Project Sheet

Nautilus: multi-purpose interconnector Belgium - UK

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Key Information

Cross Border Project
Offshore DC transmission cable
New

Under Consideration

Description

This project considers the possibility of a multi-purpose HVDC interconnection between GB and Belgium, that combines the benefits of connecting electricity markets and offshore wind generation in GB and Belgium. The capacity of the interconnection is still under review, but is likely to be in the range of 1 GW – 2GW, with the reference NTC contribution remaining 1,4GW at this stage.

Project motivation: Increasing commercial market exchange capacity between Belgian and GB bidding zones will increase overall EU social welfare. An important security of supply contribution is also achieved through implementation of this project, both from avoided alternative investments as from a reduction in loss of load expectancy. Such adequacy contribution can be linked to the decreasing figures of installed conventionals and increasing RES. Finally, significant benefits related to integration of XB redispatching, balancing markets, and exchange or sharing of ancillary services (frequency coupling, frequency reserves, blackstart, reactive power) across the HVDC-IC between synchronous areas can be obtained. Considering the above, the project therefore also contributes directly to the 2030 interconnection criteria. Additionally, integrating offshore wind capacity on to the interconnector could lead to increased benefits and/or investment savings.

Project promoters

ELIA
National Grid

Countries

Belgium
United Kingdom

National development plan(s)

NDP1, Belgium, 2020-2030, §4.2.3.3;NDP2, UK, 2017, p.23 §2.3

Additional information on the project

More information on the project can be found following these links:

- Project site:
https://www.elia.be/en/infrastructure-and-projects/infrastructure-projects/nautilus

- National Development Plan:
https://www.elia.be/-/media/project/elia/elia-site/infra-and-projects/investment-plans/federal-development-plan-2020-2030/nl/20190516_federaal-ontwikkelingsplan_nl.pdf?la=en

Project sheet backlog

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

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Project Description & Context

Project Investments

Main investment(s): This investment item envisions the possibility of a second HVDC connection between UK and a Belgian 380kV substation near the coast. Subject to further studies

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	180	Leiston (UK)	TBD (BE)	Under Consideration	2028	Investment on time	

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))
€	Infrastructure to reduce price differentials between EU and/or non-EU countries	This project increases the degree of interconnectivity between the Belgian and UK bidding zone and possibility of higher market exchanges which leads to higher price convergence. This is also a key trigger of the 2030 ITEG targets.
	Infrastructure to address system adequacy deficiencies and/or mitigate the risk of power failures.	This project has an important adequacy contribution due to decreasing figures of installed conventionals and increasing RES. This is also a key trigger of the 2030 ITEG targets.
	Infrastructure to improve system flexibility and stability e.g. improve system or local ramp rate, improve	This interconnector project between Belgium and UK is designed as a HVDC-link. The full controllability of the HVDC link facilitates the

Need		How the project addresses each need (explanation provided by the project promoter(s))
	transient stability or RoCoF to meet system Needs.	balancing of active and reactive power in the Belgian and UK grid.
	Infrastructure designed to enable cost-efficient grid connection of high volumes of RES and/or reduce RES curtailment	RES integration implies higher flows within & between AC-grid(s) and thus increases the need for cross border transmission capacity. This project satisfies this need in a cost-efficient manner. This is also a key trigger of the 2030 ITEG targets.

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)	Belgium - United Kingdom	1400	1400

Boundary capacity diagram

Network boundary the projects helps mitigate

Great Britain – Continental Europe and Nordics

Boundary capacity diagram

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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	12 11 9	39 37 36	>	>	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	max average min	3 3 2	15 13 12	>	>	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	max average min	1 1 0	7 5 4	<	>	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B4 Non-CO2 emissions (kg/year)

B4a Nitrogen oxides	average	-374	-1028	n/a	n/a	ENTSO-E assessment
B4b Ammonia	average	-22	-57	n/a	n/a	ENTSO-E assessment
B4c Sulfur dioxide	average	-451	-1133	n/a	n/a	ENTSO-E assessment
B4d Particular matter 5	average	1234	5753	n/a	n/a	ENTSO-E assessment
B4e Particulate matter 10	average	-18	-72	n/a	n/a	ENTSO-E assessment
B4f Non-methane volatile organic compounds	average	1242	5800	n/a	n/a	ENTSO-E assessment

B2a Annual CO2 variation from market simulation (ktonnes / year)		max average min	-99 -114 -134	-428 -479 -548	<	>	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	4 9 19	15 34 77	< < <	< < <	ENTSO-E assessment
B2b Annual CO2 variation due to network losses (ktonnes / year)		average	-66	443	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	6 5 11	-14 -32 -71	n/a	n/a	ENTSO-E assessment

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)		max average min	22 14 7	200 139 105	<	>	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	-13	901	n/a	n/a	ENTSO-E assessment
B5_€ Variation of network losses monetised (M€ /		average	-1	31	n/a	n/a	ENTSO-E assessment

year)					

Security of supply

B6 Annual reduction in Energy Not Served (MWh / year)	max average min		3200	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	32	>	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	57	45	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	29	15	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	3	13	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B2a Annual CO2 variation from market	average	-542	-424	ENTSO-E assessment

simulation (ktonnes / year)				
B2a_€ Annual Societal cost variation resulting from CO2 variation from market simulation monetised (M€ / year)	CO2 price	60€/ ton 100€/ ton 189€/ ton	4 25 74	11 28 65	ENTSO-E assessment

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	average	71	313	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**	
Nautilus: 2nd interco UK - BE (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€ /	average	16	ENTSO-E assessment

year)			
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	4	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	-127	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	4 9 20	ENTSO-E assessment

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	average	8	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
Nautilus: 2nd interco UK - BE	Under Consideration		

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
934. Nautilus: 2nd interco UK - BE	900	30%	8
Total	900		8

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

934 Uncertainty range is based on provided information in the PCI process