# Project Sheet

LEG1

| | |
|---|---|
| Project type | transmission |
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## Index

Key Information 3
Description 3
Project Description & Context 5
Project Investments 5
System Needs addressed by the project 5
Interconnection targets 6
Project Assessment 9
Transfer capacity increase (National Trends 2025) 9
CBA results 9
Central scenario: National Trends 9
Scenarios: Distributed Energy & Global Ambition 12
Non scenario-dependent indicator(s) 14
Sensitivity Study: Current Trends 14
Residual impact 16
Project Costs 16

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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

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.

The project promoter did not select any need.

## 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.

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# 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<br>average<br>min | 129<br>110<br>91 | 175<br>172<br>169 | < | < | ENTSO-E assessment |
| B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction | max<br>average<br>min | -43<br>-61<br>-78 | -100<br>-110<br>-117 | > | < | ENTSO-E assessment |
| B1_RES Annual Socio-Economic | max<br>average | 0<br>0 | 3<br>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<br>average<br>min | 254<br>251<br>248 | 279<br>277<br>275 | > | > | ENTSO-E assessment |
| B1_RES (Meuro/ year) in third country/ies | max<br>average<br>min | 201<br>183<br>167 | 161<br>145<br>132 | > | > | ENTSO-E assessment |
| B1_CO2 (Meuro/ year) in third country/ies | max<br>average<br>min | 225<br>108<br>4 | 274<br>134<br>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<br>average<br>min | 3396<br>2639<br>1883 | 4167<br>3911<br>3581 | < | < | ENTSO-E assessment |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| B2a_€ Annual Societal cost variation resulting from CO2 variation from market simulation monetised (M € / year) | CO2 price | 60€/ ton<br>100€/ ton<br>189€/ ton | -98<br>-203<br>-438 | -125<br>-282<br>-630 | ><br>><br>> | ><br>><br>> | 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<br>100€/ ton<br>189€/ ton | -19<br>-39<br>-84 | -19<br>-43<br>-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<br>100€/ ton<br>189€/ ton | 172<br>358<br>771 | 151<br>340<br>761 | n/a | n/a | ENTSO-E assessment |

## Integration of renewable energy sources

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| B3 Annual avoided curtailment (RES integration) (GWh / year) | | max<br>average<br>min | 0<br>0<br>0 | 82<br>28<br>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<br>average<br>min | 4<br>4<br>4 | 4<br>4<br>4 | < | < | 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<br>average<br>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<br>100€/ ton<br>189€/ ton | -14<br>-95<br>-274 | -94<br>-244<br>-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<br>100€/ | 27<br>181<br>524 | 107<br>279<br>661 | ENTSO-E assessment |

| | | | | |
|---|---|---|---|---|
| | ton<br>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 | 4 | 4 | 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).<br>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<br>100€/ ton<br>189€/ ton | -56<br>-127<br>-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<br>100€/ | 130<br>292<br>652 | ENTSO-E assessment |

| | | |
|---|---|---|
| ton<br>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 | 4 | 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

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