Project Sheet

Interconnection of Crete to the Mainland System of Greece

Project type	transmission
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ENTSOE

Key Information

Internal Project
DC transmission line
New

Under Construction

Description

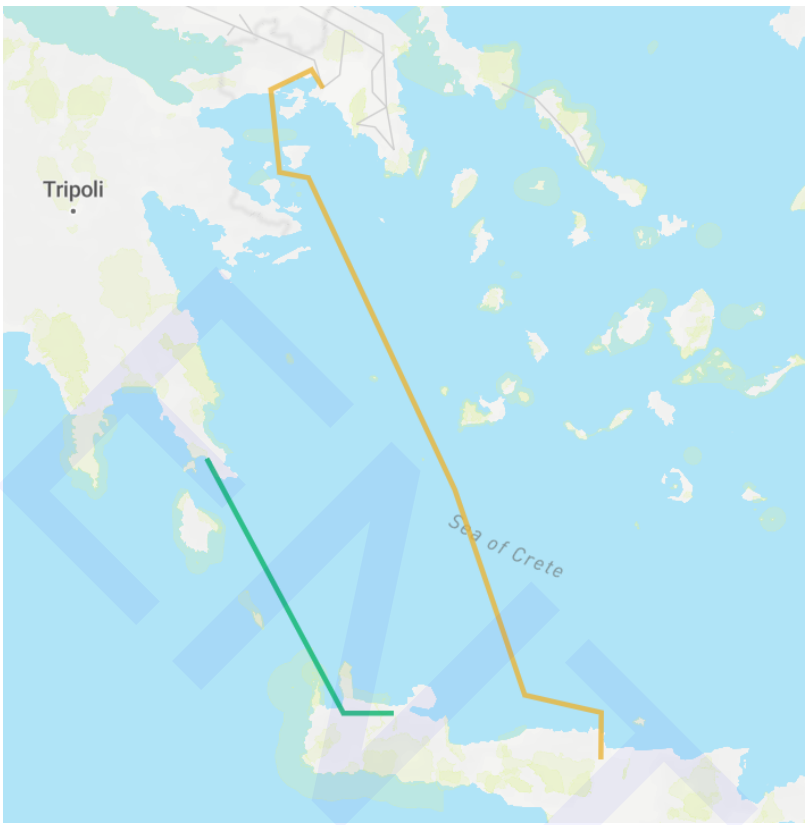
Crete is the largest electrically non-interconnected island system in Greece, representing a particular case, due to large size, rapid growth, remote location and large RES potential. The project aims to increase security of supply and improve stability issues of the island by its interconnection to the mainland system. It is expected to contribute to the reduction of the operation of oil-fired units that currently supply the island and in the long run to allow their progressive decommissioning, thus contributing to the reduction of production variable costs and greenhouse gas emissions. It will allow the full exploitation of local RES potential. The project shall ensure a more reliable and cost-effective supply of electricity to the island. This interconnection will be implemented in two phases. In Phase I Crete will be connected to Peloponnese with a 150 kV AC double circuit submarine cable interconnector of 2x200 MVA nominal transfer capacity. In Phase II Crete will be connected to Attica with a bipolar submarine HVDC-VSC link of 2x500 MW capacity transfer. The project in total contributes in achieving the EU-wide targets and policy objectives set in the 2030 climate and energy framework.

Project promoters

Admie

Countries

Greece



National development plan(s)

NDP 2018-2027, Greece, 2018, 14.26 & 17.7, 17132 (or 86),
http://www.admie.gr/fileadmin/user_upload/Files/masm/2018_2027/DPA_2018_2027.pdf

Additional information on the project

Project sheet backlog

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

Project Description & Context

Project Investments

Main investment(s): New symmetric bipolar submarine HVDC-VSC link between Crete and Attica

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
DC transmission line	373	Damasta	Koumoundouros	In Permitting	2022	New Investment	

Other investments

Description	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
New 150 kV AC double circuit submarine and underground cables between Crete and Peloponnese	AC transmission line	179	Chania I	Molai (through Sklavouna Terminal)	Under Construction	2020	New Investment	

Reason for investment clustering

The final design and implementation of the whole project with its clustering into two Phases imposed by several reasons, technical, financial and environmental. The aim to ensure security of supply for the island is the main reason for undertaking the investment. The rapid increase of electricity demand in the island, along with the need for decommissioning of the local oil-fired generation units, in short term horizon, to comply to the environmental Directives IED 2010/75/EE (IED) and 2015/2193/EE (MCPD directive), gave a character of urgency. The advanced level of maturity of the subproject of Phase I in terms of studies (detailed engineering, routing, seabed studies, environmental studies), in terms of financing (acquisition of grants in the framework of NSRF 2014-2020 and loans by EIB), in terms of low risk implementation due to capacity of promoter and its experience by similar AC interconnection projects (Cyclades interconnection to HETS) led to proceed immediately. Thus, the implementation of the Phase I has been started.

Regarding Phase II project, it took more time to reach maturity. Phase II is technically more complicated. The need for in depth studies and better organization of the project implementation led IPTO to proceed with Phase II after implementation of major parts of Phase I in order to successfully achieve the best results and obtain the objectives as security of supply, increase of RES penetration, reduction of CO2 emissions, reduction of PSOs, etc.

Is the project in the reference grid?

Yes

System Needs addressed by the project

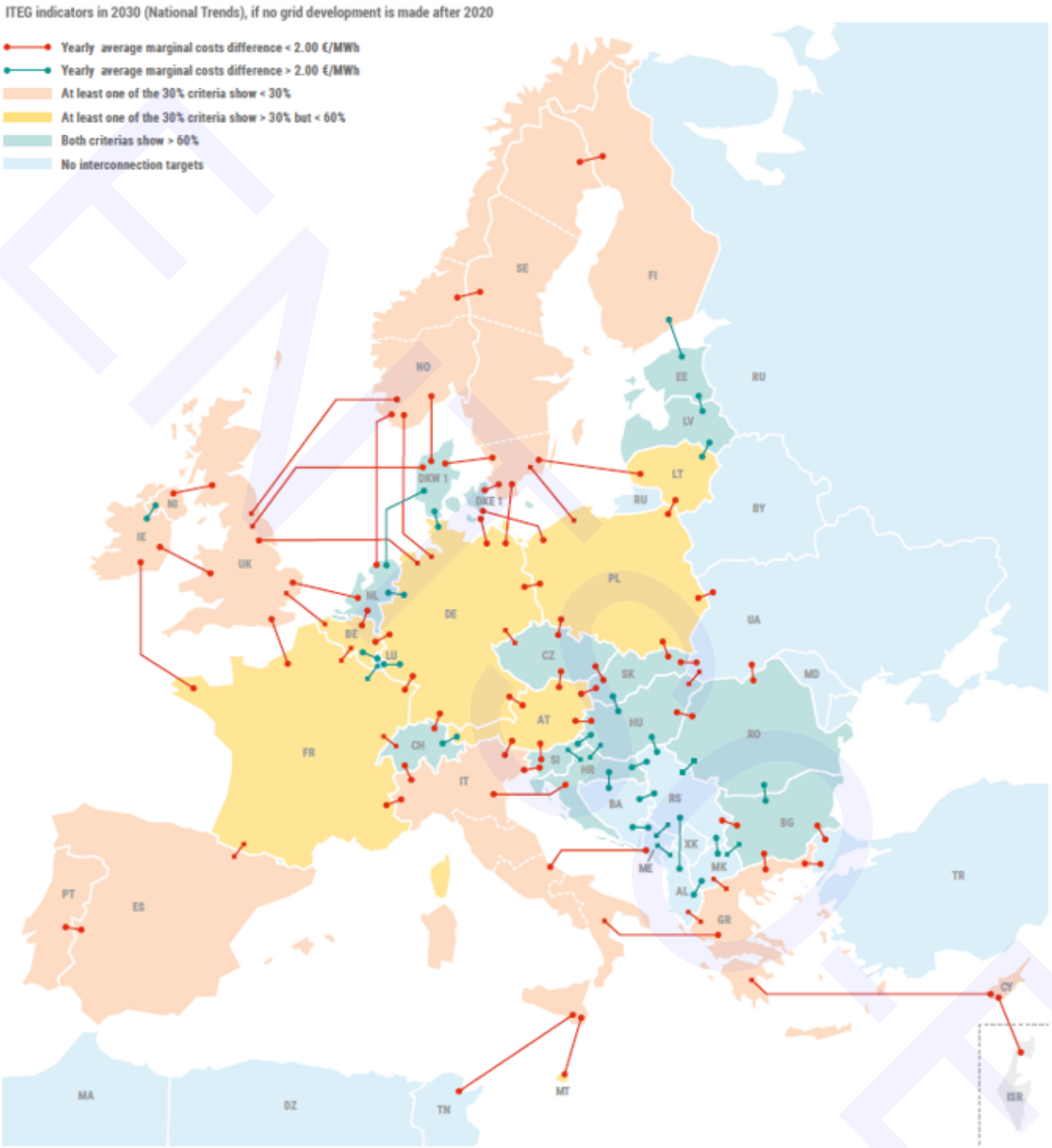
Project promoter(s) selected up to 4 system needs that are addressed by their project in a predefined list. Available needs ranged from reduction of price differentials between countries, improvement of system flexibility and stability, enabling cost-efficient connection of high volumes of RES, improvement 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))
	Infrastructure designed to enable cost-efficient grid connection of high volumes of RES and/or reduce RES curtailment	The project will allow the full exploitation of local abundant RES potential, currently subject to limitations imposed by the autonomous operation.
	Infrastructure designed to offer more supply options to isolated areas	Crete is currently the largest electrically non-interconnected island system in Greece that operates in autonomous mode. The project will increase security of supply and improve stability issues for the electric system of the island, by its interconnection to the mainland system.
	Infrastructure to address system adequacy deficiencies and/or mitigate the risk of power failures.	Crete is the largest electrically non-interconnected island system in Greece, characterized by high annual consumption and load peak. Adequacy issues have been recognized, as several generation units have to be decommissioned or replaced according to EU Directives. The project ensures system adequacy by interconnecting the island to mainland

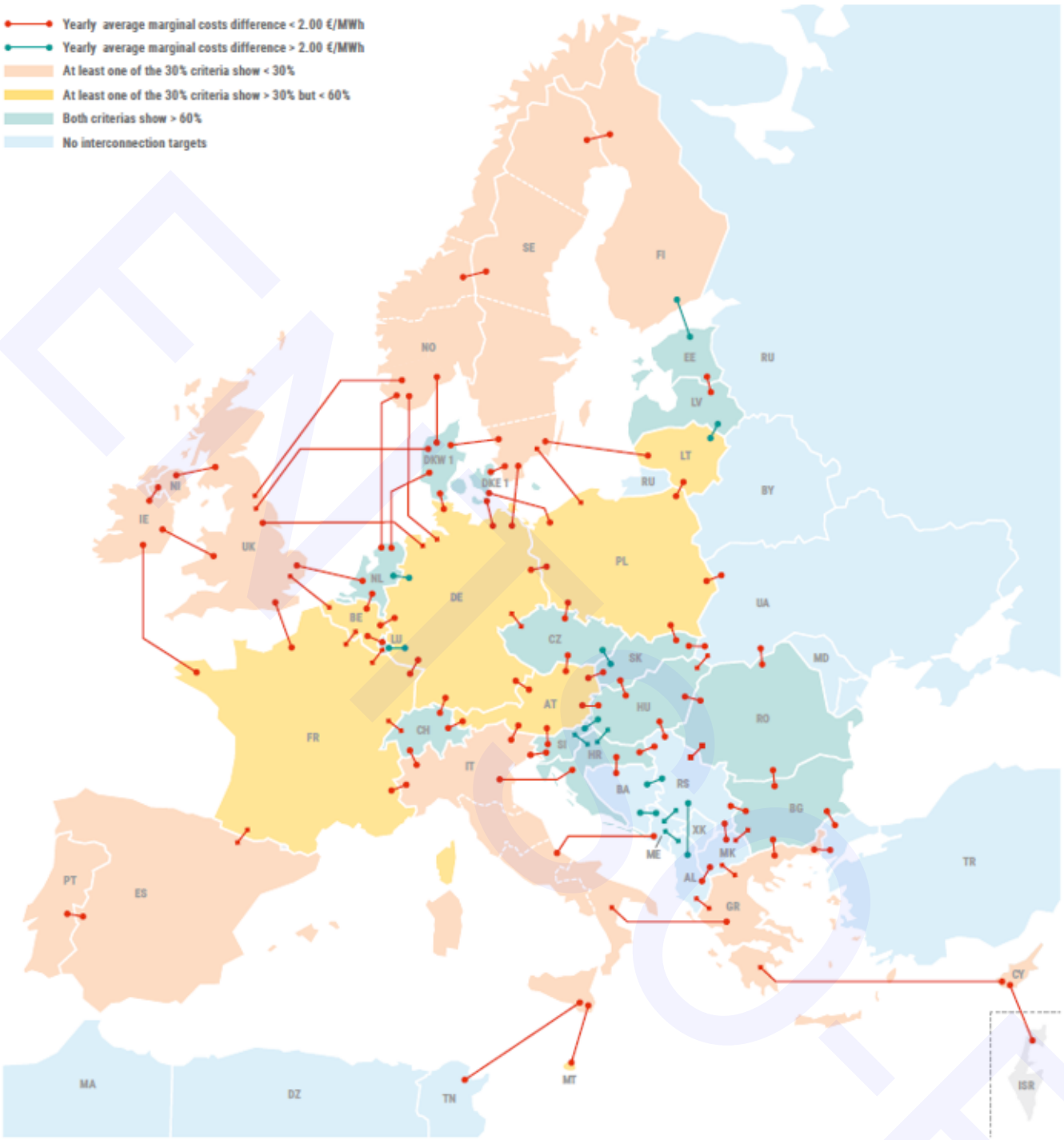
Interconnection targets

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%

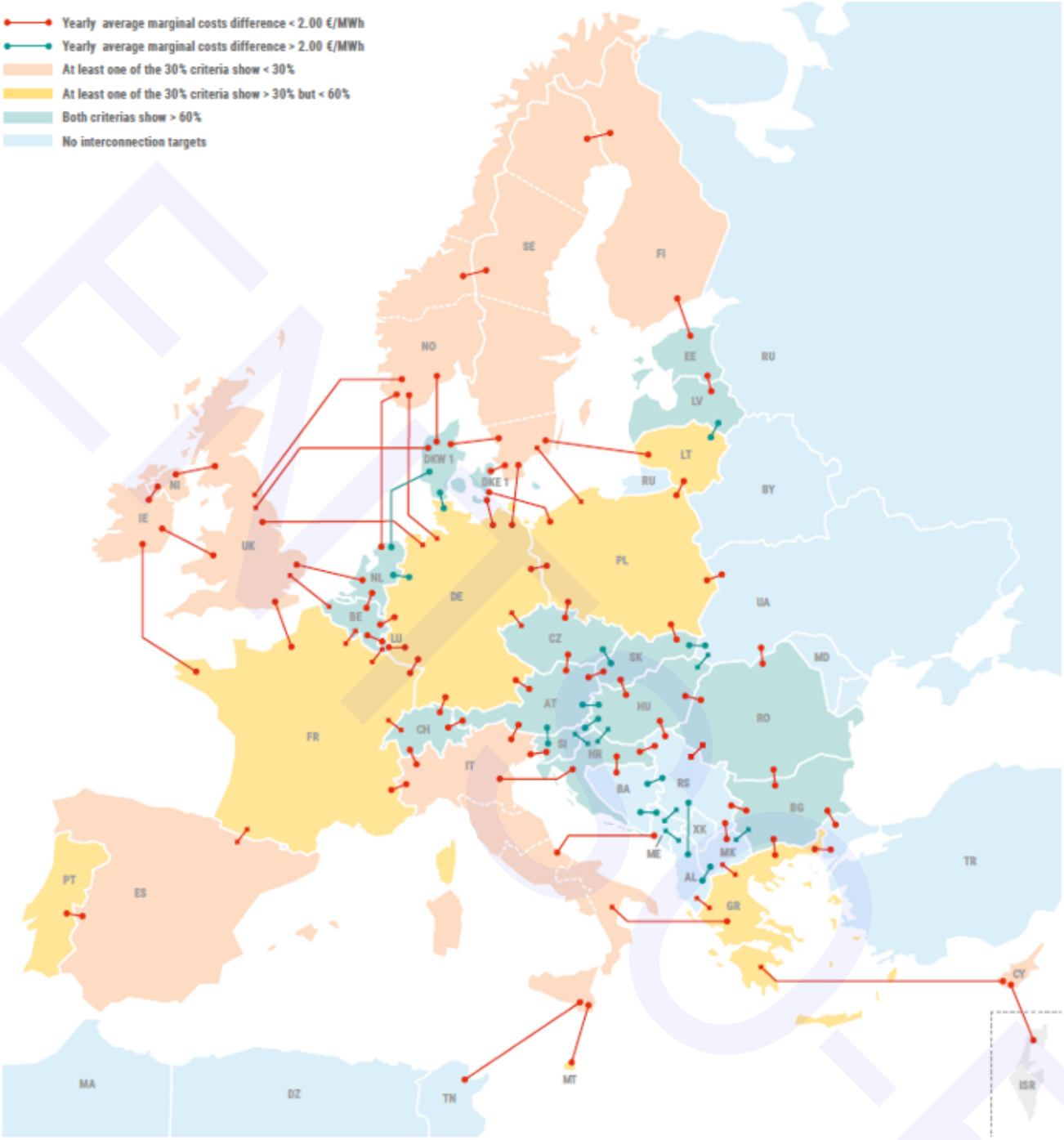
The following maps show the ITEG methodology applied to the TYNDP 2030 scenarios, with the 2020 grid.



ITEG indicators in 2030 (Distributed Energy), if no grid development is made after 2020



ITEG indicators in 2030 (Global Ambition), if no grid development is made after 2020



Project Assessment

Transfer capacity increase (National Trends 2025)

	Border	A B	B A
Transfer capacity increase (in MW)	Internal (Greece)	800	800

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	273 272 271	247 246 245	>	<	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	max average min	18 13 8	4 0 -6	>	>	ENTSO-E assessment
B1_RES Annual Socio-Economic	max average	1 0	3 2	>	>	ENTSO-E assessment

Welfare increase resulting from RES integration	min	0	1			

Reduction of CO2 and GHG emissions

B4 Non-CO2 emissions (kg/year)

B4a Nitrogen oxides	average	-1630	1047	n/a	n/a	ENTSO-E assessment
B4b Ammonia	average	62	29	n/a	n/a	ENTSO-E assessment
B4c Sulfur dioxide	average	-5503	-909	n/a	n/a	ENTSO-E assessment
B4d Particular matter 5	average	30	306	n/a	n/a	ENTSO-E assessment
B4e Particulate matter 10	average	-336	-148	n/a	n/a	ENTSO-E assessment
B4f Non-methane volatile organic compounds	average	4	127	n/a	n/a	ENTSO-E assessment

B2a Annual CO2 variation from market simulation (ktonnes / year)		max average min	-363 -568 -803	227 1 -143	< <	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	21 44 94	0 0 0	>>>>>>	ENTSO-E assessment
B2b Annual CO2 variation due to network losses (ktonnes / year)		average	92	137	n/a	n/a	ENTSO-E assessment
B2b_€ Annual Societal cost variation resulting from	CO2 price	60€/ ton 100€/	-3 -7 -15	-4 -10 -22	n/a	n/a	ENTSO-E assessment

CO2 variation from network simulation monetised (M € / year)	ton 189€/ ton					

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	max average min	14 8 2	67 49 38	>	>	ENTSO-E assessment
B3a Connected RES (MW)	-			n/a	n/a	ENTSO-E assessment

Impact on grid losses

B5 Variation of network losses (GWh / year)	average	158	183	n/a	n/a	ENTSO-E assessment
B5_€ Variation of network losses monetised (M€ / year)	average	13	15	n/a	n/a	ENTSO-E assessment

Security of supply

B6 Annual reduction in Energy Not Served (MWh / year)	max average min		11	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	0.11	>	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	289	223	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	25	6	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	4	3	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B2a Annual CO2 variation from market simulation (ktonnes / year)	average	-468	-178	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	3 22 64	4 12 27	ENTSO-E assessment

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	average	81	62	ENTSO-E assessment
B3a Connected RES (MW)	-			ENTSO-E assessment

Non scenario-dependent indicator(s)

B8.0 Stability (Transient, Voltage and Frequency Stability)	Transient stability	Voltage stability	Frequency stability	
Interconnection between Crete and Peloponnese (Phase I) (New AC line)	++	++	0	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.
Interconnection between Crete and Attica (Phase II) (New HVDC)	++	++	+ (between sync areas)	

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	321	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	19	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	0	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B2a Annual CO2 variation from market simulation (ktonnes / year)	average	-667	ENTSO-E assessment
			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	21 48 107	

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	average	5	ENTSO-E assessment
B3a Connected RES (MW)	-		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
Interconnection between Crete and Peloponnese (Phase I)	Under Construction	25	Habitats Directive (92/43/ EEC)
		11	Birds Directive (2009/147/ EC)
		2	Other nature protection areas under national law
Interconnection between Crete and Attica (Phase II)	In Permitting	5.2	Habitats Directive (92/43/ EEC)
		4.48	Other nature protection areas under national law

Residual social impact

Investment	Investment status	Distance (km)	Type of sensitivity
Interconnection between Crete and Peloponnese (Phase I)	Under Construction	9.63	Sensitivity regarding population density - Land that is close to densely populated areas
Interconnection between	In Permitting	14.9	Sensitivity regarding population

Crete and Attica (Phase II)			density - Land that is close to densely populated areas

Project Costs

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

	CAPEX (Meuro)	Uncertainty range (%)	OPEX
1716. Interconnection between Crete and Peloponnese (Phase I)	356.42	9	1.2
1717. Interconnection between Crete and Attica (Phase II)	1020	9	1.5
Total	1376.42		2.7

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

1716

1717