Invest In Veitsiluoto
Electricity grid survey

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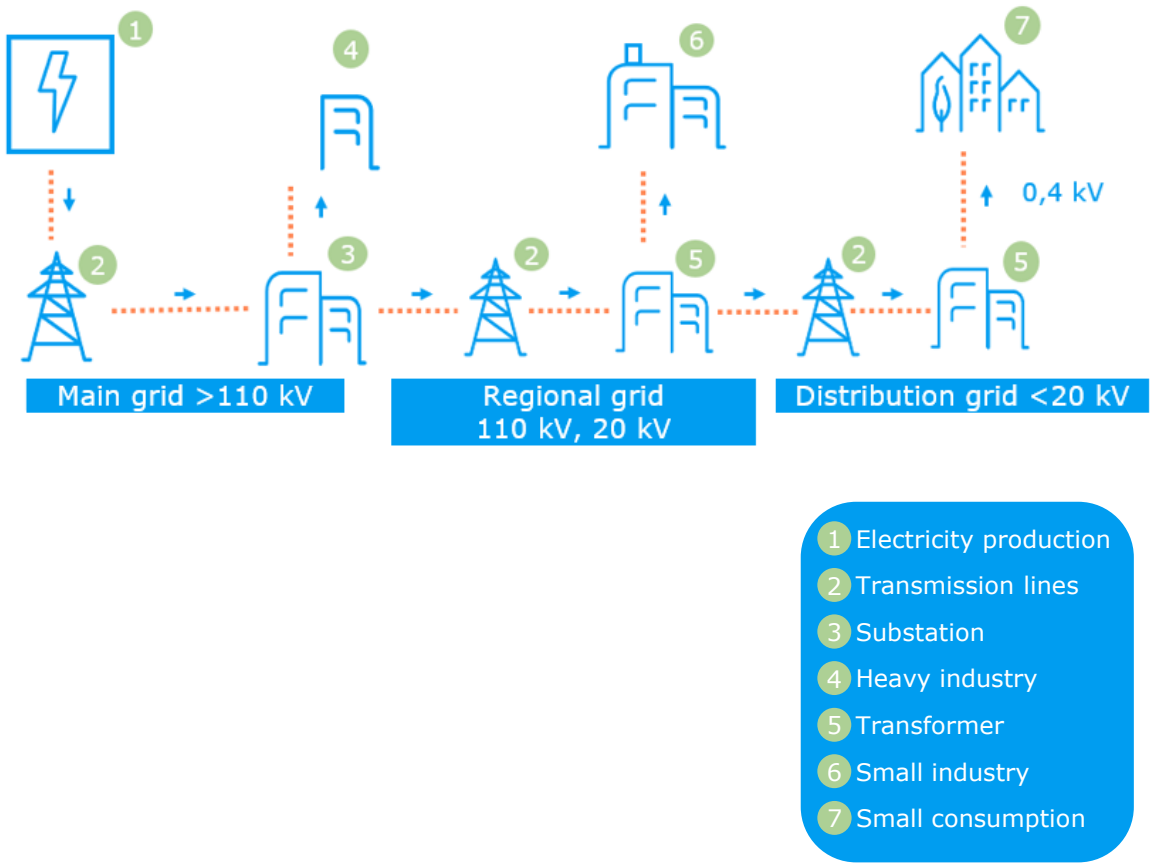
Contents

Electricity transmission
- Technical details and explantion

The technical structure of electricity transmission

- The Finnish electricity network consists of a main, regional and distribution grids. The main grid forms the backbone of the electricity transmission, and the largest power plants and factories are connected to it. The main grid (110-400 kV) is managed by Fingrid Oyj, regional grids (110 kV or 20 kV) are managed by regional electricity transmission companies and distribution grids (0.4 - 20 kV) are managed by local electricity distribution companies.
- The electricity grid consists of power lines, cables, substations, transformers and main power stations. The purpose of the electricity transmission structures is to support the conductors carrying the electricity and withstand all mechanical loads applied to them.
- Electricity is transmitted at high voltages and distributed locally at lower voltages and currents using transformers.
- You can connect to the electricity network with a connection line through different connection points, such as line branch, substation or switchgear connections.
- Electricity transmission capacity refers to the amount of electricity for limited transmission in the electricity grid according to the criteria of operational reliability.
- The connection capacity describes the limited amount of electricity consumption that can be connected to the electricity grid.

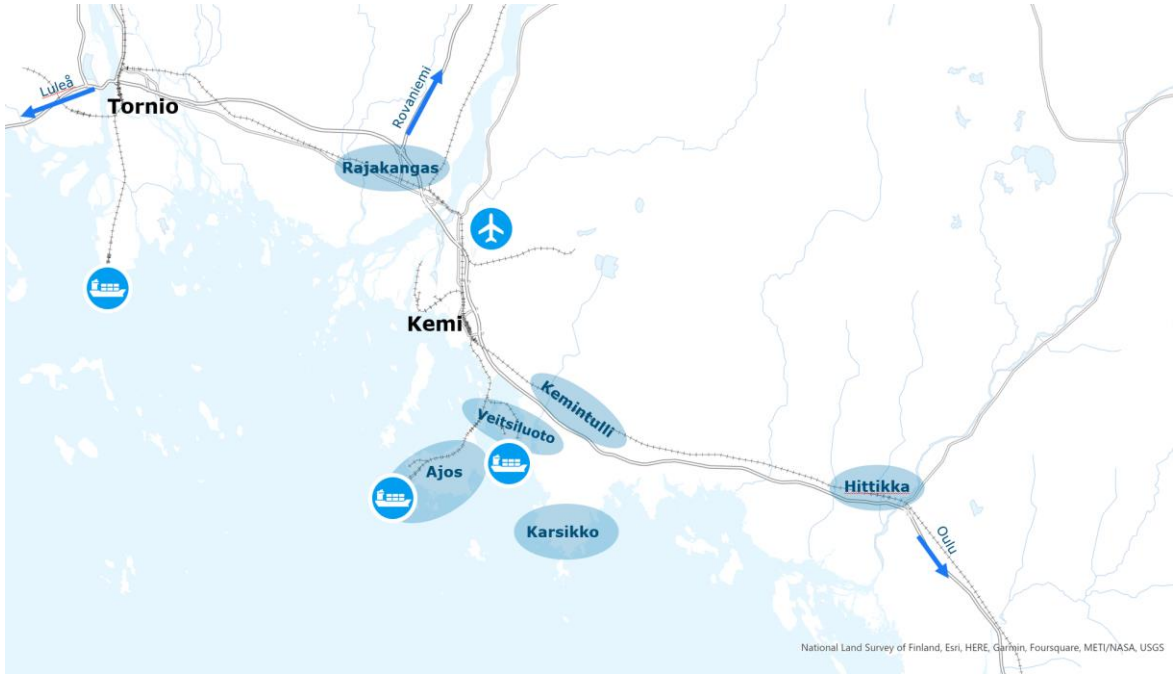


1. Electricity transmission grid in Meri-Lappi

- Current status
- Future
- Meri-Lappi transmission grid development plan
- Area summary
- Assessment of the construction of the Kittiläjärvi substation

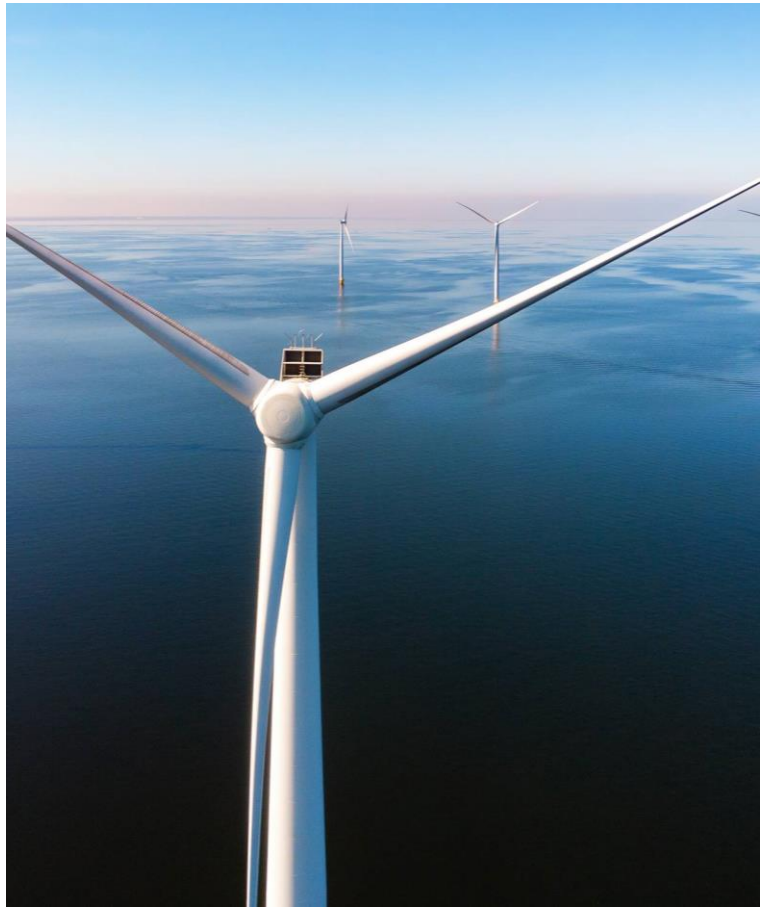
The current state of the electricity transmission grid in Meri-Lappi

- The electricity grid survey is part of the Invest In Veitsiluoto project, which supports businesses settling in the Meri-Lappi area.
- To support the development of business areas in Meri Lappi, a current situation analysis of the area's electrical transmission grid in terms of the electricity consumption capacity and the opportunities to increase the present electricity transmission capacity have been surveyed.
- In Finland, the main grid company Fingrid Oyj is responsible for electricity transmission, maintenance and development in the main grid (110-400 kV), as well as managing the balance of electricity power and promoting a market-based electricity system.
- Currently, without any investments, Stora Enso has about 100 MW of free electricity consumption capacity available in Veitsiluoto.
- Ajoksi, Veitsiluoto, Karsikko, Kemintulli, and Hittikka are all located along the same 110 kV power line, meaning that, given the present situation, these areas could altogether increase their consumption by about 100 MW. An increase in the electricity consumption capacity in these areas would require investments.
- Fingrid is in favour of increasing electricity consumption in the area, as the area's electricity production is set to increase, for example, through wind power investments. Increasing consumption near production reduces the need for electricity transmission.
- Local grid companies operating in the area include:
  - Rajakangas: Keminmaan Energia ja Vesi Oy
  - Hittikka and Karsikko: Rantakairan Sähkö Oy
  - Kemintulli, Veitsiluoto, and Ajos: Kemin Energia ja Vesi Oy.



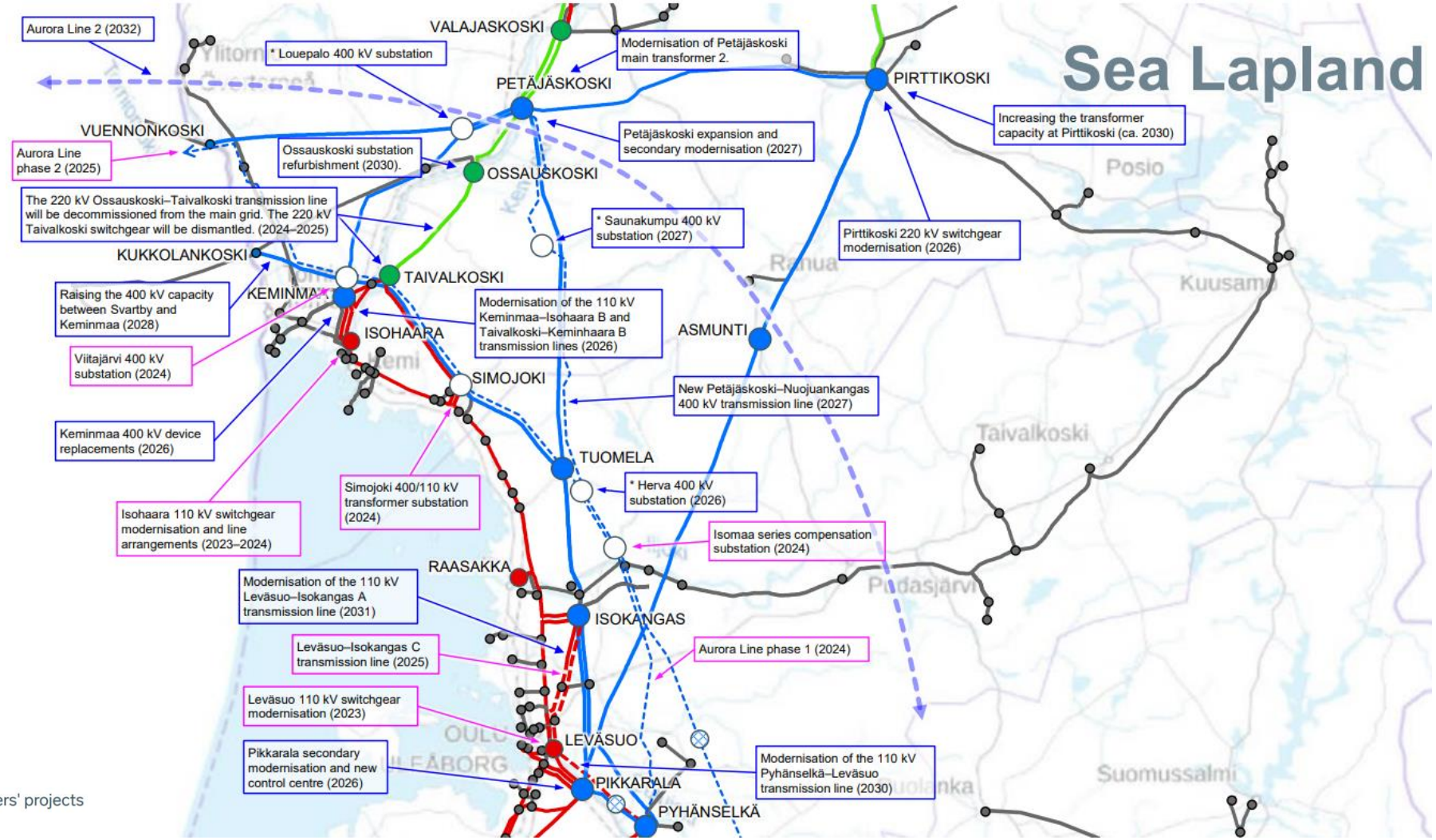
The future of the electricity transmission grid in Meri-Lappi

- Fingrid, the Finnish grid operator, and Svenska Kraftnät, the Swedish grid operator, are building a new electricity transmission link between Finland and Sweden.
- The project, called Aurora Line, will strengthen the 400 kV cross-border connection between North Ostrobothnia and Messaure in Sweden.
  - Construction work has started, and the project will be completed in 2025.
  - The new line will enable the construction of a 400 kV power line from e.g. Simojoki substation
  - Aurora Line will increase electricity transmission capacity from Finland to Sweden by about 900 MW and from Sweden to Finland by about 800 MW
  - Preliminary studies for the construction of Aurora Line 2 are underway, but the route and end points are not yet known.
- Investment decisions have been made on the following projects for the development of the electricity transmission network in the Meri-Lappi region
  - Extension of the Simojoki 110 kV substation to a 400/110 kV substation in 2024
  - Renewal of the 110 kV switchgear at Isohaara and wiring arrangements in 2023-2024
  - Isohaara substation renewed in 2023, including replacement of ageing 110 kV transmission lines to the south and north of the substation (completed in 2024)
- Skyborn Renewables' offshore wind project Pooki will bring 2 200 MW of new renewable electricity to the Bothnian Sea in 2033, when completed.



Meri-Lappi transmission grid development plan

Fingrid's main grid development plan draft for 2024-2033.



Markings on the regional investment plans:

Pink indicates that an investment decision has been made on the project

Blue means that project planning is underway

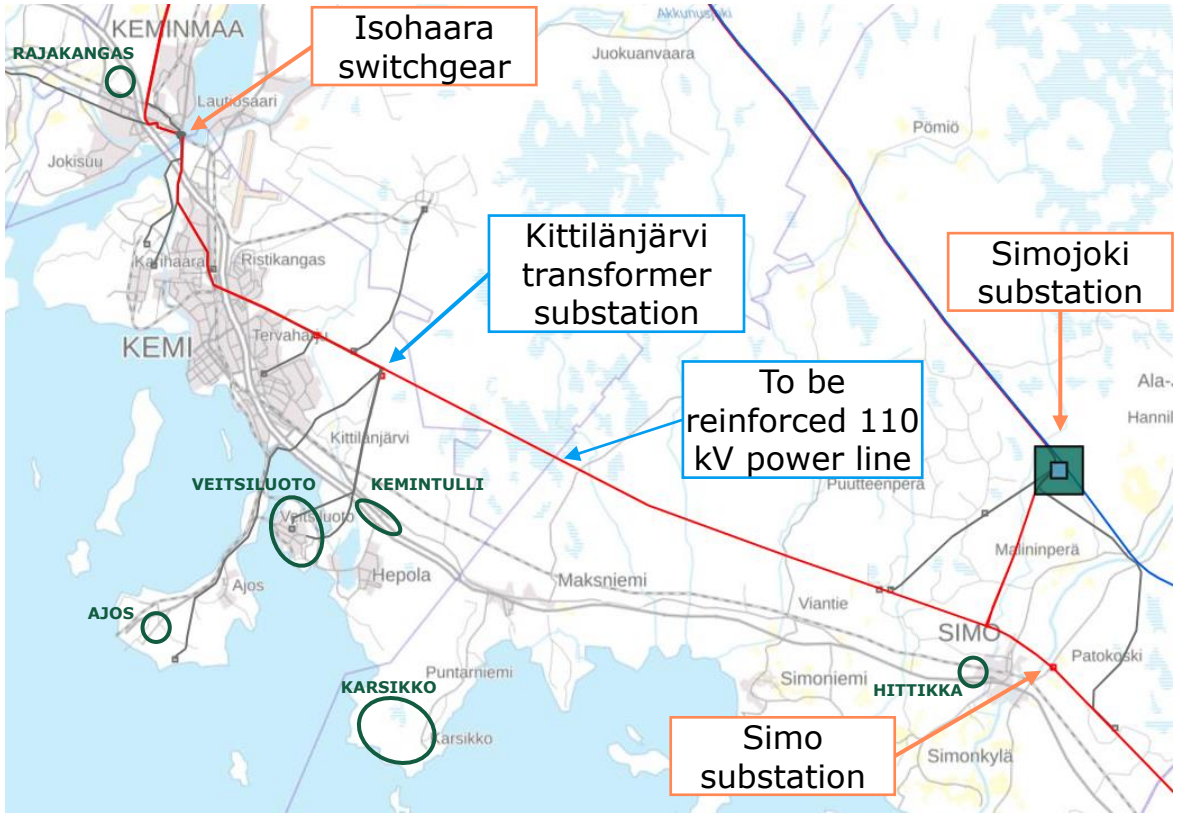
- New substation planned
- 400 kV substation, preliminary plan, exact location unknown
- 110 kV substation, preliminary plan, exact location unknown

* The investment schedule depends on the schedules of the customers' projects

Development of the electricity transmission network in the Meri-Lappi business areas

The development of the business areas in Meri-Lappi will be supported by increasing electricity transmission capacity.

- The Isohaara-Simojoki 110 kV power line has the potential to connect up to 100 MW of new electricity consumption from Ajos, Veitsiluoto, Kemintulli or Karsikko.
- The construction of the Kittilänjärvi transformer substation and the reinforcement of the 110 kV power line would allow up to 500 MW of new electricity consumption capacity in the areas of Veitsiluoto, Ajos, Karsikko or Kemintulli.
  - The electricity transmission company Fingrid is very interested in building a transformer substation and reinforcing the power line in Kittilänjärvi, if the consumption needs of the regions increase.
    - It would take 4-5 years to build a transformer substation.
    - It should be noted that a new transformer substation alone will not increase the connection capacity of the electricity grid, but that power lines will have to be reinforced or new ones built.
- Karsikko is the most potential location for construction of a dedicated 400 kV line and a large enough area for large consumption.



2. Increasing the available electricity consumption capacity

- Electricity production and consumption balance
- Fingrid and electricity grid development
- Construction of new power lines
  - Land use and permitting
  - 400 kV power line
  - Doubled 400 kV power line
  - 110 kV power line
  - Doubled 110 kV linja
- Ring line Karsikko–Ajos–Veitsiluoto

Increasing the available electricity consumption capacity

Electricity production and consumption balance

- Significantly more production than consumption in the Meri-Lappi region. Fingrid did not have exact figures.
  - The imbalance between production and consumption is reflected in the fact that wind power in the region will soon exceed 1 GW.

  →With increasing wind power, there is scope for increasing electricity consumption in terms of generation capacity

  - The main constraint to increasing electricity consumption is the capacity to connect to the grid
- The existing 110 kV line from Isohaara to Simo, which is the nearest power line for several regions, has only 100 MW of connection capacity

  →The power line is a bottleneck for increasing consumption

  →The line should be reinforced if the combined power demand of several regions exceeds 100 MW

Fingrid and electricity grid development

- Fingrid has a strong interest in developing the electricity grid in the region so that electricity consumption could increase to use the largely surplus electricity generation
- Fingrid's own development is slow → private investment in grid development will speed up the process
- Fingrid has an interest in supporting grid construction projects if someone else takes them on

Increasing the available electricity consumption capacity

Land use and permitting

- In all the areas of the survey where the lines should be built, there are numerous landowners.
- 110 kV and larger power lines require project permit from the Energy Authority.
- Based on the planned route, an assessment of the need for an EIA procedure will be requested from the ELY Centre and the ELY Centre will decide whether an EIA will be carried out.
- The EIA procedure is usually applied to projects that are likely to have significant environmental impacts. Usually over 15 km and over 220 kV.

400 kV power line

- 400 kV power line can enable around 1300 MW of capacity.
- The construction process is slow, about 5-8 years, and requires an EIA.
- Investment costs around 0,5 M€/km.

Double 400 kV power line

- Even a single 400 kV line allows for such a high capacity that it is not worthwhile to build a double 400 kV line just to increase the capacity.
- → Omitted from further analysis of options.

110 kV power line

- Enables around 200 MW of power.
- Investment costs for one 110 kV line is about 0,2 M€/km

Double 110 kV power line

- Enables around 400 MW of power.
- More power loss compared to a 400 kV line.
- EIA not necessarily required → faster construction process, around 5-6 years.
- Investment costs for a double line are around 0,3 M€/km.

Ring line between Karsikko, Ajos and Veitsiluoto

- Fingrid has no interest in building a ring line in the Meri-Lappi region because of the water bodies in the area and the high construction costs involved
- Private construction of a ring line is not legally possible at present
  - Each electricity consumption point and/or customer must have its own connection point
  - A ring connection would lead to a situation which could be interpreted as an electricity grid activity subject to authorisation.
  - Fingrid has requested a change in the law in this respect, but this is not yet in sight

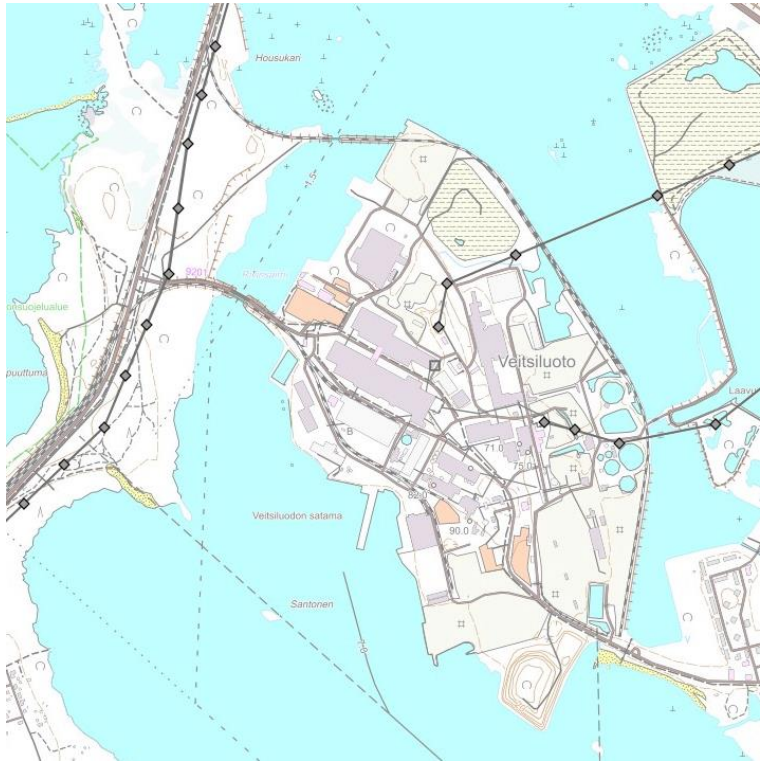
3. Current state of the electricity transmission grid and increase in electricity consumption capacity by region

- Veitsiluoto, Kemi
- Ajos, Kemi
- Karsikko, Simo
- Rajakangas, Keminmaa
- Kemintulli, Kemi
- Hittikka, Simo

Current state of the electricity transmission grid in Veitsiluoto

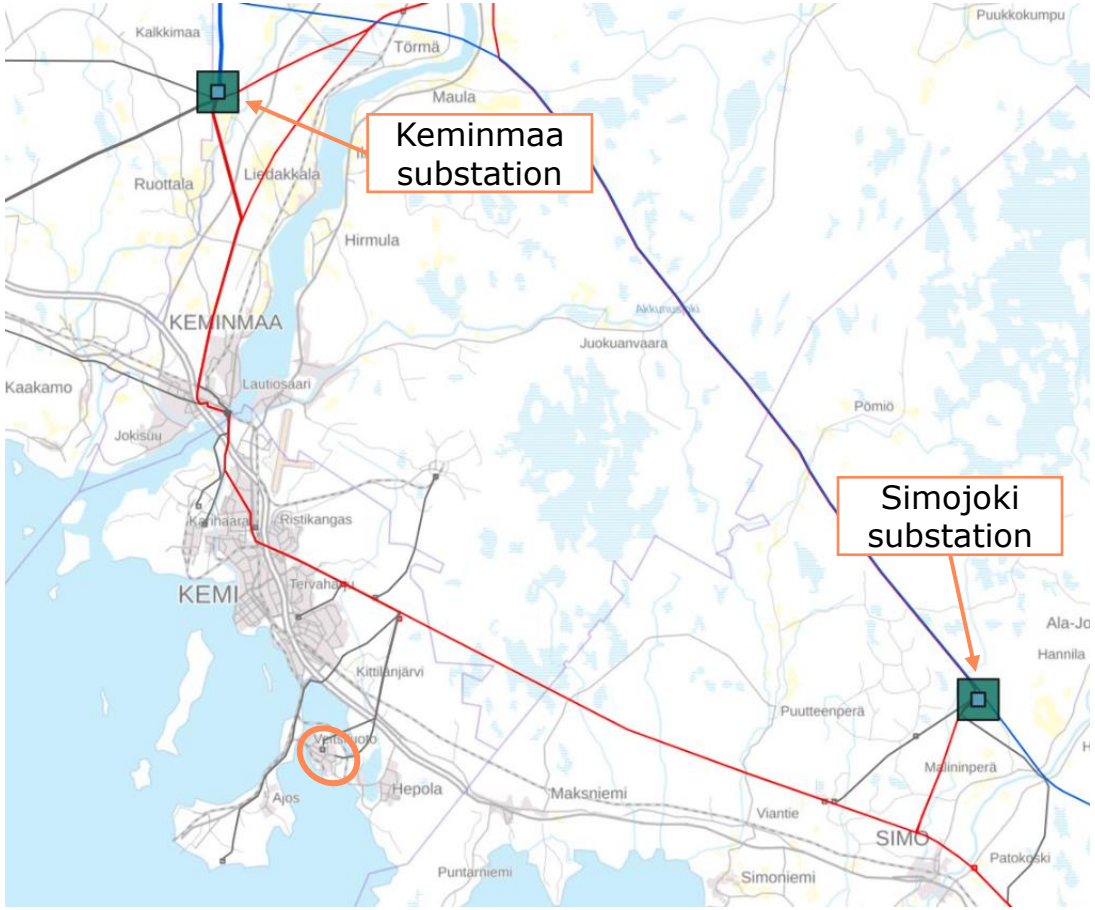
Two 110 kV power lines that go to Veitsiluoto are owned by Stora Enso

- Isohaara-Veitsiluoto, which includes a connection to the Isohaara substation and
- Line connection Isohaara-Simojoki (back-up connection).
  - The back-up connection will be used in the event of a power failure on the main line to minimise the fault and restore voltage to the network using the back-up connection.
- The current connection capacity for new electricity consumption at Veitsiluoto is about 100 MW
- The power lines are owned by Stora Enso, which means that only Stora Enso can add its own electricity consumption to the power lines
- The medium-voltage grid runs through the area. Allows for lower electricity consumption for smaller businesses in the area.
- Fingrid's 110 kV line ISOHAARA - SIMOJOKI runs 6 km away.



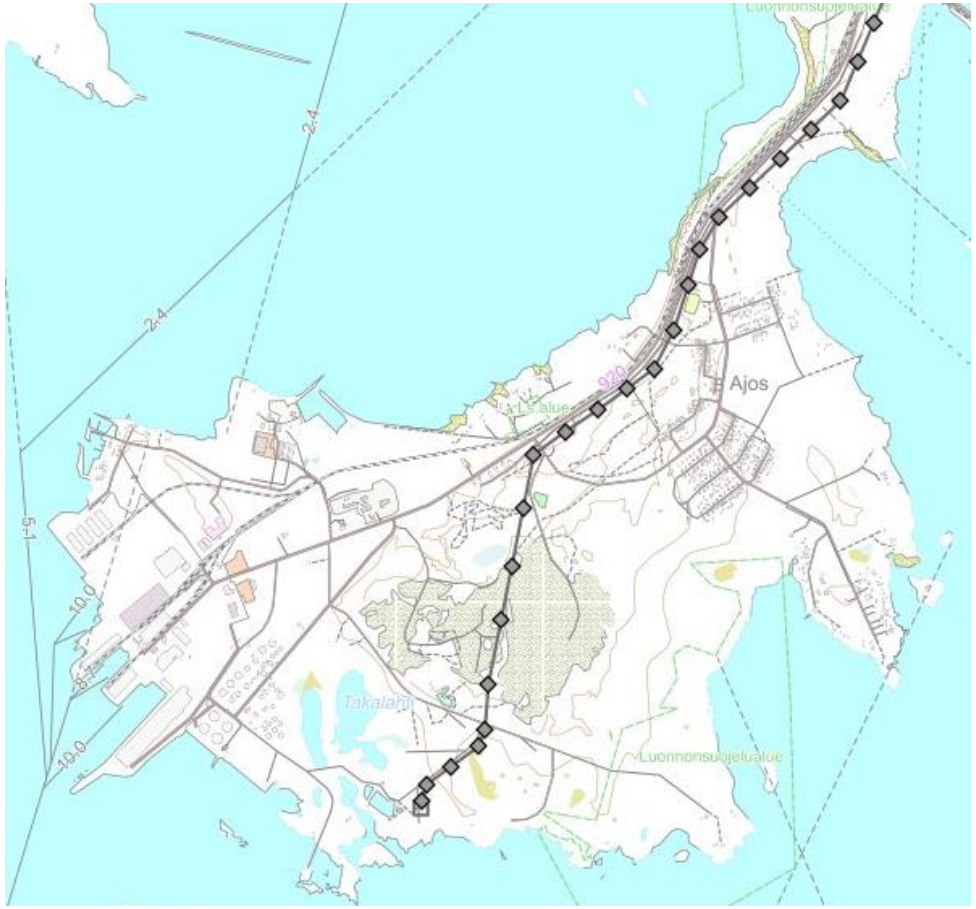
Increasing electricity consumption capacity in Veitsiluoto

- The distance from Veitsiluoto to the 400 kV substations in Simojoki and Keminmaa is about 27 km. There are fewer water crossings in the direction of Simojoki.
  - The investment cost is about 13.5 M€.
- There already are 110 kV power lines to Veitsiluoto, one of which is a back-up connection. Connection capacity on the existing lines is about 100 MW.
- A new 110 kV line could be added at Kittilänjärvi.
  - Investment cost about 1.1 M€.
- The medium voltage gird runs through the area, which has a connection possibility. Low voltage connections also available in the area.



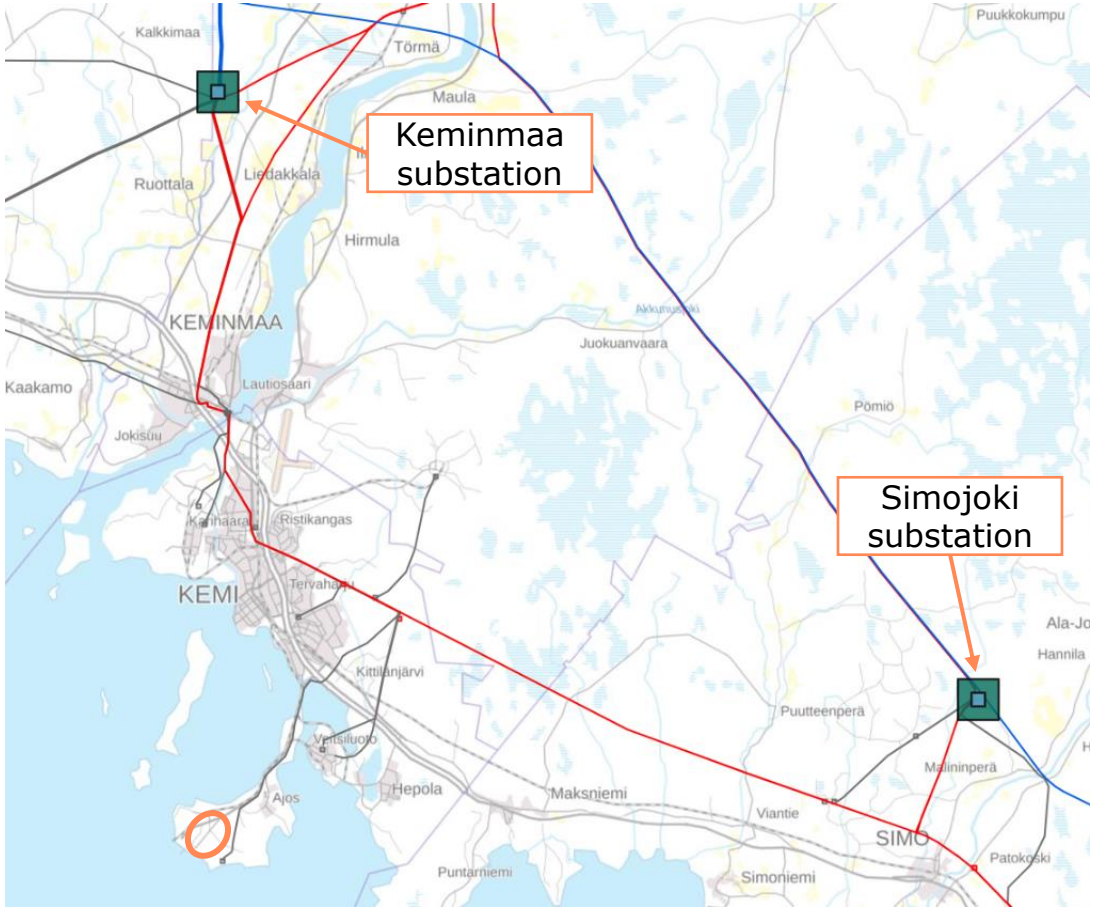
Current state of the electricity transmission grid in Ajos

- A 110 kV power line owned by Ajos Wind Oy goes to Ajos.
- 20 kV line in Ajos owned by the local grid company
- If a stronger power line is to be built to Ajos, it should be built through the Puidenpuuttuma area.
  - The area is challenging because of its narrow points and because the Ajos Wind line already passes through it.
- Fingrid's 110 kV line ISOHAARA - SIMOJOKI runs 10 km away.



Increasing electricity consumption capacity in Ajos

- The distance from Ajos to the 400 kV substations in Simojoki and Keminmaa is about 32 km. The investment cost is about 16 M€.
- A new 110 kV line could be added at Kittilänjärvi. Investment cost about 2 M€, challenging terrain may increase construction costs.
- The environment around Ajos is challenging for the construction of new power lines due to the narrow route and existing power lines. Of the power line route options, the line to the Simojoki substation has fewer water crossings.
- Landowners of the 'Puidenpuuttuma' area along the Ajoksentie:
  - Metsä Fibre sees the possibility of building lines in this area. They do not have their own use of the land and are in favour of the reinforcement of the lines.
  - Stora Enso is in favour of reinforcing the lines, but is still considering the use of the area, e.g. for solar power generation.
  - The medium voltage grid runs through the area, with the possibility of connection. Low voltage connections are also available in the area.
- Offshore wind project The Pook submarine cables have alternative landing sites in the Meri-Lappi, for example via Ajos to Keminmaa substation. If the project is implemented, there will be major changes to the electricity grid in the region and the impacts will need to be assessed separately.

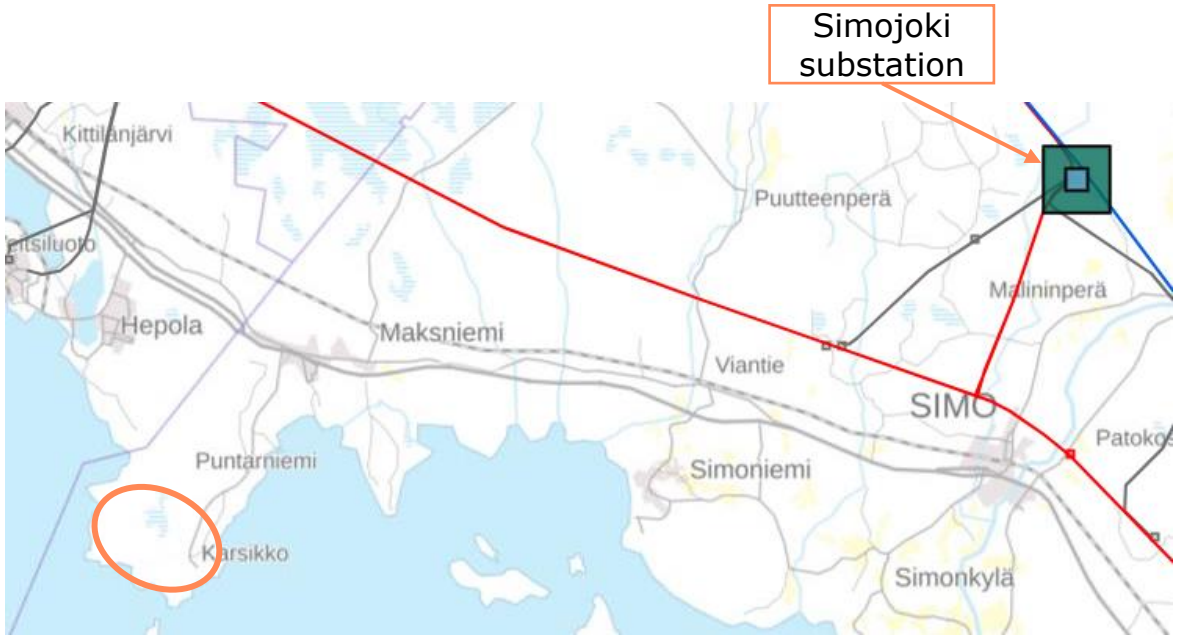


Current state of the electricity transmission grid in Karsikko

- There are currently no high-voltage connections in the area.
- A medium-voltage grid runs through the area.
- Previously there was a plot of land zoned for a nuclear power plant
- No known electricity grid plans for the area
- Area optimal for the construction of a 400kV or 110kV power line:
  - No need to build over water bodies
  - Distance about 23 km

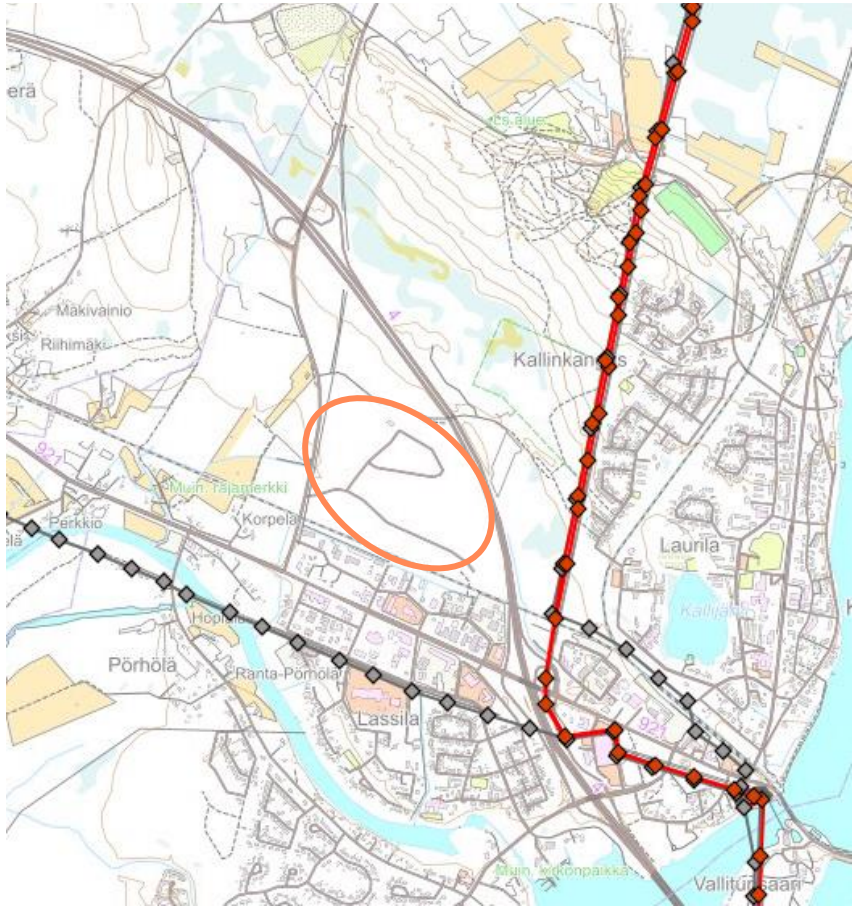
Increasing electricity consumption capacity in Karsikko

- Karsikko is well suited for the construction of an electricity network:
  - No need to build over water bodies
  - 110 kV and 400 kV connections are possible
  - Distance to Simojoki substation about 23 km
- 400 kV line from Simojoki substation
  - Investment cost about 12 M€
- Connection to 110 kV power line
  - Investment cost about 1,6 M€
  - If the Kittilänjärvi transformer substation is built and the connection is made there, the cost of the connection is about 2.4 M€
- The medium voltage grid runs through an area where connection is possible with low load. The medium voltage network should be reinforced if higher capacity is desired. Low voltage connections are also possible in the area.
- Offshore wind project Pook has alternative landing sites in Meri-Lappi for the submarine cables, for example via Karsikko to the substation in Keminmaa or Simojoki. If the project is implemented, there will be major changes to the electricity grid in the region and the impacts will need to be assessed separately.



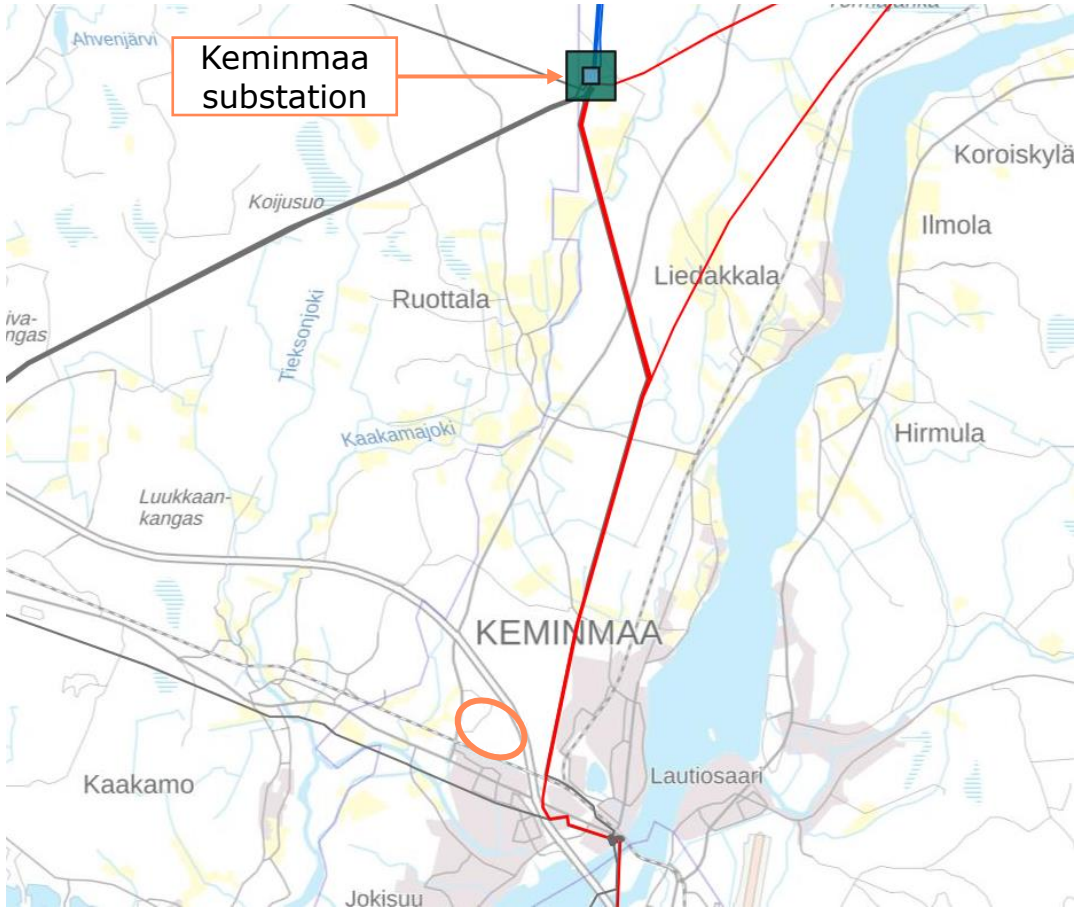
Current state of the electricity transmission grid in Rajakangas

- Two 110 kV Fingrid lines pass through the area.
  - KEMINMAA - ISOHAARA A
  - KEMINMAA - ISOHAARA B <- replacement of transmission lines planned for 2026
- Distance to Keminmaa substation about 10 km
- The medium voltage grid runs through the area. A medium voltage connection of approx. 2 MW is possible in the area. There is also the possibility of a low-voltage connection in the area



Increasing electricity consumption capacity in Rajakangas

- It is possible to build a 400 kV power line from Keminmaa substation to Rajakangas
  - With the construction of the 400 kV line, there is potential for up to more than 500 MW of new connection capacity
  - Investment cost around 5 M€
- In addition, a connection to the 110 kV power line is possible
  - The line runs almost alongside the site
  - Investment cost around 0.3 M€
- Due to the small size of the area and the resulting possible low consumption, a connection to the 20 kV local grid could be possible up to about 10 MW if the medium voltage grid is reinforced in the area.



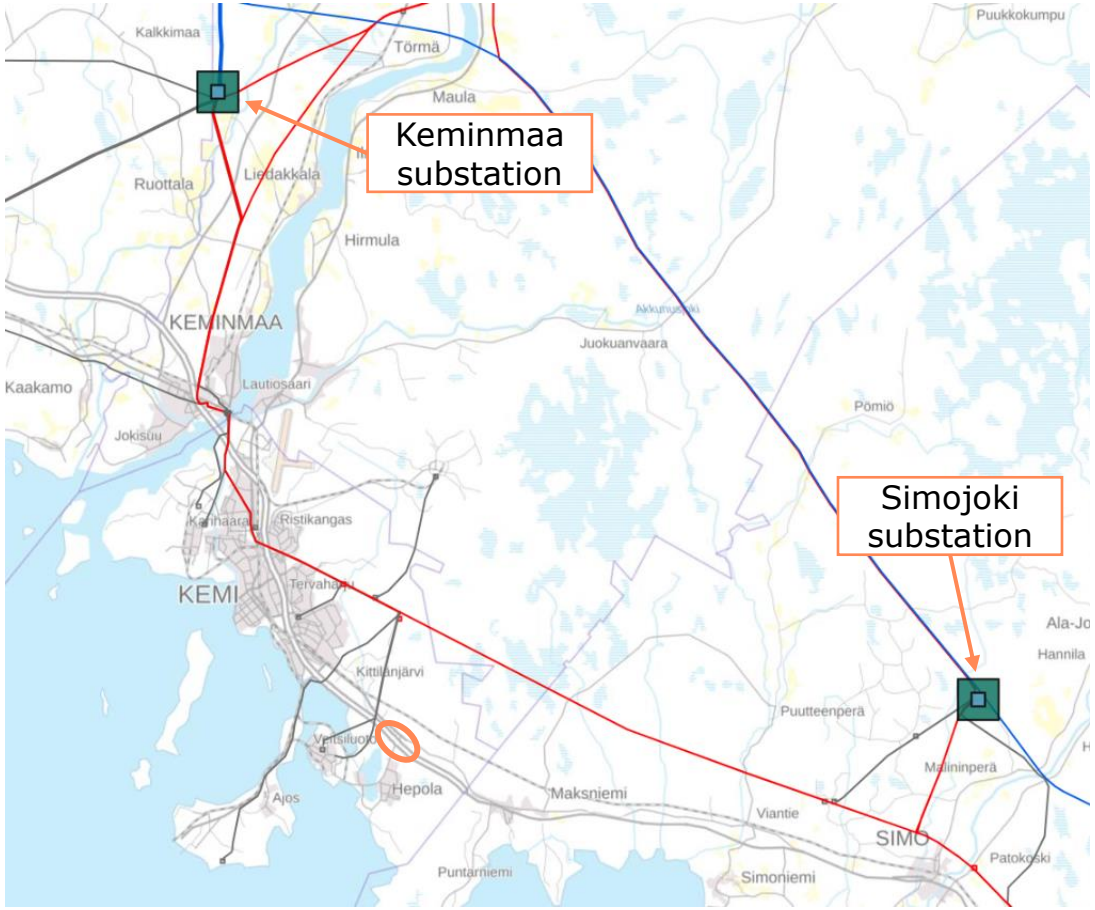
Current state of the electricity transmission grid and increasing electricity consumption capacity in Kemintulli

Current state

- There are currently no high-voltage connections in the area.
- A medium voltage grid runs through the area. Enables businesses with lower electricity consumption in the area. Low voltage connections are also available in the area.
- Fingrid 110 kV line ISOHAARA - SIMOJOKI distance from the area about 3 km

Increasing electricity consumption capacity

- The distance from Kemintulli to the 400 kV substations at Simojoki and Keminmaa is about 26 km. There are fewer water body crossings in the direction of Simojoki.
- Investment cost about 13 M€.
- The 110 kV line could be added at Kittilänjärvi.
- Investment cost about 1 M€.
- The medium voltage grid runs through the area, with the possibility of connection.



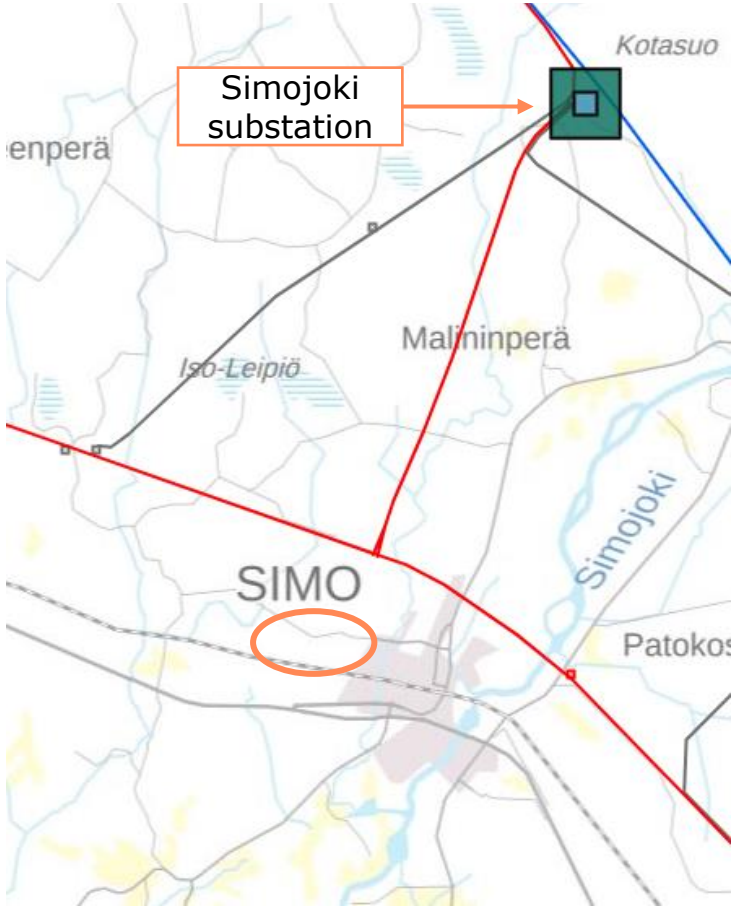
Current state of the electricity transmission grid and increasing electricity consumption capacity in Hittikka

Current state

- There are currently no high-voltage connections in the area.
- The medium voltage grid runs adjacent to the site and connection to it is possible. There is also the possibility of a low-voltage connection.
- Simojoki substation is about 5 km from the site
- Fingrid 110 kV lines run alongside the site at a distance of about 1 km.
  - SIMOJOKI – RAASAKKA
  - ISOHAARA - SIMOJOKI

Increasing electricity consumption capacity

- Hittikka is very close to the Simojoki substation, and the 110 kV power line also runs nearby
- 400 kV line from Simojoki substation, 6 km
- Investment cost about 3 M€
- Connection to 110 kV power line, 1 km
- Investment cost about 0.4 M€
- Given the small size of the area and the resulting possible low consumption, a connection to the 20 kV local grid could be possible up to about 10 MW if the medium voltage grid is reinforced in the area.



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