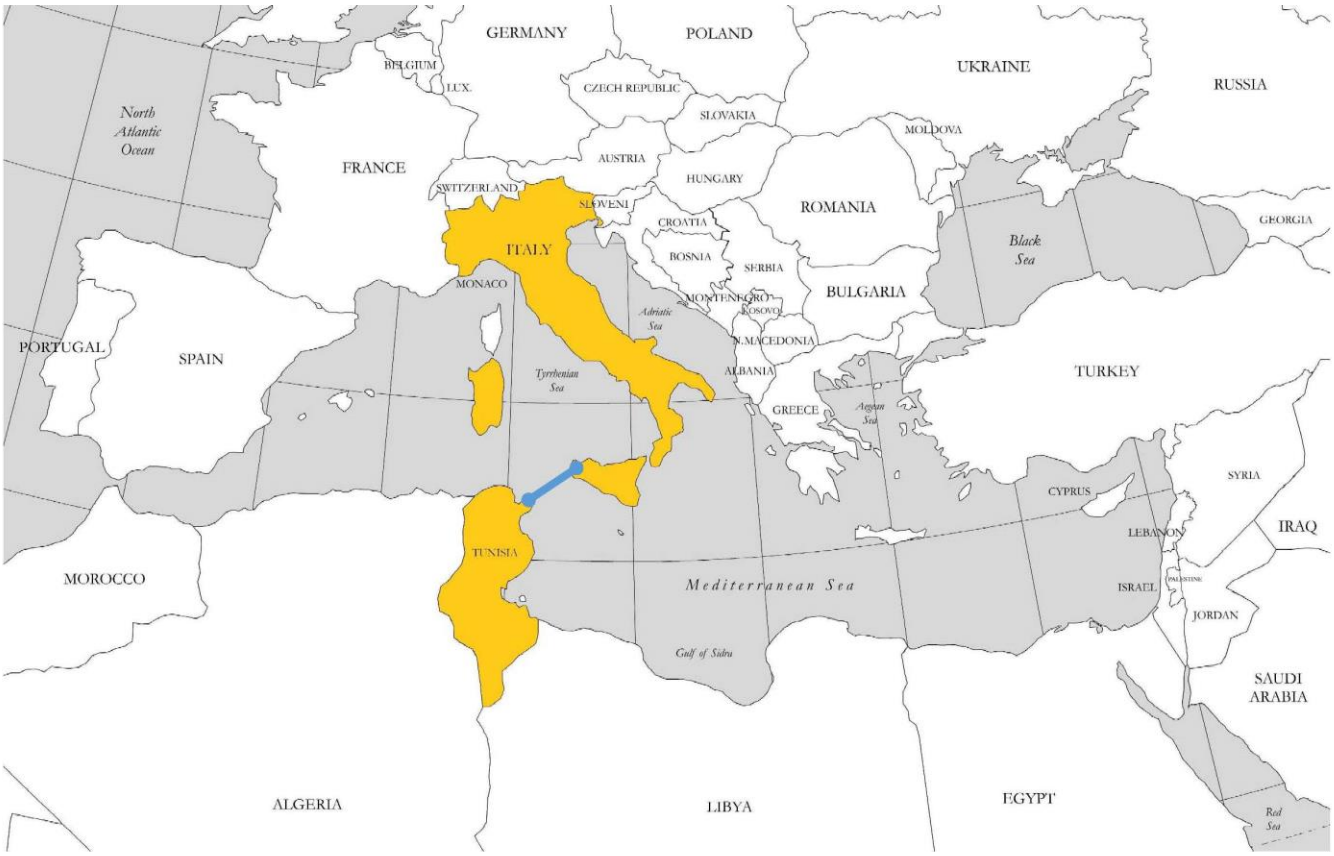
Project #4 – ITALY - TUNISIA

Description

The Tunisia-Italy interconnection will be the first link between these two countries, as well as in the central corridor between the North and the South bank of the Mediterranean. This project, which is expected to be completed by 2027, has been intensely promoted by Terna and STEG, with full support of the European Commission, which included the interconnection in the list of Projects of Common Interest (PCI). The potentials of this interconnection are considered deeply strategic for both countries in terms of RES power flows optimization and grid operation to guarantee security and adequacy standards.



Considering its maturity, the Tunisia – Italy project is the only that is already included in the reference grid considered for the base case of MedTSO studies. Consequently, this project is analysed with a TOOT methodology in the Master Plan 2020. This also implies that the Tunisia-Italy project is included in the base case of the analysis of all the remaining projects.

Project Description Table

Description	*Substation (from)*	*Substation (to)*	*GTC contribution (MW)*	*Total Route length (km)*	*Present status*	*Expected commissioning date*	*Evolution*
New interconnection between Italy and Tunisia	Partanna - Italy	Hawaria - Tunisia	600	200	Long-term project	2027 Approved as Project of Common Interest (PCI) by the European Comission	

Project #4 – ITALY - TUNISIA

Project Merits

The major merits of the project relevant to the Mediterranean electricity system are listed below:

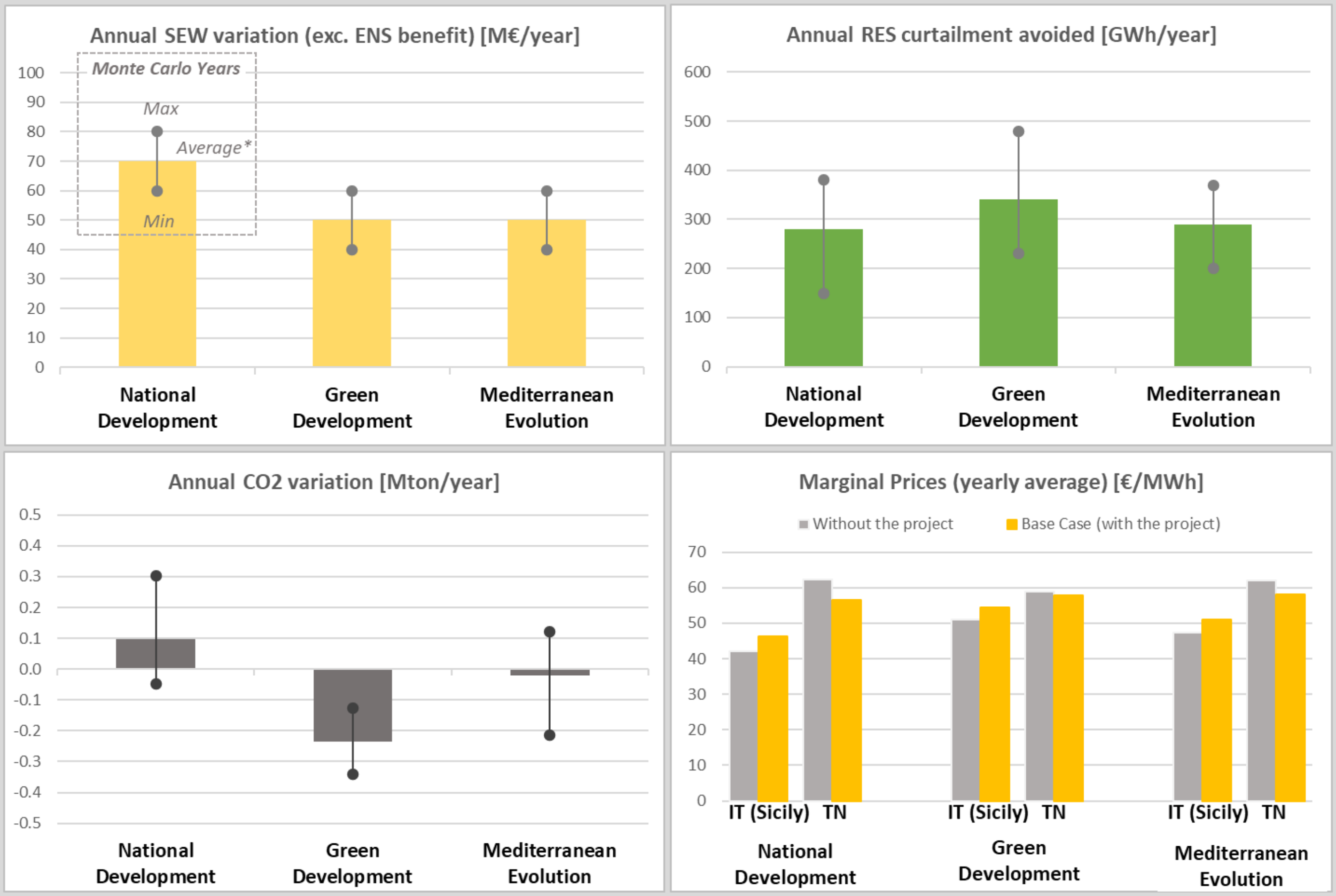
	PROJECT MERITS	ASSOCIATED SYSTEM NEEDS	PROJECT 4
Market	Reduce high price differentials between different market nodes and/or countries	Power studies with a 2030 time horizon can highlight significant differences in average marginal prices between countries, groups of countries or bidding zones. These differences are generally the consequence of structural differences in the composition of production fleets. The increase in the exchange capacity between these zones allows an economic optimization of the use of the generation plants and will be accompanied by electricity flow massively oriented in one direction, from the lower price country to the higher prices country, thus reducing the price differential	X
Dispatch, Adequacy and Security of Supply	Positively contribute to the integration of renewables	Infrastructure to mitigate RES curtailment and to improve accommodation of flows resulting from RES geographic spreading	X
	Contribute to solving issues related to adequacy and security of supply	Infrastructure that presents a benefit for the security of supply or system adequacy, in general by allowing additional importation at peak hours, in countries and areas presenting current of future risk of deficiencies	X
Operation	Fully or partially contribute to resolving the isolation of countries in terms of power system connectivity or to meeting specific interconnection targets	Infrastructure to connect island systems, or to improve exchange capacity of countries showing low level of connectivity, or to contribute to meeting specific interconnection capacity targets X	X
	Introduce additional System Restoration mechanisms	Infrastructure that could provide capability for Black Start & Islanding Operation thus decreasing the need for generation units with such capabilities	
	Improve system flexibility and stability	Infrastructure to improve system flexibility and stability, by increasing sharing possibilities, namely in countries were expected changes in the generation fleet may raise concerns in those specific issues. Decreasing levels of dispatchable generation can be compensated by infrastructure and/or market design to provide balancing flexibility at cross-border level (international pooling/sharing of reserves, coordinated development of reserve capacity). The large increase in the penetration of asynchronous renewable generation is leading to Higher Rate of Change of Frequency (RoCoF) on the system, creating transient stability issues and causing voltage dips. This can be compensated through infrastructure designed to contain frequency during system events	
	Increase system voltage stability	Reactive power controllability of converters can be used to increase system voltage stability	X
	Enable cross-border flows to overcome internal grid congestions	Infrastructure to facilitate future scenarios and enable cross border flows, accommodating new power flow patterns, overcoming internal grid congestions	
	Mitigate loop flows in bordering systems	Infrastructure to mitigate the loop flows occurrence in the borders between Mediterranean countries, contributing to the improvement of exchange capacity.	
	Contribute to the flexibility of the power systems through the control of power flows	Contribution to flexibility of power system operation by controlling power flows and optimizing usage of existing infrastructure	
Physical infrastructure	Refurbishment of obsolete infrastructure	Infrastructure to contribute to the refurbishment of obsolete part of grid initially designed in different context	

Project #4 – ITALY - TUNISIA

Project assessment analysis

CBA Indicators

Project 4 yields a positive impact in the expected values of the Social Economic Welfare and the RES Curtailment across the three scenarios. As for the CO2 emissions the impact is scenario-dependent, with the greater expected benefit being noticed in the Green Development Scenario. Concerning the Energy not Supplied indicator, the impact of the project is negligible, considering the value of this indicator is also negligible in the situation without the project.



* Average of the outputs calculated for all the Monte Carlo Years

Project #4 – ITALY - TUNISIA

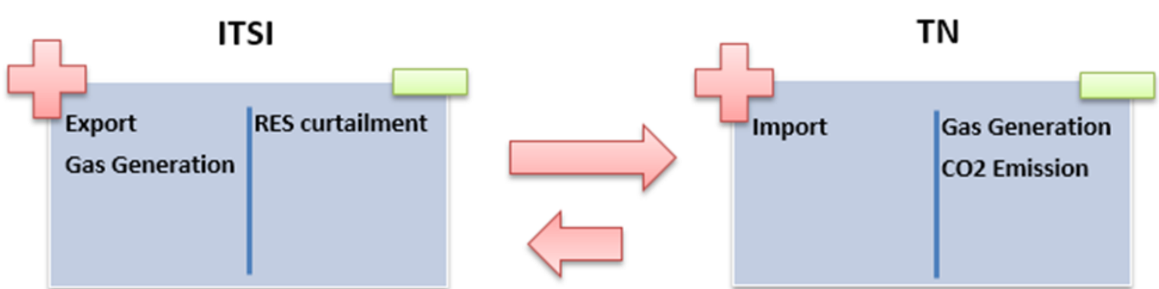
Project assessment analysis

Market Studies

Project 4 drives an overall decrease in Gas Generation, which is most noticeable in Tunisia, but is also observable in Algeria and Libya. This decrease in Gas Generation is compensated by an increase in RES (avoided curtailment) and by an increase in Lignite Generation (mostly outside the MedTSO perimeter). The avoidance of RES Curtailment is mostly due in Italy, where an increase in Gas Generation may also be observed.

- **IT:** increase in Gas Generation and decrease in RES Curtailment
- **TN:** decrease in Gas Generation
- **DZ:** decrease in Gas Generation
- **LY:** decrease in Gas Generation

Country balance and cross-country power flows: the flows observed in this new interconnection are mostly from Italy (Sicily) to Tunisia, with an expected significant number of hours of saturation of the flow in this direction. Overall, by including this project, Tunisia becomes a net importer in the National Development and Mediterranean Evolution scenarios, whereas without the project Tunisia would be a net exporter in the three scenarios. The project also impacts the balances of Algeria and Libya. In the case of Algeria by either decreasing exports or increasing imports (depending on the scenario) and in the case of Libya by increasing the imports.



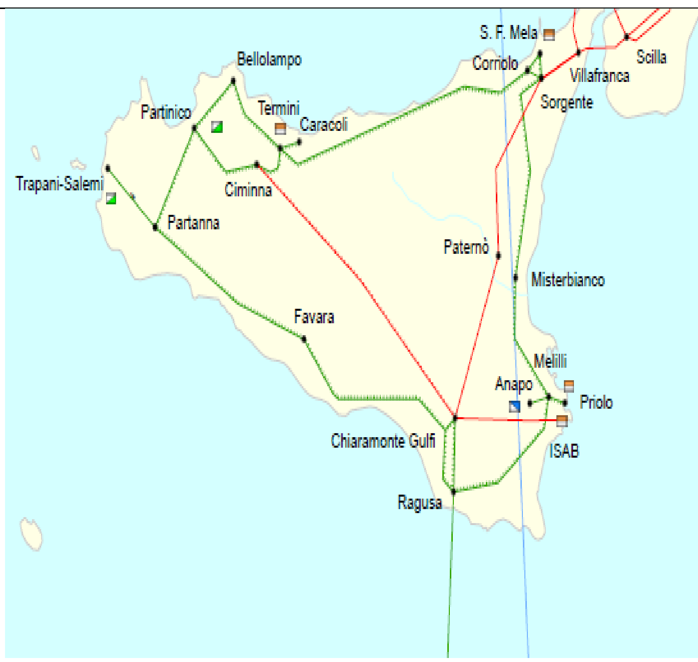
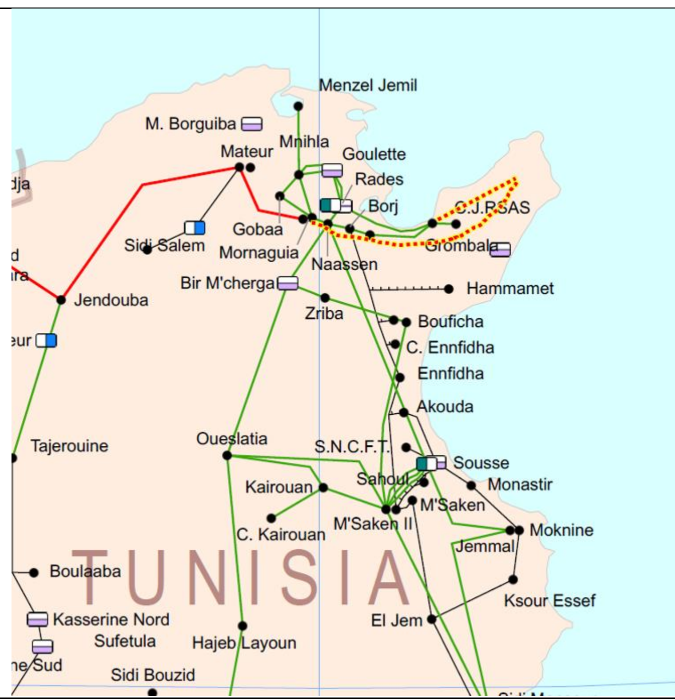
Project #4 – ITALY - TUNISIA

Project assessment analysis

The project consists in a new HVDC interconnection between Italy-Sicily and Tunisia. The HVDC submarine cable between Sicily and Tunisia will have a carrying capacity of 600MW and a total length of 200km.

For the security analysis, with full network model are represented both the system of Tunisia and the system of Italy-Sicily.

For this project three different scenarios have been distinguished and 8 Points in Time have been defined. The N and N-1 static analysis applied to transmission level identified that no internal reinforcements are necessary for the system of Italy-Sicily, while for the system of Tunisia the reinforcements identified are present below. For the third countries that are included in the project no internal reinforcements are suggested.

Scenario 1, 2, 3	
Description (Italy-Sicily)	**Description (Tunisia)**
	New 400kV OHL between Mornaguia and Mlaaba
	New 400kV OHL between Grombalia and Mlaaba
	

Project #4 – ITALY - TUNISIA

Project assessment analysis

The investment cost for this project is estimated to be between 600M€ and 660M€, 7%-6.6% of which represent investement cost for internal reinforcement. The more detailed breakdown of the cost is presented below.

Investment cost-Interconnection				
Line	***Cost [M€]****			
	LCC		***VSC***	
Voltage level [kV]	**400kV**	**500 kV**	**400 kV**	**500 kV**
DC cable	260	280	260	280
AC/DC converter station Italy	100	110	110	120
AC/DC converter station Tunisia	100	110	110	120
Electrode + cables	20	20	20	20
Externalities	70	80	60	70
TOTAL	**550**	**600**	**560**	**610**

Investment cost –internal reinforcements	
New Lines (Tunisia)	***Cost [M€]****
400kV OHL Mornaguia-Mlaaba	30
400kV OHL Grombalia-Mlaaba	20
TOTAL	**50**

*Rounded valued

Project #4 – ITALY - TUNISIA

Project cost benefit analysis results

Assessment results for the Project #4: Italy - Tunisia											
GTC increase direction 1 (MW)			600								
GTC increase direction 2 (MW)			600								
Scenario Specific			MedTSO Scenario								
			1 - National Development (ND)			2 - Green Development (GD)			3 - Mediterranean Evolution (ME)		
			Without the project	With new project	Delta	Without the project	With new project	Delta	Without the project	With new project	Delta
GTC/NTC - Import		IT	10550	11150	600	10550	11150	600	10550	11150	600
		TN	750	1350	600	750	1350	600	750	1350	600
GTC/NTC - Export		IT	6330	6930	600	6330	6930	600	6330	6930	600
		TN	750	1350	600	750	1350	600	750	1350	600
Interconnection Rate - Import/Export (%) [1]		IT	6.8% / 4.1%	7.2% / 4.5%	0.4%	6.8% / 4.1%	7.2% / 4.5%	0.4%	7.8% / 4.7%	8.2% / 5.1%	0.4%
		TN	9.2% / 9.2%	16.5% / 16.5%	7.3%	7.8% / 7.8%	14.0% / 14.0%	6.2%	7.2% / 7.2%	13.0% / 13.0%	5.8%
Scenario Specific			MedTSO Scenario								
			1 - National Development (ND)			2 - Green Development (GD)			3 - Mediterranean Evolution (ME)		
Based on Monte Carlo Years			Average	Min	Max	Average	Min	Max	Average	Min	Max
Benefit Indicators	B1 - SEW[2]	(M€/y)	70	80	60	50	60	40	50	60	40
	B2 - RES Integration[3]	(GWh/y)	280	380	150	340	480	230	290	370	200
	B3 - CO2	(Mton/y)	0.1	0.3	0.0	-0.2	-0.1	-0.3	0.0	0.1	-0.2
	B4 - Losses[2]	(M€/y)	10			10			10		
		(GWh/y)	130			170			70		
	B5a - SoS Adequacy[4]	(GWh/y)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(M€/y)	0	0	0	0	0	0	0	0	0
	B5b - SoS System Stability										
Residual Impact Indicators	S1 - Environmental Impact										
	S2 - Social Impact										
	S3 - Other Impact										
Costs	C1 - Estimated Cost[5]	(M€)	630								

[1] considering the GTC/NTC for 2030 and the Installed generation for 2030

[2] considering adequate rounding of values (to the tens)

[3] ignoring low values and negative values of RES integration (average values below 50GWh lead to setting average, min and max equal to zero) and considering adequate rounding of values (to the tens)

[4] ignoring low values (average values below 0.1 GWh/y lead to setting average, min and max equal to zero)

[5] based on the average value of the different technology options considered in the analysis (if applicable)

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-CO2 [Mton/Year] =	Negative when a project reduces the whole quantity of CO2 emitted in one year
B4-Losses - [M€/Year] and [GWh/Year] =	Negative when a project reduces the annual energy lost in the Transmission Network
B5a-SoS [GWh/Year] and [M€/y]=	Positive when a project reduces the risk of lack of supply

negative impact	
neutral impact	
positive impact	
Not Available/Not Applicable	
monetized	

Project #4 – ITALY - TUNISIA

Additional Information

- https://www.terna.it/en/electric-system/grid/national-electricity-transmission-grid-development-plan
- https://ec.europa.eu/energy/sites/ener/files/technical_document_4th_pci_list.pdf