FINGRID

Main grid development plan 2026–2035

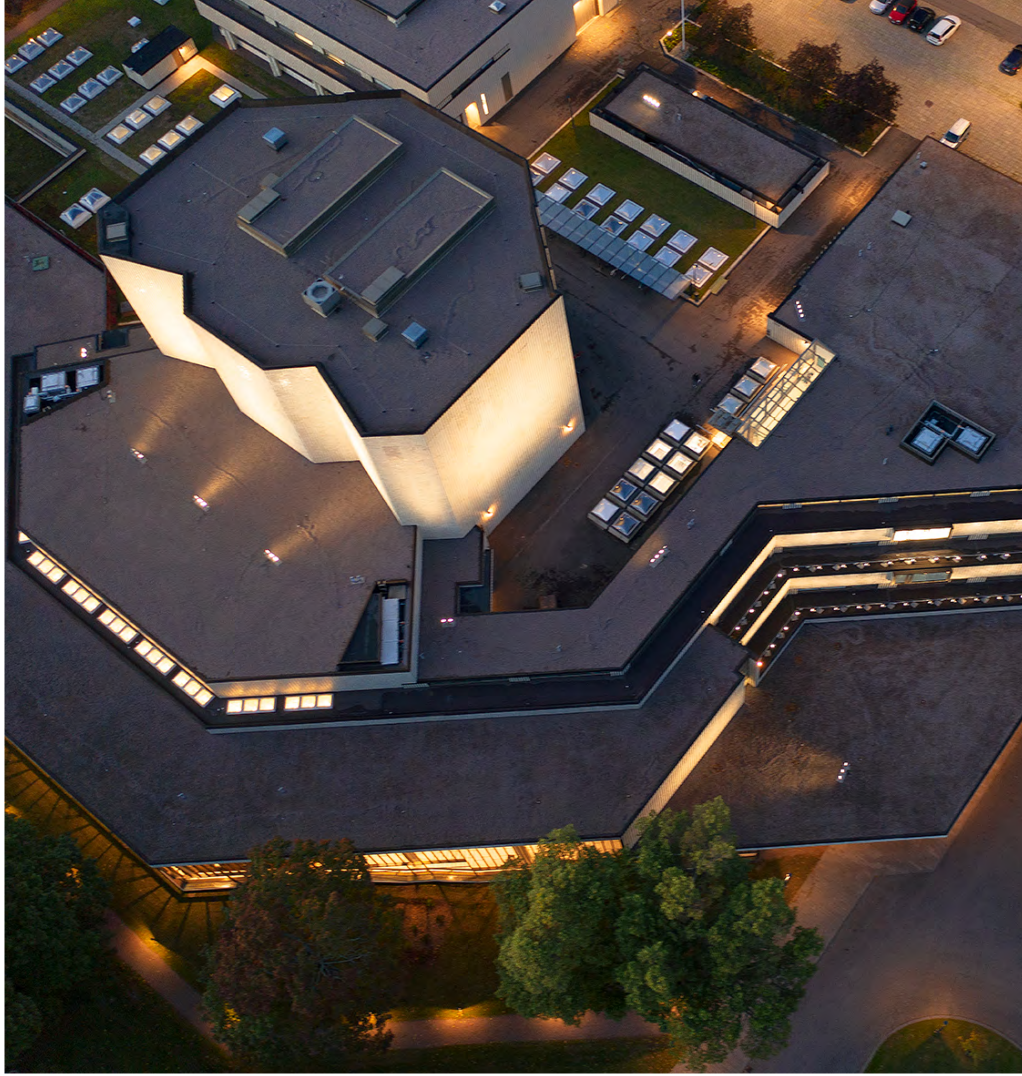
December 2025

Contents

A vision for a competitive Finland

Finland's attractiveness as a place for investments relies in part on clean, reliable and affordable electricity. Finland is well placed to compete for investments in these areas. Since the electricity market is subject to the normal laws of supply and demand, the growth of electricity production and consumption are interlinked. This is not a problem in Finland, as we have the potential to significantly increase the production of clean electricity for industrial needs. At the same time, we need reliable electricity networks with enough transmission capacity to connect the growing amounts of electricity production and consumption. Forecasting the future transmission needs of the main grid is challenging, as Fingrid has received thousands of preliminary connection enquiries for electricity generation and production with an aggregate power of around 500,000 MW. At the same time, battery energy storage systems, which can be implemented more quickly than production and consumption projects, have begun competing for connection capacity in the power system. The connection enquiries for batteries have a total power of over 30,000 MW. It is clear that not all of the above mentioned connection enquiries will come to fruition as investments, but which ones will, and in what order?

We need reliable electricity networks with enough transmission capacity to connect the growing amounts of electricity production and consumption.



Fingrid's vision is to operate a clean, reliable power system, the most competitive of its kind in Europe.

The construction of the main grid and the related permit processes take time, so the grid needs to be developed with foresight before individual connection needs are realised. To do this, Fingrid builds and updates forecasts and uses them as the foundation for grid planning. The result is a grid development plan that includes various alternatives. Not all the projects in the plan will ultimately be implemented, and some may be replaced by other projects. Investments in the main grid should, therefore, remain flexible to meet changing customer needs. We anticipate changes in customer needs through network planning, zoning and permit processes. We have done this, for example, in Eastern Finland, where we are still waiting for major customer projects to come to fruition. At the same time, we must have adequate financial resources and effective permit processes.

However, despite this flexibility, there is a need for a determined and proactive approach to develop the transmission capacity in key parts of the grid, such as at the Finnish-Swedish border and between Northern and Southern Finland, so that these places do not become constraints on the local connection capacity. We do not always have time to respond to all the changes that arise quickly, and there may be occasional shortages of connection capacity. An example of this is the transformation underway in Southern Finland, where combined heat and power plants are being replaced by heat-generating electric boilers at an increasing pace. This causes greater demand for transmission capacity towards south, further exacerbated by the discontinuation of electricity imports from Russia.

Fingrid's vision is to operate a clean, reliable power system, the most competitive of its kind in Europe. We are developing the main grid to ensure that our customers have the opportunity to. And we are currently building out the main grid more than ever. But this is not enough. In addition to new transmission lines and substations, there is an increasing need for flexible solutions that support the electricity system and its development, also on the customer side. These include solutions that better match electricity production and consumption, both in terms of time and geography. It is also necessary to develop the grid requirements for connections to ensure the reliability and efficiency of the electricity system as it grows and evolves. In cooperation with the authorities and its customers, Fingrid wants to continue developing new, economically efficient grid and connection solutions to help Finland compete for clean energy investments.

Jussi Jyrinsalo, Senior Vice President, Customers and Grid Planning

01

Summary

Development plan 2026–2035

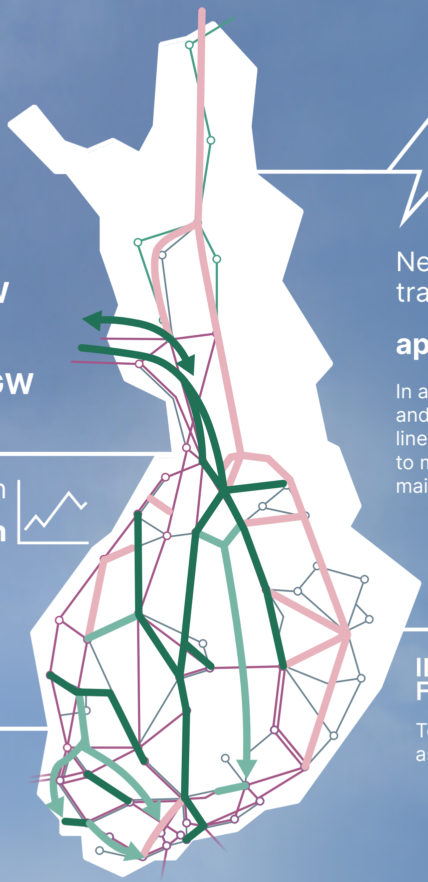
Over 30 GW of wind power

Almost 15 GW of solar power

Electricity consumption **approx. 160 TWh**

A CLEAN ENERGY SYSTEM

A clean, reliable power system, the most competitive of its kind in Europe



New 400 kV transmission lines **approx. 3,800 km**

In addition, several 400 kV and 110 kV transmission line and substation projects to meet customer and maintenance needs

INVESTMENT IN FINLAND

Together with society as a whole

02

Introduction

Clean, affordable and reliable electricity is a key factor in Finland's competitiveness and a source of prosperity. Industrial investments are expected to increase consumption significantly, especially from the late 2020s onwards. In the future, the price and availability of clean electricity will be a decisive factor influencing the operating environment of electricity-intensive industries. In addition, the high reliability of electricity transmission and distribution and the main grid's transmission and connection capacity are prerequisites for growth in both electricity consumption and production.

Due to its high onshore and offshore wind potential, Finland is in an excellent position to compete for industrial investments. In addition, Nordic hydroelectric power, nuclear power and bioenergy are resources that not all of Finland's competitors have at their disposal. Finland also has significant solar power potential, especially in terms of the land area available. The main grid plays an important role in enabling growth based on these competitive advantages.

Fingrid seeks to cost-effectively secure reliable electricity for customers and society and develop the clean, market-oriented power system of the future in a rapidly evolving operating environment. By designing, building and maintaining a reliable grid and developing customer

solutions and the electricity market, we can lay the foundations for the clean electricity system of the future and mitigate climate change. The development plan seeks to enable investments that use clean electricity, which help to attain the climate targets and create prosperity.

The preparation of the main grid development plan is subject to the provisions of the Electricity Market Act, and the plan is updated every two years. This development plan sets out Fingrid's key measures for the next ten years to fulfil its obligation to develop the transmission network and meet the quality requirements for operating the transmission network, assuming the forecast is realised. The development plan is based on regional plans compiled in cooperation with electricity transmission customers and the other European transmission system operators. The plan is aligned with the development plan for the Baltic Sea region, as well as the Ten-Year Network Development Plan (TYNDP) covering the entire European Union.

Clean, affordable and reliable electricity is a key factor in Finland's competitiveness and a source of prosperity.

The grid development needs are based on the latest forecasts and various assumptions about the future. Over time, customer needs and forecasts will become more accurate, and the implementation and timing of system reinforcements may also need to change. In addition to the grid development needs, this development plan presents Fingrid's grid development process. The development plan is accompanied by the forecasts of electricity consumption and production on which the plan is based.

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Main grid development plan

What was done from 2020 to 2024

400 kV transmission lines	**approx. 500 km**
Substation projects	**approx. 100**
Investments in the main grid	**approx. 1,5 mrd€**

About 900 km of 400 kV transmission lines and about 70 substation projects **under construction in 2025**

- ✓ A broader and cleaner production base
- ✓ More domestic production
- ✓ Imports from Russia replaced
- ✓ Electrification of heating in cities
- ✓ Electricity prices at the same level as in 2019 (many other EU countries experienced 100% growth)

Transformation of Finland's electricity system over the last five years	2019	2024	Direction
CO_2 emissions from electricity production (gCO_2/kWh)	83	24	↓
Electricity produced (TWh)	66	80	↗
Wind power (TWh)	6	20	↑
Solar power (TWh)	0,1	1,2	↑
Nuclear power (TWh)	23	31	↗
Fossil fuel-based production (TWh)	12	4	↓
Net imports of electricity (TWh)	20	3	↓
Wholesale electricity prices (EUR/MWh)	44	46	→
European price comparison ranking*	#13	#3	↑
Electricity consumption (TWh)	86	83	→

Sources: Energiatietoisuus, Statistics Finland
* Countries ranked from cheapest to most expensive based on wholesale electricity market prices. If a country has several bidding zones, a weighted average is used.

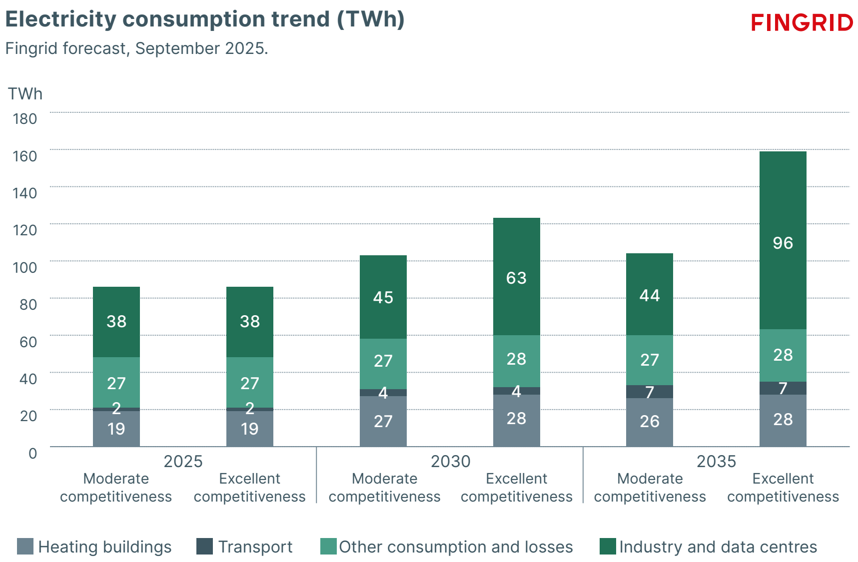
Electricity consumption and production forecasts

The number of main grid connection enquiries for renewable electricity production has increased significantly in the 2020s. Enquiries for new electricity production projects have increased to more than 400 gigawatts, which is about 15 times Finland's current production capacity. Similarly, connection enquiries for projects increasing electricity consumption have increased to around 70 gigawatts – almost five times Finland's current peak electricity consumption. In addition, the number of connection enquiries for grid energy storage systems has grown rapidly to over 30 gigawatts. Based on the connection enquiries for production and consumption and the results of electricity market modelling, a forecast is developed as a basis for transmission grid planning. The forecast takes into account the growing demand for clean electricity and electricity-based products in Europe, as well as Finland's excellent potential to be a competitive producer of these products. The scenario of excellent competitiveness and high consumption growth presented in the forecast is designed to be challenging but possible for the planning of the grid and the electricity system. However, this scenario does not assume that all the connection enquiries received by Fingrid will be realised.

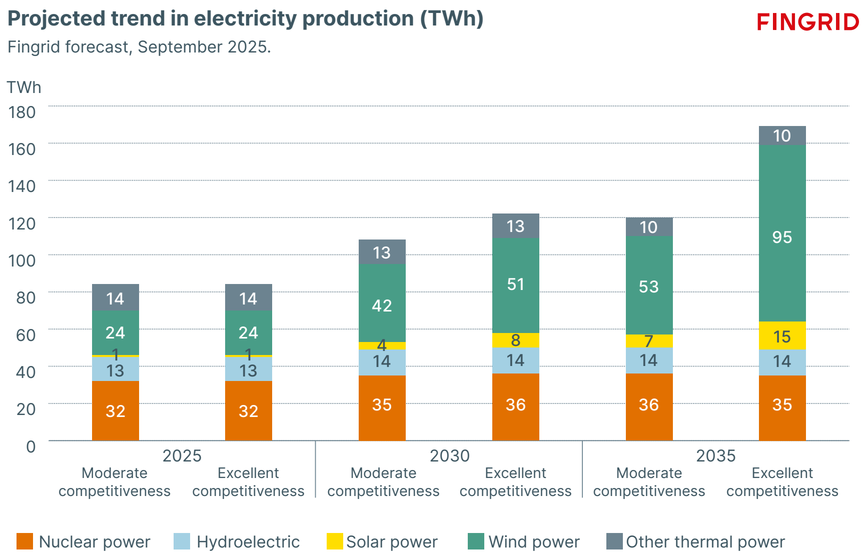
The forecast directs Fingrid to proactively address challenges related to the power system transition and identify solutions that enable the company to enable investments in clean electricity in Finland.

The appendix **"Outlook for electricity production and consumption, Q3/2025"** presents Fingrid's forecasts for the development of electricity production and consumption. The higher-growth scenario describes a situation where Finland's competitiveness in electricity-intensive industrial projects is excellent, and Finland is able to attract significant electricity-intensive industrial investments. The scenario is used as a basis for planning the main grid. The lower-growth scenario reflects a level of competitiveness where industrial electricity consumption is increased only by the demand projects that are already under construction and partly by projects for which a connection agreement has been signed but no investment decision has yet been made. Both scenarios also account for the expected growth in household, service and transport sector electricity consumption.

Several uncertainties affect the realisation of the forecasts, influencing either the overall progress of the clean transition, Finland's competitiveness in the transition, or both. These uncertainties include, among others, the stability and predictability of the operating environment, energy and climate policy, geopolitics, regulation, permitting, taxation, demand outlooks for electricity-intensive sectors, financing conditions and cost developments in energy production and storage technologies. One key consideration is the effect of the various uncertainties on Finland's position as an investment destination for electricity-intensive industries and on the growth potential and price competitiveness of Finnish wind power relative to its European and global competitors. This is important because a significant part of the projected growth in electricity consumption in Finland in the excellent competitiveness scenario is based on refining wind-generated electricity into export products and services.



Electricity consumption trend (TWh)
FINGRID
Fingrid forecast, September 2025.
TWh
180
160
140
120
100
80
60
40
20
0
38
27
2
19
38
27
2
19
45
27
4
27
63
28
4
28
44
27
7
26
96
28
7
28
2025
2030
2035
Moderate competitiveness
Excellent competitiveness
Moderate competitiveness
Excellent competitiveness
Moderate competitiveness
Excellent competitiveness
Heating buildings
Transport
Other consumption and losses
Industry and data centres



Projected trend in electricity production (TWh)
FINGRID
Fingrid forecast, September 2025.
TWh
180
160
140
120
100
80
60
40
20
0
14
24
1
13
32
14
24
1
13
32
13
42
4
14
35
13
51
8
14
36
10
53
7
14
36
10
95
15
14
35
2025
2030
2035
Moderate competitiveness
Excellent competitiveness
Moderate competitiveness
Excellent competitiveness
Moderate competitiveness
Excellent competitiveness
Nuclear power
Hydroelectric
Solar power
Wind power
Other thermal power

Developing the main grid transmission capacity

Based on the connection enquiries received by Fingrid, it appears that electricity production will be increasingly concentrated in the western and northern parts of the country, with consumption concentrated in southern Finland. Much stronger north-to-south and west-to-east transmission links will be required to transmit this electricity to consumption centres in Southern Finland.

The discontinuation of the transmission connections to Russia in 2022 and the start-up of the Olkiluoto 3 nuclear power plant in 2023 have contributed significantly to the transmission of electricity in the main grid. Another big change has been the electrification of heating. As a development, the electrification of heating is a very rapid one-off process. Higher fuel prices following Russia's invasion of Ukraine and a change in the tax bracket for electric boilers have further accelerated the change. Building 400 kV transmission lines to respond to such rapid development is challenging, as it takes around 7–8 years from planning to commissioning, including the permit process. For example, in the last three years, around 600 MW of electricity production has been removed from the Helsinki metropolitan area, and the utilisation rate of the remaining production facilities has been significantly reduced. At the same time, the decision was made to build more than 1,300 MW of new boiler capacity. This will result in an increase of around 2,000 MW in peak electricity demand in the Helsinki metropolitan area, which will require the construction of at least two new 400 kV connections from north to south. In addition to the Helsinki metropolitan area, heating will also be electrified in other population centres that use district heating. In terms of the adequacy of the main grid's transmission capacity, it is especially challenging when high wind power production lowers electricity prices so that it becomes most economically

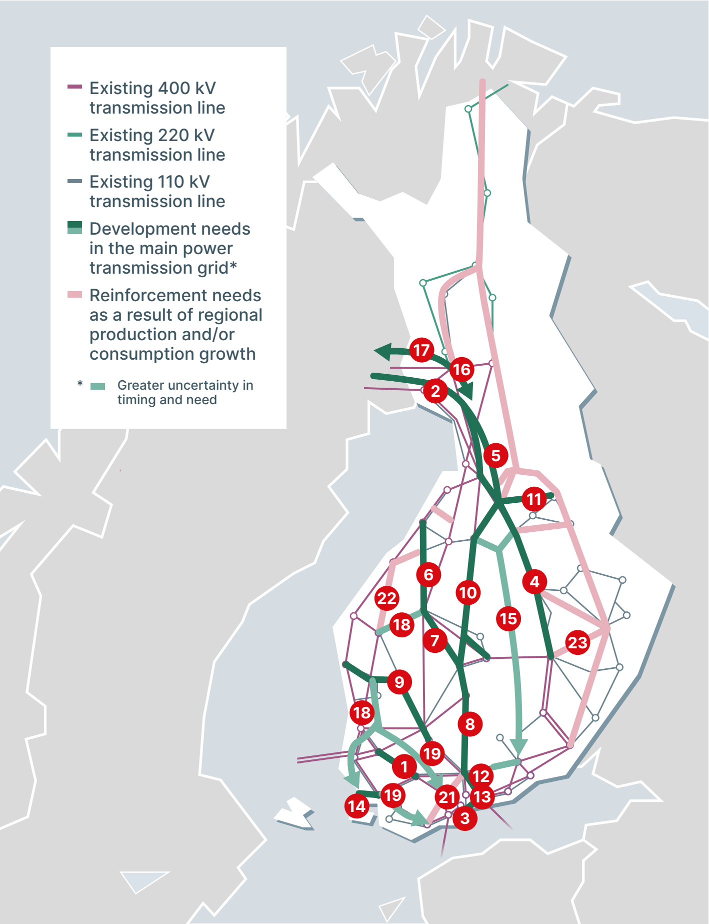
advantageous to generate heat mainly with electricity.

In parallel with the electrification of heating, the number of connection enquiries for new electricity-intensive industrial projects has multiplied. About half of these enquiries are for data centres, ranging in size from ten megawatts to thousands of megawatts. There are projects all over Finland, but the focus is mainly on southern Finland. This contributes to the pressure to strengthen the links between consumption and production facilities. Uncertainties about the location of new production and consumption facilities and the huge number of projects increase the uncertainty in assessing future development needs. The higher-growth scenario used as a basis for planning includes assumptions about the location of electricity production and consumption facilities. However, the need for grid development may be very different if consumption and production double but their locations differ from the assumptions in the scenario. Regular updates to the consumption and production forecasts aim to identify the most likely implementation sequence and clarify the need to proceed with planning and permit applications for the required system reinforcements. The grid projects will only proceed to implementation as the needs are realised and as production and consumption projects progress.

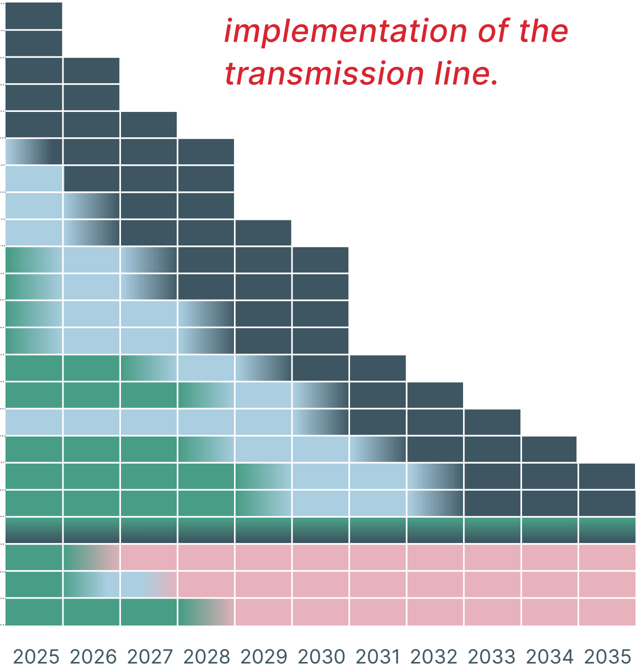
In addition to industrial-scale projects, grid planning is challenged by grid energy storage systems ranging from 5 to 125 megawatts, which can be as large as the electricity consumption of a city. Fluctuating renewable electricity production requires parallel grid energy storage systems that balance fluctuations in consumption and production through the electricity and reserve markets. A major challenge is the concentration of grid energy storage facilities in areas where there is already a shortage of connection capacity for consumption. When a grid energy storage system is connected in a consumption-heavy area, the system can reserve the entire connection capacity and increase the need for system-level transmission cuts. At present, the risk is that much of the connection capacity for consumption will be reserved for grid energy storage systems, which can be implemented quickly, thereby taking capacity away from longer-term electrification projects in green transition industries and other businesses. The location of a grid energy storage facility is not of great importance for its own business, so it would make sense to connect them in appropriate locations in the electricity system. In production-heavy areas, grid energy storage facilities increase the efficiency of network utilisation and reduce the need for investment, compared to a situation in which grid energy storage facilities are connected in consumption-heavy areas. In addition to grid energy storage, various other energy storage projects are planned, such as pumped storage power plants (Kemijoki Oy, Pohjolan Voima Oyj and Suomen Voima Oy).

Map 1 shows the grid development plan using different colour codes. The dark green reinforcements are under construction or their need has already been realised through investment decisions in consumption and production projects. The reinforcements to the main cross-sections marked in light green are needed to allow for the higher growth projections in this document, and there is more uncertainty about their implementation and timing. The 400 kV system reinforcements that will be needed as a result of regional production and/or consumption growth are indicated in pink. The need for these will be monitored, and as production and consumption projects in the region progress, a decision may also be taken on the implementation of the transmission line.

Much stronger north-to-south and west-to-east transmission links will be required to transmit this electricity to consumption centres in Southern Finland.

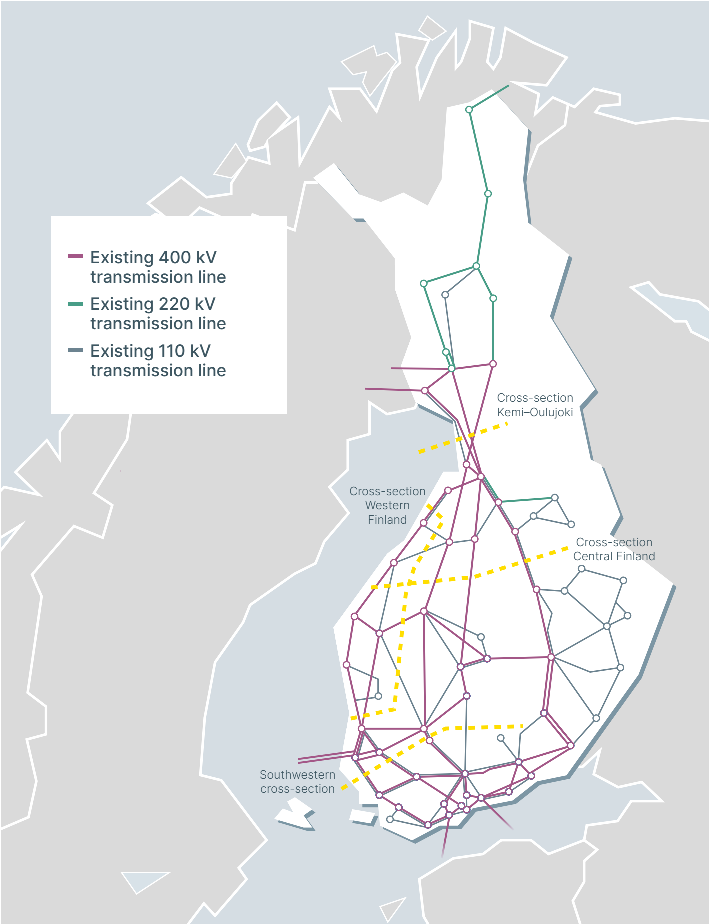


1	Huittinen–Forssa 400+110 kV transmission line
2	Aurora Line
3	Helsinki 400 kV cable link
4	Lake Line reinforcement
5	Herva–Nuojuankangas 400 kV transmission line
6	Jylkkä–Alajärvi 400+110 kV transmission line
7	Alajärvi–Toivila 400+110 kV transmission line
8	Toivila–Hikiä 400 kV
9	Kristiinankaupunki–Nokia 400+110 kV transmission line
10	Forest Line reinforcement
11	Nuojuankangas–Seitenoikea 400+110 kV transmission line
12	Hausjärvi–Anttila 400 kV -transmission line
13	Länsisalmi–Anttila 400 kV transmission line
14	Lieto–Raisio 400 kV transmission line
15	Ridge Line
16	Petäjäskoski–Herva 400 kV transmission line
17	Aurora Line 2
18	West coast reinforcements
19	Southwestern cross-section reinforcements
20	Compensation solutions
21	Hikiä–Inkoo 400 kV transmission line
22	Seinäjoki–Hirvisuo 400+110 kV transmission line
23	Huutokoski–Kontiolahti 400+110 kV transmission line



EIA procedure/preliminary planning
General planning and permit applications
Construction
General planning and construction if regional production/consumption increases

As the region's production and consumption projects progress, a decision may also be taken on the implementation of the transmission line.



The next chapter presents the development of the main grid's transmission capacity in more detail, broken down into cross-section reinforcements and other reinforcements. A system-level cross-section is an electrically defined transmission route consisting of several transmission lines that has been identified as a bottleneck in the power system. Such a cross-section is crossed by transmission lines of the main transmission lines, which determine the transmission capacity of the cross-section. If the demand for transmission momentarily exceeds the transmission capacity of the cross-section, transmission will have to be limited in order to maintain security of supply. The currently identified system-level cross-sections are located in northern Finland, central Finland, the west coast and southwest Finland. Increasing the transmission capacity at the identified cross-sections through line investments is one of the main ways to improve system-level transmission capacity and connectivity. In the future, as transmission needs change, it is possible that the number of cross-sections may also change.

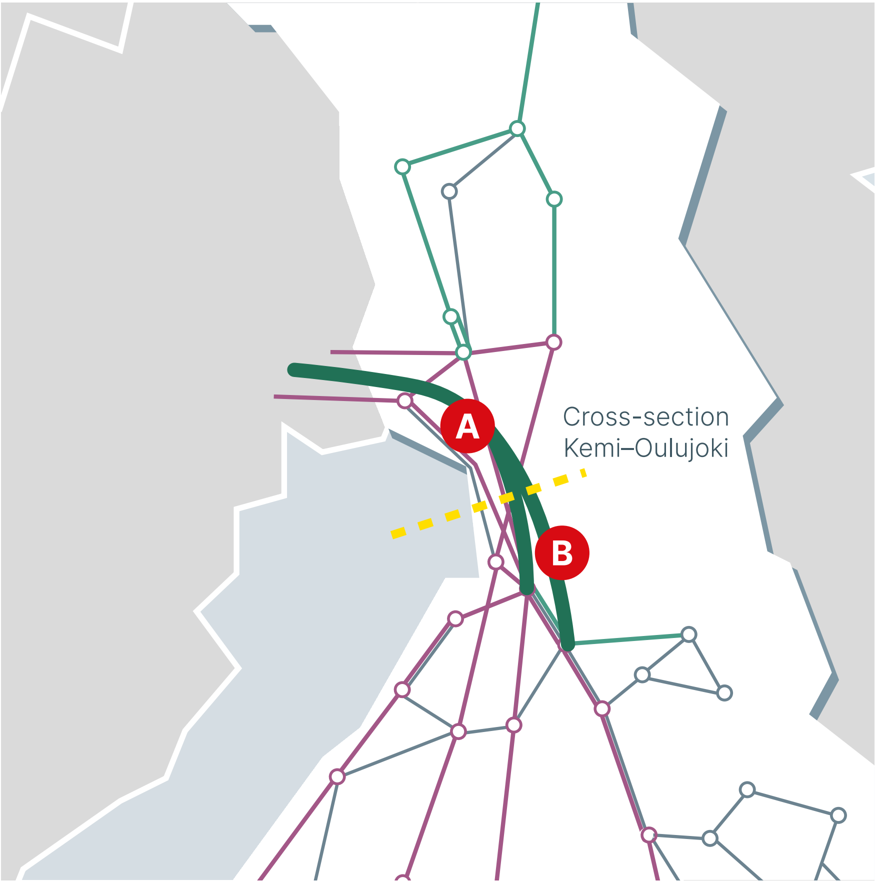
Increasing the transmission capacity at the identified cross-sections through line investments is one of the main ways to improve system-level transmission capacity and connectivity.

Cross-section Kemi–Oulujoki

Cross-section Kemi–Oulujoki divides Finland's northern region into areas north and south of the River Iijoki. Three 400 kV transmission lines currently run through the cross-section. The transfer needs of Cross-section Kemi–Oulujoki are affected by transmissions for the Swedish cross-border connection and the construction of wind power north of the River Iijoki, which has progressed more slowly than previously estimated.

Over the next ten years, Cross-section Kemi–Oulujoki will need to be reinforced with a total of two new transmission lines. One of these is the recently completed Aurora Line section from Viitajärvi to Pyhänselkä, and the other is the Herva–Nuojuankangas transmission line, which is under construction and will be completed in 2027.

	Confirmation	Schedule	Phase
A	Aurora Line	2025	Completed
B	Herva - Nuojuankangas	2027	Under construction



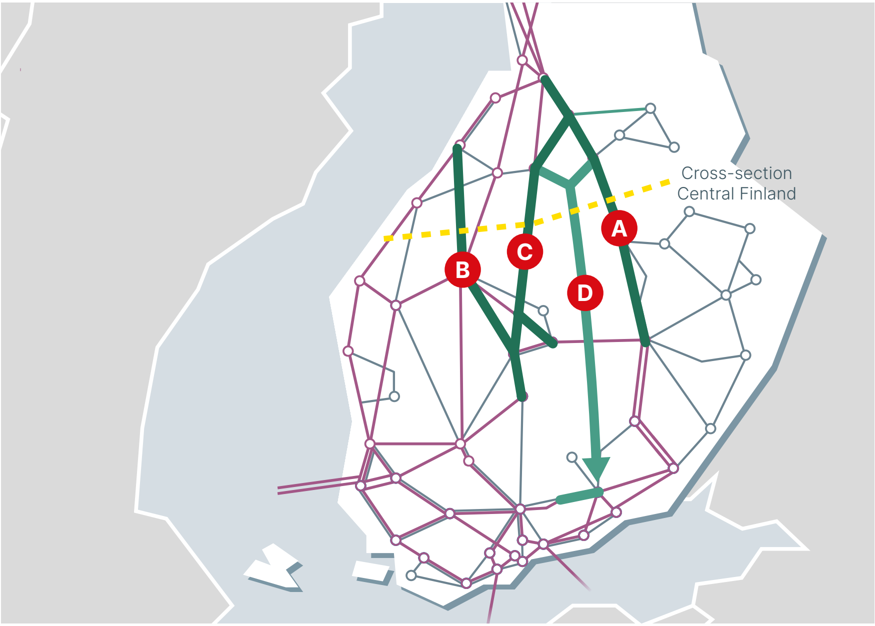
Cross-section Central Finland

Cross-section Central Finland goes from Kokkola via north Iisalmi to the east. The northern region is dominated by hydro-electric and wind power, and there is a surplus of produced electricity. The southern region has a deficit due to the high volumes of consumption. The vast majority of electricity exports to Sweden and Estonia take place via the cross-border connections in the south. Five 400 kV transmission lines run through the cross-section in four different transmission corridors: the Coastal Line, the River Line, the Forest Line and the Lake Line.

In Fingrid's forecast for the higher scenario, an average of more than 2,000 MW of wind power per year is expected to be built over the next 10 years. Much of this wind power is located on the west coast, in the Sea Lapland region, in Northern Ostrobothnia and in Kainuu. Electricity consumption and its future growth will be concentrated in Southern Finland, so the main grid will need more transmission capacity between the production and consumption areas. It should also be noted that most of the electricity imports cross the border in the north.

One constraint on the transmission capacity of Cross-section Central Finland is the management of the network voltage south of the cross-section. Therefore, in addition to the construction of transmission lines, the transmission capacity can also be increased by shunt compensation to increase voltage support as a fast, cost-effective and environmentally friendly solution. Over the coming ten years, shunt compensation will be implemented at several substations by adding capacitors at the 20 kV and 400 kV voltage levels.

Based on the forecasts, Cross-section Central Finland will need to be reinforced with a total of six new transmission lines over the next ten years. Three of these are already under construction and three are still in the planning and permit application phase. The progress of planned projects to the implementation phase depends on the realisation of production and consumption projects.



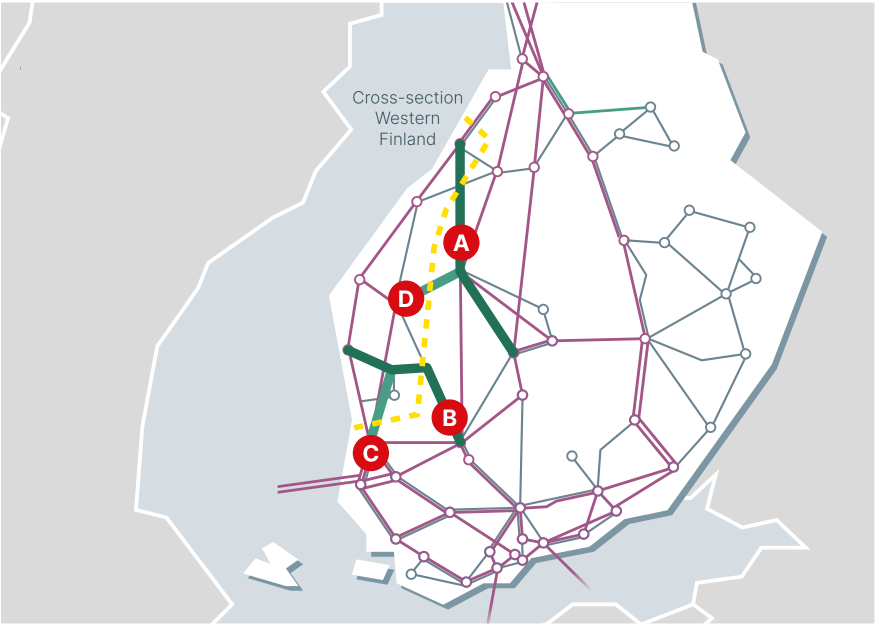
	Confirmation	Schedule	Phase
A	Lake Line 2	2026	Under construction
B	Lowlands Line (2 lines)	2027-2028	Under construction
C	Forest Line 2	2030	Planning/Permit applications
D	Ridge Line (2 lines)	2032	Planning/Permit applications

Cross-section Western Finland

The number of wind and solar power plants has increased markedly in recent years. Growth has been fastest on the west coast. Power park modules, such as wind and solar power plants, lack the natural properties of synchronous machines to resist voltage and frequency changes. Based on international experience and Fingrid's observations, plants with inverter technology can become unstable if their share of total production becomes regionally large. In the worst case, the instability could lead to a major disturbance in the power system. Fingrid is working closely with its connecting parties to seek solutions. As a result of development work, Fingrid has updated its grid code specifications for grid energy storage systems. Solving these problems will require changes to the control systems of power plants and investments in the grid. These investments include 400 kV network reinforcements in the region, as well as the Jylkkä synchronous compensator and the Kristinestad STATCOM, which are under construction.

Several large-scale electricity production projects and electricity-intensive industrial projects are planned on the west coast. If these projects are implemented on a large scale, new 400 kV transmission lines will be needed on the west coast to reinforce Cross-section Western Finland. The four existing transmission lines in Cross-section West Finland do not have enough capacity to transmit all the energy to be produced by the projects that are planned and under construction on the west coast, away from the surplus area. Connecting new consumption facilities in the area also requires the development of the grid, as there must be sufficient capacity to bring in the electricity from outside the area during windless periods.

Over the next ten years, Cross-section Western Finland will need to be reinforced with a total of five new transmission lines, based on forecasts. Three of these are already under construction, one is in the planning/permit application phase, and two are in the planning phase. The progress of planned projects to the implementation phase depends on the realisation of production and consumption projects.



	Confirmation	Schedule	Phase
A	Lowlands Line (2 lines)	2028	Under construction
B	Kristiinankaupunki - Nokia	2029	Planning/Permit applications
C	Honkajoki - Ulvila	2033	Need
D	Seinäjoki - Alajärvi	2035	Need

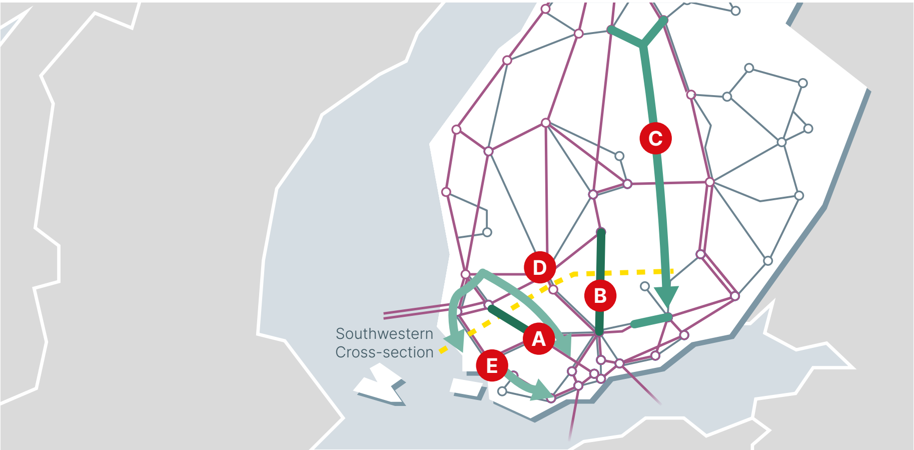
Southwestern Cross-section

The replacement of heat production based on fossil fuels and other combustion with electric boilers and heat pumps, and the concentration of renewable electricity production on the west coast, have rapidly increased the transmission needs of the grid in southern Finland. In addition, the discontinuation of the transmission connections to Russia in 2022 and the start-up of the Olkiluoto 3 nuclear power plant in 2023 have contributed significantly to the transmission of electricity in the main grid. As a result of these changes, the transmission needs in the grid have shifted from the east–west direction to being heavily weighted towards the west. Changes in transmission needs have led to the emergence of a new cross-section constraining the transmission capacity in Southern Finland. Three 400 kV transmission lines currently run through the cross-section. The Southwestern Cross-section, defined in 2023, will be the most significant bottleneck for the growth of electricity consumption in Southern Finland in the coming years.

The scarcity of transmission capacity has been reflected in low voltages in the 400 kV grid in the early 2020s and a sharp increase in transmissions on 400 kV lines. This scarcity of transmission capacity is not only affected by the increase in electricity consumption due to electric boilers, for example, but also by the reduction in local power production. Closing down local power production increases the need for transmission to Southern Finland and weakens voltage support in the region.

The voltage problem is solved with shunt capacitors, which are a quick and cost-effective solution to increase voltage support. Shunt capacitors have been and will be added to several substations at the 20 kV and 400 kV voltage levels over the coming ten years. In addition, adjustable voltage support will be added to the Anttila substation using a STATCOM installation.

Over the next ten years, the cross-section will need to be reinforced with a total of eight new transmission lines, according to forecasts. Of these, one was completed this autumn, four are in the planning/permit application phase, and three are in the planning phase. The progress of planned projects to the implementation phase depends on the realisation of production and consumption projects.



	Confirmation	Schedule	Phase
A	Huittinen - Forssa	2025	Completed
B	Toivila - Hikiä (2 lines)	2028	Planning/Permit applications
C	Ridge Line (2 lines)	2032	Planning/Permit applications
D	Kangasala - Lavianvuori reinforcement	2033	Need
E	Ulvila - Helsinki metropolitan area (2 lines)	2035	Need

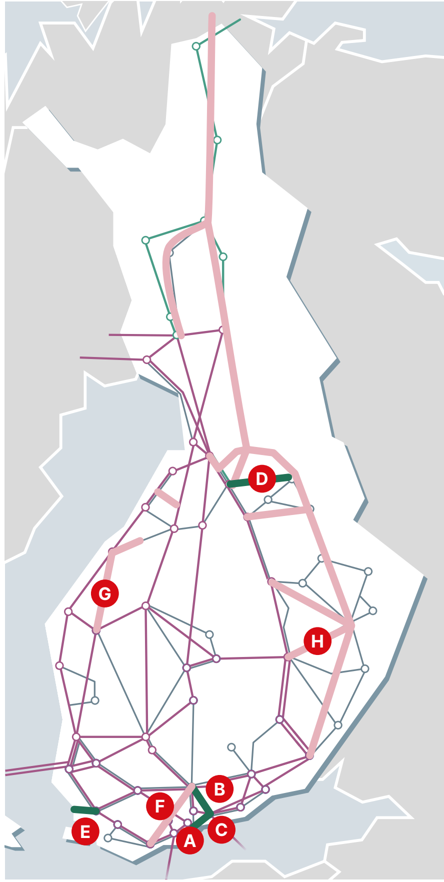
Other main grid reinforcements

Fingrid also plans to develop the 400 kV grid in addition to reinforcing the four cross-sections described above. Fingrid monitors trends in production and consumption projects throughout Finland. Numerous 400 kV system reinforcements will be needed as a result of regional production and/or consumption growth. Uncertainty about the location, volume and sequence of new production and consumption causes challenges in identifying the right investments. Potential needs will be promoted in stages, with Fingrid ensuring the development of the grid as quickly as possible when customer needs materialise. Initially, the identified transmission line needs will be incorporated into regional land use plans as connection needs. As customer projects progress, more in-depth design, an environmental impact assessment, and the permit application process will begin in stages, followed by construction as customer projects advance towards completion.

The development needs of the main grid, shown in dark green on the map below, have already been realised through investment decisions in production and consumption projects. The identified alternative development needs are shown in pink on the map.

The following sections outline the potential development and refurbishment needs, grouped into four areas.

	Confirmation	Schedule	Phase
A	The Helsinki cable	2026	Under construction
B	Hikiä - Anttila	2030	Planning/Permit applications
C	Anttila - Länsisalmi	2030	Planning/Permit applications
D	Nuojuankangas - Seitenjärvi	2030	Planning/Permit applications
E	Lieto - Raisio	2031	Planning/Permit applications
F	Inkoo - Hikiä		Planning
G	Seinäjoki - Hirvisuo		Planning
H	Huutokoski - Kontiolahti		Planning



Southern Finland

The Southern Finland area is energy-intensive – approximately two-thirds of Finland's electricity consumption is located south of Tampere. Electricity consumption is mainly concentrated in urban areas. The electricity deficits of urban areas have increased and will increase significantly as the production of heat at combustion plants is increasingly replaced by solutions such as electric boilers, further emphasising the need for strong and reliable electric transmission connections. The electrification of heating has created the need to strengthen regional transmission links.

In the Helsinki metropolitan area, electricity consumption is increasing and electricity production is declining significantly. To safeguard the supply of electricity for functions important to society and residents in the region, Fingrid is building a 400 kV cable link from the Länsisalmi substation to the Vanhakaupunki substation. The Helsinki cable will be completed in 2026.

In addition, a new 400 kV transmission line will be built from Hikiä to Anttila substation and onwards to Länsisalmi substation in 2030 to serve the rapidly growing electricity consumption in the Uusimaa region. Between Hikiä and Anttila, preparations are being made to build the connection with two circuits.

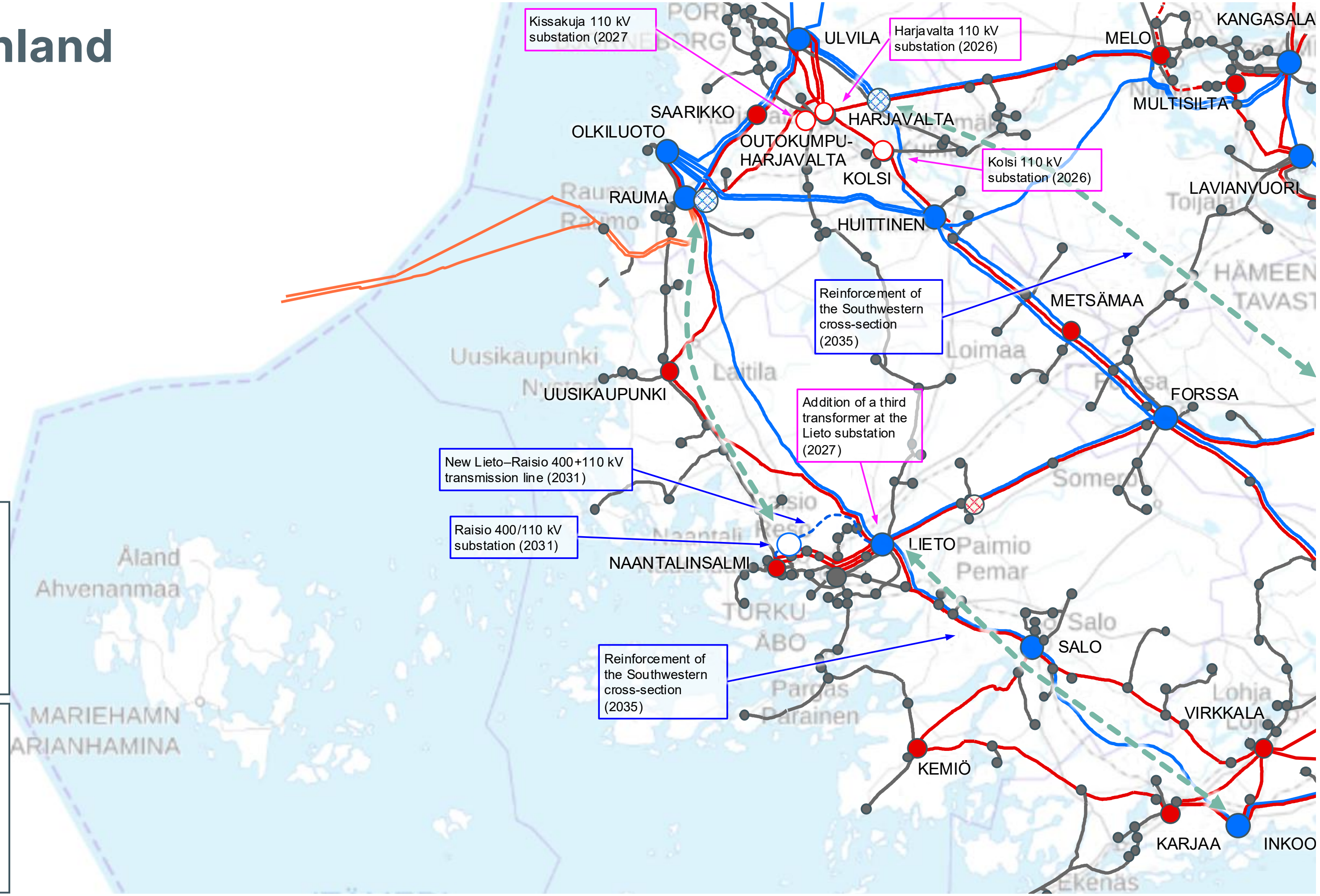
Electricity consumption in Southwest Finland will increase in the future as a result of the electrification of heating and new electricity-intensive industrial projects. To facilitate the projects, a new 400 kV transmission line is planned from the Lieto substation to a new substation in Raisio, which is scheduled for completion in 2031. In the longer term, this transmission line is likely to be part of a link reinforcing the Southwestern Cross-section towards Rauma.

The future 400 kV development needs in the area will depend on the location and scheduling of planned large-scale industrial projects. In addition to new projects, existing industrial plants are also switching to electricity. The environmental impact assessment of the Hikiä–Ingå 400 kV transmission line is underway, and Fingrid is preparing for the potential need for development in response to increased consumption in Western Uusimaa.

The following map illustrates the regional development plans for Southern Finland in more depth.

The timetables are preliminary and will become more accurate as the date of implementation draws closer.

Southwest Finland



- 400 kV main grid transmission line
- 220 kV main grid transmission line
- 110 kV main grid transmission line
- Need for development of the 400 kV main grid
- Potential need for development of the 400 kV main grid
- * The investment schedule depends on the schedules of customer projects

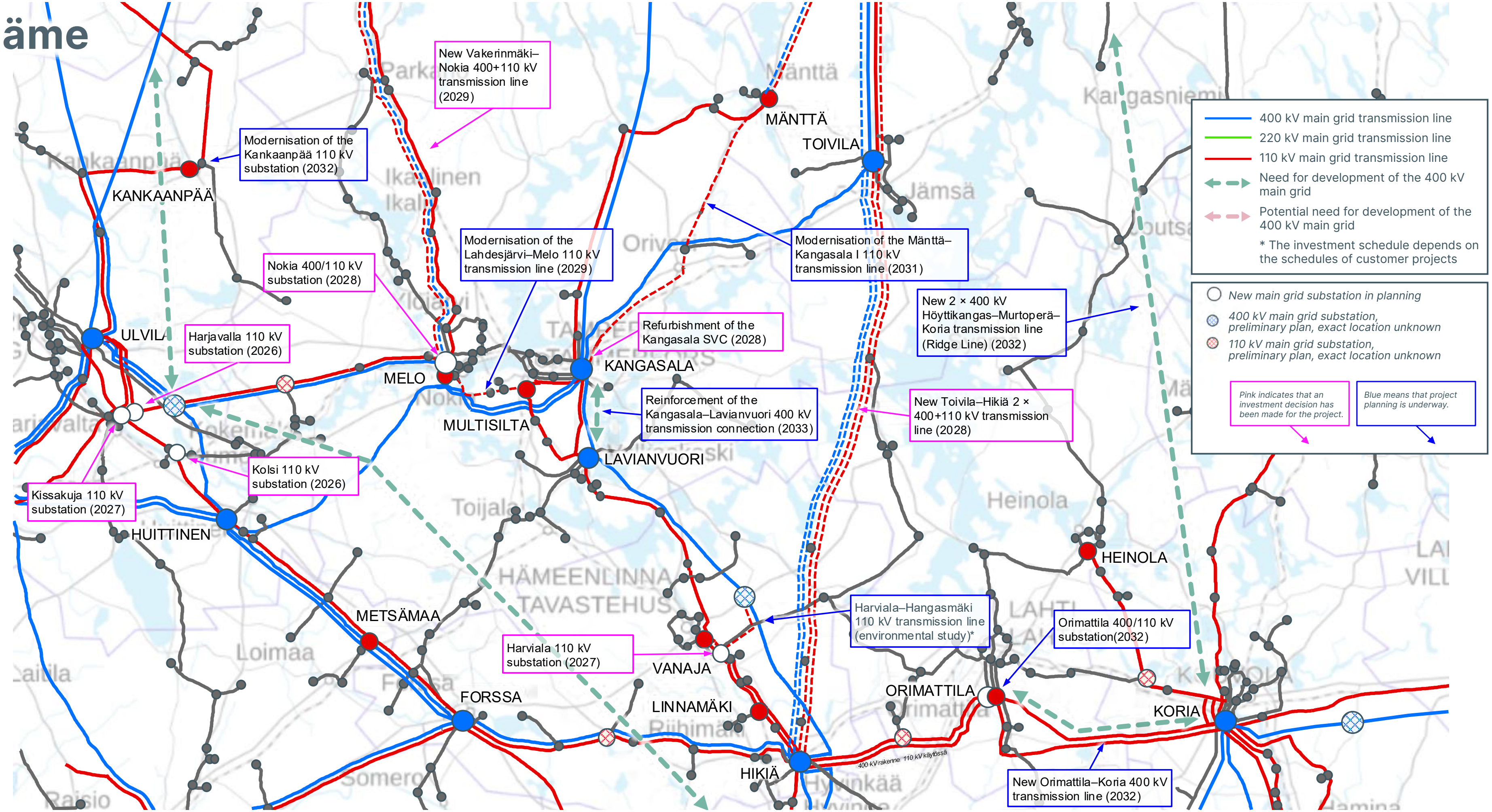
- *New main grid substation in planning*
- *400 kV main grid substation, preliminary plan, exact location unknown*
- *110 kV main grid substation, preliminary plan, exact location unknown*

Pink indicates that an investment decision has been made for the project.

Blue means that project planning is underway.

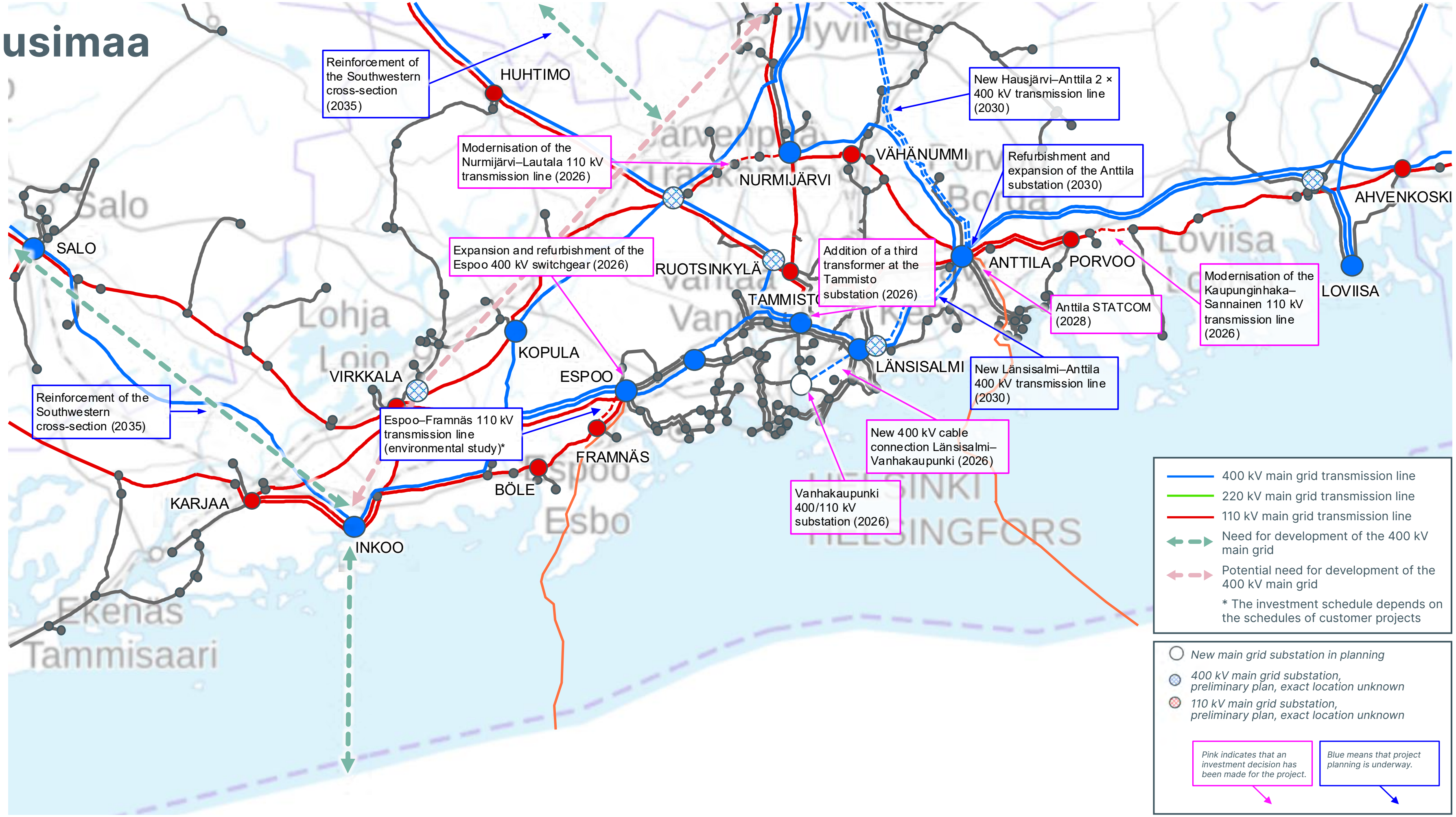
The timetables are preliminary and will become more accurate as the date of implementation draws closer.

Häme



The timetables are preliminary and will become more accurate as the date of implementation draws closer.

Uusimaa



Eastern Finland

The Eastern Finland region covers about one-third of Finland's territory. One of the five 400 kV transmission lines on the north–south axis runs through the region from Kainuu via Savo to Southeast Finland. In addition, the main grid in Eastern Finland is mainly a 110 kV meshed grid, which has been and will continue to be developed. The grid is being developed based on the current maintenance needs in anticipation of future capacity needs. Depending on the area, new consumption and/or production can currently be added to the Eastern Finland region, ranging from tens of megawatts to hundreds of megawatts. In total, Eastern Finland can accommodate at least 1,000 MW of distributed consumption.

The first 400 kV reinforcement will come online in 2030: a new 400+110 kV transmission line will be built from the Nuojuankangas substation to the new Seitenjärvi substation to replace the existing 220 kV transmission line, which is reaching the end of its service life. This will increase the grid's connection capacity, allowing electricity production to be connected in the region.

Eastern Finland's geography enables a significant amount of new wind power production to be built. The wind power potential can be realised if the means can be found to reconcile the needs of radar monitoring and wind power construction. As the potential is converted on a large scale into tangible projects, the 400 kV grid in the region will need to be developed. The permit application process for wind power generation takes time, so it can be well coordinated with the grid reinforcement schedule. The need may also be triggered if large-scale consumption projects in the region advance towards implementation.

Grid development solutions are planned in cooperation with the actors in the region. Fingrid has prepared for the development of the 400 kV grid from Kainuu to South Karelia with many connection needs in land use planning. In autumn 2024, Fingrid worked with the distribution system operators in Eastern Finland to compile a separate network development proposal for Eastern Finland.

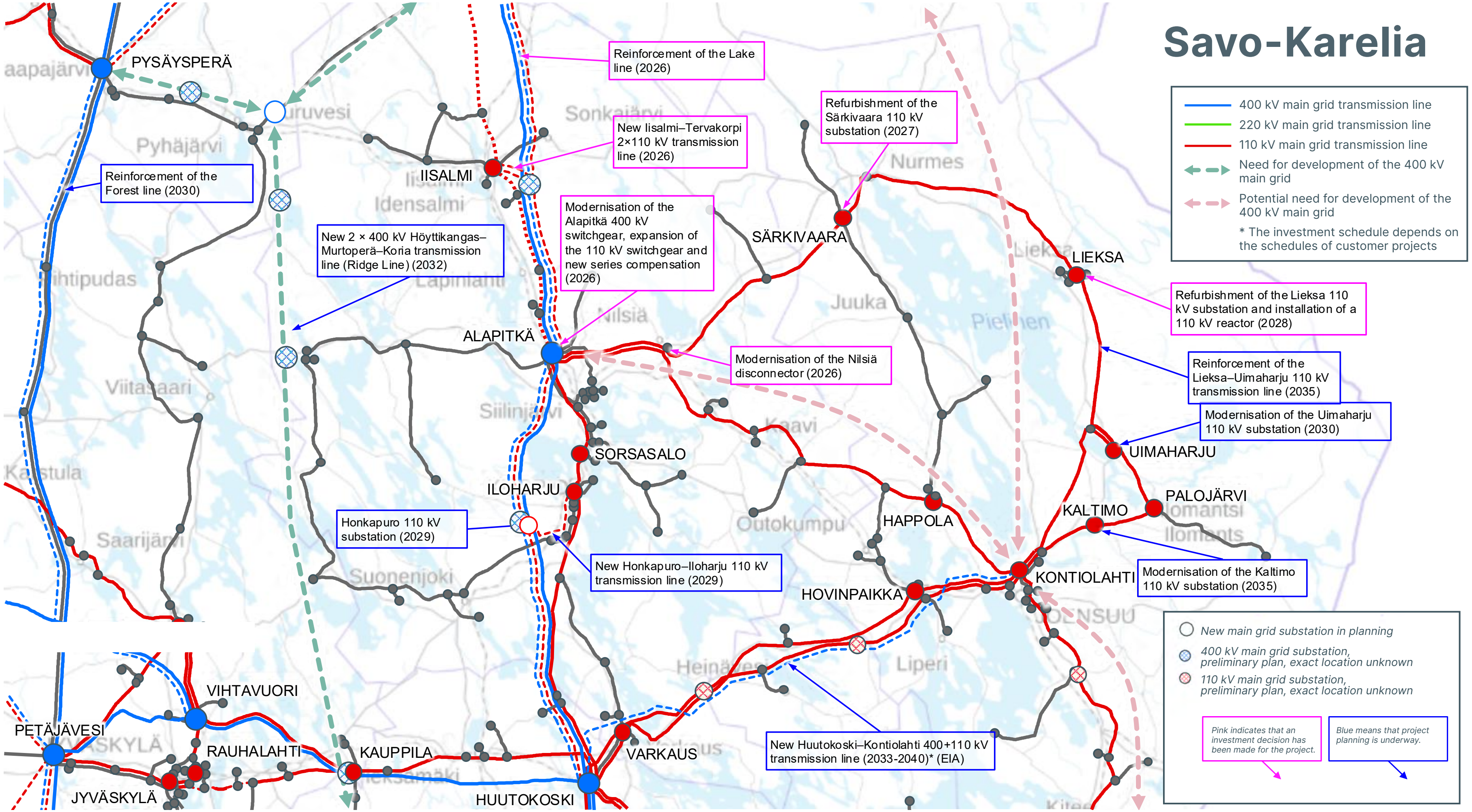
As a result of the cooperation, Fingrid has launched an environmental impact assessment of the 400 kV Huutokoski–Kontionlahti connection. By doing this, Fingrid ensures the development of the grid in case customer needs arise at short notice. Fingrid is actively monitoring the development of projects in Eastern Finland and is preparing to initiate the necessary 400 kV network reinforcements as customer projects progress.

The following map illustrates the regional development plans for Eastern Finland in more depth.

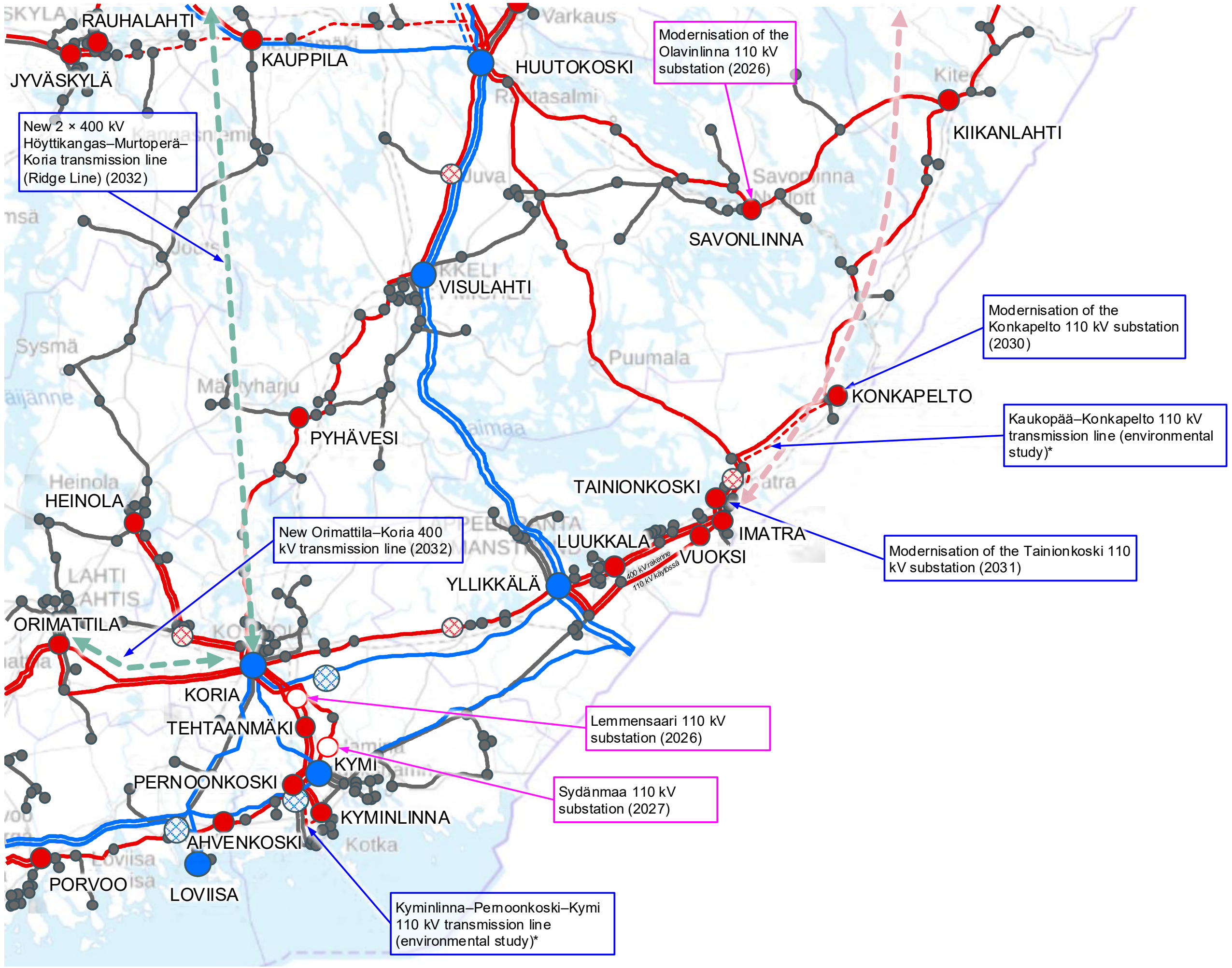
Potential needs will be promoted in stages, with Fingrid ensuring the development of the grid as quickly as possible when customer needs materialise.

The timetables are preliminary and will become more accurate as the date of implementation draws closer.

Savo-Karelia



The timetables are preliminary and will become more accurate as the date of implementation draws closer.



Southeast Finland

- 400 kV main grid transmission line
- 220 kV main grid transmission line
- 110 kV main grid transmission line
- Need for development of the 400 kV main grid
- Potential need for development of the 400 kV main grid
- * The investment schedule depends on the schedules of customer projects

- *New main grid substation in planning*
- *400 kV main grid substation, preliminary plan, exact location unknown*
- *110 kV main grid substation, preliminary plan, exact location unknown*

Pink indicates that an investment decision has been made for the project.

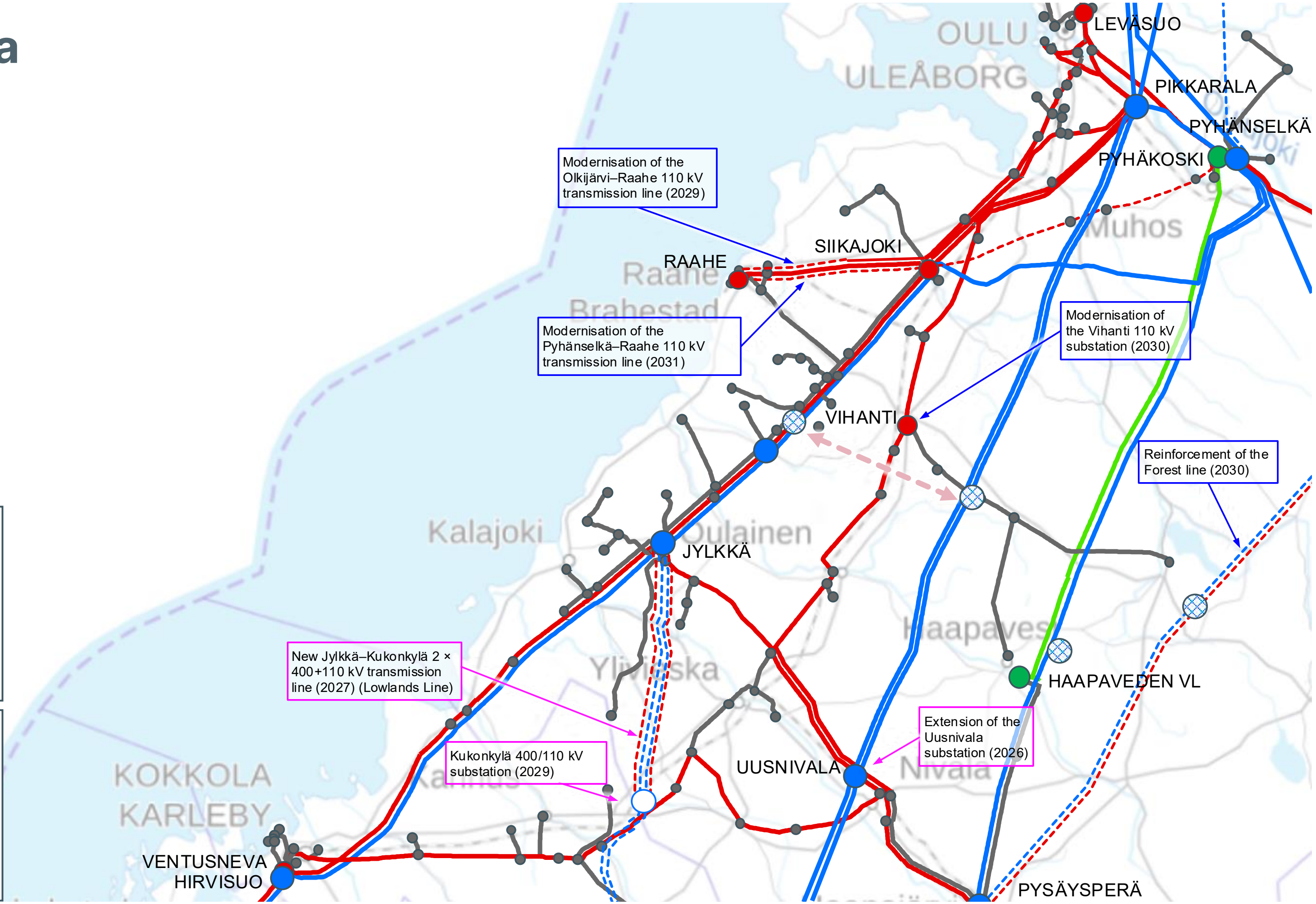
Blue means that project planning is underway.

Western Finland
The Western Finland planning area contains most of the completed onshore wind projects. In addition to the onshore wind potential, large-scale offshore wind farms are planned for the region, which, if realised, could trigger regional 400 kV reinforcement needs. Large-scale consumption projects are also planned for the area. The large-scale implementation of consumption projects may also result in the need to reinforce the grid in order to maintain system security during windless periods, when electricity would need to be imported from other parts of Finland.

The future 400 kV development needs in the area will depend on the location and scheduling of planned large-scale industrial and electricity production projects. The environmental impact assessment of the Hirvisuo–Seinäjoki 400 kV transmission line is ongoing, and Fingrid is preparing for possible development needs arising from production and consumption projects in the area.

The following map illustrates the regional development plans for Western Finland in more depth.

Raahe-Kokkola



- 400 kV main grid transmission line
- 220 kV main grid transmission line
- 110 kV main grid transmission line
- Need for development of the 400 kV main grid
- Potential need for development of the 400 kV main grid
- * The investment schedule depends on the schedules of customer projects

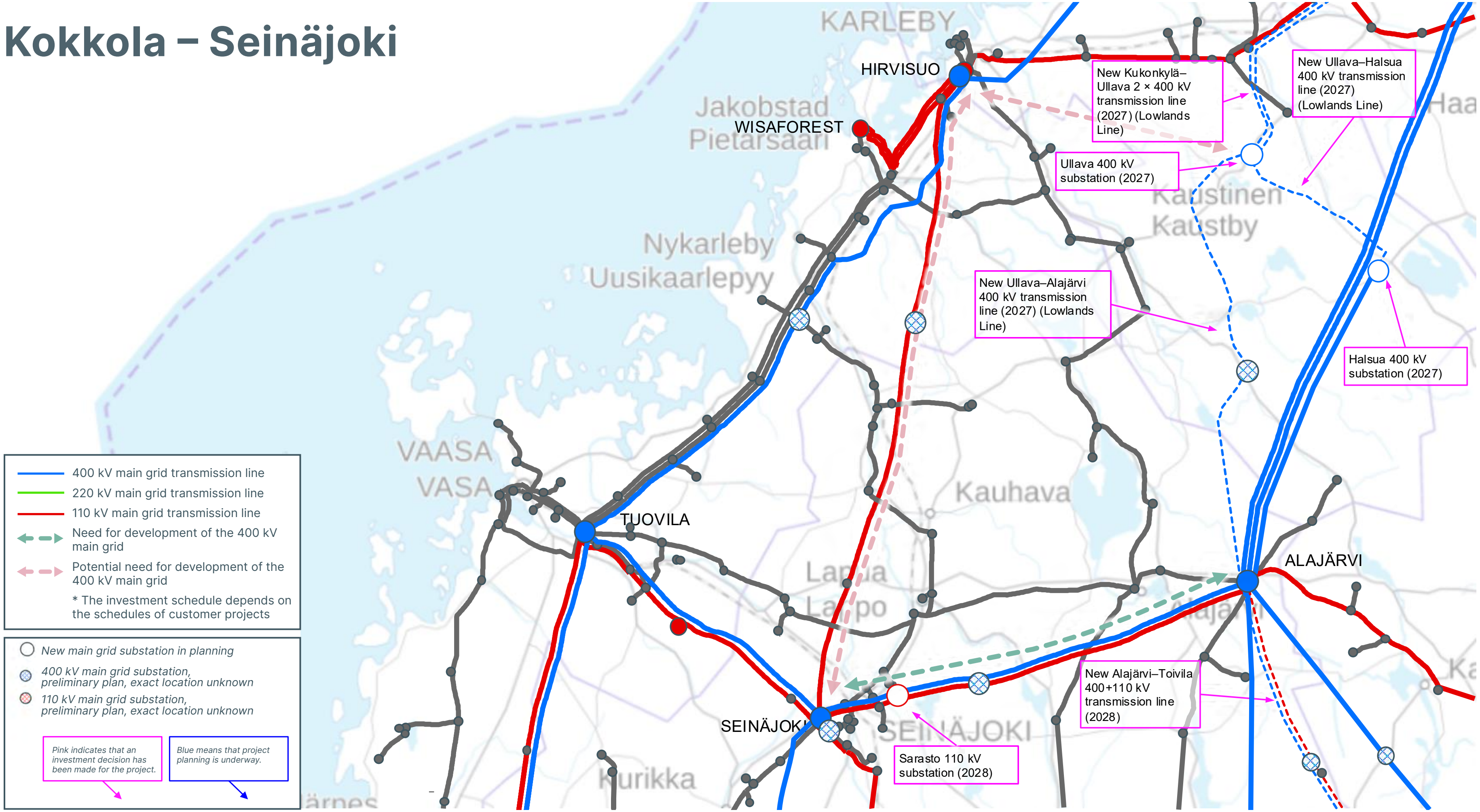
- *New main grid substation in planning*
- *400 kV main grid substation, preliminary plan, exact location unknown*
- *110 kV main grid substation, preliminary plan, exact location unknown*

Pink indicates that an investment decision has been made for the project.

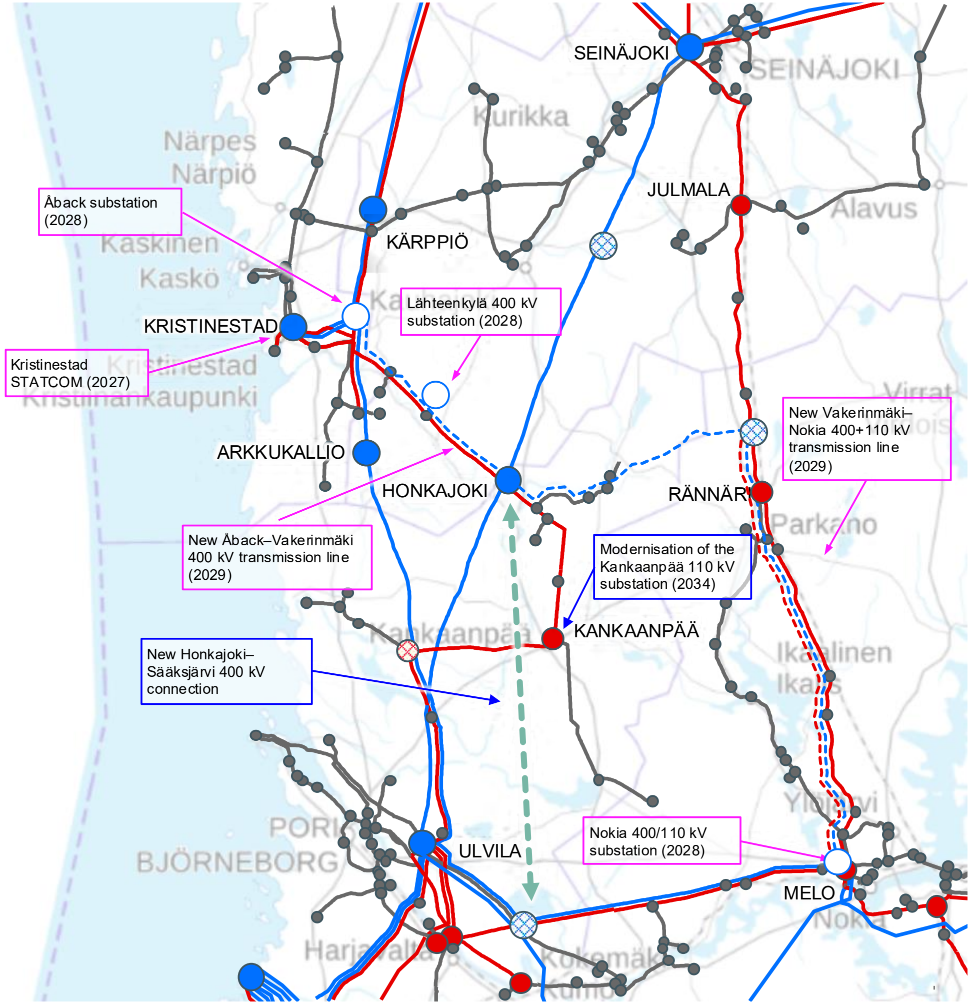
Blue means that project planning is underway.

The timetables are preliminary and will become more accurate as the date of implementation draws closer.

Kokkola – Seinäjoki



Seinäjoki – Pori



- 400 kV main grid transmission line
- 220 kV main grid transmission line
- 110 kV main grid transmission line
- Need for development of the 400 kV main grid
- Potential need for development of the 400 kV main grid

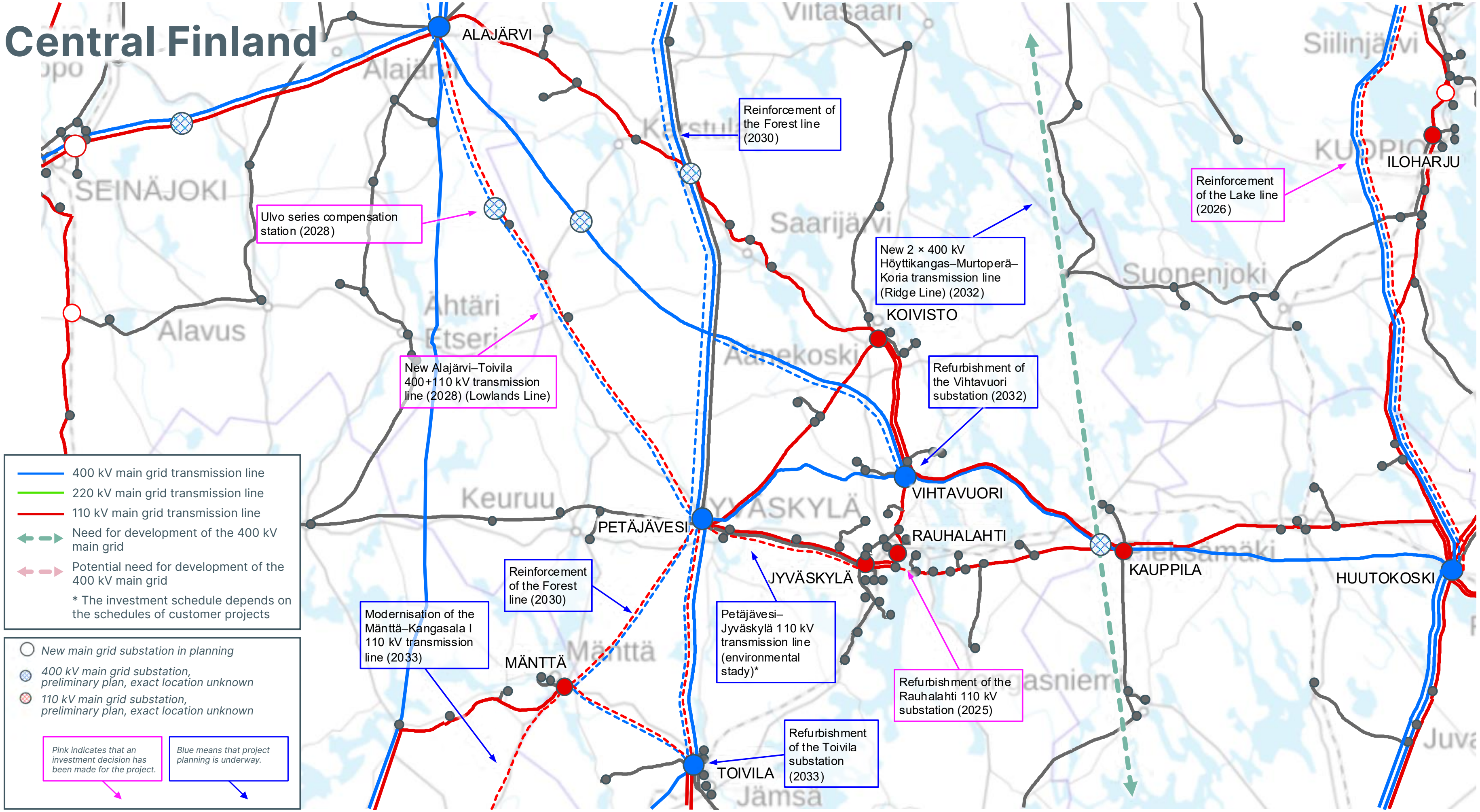
* The investment schedule depends on the schedules of customer projects

- *New main grid substation in planning*
- *400 kV main grid substation, preliminary plan, exact location unknown*
- *110 kV main grid substation, preliminary plan, exact location unknown*

Pink indicates that an investment decision has been made for the project.

Blue means that project planning is underway.

The timetables are preliminary and will become more accurate as the date of implementation draws closer.



Northern Finland

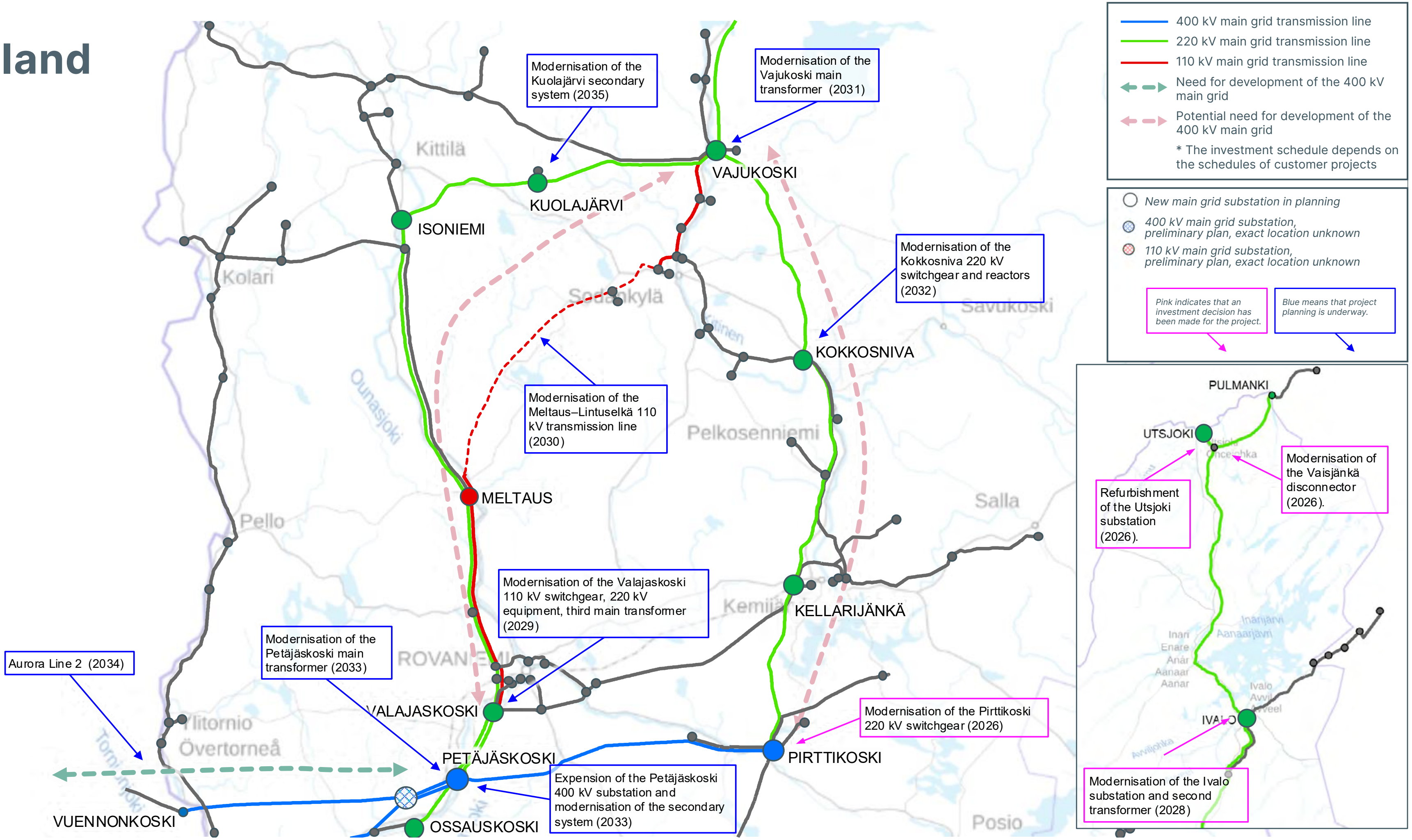
The Northern Finland region covers about one-third of Finland's territory. The region has long transmission distances, and production and consumption are highly dispersed. The 400 kV grid in the region reaches up to Rovaniemi, and a 220 kV solution is used further north.

Northern Finland is characterised by a high production volume, strong onshore wind potential and several pumped-storage projects. The wind power potential can be realised if the means can be found to reconcile the needs of radar monitoring and wind power construction. The planned pumped-storage power plants (Kemijoki Oy (Kemijoki PSH), Pohjolan Voima (PUHTI PSH) Oyj and Suomen Voima Oy (NOSTE PSH)) are in the Kemijärvi area and, if implemented, the projects will be connected to the Pirttikoski substation. Large-scale consumption projects are also planned in the area, including data centres, with a particular focus on the southern part of the region. To enable the large-scale implementation of the projects, Fingrid has proposed several 400 kV connection needs for the regional planning process. These will allow for the regional capacity to be increased with new 400 kV connections if necessary. Fingrid is actively monitoring the development of projects in Northern Finland and is preparing to initiate the necessary 400 kV network reinforcements as customer projects progress.

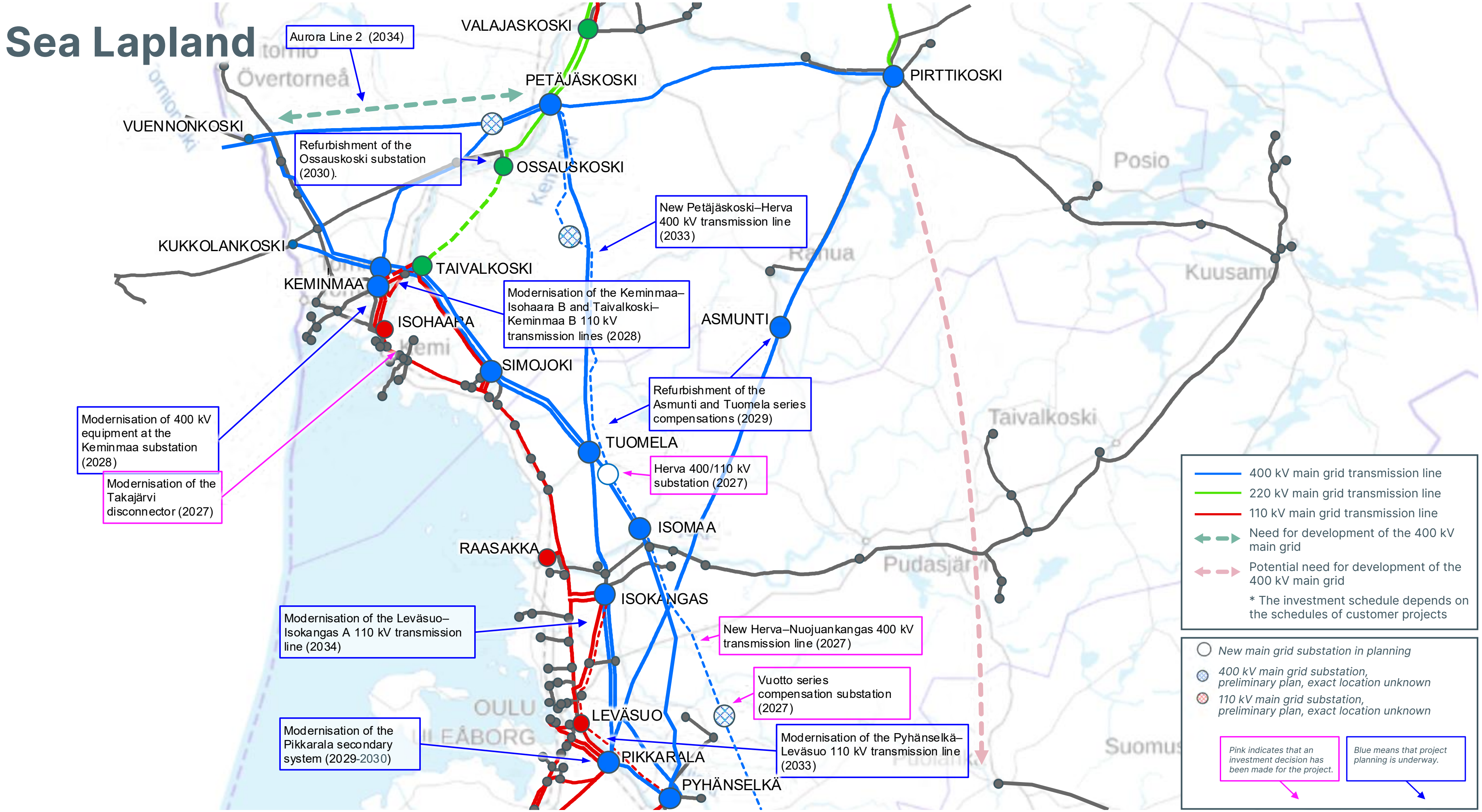
The following map illustrates the regional development plans for Northern Finland in more depth.

Fingrid monitors trends in production and consumption projects throughout Finland.

Lapland

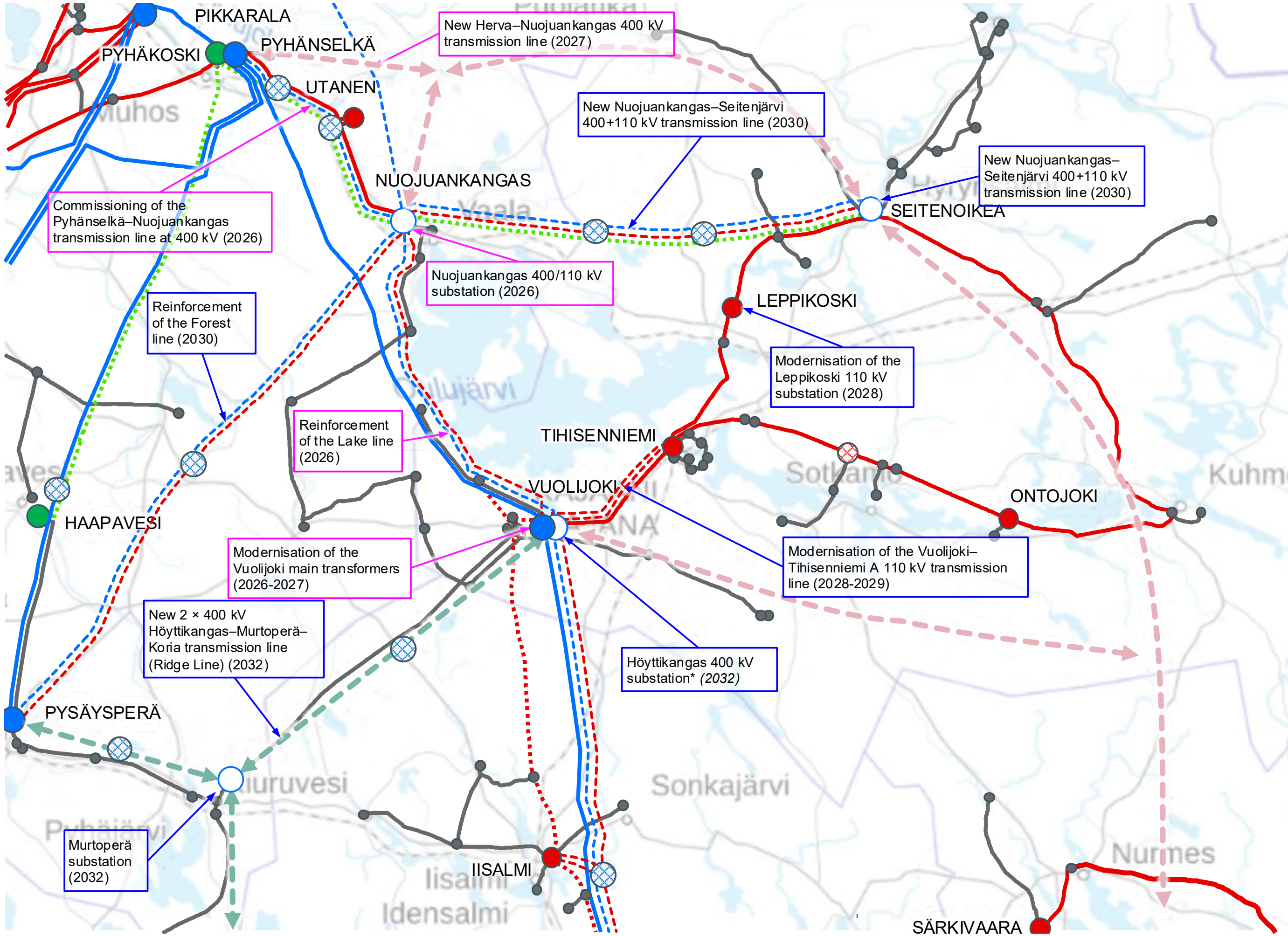

400 kV main grid transmission line
220 kV main grid transmission line
110 kV main grid transmission line
Need for development of the 400 kV main grid
Potential need for development of the 400 kV main grid
* The investment schedule depends on the schedules of customer projects
New main grid substation in planning
400 kV main grid substation, preliminary plan, exact location unknown
110 kV main grid substation, preliminary plan, exact location unknown
Pink indicates that an investment decision has been made for the project.
Blue means that project planning is underway.
Modernisation of the Kuolajärvi secondary system (2035)
Modernisation of the Vajukoski main transformer (2031)
Modernisation of the Kokkosniva 220 kV switchgear and reactors (2032)
Modernisation of the Meltaus–Lintuselkä 110 kV transmission line (2030)
Modernisation of the Valajaskoski 110 kV switchgear, 220 kV equipment, third main transformer (2029)
Modernisation of the Petäjäskoski main transformer (2033)
Aurora Line 2 (2034)
Expansion of the Petäjäskoski 400 kV substation and modernisation of the secondary system (2033)
Modernisation of the Pirttikoski 220 kV switchgear (2026)
VAJUKOSKI
KUOLAJÄRVI
ISONIEMI
KOKKOSNIVA
MELTAUS
KELLARIJÄNKÄ
VALAJASKOSKI
PETÄJÄSKOSKI
PIRTTIKOSKI
OSSAUSKOSKI
VUENNONKOSKI
Kittilä
Kolari
Sodankylä
Savukoski
Pelkosenniemi
Pello
Salla
Kemijärvi
ROVANIEMI
Ylitornio
Övertorneå
Posio
Ounasjoki
PULMANKI
UTSJOKI
IVALO
Refurbishment of the Utsjoki substation (2026).
Modernisation of the Vaisjänkä disconnector (2026).
Modernisation of the Ivalo substation and second transformer (2028)
Inari
Enare
Anár
Aanaar

The timetables are preliminary and will become more accurate as the date of implementation draws closer.



The timetables are preliminary and will become more accurate as the date of implementation draws closer.

Kainuu



400 kV main grid transmission line
220 kV main grid transmission line
110 kV main grid transmission line
Need for development of the 400 kV main grid
Potential need for development of the 400 kV main grid
* The investment schedule depends on the schedules of customer projects

New main grid substation in planning
400 kV main grid substation, preliminary plan, exact location unknown
110 kV main grid substation, preliminary plan, exact location unknown

Pink indicates that an investment decision has been made for the project.
Blue means that project planning is underway.

Solutions to boost the transmission capacity and stability of the grid

With the rapid energy transition, significant investments have been and will continue to be made in the grid. In parallel, the aim is to make the most efficient use of the existing network to connect customer projects without compromising system security.

Stability of an inverter-dominated system

Fingrid is developing and implementing new technical solutions to meet the challenges of a rapidly changing electricity system. The transmission capacity of the electricity grid will be put to the test, especially on the west coast, where wind power dominates. This is because the current types of inverter-connected power plants, such as wind and solar power plants, lack the natural ability of synchronous machines to resist voltage and frequency changes. The west coast had almost 5 GW of wind power in early 2025, and more is planned. During periods of high wind power production and, in particular, grid outages, the grid can become unstable in the region, and wind farms can be disconnected from the electricity system due to grid faults.

Fingrid is addressing the challenges of an inverter-dominated system by working with the industry and developing methods to ensure the reliable operation of the electricity system in Finland and elsewhere in the Nordic countries. One good example of the development work is the new grid energy storage system with grid-forming functionality, which supports inverter-dominated electricity production. As a result of the development work, Fingrid has updated its grid code specifications for power generating facilities and grid energy storage systems (VJV2024 and SJV2024). Connecting parties' installations are required to have certain technical capabilities, which are playing an increasingly crucial role in ensuring the stable and predictable operation of the future electricity system.

Over the next ten years, in addition to the construction of transmission lines, the necessary number of network stabilising devices, such as synchronous compensators and STATCOMs, will be added to the grid to stabilise the voltage and frequency in inverter-dominated areas. Currently, a synchronic compensator is already under construction for the Jylkkä substation and will be completed in 2025. A STATCOM is under construction for the Kristinestad substation and will be completed in 2027. The locations and schedules of the next installations will be determined on the basis of more detailed studies that are underway. This will be significantly influenced by the location of future wind and solar power and grid energy storage systems and the technical customer requirements applying to them.

Requirements for large consumption connections

The number of connection enquiries for large consumption facilities has increased enormously in recent years, so Fingrid has been studying their impact on the operation of the power system of Finland. In particular, the disconnection of loads during voltage dips and their recovery from disturbances can pose challenges for system security.

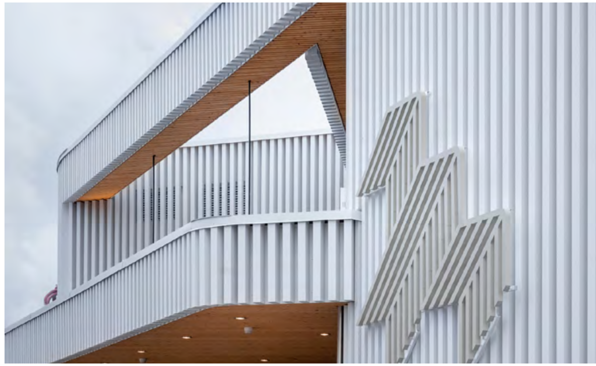
Fingrid will update the grid code specifications for demand connections in 2025. The specifications will enter into force in 2026 and will impose a number of new technical requirements for consumption connections. This will ensure the reliable and predictable operation of consumption facilities as part of an inverter-dominated electricity system.

The main grid's transmission capacity and voltage stability

In addition to new transmission lines, the transmission capacity of existing and future transmission lines can be increased through series and shunt compensation. Investments in series and shunt compensation, together with customer requirements for reactive power production and consumption, ensure that the necessary and predictable transmission capacity and voltage stability are maintained.

Series capacitors have been deployed in Finland's main grid as a cost-effective way of boosting the network's transmission capacity. The capacitors compensate for some of the inductive resistance of the lines. Series compensation can be considered to reduce the network's electrical length, thereby improving the damping of power fluctuations at power plants and voltage stability. Series compensation is used on the long 400 kV transmission links between Northern and Southern Finland and between Finland and Sweden.

Over long transmission distances, voltages also fall on the sections that do not



In parallel, the aim is to make the most efficient use of the existing network to connect customer projects without compromising system security.

have series compensation in central and southern Finland. The main grid below Cross-section Central Finland is highly meshed, and the line lengths are short, so series compensation is not technically feasible.

Electricity production from fossil fuels is declining significantly in Southern Finland. As traditional generation is phased out and electricity consumption increases, the grid's transmission needs will grow, so the 400 kV transmission lines supplying southern Finland will run at "very high loading" in high transmission situations. In this case, the lines consume considerable reactive power, which must be compensated for locally. At the same time, the reduction in conventional generation weakens the dynamic voltage support of the grid. If the grid does not have sufficient voltage support, voltage stability will deteriorate, and it will determine the transmission capacity.

In Southern Finland, the primary solution for static voltage support on the grid is to use 20 kV shunt capacitors connected to the tertiary of main transformers. An alternative solution is 400 kV shunt capacitors, if the local need for support is high and there are not enough suitable sites for 20 kV shunt capacitors.

In recent years, shunt compensation has been implemented at nine substations. Over the next two years, new shunt compensators will be completed at 13 substations. The need to increase shunt compensation will continue in the future. The implementation and sites of these compensation investments will depend on where consumption is focused, the evolution of transmission needs, and the realisation of new 400 kV connections.

Adding static compensation alone is not enough to improve voltage stability. Dynamic voltage support is required to manage rapid changes in the network.

Fingrid will implement a system to use real-time data on the current-carrying capacity of transmission lines.

Dynamic voltage support will be needed in Southern Finland by the end of the decade to ensure voltage quality and avoid excessive voltage fluctuations in various switching and disturbance situations. More dynamic voltage support will be provided with the construction of a STATCOM at the Anttila substation. Further investments to increase dynamic voltage support are being explored.

Using dynamic current-carrying capacity

The current-carrying capacity of overhead lines depends significantly on the prevailing environmental conditions. Typically, the current-carrying capacity of overhead lines is reported in low wind conditions at warm temperatures. In Finland, however, the weather is cooler and more windy for most of the year, which means that the current-carrying capacity is higher than this static load rating (SLR). The dynamic line rating (DLR) technique can be used to determine the real-time current-carrying capacity of a transmission line by taking into account environmental conditions such as the prevailing temperature and wind speed. By determining the real-time thermal load, the transmission capacity of transmission lines can be fully utilised.

To enable DLR, Fingrid will implement a system for determining and using the real-time current-carrying capacity on transmission lines. Future planning will also make greater use of DLR through statistical analysis.

Measures to be taken to ensure the transmission and connection capacity of the grid, in addition to grid investments

Other solutions are required alongside grid investments if the planned doubling of electricity consumption is to be possible and more customer projects are to be connected to the main grid. These may include steering the locations of projects and hybrid and flexible connections to ensure transmission and connection capacity. These could allow more customer projects to be connected and speed up the connection process.

Based on the production and consumption surveys received by Fingrid, the majority of production and consumption projects are located in different parts of the country, mostly far apart from each other. This will require significant reinforcements for the main grid. When production and consumption are closer to each other – perhaps even linked to the same connection point – more and faster connections can be enabled and transmission losses are lower.

At present, the challenge is that much of the connection capacity for consumption will be reserved for grid energy storage systems, which can be implemented quickly, thereby taking capacity away from electrification projects in green transition industries and other businesses that have a longer permit application process. From an overall perspective, it would make sense to locate grid energy storage facilities closer to electricity production than to areas where electricity-consumption investments are planned.

With flexible connections, the connecting party accepts occasional restrictions on transmission under pre-agreed conditions. Flexible connections could allow customers to be connected before network reinforcements are completed or even as a permanent solution, avoiding unnecessary network investments, as it is not essential to prepare for very unlikely combinations of faults and transmission situations.

Maintenance

Finland's main grid has evolved over almost 100 years. The majority of the main grid's oldest parts have already been refurbished or replaced. The oldest 110 kV transmission lines still in use were built in the 1940s. Currently, the average age of the main grid's transmission lines is 31 years, which is more than 15 years higher than the average age of the high-voltage devices in substations, which is 16 years. Approximately one-sixth of the total line length is more than 50 years old, while less than 5 per cent of the substation equipment is over 40 years old.

When an installation approaches the end of its service life, the aim is to replace it in a timely manner before damage to the installation can cause harm. The life cycle can be extended by repairing and refurbishing equipment. However, replacement investments can sometimes be delayed deliberately. Devices that are damaged by faults or external causes must be replaced immediately. Network components with insufficient current-carrying capacity are replaced by stronger networks. If necessary, an old device can also be replaced by a new one if the new device has superior technical features or lower losses. A device or grid component that becomes unnecessary can be moved to a new location or decommissioned. Early replacement investments can also be made for safety and environmental reasons.

A comprehensive and up-to-date asset management system containing historical data on the devices is an important tool for optimising service lives. Such a system makes it possible to take all the data generated during procurement, operation, inspections, and maintenance into consideration in lifespan planning. More of the background information

needed in decision-making is gained through international cooperation among network operators. Among other things, cooperation provides experience-based information about device usage and faults – information that would otherwise accumulate slowly.

The main grid's system security is kept at a good level despite ageing. The timing decisions related to the refurbishment, repair and replacement investments of an ageing grid play a key role in the cost-effective and high-quality management of the main grid as an asset. Main grid maintenance and refurbishment needs obtained by means of digital maintenance and other methods are collected in the network asset management system. These needs are used to define feasible entities that are implemented in the form of maintenance improvements or as a separate, larger refurbishment project. An important aspect of maintaining the main grid investment plan is close cooperation between maintenance management and grid planning.

A lot of grid construction occurred in the 1970s and 1980s, as industrial electricity consumption increased and nuclear power plants were connected to the grid. Today, almost all the substations from that era have already been replaced or upgraded. The next in line for modernisation and refurbishment are properties built in the 1990s, which are fewer in number. From 2030 onwards, refurbishments will focus on replacing the secondary systems in substations. The secondary systems are replaced every 20 years, so the accelerated construction in the 2010s is reflected in their number. 110 kV transmission lines are being replaced all over Finland.

Connecting customers

The number of connection enquiries received by Fingrid has increased significantly, and there are currently thousands of enquiries at various stages. Some of these are for connections to the main grid, and others are for connections to distribution networks. In addition, preparations need to be made for higher capacities among existing customers and the growth in electricity consumption in the distribution network.

In Fingrid's view, only a limited proportion of the consumption and production projects in the enquiries will come to fruition, adding to the uncertainty about the location of new production and consumption facilities. In addition to the number of projects, the size of projects has increased many times over in recent years. As the size of the projects in the enquiries has become very large, a single customer project can take up the entire capacity of the grid in some areas.

Although Fingrid's forecasts do not assume that all the projects in the connection enquiries will be realised, a connection point is assigned to each enquiry, and regional grid planning is based on the enquiries and their maturity. Uncertainty about the location of new production and consumption facilities adds to the challenge of assessing future transmission needs in the main grid, but it creates even greater uncertainty in forecasting the investment needs for customer connections. As a result, the required transmission investment projects only proceed to implementation once the production and/or consumption projects are sufficiently close to implementation.

Fingrid aims to enable the connection of all projects in the pipeline to the grid. However, it takes years to reinforce the network, including the permit application and construction phases, and if projects move faster or are highly concentrated

in a particular area, the grid capacity may become scarce from time to time. In addition, unexpected changes in electricity production and consumption, such as the closure of a large power plant or an industrial facility, can weaken the capacity.

The aim is also to enable the connection of projects to the grid when there is a temporary scarcity of regional transmission capacity. In this case, various flexibility solutions will be used until the necessary network reinforcements are completed. The possibilities for flexible solutions are assessed on a case-by-case basis and may include a temporary direct-line connection, network protection or power limitation. Flexibility solutions must not compromise system security or reliability for other customers connected to the area. The conditions for flexible solutions will become clearer with the new Electricity Market Act.

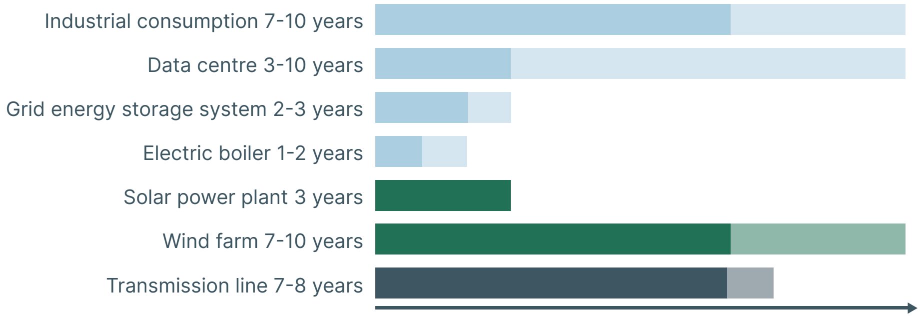


Figure 1. Implementation schedules for different types of investments, from planning to commissioning. The implementation times are based on Fingrid's expert estimates.

Main grid connections are subject to separate connection agreements, which define the ownership, limits of liability, and connection fees. The prerequisites for making an agreement are that the local town plan (or planning decision) and building permit required by the project are in force, the connection method corresponds to the technical conditions, and any expropriation permit applications that may be required for the connecting line have been submitted to the authorities. The connection agreement includes Fingrid's general connection conditions and the grid code specifications for power systems, which form part of the terms of the agreement.

Alongside the traditional connection agreement, Fingrid has introduced a new conditional connection agreement, which can be made at an earlier stage. This aims to support and facilitate in-

Fingrid aims to enable the connection of all projects in the pipeline to the grid.

vestment decision-making processes for large industrial projects by increasing the certainty of grid connectivity. Initially, the model will apply to large-scale consumption projects of 250 MW or more with long permit application processes. In the future, it will be extended to also cover large-scale production projects. A conditional connection agreement can be made once the customer has received a reasoned conclusion from the EIA procedure for the project, the environmental permit process has been initiated, and the customer has acquired or leased the land for the project site. In addition, the network investments required for the customer connection must be feasible both technically and economically and within a reasonable timeframe. A conditional connection agreement sets out the terms and conditions for the connection of the customer's project.

Connecting to the grid is a step-by-step process, planned well in advance in cooperation with the customer. The process starts with the connection data provided by the customer, which is used to assess the connection possibilities and agree on the connection method. At the planning stage, realistic customer power forecasts are particularly important to ensure that the required network reinforcements can be scheduled correctly. Aspects such as the system security and transmission capacity of the main grid, electrical safety, environmental impacts, and overall costs are considered when agreeing upon the connection method. The general connection conditions (YLE) set out the requirements for grid connections.

Fingrid makes substantial investments every year to connect customer projects. In addition to grid connections, the investments include system reinforcements of various types, such as new main transformers or transmission lines. Grid investments are planned in cooperation with customers to reflect

the latest realistic power forecasts and by monitoring the progress of projects. Grid investments are managed through regional, continuously updated network plans based on these forecasts. Regional development is actively monitored, and network reinforcements proceed as electricity consumption or production in the area increases.

This document does not identify the immediate investments required for the connection of individual production and consumption facilities, as Fingrid cannot comment on the likelihood of planned customer projects coming to fruition.

Cross-border capacity

The maintenance and development of cross-border connections are key to ensuring the functionality and efficiency of the electricity system and the electricity market. Fingrid is developing cross-border connections in cooperation with neighbouring countries to promote system flexibility and electricity market integration. The cross-border connections will also improve the connectivity of the electricity system and the adequacy and security of the electricity supply at the system level.

Existing cross-border connections

The Finnish electricity system is connected to Northern Sweden and Northern Norway via high-voltage alternating current connections and to Central Sweden and Estonia via high-voltage direct current transmission links. The direct current connection to Russia was disconnected in 2022 due to Russia's invasion of Ukraine and the resulting economic sanctions.

In November 2025, the maximum commercial transmission capacities of connections managed by Fingrid and made available to the electricity markets were as follows (From Finland / To Finland).

Sweden:	3100 / 3100 MW
Estonia:	1016 / 1016 MW

Traditionally, the transmission capacities of AC interconnectors have been determined on the basis of Net Transfer Capacity (NTC), which is the maximum commercial import capacity. This method has kept capacities fairly stable, with changes only occurring due to outages for maintenance and faults.

In 2024, the Nordic countries switched to a flow-based method for determining commercial transmission capacity between electricity market areas. In flow-based calculation, capacities are determined in a coordinated calculation that also takes into account the constraints within the network. The

method may result in interdependencies between the capacities at the borders and an unintuitive market outcome, i.e. electricity may also be transmitted from a more expensive area to a cheaper one.

Development of cross-border capacity

SWEDEN
The Aurora Line, a new cross-border connection between Sweden and Finland, was completed in 2025. The EU has granted the project a Project of Common Interest (PCI) status. Benefits received by projects selected as PCI projects include an accelerated permit process and eligibility to apply for financial assistance from the Connecting Europe Facility (CEF) financial instrument. The EU awarded the project EUR 127 million in funding due to the Aurora Line's significance. The funding was granted under the Connecting Europe Facility.

In late 2022, Fingrid and Svenska kraftnät initiated a study to gain more insight into the implementation of the next new cross-border line to the north. The study examines issues such as capacity, interconnection points and the implementation schedule. PCI status has also been sought for Aurora Line 2, a planned cross-border line. Aurora Line 2 will strengthen the transmission capacity between Finland and the SE1 zone in Sweden, and Fingrid's development plan foresees the commissioning of Aurora Line 2 in 2034. Discussions on the exact timing of the connection are ongoing with Svenska kraftnät.

In spring 2025, Fingrid and Svenska kraftnät signed a letter of intent to launch a study for a new submarine cable link, Fenno-Skan 3. The capacity of Fenno-Skan 3 is estimated at 800 MW, and the connection is expected to be completed by 2038. There are currently two high-voltage DC connections between Finland and Sweden: Fenno-Skan 1, completed in 1989, and Fenno-Skan 2, completed in 2011. Their combined transmission capacity is 1200 MW. Fenno-Skan 3 is expected to replace Fenno-Skan 1 when it reaches the end of its lifetime by the end of the 2030s. This would bring the total capacity of the Finnish and DC interconnectors to 1600 MW. PCI status for Fenno-Skan 3 has been applied for.

The maintenance and development of cross-border connections are key to ensuring the functionality and efficiency of the electricity system and the electricity market.

ESTONIA

There are currently two high-voltage direct current transmission links between Estonia and Finland: EstLink 1 (358 MW) and EstLink 2 (658 MW). Fingrid and Elering are conducting a study on the viability of the EstLink 3 connection. The study also aims to gain greater insight into the distribution of costs and timing of the projects. Planning will also continue as part of international grid planning cooperation, and PCI status has been applied for. EstLink 3 is planned to be commissioned in 2038.

NORWAY

Fingrid and Statnett, the Norwegian transmission system operator, have examined the development of transmission connections between Northern Finland and Northern Norway. The possible need for transmission capacity is associated with the increase in electricity consumption by industries in Northern Norway and the possibility of exploiting the wind power potential in the region. The problem in Northern Norway is that the Finnmark region is poorly connected to other parts of Norway's grid. Development options include converting the existing AC link to a DC link with a DC substation on the Norwegian side (back to back HVDC) or improving the controllability of the existing transmission link with a phase shifting transformer. Stattnett's approximate timetable for the project is the early 2030s. In both cases, the capacity of the interconnector would be around 150 MW, and the increase in capacity to this level from the current level of less than 100 MW will depend on the implementation schedules of the internal development projects in the Norwegian grid.

Summary of the main grid development plan

Fingrid has invested a record amount in the development of the electricity system in recent years. There are also more investment projects going on than ever before. Investments have mainly focused on the Finnish network, with the exception of the Aurora Line cross-border link to Sweden, completed in 2025.

The energy transition has been driving the increase in investment levels. The ongoing investments will enable renewable electricity to replace fossil fuels in heat production. A large part of the future development needs relate to connecting new energy-intensive industries with the renewable electricity production they need.

If electricity consumption develops in line with forecasts and doubles, the grid will have to be further developed at the current pace or even more quickly. However, the need to develop the main grid depends strongly on the geographical location of electricity production and consumption projects. Needs for development are regularly assessed. From 2025 to 2028, Fingrid's estimated investments will be EUR 2.0 billion, of which approximately EUR 0.6 billion is already committed under existing agreements (30 September 2025). Looking ahead to 2035, Fingrid estimates that the total amount of investments will rise to EUR 5.2 billion. The level of investment will strongly depend on the evolution of customers' connectivity needs.

Most of the investment costs are in new investments. The high share of new investments is explained in particular by the number of new 400 kV connections, cross-border connections, compensation solutions and substation investments. New electricity production facilities are being built mainly in Western and Northern Finland, while

electricity consumption and electrifying industries are concentrated in Southern Finland. This increases the need for strong transmission connections in the main grid. In addition, new industrial and electricity production projects require new substations for connections.

In addition to new investments, substation refurbishments will take place, and ageing 110 kV transmission lines will be renewed during the planning period. The number of sites to be renovated over the next ten years will be relatively small. The number of annual modernisations of secondary systems will increase significantly towards the end of the period. The main grid does not have a maintenance backlog, and the grid has been renewed according to the plan and as needed. Fingrid does not have any plans to construct new reserve power capacity during the review period.

Over the next ten years, border connections will be developed by reinforcing the transmission capacity between Finland and Sweden with two reinforcements. The first to be completed was Aurora Line 1 in 2025. Studies for the next connection, Aurora Line 2, are underway, with completion planned for 2034. Two HVDC connections are also planned: one to Estonia and one to Sweden. Studies have been launched, but their completion is outside the period covered by this development plan.

In addition to the development needs identified in the development plan, Fingrid is also preparing for other network development needs. Fingrid makes substantial investments every year to connect customer projects. In addition to grid connections, the investments include system reinforcements of various types, such as new main transformers or transmission lines. Grid investments are planned in cooperation with customers to reflect the latest realistic power forecasts and by monitoring the progress of projects. Grid investments are managed through regional, continuously updated network plans based on these forecasts. Regional development is actively monitored, and network reinforcements proceed as electricity consumption or production in the area increases. This document does not identify the immediate investments required for the connection of individual production and consumption facilities, as Fingrid cannot comment on the likelihood of customer projects coming to fruition.

The development plan is subject to major uncertainties regarding the rate of growth of consumption and the location of consumption and production projects. For example, the amounts and locations of wind power facilities and new, electricity-intensive industrial plants and the rate of electrification of society will have a major impact on Fingrid's investments. Fingrid is cooperating closely with customers and preparing for possible new connections.

A large part of the future development needs relate to connecting new energy-intensive industries with the renewable electricity production they need.

Fingrid updates its investment plan as a continuous process in step with the changing operating environment. For the latest information about the investment plan, please visit Fingrid's website or contact Fingrid directly. Fingrid will publish its next main grid development plan in 2027.

04

Development of the main grid – process description

Fingrid's grid development is guided by customer needs, the statutory obligations of the transmission system operator, and the condition and needs of the existing grid. There are also many different boundary conditions that affect the development of the grid. Key constraints on planning include ensuring safety, managing land use and environmental impacts, obtaining permits to build the network, technological developments, cost-effectiveness of investments and matching new network construction with the maintenance, upgrade and renewal needs and the company's finances. The development of the main grid will provide a reliable, cost-effective platform for a clean electricity system.

The key objectives for the development of the network are to ensure:

- Sufficient transmission capacity for the needs of customers and society
- Operational efficiency and safety
- Quality, measured correctly

In order to achieve these targets, Fingrid operates interactively with its customers, other main grid organisations,

the authorities, landowners and other partners, and ensures the availability of services in the sector. The company invests in staff competences and the management of specific issues in the electricity system. Fingrid develops its operations over the long term by utilising in-house expertise and the expertise of other pioneers in the sector, and it manages the main grid in accordance with the principles of good asset management.

Fingrid takes a sustainable and long-term approach to occupational safety and environmental and land use matters at all stages of the main grid's life-cycle management. Fingrid promotes the general safety of stakeholders, company employees, and service providers, as well as environmental safety, by means of new operating methods, training and guidance, and monitoring of operations. Fingrid ensures that sustainability is implemented throughout the supply chain.

Principles of main grid development

The starting points for main grid development are the future needs of customers and society, promoting the operation of electricity markets in the European and Baltic Sea regions, maintaining system security, cost-effectiveness, and managing the ageing of the grid. The revolution in the electricity system will lead to significant changes in transmission requirements, making them more difficult to forecast. Main grid development is based on extensive and interactive cooperation with numerous stakeholders. Fingrid acquires information about its customers' needs and plans by means of confidential and systematic cooperation with the customers.

In terms of grid development, Fingrid strives to manage the environmental and safety impacts of its operations. The aim is to minimise the harmful impacts within the limits of public interest and the technical and economic boundary conditions. Main grid construction, use and maintenance cause a variety of environmental impacts. Minimising and managing environmental impacts are an important part of Fingrid's practical operating methods. Observing the obligations and guidelines in the legislation and maintaining real-time plans for emergency situations are the cornerstones of environmental management and managing environmental risks. Fingrid is an active participant in land use planning to ensure that the land use reservations required for grid development and the related impacts on the environment are taken into consideration during the zoning of land areas. In accordance with the nationwide land-use objectives stipulated in the Land Use and Building Act, the primary objective is to utilise existing transmission line routes in the planning of transmission lines.

Grid development is governed by European network codes and guidelines. The application of dimensioning regulations and transmission capacity specifications is governed by Fingrid's internal guidelines. Fingrid has committed to these principles in main grid service contracts. Fingrid can decide to use more reliable grid dimensioning in order to reduce particularly harmful risks. Fingrid uses the operational performance requirements and connection conditions that it has set to ensure that the power system is dimensioned adequately in terms of disturbance tolerance.

The main grid is developed over the long term in a way that benefits the national economy overall while simultaneously ensuring future operating conditions. For this purpose, Fingrid compiles and maintains a main grid development plan that is coordinated with grid plans covering the Baltic Sea region and all of Europe. The grid development plan is based on future transmission forecasts and grid plans drawn up on the basis of grid renewal needs. The aim is to align grid reinforcement needs with maintenance, refurbishment and renewal needs. Furthermore, the projects selected for implementation must be cost-effective and in line with the company's finances. The company's revenue is mainly generated through electricity consumption, so it is particularly important that new consumption is also added to the planned network. This will contribute to a competitive transmission tariff and support the company's investment capacity and finances.

Fingrid measures the success of grid development by analysing the adequacy of capacity, the fulfilment of customers' connection requirements, system security, project quality and costs and by monitoring the realisation of targets. The principles for ensuring the transmission capacity are available on Fingrid's website: fingrid.fi/en/grid/development/.

The needs of customers and society are the starting points for the development of the main grid.

Main grid development process

International main grid development cooperation

International network planning takes place at several levels: between Europe, the Baltic Sea region and the Nordic countries, and bilaterally with transmission system operators in neighbouring countries.

European cooperation takes place under the auspices of the European Network of Transmission System Operators for Electricity (ENTSO-E). ENTSO-E's mission is to develop electricity markets and improve cooperation between transmission system operators and to harmonise market and technical regulations in cooperation with the Agency for the Cooperation of Energy Regulators (ACER). ENTSO-E prepares ten-year network development plans (TYNDPs) for European electricity networks. The European TYNDP is based on the future scenarios developed jointly by ENTSO-E and ENTSOG, which represents gas network companies.

Network planning is also conducted regionally under the auspices of ENTSO-E. Finland is part of the Baltic Sea regional planning group, which also includes Estonia, Latvia, Lithuania, Sweden, Norway, Denmark, Germany, and Poland. The group engages in main grid planning in the Baltic Sea region. In addition, at the start of 2021, it initiated the Baltic Offshore Grid Initiative, which focuses on developing the transmission infrastructure needed for offshore wind power.

Led by the European Commission, the Priority Corridor Baltic Energy Market Integration Plan (BEMIP) includes the same countries as ENTSO-E's Baltic Sea region group. In addition to the transmission system operators, the BEMIP group includes the ministries and regulators of the countries. BEMIP's primary aim is to integrate the Baltic countries with European electricity markets.

In addition to ENTSO-E and BEMIP cooperation, grid planning cooperation takes place in the Nordic context, especially in matters related to the synchronised area. This work is carried out by the Nordic Planning Group and its sub-groups. Fingrid also conducts bilateral studies with transmission system operators in the neighbouring countries of Sweden, Norway and Estonia on topics such as the capacity needs and the location and technical solutions for new transmission connections.

When analysing the need for new cross-border connections, investments are based on calculations of their benefits to the national economy. Fingrid makes cross-border transmission investments whose expected benefits to society exceed their costs. The benefits

When analysing the need for new cross-border connections, investments are based on calculations of their benefits to the national economy.

are calculated on a transnational basis and consider the benefits for electricity users and producers, the development of congestion revenues, and the effects on electricity adequacy, integration of renewable energy, CO2 emissions, the technical functioning of the electricity system and flexibility. The costs that are taken into account are the investment, operating and maintenance costs, environmental impacts, and impacts on transmission losses. These cost-benefit analyses are carried out both at the pan-European level by ENTSO-E and bilaterally between Fingrid and its neighbouring TSOs.

National grid development methods

Main grid planning can be structured into three main entities: planning of the main transmission grid, planning related to regional development, and planning of connections. Planning of the main transmission grid focuses mainly on the 400 kV and 220 kV networks. Regional planning also examines the development needs of the 110 kV network and the sufficiency of the transformer capacity. Connection planning identifies potential connection points for new projects and assesses the necessary reinforcements or special solutions to enable connections to the grid. The main grid is always planned as a whole with a long-term outlook.

At the moment, a lot of large, high-powered connection projects are planned. This is why connectivity studies often require extensive regional plans, including at the level of the main transmission network. In addition, the planning process must take into account different development paths and alternative solutions. The long-term uncertainties are addressed by the electricity system vision, which examines the evolution of the transmission needs of the grid under different future scenarios.

Electricity system vision

The electricity system vision examines alternative development paths for Finland's energy system and creates a vision for the long-term development needs of the grid. Scenarios are used to examine long-term changes that are difficult to predict. The vision aims to identify the development needs of the main transport network to serve as many different future scenarios as possible.

It does not aim to identify a single likely scenario; instead, it highlights the phenomena that pose challenges to the main grid and the electricity system in each scenario. Assessing the need for changes through challenging scenarios helps to ensure a comprehensive and timely evaluation of the means to enable electrification and the transition to a clean energy system. Underestimating the need for change could, in the worst case, lead to a situation where a lack of preparation would limit the implementation of clean transition investments in Finland.

The electricity system vision will be updated when necessary every few years, taking into account the latest signals from society and the energy sector. Fingrid published a new electricity system vision for 2040 in October 2025.

Planning of the main transmission grid

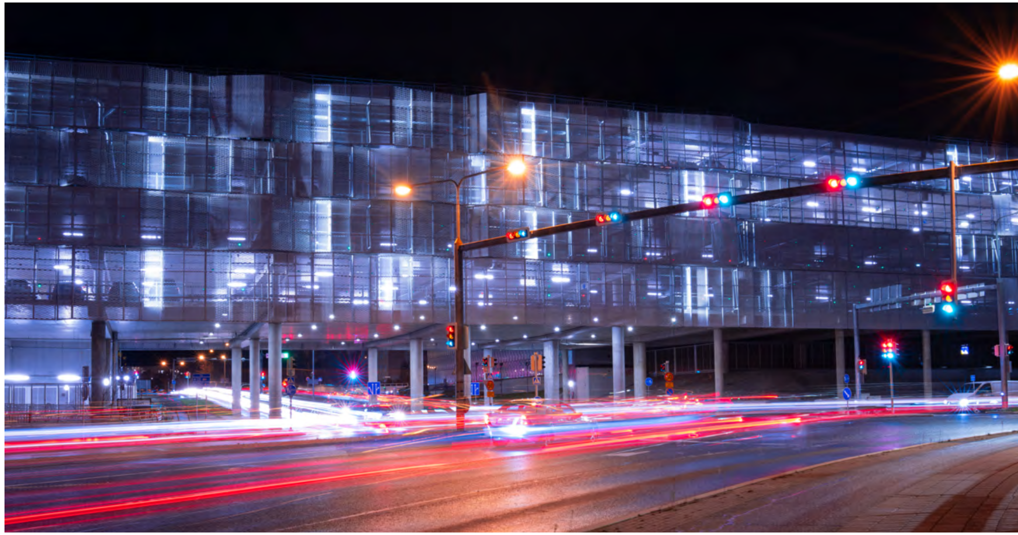
The main transmission grid enables the connection of large power plants and production clusters to the main grid and caters for the power transmission needs between countries and regions. The main transmission grid includes 400 and 220 kV main grid connections, which are considered important in terms of the Nordic synchronous system.

Fingrid is developing the entire main grid in a long-term and proactive manner. As these are long-term infrastructure solutions, it is important to identify the uncertainties in the operating environment as fully as possible. The design must be flexible, as the network solutions to be implemented must serve the system effectively, even if situations change in the future. Fingrid aims to develop the main grid in such a way that it enables Finland to achieve its climate-neutrality targets without forming a bottleneck under any likely future scenario.

The planning of the main transmission network is based on the requirements placed on the main grid and the structure of the existing electricity system. The planning takes into account changes in electricity production and consumption. These are assessed with the help of connection enquiries for production and consumption facilities and projections based on the results of electricity market modelling. The key issues to be addressed are the electricity transmission needs within Finland and at the cross-border connections. In addition, the plans account for various network failures and outages to ensure that the system remains reliable under all circumstances. Technical system studies, such as power and energy balance analyses and network analyses, support the assessment of technical solutions.

Finally, the various techno-economic alternatives are compared and evaluated to find the most cost-effective and reliable solution. Figure 5 illustrates the planning process, and Figure 6 shows the various phases from design to implementation.

Fingrid is developing the entire main grid in a long-term and proactive manner.



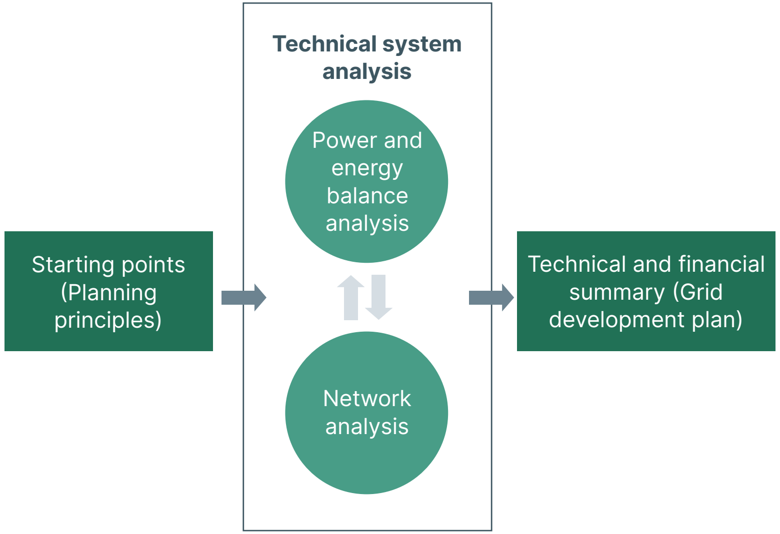


Figure 2. Overview of the planning process.

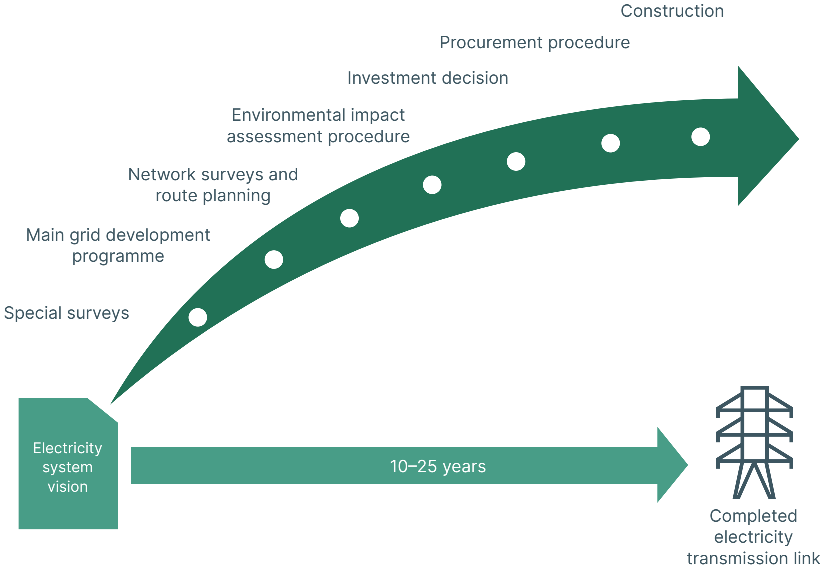


Figure 3. The phases in the main grid investment process, from planning to implementation.

The time required to build a new transmission line, from planning to the finished transmission line, is 7–8 years for lines within Finland and often longer for cross-border lines. Therefore, investment needs are identified as early as possible, for example, as part of the electricity system vision and other strategic network planning. Investment needs are revised as planning progresses. When planning the main transmission network, it is also important to examine how the system will work as a whole when the structure of production and consumption changes. A further question is whether a different range of network technologies will be needed in the future.

Important assessment criteria in main transmission grid planning are:

- System security
- Transmission capacity corresponding to customers' transmission requirements
- Benefits for electricity market parties and the operation of the electricity market
- Risk of an electricity shortage
- Changes in transmission losses
- Creating connection opportunities

The transmission capacity can be increased by means such as building new line connections and investing in series and parallel shunt compensation. In addition, the capacity of the main transmission grid can be increased with various balancing power and reactive power compensation solutions, as system stability often limits the transmission capacity before the thermal current-carrying capacity of transmission lines has an effect. New technologies such as Dynamic Line Rating (DLR) present new opportunities to use the existing network more efficiently. These solutions are described in more detail in the section on solutions for promoting the grid's transmission capacity and stability.

System security is considered in the dimensioning of the looped 400 kV main transmission network using the N-1 principle. This means making contingencies for the failure of an individual main transmission grid component or power plant so that it does not cause an expanding disturbance.

Grid planning related to the development of various regions

The main grid is divided into four planning areas: north, south, east and west. Planning includes customers' needs, the condition of the grid, the development projects required for system security, and, for example, studies of the adequacy of transformer capacity. In addition to the main grid, planning takes into account the high-voltage distribution networks owned by other companies and their development plans and needs.

Starting points for planning

The starting points for planning are the dimensioning principles. The 110 kV and 220 kV main grid is dimensioned according to the N-1 principle. This means that the grid must be capable of withstanding a fault in an individual component without the grid becoming overloaded, voltages falling below the allowed limits, or the fault spreading to other parts of the grid. Dimensioning of the 110 and 220 kV grid is mainly done according to the thermal transmission capacity, short-circuit currents and the allowed voltage reduction. In Lapland, for example, the stability of the network also limits transmissions due to the long distances involved. The 110 kV network is dimensioned to allow for regional interruptions in supply caused by a single fault.

Dimensioning grid situations vary by planning area. In certain regions, transmissions in the main transmission grid have a strong effect on the loading of the meshed 110 kV network and result in, for example, losses. Exceptional main grid switching situations or extended grid outages must also be taken into account in extraordinary situations. As a rule, the grid is rated to withstand a failure or outage in any of its components. Outages required for maintenance and construction are scheduled to take place during lower transmission needs as far as possible.

With regard to the 110 kV grid, dimensioning scenarios can include peak loads on a winter's day, spikes in electricity consumption during winter nights when the volume of hydro power is low, a large production surplus during the flooding period in the spring, or a large deficit on a summer's day when local power plants are undergoing annual maintenance. As wind power volumes increase, this form of energy has become regionally significant and a planning criterion for dimensioning.

Grid planning requires group work in which experts from different areas participate in defining the boundary conditions for planning and brainstorming.

Finland's electricity consumption is traditionally highest during the long, cold winter. In the future, peak electricity consumption is likely to occur during cold but windy periods, when electricity prices are low and when both flexible and inflexible electricity consumption are therefore high. However, more transmission capacity is available in the winter as the cold air cools the transmission lines and network components. The heating load in the summer is smaller, but the cooling load is larger. Power plant overhauls are usually carried out in the summer. Consequently, large grid transmissions can also occur during the summer. The thermal transmission capacity of overhead wires presents a particular challenge in the summer, as the warmer weather reduces the capacity. The outdoor temperature has a major impact on the thermal current-carrying capacity of transmission lines and transformers.

When calculating the grid transmission capacity, the aim is to model power plant operation as realistically as possible. Wind power, solar power and grid energy storage systems pose new and specific challenges with regard to dimensioning the main grid. Wind power production varies according to the wind strength and can change suddenly. This means that the grid must be dimensioned for the largest and smallest outputs. In Finland, the principle is that neither production nor load is limited in a normal grid situation. As a result, mechanisms to limit wind power production have not yet been used as a grid planning tool, except as a solution for changeover periods when the limit mechanism is temporary.

Taking grid energy storage systems into account in regional network planning is challenging. The behaviour of grid energy storage systems does not depend directly on physical quantities in the same way that, for example, wind and solar power production depend directly on the wind speed and the intensity of solar radiation. In addition, grid energy storage systems may vary in their participation in different marketplaces over their service lives, which means that their behaviour cannot be directly estimated, for example, according to the price of electricity. Challenges in predictability mean that dimensioning must take into account discharging and charging the battery at full power in the worst transmission situations. This in turn can lead to a shortage of regional electricity transmission capacity. Fingrid is currently working on more detailed principles for taking grid energy storage systems into account in planning and connecting them to the grid.

Planning process

Grid planning requires group work in which experts from different areas par-

Planning is based on confidential discussions with electricity producers, large industrial companies and network operators.

ticipate in defining the boundary conditions for planning and brainstorming.

Fingrid aims to enable the connection of all projects in the pipeline to the grid. However, it takes years to reinforce the network, including the permit application and construction phases, and if projects move faster or are highly concentrated in a particular area, the grid capacity may become scarce from time to time.

Planning is based on confidential discussions with electricity producers, large industrial companies and network operators, and customers' views on the electricity grid development needs in the region. Trustful and open communication with the industry is essential for planning the grid. It can take years to reinforce the network, including the permit application and construction phases, and if projects move faster or are highly concentrated in a particular area, the grid capacity may become scarce from time to time. When the number of projects and growth projections are high, realistic power projections are particularly important to ensure that network reinforcements can be correctly targeted and timed. A further aim of discussions with industry and power producers is to survey the possible changes in capacity and the impacts of improving process efficiency on consumption or production.

Electricity consumption forecasts for regional and distribution networks are influenced by trends in the population and residential areas, service clusters, and SME industry in the area under examination. Grid planning also involves sensitivity analyses related to the trends in loads and production. The actual power levels, transmissions and operational methods of power production can be estimated by analysing main grid metering data. Industrial changes can occur at a rapid pace, but investment decisions sometimes take a very long time to happen. As a result, main grid planning must strive for flexible solutions that can cover the transmission needs of electricity consumers and producers without unnecessary investments.

The actual grid planning process begins with a survey of development needs. These needs include managing grid ageing, grid transmission capacity, managing short-circuit currents, electricity quality problems (including voltage variations), and problems related to connection and outage needs.

Power flow calculations are used in the basic planning of the main grid. The expected electricity consumption and production for each substation and connection point is estimated based on forecasts and measurements and

added to the model in the network calculation software. Grid sufficiency can be assessed by simulating various faults and abnormal switching situations. If the network as such does not have sufficient transmission capacity, a number of network solutions are devised, and their adequacy is assessed through calculations. Power flow and short-circuit current calculations are usually sufficient for planning the 110 kV and 220 kV networks. Dynamics calculation is performed in extraordinary situations, making it possible to assess the angle and voltage stability of the grid.

Potential development trends are also assessed over the coming ten years and over a longer horizon. Grid development needs in the distant future occasionally influence grid planning and construction in the near future. For example, substation location plans and transmission line routes must consider the future situations and requirements.

The land use needs of new substations and transmission lines must be considered when planning. A new plan must be developed if projects are not possible with regard to land use. Grid investments should not be made up-front unless there is a special reason to expedite the timetable. One such reason could be the lack of available transmission outage times. Predicting the future is very difficult, and it is only becoming more challenging as the operating environment changes rapidly. It is easier to make correct investments when the grid plan is implemented as close as possible to the time of need.

The plans are reviewed with customers during collaboration meetings and grid development events.

Connection of new production and consumption to the main grid

The Electricity Market Act stipulates that the transmission system operator has grid development and connection obligations. The grid operator must, upon request and in return for reasonable compensation, connect to the grid any electricity accounting sites, power plants, and grid energy storage systems that meet the technical requirements in its area of operation. As the main grid must always meet the system security criteria set for it and, in principle, the entire network must be a uniform bidding area for electricity trading, the requisite network reinforcement measures must be taken before implementing any connections. Fingrid decides upon these before concluding connection agreements. In practice, customers' connection requirements and other changes in generation and consumption require continuous development of the grid as a whole – not just in terms of connections.

Fingrid describes the connection conditions and process on its website. The connecting party and Fingrid agree on a connection point in cooperation. The main principle is that the customer pays a fixed connection fee for its connection, while Fingrid handles the changes to the main grid and any grid reinforcement needs. The connection methods are a substation connection and a transmission line connection.

A substation connection is a connection to 400, 220, or 110 kV switchgear at a Fingrid substation. For reasons of system security, connections at the 400 kV or 220 kV voltage levels are always implemented at a Fingrid substation. Finland's main grid transmission lines are long, with sparse switchgear installations due to the length of the country and its low population density. For this

Fingrid describes the connection conditions and process on its website.

reason, connections to 110 kV transmission lines are also permitted after consideration of the available transmission capacity on the transmission line and other technical constraints. A transmission line connection means connecting a branch line or substation to a 110 kV main grid transmission line via a fixed connection or a switching device. The maximum rated power of a transformer connected to the transmission line is 40 MVA, and the minimum short-circuit reactance is 48.0 Ω. If the transmission capacity of the main grid transmission line allows it, up to 65 MVA of transformer capacity can be connected to the same connection point, and the connection can be loaded up to a maximum of 60 MW. Within the constraints of the specific requirements, a single 63/31.5/31.5 MVA three-winding transformer may also be used. The negative side of a transmission line connection is that when a fault occurs in that transmission line, all of the parties connecting directly to that transmission line suffer an interruption in delivery. In addition to faults, maintenance may cause outages in transmission line connections, and the connecting party is responsible for arranging alternate supply. Transmission line connections also reduce the transmission capacity reserved for the main purpose of the transmission line, which is to transmit electricity between main grid substations, and the availability of the transmission line.

Fingrid's general connection terms (YLE), which are a part of the connection agreement, specify the general technical requirements for electrical installations connected to the grid. The connection terms ensure that the connected networks are technically compatible with the grid and specify the rights, responsibilities, and obligations associated with the connection.

Fingrid delivers. Responsibly.

For more information about Fingrid and the contact persons for different functions, please refer to Fingrid's website: www.fingrid.fi

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