Project Sheet

3rd AC Finland-Sweden north

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Key Information

Cross Border Project
AC transmission line
New

In Permitting

Description

Third AC 400 kV overhead line interconnector between Finland north and Sweden SE1. Strengthening the AC connection between Finland and Sweden is necessary due to market needs, security of supply in Finland, new wind power generation and larger conventional units.

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, page 39, FI-XB-FISEAC3; 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): Third AC 400 kV overhead line interconnector between Finland north and Sweden SE1.

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
AC transmission line	200	Keminmaa (Finland)	Messaure (Sweden, bidding area SE1)	In Permitting	2025	Investment on time	

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
The investment is a 400 kV overhead line in North Finland. It is part of the 3rd AC cross border project between Finland and Sweden and will enable its full capacity to be utilized. The project will also allow integration of new RES generation at Bothnian bay.	AC transmission line	156	Keminmaa	Pyhänselkä	In Permitting	2024	Investment on time	

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 to reduce price differentials between EU and/or 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 investment '3rd AC Finland-Sweden north' has been updated to 226 km (178 km in Sweden and 48 km in Finland). This investment will be connected to the New Viitajärvi substation in Keminmaa municipality (Finland).

The total route length of investment 'Keminmaa-Pyhänselkä' has been revised to 153 km. This investment will connect the New Viitajärvi substation in Keminmaa municipality to Pyhänselkä substation.

Project Assessment

Transfer capacity increase (National Trends 2025)

	Border	A B	B A
Transfer capacity increase (in MW)	Finland - Sweden	900	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	20 17 14	47 44 41	>	<	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	max average min	4 4 4	7 7 7	<	<	ENTSO-E assessment
B1_RES Annual Socio-Economic	max average	1 1	3 2	<	<	ENTSO-E assessment

Welfare increase resulting from RES integration	min	0	0			

Reduction of CO2 and GHG emissions

B4 Non-CO2 emissions (kg/year)

B4a Nitrogen oxides	average	1338574	-1000	n/a	n/a	ENTSO-E assessment
B4b Ammonia	average	59394	-63	n/a	n/a	ENTSO-E assessment
B4c Sulfur dioxide	average	1590079	-1391	n/a	n/a	ENTSO-E assessment
B4d Particular matter 5	average	3923977	10300	n/a	n/a	ENTSO-E assessment
B4e Particulate matter 10	average	89806	-75	n/a	n/a	ENTSO-E assessment
B4f Non-methane volatile organic compounds	average	3859101	10338	n/a	n/a	ENTSO-E assessment

B2a Annual CO2 variation from market simulation (ktonnes / year)		max average min	-162 -165 -169	-253 -256 -259	>	>	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	6 13 27	8 18 41	< < <	< < <	ENTSO-E assessment
B2b Annual CO2 variation due to network losses (ktonnes / year)		average	-95	-79	n/a	n/a	ENTSO-E assessment
B2b_€ Annual Societal cost variation resulting from	CO2 price	60€/ ton 100€/	5 7 16	3 6 13	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	24 12 0	78 42 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	150	247	n/a	n/a	ENTSO-E assessment
B5_€ Variation of network losses monetised (M€ / year)	average	7	12	n/a	n/a	ENTSO-E assessment

Security of supply

B6 Annual reduction in Energy Not Served (MWh / year)	max average min		105	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	>	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	113	29	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	6	3	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	1	2	ENTSO-E assessment
Reduction of CO2 and GHG emissions				
B2a Annual CO2 variation from market simulation (ktonnes / year)	average	-115	-76	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	1 5 16	2 5 12	ENTSO-E assessment
Integration of renewable energy sources				
B3 Annual avoided curtailment (RES integration) (GWh / year)	average	22	40	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	
3rd AC Finland-Sweden north (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.
Keminmaa-Pyhänselkä (New AC line)	++	++	0	

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	12	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	2	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	3	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B2a Annual CO2 variation from market simulation (ktonnes / year)	average	-79	ENTSO-E assessment
B2a_€ Annual Societal cost variation	CO2 price 60€/ton 100€/	3 6 13	ENTSO-E assessment

resulting from 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	60	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

Additional information by the project promoter(s)

The Finnish EIA-processes were executed according to Finnish EIA legislation, which is based on EU legislation (2011/92/EU, 2014/52/EU), and according to the assessments there are no significant adverse effects of the Finnish part of the project on the environmental aspects, which can prevent the implementation of the project.

The Swedish EIA-processes are executed according to Swedish EIA-legislation, which is based on EU- legislation (2011/92/EU, 2014/52/EU). The Swedish part of the project is still at an early stage of the EIA-process. The preliminary assessments indicate that the planned action in Sweden might affect NATURA 2000-sites (Habitats directive (92/43/EEC)), as well as other nature protection areas under national law (e.g. nature reserves and shore protection areas). The matter is therefore being carefully investigated and measures to avoid, prevent and reduce adverse effects on the environment will be suggested.

Residual social impact

Investment	Investment status	Distance (km)	Type of sensitivity

Additional information by the project promoter(s)

The Finnish EIA-processes were executed according to Finnish EIA legislation, which is based on EU legislation (2011/92/EU, 2014/52/EU), and according to the assessments there are no significant adverse effects of the Finnish part of the project on the environmental aspects, which can prevent the implementation of the project.

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Project Costs

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

	CAPEX (Meuro)	Uncertainty range (%)	OPEX
396. 3rd AC Finland-Sweden north	238	+-10%	0.11
1710. Keminmaa-Pyhänselkä	59	+-10%	0.19
Total	297		0.3

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

396 standard uncertanty factor based on similar project

1710