Project Sheet

Fenno-Skan 1 renewal

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Key Information

Cross Border Project
Offshore DC transmission cable
Upgrade

Under Consideration

Description

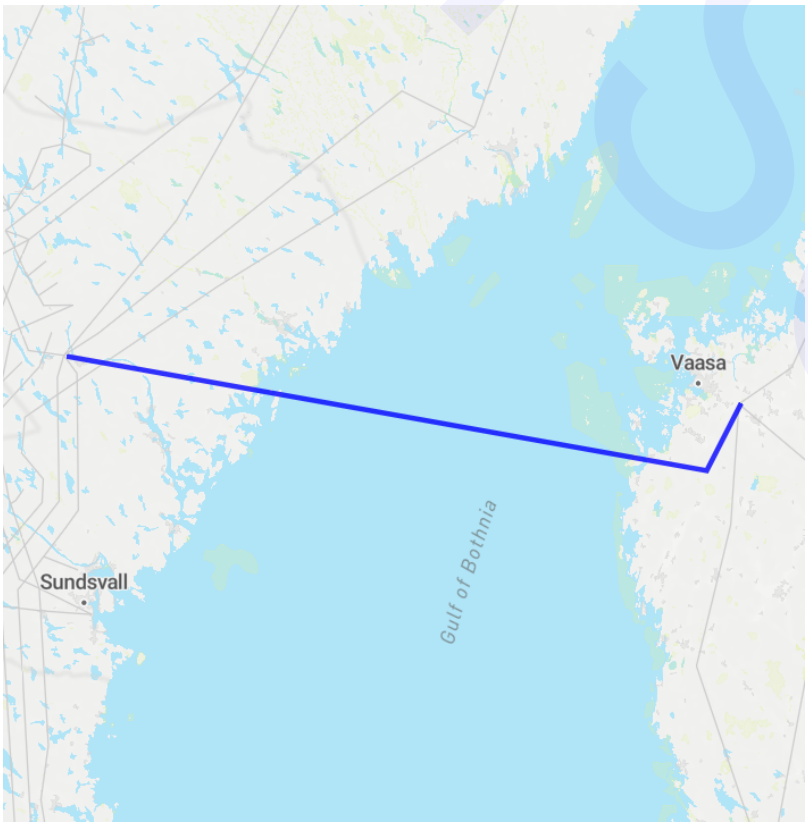
Replacement of the existing 400 kV HVDC cable interconnection between Finland and Sweden. Fennoskan 1 will be decomissioned at the same time with this project being commisioned.

Project promoters

FINGRID
Svenska Kraftnät

Countries

Finland
Sweden



National development plan(s)

Kantaverkon kehittämissuunnitelma 2019-2030 (currently in Finnish, will be available in english later), Finland, 2019; System Development Plan 2018-2027, Sweden, 2017, p. 60

Additional information on the project

Svenska kraftnät has published a national development plan in 2017. The purpose of the plan is to be an investment plan for the following ten years, 2018-2027. The investment plan presents a detailed look of the projects Svenska kraftnät intends to realize under the stated time period. The plan is available in Swedish through the following link:

https://www.svk.se/siteassets/om-oss/rapporter/2017/svenska-kraftnats-systemutvecklingsplan-2018-2027.pdf
(Swedish)

Fingrid has published a national development plan in 2019. The investment plan presents a detailed look of the projects. The plan is available in Finnish:

https://www.fingrid.fi/globalassets/dokumentit/fi/kantaverkko/kantaverkon-kehittaminen/kantaverkon_kehittamissuunnitelma-2019-2030.pdf

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): Replacement of the existing 400 kV HVDC cable interconnection between Finland and Sweden. Fennoskan 1 will be decomissioned at the same time with this project being commisioned, which reduces capacity between FI and SE3 by 400 MW while increasing SE2-FI by 800 MW.

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	200	Hjalta (SE2)	Tuovila (FI)	Under Consideration	2035	Rescheduled	The remaining lifetime of Fenno-Skan 1 will be investigated before making final decisions on its renewal. In addition, a joint study showed that the substantial benefits of this project will be realized in case of significant increase of consumption, new RES generation or the decommissioning of the remaining Swedish Nuclear plants which is expected in the 2040s.

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	

Need		How the project addresses each need (explanation provided by the project promoter(s))
€	non-EU countries	
	Infrastructure to address system adequacy deficiencies and/or mitigate the risk of power failures.	
ITEG	Infrastructure to tackle a Need identified by one of the European ITEG indicators referring to the 15% interconnection target for 2030:1. Reduce the price differential between EU countries to below 2EUR/MWh.2. Contribute to pushing ratio between nominal transmission capacity and installed RES capacity past 30%.3. Contribute to pushing ratio between nominal transmission capacity and peak load past 30%.	
	Infrastructure to improve system flexibility and stability e.g. improve system or local ramp rate, improve transient stability or RoCoF to meet system Needs.	

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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Updated data provided by the project promoter after the deadline for CBA assessment - This data is provided for information only and has not been used by ENTSO-E in the cost-benefit analysis.

The total route length of the project is estimated between 300-315 km.

Project Assessment

Transfer capacity increase (National Trends 2025)

	Border	A B	B A
Transfer capacity increase (in MW)	Finland - Sweden	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.

Because its planned commissioning date is in 2035 or later, this project has only been assessed in the 2030 scenarios and based on a subset of CBA indicators.

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 12 12	29 27 25	>	<	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	max average min	5 5 5	4 4 4	<	<	ENTSO-E assessment

B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	max average min	0 0 0	2 1 0	<	<	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B4 Non-CO2 emissions (kg/year)

B4a Nitrogen oxides	average	N/A	45	n/a	n/a	ENTSO-E assessment
B4b Ammonia	average	N/A	-1	n/a	n/a	ENTSO-E assessment
B4c Sulfur dioxide	average	N/A	120	n/a	n/a	ENTSO-E assessment
B4d Particular matter 5	average	N/A	-5260	n/a	n/a	ENTSO-E assessment
B4e Particulate matter 10	average	N/A	10	n/a	n/a	ENTSO-E assessment
B4f Non-methane volatile organic compounds	average	N/A	-5265	n/a	n/a	ENTSO-E assessment

B2a Annual CO2 variation from market simulation (ktonnes / year)	max average min	-203 -203 -203	-143 -148 -153	>	>	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	8 16 34	5 11 24	< < <	< < <	ENTSO-E assessment
B2b Annual CO2 variation due to network losses (ktonnes / year)	average	0	0	n/a	n/a	ENTSO-E assessment
B2b_€ Annual Societal cost	CO2 price 60€/ ton	0 0	0 0	n/a	n/a	ENTSO-E assessment

variation resulting from CO2 variation from network simulation monetised (M € / year)	100€/ ton 189€/ ton	0	0			

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	max average min	0 0 0	58 31 5	<	<	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	N/A	0	n/a	n/a	ENTSO-E assessment
B5_€ Variation of network losses monetised (M€ / year)	average	N/A	0	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	73	18	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	0	2	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	-2	1	ENTSO-E assessment
Reduction of CO2 and GHG emissions				
B2a Annual CO2 variation from market simulation (ktonnes / year)	average	-6	-46	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	0 0 1	1 3 7	ENTSO-E assessment
Integration of renewable energy sources				
B3 Annual avoided curtailment (RES integration) (GWh / year)	average	-27	18	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	
Fenno-Skan 1 renewal (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	6	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	0	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	2	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B2a Annual CO2 variation from market simulation (ktonnes / year)	average	-15	ENTSO-E assessment
B2a_€ Annual Societal cost variation resulting from	CO2 price 60€/ton 100€/	0 1 2	ENTSO-E assessment

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

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	average	35	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

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.

Additional information by the project promoter(s)

This information is not available yet as the project is in a very early phase.

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.

Additional information by the project promoter(s)

This information is not available yet as the project is in a very early phase.

Project Costs

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

	CAPEX (Meuro)	Uncertainty range (%)	OPEX

	CAPEX (Meuro)	Uncertainty range (%)	OPEX
1241. Fenno-Skan 1 renewal	488	+/-15 %	0.75
Total	488		0.75

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

1241 the project is still in an early stage

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