may be used to recommend investment decisions in generation, grids, storage, demand-side response mechanisms, etc.

In the framework of Med-TSO, a Mid-Term Adequacy Assessment constitutes a pivotal opportunity to identify some of the fundamental benefits of an interconnected regional power system. In system adequacy terms, interconnections may be regarded as opportunities to pool resources among different individual power systems, aiming at strengthening the interconnected system while reducing burdens for reserve and redundancy within each national system. Therefore, an integrated regional Mid-Term Adequacy Assessment facilitates exploring the full potential of the existing and new envisioned interconnections, by highlighting their merits in terms of their contribution to the security of supply. Such merits are enhanced by the well-known existing complementarities between Med-TSO countries in terms of generation and demand profiles.

1.2. How is an Adequacy Study performed?

Considering the variability and randomness associated with the input variables used for an adequacy analysis, the most suitable method to perform a mid-term adequacy assessment is a probabilistic approach, such as a Monte Carlo (MC) simulation, with an hourly granularity on a full simulated year depicted in Figure 1.

The input variables of a MC simulation for adequacy assessment are the following:

Climate data: several historical years of interdependent climate data are used, including data on wind, temperature, solar irradiance, and humidity. These data sets are used to estimate the output of each type of generation technology, combining the climate data with the envisaged installed capacities. Additionally, the climate data are used to build the climate-dependent part of the demand time series. The interdependent characteristic of climate/weather data is very important, in order to ensure consistency among the simulated input data and time series of supply, demand and grid status.

Demand: estimates of demand hourly profiles at the target year. Based on available climate data, different demand time series could be used to consider climate-dependency of part of the electrical demand

Grid: The estimated Net Transfer Capacities shall be provided in order to model the exchange balance between bidding zones.

Supply: Available generation capacity and generation profiles for climate-dependent generation at the target year. Planned and random generation outages must also be added to the analysis.

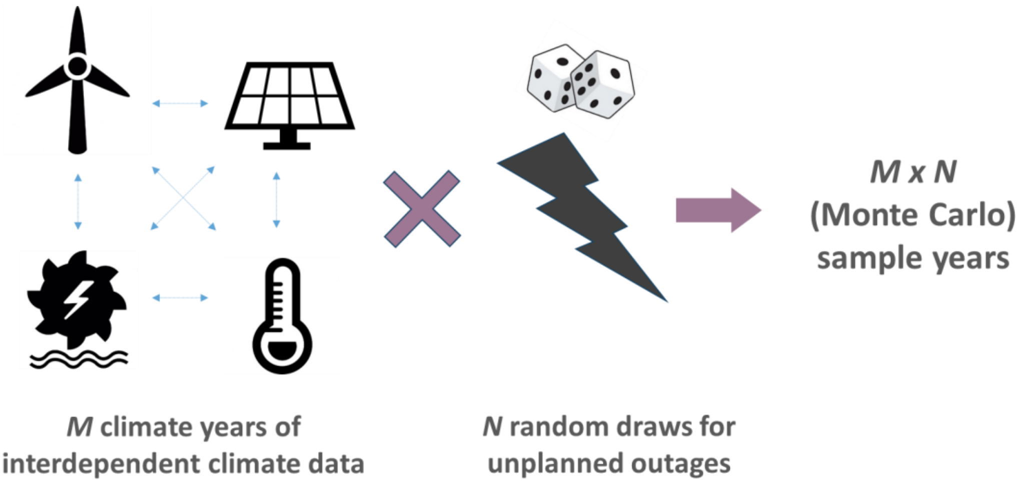


Figure 1 Monte-Carlo years building principle - Source: ENTSO-E

Several possible scenarios (or time-series) for each variable are constructed to assess adequacy risks under various conditions for the timeframe under analysis. For all those scenarios, hourly calculations are performed for the whole geographical perimeter.

A range of indicators may be used for mid-term adequacy assessments; each indicator may provide specific insight on adequacy assessment. These include but are not limited to:

- Expected Energy Not Served (EENS), for each simulation year, if the geographical zone's electricity demand cannot be supplied by its own available resources including imports, this will lead to (EENS) and can be expressed in GWh per year.

- Loss of Load Expectation (LOLE), the period (Number of Hours) where there is EENS can be represented by (LOLE) and can be expressed in hours per year). This indicator is very useful for overview of adequacy in long period and is commonly used in mid-term adequacy assessments.
- Loss of Load Probability (LOLP) indicates the probability of no-load coverage, combining duration and severity of failures of individual sources and can be expressed by (%).

2. MAA for Med-TSO: Members expectations

The survey circulated among Med-TSO members allowed to construct a general view of the content of MAA studies defining the scope and the perimeter of such studies. The dedicated task force was able to answer some of the key questions in relation with this kind of studies. The detailed answers on the survey are included in Appendix 1.

2.1. Objectives of MAA studies

Q: Do Med-TSO's members consider a Mid-term Adequacy Assessment useful?

All Med-TSO's members acknowledge that a Mediterranean Mid-term Adequacy Assessment could be a useful tool since it will provide TSOs and relevant stakeholders with comprehensive support to take balanced and consistent decisions related to the level of adequacy of their power system. The MAA intends to provide elements to answer questions such as:

a. Will the country 'A' has enough capacity to cover power demand even under severe/extreme conditions at a certain time horizon?
b. How do interconnections contribute to reducing shortage situations?

2.2. Feasibility of MAA studies

Q Is it feasible to perform such studies?

Despite challenging, it is certainly doable. The prerequisite to perform the studies is having access to countries' data on climate, demand, supply and network capacity.

2.3. Methodology of MAA studies

QIs there an agreement on which methodology should be adopted and implemented?

It is acknowledged that in order to assess the balance between net available generation and net load levels in the power system on a continuous basis, due to the increasing level of variable renewable energy sources, a probabilistic "Monte Carlo" approach is preferable. The core idea of the MC method is to use random input variable samples or inputs to explore the behaviour of a complex system or process under several possible future grid states. The MC method is suited to the MAA studies as there is a high number of random input variables influencing a power system's adequacy.

2.4. Overlaps with National Studies

Q: Are there any overlaps with National studies?

Security of Supply is a responsibility and prerogative of each country. Typically, TSOs run adequacy studies at national level, which might show higher granularity than the studies performed at Med-TSO level. Nonetheless, MAA could be complementary in providing additional information on the contribution of interconnections to adequacy.

2.5. Overlaps with other Studies

Q : Are there any overlaps with other studies e.g. ENTSO-E MAF / ERAA?

ENTSO-E and Med-TSO have members in common, namely TSOs located in countries on the northern shore of the Mediterranean Sea. All ENTSO-E and Med-TSO members fulfil the common mission to ensure the security of their power system and are deeply involved in achieving new and challenging climate objectives, having all the European and Mediterranean countries signed the Paris Agreement. Med-TSO and ENTSO-E signed a cooperation agreement aiming to enhance coordination in different areas, exploit synergies and ensure consistency between similar studies. Med-TSO MAA and ENTSO-E MAF / ERAA will therefore complement each other since MAA is expected to cover the Mediterranean region not covered by ENTSO-E studies in the objective of completing an unfinished picture of Mid-Term adequacy situation in the Mediterranean basin. For the interconnected Power Systems, in order to properly quantify the contribution of interconnection in times of scarcity, ENTSO-E and Med-TSO agree to join forces and cooperate to produce reliable and consistent results.

2.6. Time horizons for MAA studies

Q. Time horizons?

According to Med-TSO's members, the MAA should span the timeframe +3/+5/+7 up to 10 years ahead maximum. Care should be taken, when it comes to longer time horizons due to the higher degree of uncertainties and to ensure consistency, avoiding overlaps and inconsistency with scenarios for planning studies.

2.7. Periodicity of MAA studies

Q. Frequency?

The objective is to perform a yearly MAA publication, provided the required resources are available to perform such studies yearly.

2.8. Publication

Q. When will be the first publication?

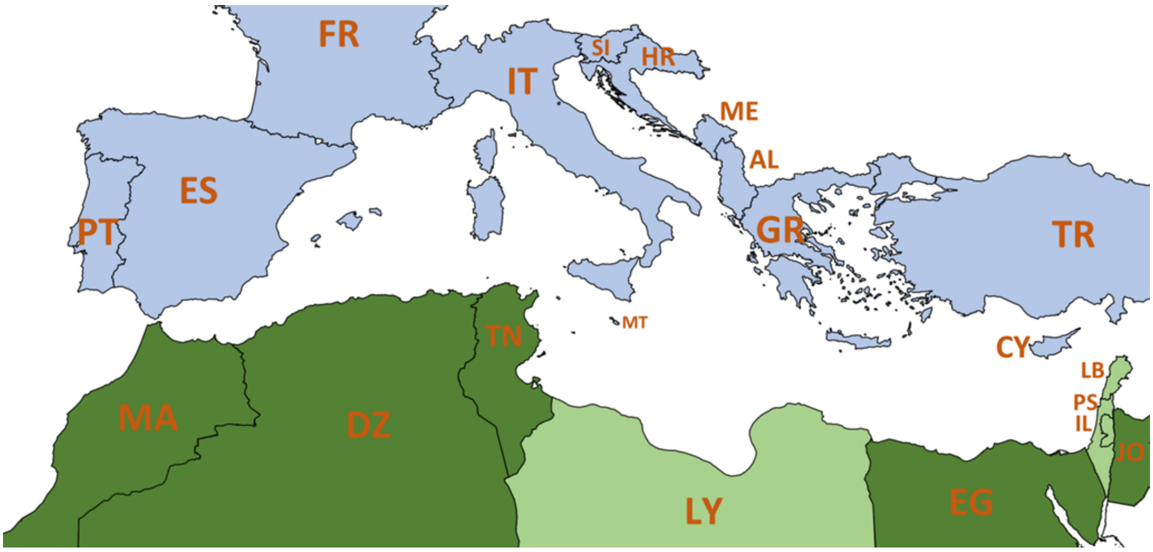
By collecting data during the 4Q2021, it should be feasible to perform a first attempt of “dry run” Med-TSO MAA by the end of 2022. The publication of the results of this first “dry-run” will depend on the robustness of the outcome.

3. Application: 2025 & 2027 Adequacy assessment for a selection of countries

3.1. Approach and methodology

This Report presents the adequacy situation among non-EU Med-TSO members expected in 2025 and 2027. With this assessment, Med-TSO is aligning with the world-wide best practice and the latest development of the EU regulations[1]. These investigations consider the security of electricity supply to consumers through a detailed power system adequacy assessment, using probabilistic criteria. This approach is inevitable due to the stochastic nature of renewable energy systems (RES), their intermittency, and the power system operation based on open electricity market conditions which raise the question of power system adequacy in the short, mid, and long run. Moreover, the integration of immense amounts of RES must be closely followed by the commissioning of devices that can provide adequate power system flexibility. With all the changes in the electricity sector in countries around the Mediterranean Sea - from the energy markets development, integration of renewable energy sources and efforts to decarbonize energy systems - adequacy monitoring becomes more and more important.

This Mid-Term Adequacy Assessment Report provides information about potential adequacy issues during years 2025 and 2027 in the 5 MED-TSO members: Morocco, Algeria, Tunisia, Egypt, and Jordan, depicted in Figure ***2***.



Med-TSO members that is analysed in this adequacy assessment
Med-TSO members that is not analysed in this adequacy assessment
Med-TSO members taking part to the ENTSO-E adequacy study

1 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0943&from=en

Figure 2: MED TSO members and neighboring countries (source: MED-TSO)

Data for Israel, Lebanon, Libya, and Palestine is not available at the moment.

The analyses have been carried out with the ANTARES simulator, having in mind the following:

- The ANTARES (ANTARES – A New Tool for Adequacy Reporting of Electric Systems) simulator, developed by the French TSO RTE, was specifically designed and created to tackle generation adequacy assessments in a probabilistic manner.
- The ANTARES simulator is well recognized and used in ENTSO-E for TYNDP and Adequacy assessments (ENTSO-E 2020 edition of the Mid-Term Adequacy Forecast (MAF) was carried out with ANTARES)
- The ANTARES simulator was already used by Med-TSO in the project "Mediterranean Master Plan 2020"
- ANTARES Simulator is an Open-Source software; hence it is accessible to all Med-TSO members.

Within this assessment, mid-term risks that might occur in the next 3-5 years that are likely to result in a significant deterioration of the electricity supply situation are analysed.

The data collection process has been carried out by Med-TSO, and it included the collection of all relevant data and information necessary to model the power systems of Med-TSO countries.

As a general approach, a probabilistic Monte Carlo with Unit Commitment and Economic Dispatch (UCED) model has been used, ensuring inter-zonal and inter-temporal correlation of model variables, and considering specificities of the assessed geographical perimeter. The hourly resolution has been implemented in the model and the Monte Carlo approach has been used to reflect the variability of weather as well as the randomness of supply and transmission outages.

3.1.1. Adequacy indicators and other results of adequacy assessment

Mid-term adequacy assessment is based on the following main indicators:

- **P95/P50 loss of load duration (P95/P50 LOLD).** LOLD in a given geographical zone for a given period is the number of hours during which the zone experiences ENS during a single Monte Carlo sample/simulation year; P95/P50 LOLD are LOLD in more or less severe operational conditions:
  - P95: LOLD value not exceeded with a 95% statistical likelihood (in a simplified view: that happens once in 20 years)
  - P50: LOLD value not exceeded with a 50% statistical likelihood (in a simplified view: that happens once in 2 years)

- **Loss of Load Expectation (LOLE)** in a given geographical zone for a given period is the expected number of hours per year when there is a lack of resources to cover the demand needs, within a sufficient transmission grid operational security limit.

A more detailed presentation of the relations between average, P50 and P95 values is presented in the following diagram (Figure 3).

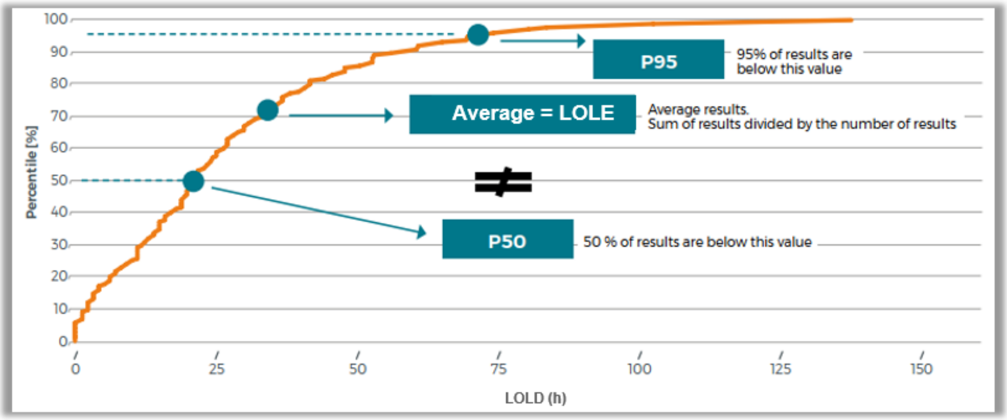


Figure 3: Illustrative Example of the relation between average, P50 and P95 values

- **P95/P50 Energy Not Serve (P95/P50 ENS).** ENS in a given geographical zone for a given period is the energy that is not supplied during a single Monte Carlo sample/simulation year, due to the demand in the zone exceeding the combination of available resource capacity and electricity imports; P95/P50 ENS are ENS in more or less severe operational conditions:
  - P95: ENS that happens once in 20 years
  - P50: ENS that happens once in 2 years
- **Expected Energy Not Served (EENS)** in a given geographical zone for a given period, is the expected value of energy not to be supplied due to lack of resources while complying with transmission grid operational security limits.
- **Relative EENS:** is a more suitable indicator to compare adequacy across geographical scope as it represents the percentage of demand in a given period which is expected to be not supplied due to lack of supply resources.
- **Dump Energy:** or RES curtailment, in a given geographical zone for a given period, is the RES energy that would be generated in excess of demand, and that cannot therefore be actually produced, for instance when the load is low and the in-feed from renewable is high.

➢ **The Capacity Margin** for a given geographical zone for a given point in time is the difference between the available and engaged TPP capacity, as presented in the following diagram[2] (***Figure 4***). These values point to the excess of capacity in the system.

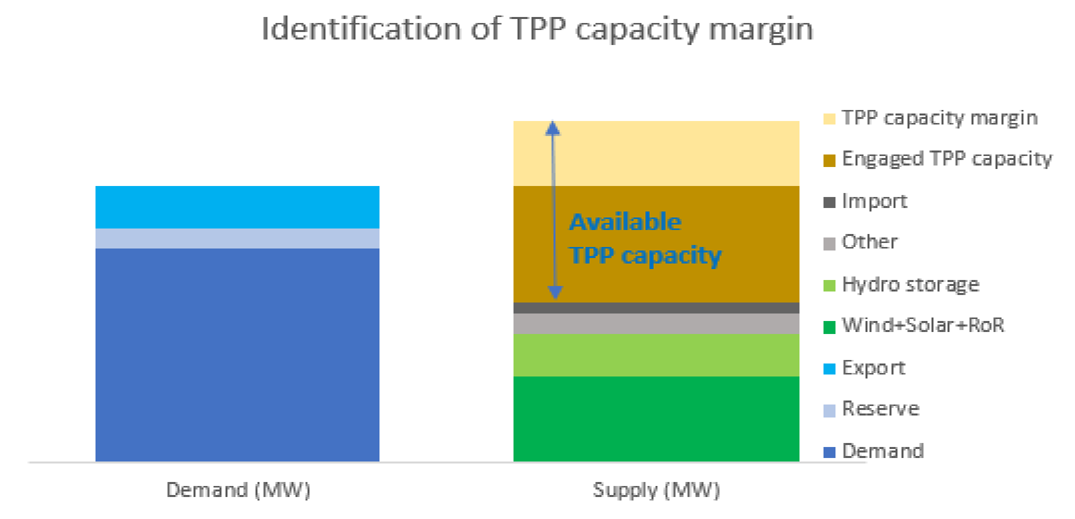


Figure 4: Illustrative Example of TPP capacity margin identification

Besides the above-mentioned main indicators, mid-term adequacy assessment analyses include temporal screening that gives the indication when adequacy risks are the highest.

In addition, available thermal capacities and thermal capacity margins are also presented at a daily/hourly level pointing to the excess of thermal capacities in cases when adequacy risks do not exist or pointing to the specific days when adequacy risks are at maximum. Average and minimum daily values of all simulated MC years are presented as given in the following figures (Figure 5 & Figure 6).

[2] Traditionally, only TPP provide a reserve margin, due to their intrinsic dispatchability; innovations are being pursued to allow also other power plants typologies to provide capacity margin.

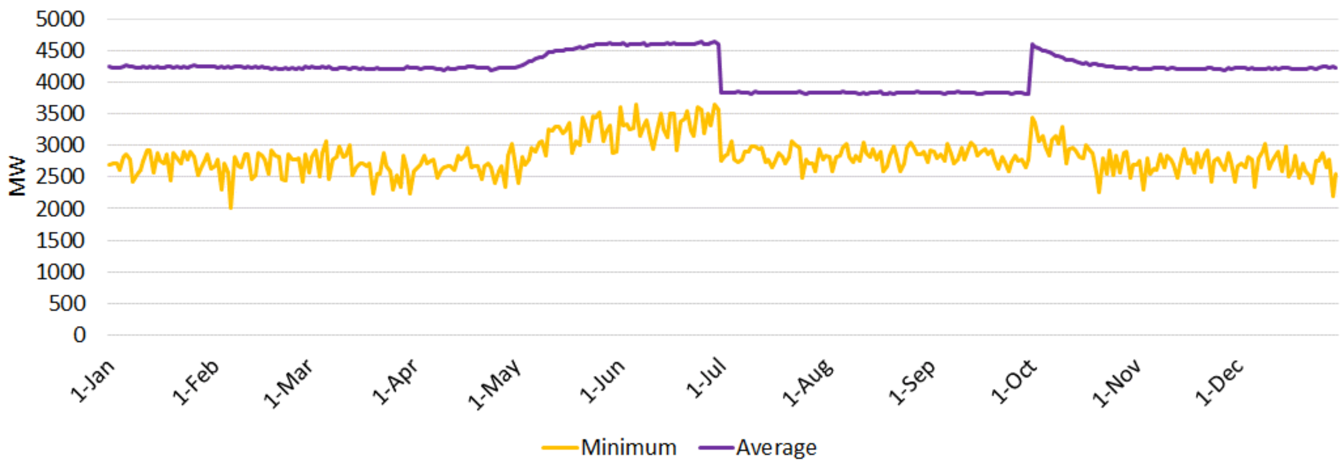


Figure 5: Illustrative example of TPP capacity available as reserve margin

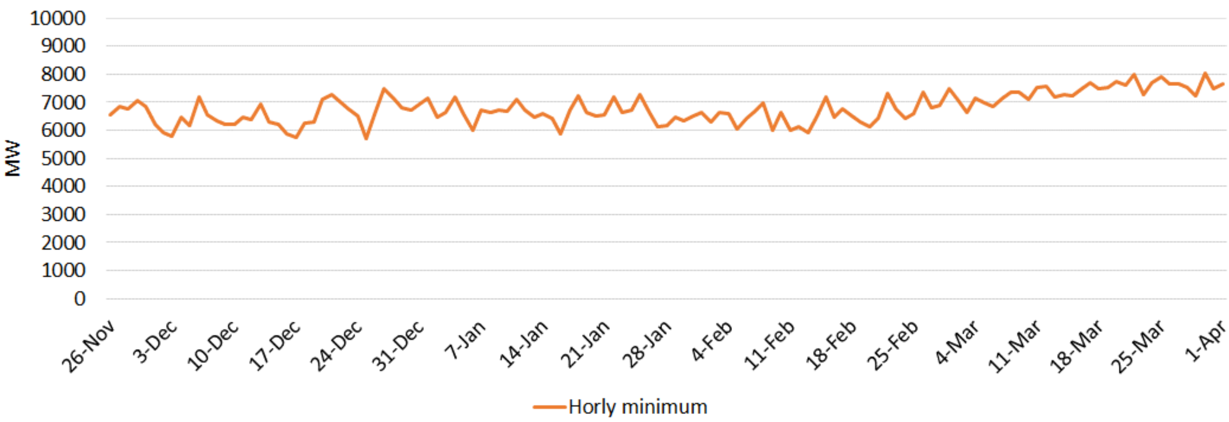


Figure 6: Minimum hourly TPP margin on each day of the analysed period

3.1.2. Data collection and preparation of the database

This process included a collection of all relevant data and information necessary to model the power systems of Med-TSO. In case of missing data, standard values and appropriate assumptions have been used, all based on publicly available data from relevant sources such as National Network Development Plans and annual reports, Med-TSO publications[3], TYNDP 2020, ERAA 2021 and any other relevant documents from ENTSO-E website.

As an additional quality assurance, all provided data have been analysed and sanity checks were conducted.

3 https://www.med-tso.com/publications.aspx?f=&title=Reports

Relevant data have been collected via forms specialized for collection of the data for different generation technologies, interconnections and demand. The set of forms (set of excel files) presents a database that will be regularly updated for each seasonal and mid-term adequacy assessment.

For this Mid-Term Adequacy Assessment data have been collected during February/March 2022 and presented in the Inception Report which was reviewed and approved in May 2022. During Summer 2022, some input data have been revised and updated (whether for demand or RES capacities) but they have not been used in this adequacy assessment.

Within data collection particular attention has been paid to the following data:

1. **Hourly demand per each market area/country**

   Hourly demand data per each market area to different climatic conditions (mainly for the period 1981-2019 or similar, depending on the country). Demand data include losses in the transmission network but do not include self-consumption of generating units.

   Data about market-based demand-side responses are not provided and are not modelled.

   Additional demand during the charging of storage units is obtained as the result of the simulations.

2. Supply

Supply data include the best estimates of available supply resources considering planned and unplanned outages. Supply resources are all available generation and storage units in the assessed Med-TSO systems which are modelled on the unit-by-unit level. Planned outages are modelled as random with a specified duration and period of occurrence. Unplanned outages are not known in advance and to incorporate them, many random drawings are taken, assuming given (or standard) rates of forced outage of generation assets.

Supply-side technical constraints are also considered. These constraints include minimum and maximum generating capacities, possible capacity reduction, seasonal loss of efficiency, must run obligation, reduced capacity due to provision of FCR, etc.

Non-dispatchable weather-dependent generation (wind, solar or other renewable generation) is modelled by direct application of the time series provided by Med-TSO. These time series are based on PECD but take into account used technologies and zone splitting of each country.

The hydro generation is modelled using provided generation data, reservoir size and other relevant information, where available. Storage units are defined in terms of net discharge capacity, net charging capacity, storage capacity and cycle efficiency rate.

Reserve requirement is modelled by combining the reduction of available thermal capacity (usually due to provision of FCR) and increase of demand for the required balancing reserve (FRR or FCR+FRR). A difference between these two ways of reserve modelling lays in the fact that in the second one reserve capacity requirements (MW) are followed by energy requirements (MWh) which then make a distortion to all market or economic indicators (exchanges, price,…etc) calculated within the simulations. Due to artificial energy requirements in this case, this way of reserve modelling is not applicable for the systems with large participation of hydro power plants.

In the first type of reserve modelling, no energy requirements are involved and only certain level of the capacity in TPPs is always kept aside (and not engaged to cover the load). This does not make any distortions in system operation results, but it can happen that there are some hours during the year in which not full coverage requirements are satisfied due to outages of TPPs (planned or forced).

Having in mind the structure of analysed power systems (almost no hydro generation), balancing reserve has been modelled as demand increase in all countries having in mind that this approach is more strict and conservative providing adequacy results that are on the safe side. Only in cases when TSO provided capacity reduction at TPPs due to FCR provision, given reduction has been applied (and only FRR requirements have been modelled as demand increase).

Considering the above-mentioned, data collection covered the following information:

- Installed capacities per technology
- Technical characteristics of generating units, such as Pmin, Pmax
- Expected Maintenance schedule or other information for some countries
- Must run obligations
- Expected generation for HPPs
- Net discharge capacity, net charging capacity, storage capacity and cycle efficiency rate for storage units
- Hourly wind and solar generation for several climatic years
- Amount of reserve requirements

Concerning thermal units, it should be noted that available capacities take into account forced and planned outages, as well as derating factors which define the reduction in available thermal capacities due to reduced possibilities for efficient cooling during the summer season. In general, for the purpose of this mid-term adequacy assessment planned outages are not envisaged in the period from the 1st of May to 1st of October[4], except in Jordan, where planned outages are not envisaged in the period from 1st of June to the 1st of 1st of October and from 1st of December to the 1st of February. The reason for this change of the available maintenance period lays in different distribution of monthly consumption in Jordan in comparison to other countries in the region, as described in the next chapter.

3. **Grid**

Countries are modelled as copper plates, coupled via interconnectors described by NTCs values, provided by Med-TSO.

Since NTC values related to HVAC interconnections already take into account n-1 security constraints, no additional outages are applied to them. In the case of HVDC interconnections, forced random outages are applied with the rate of 6% and outage duration of 1 day (similar to what was applied in ERAA2021 by ENTSO-E).

Considering that the interconnection grid can play a key role in the country's security of supply and to assess that influence, two separated scenarios have been simulated:

- **Interconnected operation of the analysed countries**
- **Isolated operation of the analysed countries**

[4] In some countries periods without maintenance on thermal units are different, like e.g., in Tunisia where maintenance on TPPs are not realized between June 15th and September 15th.

3.1.3. Overview of the MED-TSO power systems in 2025 and 2027

The overview is organized in alphabetical order, including submitted data, assumptions and proxies that are used to develop the corresponding market model using the Antares software tool.

All relevant parameters are presented so that the reader may check their plausibility and confirm their usability for the adequacy analyses.

DEMAND EVOLUTION

Table 1.& Figure 7 presents the expected consumption in year 2025 and 2027. These values are the average annual consumption for 38 climatic years (1982 to 2019).

Table 1: Expected consumption and growth rates

Med-TSO Member	Expected demand in 2025 [TWh]	Expected demand in 2027 [TWh]	Average annual growth rate from 2025 to 2027 [%]
DZ	93.0	101.4	4.4%
EG	245.8	264.1	3.7%
JO	21.8	22.5	1.6%
MA	44.5	47.2	3.0%
TN	21.5	22.9	3.2%
TOTAL	**426.7**	**458.1**	**3.6%**

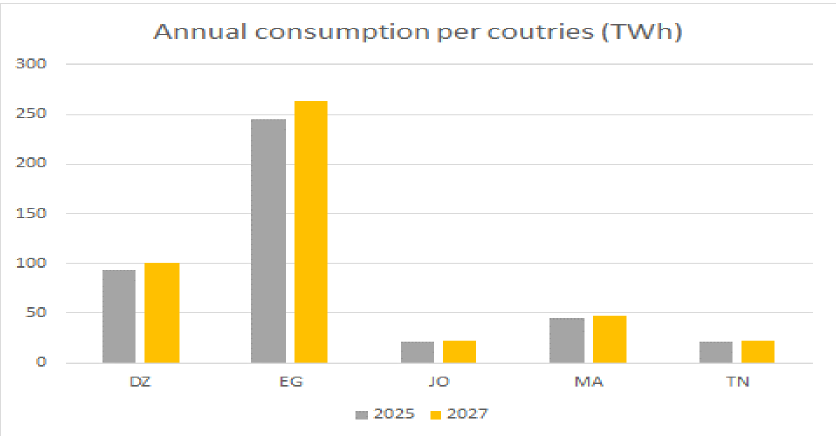


Figure 7: Expected annual consumption per country in 2025 and 2027

Consumption in Jordan and Tunisia is the lowest among the analysed 5 countries. The highest is consumption in Egypt, almost 10 times higher than in Jordan or Tunisia. Consumption in Morocco and Algeria are in between, higher than in Jordan or Tunisia around 2 or 4 times.

In all countries, except Jordan, consumption during winter is significantly lower than in summer (Figure 8). Maximum demand is expected during summer months. Due to this monthly distribution of the load, TPPs' maintenance activities are not allowed in summer, in months May, June, July, August and September.

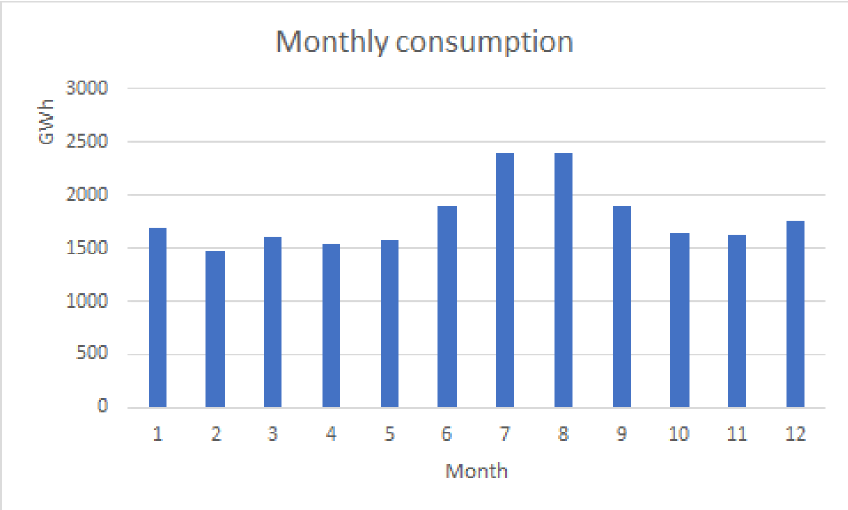


Figure 8: Monthly consumption in Tunisia in 2025

In Jordan, consumption during winter, especially in January, is similar to consumption in July and August, as it can be seen from the following diagram (Figure 9).

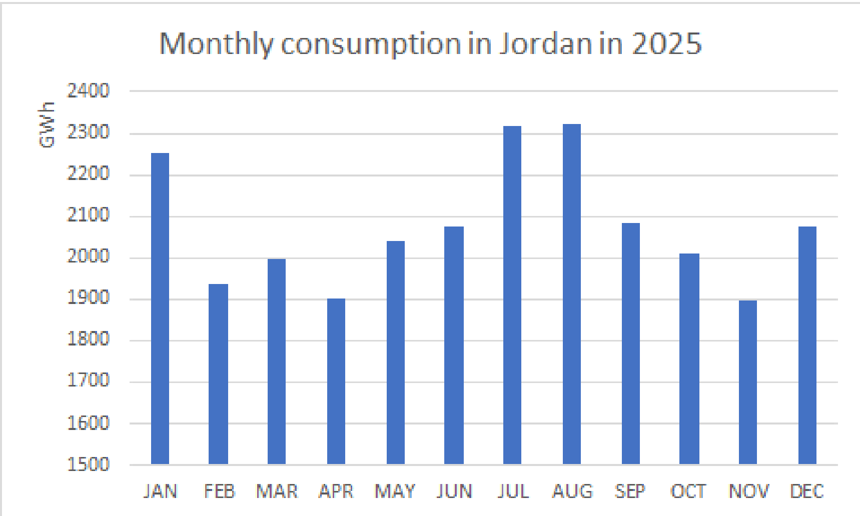


Figure 9: Monthly consumption in Jordan in 2025

Due to this monthly distribution of the load, in case of Jordan, maintenance activities are not allowed during: January, June, July, August, September and December.

Concerning, daily patterns, in each country there are seven rather similar daily profiles with one or two peaks within a day. In Algeria, daily profiles are almost the same and no day within a week is different. In the case of Egypt and Jordan, demand is slightly lower on Fridays while in Morocco and Tunisia on Sundays.

GENERATION CAPACITIES EVOLUTION

The following table (Table 2 & Figure 10,Table 3 & Figure 11) provides information about generation capacities in 2025 and 2027. Total generation capacities in the observed region in 2025 are expected to be 116 GW, with almost 93 GW (or around 80%) in thermal units. Share of thermal units decrease in 2027 to 76% although total thermal capacity raise to 128 GW.

Table 2: Total generation capacities (MW) per technology in 2025

Med-TSO Member	Expected WPP capacity		Expected SPP capacity		Expected HPP capacity		Expected TPP capacity		TOTAL [MW]
	[MW]	Share in Total [%]	[MW]	Share in Total [%]	[MW]	Share in Total [%]	[MW]	Share in Total [%]	
DZ	**0**	**0.0%**	**1700**	**6.6%**	**95**	**0.4%**	**24069**	**93.1%**	25864
EG	**4875**	7.8%	2463	4.0%	2128	3.4%	52730	84.8%	**62196**
JO	**621**	9.6%	1974	30.6%	-	-	3860	59.8%	**6455**
MA	**3473**	23.0%	2641	17.5%	1656	11.0%	7319	48.5%	**15089**
TN	**722**	10.7%	1036	15.4%	-	-	4963	73.8%	**6721**
TOTAL	9691	**8.3%**	**9814**	**8.4%**	**3879**	**3.3%**	**92941**	**79.9%**	**116325**

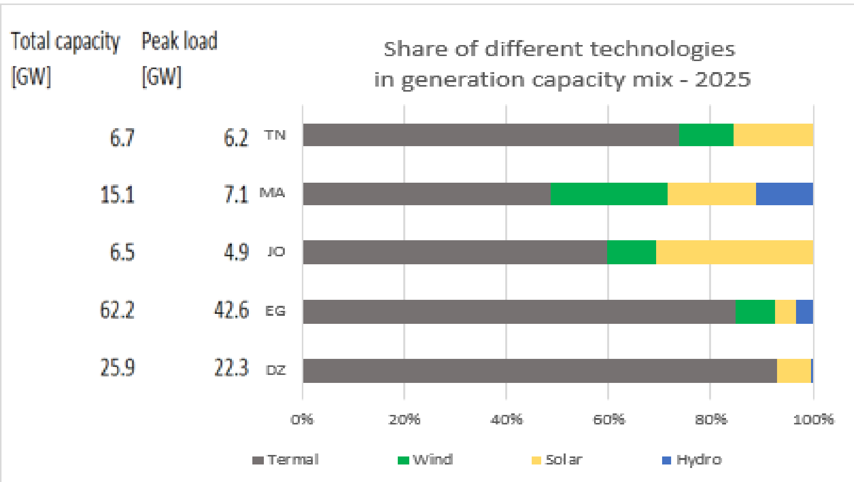


Figure 10: Generation capacity mix and peak load in 2025

Table 3: Total generation capacities (MW) per technology in 2027

Med-TSO Member	Expected WPP capacity		Expected SPP capacity		Expected HPP capacity		Expected TPP capacity		TOTAL [MW]
	[MW]	Share in Total [%]	[MW]	Share in Total [%]	[MW]	Share in Total [%]	[MW]	Share in Total [%]	
DZ	**0**	**0.0%**	**2700**	**10.1%**	**95**	**0.4%**	**24040**	**89.6%**	26835
EG	**6500**	9.3%	6140	8.8%	2128	3.0%	55202	78.9%	**69970**
JO	**621**	8.5%	2380	32.6%	-	0.0%	4310	59.0%	**7311**
MA	**3730**	24.0%	2841	18.3%	1656	10.7%	7319	47.1%	**15546**
TN	**1037**	12.7%	1271	15.6%	-	0.0%	5863	71.8%	**8171**
TOTAL	11888	**9.3%**	**15332**	**12.0%**	**3879**	**3.0%**	**96734**	**75.7%**	**127833**

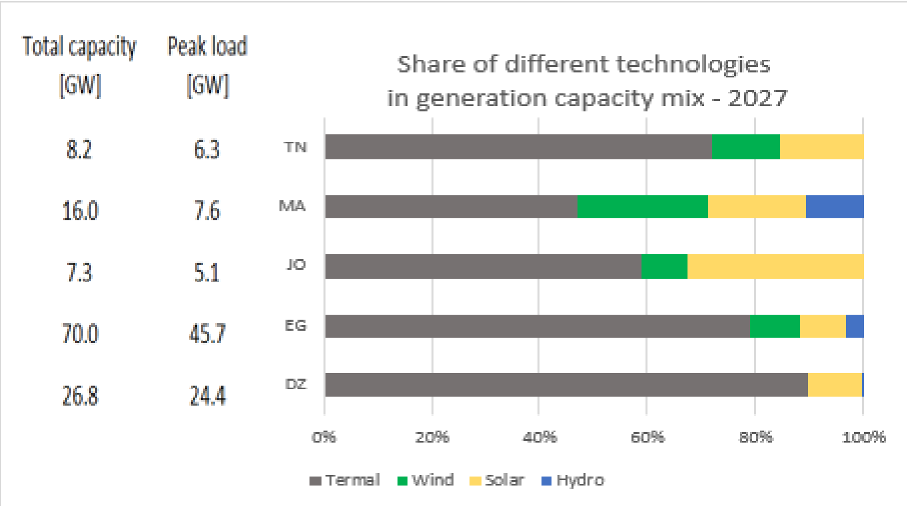


Figure 11: Generation capacity mix and peak load in 2027

Relevant hydro capacities exist only in Egypt and Morocco. In Morocco, there is also 814 MW in closed loop PS HPPs. The highest wind + solar capacities participation in total generation capacities is noted in Jordan and Morocco where their participation reaches more than 40% in 2025 and 2027. It should be noted that in Morocco, 530 MW of solar capacity is in solar thermal farms with storage, which present a relevant source of flexibility.

Capacity factors related to wind and solar generation are presented in Table 4. It is worth mentioning that capacity factors take into account the technology used and also the zone splitting of each country.

Table 4: Wind and solar capacity factors for all countries in 2025 and 2027

	2025		2027	
Country	Wind CF	Solar CF	Wind CF	Solar CF
DZ	-	21.2%	-	21.2%
EG	39.3%	26.3%	39.3%	26.3%
JO	32.5%	22.8%	32.5%	23.2%
MA	44.8%	25.1%	45.9%	26.8%
TN	38.5%	25.7%	39.3%	25.7%

In the period till 2027, all countries plan to develop wind and solar capacities and to reduce share of thermal units in the generation capacity mix. This reduction is between 5 % (in Jordan) and 20% (in Tunisia).

INTERCONNECTIONS BETWEEN COUNTRIES

Summarized NTC values provided by Med-TSO are used as available cross-border capacities and we assumed that these capacities are fully available for commercial exchanges for the entire calculation period.

Antares model included the power systems of 5 analysed Med-TSO members with detailed generation capacities and demand and a simplified representation of the transmission network and cross-border capacities, represented as NTC values. The internal transmission network has not been modelled in the market simulator. In addition to this, in the case of the borders with countries outside of the Med-TSO region, exchanges have been modelled using hourly data provided by Med-TSO members or as the export of only available excess of generation that does not impact system's adequacy; imports from third countries are instead set to zero as a prudential assumptions that they would not contribute to adequacy.

Summary of the interconnection capacities and given exchanges are presented in the following tables.

Table 5 Summarized NTC values Table

Interconnection NTC [MW]	2025	2027
DZ-TN	600	600
TN-DZ	600	600
DZ-MA	600	600
MA-DZ	300	300
EG-LY	180	180
LY-EG	0	0
TN-LY	250	250
LY-TN	0	0
EG-JO	450	750
JO-EG	450	750
MA-ES	600	600
ES-MA	900	900

Table 6 Max hourly exchanges

Interconnection Max hourly exchanges [MW]	2025	2027
EG-SD	100-240	100-240
SD-EG	0	0
EG-SA	1000-1500	1000-1500
SA-EG	1000-1500	1000-1500
JO-LB	0	0
LB-JO	0	0
JO-PS	80	80
PS-JO	0	0
JO-IQ	150-200	150-200
IQ-JO	0	0
JO-SA	0	500
SA-JO	0	500

Reserve requirements modelling

Regarding reserve requirements (Table 7), we noticed that for some countries (EG, MA) the percentages of the capacity reduction at thermal units due to the provision of FCR has been provided and these percentages have been applied in Antares modelling. No additional FCR requirements have been modelled.

In countries in which these percentages are not known, FCR has been modelled as demand increase.

FRR requirements have been modelled as demand increase in all countries.

Table 7: Balancing reserve requirements

	Reserve	2025	2027
DZ	FCR+FRR [MW]	400	400
EG	FCR+FRR [MW][5]	600	600
JO	FCR+FRR [MW]	360	360
MA	FCR+FRR [MW]	600	600
TN	FCR+FRR [MW]	450	450

[5] FCR for EG & MA has been modeled through reduced thermal capacity.

3.2. Adequacy Situation Overview

3.2.1. Number of MC years and results' convergence

MC years have been constructed by combining climate-dependent variables (wind, solar and demand from 38 climatic years), available hydro time series and given/random outages. Since hydro data are not available for the same climatic years as for the wind, solar and demand, available years of hydro generation have been combined with other climate-dependent data. Then the MC combinations have been developed as follows:

- Climate years (each of 38 years from the period 1982- 2019) are selected one by one
- Climate years are combined with 3 hydrological years related to Morocco's HPPs (2018-as wet, 2019-as average and 2020- as dry)
- Each climate year is associated with random outage samples, i.e., randomly assigned unplanned and planned outage patterns for thermal units.

The developed model was thoroughly tested concerning all relevant parameters of the generation portfolios of the different power generation technologies including RES, different weather conditions and different status of the interconnections. The sufficient number of MC years that can provide sufficiently good convergence of the main results has been determined as 684 (38 x 18).

The sufficient number of MC years that ensures good convergence of results has been defined by assessing the coefficient of variation (α) of the EENS metric and its change.

$$\propto_N = \frac{\sqrt{Var[EENS_N]}}{EENS_N}$$

Where EENSN is the expectation estimate of ENS over N, the number of Monte Carlo years, i.e., $EENS_N = \frac{\sum_{i=1}^{N} ENS_i}{N}$, i=1…N and Var[EENSN] is the variance of the expectation estimate, i.e. $Var[EENS_N] = \frac{Var[ENS]}{N}$.

The evolution of convergence criteria is presented in the following figures (.Figure 12 & Figure 13)

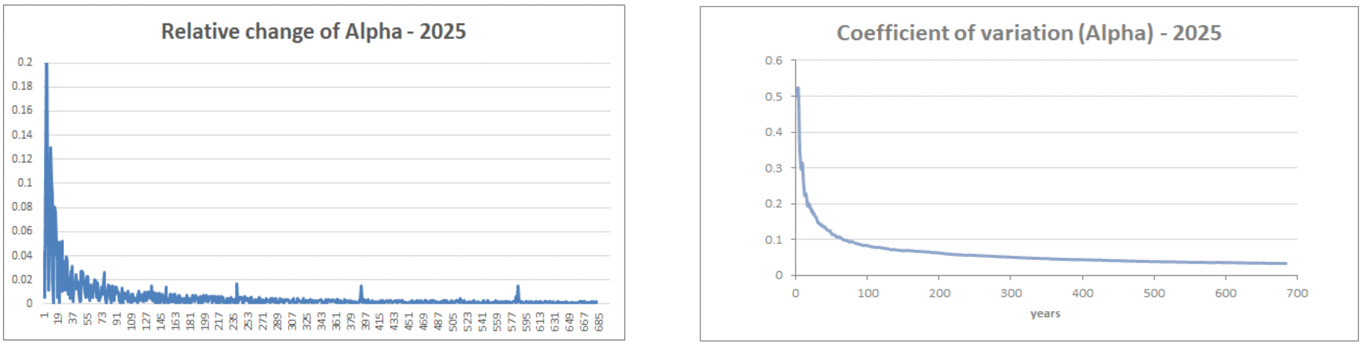


Figure 12: Evolution of convergence criteria for 684 MC years, simulations for year 2025

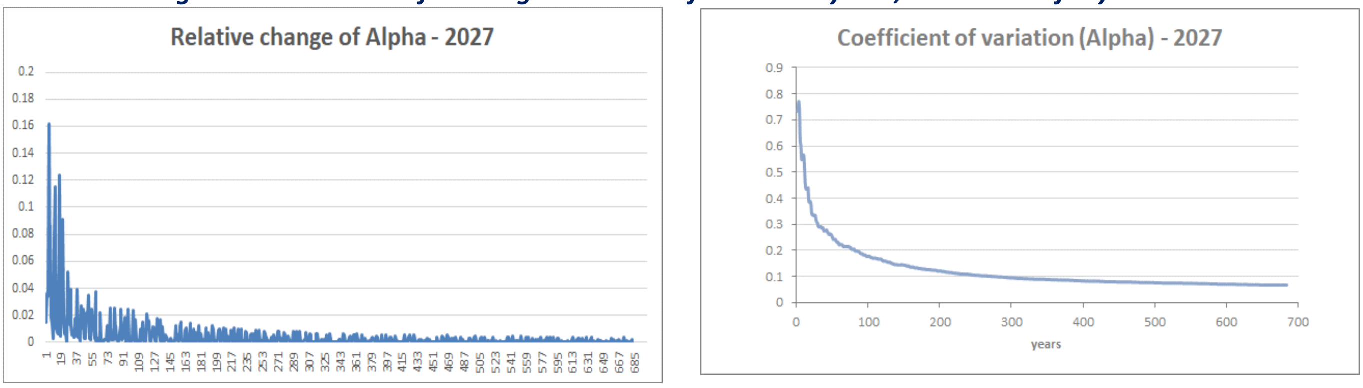
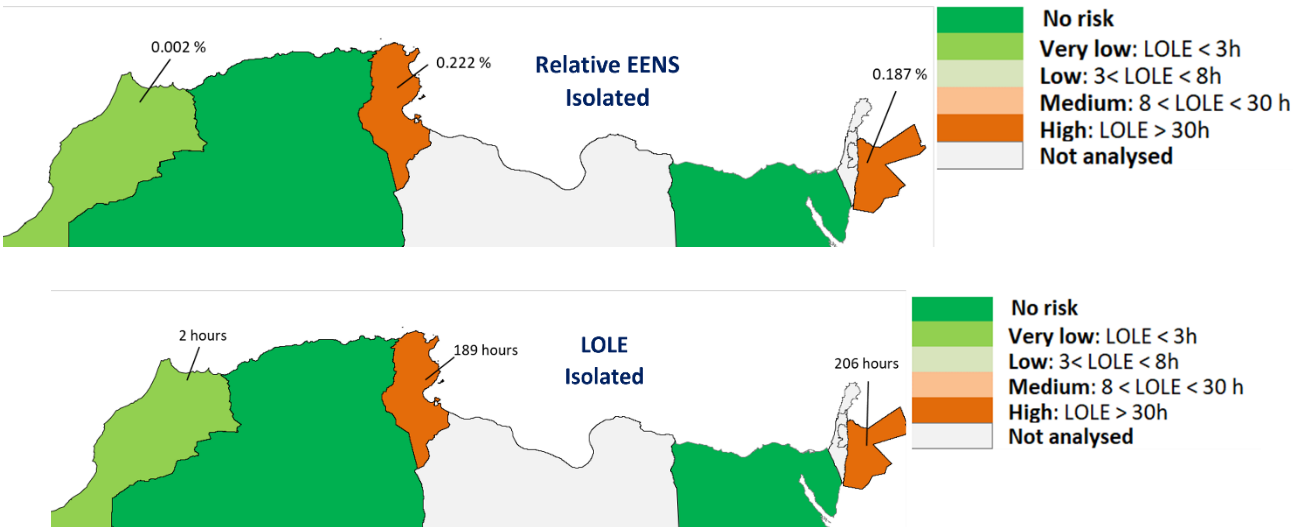


Figure 13: Evolution of convergence criteria for 684 MC years, simulations for year 2027

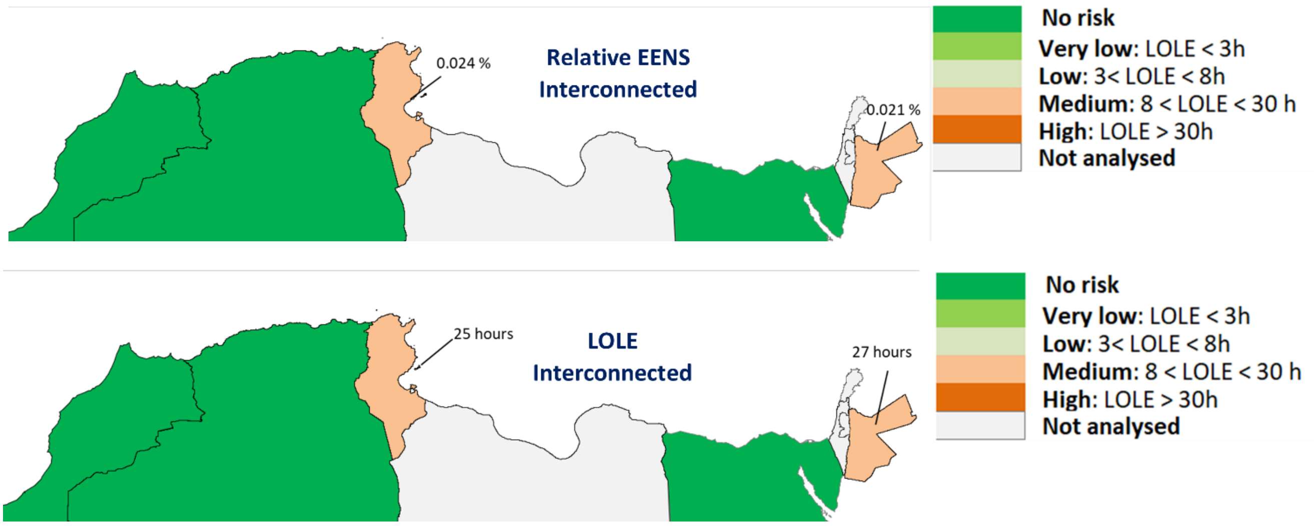
3.2.2. Adequacy assessment in 2025 and 2027

The adequacy situation is assessed using a two-step approach. In the first step, adequacy under isolated system operation is evaluated as seen in Figure 14. In the second, adequacy under interconnected system operation is assessed to quantify the importance of Med-TSO interconnections as seen in Figure 15.

In the case of a theoretical isolated scenario, adequacy risks are observed in all countries except Egypt, although they could be considered as small or marginal in Morocco and Algeria, especially in 2025. In case of Jordan and Tunisia, adequacy risks are very high under isolated system operating mode, with somewhat better situation in 2027 than in 2025. Expected generation development between 2025 and 2027 in these 2 countries provides additional capacity and reduces adequacy risks. In case of Morocco and Algeria expected consumption increase is similar or even higher than increase in generation capacities and adequacy risks increase between 2025 and 2027.

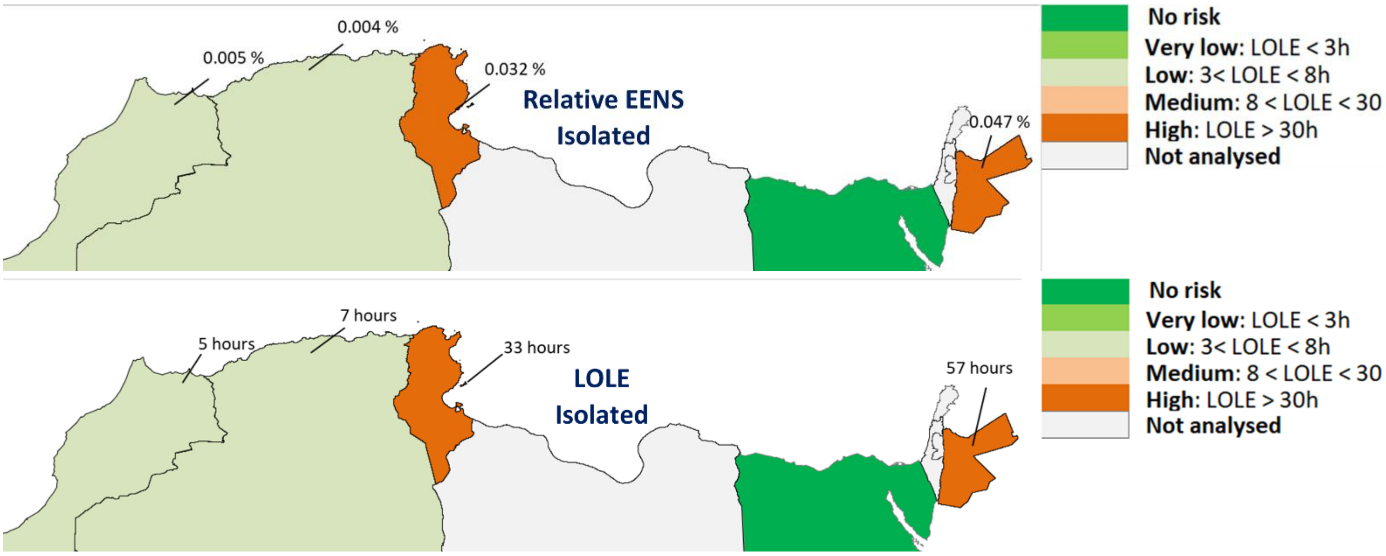


Relative EENS and LOLE for Isolated Operation – 2025

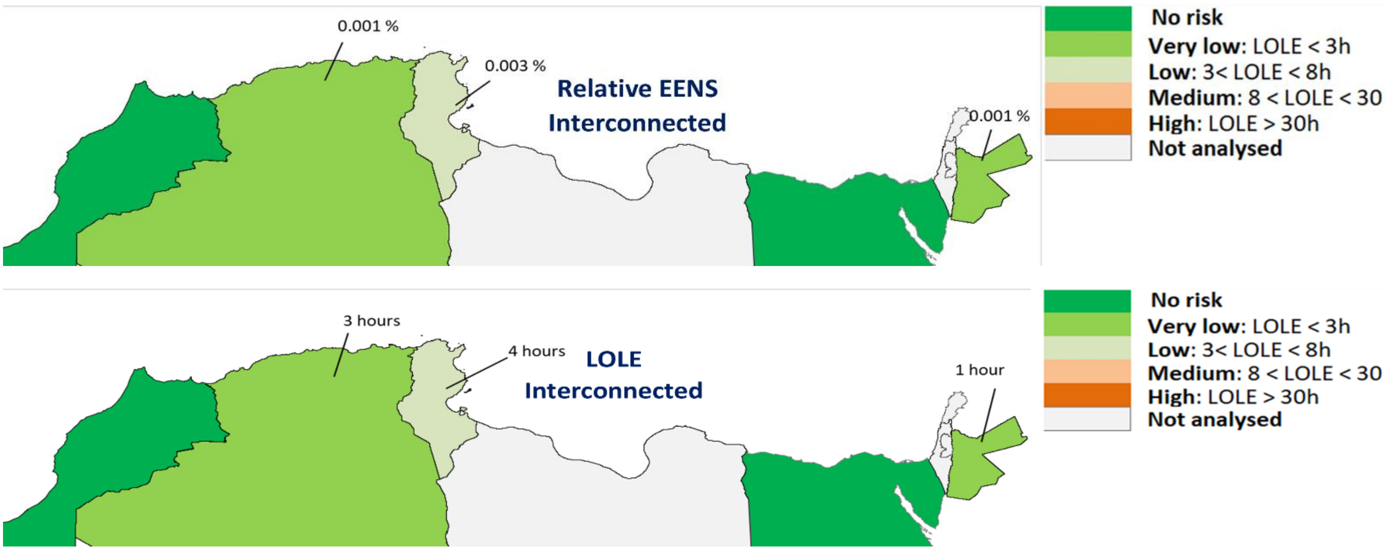


Relative EENS and LOLE for Interconnected Operation – 2025

Figure 14: Relative EENS and LOLE in 2025



Relative EENS and LOLE for Isolated Operation – 2027



Relative EENS and LOLE for Interconnected Operation – 2027

Figure 15: Relative EENS and LOLE in 2027

In the case of interconnected operation, adequacy risks are observed in all countries except Egypt and Morocco. In case of Jordan and Tunisia, adequacy risks are high, but they drop between 2025 and 2027 which is the opposite to Algeria where adequacy risks increase in the same period. Increase of consumption in Algeria is not followed by corresponding generating capacity increase and adequacy risks are increasing after 2025.

In the next tables (Table 8 & Table 9) annual ENS and LOLD results for 2025 and 2027 are given for all analysed countries.

Table 8: ENS and LOLE for Interconnected and isolated scenario – 2025

Country - 2025	Interconnected	Isolated
DZ	EENS: 63 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 0 MWh	EENS: 211 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 269 MWh
	LOLE: 0.16 h 50th percentile LOLD: 0 h 95th percentile LOLD: 0 h	LOLE: 0.45 h 50th percentile LOLD: 0 h 95th percentile LOLD: 3 h
EG	EENS: 0 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 0 MWh	EENS: 0 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 0 MWh
	LOLE: 0 h 50th percentile LOLD: 0 h 95th percentile LOLD: 0 h	LOLE: 0 h 50th percentile LOLD: 0 h 95th percentile LOLD: 0 h
JO	**EENS: 5210 MWh 50th percentile ENS: 94 MWh 95th percentile ENS: 28081 MWh**	**EENS: 46562 MWh 50th percentile ENS: 21078 MWh 95th percentile ENS: 176622 MWh**
	LOLE: 27.44 h 50th percentile LOLD: 4 h 95th percentile LOLD: 132 h	**LOLE: 205.94 h 50th percentile LOLD: 133 h 95th percentile LOLD: 657 h**
MA	EENS: 0.0 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 0 MWh	EENS: 810 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 240 MWh
	LOLE: 0 h 50th percentile LOLD: 0 h 95th percentile LOLD: 0 h	LOLE: 1.73 h 50th percentile LOLD: 0 h 95th percentile LOLD: 2 h
TN	**EENS: 5274 MWh 50th percentile ENS: 955 MWh 95th percentile ENS: 31258 MWh**	**EENS: 56296 MWh 50th percentile ENS: 35220 MWh 95th percentile ENS: 210621 MWh**
	LOLE: 24.74 h 50th percentile LOLD: 10 h 95th percentile LOLD: 117 h	**LOLE: 188.9 h 50th percentile LOLD: 147 h 95th percentile LOLD: 565 h**

Table 9: ENS and LOLE for Interconnected and isolated scenario – 2027

Country - 2027	Interconnected	Isolated
DZ	EENS: 1375 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 8937 MWh	EENS: 4224 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 25880 MWh
	LOLE: 2.57 h 50th percentile LOLD: 0 h 95th percentile LOLD: 17 h	LOLE: 6.58 h 50th percentile LOLD: 0 h 95th percentile LOLD: 37 h
EG	EENS: 0 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 0 MWh	EENS: 0 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 0 MWh
	LOLE: 0 h 50th percentile LOLD: 0 h 95th percentile LOLD: 0 h	LOLE: 0 h 50th percentile LOLD: 0 h 95th percentile LOLD: 0 h
JO	**EENS: 193 MWh** **50th percentile ENS: 0 MWh** **95th percentile ENS: 591 MWh**	**EENS: 11930 MWh** **50th percentile ENS: 2363 MWh** **95th percentile ENS: 56090 MWh**
	LOLE: 1.18 h **50th percentile LOLD: 0 h** **95th percentile LOLD: 7 h**	**LOLE: 57.05 h** **50th percentile LOLD: 21 h** **95th percentile LOLD: 240 h**
MA	EENS: 0 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 0 MWh	EENS: 2382 MWh 50th percentile ENS: 0 MWh 95th percentile ENS: 5835 MWh
	LOLE: 0 h 50th percentile LOLD: 0 h 95th percentile LOLD: 0 h	LOLE: 4.95 h 50th percentile LOLD: 0 h 95th percentile LOLD: 20 h
TN	**EENS: 922 MWh** **50th percentile ENS: 0 MWh** **95th percentile ENS: 5610 MWh**	**EENS: 8541 MWh** **50th percentile ENS: 1944 MWh** **95th percentile ENS: 40966 MWh**
	LOLE: 4.06 h **50th percentile LOLD: 0 h** **95th percentile LOLD: 24 h**	**LOLE: 32.72 h** **50th percentile LOLD: 15 h** **95th percentile LOLD: 144 h**

Results point to adequacy issues in some countries. Notably in:

- Algeria

  This is the country that can experience the increase of adequacy risks in the period after 2025 with increase of EENS from 63 MWh to 1375 MWh and increase of LOLE from 0.16 hours to 2.57 hours (LOLE would drop to 1.26 if no reserve requirements are satisfied). If more critical, but less probable (P95) cases happen (hot summer, higher demand, higher outages of TPPs) ENS can reach 8937 MWh with LOLD 17 hours in 2027.

In the isolated mode of operation, adequacy is more endangered: EENS reaches 4224 MWh with LOLE of 6.58 hours in 2027. Difference in adequacy risks in interconnected and isolated cases points to the fact that Algeria's interconnections with neighbouring countries reduce adequacy risks but cannot completely solve them.

It should be also noted that this level of adequacy risks is low and still acceptable, but points to the increased probability of risks in the period after 2025.

- Jordan

  Jordan with EENS of 5210 MWh for the interconnected mode of operation and LOLE of 27 hours in 2025 shows rather high adequacy risk (LOLE would drop to 4.1 hours if no reserve requirements would be satisfied). This risk is reduced in 2027, since new generating capacities are expected to be commissioned in this period. These new generating capacities and increased interconnection capacities with Egypt (increase from 450 MW in 2025 to 750 MW in 2027) provides good basis for satisfactory adequacy level in 2027 with EENS of 193 MWh and LOLE of 1.8 hour. In 2027, even in more critical and less probable situations, EENS would be below 591 MWh with LOLD of 7 hours.

  In the isolated mode of operation, adequacy is far more endangered: EENS reaches 46 GWh with LOLE of 206 hours in 2025 and EENS of 12 GWh with LOLE of 57 hours in 2027. Difference in adequacy risks in interconnected and isolated cases points to the fact that Jordan's interconnection with Egypt significantly reduces adequacy risks and present important driver for the system's adequacy.

- Tunisia

  This is the country that together with Jordan has the highest EENS and LOLE in 2025 and 2027: EENS of 5274 MWh with LOLE of 24.74 hours in 2025 and EENS of 922 MWh with LOLE of 4 hours in 2027, both in interconnected case. If no reserve requirements would be satisfied, LOLE would drop from 24.74 hours to 3.83 hours in 2025. If more critical, but less probable (P95) cases happen (hot summer, higher demand, higher outages of TPPs) ENS can reach 31 GWh and LOLD 117 hours in more critical year 2025.

  In the isolated mode of operation, adequacy is more endangered: EENS reaches 56 GWh with LOLE of 189 hours in 2025 and EENS of 8.5 GWh with LOLE of 33 hours in 2027. This also points to the fact that interconnection between Algeria and Tunisia reduces adequacy risks almost 10!

Additional rationales behind these results are given in relevant country chapters.

It should be noted that relevant curtailment of RES generation can only happen in Morocco in isolated operation reaching more than 300 GWh, although this curtailment still presents less than 2 % of RES generation in both years.

3.2.3. Contribution of interconnections[6]

As presented in the previous chapter, interconnections improve the adequacy situation in some of the countries but present the inevitable support to adequacy in Jordan and Tunisia. Exchanges on the borders of the five analysed countries show that in almost all cases there are prevailing direction of the power flows (Figure 16 & Figure 17):

- From DZ to MA
- From DZ to TN
- From MA to ES (from North Africa to Europe)
- From EG to JO

Link	Possible Annual Exchanges (GWh)	NTC direct (MW)	NTC indirect (MW)	Utilization factor (%)
DZ00 - MA00	2,468	600	300	56.26%
DZ00 - TN00	4,454	600	600	84.98%
EG00 - JO00	2,758	750	750	78.12%
EG00 - LY00	1,572	180	0	100.00%
EG00 - SD00	1,398	240	0	66.67%
EG00 - SA02	0	1500	1500	41.67%
IQ00 - JO00	-1,464	0	200	83.79%
JO00 - PS00	694	80	0	99.36%
ES00 - MA00	-5,241	900	600	99.98%
JO00 - SA01	0	500	500	0.00%
LY01-TN00	-2,174	0	250	99.54%

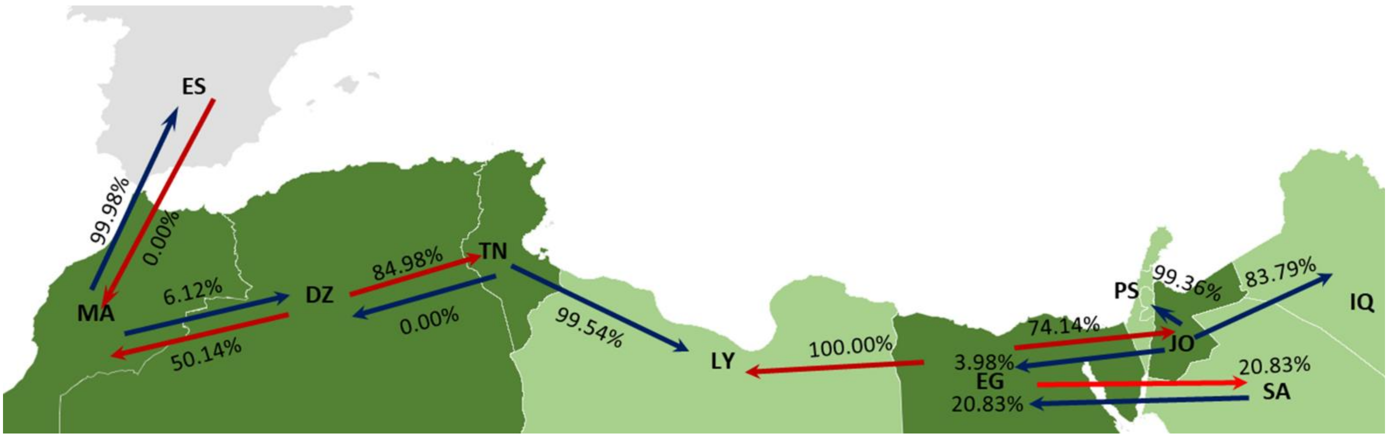


Figure 16 Exchanges directions and transfer capacity utilization in 2027 (average of all MC years)

Note: Diagram presents potential commercial exchanges that include exchanges that support adequacy

6 Please have in mind that exchanges are not completely in line with market operation since loads are increased for required reserve which distort all market operation indicators.

Link	Possible Annual Exchanges (GWh)	NTC direct (MW)	NTC indirect (MW)	Utilization factor (%)
DZ00 - MA00	2,686	600	300	59.96%
DZ00 - TN00	2,073	600	600	42.26%
EG00 - JO00	3,877	750	750	61.51%
EG00 - LY00	1,572	180	0	100.00%
EG00 - SD00	1,398	240	0	66.67%
EG00 - SA02	2	1500	1500	41.66%
IQ00 - JO00	-1,474	0	200	84.35%
JO00 - PS00	699	80	0	99.98%
ES00 - MA00	-5,239	900	600	99.95%
JO00 - SA01	-12	500	500	58.06%
LY01-TN00	-2,182	0	250	99.92%

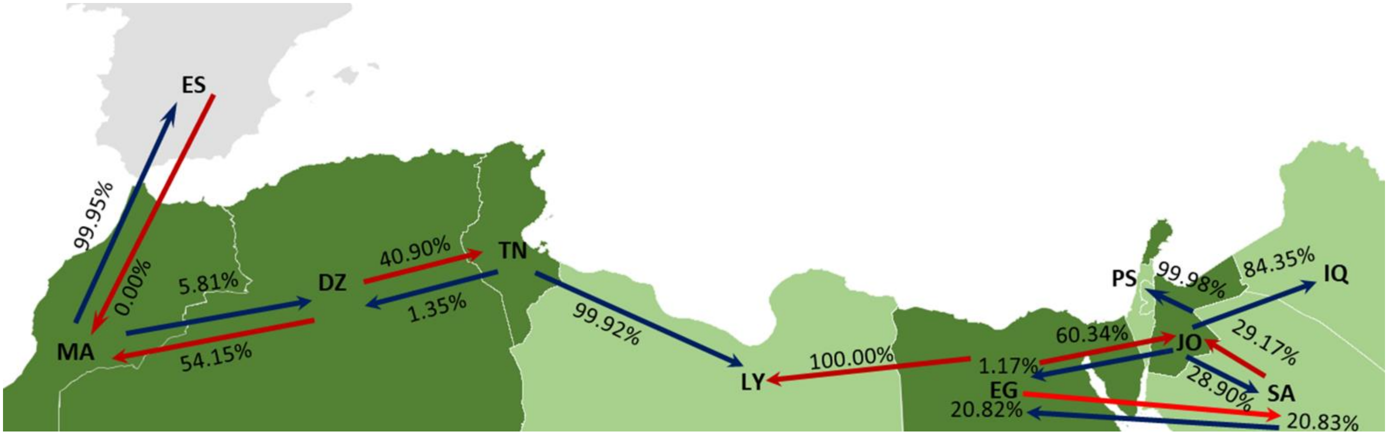


Figure 17: Transfer capacity utilization and exchange directions in 2027 (average of all MC years)

Note: Diagram presents potential commercial exchanges that include exchanges that support adequacy.

Presented exchanges point to the fact that Algeria has excess of energy to support secure operation of Tunisia that is limited by the transmission constraints (NTC=600 MW). Further increase of cross-border capacities between DZ and TN would not bring high benefit having in mind decrease in generation excess in Algeria, especially in 2027.

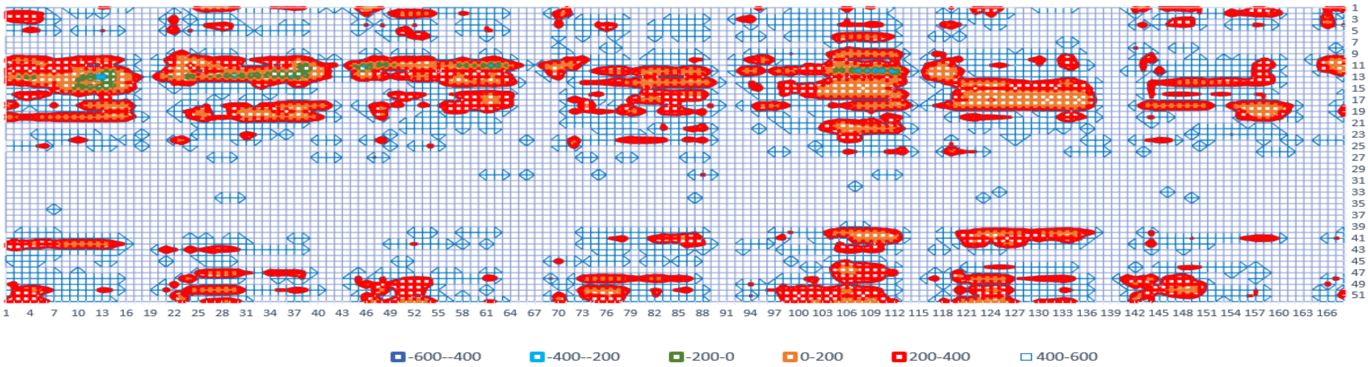
Export from Egypt to Jordan significantly improves adequacy situation in Jordan and increase in cross border capacity in 2027 (from 450 to 750 MW) enables more secure operation of Jordan power system in these years. In addition to Jordan, Egypt is exporting around 140 GWh to cope with the need of Sudan

The following heat maps present the hourly flows (168 hours in each week) on the selected borders for the selected MC year (first MC year):

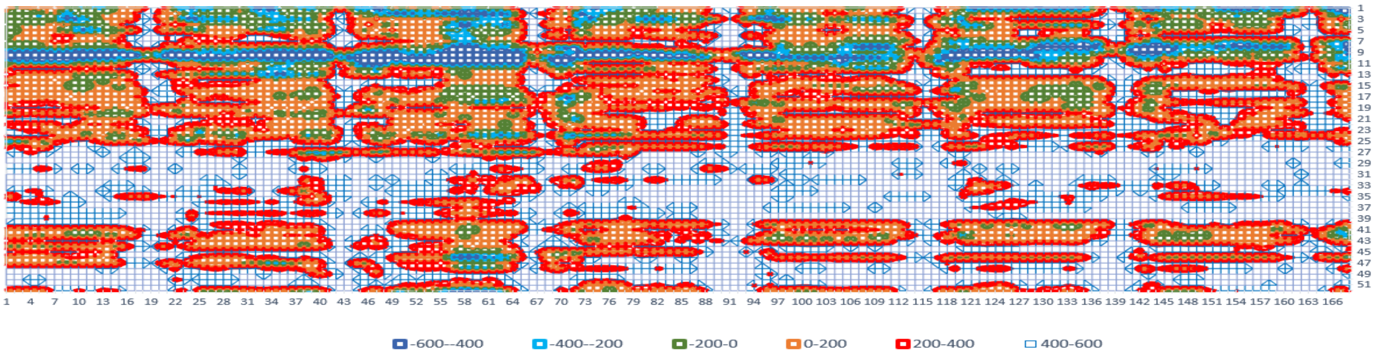
- DZ – TN in 2025 and 2027

  Flows in almost all hours are towards Tunisia, especially in 2025. Excess of generation in Algeria in 2027 is reduced while generation in Tunisia is increased and flows on the interconnection with Tunisia become more variable in level and direction, as it can be seen on the following figures.

DZ-TN exchanges - 2025



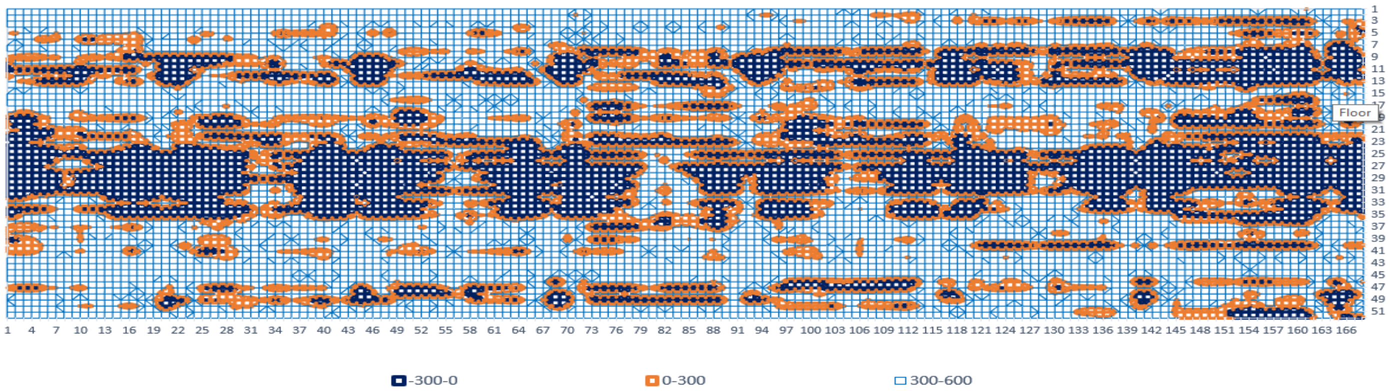
DZ-TN exchanges - 2027



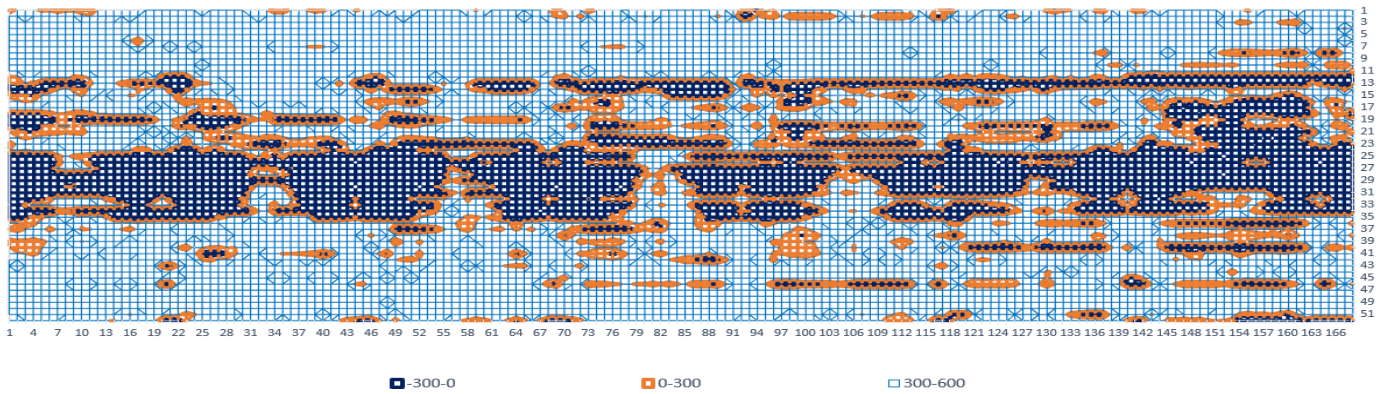
- DZ - MA

  Prevailing flows are from Algeria to Morocco mainly due to high export to Spain. Flows from Morocco to Algeria are noted mainly during night and early morning hours when demand is still low and Morocco has excess in RES generation. This is especially related to summer months and no specific changes can be seen between 2025 and 2027.

DZ-MA exchanges - 2025



DZ-MA exchanges - 2027

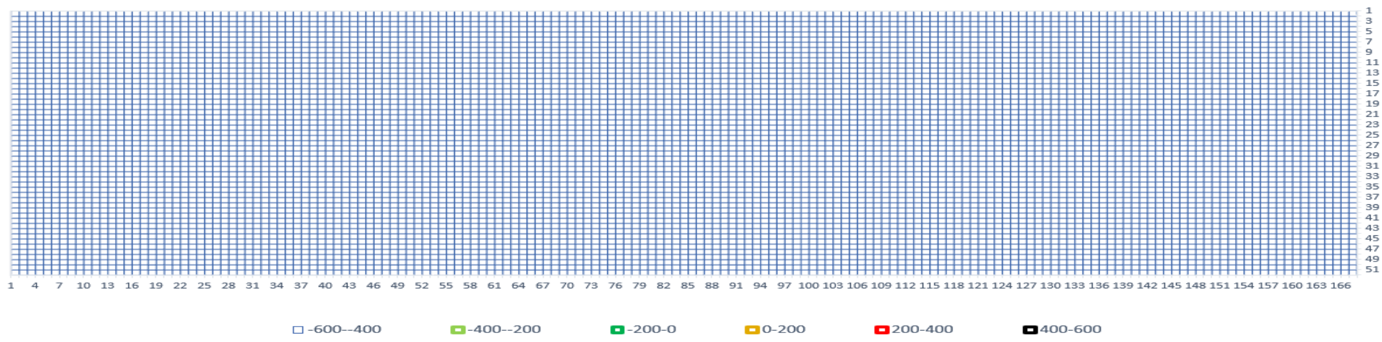


- ES-MA

  Spain is modelled as a spot market with generation more expensive than generation in Algeria and Morocco, and, due to this fact, all available excess of generation in these two countries are exported to Spain respecting cross-border capacities. Heat diagram shows practically one value - 600 MW in both analysed years.

  Deeper look at flows on the border with Spain shows that there are hours during October, November and December with flows from Spain to Morocco which help in supplying the load and support adequacy in the Maghreb region. These situations happen almost only during these 3 autumn/winter months and are very rare,

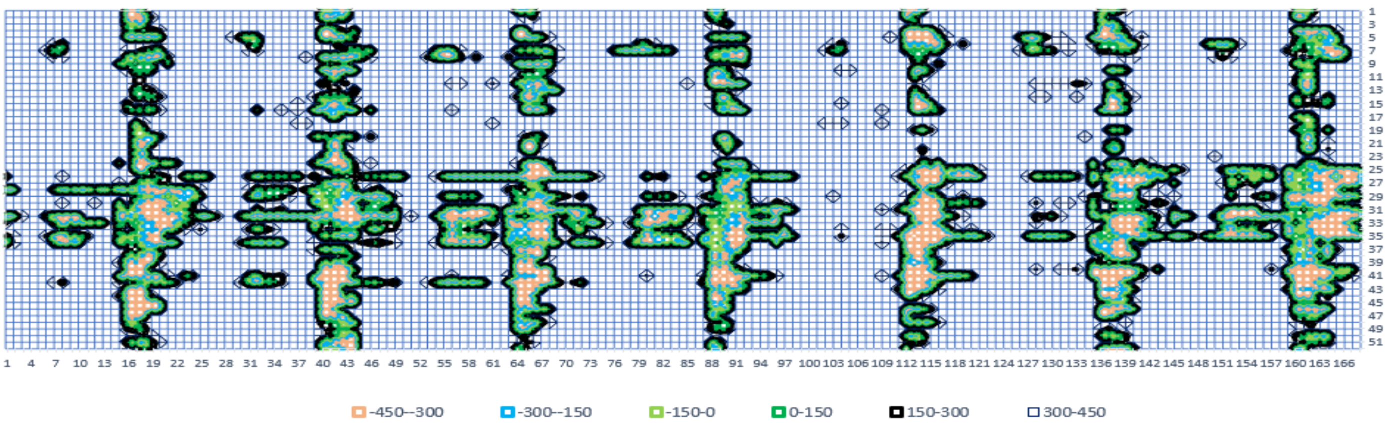
ES-MA exchanges



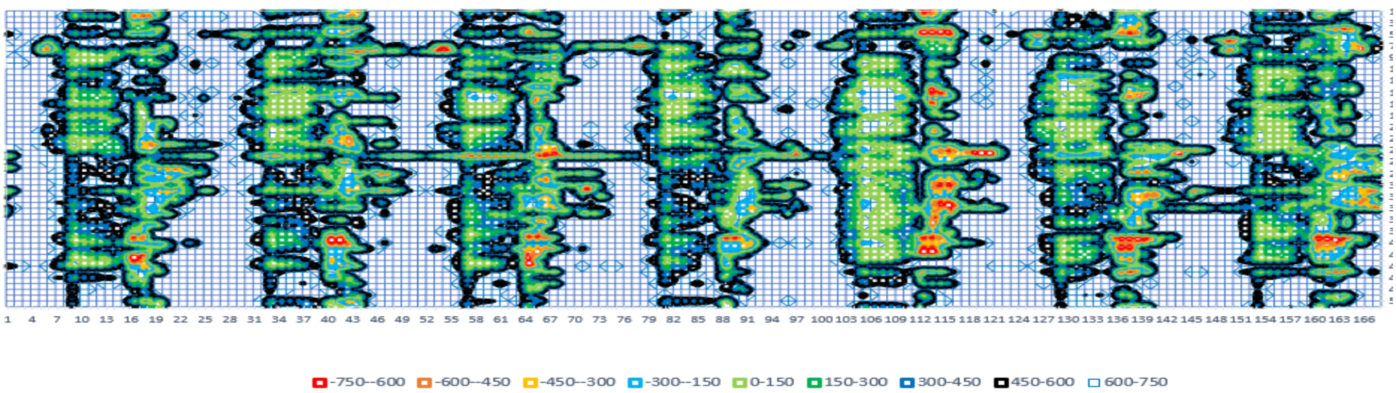
- EG - JO

  Prevailing flows are from Egypt to Jordan. However, there are lower flows or even flows in opposite direction during afternoon and evening hours when load in Jordan is lower. This kind of flows are more evident in 2027 than in 2025 when Jordan has higher generated capacities and generation excess.

EG-JO exchanges - 2025



EG-JO exchanges - 2027



3.3. Adequacy Situation on Country Level

3.3.1. Algeria

DEMAND

Algerian monthly demand in 2025, depicted in Figure 18, goes from around 6618 GWh to 10264 GWh, while peak hourly demand in each month varies from 12273 MW to 22335 MW. Similarly, in 2027, monthly demand varies between 7218 GWh and 11193 GWh and peak load between 13384 W and 24358 MW. It should be noted that monthly demand refers to average values of all 38 analysed climatic years, while peak hourly demand values refer to the monthly maximum for all 38 analysed climatic years.

Maximum electricity needs are expected in July and August, due to high temperatures and high cooling consumption. Due to this monthly distribution of the load, TPPs' maintenance activities are not allowed during summer, in months May, June, July, August and September.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly consumption (GWh)	7,587	6,795	7,183	6,618	7,124	8,101	10,264	10,051	7,901	7,200	6,806	7,189
Monthly peak loads (MW)	14,222	14,160	13,429	12,273	16,772	19,332	21,815	22,335	18,204	14,288	13,084	13,884

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly consumption (GWh)	8,274	7,411	7,834	7,218	7,770	8,835	11,193	10,961	8,616	7,852	7,422	7,840
Monthly peak loads (MW)	15,510	15,442	14,645	13,384	18,290	21,082	23,791	24,358	19,853	15,581	14,269	15,141

Figure 18: Monthly demand in Algeria -2025 (Top) and 2027 (Bottom)

SUPPLY AND NETWORK OVERVIEW

Algerian power generation fleet is almost exclusively based on natural gas, with the gas TPP share in total installed capacities around 90%, which is divided further into conventional, CCGT and OCGT TPPs. Solar capacities amount to 7% and 10% in 2025 and 2027, respectively. Total installed capacities are 25864 MW and 26835 MW in 2025 and 2027, respectively, which combined with import capacity of up to 900 MW, is substantially higher than the maximum hourly consumption of 22335 MW and 24358 MW. However, it can be seen that increase in peak load between 2025 and 2027 is 2023 MW which is followed by increase in generation capacities of only 971 MW. This is the reason for increase of adequacy risks in Algeria in 2027 when compared to situation in 2025.

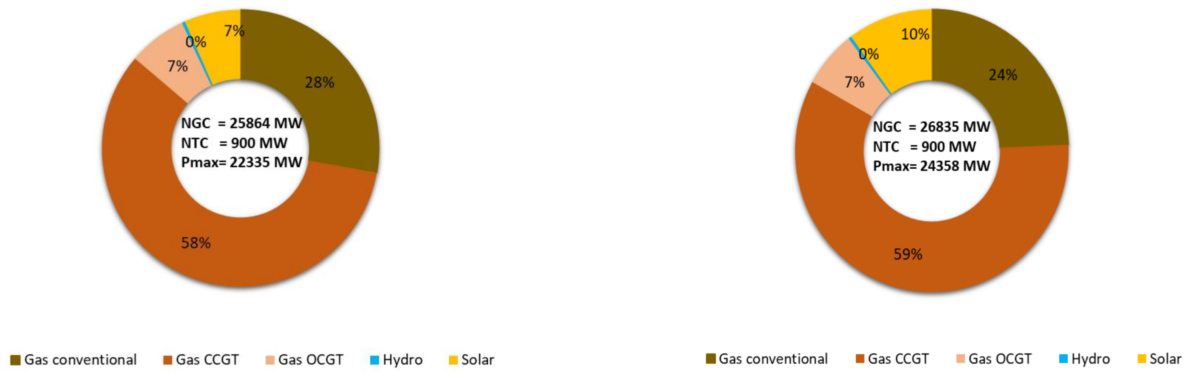


Figure 19: Installed Capacity mix with total NGC, import NTC and peak demand in Algeria – 2025 (left) and 2027 (right)

The average daily available TPP capacity, after reduction due to derating factors, forced and planned outages is shown in Figure 20. Each daily value presents the average of all simulated MC years. These values are the same for the interconnected and isolated mode of operation. Algerian average available TPP capacities level varies between 19500 MW and 22500 MW in 2025 and similarly in 2027. Summer period is characterized by reduced TPPs capacity because of reduced efficiency (and applied derating factors), while TPPs capacity outside summer season are mainly driven by planned outages. Forced outages are randomly distributed in the same manner in all seasons.

The minimal average daily available TPP capacity (minimum among all simulated MC years) fluctuates between 16000 and 21000 MW in 2025, and similarly in 2027. Available TPP capacity in 2025 and 2027 are very similar since planned development between 2025 and 2027 in Algeria includes commissioning of new gas fired units but also decommissioning of the old ones.

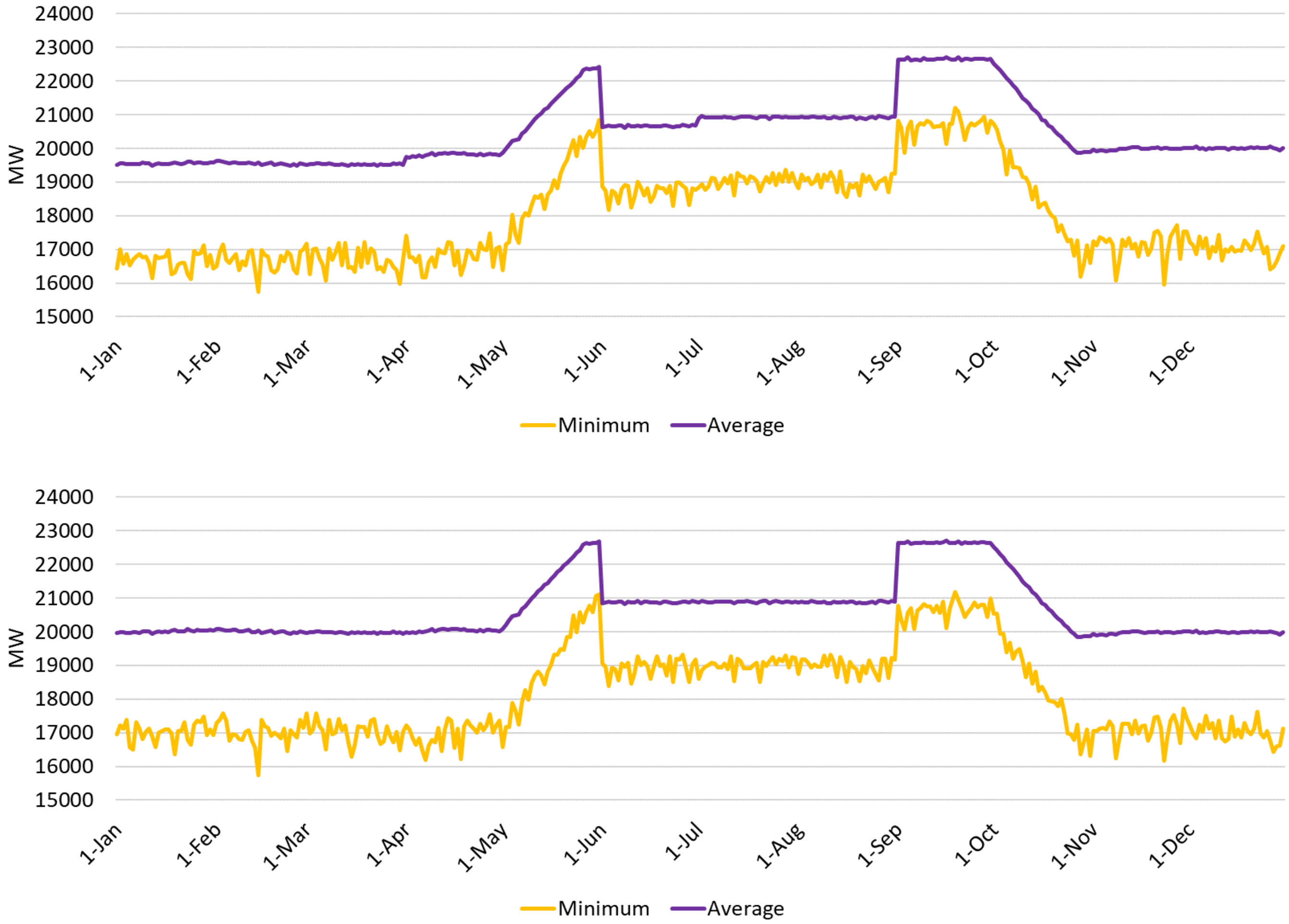


Figure 20: Average and minimum TPP available capacity in Algeria – 2025 (Top) and 2027 (Bottom)

As a result of system simulations, the hourly minimum TPP capacity margin for the interconnected mode of operation is calculated and depicted in Figure 21. It represents the difference between available and activated TPP capacities. The hourly minimum TPP margin is at zero level during July and August and as a maximum value reaches 7000 MW in June and September (months in which maintenance at TPPs is not assume din these analyses and with demand lower than in July and August). The Algerian TPP capacity margin is lower in 2027 and it indicates that Algeria can be faced with adequacy issues. Also, the daily capacity margin follows both seasonal and daily consumption patterns, and it is the lowest during the middle of summer and working days, due to higher demand.

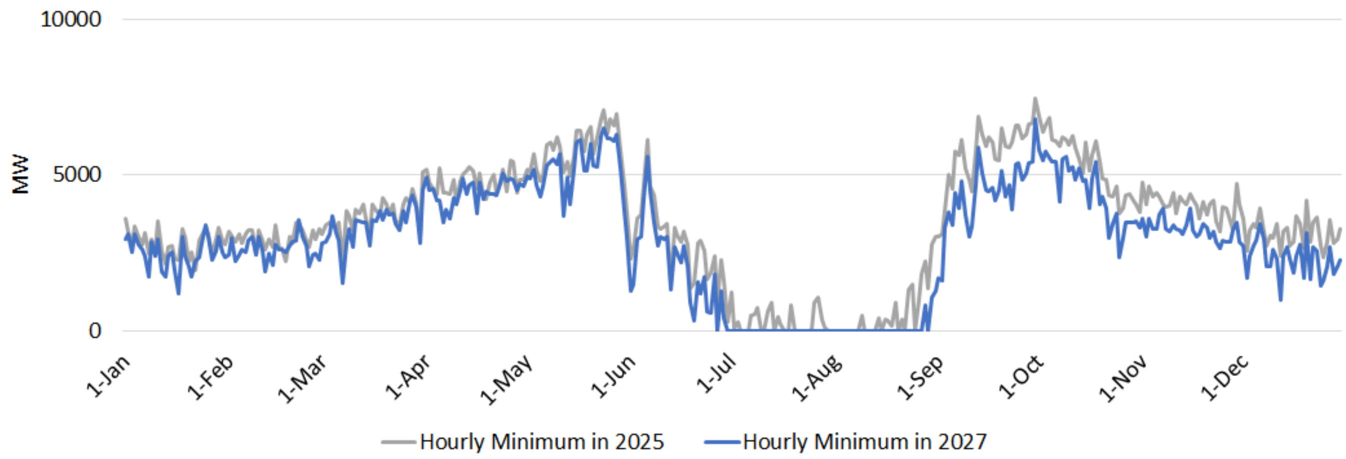


Figure 21: Hourly minimum TPP margin in each day in 2025 and 2027

Adequacy assessment

The temporal distribution of detected adequacy risk is given in Figure 22, for both modes of operation – interconnected and isolated in 2025 and 2027. The conclusion is that adequacy risk is marginal in 2025, but in 2027 it becomes detectable, in both modes of operation – interconnected and isolated. In all cases, months with adequacy risks are July and August, as months with the highest consumption.

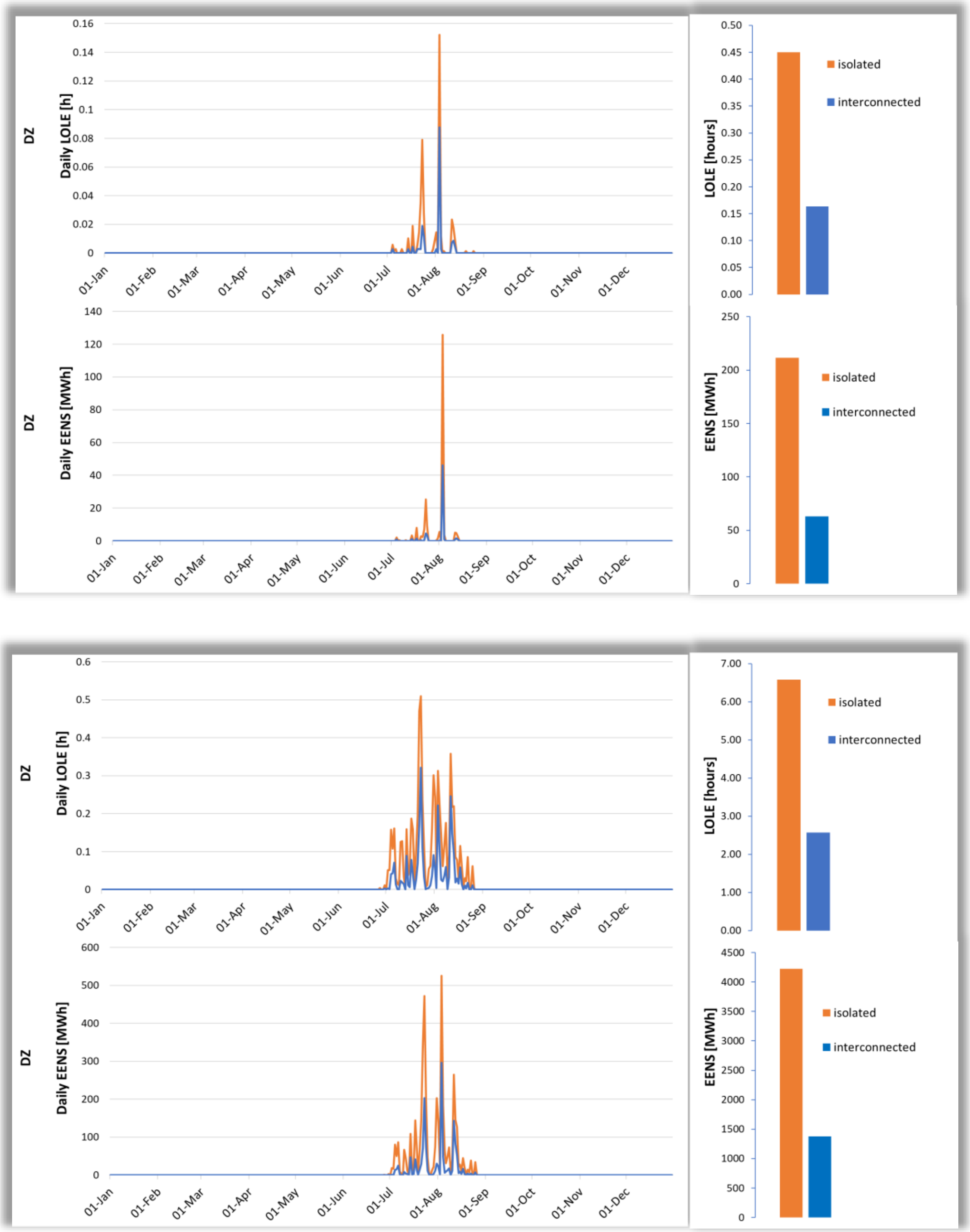


Figure 22: Daily LOLE and EENS for the interconnected and isolated mode of operation – Algeria – 2025 (Top) and 2027 (Bottom)

Annual LOLE and EENS for both modes of system operation points to the fact that interconnections do not make significant change with respect to Algerian adequacy situation.

The worst possible situation is presented in the following Figure 23 – the maximum hourly ENS in each day. This figure shows how big is the lack of capacity in the most critical case but does not show the frequency of that kind of situations. The maximum value of ENS can reach almost 3000 MW in 2027 when adequacy risk is higher. Maximum ENS in 2025 is significantly lower - 1100 MW.

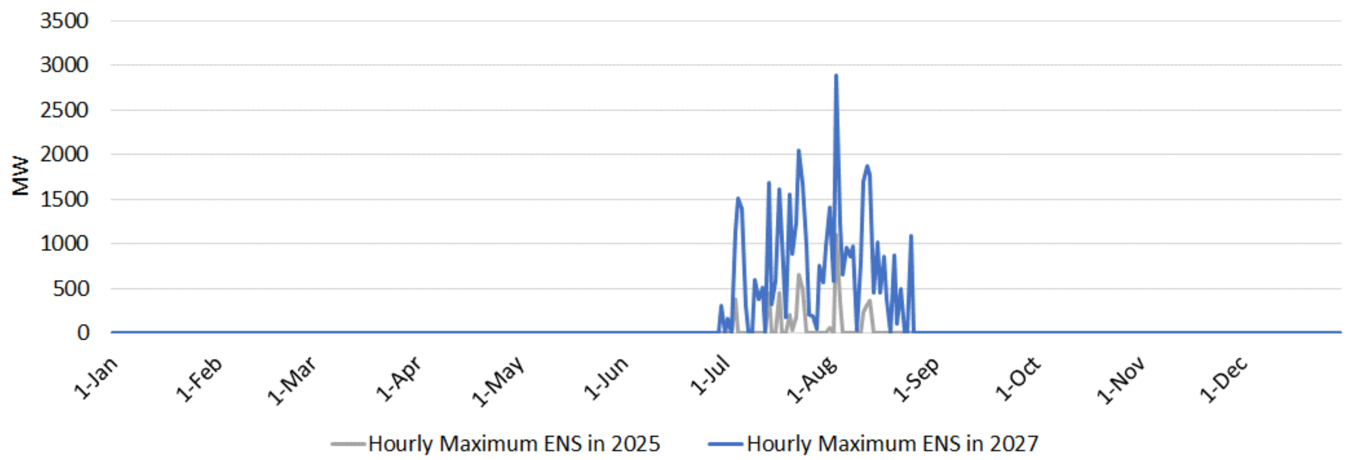


Figure 23: Hourly maximum ENS in interconnected mode of operation in Algeria – 2025 and 2027

3.3.2. Egypt

DEMAND

Egyptian monthly demand in 2025, depicted in Figure 24 goes from 16695 GWh to 25106 GWh, while peak hourly demand in each month varies from 32157 MW to 42592 MW. It should be noted that monthly demand refers to average values of all 38 analysed climatic years, while peak hourly demand values refer to the monthly maximum for all 38 analysed climatic years.

Similarly, Egyptian monthly demand in 2027, depicted in Figure 24 goes from around 17035 GWh to 26617 GWh, while peak hourly demand in each month varies from 34517 MW to 45715 MW. Increase of peak load in the period from 2025 to 2027 is 3,123 MW or 7%.

Maximum electricity needs are expected in July and August, due to high temperatures and high cooling consumption, similar as in all other countries. Due to this monthly distribution of the load, TPPs' maintenance activities are not allowed during summer, in months May, June, July, August and September.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly consumption (GWh)	18,580	16,695	18,474	18,444	21,349	22,338	24,802	25,106	22,570	20,807	18,219	17,792
Monthly peak loads (MW)	32,853	32,157	32,348	35,449	38,696	40,665	42,592	42,105	40,168	37,441	33,731	32,473

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly consumption (GWh)	19,960	17,935	19,846	19,813	22,931	23,992	26,637	26,963	24,241	22,349	19,572	19,113
Monthly peak loads (MW)	35,263	34,517	34,722	38,049	41,534	43,647	45,715	45,193	43,114	40,188	36,206	34,856

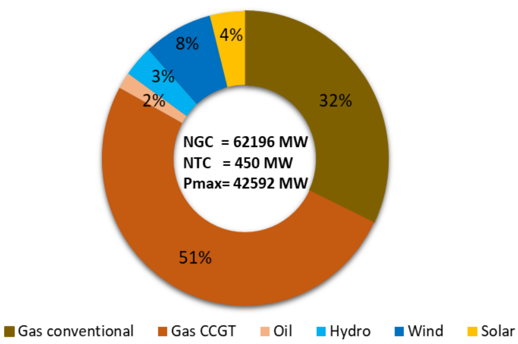
Figure 24: Monthly demand in Egypt – 2025 (Top) and 2027 (Bottom)

SUPPLY AND NETWORK OVERVIEW

Current (2022) Egyptian power generation fleet is almost exclusively based on natural gas, but in the next 5 years share of gas fired units will decrease. In 2025 gas-fired units share will be 85% which will further decrease to 76% in 2027. New generation capacities expected to be commissioned after 2025 are at the level of 7700 MW, mainly including wind and solar capacities. Smaller part of this increase is related to new nuclear capacity of 2500 MW.

Total installed capacities in 2025 are 62196 MW with import capacity up to 450 MW from Jordan, which combined is substantially higher than the maximum hourly consumption of 42592 MW. Similarly, in 2027 total installed capacities of 69970 with import capacity from Jordan of up to 750 MW is significantly higher than peak load of 45715 MW.

In the sense of demand and installed capacities, Egypt is the biggest of all analysed power systems.



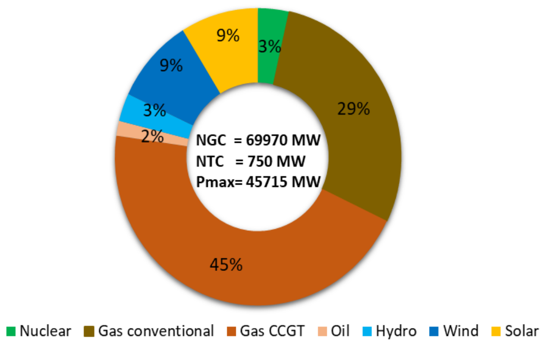


Figure 25: Installed Capacity mix with total NGC, import NTC and peak demand in Egypt – 2025 (Left) and 2027 (Right)

The average daily available TPP capacity, after reduction due to planned and forced outages, is shown in Figure 26. Each daily value presents the average of all simulated MC years. These values are the same for the interconnected and isolated mode of operation. Since there is a specific decrease of TPPs efficiency (10%) during February, available TPPs capacity is evidently decreased during this month.

Egyptian average available TPP capacity is stable during the entire summer season, and it amounts to around 48000 MW in 2025 while in 2027 addition of the new nuclear capacity from July 1st increases the available TPPs capacity. The minimal average daily available TPP capacity (minimum among all simulated MC years) fluctuates from 32000 MW and 45000 MW in 2025 and between 32000 MW and 47000 MW in 2027. Minimum is expected during February.

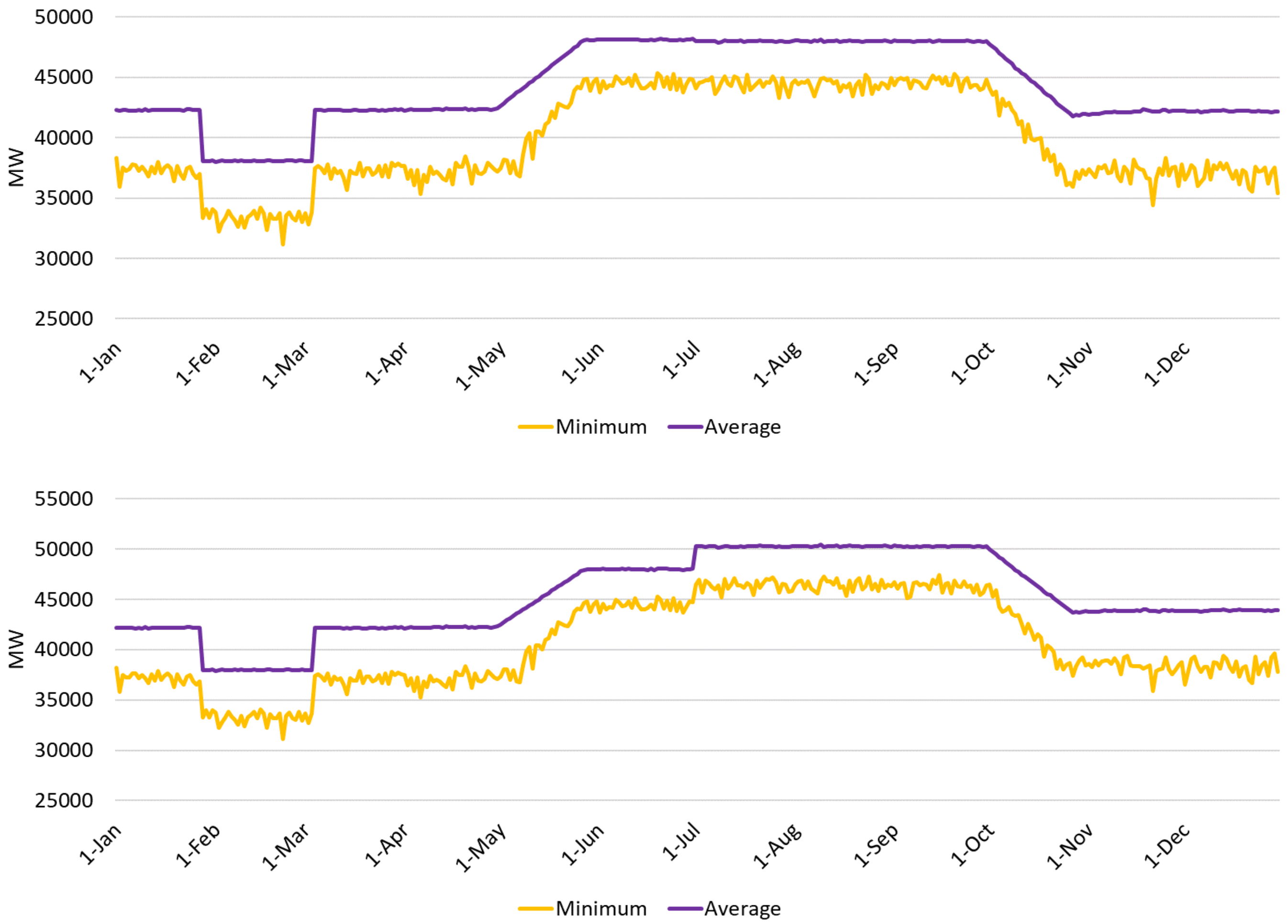


Figure 26: Average and minimum TPP available capacity in Egypt – 2025 (Top) and 2027 (Bottom)

As a result of system simulations, the hourly minimum TPP capacity margin for the interconnected mode of operation is calculated and depicted in Figure 27. It represents the difference between available and activated TPP capacities. The minimum hourly capacity margin is between 14000 MW in June and almost zero in February. In 2027 TPPs margin is little bit higher but after July 1st, after new nuclear unit is commissioned.

The TPP capacity margin in Egypt is low only during February due to applied derating factor by which capacity at TPPs is reduced by 10%. However, further results indicates that Egypt will not have adequacy issues during these years and that it has huge export potential that can bring benefit to neighbouring countries' adequacy situation.

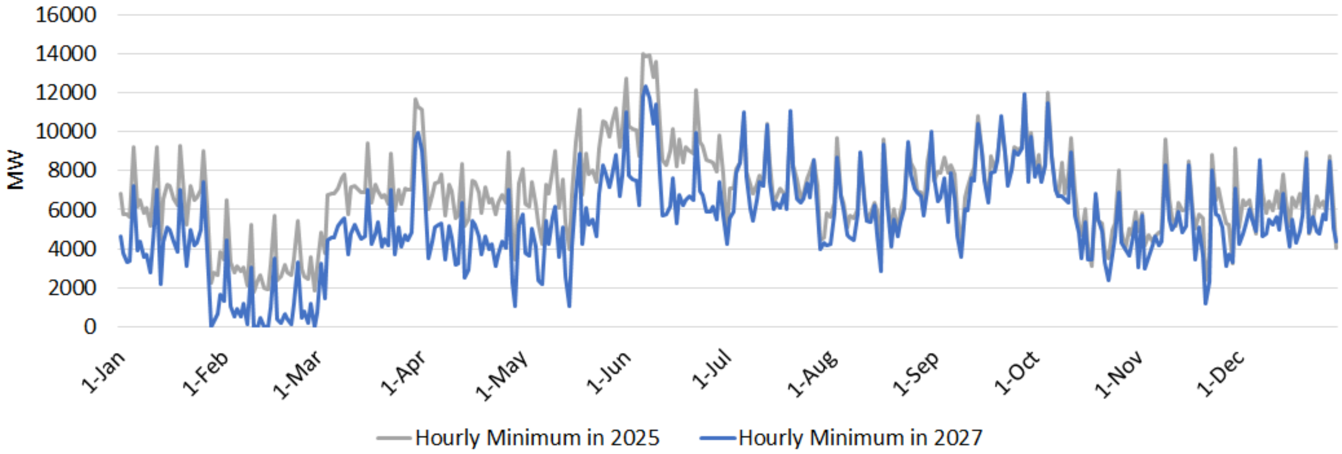


Figure 27: Hourly minimum TPP margin in Egypt – 2025 and 2027

ADEQUACY ASSESSMENT

No adequacy concerns are detected for both analysed modes of operation in the case of Egypt in 2025 and 2027.

3.3.3. Jordan

DEMAND

Jordan's monthly demand in 2025, depicted in Figure 28, goes from 1640 GWh to 2054 GWh, while peak hourly demand in each month goes from 3336 MW to 4964 MW. Similarly, Jordan's monthly demand in 2027, depicted in Figure 28, goes from 1691 GWh to 2118 GWh, while peak hourly demand in each month goes from 3441 MW to 5118 MW. It should be noted that monthly demand refers to average values of all 38 analysed climatic years, while peak hourly demand values refer to the monthly maximum for all 38 analysed climatic years.

It should be also noted that in case of Jordan maximum demand is expected during summer but also during winter months. Due to this monthly distribution of the load, TPPs' maintenance activities are not allowed during January, June, July, August, September, and December, which is different from all other analysed countries.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly consumption (GWh)	1,983	1,693	1,727	1,642	1,774	1,815	2,048	2,054	1,826	1,742	1,640	1,813
Monthly peak loads (MW)	4,753	4,964	4,071	3,511	3,762	3,738	4,391	4,394	3,754	3,336	3,800	4,593

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly consumption (GWh)	2,045	1,746	1,781	1,694	1,830	1,871	2,112	2,118	1,883	1,797	1,691	1,870
Monthly peak loads (MW)	4,901	5,118	4,198	3,621	3,880	3,856	4,528	4,531	3,872	3,441	3,919	4,736

Figure 28: Monthly demand in Jordan- 2025 (Top) and 2027 (Bottom)

SUPPLY AND NETWORK OVERVIEW

Jordan's power generation fleet is dominantly based on gas fuelled TPPs, with the share in total installed capacities around 53%, in both years, which is divided further into conventional and OCGT TPPs. Oil shale amounts to 6-7% of installed capacities, while RES – wind and solar share in installed capacities are 41% in both years (
Figure 29).

Total installed capacities amount to 6455 MW and 7311 MW in 2025 and 2027, respectively. Import capacity is up to 450 MW and 750 MW from Egypt, in 2025 and 2027, respectively. Increase in generation capacity and increase of interconnection capacity with Egypt significantly change adequacy situation in Jordan in 2027 in comparison with 2025.

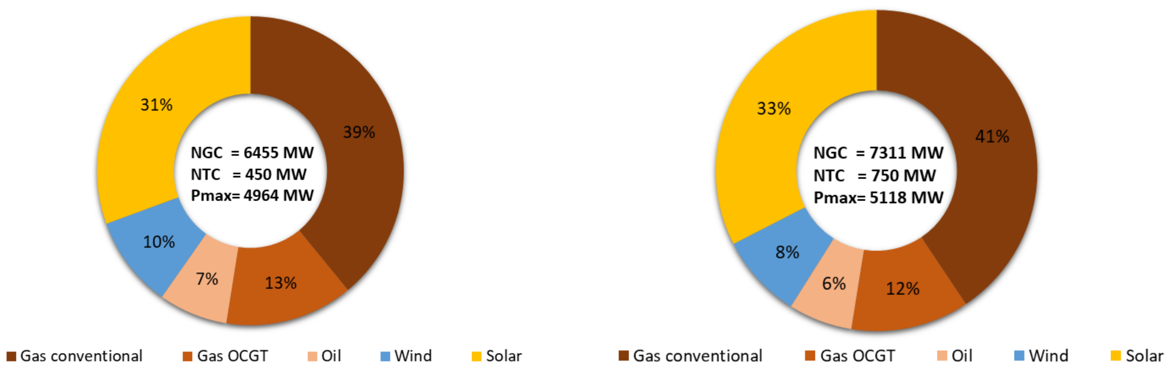


Figure 29: Installed Capacity mix with total NGC, import NTC and peak demand in Jordan – 2025 (Left) and 2027 (Right)

The average daily available TPP capacity, after reduction due to derating factors, forced and planned outages, is shown in
Figure 30. Each daily value presents the average of all simulated MC years. These values are the same for the interconnected and isolated mode of operation. The average available TPP capacities are rather flat during the year, with variations between 3000 MW and 3700 MW in 2025 and between 3400 MW and 4100 MW in 2027. This rather flat profile is the consequence of the selection of the months in which TPPs' maintenance activities are allowed.

The minimal average daily available TPP capacity (minimum among all simulated MC years) goes from 1500 MW to 3000 MW in 2025 and from 1900 MW to 3400 MW in 2027.

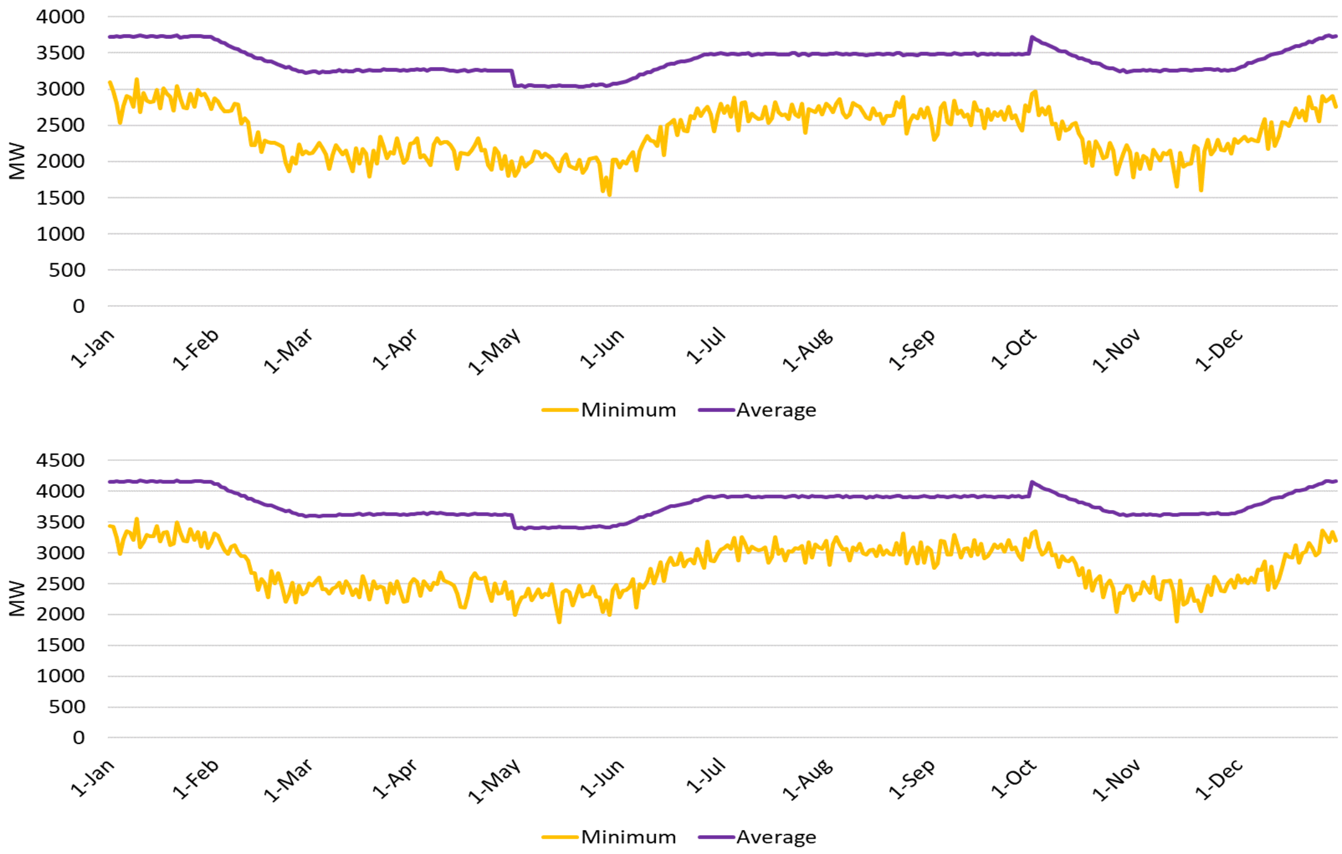


Figure 30: Average and minimum TPP available capacity in Jordan – 2025 (Top) and 2027 (Bottom)

As a result of system simulations, the hourly minimum TPP capacity margin for the interconnected mode of operation is calculated and depicted in Figure 31. It represents the difference between available and activated TPP capacities. As it can be seen from the Figure 31, there is at least one hour in each day in which TPP margin is at zero level in at least one MC year.

This low margin points to the fact that there is a possibility that during some hour's adequacy can be endangered. Notably, the daily margin follows daily consumption patterns, and it is the lowest during working days, due to higher demand.

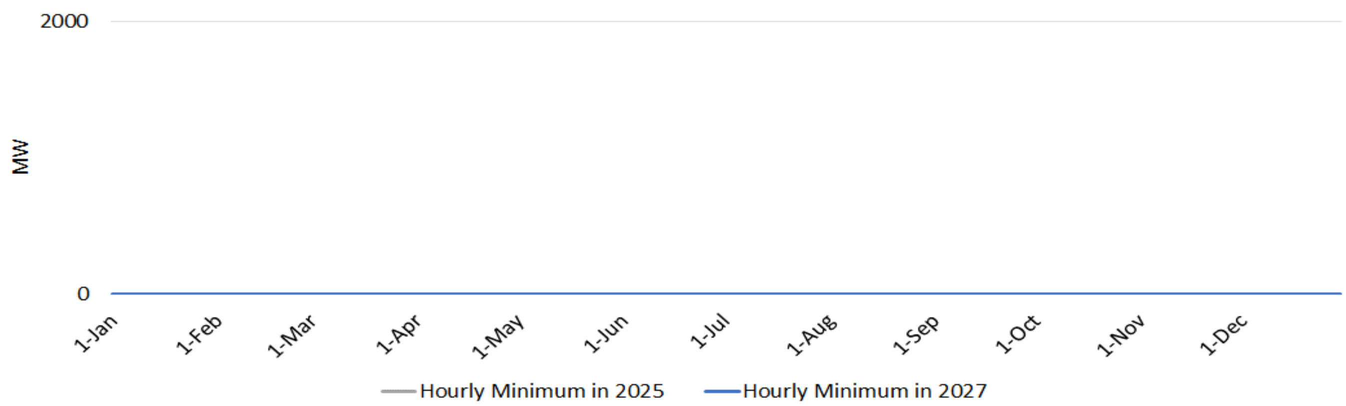


Figure 31: Hourly minimum TPP margin in Jordan – 2025 and 2027

ADEQUACY ASSESSMENT

The temporal distribution of detected adequacy risk is given in Figure 32, for both modes of operation – interconnected and isolated in both years.

The conclusion is that for the interconnected mode of operation adequacy risk is significantly lower in comparison to isolated mode, but also that adequacy situation is improved in 2027 in comparison to 2025. This is due to additional generation capacities in Jordan plus increased interconnection capacity with Egypt (increase from 450 MW to 750 MW).

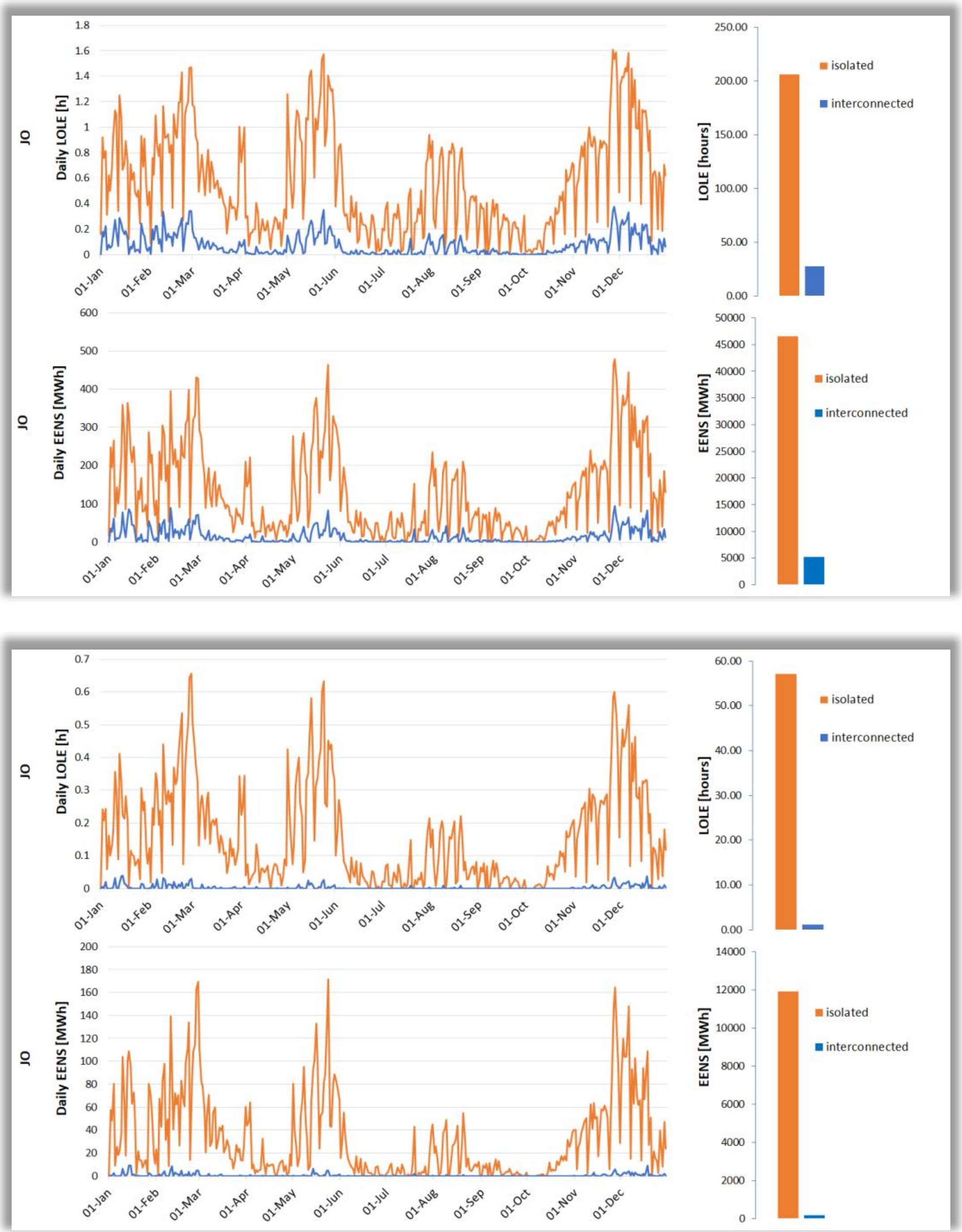


Figure 32: Daily LOLE and EENS for the interconnected and isolated mode of operation in Jordan – 2025(Top) and 2027 (Bottom)

In both operation modes and both years, distribution of the adequacy issues to months is rathe even, although as the most critical months one can recognize January, February, May, and December. Also important is to emphasize that adequacy situation in 2027 is improved and that determined LOLE is 1 hour which is within widely accepted reliability standard of 8 hours per year.

The worst possible situation is presented in the following Figure 33 – the maximum hourly ENS in each day. This figure shows how big is the lack of capacity in the most critical case but does not show the frequency of that kind of situations. The maximum value of ENS can reach 1200 MW in 2025 while in 2027 it is reduced to 800 MW.

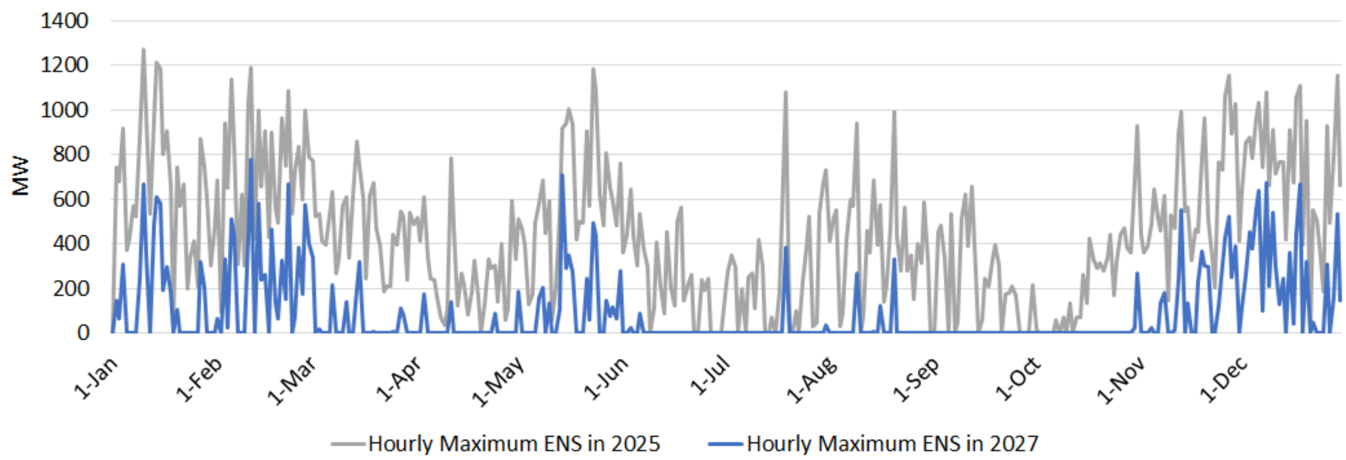


Figure 33: Hourly maximum ENS in interconnected mode of operation in Jordan – 2025 and 2027

3.3.4. Morocco

DEMAND

Moroccan monthly demand in 2025, depicted in Figure 34, goes from 3239 GWh to 4152 GWh, while peak hourly demand in each month varies from 6401 MW to 7148 MW. Similarly, monthly demand in 2027, depicted in Figure 34, goes from 3435 GWh to 4403 GWh, while peak hourly demand in each month varies from 6789 MW to 7582 MW. It should be noted that monthly demand refers to average values of all 38 analysed climatic years, while peak hourly demand values refer to the monthly maximum for all 38 analysed climatic years.

Maximum electricity needs are expected in July and August, due to high temperatures and high cooling consumption. Due to this monthly distribution of the load, TPPs’ maintenance activities are the same as in case of other countries (except Jordan). Maintenance activities are not allowed during: May, June, July, August, and September

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly consumption (GWh)	3,583	3,239	3,586	3,534	3,817	3,762	4,119	4,152	3,796	3,828	3,498	3,455
Monthly peak loads (MW)	6,818	6,594	6,672	6,401	6,760	6,940	6,966	7,148	6,810	6,738	6,670	6,622

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly consumption (GWh)	3,800	3,435	3,803	3,748	4,048	3,990	4,369	4,403	4,026	4,060	3,710	3,664
Monthly peak loads (MW)	7,231	6,994	7,076	6,789	7,170	7,361	7,388	7,582	7,223	7,147	7,074	7,023

Figure 34: Monthly demand in Morocco – 2025(Top) and 2027 (Bottom)

SUPPLY AND NETWORK OVERVIEW

Moroccan power generation fleet is balanced and well-diversified in comparison with other analysed countries, with the TPP share in total installed capacities around 47%, which is divided further into Coal, Gas and Oil TPPs. Hydro capacities amount to 16%, while RES – wind and solar share in installed capacities is 22% and 17% respectively in 2025 and 2027. In 2027 the only change that is expected is related to additional capacities in wind and solar which will increase their share in the generation capacity mix from 39% in 2025 to 41% in 2027. Total increase in generation capacity between 2025 and 2027 is only 500 MW.

Total installed capacities are 15552 MW and 16010 MW in 2025 and 2027, respectively. Import capacity is up to 1500 MW, which combined with generating capacities is substantially higher than the maximum hourly consumption of 7148 MW and 7582 MW in 2025 and 2027, respectively.

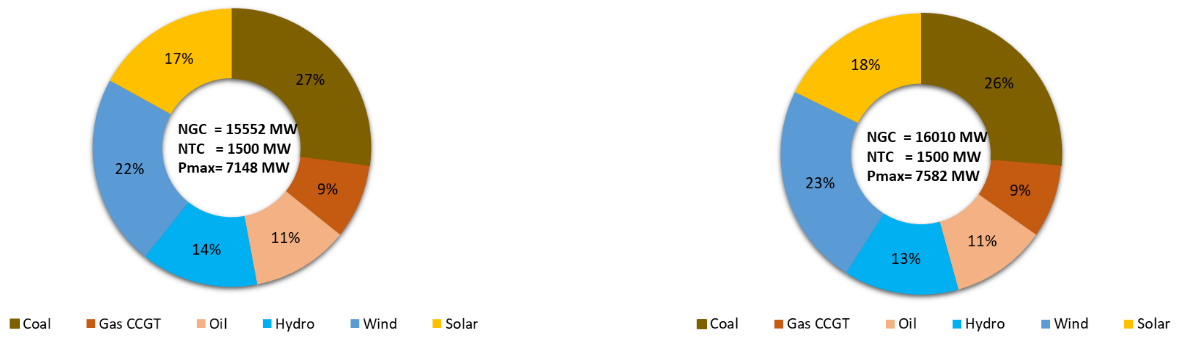
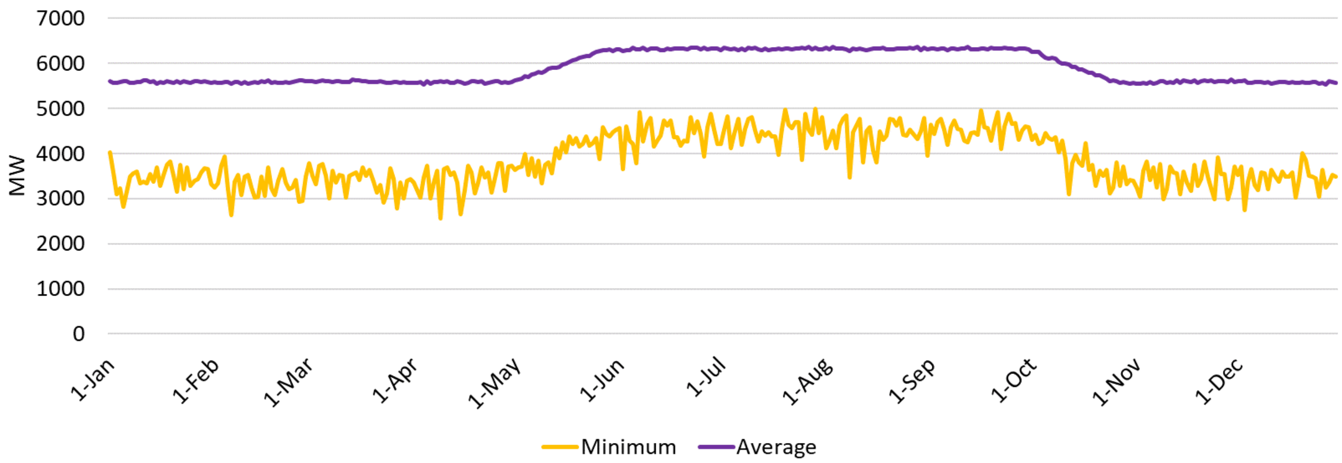


Figure 35: Installed Capacity mix with total NGC, import NTC and peak demand in Morocco – 2025 (Left) and 2027 (Right)

The average daily available TPP capacity, after reduction due to planned and forced outages, is shown in Figure 36. Each daily value presents the average of all simulated MC years. These values are the same for the interconnected and isolated mode of operation, and in this case available TPPs capacities are the same in 2025 and 2027.

Moroccan average available TPP capacities level is stable, and it is between 5800 and 6150 MW during the entire year. The minimal average daily available TPP capacity (minimum among all simulated MC years) goes from 2700 MW to 5000 MW.



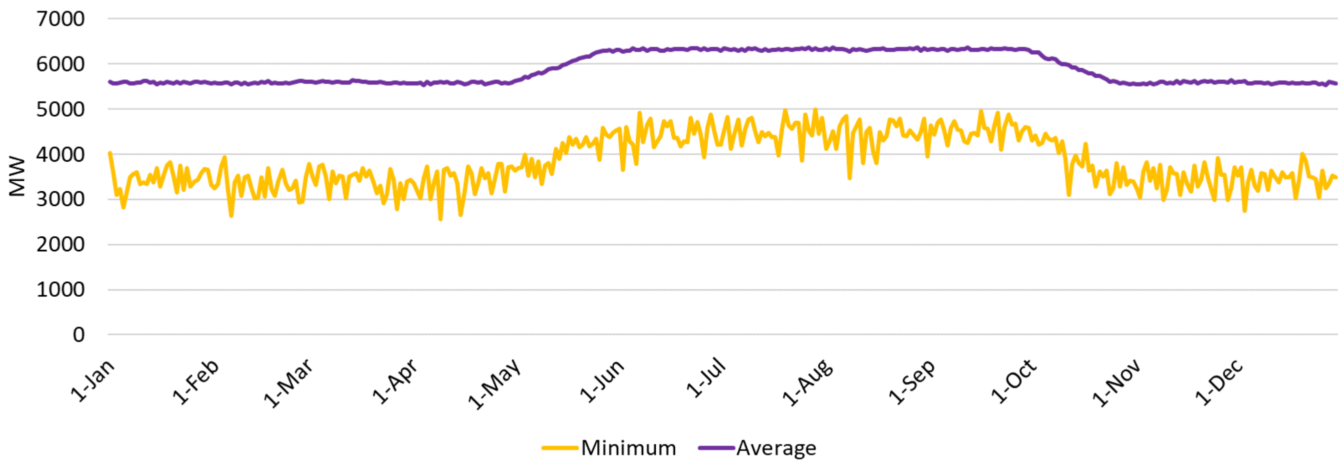


Figure 36: Average and minimum TPP available capacity in Morocco 2025 (Top) and 2027 (Bottom)

As a result of system simulations, the hourly minimum TPP capacity margin for the interconnected mode of operation is calculated and depicted in Figure 37. It represents the difference between available and engaged TPP capacities and it shows somewhat lower levels in 2027. However, the main message is that TPP capacity in Morocco in winter season is very low, almost in each day drops to zero level. At the beginning of summer season, hourly minimum TPP margin reaches 1900 MW, due to low demand and higher availability of TPP capacities. Considering that Morocco has substantial hydro capacities and strong interconnections with Spain and Algeria, a low TPP capacity margin does not need to indicate adequacy risk. Also, the daily capacity margin follows both seasonal and daily consumption patterns.

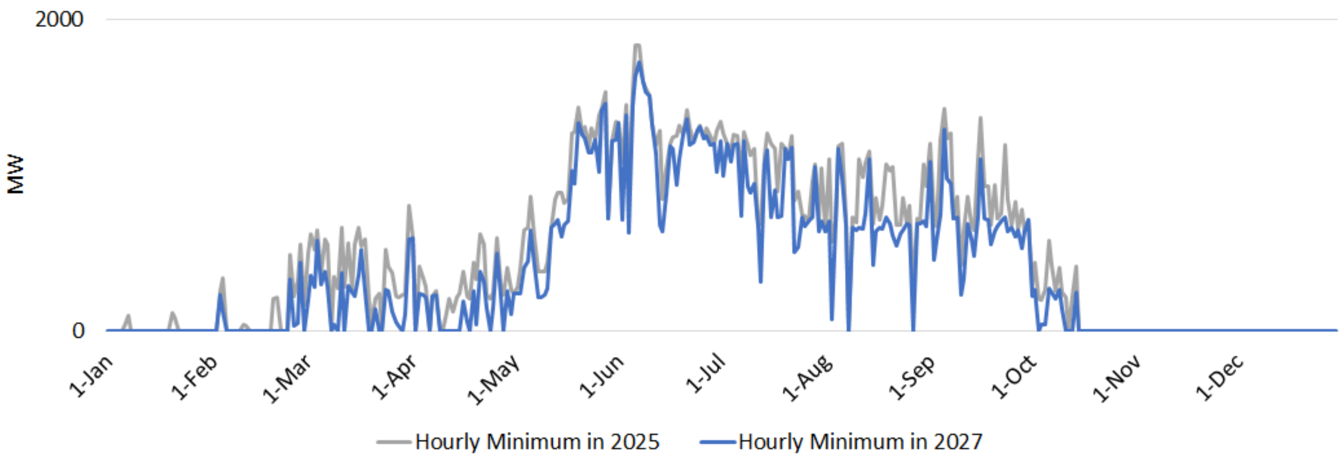


Figure 37: Hourly minimum TPP margin in Morocco – 2025 and 2027

ADEQUACY ASSESSMENT

The temporal distribution of detected adequacy risk is given in Figure 38. Adequacy risks are detected only for an isolated mode of operation.

Even for the isolated mode of operation, adequacy risk is almost negligible. It may be interesting to point out that adequacy risks are detected in winter months – from November to February, and more in 2027 than in 2025.

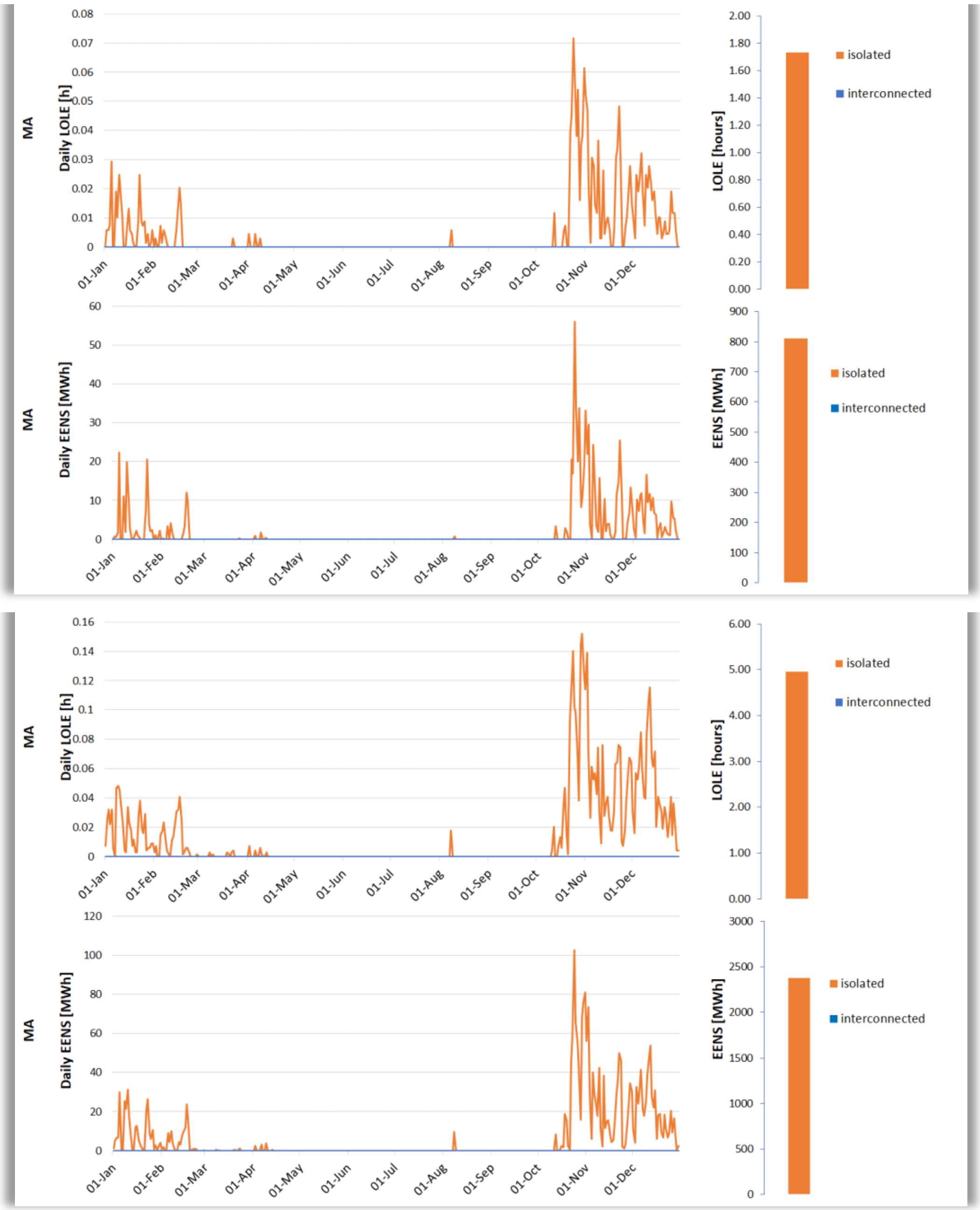


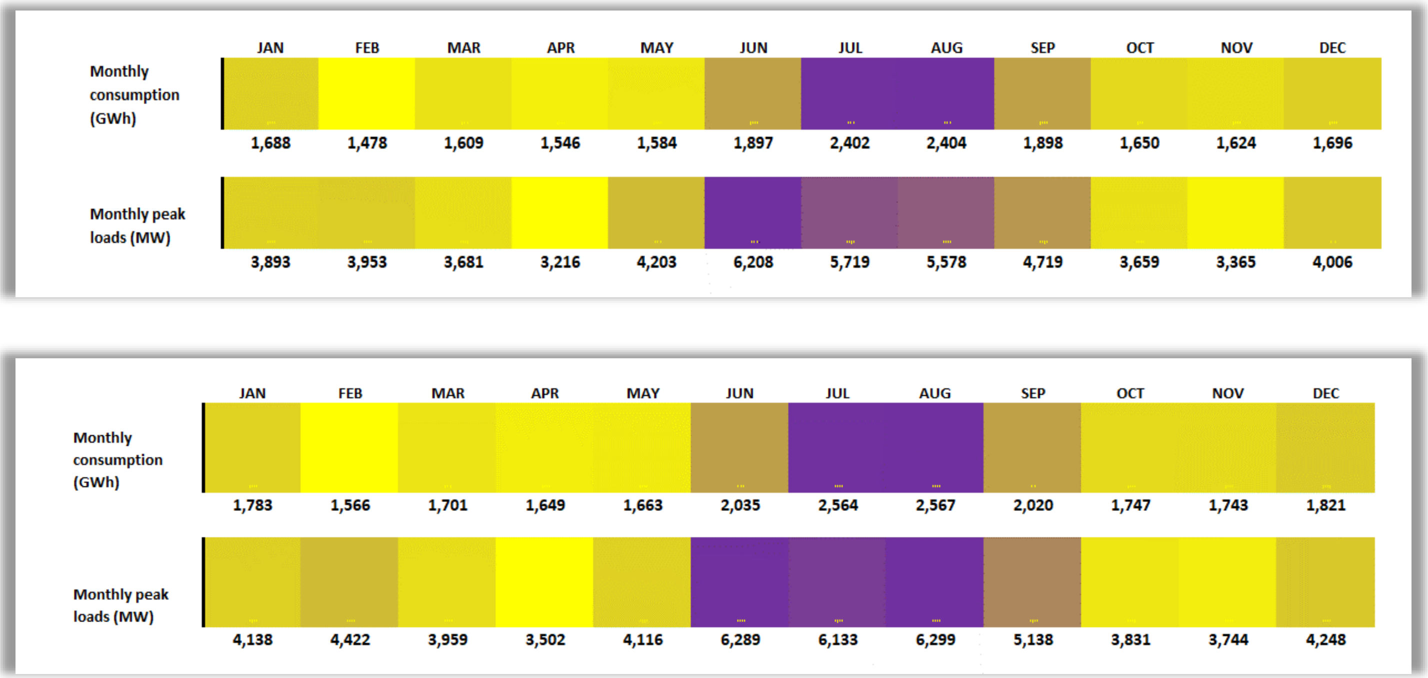
Figure 38: Daily LOLD and ENS for the isolated mode of operation in Morocco – 2025 (Top) and 2027 (Bottom)

3.3.5. Tunisia

DEMAND

Tunisian monthly demand in 2025, depicted in Figure 39, goes from 1478 GWh to 2404 GWh, while peak hourly demand in each month goes from 3216 MW to 6208 MW. Similarly, Tunisian monthly demand in 2027, depicted in Figure 39, goes from 1566 GWh to 2567 GWh, while peak hourly demand in each month goes from 3502 MW to 6299 MW. It should be noted that monthly demand refers to average values of all 38 analysed climatic years, while peak hourly demand values refer to the monthly maximum for all 38 analysed climatic years.

Maximum electricity needs are expected from June to August, due to high temperatures and high cooling consumption. Due to this monthly distribution of the load, TPPs' maintenance activities are the same as in case of other countries (except Jordan). For the purpose of this adequacy assessment, maintenance activities are not allowed during May, June, July, August and September[7].



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly consumption (GWh)	1,688	1,478	1,609	1,546	1,584	1,897	2,402	2,404	1,898	1,650	1,624	1,696
Monthly peak loads (MW)	3,893	3,953	3,681	3,216	4,203	6,208	5,719	5,578	4,719	3,659	3,365	4,006

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly consumption (GWh)	1,783	1,566	1,701	1,649	1,663	2,035	2,564	2,567	2,020	1,747	1,743	1,821
Monthly peak loads (MW)	4,138	4,422	3,959	3,502	4,116	6,289	6,133	6,299	5,138	3,831	3,744	4,248

Figure 39: Monthly demand in Tunisia – 2025 (Top) and 2027 (Bottom)

7 In reality, in Tunisia, maintenance activities are not allowed from the 15th of June to the 15th of September in general.

SUPPLY AND NETWORK OVERVIEW

Tunisian power generation fleet is highly gas-fuelled, with the share in total installed capacities around 74%, which is divided further into conventional, CCGT and OCGT TPPs. RES – wind and solar share in installed capacities is in total 26% in 2025 and 28% in 2027. Total installed capacities amount to 6721 MW in 2025 and 8171 MW in 2027, which indicates an increase in generation capacity of 1450 MW that includes increase in gas-fired capacities of 900 MW. Import capacity is up to 600 MW, while maximum hourly consumption is around 6208 in 2025 and 6299 MW in 2027, which indicates an increase of only 91 MW.

Figure 40: Installed Capacity mix with total NGC, import NTC and peak demand in Tunisia – 2025 (left) and 2027 (Right)

The average daily available TPP capacity, after reduction due to derating factors and forced and planned outages, is shown in. Figure 41 Each daily value presents the average of all simulated MC years. These values are the same for the interconnected and isolated mode of operation. By considering unplanned outages of TPPs (maintenance is not planned during the summer season) as well as given derating factors, the average available TPP capacities drops to 3800 MW in summer season in 2025 and to 4500 MW in 2027 (due to additional new capacities). This additional increase in generating capacities will improve adequacy situation in Tunisia in 2027 in comparison to 2025.

The minimal average daily available TPP capacity (minimum among all simulated MC years) in 2025 drops to 2000 MW while in 2027 minimum is at 2500 MW.

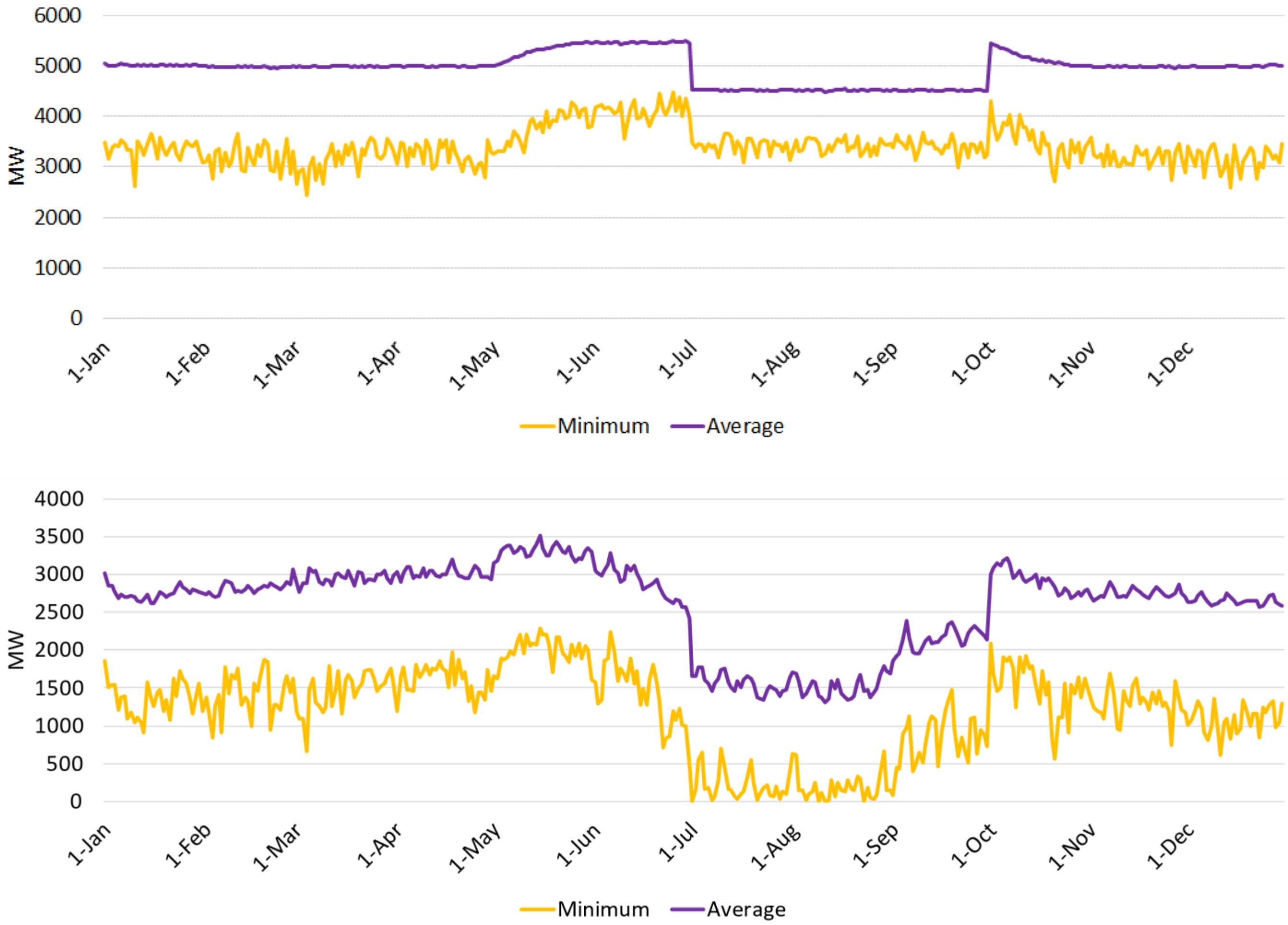


Figure 41: Average and minimum TPP available capacity in Tunisia – 2025 (Top) and 2027 (Bottom)

As a result of system simulations, the hourly minimum TPP capacity margin for the interconnected mode of operation is calculated and depicted in Figure 42. It represents the difference between available and engaged TPP capacities. The hourly minimum capacity margin shows constant zero value during summer season, from July 1st till September 1st. Winter season is obviously the season with higher capacity margin. It should be also noted, that TPP capacity margin is higher in 2027 in comparison to 2025, due to new generation capacities that are expected to be commissioned after 2025.

Notably, the daily margin follows daily consumption patterns, and it is the lowest during working days, due to higher demand.

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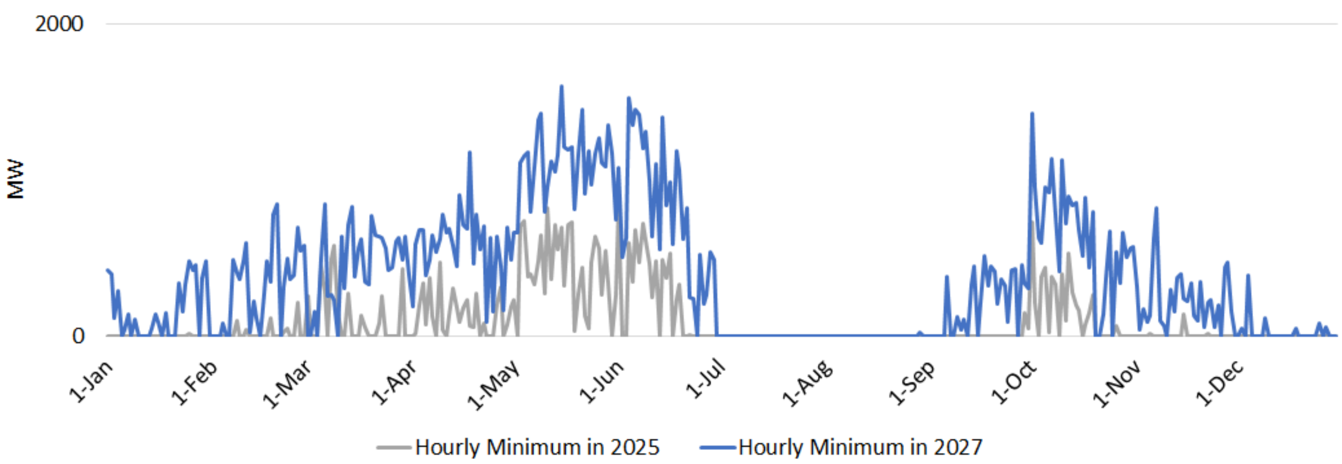
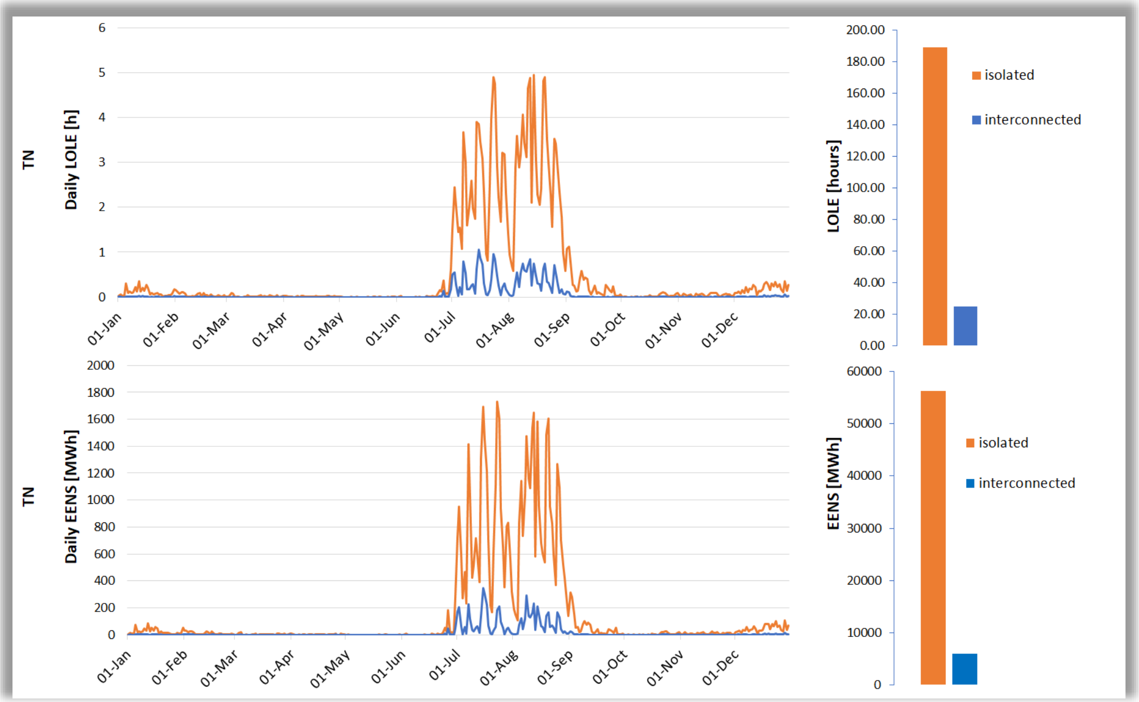


Figure 42: Average and minimum TPP margin in Tunisia – 2025 and 2027

<u>ADEQUACY ASSESSMENT</u>

The temporal distribution of detected adequacy risk is given in Figure 43, for both modes of operation – interconnected and isolated and both years 2025 and 2027.

The first conclusion is that until 1st July no adequacy issues are expected due to higher TPP availability and lower demand. From 1st July until the beginning of September adequacy issues are detected almost every day, with significant decrease in 2027 in comparison to 2025.



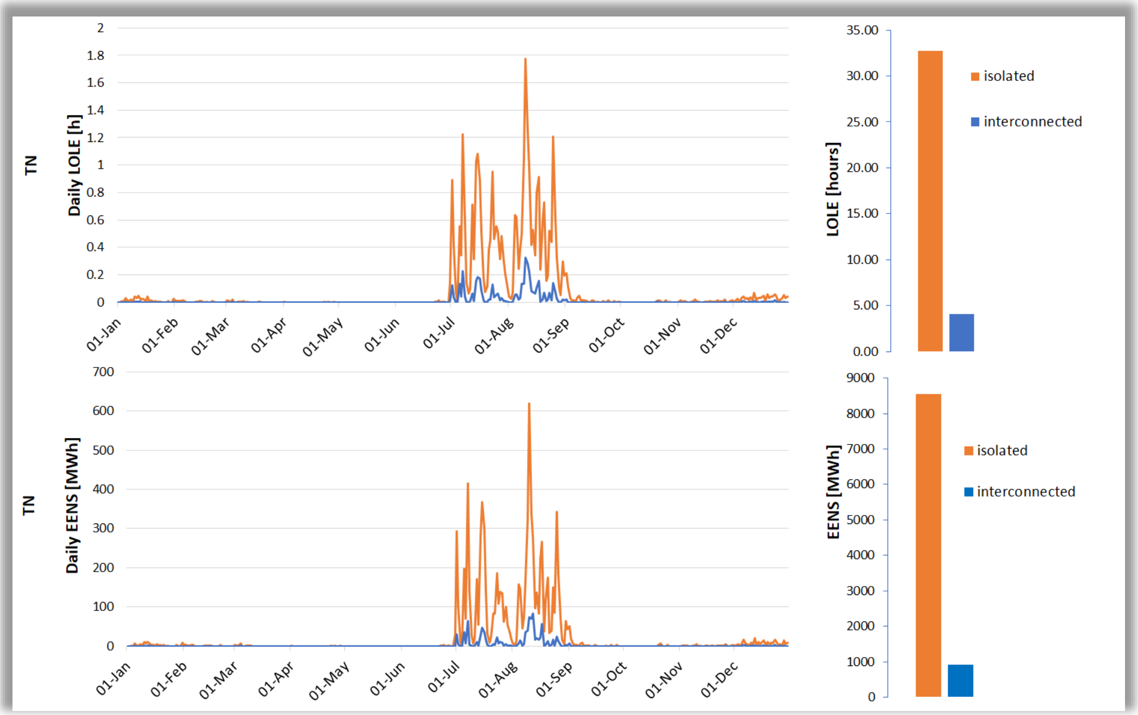


Figure 43: Daily LOLD and ENS for the interconnected and isolated mode of operation – 2025 (Top) and 2027 (Bottom)

For the interconnected mode of operation in 2025, daily LOLE varies from 0 to 5 hours, while daily EENS goes from 0 to 1700 MWh. In 2027, adequacy situation is better and daily LOLE varies from 0 to 1.8 hours, while daily EENS goes up to 600 MWh. The peak of adequacy issues is expected between the middle of July and the middle of August, as a result of multiple factors: highest seasonal demand and lowest TPP availability due to unplanned outages but also derating.

After 1st September adequacy risk again goes practically to zero, due to demand being lower again.

The worst possible situation is presented in the following Figure – the maximum hourly ENS in each day. The Figure 44 shows how big is the lack of capacity in the most critical case but does not show the frequency of that kind of situations. The maximum value of ENS can reach 1660 MW in 2025, while in 2027 it is lower – around 1200 MW.

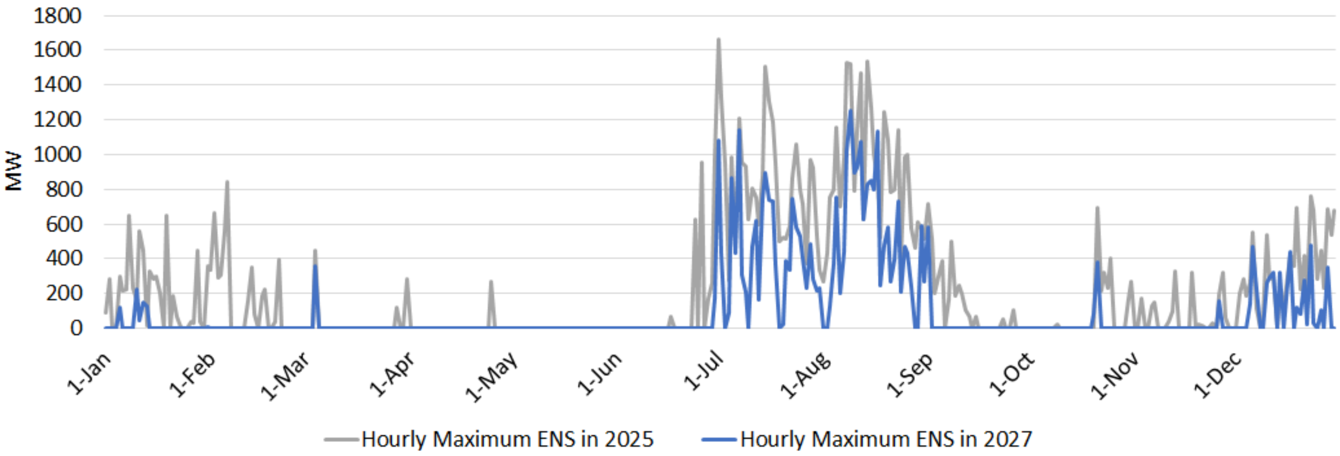


Figure 44: Hourly maximum ENS in interconnected mode of operation in Tunisia – 2025 and 2027

4. APPENDIX 1: Survey to Med-TSO members:

SECTION A: general questions about national adequacy studies (or other adequacy studies)

N°	TSO	Question: In general, do you perform MAA in your power system?	
1	ALBANIA (OST)	Yes	/
2	ALGERIA (SONELGAZ)	Yes	Supply / demand adequacy study and grid operation studies for 1 to 5 year.
3	CROATIA (HOPS)	Yes	HOPS has to prepare every year till 30th September the "Ten-Year Development Plan of the Croatian Transmission Network with detailed elaboration for the initial three-year and one-year period". In National development plan (NDP) HOPS is analysing mid-term adequacy of the power system in different development scenarios. The latest NDP was approved by NRA for the period 2021-2030.
4	CYPRUS (CYPRUS TSO)	Yes	Mid Adequacy Studies are performed: 1) Based on a methodology developed by TSOC and approved by the Regulator. The methodology is based on the ENTSO-e's MAF 2018 methodology, with several adaptations in order to comply with the needs of the local system. 2) Under the umbrella of ENTSO-E based on a probabilistic method.
5	EGYPT (EETC)	Yes	Load flow, short circuit, contingency analysis.
6	FRANCE (RTE)	Yes	Adequacy studies
7	GREECE (IPTO)	Yes	Probabilistic adequacy assessment is performed covering the period of the next 10 years.
8	ITALY (TERNA)	Yes	Probabilistic and risk assessment
9	JORDAN (NEPCO)	Yes	Three years MMA
10	MOROCCO (ONEE)	Yes	We perform the Medium-term Adequacy studies each year for the next one and three operation years
11	PORTUGAL (REN)	Yes	As required by the Portuguese national legislation, a mid and long-term Security of Supply Monitoring Report (RMSA) is developed on a yearly basis by the Portuguese Directorate-General for Energy and Geology (DGEG) with contributions from REN. In this framework, prospective assessments of the Portuguese electricity generation system are performed, taking account security of supply aspects. The security of electricity supply evaluation in the Portuguese electric system draws on probabilistic indicators.
12	SPAIN (REE)	Yes	Probabilistic assessment for all the Spanish territory (mainland and non-mainland)
13	TUNISIA (STEG)	No	/
14	TÜRKIYE (TEIAŞ)	Yes	In accordance with the Turkish Electricity Market Law, TEİAŞ as TSO is responsible for the preparation of "Generation Capacity Projection" report annually. This report covers the 5-year horizon. The report considers the existing generation, the plants under construction and the plants that that concrete commissioning dates. The projected commissioning dates for the new power plants are provided by Energy Authority EMRA and by TEİAŞ Regional Offices. The total system demand

N°	TSO	Question: In general, do you perform MAA in your power system?	
			projection is provided by Ministry of Energy. This annual forecast, consisting of three scenarios (low, high, moderate growth), is expanded over a year by scaling of last years' actual demand time series. The supply-demand is simulated over weekly peak demands. The hydrology and renewables projections are based on historical values. The available capacity and forced outage rates and maintenance periods off thermal power plants are based on the actual realized values of last years. The method does not include any probabilistic methods and does not take into account the grid constraints.
Main conclusions		▪ Almost all TSO perform MAA ▪ Difference between north and south TSOs for what regards the purpose of those studies	

N°	TSO	Question: Do you have any legal obligation to perform MAA in your power system? You perform MAA studies covering only the national electrical system or is it extended to the regional context (Arab Union of Electricity, ENTSO-E, COMELEC or other)?	
1	ALBANIA (OST)	No	
2	ALGERIA (SONELGAZ)	Yes	Obligation by law 02/01 but only at national level. No obligation at regional level
3	CROATIA (HOPS)	Yes	MAA is performed also in a regional context: In the scope of ENTSO-E activities HOPS is taking active part every year in preparing "Mid-term adequacy forecast (MAF)" which is covering national and regional adequacy of the power system and European system as well. In 2021 ENTSO-E will prepare for the first time "European Resource and Adequacy assessment (ERAA)".
4	CYPRUS (CYPRUS TSO)	Yes	MAA applies only at national level ENTSO-E mid adequacy assessment
5	EGYPT (EETC)	Yes	MAA applies only at national level
6	FRANCE (RTE)	Yes	MAA is performed also in a regional context
7	GREECE (IPTO)	Yes	The performance of the adequacy assessment is mandatory by law. The assessment focuses on national results, but simulations are performed considering an extended perimeter (Balkan region, Italy and Türkiye).
8	ITALY (TERNA)	Yes	MAA is performed also in a regional context: ENTSO-E commitments
9	JORDAN (NEPCO)	Yes	MAA applies only at national level it is necessary for national annual financial budget
10	MOROCCO (ONEE)	Yes	MAA applies only at national level
11	PORTUGAL (REN)	Yes	MAA is performed also in a regional context: Portuguese MAA covers the national electrical system as defined in national legislation Article 63º of Decree-Law nº 29/2006, revised and publishes by Decree-Law n.º 215-A/2012, and Article 32º of Decree-Law n.º 172/2006 revised and published by Decree-Law n.º 76/2019. REN also

N°	TSO	Question: Do you have any legal obligation to perform MAA in your power system? You perform MAA studies covering only the national electrical system or is it extended to the regional context (Arab Union of Electricity, ENTSO-E, COMELEC or other)?	
			provides data to carry out the European Resource Adequacy Assessment (ERAA) by ENTSO-E, as defined by Art. 23 of Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the Internal Market of Electricity.
12	SPAIN (REE)	Yes	We make our studies within a European framework (ENTSOE)
13	TUNISIA (STEG)	/	/
14	TÜRKIYE (TEIAŞ)	Yes	MAA applies only at national level. It is a national report and it is legal obligation under Electricity Market Law.
	Main Conclusions	▪ Almost all TSO perform MAA ▪ Difference between north and south TSOs for what regards the obligations to perform those studies (national or regional obligation)	

N°	TSO	Q n°3: Do you publish the results and reports of the MAA?	
1	ALBANIA (OST)	/	/
2	ALGERIA (SONELGAZ)	No	No obligation for external publication. Nevertheless, there is an obligation to transmit the results to the Ministry of Energy and to the Regulation Authority.
3	CROATIA (HOPS)	Yes	There are legal obligations to perform and publish adequacy analysis: HOPS is publishing NDP every year and the part of it is mid-term adequacy assessment (Electricity Market Act). In previous years ENTSO-E was publishing MAF annually and from 2021 ERAA will be published (Regulation (EU) 943/2019 ("Electricity Regulation") and Regulation (EU) 942/2019 ("Risk Preparedness Regulation") as part of the Clean Energy Package (CEP)).
4	CYPRUS (CYPRUS TSO)	Yes	Annual periodicity
5	EGYPT (EETC)	No	/
6	FRANCE (RTE)	Yes	With obligation of publish every year. By the Low, my TSO has to perform and to publish a 5-year adequacy study
7	GREECE (IPTO)	Yes	Up to now, there wasn't a legal obligation to publish the Adequacy Report, however typically it is has been published on an annual basis. The ERAA methodology requires the publication of the study.
8	ITALY (TERNA)	Yes	With obligation of publish every year by regulation commitments
9	JORDAN (NEPCO)	No	/
10	MOROCCO (ONEE)	No	No
11	PORTUGAL (REN)	Yes	Portuguese MAA is published on a yearly basis by Directorate-General for Energy and Geology (DGEG) in its website, as stated by legislation.
12	SPAIN (REE)	Yes	Mainland studies are published in the Spanish NECP. Non-mainland studies are asked by the Spanish regulator every year, and they cover a 5-year horizon. The latter are not published.

N°	TSO	Q n°3: Do you publish the results and reports of the MAA?	
13	TUNISIA (STEG)	/	/
14	TÜRKIYE (TEIAŞ)	Yes	Yearly
	Main conclusions	▪ For all north countries there are obligation ▪ For south countries not the case	

N°	TSO	Question: For what purpose do you perform MAA studies
1	ALBANIA (OST)	To identify possible adequacy crisis.
2	ALGERIA (SONELGAZ)	The supply / demand adequacy studies as well as the associated operational studies drawn up over the period of 1 to 5 years aim to ensure the availability of the generation fleet to cover demand as well as the identification of possible constraints on the transport network and thus the anticipation of reinforcements.
3	CROATIA (HOPS)	Resource adequacy assessments on the electricity grid, such as the MAF and ERAA, are increasingly prominent studies that use advanced methodologies to model and analyse possible events with potentially adverse consequences for the supply of electric power. They assess the balance between net available generation and net load levels in the European power system on a continuous basis. The adequacy assessment should not be interpreted as an effort to predict the system's security of supply, but rather as a measure of the grid's ability to maintain security of supply under a very high number of possible future grid states due to different plausible climate conditions and random outages.
4	CYPRUS (CYPRUS TSO)	▪ Analysis of the adequacy of the system in the future ▪ Various scenarios (load forecast or generation availability) defined by the Regulator for various Decisions. ▪ Investigate the effect of several scenarios in the system, such as Demand Shape, different generation fleet, significant increase of RES penetration (different technologies) ▪ Generation expansion plan
5	EGYPT (EETC)	To make security to network
6	FRANCE (RTE)	Security of supply is compulsory. The study can also consider robustness to any assumption.
7	GREECE (IPTO)	For estimating possible future adequacy concerns, as well as evaluating current adequacy levels (for the next 2 years), especially in light of thermal unit decommissioning.
8	ITALY (TERNA)	System resources assessment
9	JORDAN (NEPCO)	3 years financial budget
10	MOROCCO (ONEE)	We perform the MAA for the following purposes: 1. fixe the operational budget for the three next years 2. Define the quantities of energy to be imported from and exported to the neighbouring countries

N°	TSO	Question: For what purpose do you perform MAA studies
		3. To check the compliance to PPA contracts with the new capacity to be connected during the three next years; 4. Analysis of the impact of renewables on demand supply;
11	PORTUGAL (REN)	The objective of MAA is the prospective assessments of the Portuguese electricity generation system, taking account security of supply aspects. The security of electricity supply evaluation in the Portuguese electric system draws on probabilistic indicators.
12	SPAIN (REE)	Mainland: to verify whether our planning is viable or not. Non-mainland: to calculate the additional installed capacity that would be necessary to achieve a certain LOLE.
13	TUNISIA (STEG)	/
14	TÜRKIYE (TEIAŞ)	Its aim is to provide conclusions in terms of available capacity and reserve capacity need. The report is submitted to The Energy Ministry in order it to take precautions to ensure reliable electricity supply.
Main conclusions		▪ Assessment and improvement of security of supply ▪ Resource adequacy assessments ▪ Financial budget estimation

N°	TSO	Question: Which geographical perimeter do you consider in your current adequacy studies?	
1	ALBANIA (OST)	National	
2	ALGERIA (SONELGAZ)	National	The adequacy assessment is only done for the national system without considering international exchanges.
3	CROATIA (HOPS)	Regional (direct & indirect neighbouring countries)	In NDP HOPS is considering national and direct neighbouring, but MAF is considering the adequacy issue in the whole Europe. Time horizons are 5 and 10 years.
4	CYPRUS (CYPRUS TSO)	National	1) National: since Cyprus system is isolated and has no effect on other systems 2) Regional: under the umbrella of ENTSO-E.
5	EGYPT (EETC)	National	/
6	FRANCE (RTE)	Regional (direct & indirect neighbouring countries)	/
7	GREECE (IPTO)	Regional (direct & indirect neighbouring countries)	The entire Balkan region, Italy and Türkiye are considered.
8	ITALY (TERNA)	Regional (direct & indirect neighbouring countries)	/
9	JORDAN (NEPCO)	National	/
10	MOROCCO (ONEE)	Regional (direct neighbouring countries)	/
11	PORTUGAL (REN)	Regional (direct neighbouring countries)	/

N°	TSO	Question: Which geographical perimeter do you consider in your current adequacy studies?	
12	SPAIN (REE)	Regional (direct & indirect neighbouring countries)	
13	TUNISIA (STEG)	/	/
14	TÜRKIYE (TEIAŞ)	National	
Main conclusions		▪ North side: regional direct & indirect neighbouring countries (except Portugal (regional direct neighbouring countries) ▪ South side: national context	

N°	TSO	Question: What is the time horizons covered by the MAA studies that are currently performed in your country?
1	ALBANIA (OST)	05 years
2	ALGERIA (SONELGAZ)	05 years
3	CROATIA (HOPS)	10 years
4	CYPRUS (CYPRUS TSO)	05 years
5	EGYPT (EETC)	Other
6	FRANCE (RTE)	05 years
7	GREECE (IPTO)	10 years
8	ITALY (TERNA)	05 years
9	JORDAN (NEPCO)	03 years
10	MOROCCO (ONEE)	03 years
11	PORTUGAL (REN)	Other
12	SPAIN (REE)	05 years
13	TUNISIA (STEG)	/
14	TÜRKIYE (TEIAŞ)	05 years
Main conclusions		▪ The almost common horizon is 5 years, so for Med-TSO studies, it could be a common horizon.

N°	TSO	Question: For a dedicated period of study, do you perform the assessment for every year within the time period year or only for intermediate year?	
1	ALBANIA (OST)	Yes	Every year within the time period year
2	ALGERIA (SONELGAZ)	Yes	The assessment is done for each year of the period
3	CROATIA (HOPS)	No	Only for intermediate year (For example, MAF 2020 is prepared for intermediate years 2025 and 2030).
4	CYPRUS (CYPRUS TSO)	No	Only for intermediate year: Depending on the need for the specific study - both options were addressed in previous studies. If the study refers to more than 3 year time horizon, then indicative years are selected.
5	EGYPT (EETC)	Yes	Every year within the time period year
6	FRANCE (RTE)	Yes	Every year within the time period year

N°	TSO	Question: For a dedicated period of study, do you perform the assessment for every year within the time period year or only for intermediate year?	
7	GREECE (IPTO)	Yes	The assessment is performed for every year of the first five years and then usually the end of the period and one intermediate year are assessed
8	ITALY (TERNA)	No	Only for intermediate year but It is planned to be done in the coming years.
9	JORDAN (NEPCO)	Yes	Every year within the time period year
10	MOROCCO (ONEE)	Yes	every year within the time period year
11	PORTUGAL (REN)	No	Only for intermediate year: The last version of the MAA was published in 2020 and includes the assessment of the following years: 2021, 2022, 2025, 2027, 2030 and 2040.
12	SPAIN (REE)	/	Every year within the time period year: Mainland: only 1 target year currently. Non-mainland: every year within the time period.
13	TUNISIA (STEG)	/	/
14	TÜRKIYE (TEIAŞ)	/	Every year within the time period year: The analysis is done for every year. But the granularity of the input data included some uncertainties.
Main conclusions		▪ There are no common answer.	

N°	TSO	Question: Which approach do you use for MAA? Please describe the approach below	
1	ALBANIA (OST)	Deterministic	calculate the RAC (Reliable available capacity) and subtract the load
2	ALGERIA (SONELGAZ)	Probabilistic	In fact, currently both approaches are used. Indeed, since the penetration of RES is not relevant in the Algerian system, the probabilistic evaluation exercise is used to determine the annual production plan then a verification through a deterministic exercise is carried out
3	CROATIA (HOPS)	Probabilistic	In NDP HOPS uses deterministic approach. The main feature of the MAF probabilistic methodology is the usage of a Monte Carlo sampling to combine different climate conditions through climate-dependent variables and random forced outages on generation assets and interconnections for a given target year.
4	CYPRUS (CYPRUS TSO)	Probabilistic	Monte Carlo
5	EGYPT (EETC)	Deterministic	According to available data
6	FRANCE (RTE)	Probabilistic	Full probabilistic (stochastic) approach, using ANTARES
7	GREECE (IPTO)	Probabilistic	/
8	ITALY (TERNA)	Probabilistic	Probabilistic
9	JORDAN (NEPCO)	Deterministic	We make some fixed assumptions depending on actual historical data
10	MOROCCO (ONEE)	Deterministic	

N°	TSO	Question: Which approach do you use for MAA? Please describe the approach below	
11	PORTUGAL (REN)	Probabilistic	The calculation of the security of supply indicators is performed using the probabilistic tools RESERVAS and PS-MORA - mathematical models that use an application of chronological Monte Carlo simulation.
12	SPAIN (REE)	Probabilistic	none
13	TUNISIA (STEG)	/	/
14	TÜRKIYE (TEIAŞ)	Deterministic	Deterministic approach
Main conclusions		▪ Almost for north TSO the probabilistic approach is used (except Albania and Türkiye) ▪ For the others TSO the deterministic approach is used	

N°	TSO	Question: Which risks do you analyze in your current national/regional studies?				
		Peak conditions	Valley conditions	Upward adequacy	Downward adequacy (excess of generation)	Extreme conditions
1	ALBANIA (OST)	x	-	-	-	-
2	ALGERIA (SONELGAZ)	x	x	x	x	Droop voltage
3	CROATIA (HOPS)	x	x	x	x	x
4	CYPRUS (CYPRUS TSO)	x	x	x	-	x
5	EGYPT (EETC)	x	x	x	x	x
6	FRANCE (RTE)	x	x	x	x	x
7	GREECE (IPTO)	x	x	-	-	x
8	ITALY (TERNA)	x	x	x	-	x
9	JORDAN (NEPCO)	x	-	-	-	-
10	MOROCCO (ONEE)	x	-	x	-	x
11	PORTUGAL (REN)	x	x	x	x	x
12	SPAIN (REE)	x	x	x	-	x
13	TUNISIA (STEG)	-	-	-	-	-
14	TÜRKIYE (TEIAŞ)	-	x	x	-	x
Main conclusions		▪ All TSO highlight the analysis of Peak conditions (except Türkiye) ▪ For extreme conditions or extreme scenario, TSO analyse risks				

N°	TSO	Question: Do you consider regional exchanges in your current adequacy studies?	
1	ALBANIA (OST)	Yes	It is considering the NTC values
2	ALGERIA (SONELGAZ)	No	The adequacy assessment is only done for the national system without considering exchanges.
3	CROATIA (HOPS)	Yes	In order to prepare suitable adequacy analysis of the national power system it is necessary to consider regional exchanges. HOPS has several

N°	TSO	Question: Do you consider regional exchanges in your current adequacy studies?	
			coordination actions and meeting with our neighbours in the scope of ENTSO-E activities (for example Regional Group Continental South East), SECI project (South East Cooperation Initiative), EMI project (Electricity market initiative) under scope of USEA/USEAID.
4	CYPRUS (CYPRUS TSO)	/	In the base line scenarios no. In scenarios including assumptions with interconnection, the interconnector(s) are modelled as available generation/demand according to their technical restrictions only, without considering any economical or other Market oriented restrictions.
5	EGYPT (EETC)	Yes	
6	FRANCE (RTE)	Yes	The modelling includes the whole regional area
7	GREECE (IPTO)	Yes	Neighbouring systems are modelled explicitly and NTC values collected by ENTSO-E are used.
8	ITALY (TERNA)	Yes	Yes, internal assumptions
9	JORDAN (NEPCO)	Yes	Yes. exchange with Egypt interconnection
10	MOROCCO (ONEE)	Yes	We consider the NTC of interconnections
11	PORTUGAL (REN)	Yes	In the probabilistic simulations carried out to evaluate generation adequacy assessment in Portugal, only the contribution of 10% of the interconnection capacity (NTC) with Spain is considered. The NTC values result from a joint calculation by REN and REE (Spanish TSO).
12	SPAIN (REE)	Yes	Yes, based on ENTSOE models. We do not coordinate with our neighbours to do these studies.
13	TUNISIA (STEG)	/	/
14	TÜRKIYE (TEIAŞ)	No	Regional exchanges are not considered for the adequacy assessment.
Main conclusions		▪ All north side consider the regional exchanges ▪ For the other TSO not almost the case. Maybe, the fact that there is not an obligation but in the future within the framework of Med-TSO these studies will have a significant added value	

N°	TSO	Question: Which type of tools do you use for your current adequacy studies	
1	ALBANIA (OST)	Homemade tool	Just an basic excel
2	ALGERIA (SONELGAZ)	Commercial Tool	SPIRA - GRARE Tool
3	CROATIA (HOPS)	Commercial Tool	In HOPS we use Plexos. ENTSO-E is using Plexos, Antares, PowerSym etc.
4	CYPRUS (CYPRUS TSO)	Homemade tool	Tool developed in MathWorks MATLAB (based on the ENTSO-e's MAF 2018 methodology)
5	EGYPT (EETC)	Commercial Tool	/
6	FRANCE (RTE)	Antares or Others	Antares Tool
7	GREECE (IPTO)	Antares or Others	Antares
8	ITALY (TERNA)	Commercial Tool	GRERE Tool
9	JORDAN (NEPCO)	Commercial Tool	Blexos program software
10	MOROCCO (ONEE)	Commercial tool	Siemens TOOL (RESSOURCES OPTIMIZATION)
11	PORTUGAL (REN)	Homemade tool	/

N°	TSO	Question: Which type of tools do you use for your current adequacy studies	
12	SPAIN (REE)	Commercial Tool	PLEXOS
13	TUNISIA (STEG)	/	/
14	TÜRKIYE (TEIAŞ)	Homemade tool	/
Main conclusions		▪ 4 TSO use homemade tool, which 2 not identified. ▪ 3 TSO use PLEXOS Tool ▪ 2 TSO use GRARE Tool ▪ 2 TSO use ANTARES Tool ▪ 1 TSO use Siemens Tool For this point a common set point should be discussed in order to have a common approach for modelling systems and later to decide on the tool to be used	

N°	TSO	Question: Do you have any difficulties in preparing these studies? Could you explicit some of the difficulties you are facing for performing MAA studies?	
1	ALBANIA (OST)	No	/
2	ALGERIA (SONELGAZ)	No particular constraints	/
3	CROATIA (HOPS)	Yes	Staff engaged in preparing MAA has to be very skilled in usage of market modelling tools, as well as network modelling tools. The process of MAA preparation is time consuming and there is a need for sufficient human resources.
4	CYPRUS (CYPRUS TSO)	Yes	1) negotiations with the producers in the cases of maintenance of their production units. 2) Adaptation TRAPUNTA results to local predictions approved by the Regulator.
5	EGYPT (EETC)	No	/
6	FRANCE (RTE)	No	/
7	GREECE (IPTO)	Yes	Aligning with the ERAA methodology has been challenging.
8	ITALY (TERNA)	No	/
9	JORDAN (NEPCO)	No	/
10	MOROCCO (ONEE)	No	/
11	PORTUGAL (REN)	No	/
12	SPAIN (REE)	Yes	The main issue are the execution times
13	TUNISIA (STEG)	/	/
14	TÜRKIYE (TEIAŞ)	No	/
Main conclusions		▪ Almost TSO don't have constraints on performing MAA studies. ▪ For some TSO, the need is presented for: - Capacities building - Resources - Assumptions and data collections.	

SECTION B. Expectations with regards Med-TSO MAA:

N°	TSO	Question: What added value do you think that Med-TSO MAA studies could bring
1	ALBANIA (OST)	N/a
2	ALGERIA (SONELGAZ)	▪ Possible new approach for assessment ▪ The impact of the contribution of interconnections in import and export
3	CROATIA (HOPS)	MAA studies are essential for TSOs to meet adequacy demands, and to ensure security of supply.
4	CYPRUS (CYPRUS TSO)	Med-TSO MAA studies can offer useful conclusions to all members
5	EGYPT (EETC)	Interconnection economy benefits
6	FRANCE (RTE)	To fill in the gap between Seasonal and Long-term studies
7	GREECE (IPTO)	/
8	ITALY (TERNA)	Added value for Mediterranean perspective, i.e. future increase in cooperation, when interconnections shall be in place
9	JORDAN (NEPCO)	Improve our MMA approach
10	MOROCCO (ONEE)	New approaches, new tools
11	PORTUGAL (REN)	Promote cooperation, data exchange and align methodologies and studies among Med-TSO members in order to reinforce security of supply in Med-TSO perimeter.
12	SPAIN (REE)	As North and South Mediterranean countries are getting more and more interconnected, it will be useful to analyse how each of them affects on the others' adequacy and vice versa.
13	TUNISIA (STEG)	Due to the increasing level of variable renewable energy sources the Med-TSO MAA can bring significant improvements for the operation of electrical systems especially for the countries of the southern shore of the Mediterranean: - The MAA assesses the balance between net available generation and net load levels in the MED-TSO power systems on a continuous basis. - The MAA uses the indicators Expected Energy Not Served 'EENS' (amount of demand for electricity at risk of not being supplied) and Loss of Load Expectation 'LOLE'. - Verify the flexibility of the power system, the ability of the installed generation capacity to adjust to the ever-increasing dynamic of dispatch events in the system. This is mainly due to the increasing amount of variable renewable energy.
14	TÜRKIYE (TEIAŞ)	The added value will be the inclusion of probabilistic tools for the preparation of renewable and demand time-series and practical results of this approach under EU guidelines.
Main conclusions		▪ For the TSO of the south side the added value will be for: - Capacities building - Interconnection economy benefits assessment ▪ For the North side: - Improvement of security of supply - Promote cooperation in regional context - To fill in the gap between Seasonal and Long-term studies

N°	TSO	Question: Which risks do you analyse in your current national/regional studies? Not relevant	Not very important	If resources are enough	Nice to have	Must to have
1	ALBANIA (OST)	7&10 years	-	-	2&3 years	5years
2	ALGERIA (SONELGAZ)	-	-	7 and 10 years	-	2,3 and 5 years
3	CROATIA (HOPS)	-	2 years	7 years	3 years	5&10 years
4	CYPRUS(CYPRUS TSO)	-	10 years	2 years	7 years	3&5 years
5	EGYPT (EETC)	10 years	7 years	5 years	3 years	2 years
6	FRANCE (RTE)	10 years	7 years	-	2 years	3&5 years
7	GREECE (IPTO)	-	-	-	-	-
8	ITALY (TERNA)	-	-	2, 3 and 7 years	5&10 years	-
9	JORDAN (NEPCO)	7&10 years	5 years	3 years	2 years	-
10	MOROCCO (ONEE)	7 years	2 years	-	10 years	3&5 years
11	PORTUGAL (REN)	-	-	2,5 and 7 years	-	3&10 years
12	SPAIN (REE)	2,3 and 7 years	-	-	5 years	10 years
13	TUNISIA (STEG)			10 years	5&7 years	2&3 years
14	TÜRKIYE (TEIAŞ)	-	2,3 and 7 years	-	5 years	10 years
Main conclusions		▪ The common time horizon that we must have is between 2 and 5 years ▪ As a second priority is the 10 years target which is covered by Master Plan				

N°	TSO	Question: Which are the main adequacy risks that should be assessed in MAA? Peak conditions	Valley conditions	Upward adequacy	Downward adequacy (excess of generation)	Others extreme conditions
1	ALBANIA (OST)	5	3	5	3	/
2	ALGERIA (SONELGAZ)	5	4	4	4	/
3	CROATIA (HOPS)	5	3	4	4	/
4	CYPRUS (CYPRUS TSO)	5	3	5	1	/
5	EGYPT (EETC)	4	3	3	3	/
6	FRANCE (RTE)	5	3	5	3	/
7	GREECE (IPTO)	/	/	/	/	/
8	ITALY (TERNA)	5	4	5	3	1
9	JORDAN (NEPCO)	4	2	2	2	3
10	MOROCCO (ONEE)	5	5	5	3	3
11	PORTUGAL (REN)	5	3	4	3	5
12	SPAIN (REE)	1	2	1	4	1
13	TUNISIA (STEG)	5	4	5	5	4
14	TÜRKIYE (TEIAŞ)	5	5	4	3	1
Main conclusions		▪ The high priority in general is expressed for Peak condition. ▪ For the other situations there are several priorities per TSO.				

N°	TSO	Question: Do you think that Med-TSO studies should aim to have the same timeline with the different studies (in national or regional level)?	
1	ALBANIA (OST)	Yes	/
2	ALGERIA (SONELGAZ)	Yes	For more synergy between national and regional studies, Med-TSO studies should have the common target period of national studies performed by members
3	CROATIA (HOPS)	Yes	It depends on the type of studies, but if the same data is used for some other studies on national/regional level it could be convenient, but for regional assessment of MAA it is essential to have same procedure introduced in all involved countries.
4	CYPRUS(CYPRUS TSO)	Yes	/
5	EGYPT (EETC)	Yes	/
6	FRANCE (RTE)	Yes	/
7	GREECE (IPTO)	/	/
8	ITALY (TERNA)	Yes	In order to use same quantitative scenario
9	JORDAN (NEPCO)	Yes	For improving the approach and results
10	MOROCCO (ONEE)	Yes	To establish the concordance and harmony between the regional and national MAA studies.
11	PORTUGAL (REN)	Yes	Ideally, Med-TSO MAA should be performed on a yearly basis, with the time horizons being aligned with those of the national studies. Hence the suggestion for the "must have" time horizons of: 3 years and 10 years (~2025 and 2030).
12	SPAIN (REE)	Yes	To study the adequacy of the proposed scenarios
13	TUNISIA (STEG)	Yes	Yes, it is important to see the impact of interconnections on mutual exchanges between MED-TSO networks in national and regional level and to analyse the adequacy between production and demand in these systems according to climatic conditions, renewable variation and operating constraints.
14	TÜRKIYE (TEIAŞ)	Yes	/
Main conclusions		Almost the TSO express their opinion to have an alignment of the horizon and study period between national and regional level.	

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