Project Sheet

LEG1

Project type	transmission
Project id	284
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Key Information

Cross Border Project
Offshore DC transmission cable
New

Under Consideration

Description

LEG1 is a submarine HVDC interconnection project, enabling bidirectional electricity exchange between South-East Europe and North Africa.

The interconnector will link the area of Tobruk, in Libya, to Linoperamata in Crete. Landing spots have been discussed with the respective TSOs.

GreenPower2020 has identified an ideal submarine corridor (305 km) reaching a maximum depth of 2700m, providing one of the shortest possible links between continental Europe and North Africa, as Crete will be connected to continental Greece with a 1,000 MW DC interconnector in 2023.

LEG1 interconnector will have a power rating of 2,000 MW and a DC voltage of 525 kV.

VSC was chosen for converter technology because it is more favorable for power trading and has other advantages such as blackstart capacity and voltage stability support.

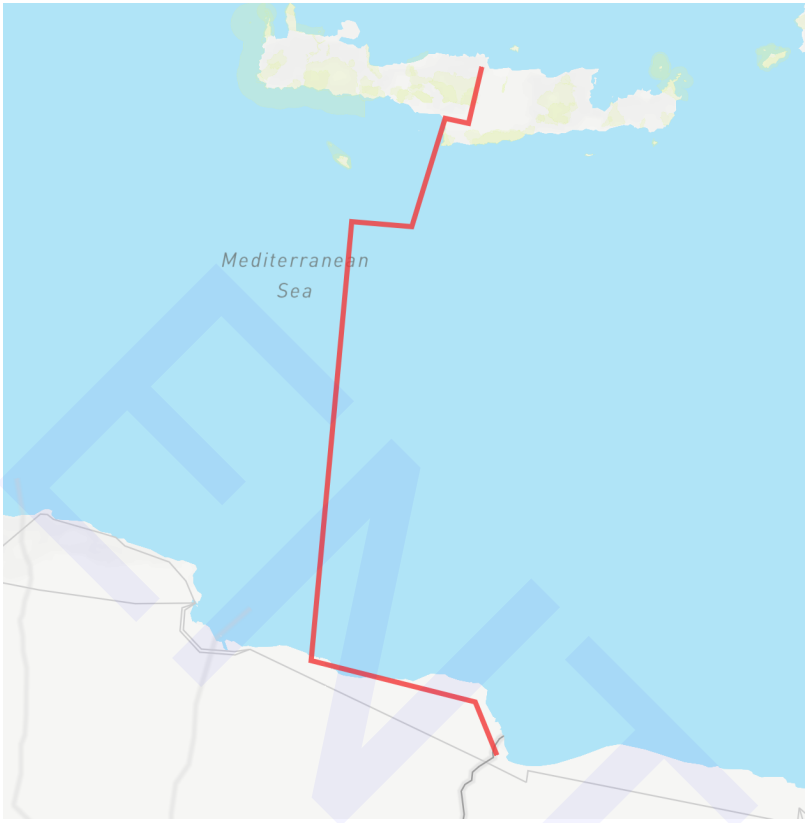
LEG1 will also connect Libya to Egypt (Salloum) through AC overhead line with related substations, benefiting from Libya and Egypt solar projects (initial 150 MW plant included), further contributing to the achievement of the EC's Green Deal 2030 objectives. It will play an essential role in optimizing competitive production and consumption, taking advantage of the strong weekly and seasonal imbalances - Fridays vs Sundays / winters vs summers

Project promoters

GreenPower 2020

Countries

Egypt
Greece
Libya



National development plan(s)

Additional information on the project

www.greenpower2020.net

In addition to creating economic value, LEG1 has far reaching social and development benefits. By optimizing the flow between the 2 regions (according to seasonality), LEG1 will bring affordable electrical power to a country which is in great need to develop its industry/commerce to reach stability and peace. And more prosperity means less migratory pressure which is of great concern for the EU.

Furthermore, GreenPower2020 will contribute to the education of Libyan engineers by setting up its “Sahara Training & Renewable Energy Development Center” in cooperation with the Alsiraj Group and the University of Sabha. MOUs have already been signed.

Also, let us not forget that by 2023 Crete will have stopped all its fossil fuels power plants and LEG1 will be a much welcome source of security of supply and competitive energy, indispensable to develop tourism.

Another significant benefit of LEG1 is a considerable saving in CO2 emissions. Thanks to the project interconnection capacity and its associated trading platform, the savings can be envisaged from 3 perspectives.:

- By importing kwh of solar origin into the EU, essentially Greece as the country has structurally deficit of electricity production

- By exporting into Libya unused kwh produced in EU (summer and Sundays)

- By exporting into the EU unused kwh produced in Libya/Egypt (winter and Fridays)

GreenPower2020 has calculated that the total amount of CO2 emissions which could be saved is: 5.234 million mT.

Project sheet backlog

9 Jul. 2021 - Updated needs addressed by project

7 Jul. 2021 - B3 (GWh / year) values changed from 4 to 3625.

30 Jun. 2021 - Needs addressed by the project added

19 Jan. 2021 - Addition of results in third countries for indicator B2a_€

15 Jan. 2021 - Correction of results for indicator B3 in third countries for all scenarios

6 Jan. 2021 - Correction of results in third countries for indicator B2a

6 Nov. 2020 - Publication as part of the draft TYNDP 2020 package for consultation

Project Description & Context

Project Investments

Main investment(s): 2000 MW subsea interconnector associated to a 150 MW solar power plant.

Type of element	Total route length (km)	From substation 1	To substation 2	Present status	Commissioning year	Progress of the investment	Explanation in case of delay or reclustering
Offshore DC transmission cable	370	Tobrouk (Libya)	"Linoperamata (Greece, Crete)"	Planned But Not Yet Permitting	2025	Rescheduled	LEG1 has been rescheduled to allow for 150 MW solar power plant (comprising energy storage) to be developped. GreenPower2020 feel this is necessary for 2 reasons: 1. to test and to qualify technologies in a given environment (hence not duplicating previous errors from others) and to identify the appropriate combination (PV + battery, CSP + steam, ...) before the utility-scale deployment of 2 x 1 GW. 2. To include energy generation as part of the project to enable LEG1's bi-lateral power exchange capability immediately.

Is the project in the reference grid?

No

System Needs addressed by the project

Project promoter(s) selected up to 4 system needs that are addressed by their project in a predefined list. Available needs ranged from reduction of price differentials between countries, improvement of system flexibility and stability, enabling cost-efficient connection of high volumes of RES, improvement of voltage stability...
As part of the TYNDP 2020, ENTSO-E released a study investigating cross-border system needs in the 2030 and 2040 horizons.

Need	How the project addresses each need (explanation provided by the project promoter(s))

Need		How the project addresses each need (explanation provided by the project promoter(s))
	Infrastructure designed to enable cost-efficient grid connection of high volumes of RES and/or reduce RES curtailment	Sustainability: The project offers a connection to additional renewable energy on the southern side of the Mediterranean Sea, supporting the EU goal of Climate Neutrality by 2050. Provides also a mean for evacuation of excess of electricity in periods of high generation and low demand
	Infrastructrure improving voltage stability by offering reactive power controllability of converters by system operator(s)	Voltage stability of the system: VSC converters can be used to support the grid by mixing active and reactive power during stressed conditions
	Infrastructure designed to offer more supply options to isolated areas	Security of supply: The link will provide enhanced security of supply for the island of Crete, which is in the process of decarbonizing its electrical generation.
	Capability for Black Start & Islanding Operation	

Interconnection targets

In 2017, the Interconnection Target Expert Group proposed alternative indicators to the 15% interconnection criteria for every country and electrified island with a new methodology developed collaboratively between the European Commission, ENTSO-E, ENTSOG, industry, universities and other experts. The methodology is based on three indicators:
1. Price differential between EU countries, with an objective to reduce it below 2 EUR/MWh
2. Ratio between nominal transmission capacity and installed RES capacity, with a target of past 30%
3. Ratio between nominal transmission capacity and peak load, with a target of past 30%

The following maps show the ITEG methodology applied to the TYNDP 2030 scenarios, with the 2020 grid.

Project Assessment

Transfer capacity increase (National Trends 2025)

	Border	A B	B A
Transfer capacity increase (in MW)	Greece - Lybia	2000	2000

CBA results

ENTSO-E has assessed the benefits delivered by each project in 2025 (scenario National Trends 2025) and in 2030 (three scenarios: National Trends, Distributed Energy and Global Ambition). Indicators B1 to B6 were computed by ENTSO-E, while promoters had the possibility to compute and submit so-called project-level benefits (B7 to B10). The benefits must be understood as benefits for Europe as a whole, not for the promoters of the project.
Results are presented per scenario.

Central scenario: National Trends

National Trends is the central policy scenario of the TYNDP2020, designed to reflect EU member state's National Energy and Climate Plans (NECP), in line with the requirement to meet current European 2030 energy strategy targets.

			Comparison of the COP21 scenarios with NT2030 average result		
	NT2025	**NT2030**	**DE2030 is < or > than NT2030**	**GA2030 is < or > than NT2030**	

Increase in socio-economic welfare

B1 Annual Socio-Economic Welfare (SEW) increase (M € / year)	max average min	129 110 91	175 172 169	<	<	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	max average min	-43 -61 -78	-100 -110 -117	>	<	ENTSO-E assessment
B1_RES Annual Socio-Economic	max average	0 0	3 1	>	>	ENTSO-E assessment

Welfare increase resulting from RES integration	min	0	0			

This project involves countries outside of the ENTSO-E area.

B1 SEW (Meuro/ year) in third country/ies	max average min	254 251 248	279 277 275	>	>	ENTSO-E assessment
B1_RES (Meuro/ year) in third country/ies	max average min	201 183 167	161 145 132	>	>	ENTSO-E assessment
B1_CO2 (Meuro/ year) in third country/ies	max average min	225 108 4	274 134 4	>	>	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B4 Non-CO2 emissions (kg/year)

B4a Nitrogen oxides	average	4550	24957	n/a	n/a	ENTSO-E assessment
B4b Ammonia	average	-152	4	n/a	n/a	ENTSO-E assessment
B4c Sulfur dioxide	average	8905	29759	n/a	n/a	ENTSO-E assessment
B4d Particular matter 5	average	1544	-169189	n/a	n/a	ENTSO-E assessment
B4e Particulate matter 10	average	316	1431	n/a	n/a	ENTSO-E assessment
B4f Non-methane volatile organic compounds	average	1212	-171249	n/a	n/a	ENTSO-E assessment

B2a Annual CO2 variation from market simulation (ktonnes / year)	max average min	3396 2639 1883	4167 3911 3581	<	<	ENTSO-E assessment

B2a_€ Annual Societal cost variation resulting from CO2 variation from market simulation monetised (M € / year)	CO2 price	60€/ ton 100€/ ton 189€/ ton	-98 -203 -438	-125 -282 -630	> > 	> > 	ENTSO-E assessment
B2b Annual CO2 variation due to network losses (ktonnes / year)		average	579	698	n/a	n/a	ENTSO-E assessment
B2b_€ Annual Societal cost variation resulting from CO2 variation from network simulation monetised (M € / year)	CO2 price	60€/ ton 100€/ ton 189€/ ton	-19 -39 -84	-19 -43 -97	n/a	n/a	ENTSO-E assessment

This project involves countries outside of the ENTSO-E area.

B2a (ktonnes/year) in third country/ies		average	-4645	-4728	>	>	ENTSO-E assessment
B2a_€ (M€/ year) in third country/ies	CO2 price	60€/ ton 100€/ ton 189€/ ton	172 358 771	151 340 761	n/a	n/a	ENTSO-E assessment

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)		max average min	0 0 0	82 28 0	>	>	ENTSO-E assessment
B3a Connected RES (MW)	-		2000	2000	n/a	n/a	ENTSO-E assessment

This project involves countries outside of the ENTSO-E area.

B3 (GWh / year) in third countries	max average min	3625 3625 3625	3625 3625 3625	<	<	ENTSO-E assessment

Impact on grid losses

B5 Variation of network losses (GWh / year)	average	1075	1150	n/a	n/a	ENTSO-E assessment
B5_€ Variation of network losses monetised (M€ / year)	average	48	53	n/a	n/a	ENTSO-E assessment

Security of supply

B6 Annual reduction in Energy Not Served (MWh / year)	max average min		N/A	n/a	n/a	ENTSO-E assessment
B6_€ Annual Socio-Economic Welfare increase resulting from reduction in Energy Not Served monetised (M€ / year)	average	n/a	N/A	>	n/a	ENTSO-E assessment

Scenarios: Distributed Energy & Global Ambition

DE and GA are two scenarios created in line with the COP21 targets to understand the impact on infrastructure needs agains different pathways reducing EU-28 emissions to net-zero by 2050. For these two scenarios, projects were assessed with a subset of CBA parameters.

	DE2030	GA2030	

Increase in socio-economic welfare

B1 Annual Socio-Economic Welfare (SEW) increase (M€ / year)	average	133	142	ENTSO-E assessment

B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	-107	-132	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	19	12	ENTSO-E assessment

This project involves countries outside of the ENTSO-E area.

B1 SEW (Meuro/year) in third country/ies	average	296	284	ENTSO-E assessment
B1_RES (Meuro/year) in third country/ies	average	174	156	ENTSO-E assessment
B1_CO2 (Meuro/year) in third country/ies	average	204	150	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B2a Annual CO2 variation from market simulation (ktonnes / year)	average	2015	3759	ENTSO-E assessment
B2a_€ Annual Societal cost variation resulting from CO2 variation from market simulation monetised (M€ / year)	CO2 price	60€/ ton 100€/ ton 189€/ ton	-14 -95 -274	-94 -244 -579	ENTSO-E assessment

This project involves countries outside of the ENTSO-E area.

B2a (ktonnes/year) in third country/ies	average	-3851	-4291	ENTSO-E assessment
B2a_€ (M€/ year) in third country/ies	CO2 price	60€/ ton 100€/	27 181 524	107 279 661	ENTSO-E assessment

	ton 189€/ ton			

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	average	332	282	ENTSO-E assessment
B3a Connected RES (MW)	-	2000	2000	ENTSO-E assessment

This project involves countries outside of the ENTSO-E area.

B3 (GWh / year) in third countries	average	3625	3625	ENTSO-E assessment

Non scenario-dependent indicator(s)

B8.0 Stability (Transient, Voltage and Frequency Stability)	Transient stability	Voltage stability	Frequency stability	
LEG1 (New HVDC)	++	++	+ (between sync areas)	Qualitative assessment by ENTSO-E based on information on the project technology provided by the project promoter(s). This indicator is not dependent on scenarios or time horizons.

Sensitivity Study: Current Trends

'Current Trends' describes a future where the energy transition is slower than planned.

	CT2030	

Increase in socio-economic welfare

B1 Annual Socio-Economic Welfare (SEW) increase (M€ / year)	average	85	ENTSO-E assessment
			ENTSO-E assessment

B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	-49	
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	0	ENTSO-E assessment

This project involves countries outside of the ENTSO-E area.

B1 SEW (Meuro/year) in third country/ies	average	276	ENTSO-E assessment
B1_RES (Meuro/year) in third country/ies	average	192	ENTSO-E assessment
B1_CO2 (Meuro/year) in third country/ies	average	113	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B2a Annual CO2 variation from market simulation (ktonnes / year)		average	1765	ENTSO-E assessment
B2a_€ Annual Societal cost variation resulting from CO2 variation from market simulation monetised (M€ / year)	CO2 price	60€/ ton 100€/ ton 189€/ ton	-56 -127 -284	ENTSO-E assessment

This project involves countries outside of the ENTSO-E area.

B2a (ktonnes/year) in third country/ies		average	-4051	ENTSO-E assessment
B2a_€ (M€/ year) in third country/ies	CO2 price	60€/ ton 100€/	130 292 652	ENTSO-E assessment

ton 189€/ ton		

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	average	0	ENTSO-E assessment
B3a Connected RES (MW)	-	2000	ENTSO-E assessment

This project involves countries outside of the ENTSO-E area.

B3 (GWh / year) in third countries	average	3625	ENTSO-E assessment

Residual impact

Information on the residual impact of the project was provided by the project promoter(s).

Residual environmental impact

Investment	Investment status	Distance (km)	Type of sensitivity

Note based on CBA Guideline 3.0: Given that the actual route of the project might not be defined due to the low degree of maturity of its investment(s), an environmental assessment is not yet available.

Residual social impact

Investment	Investment status	Distance (km)	Type of sensitivity

Note based on CBA Guideline 3.0: Given that the actual route of the project might not be defined yet because of the low degree of maturity of its investment(s), a residual social impact assessment is not yet available.

Project Costs

The project costs were provided by the project promoter(s).

	CAPEX (Meuro)	Uncertainty range (%)	OPEX
1619. LEG1	1500	15	30
Total	1500		30

Explanation provided by the project promoter on the CAPEX uncertainty range:

1619