Project Sheet

N-S Finland P1 stage 3

Project type	transmission
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ENTSOE

Key Information

Internal Project
AC transmission line
New

In Permitting

Description

This project consists of the sixth 400 kV overhead line (Nuojuankangas-Huutokoski) connecting North Finland to South Finland, new 400 kV lines Tuomela B - Nuojuankangas and Petäjävesi-Hikiä as well as reactive compensation measures to improve the voltage stability of the grid. The project is built to increase the North-South transmission capacity thus enabling the integration of new renewable and conventional generation in northern Finland.

Project promoters

FINGRID

Countries

Finland

National development plan(s)

Kantaverkon kehittämissuunnitelma 2019-2030 (currently in Finnish, will be available in english

later), Finland, 2019, codes FG-NS-5P0, FG-NS-6P1-002, FG-NS-7P2

Additional information on the project

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

ENTSO-E

Project Description & Context

Project Investments

Main investment(s): New single circuit 400 kV OHLs will be built from central part of Finland to the northern area to increase the capacity between North and South Finland. Enables integration of renewables to the northern part of the country.

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	290	Nuojuankangas	Huutokoski	In Permitting	2028	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 single circuit 400 kV OHL will be built to the northern part of Finland. Enables the integration of renewables to the northern part of the country and the increasing power transfer from North to South .	AC transmission line	100	Tuomela B	Nuojuankangas	In Permitting	2029	New Investment	
New single circuit 400 kV OHL will be built to the central part of Finland.	AC transmission line	175	Petäjävesi	Hikiä	Planned But Not Yet Permitting	2030	New Investment	

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
Enables the integration of renewables and the utilization of full transfer capacity from North to South .								

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.

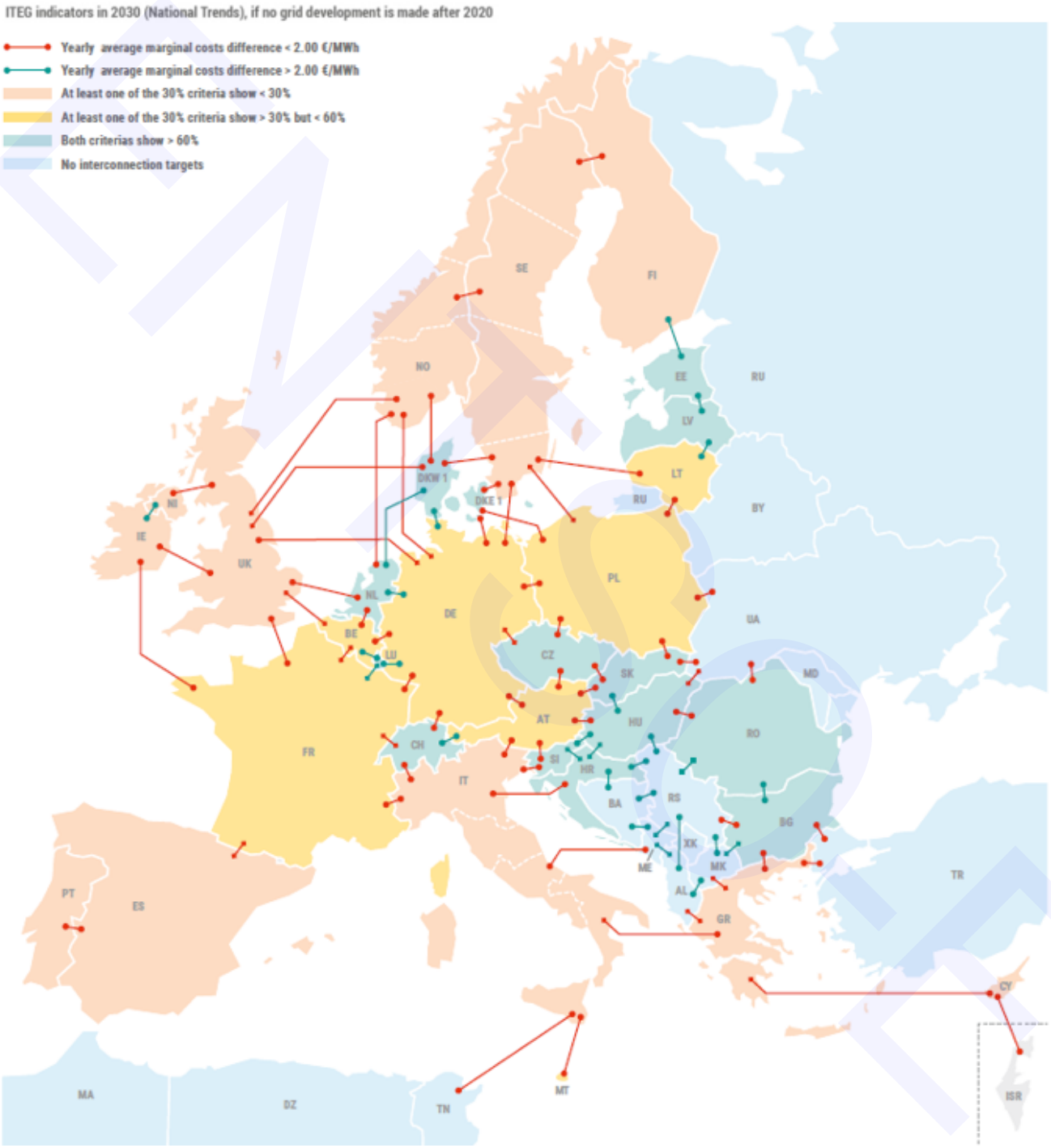
Need		How the project addresses each need (explanation provided by the project promoter(s))
	Infrastructure to reduce price differentials between EU and/or non-EU countries	
	Infrastructure designed to enable cost-efficient grid connection of high volumes of RES and/or reduce RES curtailment	
	Infrastructure to improve system flexibility and stability e.g. improve system or local ramp rate, improve transient stability or RoCoF to meet system Needs.	

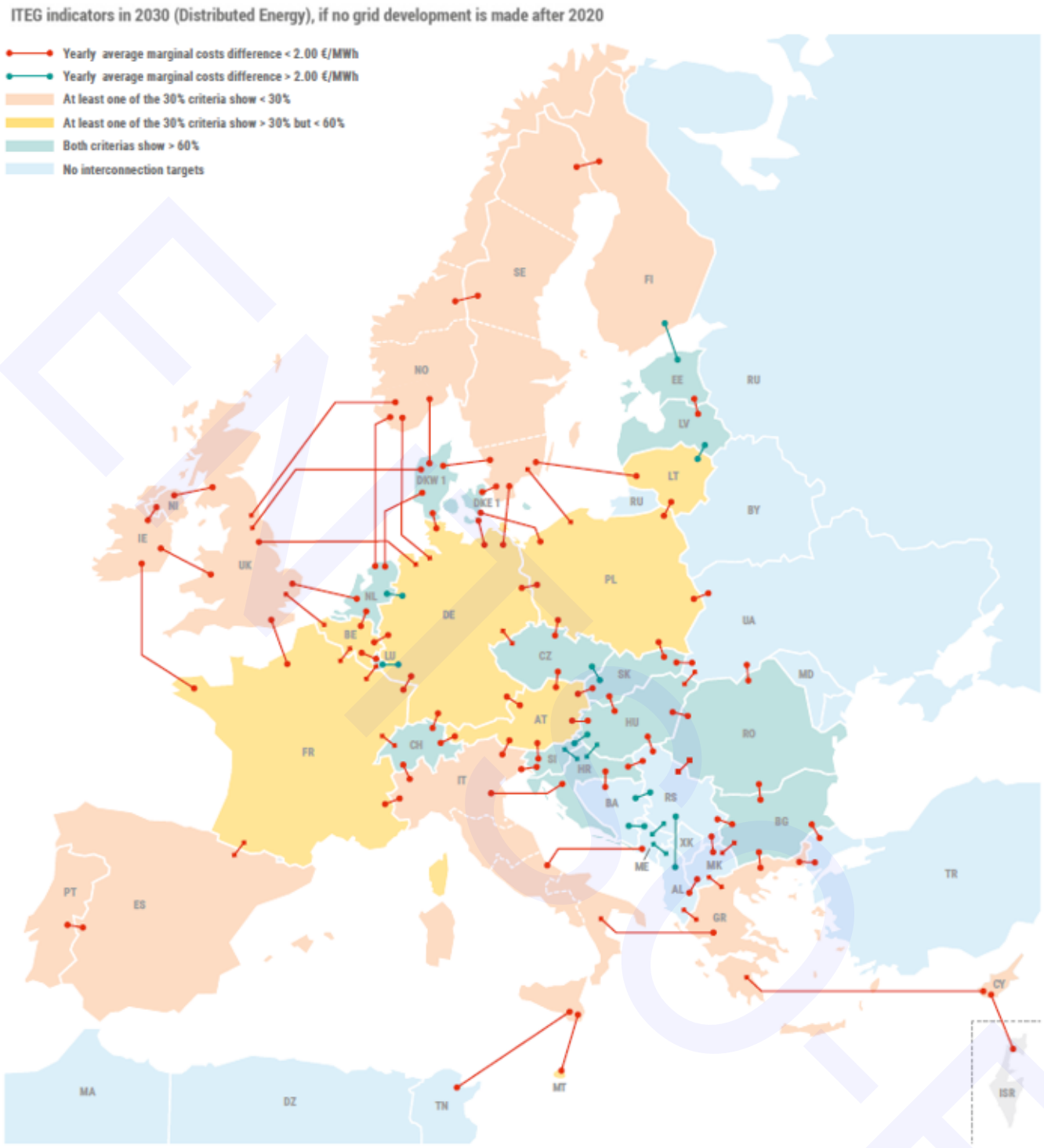
Interconnection targets

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

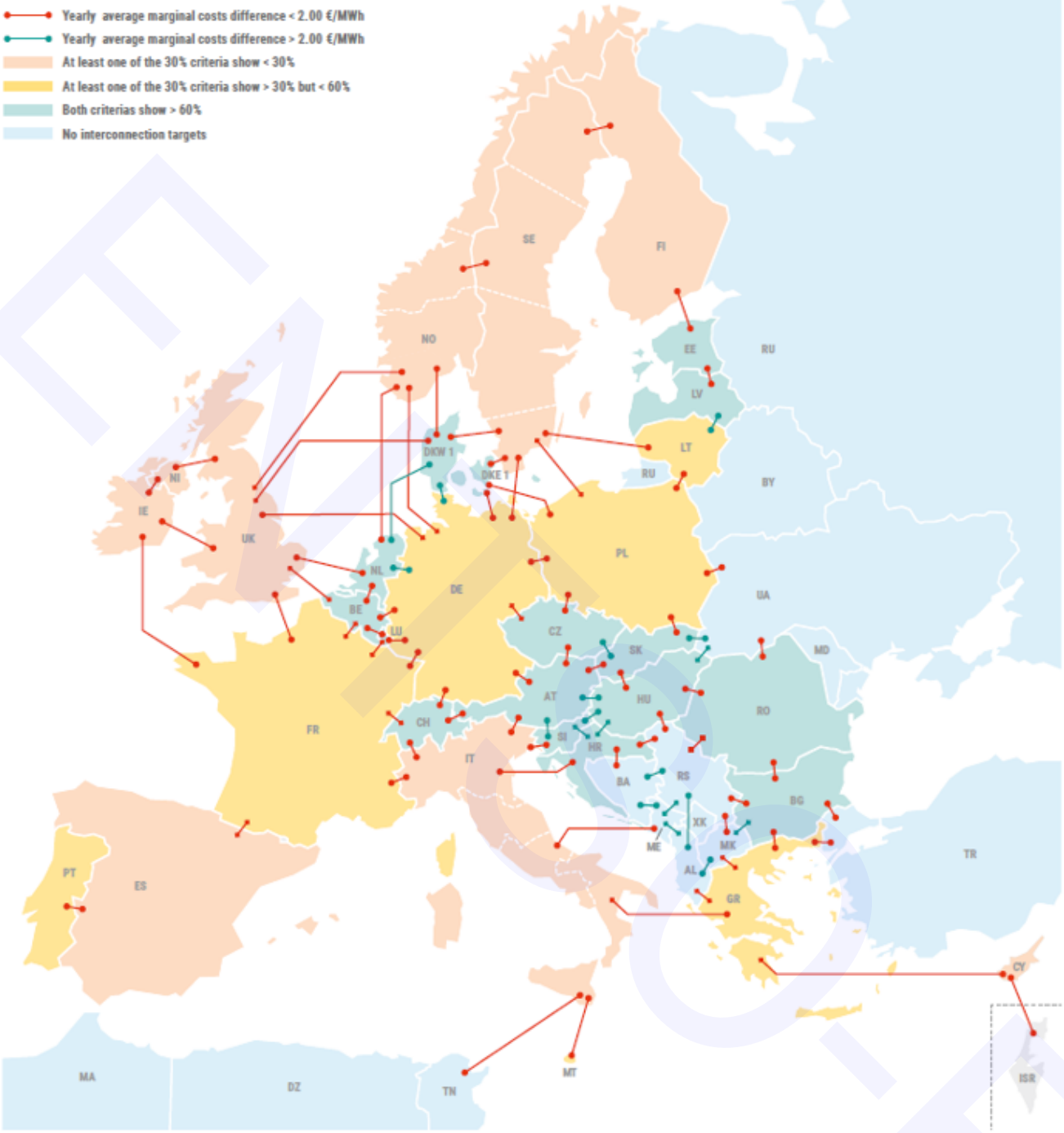
2. Ratio between nominal transmission capacity and installed RES capacity, with a target of past 30%
3. Ratio between nominal transmission capacity and peak load, with a target of past 30%

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




ITEG indicators in 2030 (Distributed Energy), if no grid development is made after 2020
Yearly average marginal costs difference < 2.00 €/MWh
Yearly average marginal costs difference > 2.00 €/MWh
At least one of the 30% criteria show < 30%
At least one of the 30% criteria show > 30% but < 60%
Both criterias show > 60%
No interconnection targets
SE
FI
NO
EE
RU
LV
LT
DKW 1
DKE 1
RU
BY
NI
IE
UK
PL
NL
DE
UA
BE
LU
CZ
SK
MD
AT
HU
RO
FR
CH
SI
HR
IT
BA
RS
BG
XK
ME
MK
AL
TR
PT
ES
GR
CY
MA
DZ
TN
MT
ISR

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 (Finland)	1000	1000

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.

This project was assessed with the internal redispatch methodology.

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	0 0 0	10 6 2	>	>	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	max average min	1 1 1	1 -6 -12	>	>	ENTSO-E assessment

B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	max average min	0 0 0	8 4 0	>	>	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B4 Non-CO2 emissions (kg/year)

B4a Nitrogen oxides	average	0	315	n/a	n/a	ENTSO-E assessment
B4b Ammonia	average	0	37	n/a	n/a	ENTSO-E assessment
B4c Sulfur dioxide	average	0	9	n/a	n/a	ENTSO-E assessment
B4d Particular matter 5	average	0	25	n/a	n/a	ENTSO-E assessment
B4e Particulate matter 10	average	0	16	n/a	n/a	ENTSO-E assessment
B4f Non-methane volatile organic compounds	average	0	11	n/a	n/a	ENTSO-E assessment

B2a Annual CO2 variation from market simulation (ktonnes / year)	max average min	36 36 36	32 -206 -443	>	>	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 -3 -6	7 15 33	> > >	> > >	ENTSO-E assessment
B2b Annual CO2 variation due to network losses (ktonnes / year)	average	-36	-32	n/a	n/a	ENTSO-E assessment
B2b_€ Annual Societal cost	CO2 price 60€/ ton	1 3	1 2	n/a	n/a	ENTSO-E assessment

variation resulting from CO2 variation from network simulation monetised (M € / year)	100€/ ton 189€/ ton	6	5			

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	max average min	10 10 10	130 103 76	>	>	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	-75	-88	n/a	n/a	ENTSO-E assessment
B5_€ Variation of network losses monetised (M€ / year)	average	-3	-5	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	N/A	N/A	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	N/A	N/A	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	N/A	N/A	ENTSO-E assessment
Reduction of CO2 and GHG emissions				
B2a Annual CO2 variation from market simulation (ktonnes / year)	average	N/A	N/A	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	N/A N/A N/A	N/A N/A N/A	ENTSO-E assessment
Integration of renewable energy sources				
B3 Annual avoided curtailment (RES integration) (GWh / year)	average	N/A	N/A	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	
Nuojuankangas-Huutokoski (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.
Tuomela B-Nuojuankangas (New AC line)	++	++	0	
Petäjävesi-Hikiä (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	N/A	ENTSO-E assessment
B1_CO2 Annual Socio-Economic Welfare increase resulting from CO2 emissions reduction	average	N/A	ENTSO-E assessment
B1_RES Annual Socio-Economic Welfare increase resulting from RES integration	average	N/A	ENTSO-E assessment

Reduction of CO2 and GHG emissions

B2a Annual CO2 variation from market simulation (ktonnes / year)	average	N/A	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	N/A N/A N/A	ENTSO-E assessment

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year)	average	N/A	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).

Project Costs

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

	CAPEX (Meuro)	Uncertainty range (%)	OPEX
1688. Nuojuankangas-Huutokoski	120	+/- 10	0.1
1689. Tuomela B-Nuojuankangas	70	+/- 10	0.1
1697. Petäjävesi-Hikiä	65	+/-10	0.1
Total	255		0.30000000000000004

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

1688

1689

1697