# Green Bond Investor Letter and Impact Report

FINGRID

February 2021

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# Green Bond Investor Letter and Impact Report

*"Fingrid's mission is to secure cost efficiently reliable electricity for our customers and the society. We shape the clean, market oriented power system of the future. As also responsibility is one of our core corporate values, it is natural for us to participate in the green bond market to finance our long term investments which have positive environmental effects", says Jan Montell, CFO, Senior Vice President.*

# Fingrid's business has significant positive impacts on society and the climate

The starting point for Fingrid's corporate responsibility work is our strategy where sustainability is an integrated goal and a corporate-level strategic choice. Fingrid creates significant positive impacts on climate and society.

The electricity transmission grid provides a platform for a clean power system. The positive impact resulting from the grid's enabling role in clean power production and consumption clearly exceeds the harm to biodiversity and people caused by the transmission lines and Fingrid's own greenhouse gas emissions. Fingrid's Green Bond financing also promotes the global development of sustainable and responsible debt capital markets.

## Value created by Fingrid in 2020

**CREATION OF VALUE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fingrid's nationwide main grid creates a platform for a clean powersystem. Around 10 kilometres of new grid transmission lines and 12 new or expanded substations. | Electricity transmission reliability 99.99995%. | The wind power connected to the main grid, 296 megawatts, will reduce future annual indirect emissions by 72,000 $CO_2$ equivalent tonnes. Reliability of cross-border transmission connections 99.67% | Top cost-effectiveness in European energy regulators' comparison study. Third cheapest in ENTSO-E's European price comparison. Customers perceive that Fingrid works for the benefit of the whole of society (4.3/5). | Personnel feel their work is meaningful and are ready to recommend their employer (eNPS 71). LTIF 11.1. Absences from work 1%. Number of training days on average 3/ employee. | One of Finland's largest corporate income tax payers (EUR 30 mill.). Payments to providers of capital EUR 149 mill. | Investments in the main grid approx. EUR 147 mill. Fingrid personnel's person-years 355 and service suppliers' person-years 491. | Direct $CO_2$ emissions and indirect emissions due to the company's own electricity consumption and losses 114,000 $CO_2$ equivalent tonnes. Waste utilisation rate 95% and recycling rate 62%. |
| Enabling a climate-neutral energy system | Reliable electricity for society and business | Well-functioning electricity market | Promoting Finland's competitiveness | Developing the electricity sector and expertise | Financial benefits for stakeholders | Employment impact and other local benefits from large capex projects | Local changes in land use and the environment and energy losses in electricity transmission |

**IMPACTS**

To ensure transparency and comparability, our reporting has complied with the international Global Reporting Initiative (GRI) framework since 2011. Fingrid's corporate responsibility reporting for 2020 is verified by a third party. Fingrid is also committed to the UN Global Compact initiative's principles on human rights, labour, the environment and anti-corruption, and the annual report stands for a Communication on Progress (COP) report. Corporate responsibility is further commented in our Annual Report (https://annualreport2019.fingrid.fi/)

We have defined the linking of Fingrid's operations to the UN's Sustainable Development Goals published in 2015. Of the 17 goals, we promote especially the following:

### Affordable and clean energy

We secure a reliable supply of electricity and affordable transmission pricing in the main grid for society. Society's demand for disturbance-free electricity is growing and serious disturbances in the electricity supply are one of the greatest security threats. Our investment programme improves the reliability of electricity transmission. We also secure a functioning electricity market and are a pioneer in electricity market services.

### Industry, innovation and infrastructure

We maintain and develop an important electricity transmission infrastructure for the needs of customers and society. The extensive investments of our main grid development programme provide several hundred person-years of employment for our service providers. We are active in international cooperation and innovation activities for when future technologies are developed in this field.

### Climate action

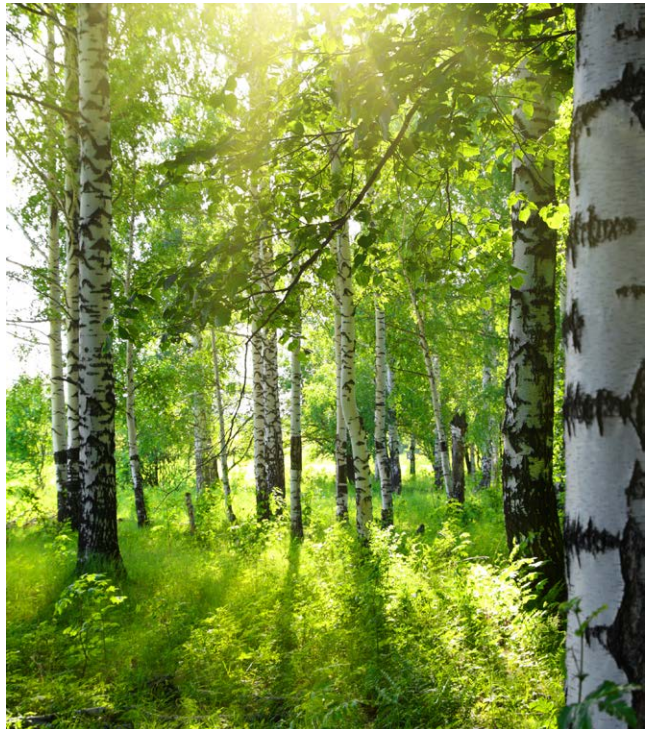
The change in the production structure of electricity resulting from the fight against climate change will cause changes in the electricity system. We enable the integration of new energy production into the main grid. We will also ensure the adequacy of system reserves in the future and prepare for a reduction in flexible production capacity while developing the electricity market for the needs of a carbon-neutral electricity system. We minimise the energy losses, which have a negative impact on the climate, in our electricity transmission.

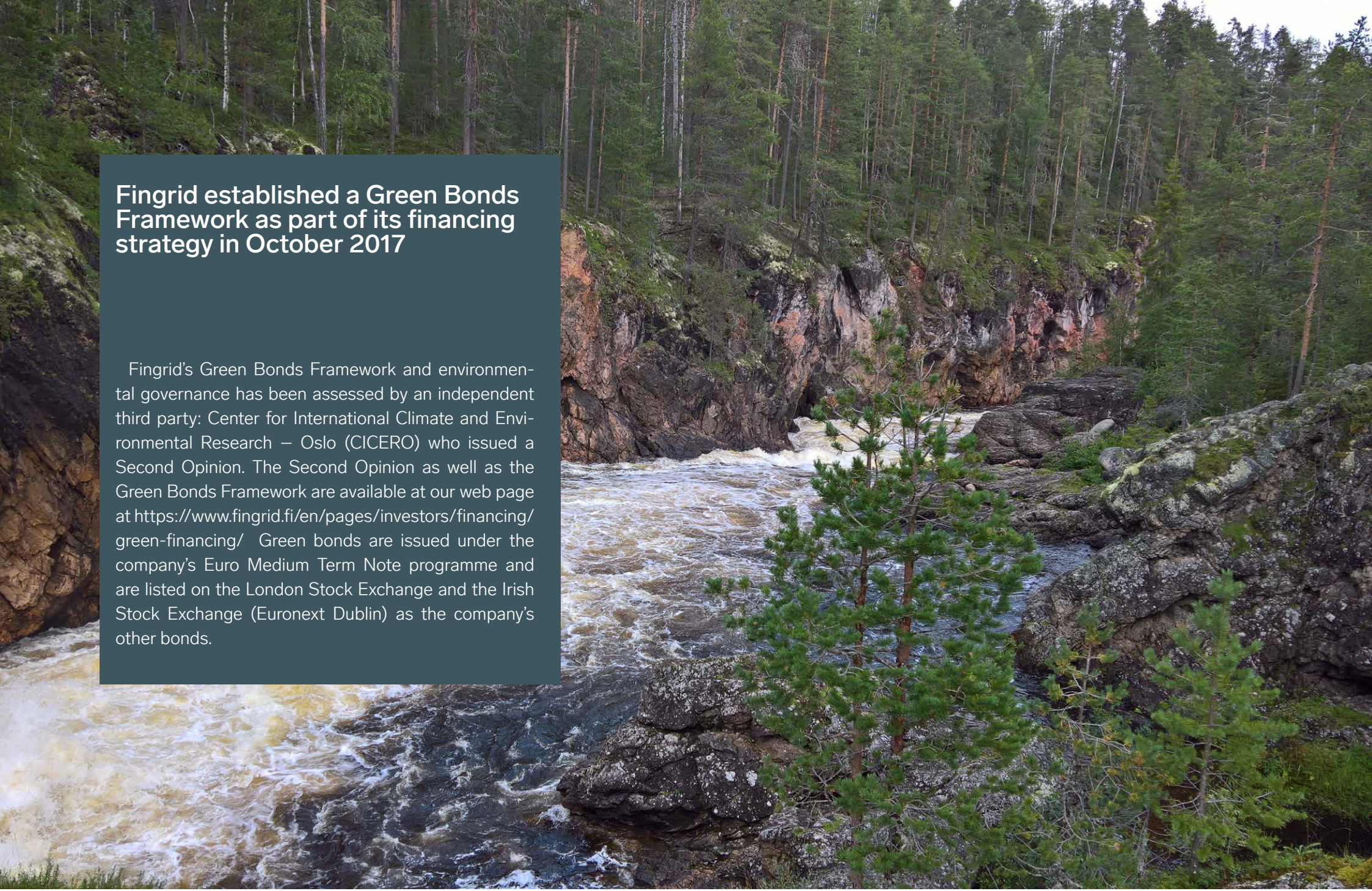
Fingrid's Green Bond eligible investments promote above listed SGDs in practice when e.g. renewable power generation is connected to our green bond financed substations and/or power transmission losses are reduced following a transmission line upgrade financed with green bond.

In 2020 Fingrid updated its materiality analysis on corporate responsibility. As part of this update certain short and long term targets were updated. Regarding green financing, Fingrid affirmed its target to increase the amount of green financing as one of the company's Environmental, Social and Governance (ESG) targets reported in context of the annual report.

This Green Bond Report is aligned to the reporting requirements of Fingrid's Green Bond Framework and is intended to provide further insight into Fingrid's green financing activity

Fingrid reports the estimated impact of CO2-equivalent (CO2-eqv) avoided thanks to the Green Bond investments. The estimated impacts of Fingrid's investments have been verified by an independent external party (Mitopro ltd.) and their statement is included to this report on page 15. This is the first year Fingrid' uses its real-time CO2 emissions estimate to calculate the estimated impact of CO2-eqv avoided. Further information of the CO2 emission estimate calculation (for electricity consumed in Finland) is available at our webpage at https://www.fingrid.fi/en/electricity-market/electricity-market-information/real-time-co2-emissions-estimate/





## Fingrid established a Green Bonds Framework as part of its financing strategy in October 2017

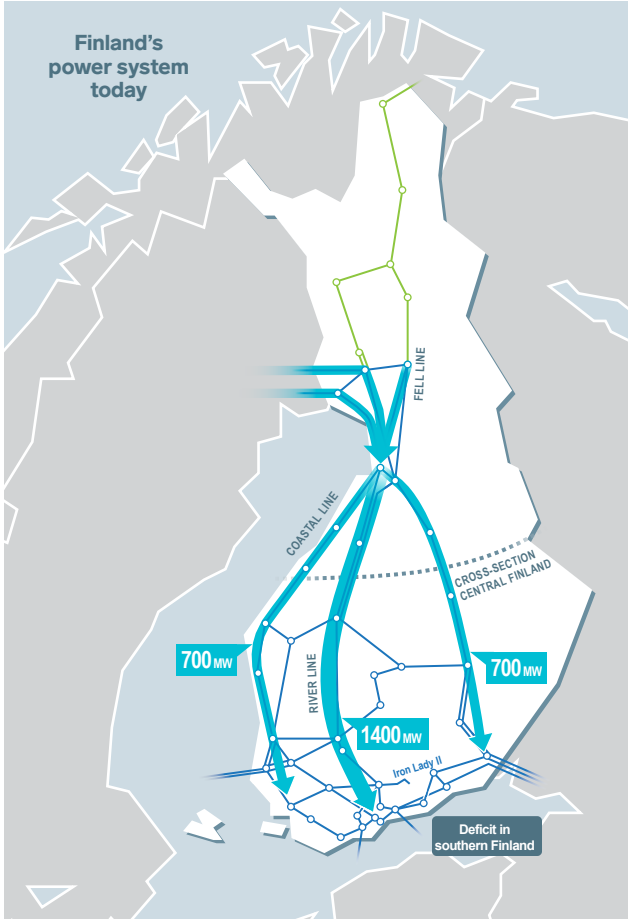
Fingrid's Green Bonds Framework and environmental governance has been assessed by an independent third party: Center for International Climate and Environmental Research – Oslo (CICERO) who issued a Second Opinion. The Second Opinion as well as the Green Bonds Framework are available at our web page at https://www.fingrid.fi/en/pages/investors/financing/green-financing/ Green bonds are issued under the company's Euro Medium Term Note programme and are listed on the London Stock Exchange and the Irish Stock Exchange (Euronext Dublin) as the company's other bonds.

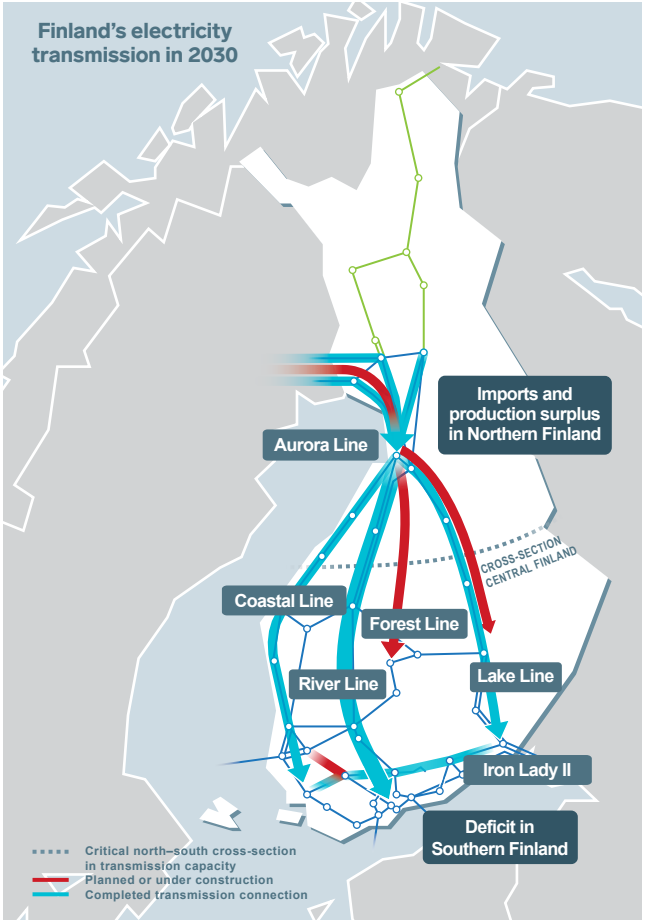
# Investments financed with Green Bonds

Under the Green Bonds Framework the company can finance investments which connect renewable energy, increase cross-border capacity, reduce electricity transmission losses and/or improve energy efficiency via smart grids.

These investments are facilitated by market developments in recent years as condensing power plants and even combined heat and power plants are being shut down in Southern Finland. The energy deficit is met mainly by renewable power generated in Northern Finland, Sweden and Norway. This new geographical distribution of energy generation requires more transmission capacity across the Swedish border and from North to South. Wind power generation in Finland has increased tenfold in last decade, and capacity growth of new onshore wind power generation is expected to continue strong in the forthcoming years. In forthcoming years wind power is estimated to reach 7000-8000 MW by the end of 2024.

Regarding green bond eligible investments, Fingrid has invested heavily in order to connect new wind farms and has also increased capacity as well as reliability of the grid for existing hydro power. As part of its long term investment plan, Fingrid has been renewing several old power lines with modern structures reducing electricity transmission losses significantly. This includes projects where one of the company's oldest East-West connection, the Iron Lady, from 1928 has been replaced with new power lines mainly on the existing right of way.



# Inaugural Green Bond issued in November 2017

Fingrid issued on the 23rd November a 10 year, EUR 100 million green bond with a coupon interest of 1.125 per cent. The issue was the first ever Finnish corporate green bond issue. The transaction raised broad international interest and expanded the company's debt investor base. The bond accounts for approximately 9 per cent of the company's total debt. The bond is listed on the London and Irish Stock Exchanges and is also included into the Climate Bonds Initiative's global green bond database.

Fingrid was awarded a certificate in recognition of creating the First Corporate Green Bond in Finland in May 2018 by the Climate Bonds Initiative. The Awards are in recognition of organisations, financial institutions and government bodies and individuals who have led the development of green finance and green bond markets in the past year and through their pioneering initiatives and issuance have provided positive examples of climate resilient and low carbon investment.

Green Bond Awards 2018

Climate Bonds

**WINNER**
**FINGRID** (FINLAND)
FIRST CORPORATE
BONDS IN COUNTRIES

Sustainability is one of Fingrid's core corporate values. Transmission lines in summery Finland.

# Projects financed with the Green Bond proceeds

The proceeds of EUR 100 million from the November 2017 Green Bond were allocated in accordance with the criteria and decision making process for eligible projects defined in Fingrid's Green Bonds Framework.

Fingrid's Steering Committee for Finance and Business Development unanimously approved in December 2017 the following list of eligible projects totaling EUR 154 million and decided that an amount equal to the proceeds from the inaugural green bond i.e. EUR 100 million shall be allocated to refinance and finance these committee approved eligible projects. An amount equal to the proceeds from the inaugural green bond i.e. EUR 100 million was fully allocated to refinance and finance committee approved eligible projects at the end of 2018. In 2020 the Committee approved new projects with a total estimated capex of around EUR 180 million. The pool of approved eligible projects will be reviewed during 2021 for new projects potentially to be financed with Green Bonds. No new Green Bonds were issued in 2020, but the company aims to increase the amount of Green Bond financing going forward,

*"Eligible projects are expected to have long-term net positive environmental impacts."*

**Estimated costs of eligible approved projects totalled EUR 154 million for the 2017 issue**

| | Project | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| Refinance | Expansion of Keminmaa substation | | | 2 | | | | | | |
| | Reconductoring of Isohaara-Raassakka 110 kV transmission line | | 1 | 1 | | | | | | |
| | New 220 kV substation Kuolajärvi | | 1 | 3 | 1 | | | | | |
| | New 110 kV substation Siikajoki | | | 3 | 1 | | | | | |
| | Refurbishment and expansion of Taivalkoski substation | | | 1 | 4 | | | | | |
| | Expansion of Tuovila substation | | 1 | 2 | 1 | | | | | |
| | Expansion of Pirttikoski substation and a new 400/220 kV transformer | | 1 | 6 | 1 | | | | | |
| | New Hikiä-Forssa 400 kV transmission line | 3 | 11 | 14 | 5 | | | | | |
| New projects | Renewal of Petäjäskoski 220 kV substation and a new 400/220 kV transformer | | 3 | 7 | 6 | 1 | | | | |
| | New 400/110 kV transformer substation Isokangas | | | 3 | 13 | 1 | | | | |
| | New 400/110 kV transformer at Kristinestad substation | | | | 6 | 1 | | | | |
| | New Vihtavuori-Koivisto 110 kV transmission line | | | | | 3 | | | | |
| | New 220/110 kV transformer at Seitenoikea substation | | | | 1 | 2 | | | | |
| | New Lieto-Forssa 400 kV transmission line | | | 2 | 10 | 10 | 1 | | | |
| | New Lempiälä-Vuoksi 400 kV transmission line | | | | | 1 | 5 | 2 | | |
| | New Hikiä-Orimattila 400 kV transmission line | | | | | 3 | 10 | 9 | 1 | |
| Totals | Refinance MEUR 64 | 3 | 15 | 33 | 14 | | | | | |
| | New projects MEUR 90 | | 3 | 12 | 37 | 21 | 16 | | | |
| | **Total MEUR 154** | **3** | **18** | **45** | **50** | **22** | **16** | | | |

## Allocation of green bond proceeds to approved eligible projects

| | Project | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| Refinance | Reconductoring of Isohaara-Raassakka 110 kV transmission line | | | 1 | | | | | | |
| | New 220 kV substation Kuolajärvi | | 1 | 3 | 1 | | | | | |
| | New 110 kV substation Siikajoki | | 1 | 3 | 1 | | | | | |
| | Refurbishment and expansion of Taivalkoski substation | | | 1 | 4 | | | | | |
| | Expansion of Tuovila substation | | 1 | 3 | 1 | | | | | |
| | Expansion of Pirttikoski substation and a new 400/220 kV transformer | | 1 | 6 | 1 | | | | | |
| | New Hikiä-Forssa 400 kV transmission line | 4 | 9 | 16 | 4 | | | | | |
| New projects | New 400/110 kV transformer substation Isokangas | | 1 | 3 | 13 | 1 | | | | |
| | New 400/110 kV transformer at Kristinestad substation | | | | 6 | 1 | | | | |
| | New Hikiä-Orimattila 400 kV transmission line | | | | | 2 | 9 | | | |
| | New Lempiälä-Vuoksi 400 kV transmission line | | | | | | 2 | | | |
| Totals for MEUR 100 allocation | Refinance MEUR 62 | 4 | 13 | 32 | 12 | | | | | |
| | New projects MEUR 38 | | 1 | 3 | 19 | 4 | 11 | | | |
| | **Total MEUR 100** | **5** | **13** | **35** | **31** | **4** | **11** | | | |

*"No new Green Bonds were issued in 2020, but the company aims to increase the amount of Green Bond financing going forward,"*

The projects completed in 2015–2016 and with a cost of EUR 62 million in total were fully refinanced with the green bond proceeds. The new projects completed in 2017 were also fully financed with EUR 27 million of green bond proceeds. The remaining EUR 11 million was placed into company's liquidity reserves and was allocated to costs incurred during in 2018 arising from Hikiä-Orimattila (EUR 9 million) and Lempiälä Vuoksi (EUR 2 million) transmission line projects. Green bond financing accounted for an estimated 60% for Hikiä-Orimattila's and 40% of Lempiälä- Vuoksi's total project costs of estimated EUR 18 million and EUR 7.5 million in total. Hikiä-Orimattila transmission line investment project was completed in December 2019 and Lempiälä-Vuoksi project in September 2019 – both in budget and well in schedule.

*"Green Bond proceeds were allocated across eleven eligible projects."*

## Description of projects

| Project | Description |
|---|---|
| Reconductoring of Isohaara-Raassakka 110 kV transmission line | Conductors were changed to connect more wind power and reduce losses |
| New 220 kV substation Kuolajärvi | New substation for connecting new wind power |
| New 110 kV substation Siikajoki | New substation for connecting new wind power |
| Refurbishment and expansion of Taivalkoski substation | A substation was refurbished and expanded in order to connect new wind power and existing hydro power |
| Expansion of Tuovila substation | Part of new 400 kV network on western coast that enables connection of new wind power, better transmission capacity for FI-SE cross-border lines and north-south connection |
| Expansion of Pirttikoski substation and a new 400/220 kV transformer | A new transformer that enables more wind power and reliable connection for existing hydro power |
| New Hikiä-Forssa 400 kV transmission line | Old 110 kV line was replaced by 400+110 kV power line resulting in significant drop in losses |
| New 400/110 kV transformer substation Isokangas | Network was enhanced in order to connect new wind power and existing hydro power |
| New 400/110 kV transformer at Kristinestad substation | A second 400/110 kV transformer was needed to connect more wind power |
| New Hikiä-Orimattila 400 kV transmission line | An old 110 kV power line is going to be replaced with 400+110 kV power line to increase capacity to Lahti region. Old coal fired CHP is going to be shut down and replaced with bio district heating plant. New power line results also in significantly lower losses |
| New Lempiälä - Vuoksi 400 kv transmission line | Old 110 kV line is going to be replaced by 400 kV power line resulting in significant drop in losses |

## A summary of the estimated impacts to be achieved from the funded projects

| Project | Renewable capacity [2] | | | | Transmission losses reduced |
|---|---|---|---|---|---|
| Applicable SGDs to all projects | Cumulative until 12/2019 | Cumulative until 12/220 | New renewable capacity estimated in next three years[3] | Total estimated impact | 12/2020 |
| Reconductoring of Isohaara-Raassakka 110 kV transmission line | 100 MW | 100 MW | 0 MW | 100 MW | approx. 60% |
| New 220 kV substation Kuolajärvi | 50 MW | 50 MW | 0 MW | 50 MW | n/a |
| New 110 kV substation Siikajoki | 200 MW | 150 MW | 350 MW | 500 MW | n/a |
| Refurbishment and expansion of Taivalkoski substation | 100 MW | 100 MW | 100 MW | 200 MW | n/a |
| Expansion of Tuovila substation | 50 MW | 100 MW | 0 MW | 100 MW | n/a |
| Expansion of Pirttikoski substation and a new 400/220 kV transformer | 100 MW | 100 MW | 200 MW | 300 MW | n/a |
| New Hikiä-Forssa 400 kV transmission line | n/a | n/a | n/a | n/a | approx. 95% |
| New 400/110 kV transformer substation Isokangas | 50 MW | 50 MW | 300 MW | 350 MW | n/a |
| New 400/110 kV transformer at Kristinestad substation | 150 MW | 250 MW | 250 MW | 500 MW | n/a |
| New Hikiä-Orimattila 400 kV transmission line | n/a | n/a | n/a | n/a | approx. 80% |
| New Lempiälä-Vuoksi 400 kV transmission line | n/a | n/a | n/a | n/a | approx. 80% |
| **Total by these investments****** | **750 MW** | **850[4] MW** | **1 250 MW** | **2 100 MW** | **n/a** |
| **Total estimated $tCO_2$ eqv avoided p.a.** | **221 000** | **207 000** | **303 00** | **510 000** | **n/a** |

*"Thanks to the Green Bond projects an estimated 207 000 tCO2 eqv. was avoided in 2020"*

1) Approximations
2) Directly connected or through enhanced transmission capacity by these investments
3) Estimated upon completion 2023 in addition to impacts estimated until 12/2020
4) Reported capacity at 12/2020 increased by 100 MW (net). Renewable generation capacity connected to Siikajoki substation was lowered to 150 MW from 200MW previous year because one wind farm no longer feeds production to this substation but elsewhere. Renewable generation capacity connected to Tuovila substation was increased from 50MW to 200MW because new wind farms connecting to this substation

The estimated tC02 eqv avoided p.a. for 2020 in the table above has been calculated as follows: total realized annual electricity generation of approximately 2,8 GWh from wind farms enabled by the green bond investments in 2020 multiplied by CO2 baseline of 72kg CO2/MWh, which is the 2020 average of CO2 emission coefficient (baseline) for electricity consumption in Finland estimated by Fingrid, (https://www.fingrid.fi/en/electricity-market/electricity-market-information/real-time-co2-emissions-estimate/). In 2020 Fingrid decided to replace previously used baseline coefficient (Statistics Finland's emissions factor) with its own estimated one year average baseline coefficient, which is generally applied also at the company's annual report. Therefore the 2019 total estimated tCO2 eqv avoided was restated resulting to a lower amount of 211 000 tC02 eqv as the baseline used was based on Fingrid's estimation of 101kg CO2/MWh instead of Statistic Finland's emission factor of 158 kg C02/MWh.

The estimated tCO2 estimated in next three years p.a. is calculated as follows: tC02 avoided in 2020 plus estimated new renewable electricity generation capacity enabled by the green bond investments by 2023 multiplied by an estimated annual generation in MWh per annum per installed MW multiplied by CO2 baseline of 72kg CO2/MWh. Estimated annual generation in MWh per annum per installed MW of around 3400 MWh p.a. is based on a weighted average of annual production estimates publicly available of recently commissioned new wind farms in Finland per MW. The C02 baseline applied is the same, which is used for Fingrid' corporate responsibility reporting.

# Health, Safety and Environment

When building and maintaining the main grid, we take landowners and other stakeholders into account, and we reduce environmental impacts at all stages of the grid's life cycle in accordance with Fingrid's land-use and environmental policy.

Key aspects include a thorough environmental impact assessment (EIA) and preparedness for environmental risks. The Finnish Association for Impact Assessment (FAIA) has twice rewarded Fingrid's environmental impact assessment work with its EIA award; the award annually rewards assessments that have significantly developed the assessment procedure.

We commit our contractors and suppliers to operating practices with the help of contractual terms, training and auditing. Fingrid's Supplier Code of Conduct covers issues such as business practices, human rights, labour rights, occupational safety and the environment. It is applied to procurements worth at least EUR 60,000 and they are linked to material, equipment, ICT etc. purchase agreements. Fulfilment of the requirements is monitored on a risk basis. Acknowledgement of the Code is a condition for being included in supplier registers used in recurring substation and power line procurements. In addition, contractual partners are subject to separate contract conditions related to the use of subcontractors and workforce, and to occupational safety and environmental matters.

In 2020, we verified compliance with corporate social responsibility requirements through dozens of risk-based audits. Following a competitive tendering process, expert, outsourced workforce, including from abroad, were employed on the grid's work and maintenance sites in various parts of Finland In addition, key foreign subcontractors were audited by a third party, focusing especially on employment matters and wages. In international goods sourcing, third-party supplier audits were carried out at 15 production plants in a total of nine countries, and six follow-up audits were carried out in order to rectify any observed deficiencies. The audits covered both Fingrid's direct contractual partners and their suppliers, including key material suppliers.

*Fingrid has audited work sites through a risk-based approach toverify compliance with contractor obligations, occupational safety and environmental management.*

# Independent Limited Assurance Report

## To the Management of Fingrid Oyj

### Scope and Objectives

The Management of Fingrid Oyj ("Fingrid") commissioned us to perform a limited third-party assurance engagement over Selected Information presented in the Fingrid Green Bond Investor Letter and Impact Report ("the Report") for the period of 1st January to 31st December 2020.

The assurance engagement was conducted in accordance with the International Standard on Assurance Engagements (ISAE) 3000 revised – 'Assurance Engagements other than Audits and Reviews of Historical Financial Information'.

### Selected Information

The scope and boundary of our work is restricted to the assurance over the avoided greenhouse gas emissions in tonnes of carbon dioxide equivalents, tCO2-eqv ("Selected information") from the Green Bond projects described in page 12 of the Report.

### Responsibilities

Fingrid is responsible for the collection, calculation, and presentation of the Selected information according to the reporting criteria. The Management of Fingrid has approved the Selected information disclosed in the Report. Our responsibility as assurance providers is to express an independent conclusion on the Selected information subject to the limited assurance engagement. To assess the Selected information, which includes an assessment of the risk of material misstatement in the Report, we have used Fingrid's Green Bond Framework and internal impact reporting instructions for estimating the avoidance of greenhouse gas emissions from the Green Bond projects ("the Criteria").

### Assurance Provider's Independence and Competence

We have conducted our assessment as independent and impartial from the reporting organisation. We were not committed to any assignments for Fingrid that would conflict with our independence, nor were we involved in the preparation of the Report. Our team consists of competent and experienced sustainability reporting experts, who have the necessary skills to perform an assurance process.

### Basis of Our Opinion

Assurance providers are obliged to plan and perform the assurance process so as to ensure that they collect adequate evidence for the necessary conclusions to be drawn. The procedures selected depend on the assurance provider's judgement, including their assessment of the risk of material misstatement adhering to the Reporting criteria.

Our opinion is based on the following procedures performed:

- Interviews with Fingrid's specialists responsible for data collection and reporting of the Selected information.
- Review of systems, internal reporting instructions and procedures to generate, collect and report the Selected information for the Report.
- Assessment of calculations and data consolidation procedures and internal controls to ensure the accuracy of the Selected information.
- Testing the accuracy and completeness of the Selected information from original documents and systems on a sample basis.

### Conclusion

Based on the work described in this report, nothing has come to our attention that causes us to believe that the Selected information disclosed in the Report has not been prepared, in all material respects, in accordance with the Criteria.

Helsinki, Finland, 4th February 2021

Mitopro Oy

Mikael Niskala
Independent Sustainability Practitioner

Tomi Pajunen
Independent Sustainability Practitioner

Annex 1.

# Projects financed under the EUR 100 million green bond

TRANSMISSION LOSSES

TOTAL ESTIMATED IMPACT

CROSS-BORDER TRANSMISSION

# Reconductoring of Isohaara-Raasakka 110 kV power line

## Connecting renewable power and reducing losses

- Single conductors were changed to thicker double conductors.
- Transmission losses reduced > 60%.
- Higher transmission capacity made it possible to connect extra 100 MW new wind power with minimum connection costs.
- No new right of way was needed so the negative environmental impact was negligible.
- Project also included new lightning conductors which resulted to much higher reliability: Less failures caused by lightning or snow adhesion to lightning conductors.

TOTAL ESTIMATED IMPACT

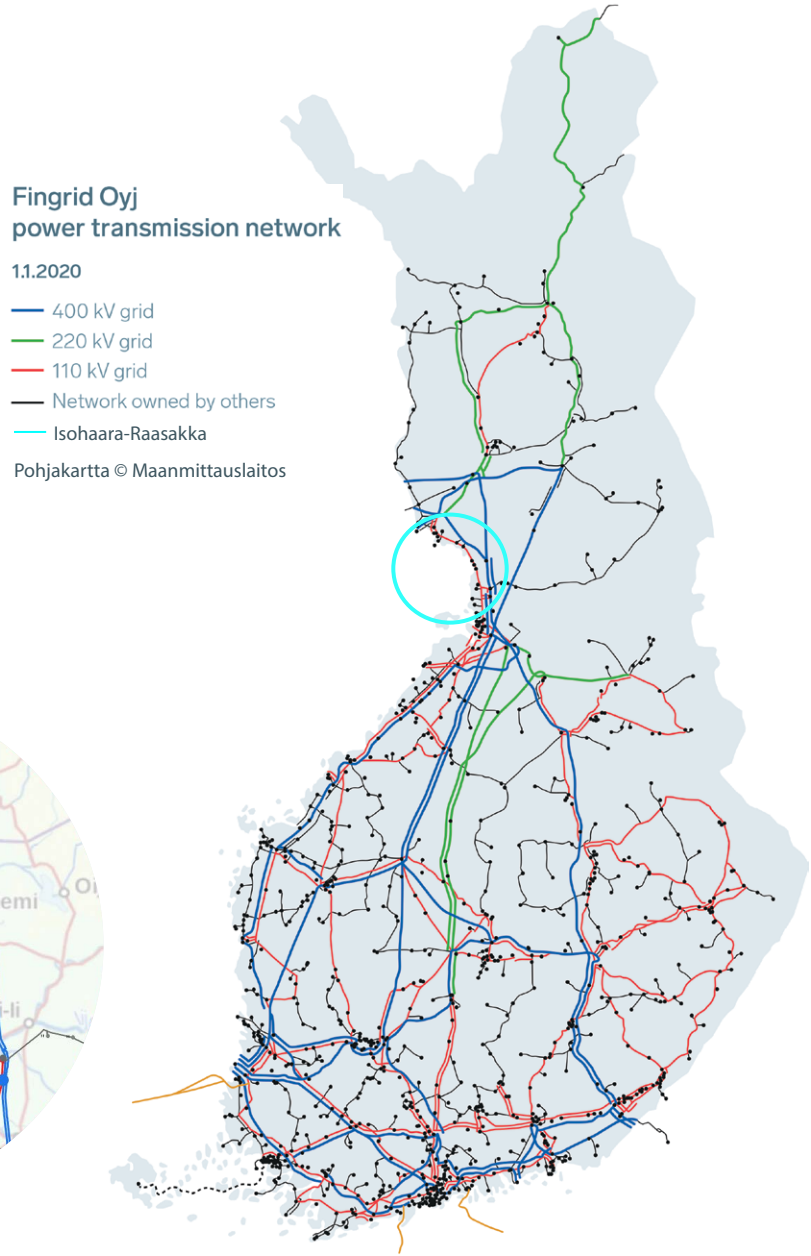
+100 MW

TRANSMISSION LOSSES

-60%

COMMISSIONED

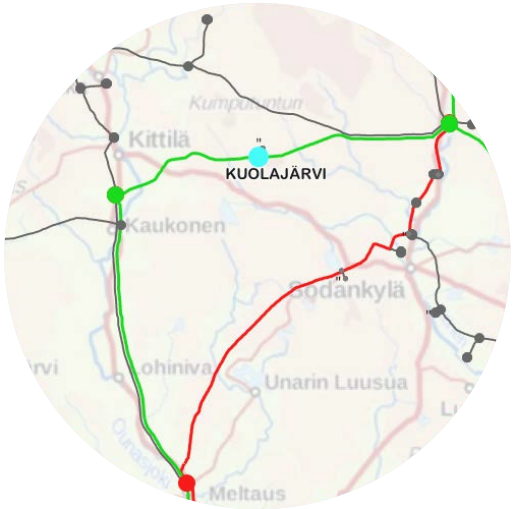
2016

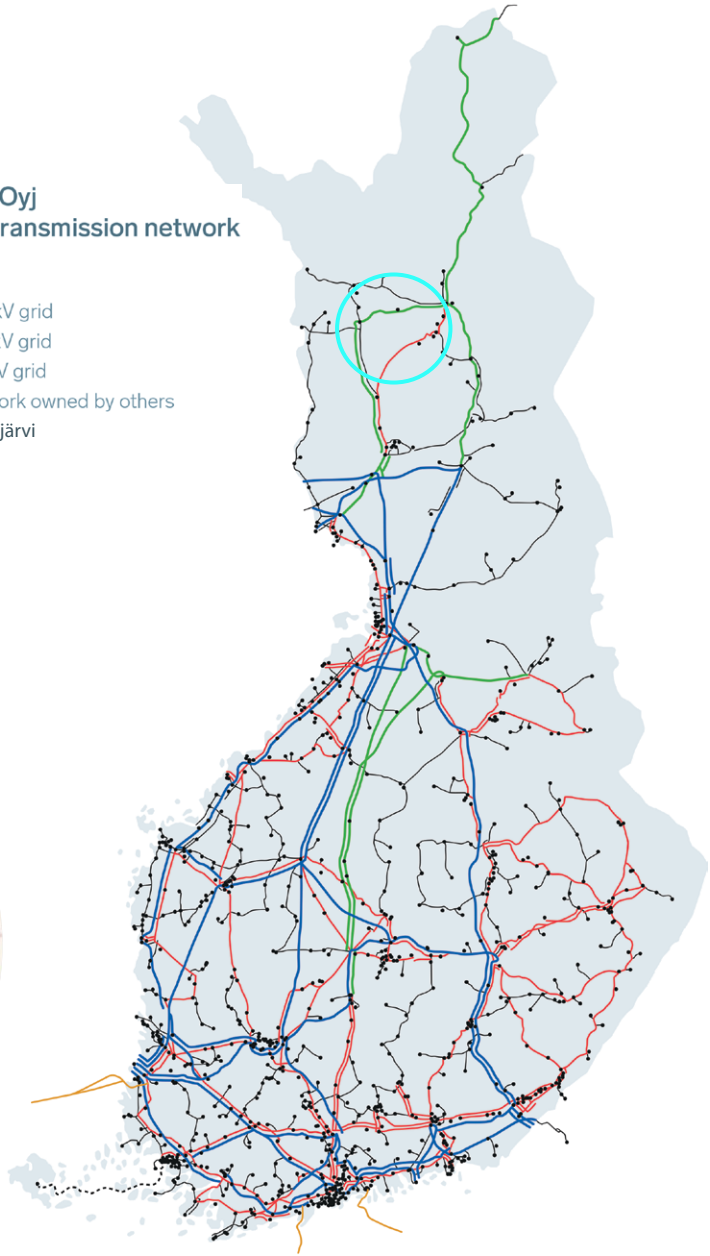



# New 220 kV substation at Kuolajärvi

## Connecting renewable power

- Lapland is very sparsely populated (1,9 people/km2) and distance between existing grid connection points can be more than 100 km.
- Kuolajärvi substation was built in order to connect new wind power to Fingrid's 220 kV transmission line.
- Kuolavaara-Keulakkopää wind park consists of 17 turbines totaling 51 MW.




TOTAL ESTIMATED IMPACT

+50 MW

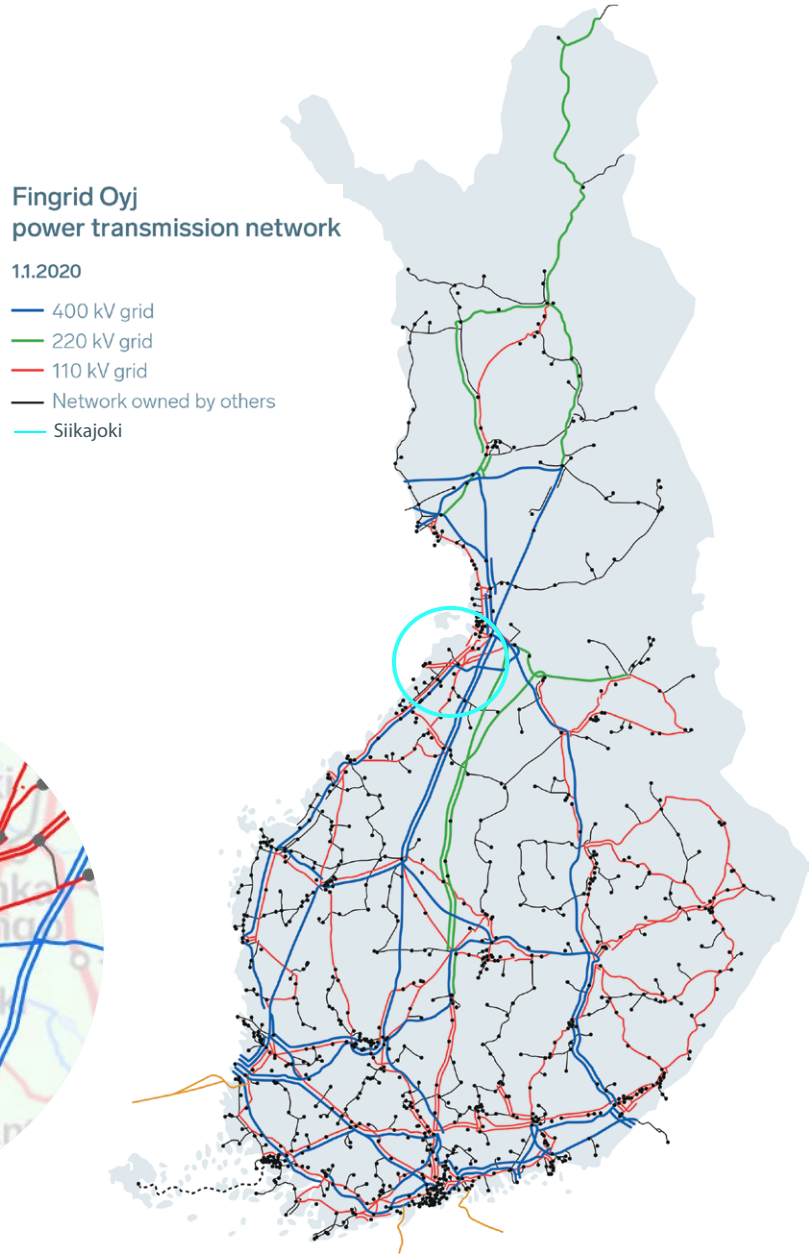
COMMISSIONED

2015

# New 110 kV substation at Siikajoki

## Connecting renewable power

- Ostrobothnian coast is excellent for wind power.
- A new substation was built in order to offer a connection point for wind power.
- 200 MW of wind power has already been connected to the substation and many new projects are expexted in next few years.


TOTAL ESTIMATED IMPACT

**+450 MW**

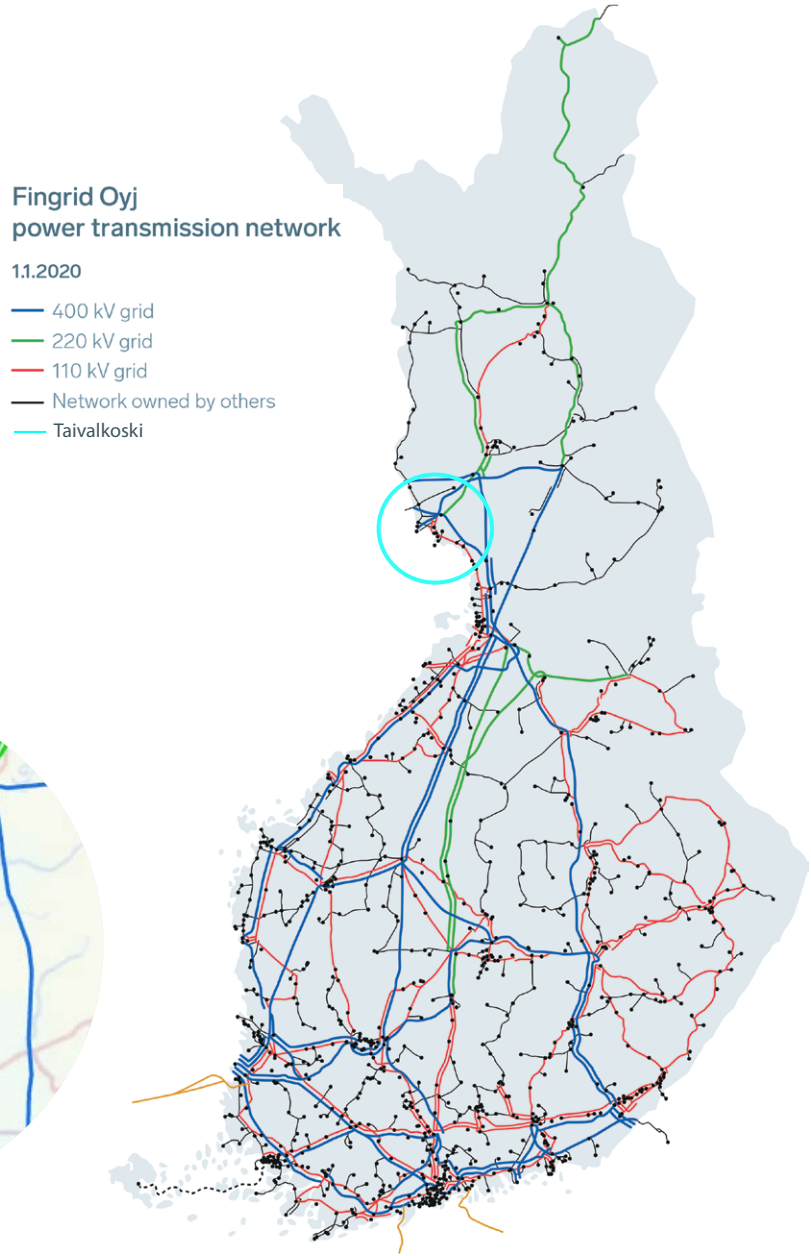
COMMISSIONED

**2016**

# Refurbishment and expansion of Taivalkoski substation

## Connecting renewable power

- More than 130 MW of hydro power is connected to Taivalkoski Substation.
- An old substation was renewed for better reliability and higher transmission capacity.
- Substation was expanded and 100 MW new wind power was connected to the substation and more is expected in next few years.


TOTAL ESTIMATED IMPACT

**+200 MW**

COMMISSIONED

**2016**

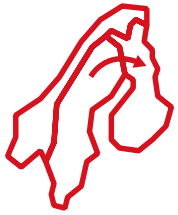
# Expansion of Tuovila substation

## Connecting renewable power

- New 400 kV transmission connection was built on the western coast. Tuovila substation ties the power lines together and offers a strong connection point for new wind power.
- Geographic distribution of power generation requires new transmission capacity from Northern to Southern Finland:
  - » Renewables are replacing fossil fuel power plants in Finland.
  - » Several power plants have been closed down in Southern Finland.
  - » More and more power is coming from wind parks in Northern Finland and from Sweden.
- Ostrobothnian coast is excellent for wind power but the grid was too weak for new power generation:
  - » New 400 kV power line offers enough capacity and new connection point for wind power.

TOTAL ESTIMATED IMPACT

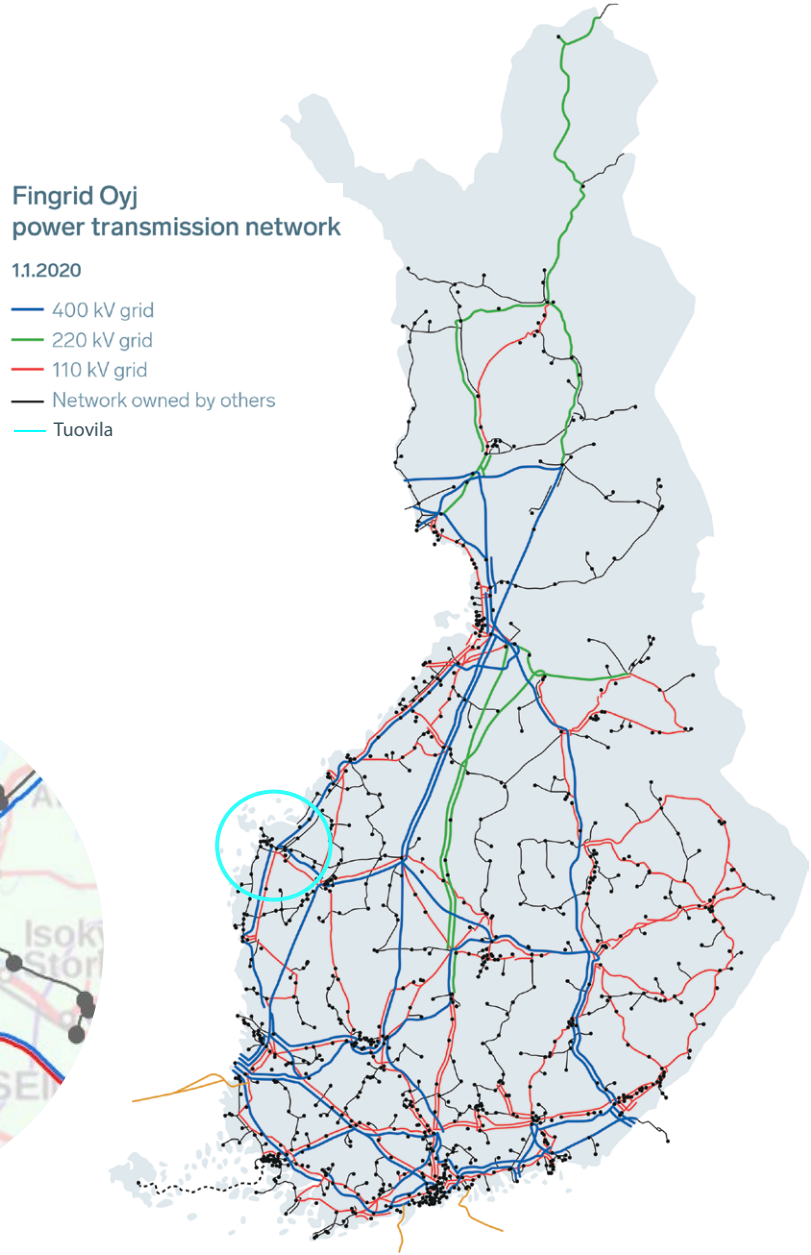
+100 MW



TRANSMISSION CAPACITY

COMMISSIONED

2016

# Expansion of Pirttikoski substation and a new 400/220 kV transformer

## Connecting renewable power

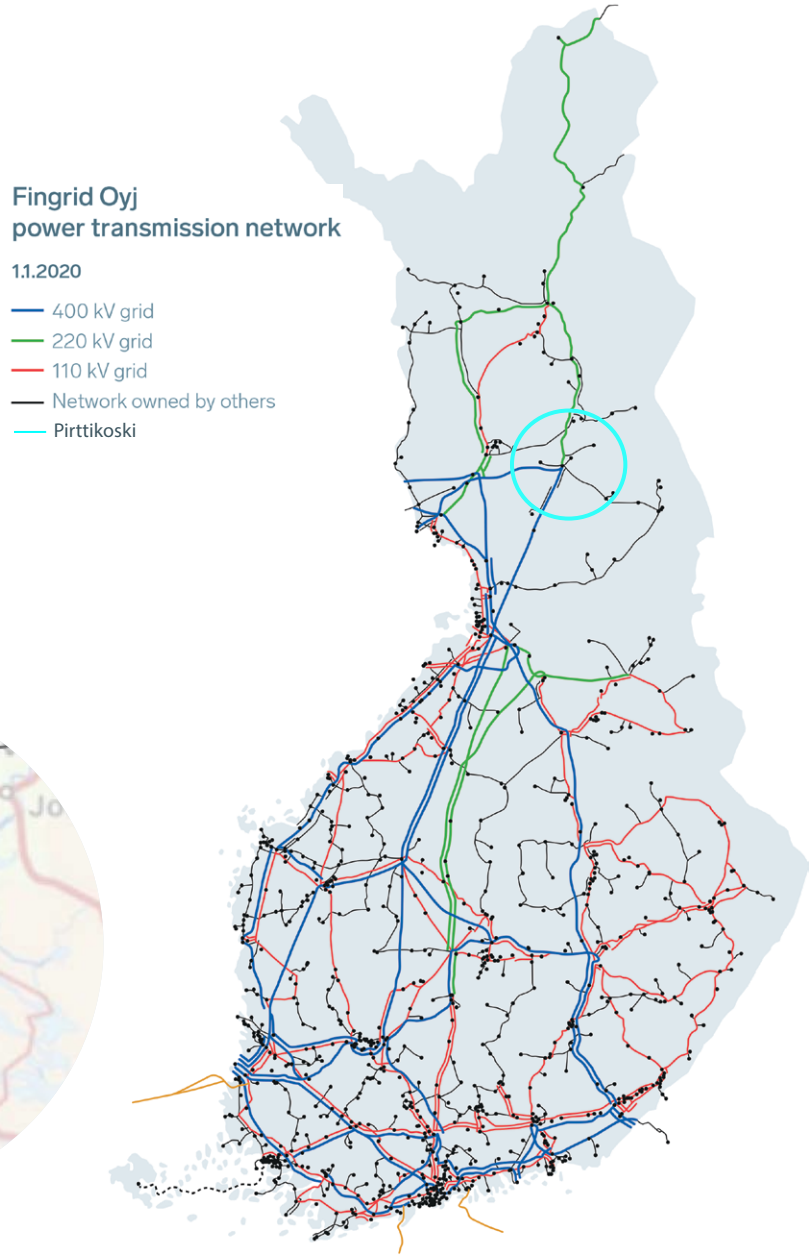
- One third of Finnish hydro power is situated in Lapland. On top of 1000 MW of hydro there is also more than 100 MW of wind power and there are numerous wind power projects being planned.
- Power grid in Lapland is connected to rest of Finnish power system in Pirttikoski and Petäjäskoski 400/220 kV transformer substations.
- Transmission capacity and reliability in Pirttikoski were insufficient:
  - » A second transformer was added and 400 kV substation was expanded and modified to more reliable.
- New transformer capacity makes it possible to connect new wind power and eliminates the need to limit power in outage situations.

TOTAL ESTIMATED IMPACT

+100 MW

COMMISSIONED

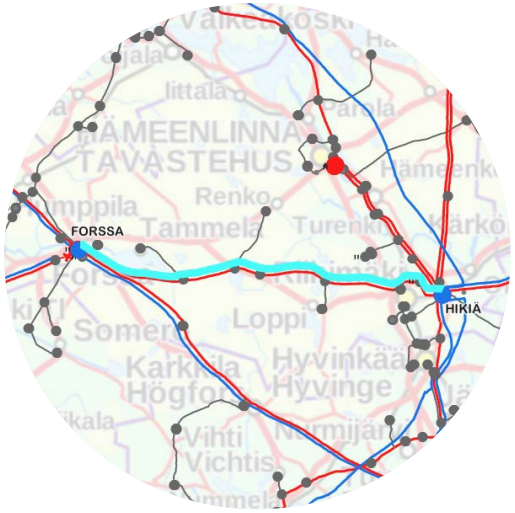
2015

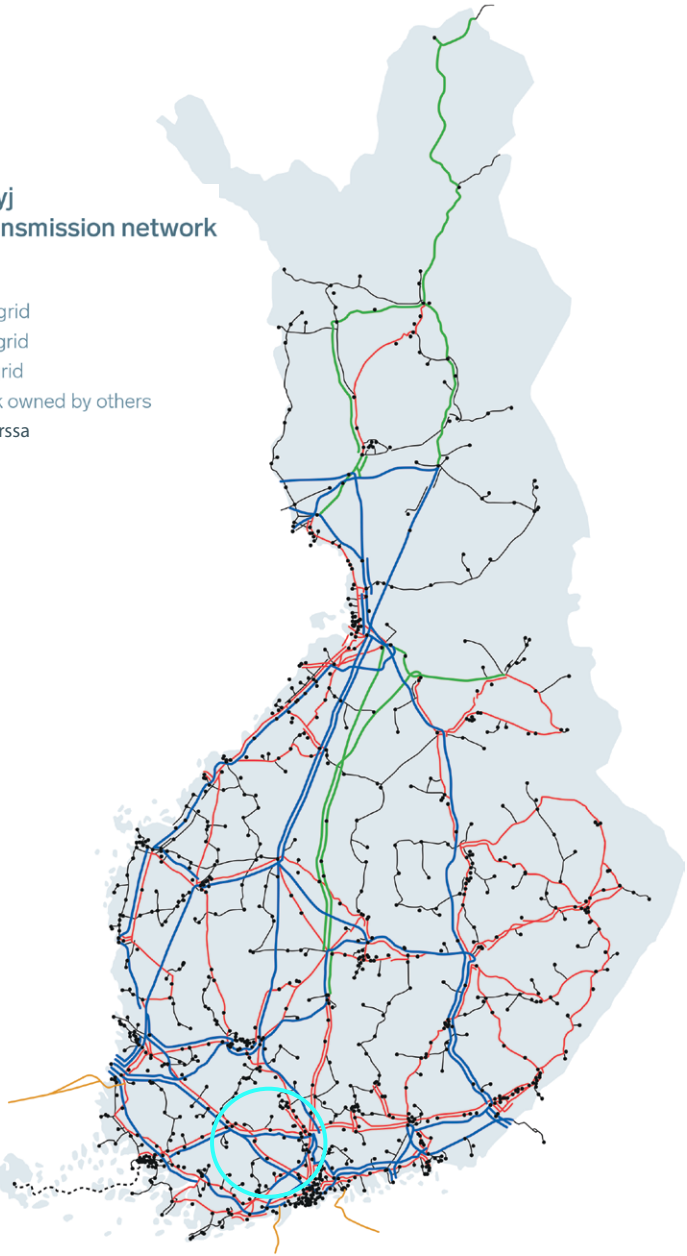



# New Hikiä-Forssa 400 kV transmission line

## Reducing losses

- Oldest 110 kV power line in Finland is being replaced with a new one.
- New power line was built on existing right of way. In Riihimäki city area a new route was used in order to free up land for city development.
- New power line has 95 % lower transmission losses and more than 700 % higher transmission capacity.
  - » New power line carries more and thicker conductors and losses sink when transmission voltage is upgraded to 400 kV.




TRANSMISSION LOSSES

**-95%**

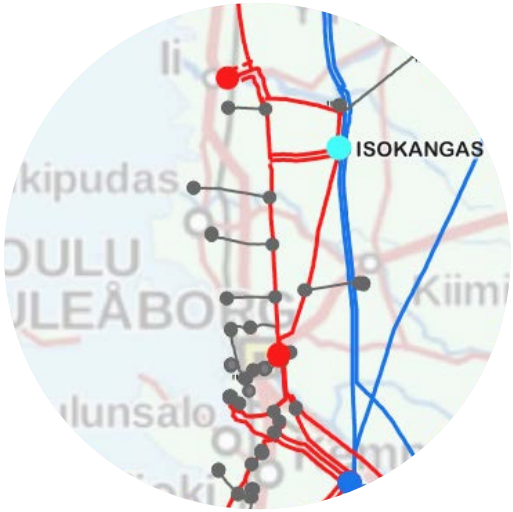
COMMISSIONED

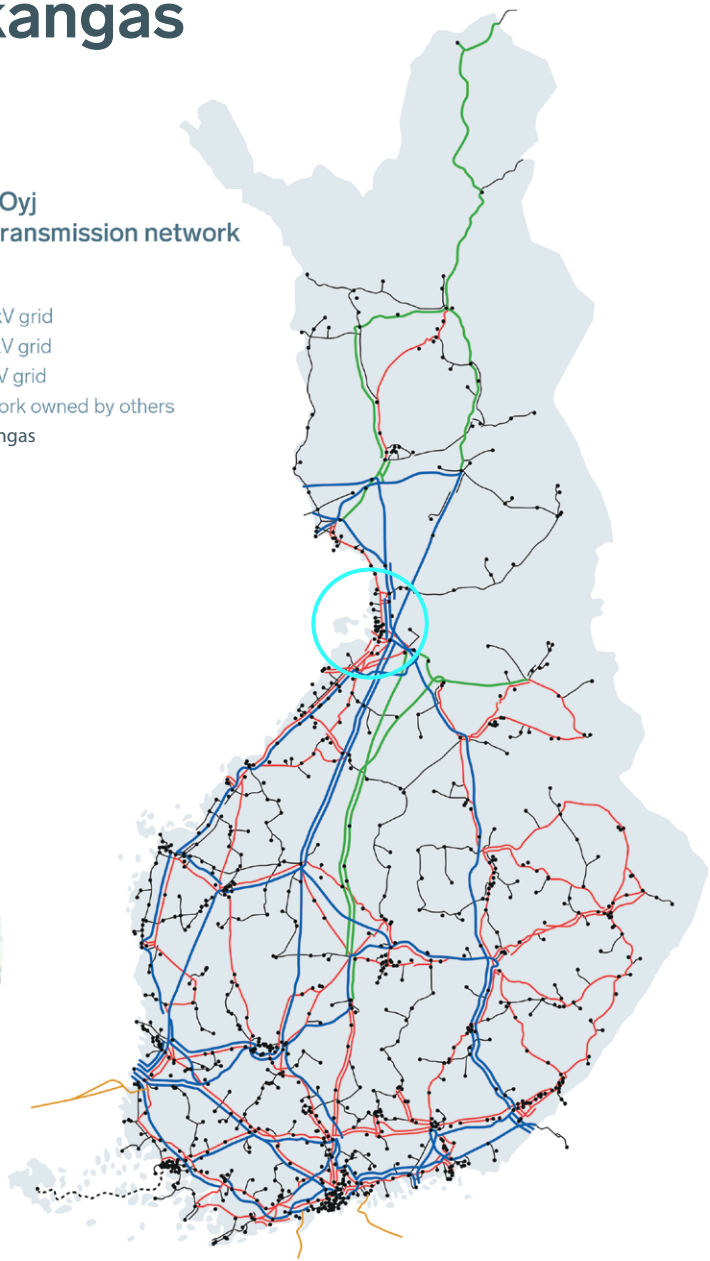
**2016**

# New 400/100 kV transformer substation Isokangas

## Connecting renewable power

- There are several hydro power plant in Iijoki river. Total power is 200 MW.
- New wind power is being built and planned in Iijoki region and Sea-Lapland coast.
- Transmission capacity had run out after several capacity increases in existing hydro power plant.
- A new 400/110 kV transformer station was built in order to increase realiability and transmission capacity for existing hydro power and make it possible to connect new wind power to the network.
- New transformer station also reduces losses by several megawatts.




TOTAL ESTIMATED IMPACT

**+300 MW**

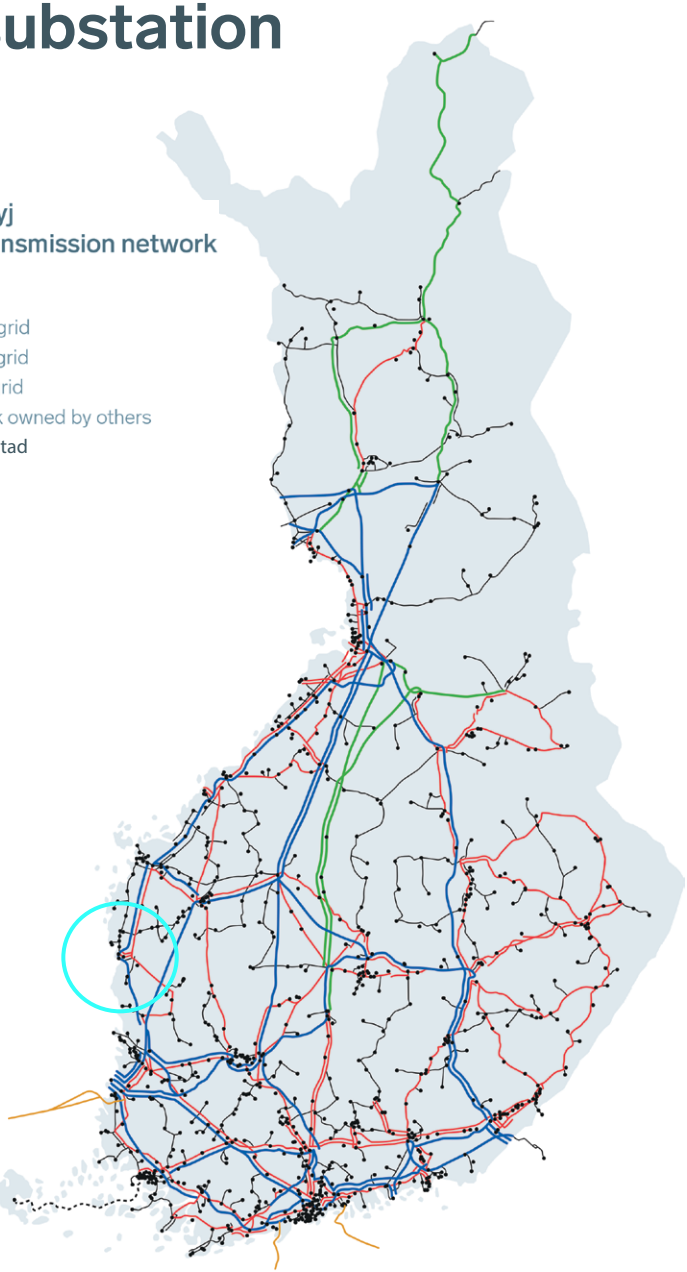
COMMISSIONED

**2016**

# New 400/110 kV transformer at Kristinestad substation

## Connecting renewable power

- Kristinestad substation was built in 2014 in the center of one of the best wind power areas in Finland:
  - » Kristinestad substation replaced an old substation that was situated 6 km from the new substation next to oil and coal fired condensing power plants. These power plants have now been closed.
- A second 400/110 kV transformer was added to Kristinestad in 2017.
- Connection capacity for wind power increased 300 MW totaling 500-600 MW:
  - » The transformer also made it possible to change the use of surrounding 110 kV network. New wind power can now be connected to grid without the need of building new power lines.


TOTAL ESTIMATED IMPACT

**+500 MW**

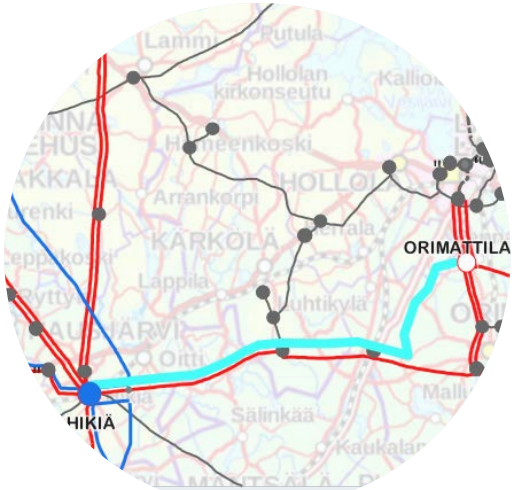
COMMISSIONED

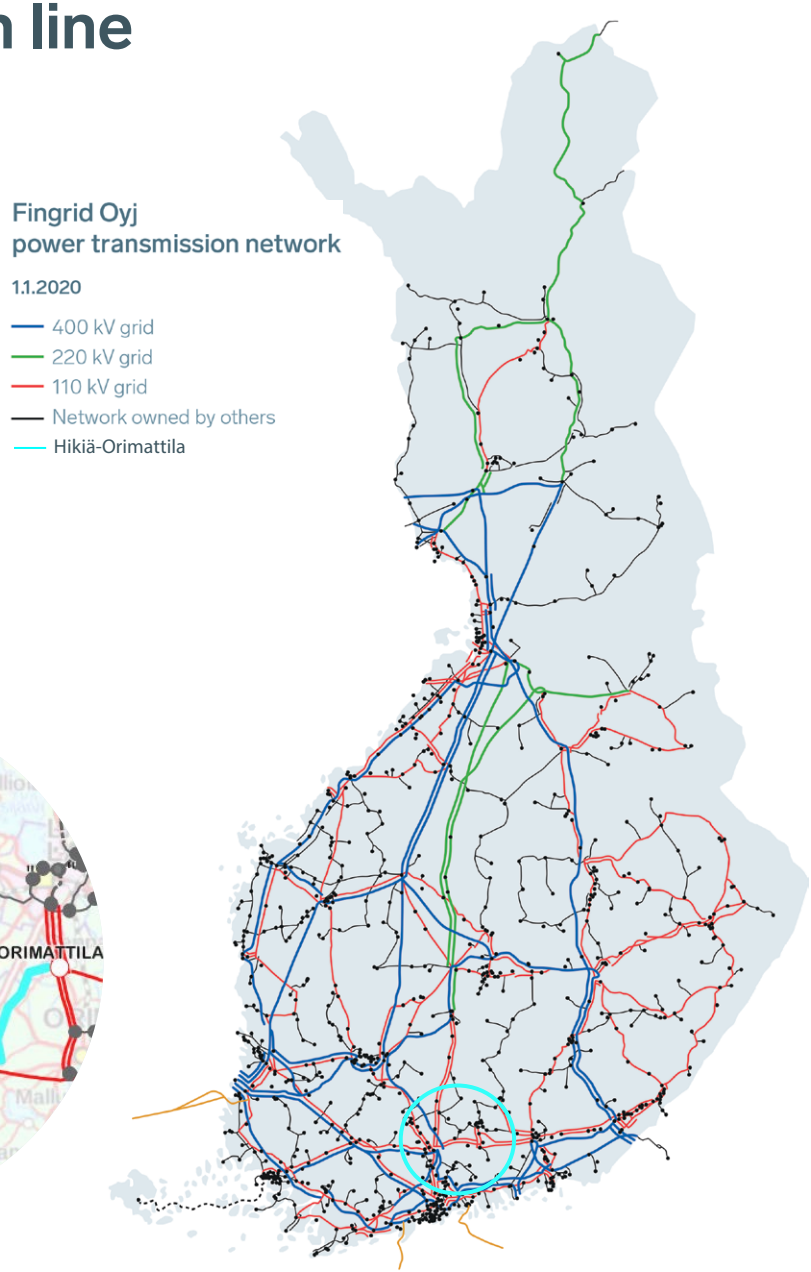
**2017**

# New Hikiä-Orimattila 400 kV transmission line

## Reducing losses

- Oldest 110 kV power line in Finland is being replaced with a new one.
- New power line has 80% lower transmission losses and almost 500% higher transmission capacity:
  - » Power line structure makes it possible to upgrade voltage from 110 to 400 kV → Even higher capacity and lower losses.
- The new transmission line will provide (replacement) transmission capacity to a region where a coal fired combined heat and power plant is being closed and replaced with bio district heating plant, which has no electricity production.




TRANSMISSION LOSSES

**-80%**

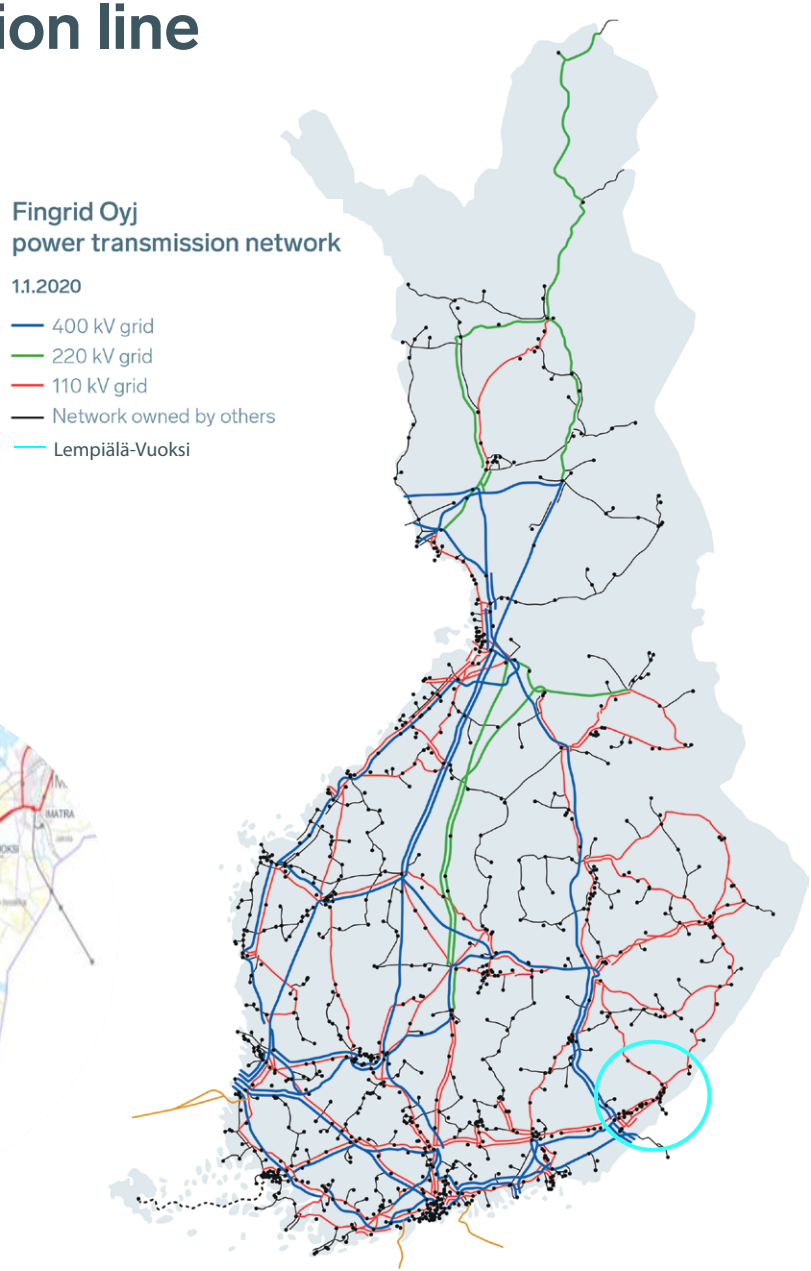
COMMISSIONED

**2019**

# New Lempiälä – Vuoksi 400 kV transmission line

## Reducing losses

- Old 110 kV wooden power line is being replaced by a new structure on existing right of way.
- New power line is built with 400 kV towers and conductors but is used in 110 kV voltage level.
- New power line has **80 % lower transmission losses** and more than **400 % higher transmission capacity**
- New power line can be taken into 400 kV use later if more transmission capacity is needed. This upgrade would lower the losses yet another 90% (total drop almost 99%).


TRANSMISSION LOSSES

**-80%**

COMMISSIONED

**2019**

FINGRID

Fingrid Oyj
Läkkisepäntie 21
FI-00620 Helsinki
P.O.Box 530
FI-00101 Helsinki, Finland
Tel. +358 30 395 5000
Fax. +358 30 395 5196