Deliverable 2.1.2

Detailed Project Description

12 - JOSYTR Jordan-Syria-Turkey

EC DEVCO - GRANT CONTRACT: ENPI/2014/347-006

"Mediterranean Project"

Task 2 "Planning and development of the Euro-Mediterranean Electricity Reference Grid "

Med-TSO is supported by the European Union.

This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of Med-TSO and do not necessarily reflect the views of the European Union.

INDEX

1 Introduction

The present document contains the studies on project JOSYTR, in the context of the Mediterranean Master Plan of Interconnections. Project JOSYTR consists of new interconnections between Jordan and Syria (+800 MW AC), and between Syria and Turkey (+600 MW AC).

The document is structured as follows. Section 2 describes in detail the interconnection project and the different sources for data employed. Section 3 presents the definition of the different snapshots to be considered and the description of the building process followed. Section 4 comprises the criteria and results of the security analysis. Section 5 summarizes the results on security analysis and reinforcements' assessment. Section 6 contains the estimations made for the active power losses. Finally, section 7 comprises the estimation for the different investment costs.

2 Project description and data acquisition

The project consists in two new interconnections: one between Jordan and Syria and one between Syria and Turkey, to be realized through AC overhead lines and HVDC Back-to-Back station in Turkey.

Jordan, Syria, and Turkey are electrically interconnected by 400 kV grid with existing capacity of 600 MW (Turkey-Syria) and 800 MW (Jordan-Syria). These countries are part of the 8th countries interconnection which consists in addition to them Egypt, Lebanon, Iraq, Palestine, and Libya.

The main driver of the project is to further increase the interconnection capacity between Syria, Turkey, and Jordan by another 800 MW between Jordan and Syria and 600 MW between Turkey and Syria. This will allow mainly meeting the Syrian demand and integrating more RES and base load units in the region. Main drivers for the selection of scenarios:

- Simultaneous high saturation on the interconnections (on both directions) representing a high time percentage especially the period where Jordan and Turkey Imports/Exports Energy to both Syria.
- Extreme (high/low) load in the countries involved.
- High/low RES production of different categories (PV, wind) in interconnected countries.
- High/Low Nuclear new production in Jordan and Turkey

Project details

Description	Substation (from)	Substation (to)	GTC contribution (MW)	Present status	Expected commissioning date	Evolution	Evolution driver
New interconnections between Jordan-Syria (AC) and Syria-Turkey (AC)	Jordan (JO) Hasheimya	Syria (SY) Suriye	800	Long-term project	*n.d.*	*n.d.*	Double the transfer capacity in the Turkey – Syria – Jordan transmission corridor
	Syria (SY) Deir Ali	Turkey (TR) Birecik	600				

The system defined for project JOSYTR is described in the table and figure below.

Full models	Boundaries
Turkey TR	Greece GR
Syria SY	Bulgaria BG
Jordan JO	Lebanon LE
Egypt EY	Palestine PA
	Libya LY

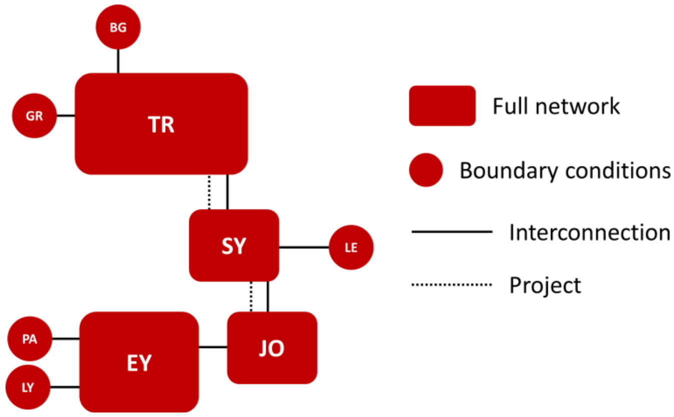

Table 1 – Participation of each of the systems involved in project JOSYTR

For this project, the Egyptian, Jordanian, Syrian and Turkish systems have been considered as full represented by their transmission network models. Boundary systems, i.e. Bulgaria, Greece, Lebanon, Palestine and Libya, are considered as external buses with loads to simulate energy interchanges.

In the snapshots definition, 4 scenarios (S1, S2, S3 and S4) and seasonality (Winter/Summer) were distinguished, based on the distinctively different assumptions of future evolution considered in the Mediterranean project. Models provided:

- One model for S1 including full representation of the Jordanian network and equivalents for the Egyptian and Syrian systems
- For the Turkish system, a set of eight models, corresponding with 4 scenarios and seasonality (Winter/Summer).

Full list of provided files is included in [1]. Technologies for generating units have been specified in the Jordanian and Turkish systems with respect to the generating technologies considered in the Mediterranean project, while all Egyptian and Syrian generating units have been considered of the same technology and rank. In all models provided interconnected Areas are well identified.

Merging process consists of joining the different networks using the connecting buses defined in the next tables. First, Table 2 summarizes the interconnections between systems, which correspond with pairs of modelled systems, thus two interconnection buses must be identified, one for each of the systems in the interconnection.

Bus	Area	Substation	Bus	Area	Substation
XAL_BR11	Turkey TR	Birecik	TURKYA	Syria SY	Suriye
DIR-ALI	Syria SY	Deir Ali	HASSAN_IND	Jordan JO	Hasheimya

Table 2 – Points of merging between systems in the JOSYTR project

Table 3 shows the set of interconnections that correspond with pairs formed by a modelled system and a boundary system, thus only one bus in the modelled system needs to be identified.

Bus	Area (from)	Substation	Area (to)
XNS_BA11	Turkey TR	Babaeski	Greece GR
XMI_HA11	Turkey TR	Hamitabat	Bulgaria BG
XMI_HA12	Turkey TR	Hamitabat	Bulgaria BG
AQBACBL	Jordan JO	Aqaba	Egypt EY
SMREAN	Syria SY	Tartous	Lebanon LE
DIMAS	Syria SY	Dimas	Lebanon LE

Table 3 – Points of merging between systems and external buses in the JOSYTR project

Finally, Table 4 presents the new interconnections associated to the JOSYTR project. More specifically, the project JOSYTR considers two AC links. For the first link (Syria-Turkey), buses XAL_BR11 and TURKYA are identified in both sides. For the second link (Jordan-Syria), bus DIR-ALI and HASSAN_IND.

PROJECT	Bus	Area	Subs.	Bus	Area	Subs.	LINK
JOSYTR	XAL_BR12	Turkey TR	Birecik	TURKYA	Syria SY	Suriye	AC
JOSYTR	DIR-ALI	Syria SY	Deir Ali	HASSAN_IND	Jordan JO	Hasheimya	AC

Table 4 – Points of merging in the Projects in the JOSYTR project

3 Snapshots definition and building process

For the project JOSYTR, a total number of nine Points in Time (PiT) have been defined [2]. Each of the PiT contains, for each of the systems considered, the active power generated, demanded and exported to the other systems. Active power production comes with a breakdown of technologies. Next table shows the power balance for each of the PiTS in JOSYTR project.

project JOSYTR PiT 1 - Power Balance [MW]

sys	PG	PD	Pextra	Pexport	JO	SY	TR	GR	BG	LE	EY
Jordan JO	6030.1	3894.1	0.0	2135.9	0.0	1592.3	0.0	0.0	0.0	0.0	543.6
Syria SY	10491.7	13284.0	0.0	-2792.3	-1592.3	0.0	-1200.0	0.0	0.0	0.0	0.0
Turkey TR	32473.6	29724.6	274.0	3023.0	0.0	1200.0	0.0	580.0	1243.0	0.0	0.0

project JOSYTR PiT 2 - Power Balance [MW]

sys	PG	PD	Pextra	Pexport	JO	SY	TR	GR	BG	LE	EY
Jordan JO	3309.5	3745.7	0.0	-436.1	0.0	-204.3	0.0	0.0	0.0	0.0	-231.8
Syria SY	9012.3	9508.0	0.0	-495.7	204.3	0.0	-1200.0	0.0	0.0	500.0	0.0
Turkey TR	**34350.1**	**33748.6**	**41.0**	**642.5**	**0.0**	**1200.0**	**0.0**	**0.0**	**-557.5**	**0.0**	**0.0**

project JOSYTR PiT 3 - Power Balance [MW]

sys	PG	PD	Pextra	Pexport	JO	SY	TR	GR	BG	LE	EY
Jordan JO	8398.5	6248.5	0.0	2150.0	0.0	1600.0	0.0	0.0	0.0	0.0	550.0
Syria SY	**17150.0**	**19950.0**	**0.0**	**-2800.0**	**-1600.0**	**0.0**	**-1200.0**	**0.0**	**0.0**	**0.0**	**0.0**
Turkey TR	**65128.6**	**63853.0**	**107.0**	**1382.6**	**0.0**	**1200.0**	**0.0**	**161.4**	**21.3**	**0.0**	**0.0**

project JOSYTR PiT 4 - Power Balance [MW]

sys	PG	PD	Pextra	Pexport	JO	SY	TR	GR	BG	LE	EY
Jordan JO	**5270.3**	**3670.3**	**0.0**	**1600.0**	**0.0**	**1600.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Syria SY	**9773.1**	**11678.0**	**0.0**	**-1904.9**	**-1600.0**	**0.0**	**-804.9**	**0.0**	**0.0**	**500.0**	**0.0**
Turkey TR	42177.4	42715.8	297.0	-241.4	0.0	804.9	0.0	-660.0	-386.4	0.0	0.0

project JOSYTR PiT 5 - Power Balance [MW]

sys	PG	PD	Pextra	Pexport	JO	SY	TR	GR	BG	LE	EY
Jordan JO	6390.8	5482.0	0.0	908.8	0.0	1458.8	0.0	0.0	0.0	0.0	-550.0
Syria SY	8964.2	11123.0	0.0	-2158.8	-1458.8	0.0	-1200.0	0.0	0.0	500.0	0.0
Turkey TR	62072.4	62915.4	43.0	-800.0	0.0	1200.0	0.0	-660.0	-1340.0	0.0	0.0

project JOSYTR PiT 6 - Power Balance [MW]

sys	PG	PD	Pextra	Pexport	JO	SY	TR	GR	BG	LE	EY
Jordan JO	3675.8	4624.8	0.0	-949.0	0.0	-398.9	0.0	0.0	0.0	0.0	-550.0
Syria SY	9773.9	9316.0	0.0	457.9	398.9	0.0	-441.0	0.0	0.0	500.0	0.0
Turkey TR	42938.0	43210.0	175.0	-97.0	0.0	441.0	0.0	-660.0	122.0	0.0	0.0

project JOSYTR PiT 7 - Power Balance [MW]

sys	PG	PD	Pextra	Pexport	JO	SY	TR	GR	BG	LE	EY
Jordan JO	2951.1	3906.4	0.0	-955.3	0.0	-405.3	0.0	0.0	0.0	0.0	-550.0
Syria SY	11135.3	9089.0	0.0	2046.3	405.3	0.0	1141.1	0.0	0.0	500.0	0.0
Turkey TR	**46262.7**	**46993.8**	**270.0**	**-461.0**	**0.0**	**-1141.1**	**0.0**	**-660.0**	**1340.0**	**0.0**	**0.0**

project JOSYTR PiT 8 - Power Balance [MW]

sys	PG	PD	Pextra	Pexport	JO	SY	TR	GR	BG	LE	EY
Jordan JO	6845.9	6326.2	0.0	519.6	0.0	1069.6	0.0	0.0	0.0	0.0	-550.0
Syria SY	13458.1	15774.0	0.0	-2315.9	-1069.6	0.0	-1200.0	0.0	0.0	-46.2	0.0
Turkey TR	77365.2	76109.3	283.0	1538.9	0.0	1200.0	0.0	-660.0	998.9	0.0	0.0

project JOSYTR PiT 9 - Power Balance [MW]

sys	PG	PD	Pextra	Pexport	JO	SY	TR	GR	BG	LE	EY
Jordan JO	6129.4	3979.4	0.0	2150.0	0.0	1600.0	0.0	0.0	0.0	0.0	550.0
Syria SY	12612.8	15774.0	0.0	-3161.2	-1600.0	0.0	-1200.0	0.0	0.0	-361.2	0.0
Turkey TR	41180.1	41657.6	14.0	-463.5	0.0	1200.0	0.0	-660.0	-1003.5	0.0	0.0

Table 5 – Power balance for each of the PiTS defined in the JOSYTR project

In Table 5, the column 'Pextra', only non-zero for the Turkish system, represents extra energy that comes from Georgia, Iran and Iraq.

4 Power flow and security analysis

This section presents the criteria agreed to run the power flow and security analysis over the different snapshots built for project JOSYTR. Details on the methodology used for the security analysis are compiled in [3].

Jordan

For the Jordanian system, the perimeter of the security analysis was limited in the transmission levels. Therefore, the branches considered for the N-1 analysis are only those 400 kV, whereas the monitored elements include branches at 132 kV and 400 kV.

Concerning rates and tolerances, from the three different values, i.e. rateA, rateB and rateC, identified in the models provided, for lines and transformers, rateB was considered for all snapshots, while rateA and rateC were not taken into consideration. The tolerance considered for overload was -10% for all branches in N, and 0% in N-1 situations.

Regarding the loss of generating units, the 10% of the energy lost was compensated from local (Jordanian) generating units, and the 90% is shared by Syria (10%), Egypt (50%) and Turkey (30%).

Finally, no N-2 situations have been considered for Jordan.

Syria

For the Syrian system, the perimeter of the security analysis was limited in the transmission levels. Therefore, the branches considered for the N-1 analysis but also as the monitored elements were only those at 220 kV or 400 kV.

Concerning rates and tolerances, from the three different values, i.e. rateA, rateB and rateC, identified in the models provided, for lines and transformers, rateA was considered for all snapshots, thus rateB and rateC were not taken into consideration. The tolerance considered for overload was 0% for all branches in N and in N-1 situations.

Regarding the loss of generating units, the energy lost was compensated internally, using the rest of Syrian generating units.

Finally, no N-2 situations have been considered for Syria.

Turkey

For the Turkish system, the perimeter of the security analysis was limited in the bulk transmission levels. Therefore, the branches considered for the N-1 analysis but also as the monitored elements were only those at 400 kV.

Concerning rates and tolerances, from the three different values identified in the models provided, i.e. rateA, rateB and rateC, for lines, rateB was considered for Summer and rate A for Winter. The tolerance considered for overload was 0% for N situations and +10% for and N-1 situations. Regarding the loss of generating units, the energy lost was compensated internally, using the rest of Turkish generating units.

Finally, a set of N-2 outages has been specified for the project JOSYTR. This set is formed by two different clusters of lines:

'Sinop NPP' set				'Akkuyu NPP' set		
bus FROM	bus TO	IC		bus FROM	bus TO	IC
TALTIN11 400,00	TSINPN11 400,00	1		TKONYA11 400,00	TAKKYN11 400,00	1
TKURSN11 400,00	TSINPN11 400,00	1		TKRMND11 400,00	TAKKYN11 400,00	1
TKURSN11 400,00	TSINOP11 400,00	1		TSEYDS11 400,00	TAKKYN11 400,00	1
TSINOP11 400,00	TSINPN11 400,00	1		TERMEN11 400,00	TAKKYN11 400,00	1
TKSTMN11 400,00	TSINPN11 400,00	1		TMERSN11 400,00	TAKKYN11 400,00	1
TBARTN11 400,00	TKSTMN11 400,00	1		TMNVGT11 400,00	TAKKYN11 400,00	1
TBARTN11 400,00	TSINPN11 400,00	1				

Table 6 – N-2 outages considered for the Turkish system in project JOSYTR

From each of the sets, N-2 considered the simultaneous outage of two lines.

5 Assessment of reinforcements

Jordan

Since no remarkable overloads associated with the new interconnection have been identified, no reinforcements are considered for the Jordanian network.

Syria

For the Syrian network, only one reinforcement close to the Jordan-Syria interconnection is considered. The 400 kV link between Adra and Deir Ali is going to be doubled.

Turkey

Reinforcements that are required to secure operation of Turkish grid with the JOSYTR interconnection project could be listed in two categories: 1. upgrade of existing OHL and 2. addition of new OHL/addition of new connection point to existing OHL.

To increase transmission capacity of an existing 2-bundle OHL, existing route replaced with 3-bundle Cardinal or Pheasant OHL. Parameters of 3-bundle Cardinal and Pheasant OHLs are listed in the table below. In this study 3-bundle Cardinal OHL used in simulation for upgrade of existing 2-bundle OHLs.

	Rs [pu/100km]	Xs [pu/100km]	Bp [pu/100km]	rateA [MVA]	rateB [MVA]	rateC [MVA]
3-bundle Cardinal OHL	0,001306	0,016625	0,69266	1589	1334	2178
3-bundle Pheasant OHL	0,000994	0,016437	0,703719	1921	1604	2610

Table 7 – Parameters of 3-bundle Cardinal and Pheasant OHLs for the project GRTRBG

2-bundle OHLs required to be upgraded with the JOSYTR interconnection project is listed as below:

- 400kV Atatürk - BirecikHES OHL – 2bundle Cardinal, 59km (double circuit replacement is needed to reinforce grid)
- 400kV Birecik - BirecikHES OHL – 2bundle Cardinal, 2km

There is no need for new additional line to reinforce Turkish grid for JOSYTR project. Next figures show the maps of interconnections, both existing (dashed-yellow line) and planned (yellow line), and corresponding reinforcements (green line).

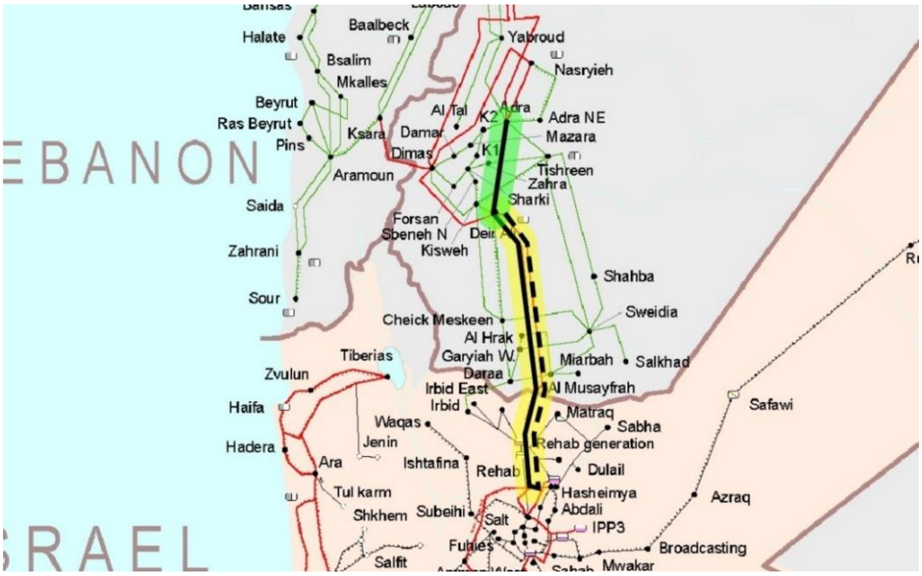

Figure 1 – Map of interconnections and reinforcements for project JOSYTR, detail of JOSY interconnection area

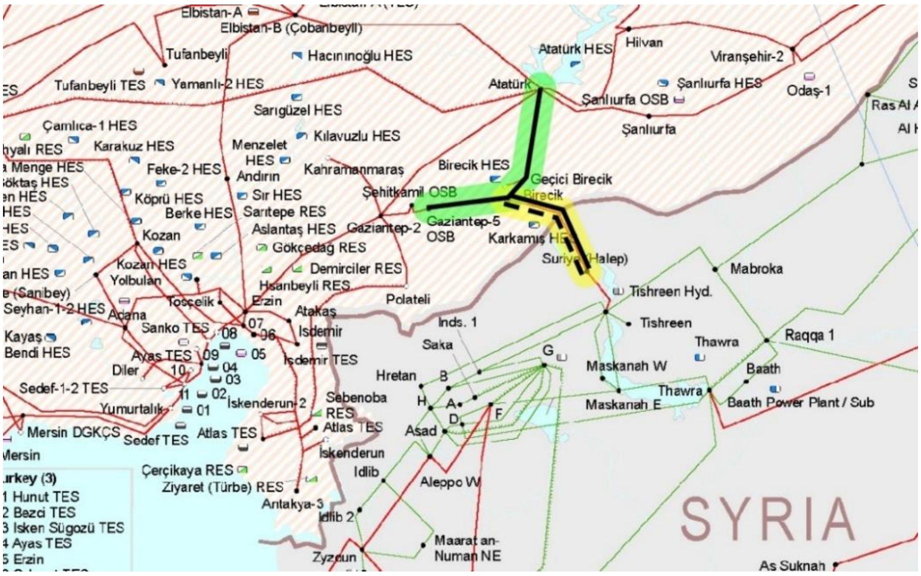

Figure 2 – Map of interconnections and reinforcements for project JOSYTR, detail of SYTR interconnection area

6 Estimation of Active Power Losses

Internal losses in each country

To evaluate the performance of the new interconnection projects plus the planned reinforcements, the active power losses have been computed for 1) the snapshots built with the specified reinforcements considered, and for 2) the snapshots without interconnection projects and without reinforcements. Next tables show the active power losses summary for each of the PiTs, **Errore. L'origine riferimento non è stata trovata.** with the results for the Egyptian system, **Errore. L'origine riferimento non è stata trovata.** with the results for the Jordanian system, **Errore. L'origine riferimento non è stata trovata.** with the results for the Syrian system and **Errore. L'origine riferimento non è stata trovata.** with the results for the Turkish system.

	Power losses [MW]		
PiT	Without proj&reinf	With proj&reinf	Difference (W-WO)
1	571.9	575.4	3.4
2	285.9	288.5	2.7
3	1278.7	1278.0	-0.7
4	448.7	448.6	-0.1
5	445.2	445.8	0.6
6	297.9	298.0	0.1
7	282.8	284.4	1.6
8	799.5	802.3	2.8
9	810.9	814.2	3.4

Table 8 – Comparison of the active power losses for each snapshot, with and without interconnection projects and reinforcements, for the Egyptian system

	Power losses [MW]		
PiT	Without proj&reinf	With proj&reinf	Difference (W-WO)
1	68.8	83.6	14.9
2	63.5	56.2	-7.4
3	167.3	173.7	6.4
4	63.0	73.5	10.4
5	103.8	118.7	14.9
6	125.7	99.0	-26.7
7	138.6	108.0	-30.6
8	165.2	161.5	-3.7
9	72.3	88.3	16.0

Table 9 – Comparison of the active power losses for each snapshot, with and without interconnection projects and reinforcements, for the Jordanian system

	Power losses [MW]		
PiT	Without proj&reinf	With proj&reinf	Difference (W-WO)
1	4.5	5.6	1.2
2	3.1	3.3	0.2
3	8.3	7.2	-1.1
4	4.1	5.3	1.2
5	4.2	1.8	-2.4
6	2.8	4.4	1.6
7	2.9	5.0	2.1
8	19.8	5.2	-14.6
9	6.3	7.2	0.9

Table 10 – Comparison of the active power losses for each snapshot, with and without interconnection projects and reinforcements, for the Syrian system

	Power losses [MW]		
PiT	Without proj&reinf	With proj&reinf	Difference (W-WO)
1	496.1	515.8	19.7
2	332.9	344.7	11.8
3	1097.8	1067.1	-30.7
4	522.6	536.1	13.5
5	986.7	1021.0	34.3
6	391.7	413.3	21.6
7	406.7	396.2	-10.5
8	1519.8	1566.3	46.4
9	374.2	407.9	33.7

Table 11 – Comparison of the active power losses for each snapshot, with and without interconnection projects and reinforcements, for the Turkish system

Taking into account the time percentile (hours of the year) that each PiT represents, internal active power losses with and without the new interconnection project computed for each PiT have been converted to annual energy losses for each one of the 4 scenarios. The following table shows the annual internal delta losses estimate for each system, as well as the total annual internal losses:

Scenario	Annual Internal Losses (MWh)				
	EY	JO	SY	TR	Total
S1	13,846	56,227	7,525	171,767	249,365
S2	12,637	51,316	6,868	156,765	227,586
S3	12,919	52,461	7,021	160,265	232,667
S4	13,197	53,588	7,172	163,706	237,662

Table 12 – Annual internal delta losses estimate for each country

Losses in the new AC interconnection project

Based on the hourly time series of exchange among countries provided by Market studies for each one of the 4 scenarios, with and without the new interconnection project, yearly losses on the interconnection have also been computed.

Computation of the losses in the new AC interconnection has been carried out for the four scenarios S1 to S4 and 8760 hours of estimated flows through the interconnections. The following table summarizes the values used for this estimation exercise:

link	r_l [pu]	NTC_{new} [MW]	NTC_{total} [MW]
JO-SY	0.00176	800	1600
SY-TR	0.00106	600	1200

Table 13 – Parameters for the losses estimation in the JOSYTR interconnections

Based on the above calculation the following table presents the annual losses estimate on the interconnection project for each scenario:

Scenario	Annual Losses on Interconnection (MWh)		
	SY-TR	JO-SY	Total
S1	19,182	66,167	85,349
S2	14,511	71,590	86,102
S3	16,816	58,122	74,938
S4	14,509	78,982	93,491

Table 14 – Annual losses estimate for the new JOSYTR interconnection

Both internal losses and losses on the interconnection were monetized for each scenario, taking into account the Annual Average Value of Marginal Cost, for the countries involved, as provided by the Market Studies. Results are presented in the following table:

Scenario	Annual cost of losses (M€)										Total Interconnection (M€)	Total System (M€)	Total (M€)
	EY	JO			SY			TR					
	System	Interconnection	System	Total	Interconnection	System	Total	Interconnection	System	Total			
S1	1.05	2.51	4.26	6.77	3.23	0.57	3.80	0.73	13.02	13.74	6.47	17.85	**25.36**
S2	1.13	3.21	4.60	7.81	3.86	0.62	4.48	0.65	14.06	14.71	7.72	19.28	**28.14**
S3	1.08	2.43	4.39	6.82	3.13	0.59	3.72	0.70	13.41	14.11	6.27	18.38	**25.73**
S4	1.22	3.64	4.94	8.59	4.31	0.66	4.97	0.67	15.10	15.77	8.62	20.71	**30.55**

Table 15 – Annual cost of losses estimate for the new JOSYTR interconnection

As a general remark, the project results in rather negligible losses in the interconnection, while for internal losses there is a small increase in all countries involved, resulting in a small increase of the overall losses of the project.

7 Estimation of Investment Cost

Based on the information on the interconnection project and the relevant internal reinforcements that were identified in the security analysis the total investment cost was estimated as presented in the following tables. As a general remark, internal reinforcements in Syria and Turkey associated with the project are rather shallow (close to the point of connection), representing a very small yet not negligible part of the investment cost (10%).

The following tables provide an estimate for the investment cost for the internal reinforcements, and the Cost Benefit Analysis (CBA) carried out based on the results of EES and TC1 activities of the Mediterranean Project. It should be noted that this is an estimation of the cost based on the best practices in the region.

P12 - JOSYTR - Investment Cost								
New Interconnections								
Description	**Type**	**Countries Involved**	**Length/number**		**Total Investment Cost**	**GTC Contribution**	**Location**	**Status**
			OHL [km]	**Cable [km]**	**M€**	**MW**		
New interconnection Jordan-Syria	AC OHL 400kV	JO - SY	102	-	51	800	N JO – S SY	Long-term
	OHL 400kV Circuit breaker	JO		1	1.5		N JO	Long-term
	OHL 400kV Circuit breaker	SY		1	1.5		S SY	Long-term
New interconnection Syria-Turkey	AC OHL 400kV	SY - TR	61	-	31	600	N SY – S TR	Long-term
	OHL 400kV Circuit breaker	SY		1	1.5		N SY	Long-term
	OHL 400kV Circuit breaker	TR		1	1.5		S TR	Long-term
	HVDC Back to Back Station	TR		1	135		S TR	Long-term
Total Cost of New Interconnections (M€ / %total)					**223**	**90%**		
Internal Reinforcements								
Description	**Type**	**Countries Involved**	**Length/number**		**Total Investment Cost**	**Capacity**	**Location**	**Status**
			OHL [km]	**Cable [km]**	**M€**	**MW / MVA**		
New AC OHL 400kV Adra - Deir Ali	AC OHL 400kV	SY	60	-	18		SW SY	Long-term
Replacement of conductors AC OHL 400kV 2-bundle Atatürk - BirecikHES	AC OHL 400kV - 3-bundle	TR	59	-	7.08	1589-2610	N TR	Long-term
Replacement of conductors AC OHL 400kV 2-bundle Birecik - BirecikHES	AC OHL 400kV - 3-bundle	TR	2	-	0.24	1589-2610	N TR	Long-term
Total Cost of Internal Reinforcements (M€ / %total)					**25**	**10%**		
Total Project Investment Cost					**248**			

Table 16 – Investment cost of the project JOSYTR project

Assessment results for the Cluster P12 - JOSYTR														
non scenario	GTC increase direction 1 (MW)		800 (JO-SY) - 600 (TR-SY)											
	GTC increase direction 2 (MW)		800 (SY-JO) - 600 (SY-TR)											
scenario specific			MedTSO scenario											
			1			**2**			**3**			**4**		
			Ref. Scenario	with new project	Delta	Ref. Scenario	with new project	Delta	Ref. Scenario	with new project	Delta	Ref. Scenario	with new project	Delta
GTC / NTC (import)		JO	1350	2150	800	1350	2150	800	1350	2150	800	1350	2150	800
		SY	2200	3600	1400	2200	3600	1400	2200	3600	1400	2200	3600	1400
		TR	6200	6800	600	6200	6800	600	6200	6800	600	6200	6800	600
Interconnection Rate (%)*		JO	12.6%	20.1%	7.5%	11.6%	18.4%	6.9%	12.4%	19.8%	7.3%	11.0%	17.5%	6.5%
		SY	8.3%	13.6%	5.3%	8.3%	13.6%	5.3%	8.3%	13.6%	5.3%	8.3%	13.6%	5.3%
		TR	4.9%	5.4%	0.5%	4.9%	5.3%	0.5%	4.4%	4.8%	0.4%	4.1%	4.4%	0.4%
Benefit Indicators	B1-SEW	(M€/y)	330			210			210			220		
	B2-RES	(GWh/y)	0			0			0			0		
	B3-CO_2	(kT/y)	400			300			-900			200		
	B4 - Losses	(M€/y)	20.6			26.5			24.0			29.4		
		(GWh/y)	335			314			308			331		
	B5a-SoS Adequacy	(MWh/y)	0			0			540			20		
	B5b-SoS System Stability													
Residual Impact Indicators	S1- Environmental Impact													
	S2-Social Impact													
	S3-Other Impact													
Costs	C1-Estimated Costs	(M€)	248											

* considering the GTC for 2030 , the Install generation for 2030 and the GTC for importation (the same criteria used in the ENTSO-E)

Rules for sign of Benefit Indicators

B1- Sew [M€/year] =	Positive when a project reduces the annual generation cost of the whole Power System
B2-RES integration [GWh/Year] =	Positive when a project reduces the amount of RES curtailment
B3-CO_2 [kt/Year] =	Negative when a project reduces the whole quantity of CO_2 emitted in one year
B4-Losses - [M€/Year] and [GWh/Yea	Negative when a project reduces the annual energy lost in the Transmission Network
B5a-SoS [MWh/Year] =	Positive when a project reduces the risk of lack of supply

Assessment	**Color code**
negative impact	red
neutral impact	light pink
positive impact	green
Not Available/Not Available	grey
monetized	yellow

Table 17 – Results of the Cost Benefit Analysis for the JOSYTR project

8 References

1	Snapshots building process	Share point
2	Guide for setting up grid models for Network studies V 5.0	Share point
3	Network Analysis and Reinforcement Assessment	Share point

DISCLAIMER

This document contains information, data, references and images prepared by the Members of the Technical Committees "Planning", "Regulations and Institutions"; "International Electricity Exchanges" and Working Group "Economic Studies and Scenarios", for and on behalf of the Med-TSO association. Whilst the information contained in this document and the ones recalled and issued by Med-TSO have been presented with all due care, the Med-TSO Members do not warrant or represent that the information is free from errors or omission.

The information are made available on the understanding that the Med-TSO Members and their employees and consultants shall have no liability (including liability by reason of negligence) to the users for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on the information and whether caused by reason of any error, negligent act, omission or misrepresentation in the information or otherwise.

Whilst the information is considered to be true and correct at the date of publication, changes in circumstances after the time of publication may impact on the accuracy of the information. The information may change without notice and the Med-TSOs Members are not in any way liable for the accuracy of any information printed and stored or in any way interpreted and used by a user.

The information of this document and the ones recalled and issued by Med-TSO include information derived from various third parties. Med-TSOs Members take no responsibility for the accuracy, currency, reliability and correctness of any information included in the information provided by third parties nor for the accuracy, currency, reliability and correctness of links or references to information sources (including Internet Sites).