2 2024

FINGRID

TRANSMISSION SYSTEM OPERATOR'S MAGAZINE / RENEWING THE ENERGY SYSTEM / *fingridlehti.fi*

ELINA KÄRKIMAA, ILMATAR:
"Solar power production has become financially viable in Finland."

Clean electricity is a competitive advantage

The work done to balance electricity production and consumption is becoming more efficient

THE AURORA LINE WILL TRAVEL

380
kilometres

FROM FINLAND TO SWEDEN.

THE PROJECT HAS RECEIVED

EUR 127
million

IN EU GRANTS FROM THE CONNECTING EUROPE FACILITY.

Many balls in the air

Detailed planning and foresight are the key jobs of a project manager on a transmission line project. They must also be ready to respond swiftly to unexpected challenges.

Fingrid and Svenska kraftnät, the Swedish transmission system operator, are building the 400 kilovolt Aurora Line from Pyhänselkä in Finland to Messaure in Sweden. The project will be completed next year.

"My main responsibilities on the transmission line project are to keep to the timetable and ensure high standards of quality and occupational safety. I also need to keep the costs under control," says **Ritva Laine**, Senior Project Manager at Fingrid.

The project began with the Environment Impact Assessment phase in 2016. Laine, the project manager, contributed to the process as a technical specialist responsible for the feasibility of construction along the chosen route, among other things.

"That phase included identifying a route that would minimise the harm to nature and people," she explains.

The Aurora Line is Fingrid's largest investment this decade. When complete, the transmission line will enhance the efficiency of the electricity market, improve the reliability of the electricity supply, and enable more renewable electricity production in the Nordic and Baltic Sea regions.

At the start of the construction project, an international competitive tendering procedure was carried out to select the contractors. After that, the work could begin.

One challenge of the project has been the sudden changes in the prices and availability of materials since Russia invaded Ukraine. Other bumps in the road include the planning and implementation of electricity distribution outages where old lines cross new ones.

Building in the middle of the wilderness also keeps the project manager on her toes:

"In the morning, it is hard to predict what issues I will have to address as the day goes on. Bad weather can cause delays – large machinery can only get to some worksites in the winter when the ground is frozen. Sometimes work is suspended because of strong wind or severe cold," Laine explains.

Next year, when the construction project is complete, Laine's share of the work will also be done:

"My role in the Aurora Line ends when the project is handed over to maintenance." ◆

Inspections are also among the project manager's responsibilities. Ritva Laine inspects sites to check, for example, that towers have been assembled properly and are safe to erect. "Most of this is work and planning done in advance to ensure that towers are assembled in the correct locations and in suitably-sized sections in light of the terrain, among other things."

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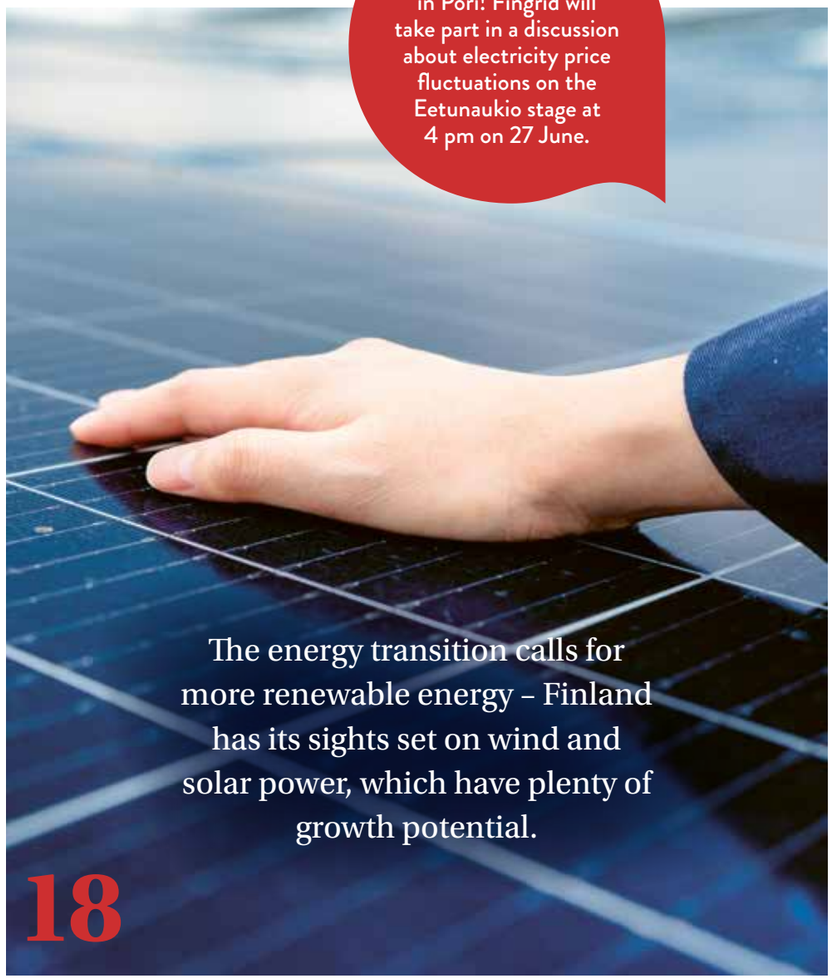
RENEWING
THE ENERGY SYSTEM

See you at **SuomiAreena** in Pori! Fingrid will take part in a discussion about electricity price fluctuations on the Eetunaukio stage at 4 pm on 27 June.



The energy transition calls for more renewable energy – Finland has its sights set on wind and solar power, which have plenty of growth potential.

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REGULAR SECTIONS

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The green transition needs grids

LAST YEAR, Europe finally realised that the green transition depends on energy networks.

In November 2023, the Commission published EU Action Plan for Grids. By 2030, the cross-border transmission capacity must double, and EUR 600 billion must be invested in electricity networks.

The action plan suggests ways to accelerate network investments. Long-term network planning must be improved by integrating the needs of the rapidly developing renewable electricity production technologies and the increasing volume of production.

More efficient use of networks should be promoted by providing more open information on where connectivity is available and how connection capacities can be maximised. Various incentivizing methods, such as tariffs, can encourage more efficient use of networks.

Regulation also has a role to play: it can enable forward-looking investments and, with good permit processes, accelerate the implementation of investments. Considerations include distributing the costs of offshore networks, although it must be weighed carefully. There has been less discussion of the amount of return permitted by the regulations on network operators' businesses and the financing requirements in a major investment phase.

Networks are the backbone of the green transition.

Sampo Korhonen

Networks are the backbone of the green transition. As a grid operator, Fingrid does its best to cater to the needs of its customers and the country as a whole. We have the most competitive network in Europe, demonstrated by our high transmission reliability rate and competitive transmission price.

We must make sure we can continue to develop the power system and the networks it requires vigorously.

The slow and unpredictable permit application processes and an economic regulatory model that constrains financial leeway do not bode well. The EU is now aware of the importance of networks, and the means of developing networks are a major focus.

The backbone of Finland's energy system should also be a matter of prime importance to the country.

Asta Sihvonen-Punkka
CEO
Fingrid

FINGRID

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ClimateCalc CC-000101.IR1 PunaMusta News

We study the potential of offshore wind power

Fingrid has published a report presenting the preliminary possibility of connecting offshore wind power to Mainland Finland's main grid in the 2030s. Fingrid has already received enquiries about connections with a total capacity of 95 gigawatts. We have preliminarily identified five areas along the west coast where large offshore wind power projects could connect to the main grid in the 2030s. The areas are Ulvila, Närpes, Vaasa, Raahe and Raisio. In addition, the Ingå region has been defined as a potential connection area if offshore wind power is also allowed in Finland's southern sea areas.

A model created for the study indicated that to connect offshore wind power to the grid, approximately 1,000 kilometres of new 400-kilovolt transmission lines and at least two new substations would be required.

The plan for the report rests on certain assumptions about electricity production and consumption trends that differ from Fingrid's baseline scenario. Consequently, the main grid development plan published last year does not include all the necessary system reinforcement investments.

Fingrid welcomes feedback on the report until 23 June. ◆

fingrid.fi/en/offshore_windpower_study

PRELIMINARY MAIN GRID REINFORCEMENT REQUIRED TO ENABLE OFFSHORE WIND POWER CONNECTIONS IN THE 2030S

PROFILE

A new role in a new unit

Jaana Suontausta works with technology solutions and is passionate about solving problems.

TEXT MINNA SAANO / PHOTO TERO IKÄHEIMONEN

Last August, I started working as a Senior Expert in Fingrid's new Operational Engineering Unit, which was set up a year ago.

This is a brand new role in Fingrid – one which my supervisor and I can develop together. I find it motivating to be able to influence my responsibilities and the scope of my job, and I can take advantage of my prior experience in power systems and electrical engineering like relay protection.

My job includes specifying the technical requirements from operational point of view for new devices deployed in the grid. I am currently working on a synchronous compensator under construction at the Jylkkä substation and acquiring STATCOM installations at the Kristinestad and Anttila substations.

During this spring our team has also been thinking about the principles and use of system protection schemes (SPS) in Fingrid. SPS refers to automatic protection that rapidly reacts disturbances and changes the load flow in the system. Typically, system protection schemes are used to improve operational security in the event of abnormal contingencies.

What I like most about my work is solving problems with a team of experts. It is rewarding to resolve an issue and get everything working again. It is a good feeling." ◆

WHO?
Jaana Suontausta

WORK
Senior Expert, Technology Solutions

FAMILY
husband and three adult children

FREE TIME
singing in Mystica, a women's choir

Reader survey yields positive feedback for the Fingrid magazine

In the spring, we asked our readers for their opinions of the Fingrid magazine. The topics included reading habits, interests in various subjects, and ideas for improvement. We received 177 responses.

Readers enjoy the printed magazine, but many also read articles from the online magazine. The magazine reaches many people: more than half the respondents said that when they receive the magazine in the post, at least one other person also reads it.

Readers said that the most interesting topics in the magazine were the power system, electricity markets, new technologies and how they are applied, and the construction and maintenance of the main grid. The Fingrid magazine received the best ratings for its expertise and reliability. The magazine is considered an important information source for the sector, as it provides new information in an attractive format.

We held a surprise prize draw among all the people who had submitted their contact details. The prizes have been sent to the winners.

We congratulate the winners and thank everyone who responded to the Fingrid magazine reader survey! ◆

A triple-jump towards zero!

FINGRID'S occupational safety campaign for 2024 begins in the autumn. The campaign title is 'A triple-jump towards zero!', and it examines occupational safety on worksites through three month-long themes. The first of these will cover the topic of 'Plan, assess, and think before you begin any work'. Take a hop, skip and a jump towards zero occupational accidents – let's make our work safer!

fingrid.fi/en/occupational-safety

Energy influencers at a Fingrid substation

FINNISH Energy arranges the Energy Academy, which provides tuition for key stakeholders. In May, the Academy brought participants on a field trip to Fingrid's Anttila substation in Porvoo. The agenda included presentations on the main grid, substations and the EstLink 2 electricity transmission link. Discussions were lively despite the chilly spring weather, with participants talking about the growth of solar and wind power from the perspective of the main grid, the safety of critical infrastructure, and, of course, the enormous transformers.

PRACTICAL QUESTION

Why are electric boilers so popular?

The latest trend in the energy market is the electric boiler, which is helping industries on their path to the green transition. Jukka Ihamäki, Regional Director at Caruna, also sees challenges ahead for the electricity network due to the pace of change.

TEXT MARJO TIIRIKKA / PHOTO CARUNA

1 What are electric boilers, and where are they used?

The electric boiler's water tank acts as a hot water storage place, feeding heat into the district heating network. Electric boilers are used in district heating to heat homes, schools and workplaces or provide heat for industrial processes.

District heating was traditionally produced from fossil energy sources such as coal or natural gas. Electricity is a clean and cost-competitive alternative for a quick green transition.

The number of electric boilers in Caruna's distribution area has rocketed in just over a year. First, big cities were interested in electric boilers, but now towns and municipalities of all sizes are interested.

Electricity is a clean and cost-competitive alternative for a quick green transition.

2 What are the implications of electric boilers for local distribution system operators?

It is a huge change. The electricity required to produce heat for a city is typically significantly higher than the other forms of electricity consumption in the city.

If an entire city's district heating is electrified, it means doubling the electricity needed. The biggest challenge is whether local distribution system operators and Fingrid's main grid have enough network capacity. Electric boilers are very quick to build, but electricity networks can take years to build.

Smaller towns and built-up areas with district heating networks need less electricity, but the demand for heating may exceed the entire area's electricity consumption. An electric boiler could double the electricity consumption in these areas, so it is a major change.

All network operators face the challenge of whether they can invest enough into their electricity networks to meet the requirements of electrification.

Electric boilers are very quick to build, but electricity networks can take years to build.

3 How can the efficiency of electric boilers be maximised?

At best, electric boilers are flexible if they are connected to heat accumulators. In this case, no electricity is stored, but when the wind blows, the electric boiler operates. However, heat is stored, allowing electricity fluctuations to be balanced. ◆

Read more: fingrid.fi/kehitysnakymatQ12024
fingrid.fi/liitynta

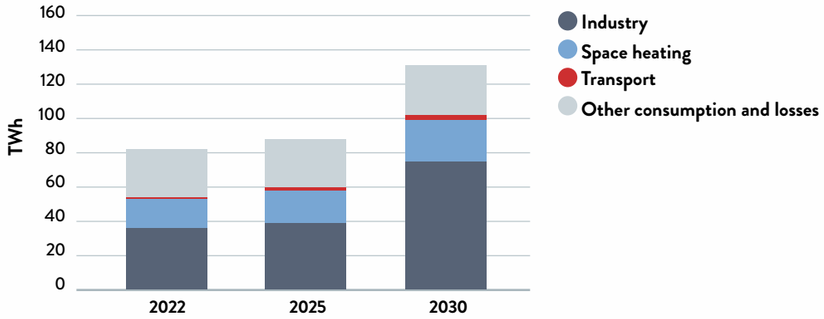
CLEAN ELECTRICITY IS A COMPETITIVE ADVANTAGE

We updated our electricity production and consumption forecasts at the start of the year. Finland has highly promising opportunities for success in the energy transition. The number of enquiries for main grid connections from electricity producers and electricity-intensive industries has continued to climb. The main grid needs significant construction and development to enable investment.

COMPILED BY RISTO KUUSI / INFOGRAPHIC BY LAURA YLIKAHRI

Electricity consumption trend (TWh)

Fingrid's forecast, January 2024



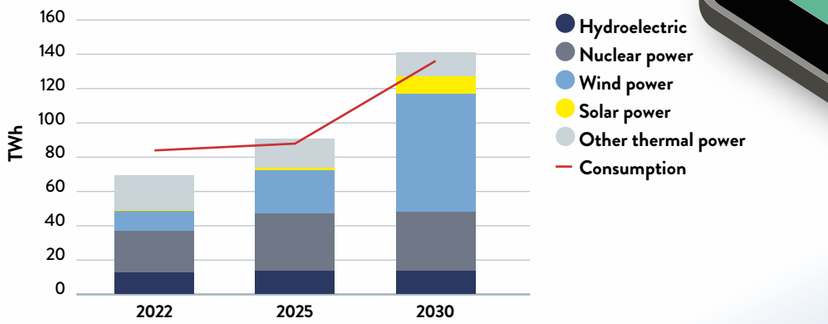
Electricity consumption will increase by approximately

50 %

by 2030.

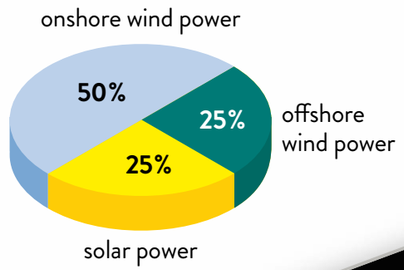
Electricity production trend (TWh)

Fingrid's forecast, January 2024



Wind and solar power production projects over

350 GW



Electricity-intensive industrial projects over

25 GW

MULTIPLE DRIVERS OF GROWTH

- Fossil-free steel
- Hydrogen/electric fuels
- Data centres
- Battery manufacturing
- Electric boilers in industry and district heating

Connection enquiry milestones

100 GW
04/2021

200 GW
10/2022

300 GW
08/2023

TEXT SUSANNA CYGNEL
PHOTOS SHUTTERSTOCK, FINGRID AND SAMPO KORHONEN

The need for electricity will rise in Finland in the coming years. At the same time, fossil fuels are being phased out entirely. Therefore, wind and solar power must produce even more clean electricity. How can we ensure there is enough electricity on calm, cloudy days?

THE POWER SYSTEM IS EXPANDING, DRIVEN BY WIND AND SOLAR POWER

Carbon-neutrality targets are pushing industry, transport and other sectors of society to use clean electricity. The energy transition is increasing the need for renewable forms of energy, as fossil fuels need to be replaced cost-effectively.

The spotlight is now on wind and solar power, which still have plenty of growth potential. Wind power currently accounts for 20 per cent of Finland's electricity consumption, while solar power makes up just one per cent. However, by 2030, the goal is for wind power to produce half of Finland's electricity, with solar power contributing 5–10 per cent.

Power plants, transmission lines, substations and connections are now being built at a brisk pace. Over the next ten years, Fingrid will invest up to EUR 4 billion in the main grid.

Transmission connections are especially needed in the north-south direction to carry electricity from production locations to consumption centres. Most electricity is consumed in Southern Finland, while most new electricity production plants are built in Western, Central and Northern Finland.

The energy transition also calls for flexibility and regulation of renewable and weather-dependent energy sources. The production capacity of wind and solar power plants is entirely dependent on the weather, which cannot be controlled. However, wind and solar power complement each other because when it is calm, the sun often shines, and there is often more wind during cloudy weather.

"Power plants with side-by-side solar and wind power production are currently under development. These plants can share one grid connection. In the future, hybrid power plants could also include grid energy storage in the form of a battery, further raising the utilisation rate of the connection," says **Risto Kuusi**, Senior Expert at Fingrid.

"Power plants with side-by-side solar and wind power facilities are currently under development."

Risto Kuusi
Senior Expert
Fingrid

CONNECTION ENQUIRIES GOING DIGITAL

An enormous number of connection enquiries and investments in facilities such as electric boilers, data centres, and grid energy storage are currently underway in Southern Finland.

Several operators are simultaneously replacing fossil-based energy with electricity, increasing the local electricity consumption. At the same time, combined heat and power (CHP) plants are being phased out, and their output is being replaced by electricity consumption.

"Many things are happening at the same time, on a tight schedule and a massive scale, exerting pressure to develop the main grid in densely populated areas," says **Markus Talka**, Customer Manager at Fingrid.

"We can meet our customers' needs for connections over the long term, but perhaps not tomorrow or even a year from now. System reinforcements can take five to ten years to build," he adds.

According to Talka, connection needs would be easier to forecast if all potential customers did not hesitate to submit connection enquiries via Fingrid's digital service. In such a case, a project in the design phase would then be placed in the right spot on the map. Then, Fingrid could monitor its life cycle and determine at which stage new customer projects require the development of the main grid and what needs to be done.

"Main grid development is based on network plans prepared according to customer needs, the electricity market, the condition of the main grid, and transmission requirements. Consequently, the connection enquiries we receive are an essential factor in planning the development of the main grid," Talka says.

When the data has been entered into the system, Fingrid can easily analyse it en masse. All of Fingrid's responses are also saved in the system for every party to see, so no information relies on phone calls, for example.

Fingrid has analysed some favourable locations for industrial-scale grid energy storage in Finland. For this reason, it is advisable to contact the transmission system operator in advance when studying projects, as this may help to avoid significant challenges or delays in projects.

"It is a good idea to ask us where the best locations are, for example, for an industrial-sized grid energy storage facility to provide the greatest

At the Fingrid Current event this spring, Risto Kuusi (right) gave a speech about the transformation of the electricity market and the fundamental role of cooperation and flexibility among operators in the sector. In the background is Fingrid's Jukka Kakkonen, who talked about the reserve market.

New connection points

AT the moment, Fingrid's team is considering what types of main grid connection points could be built to offshore wind power plants. Offshore plants could be built in Ostrobothnia, but many other wind farms also need connections to the grid in that region. More information on page 6 of the magazine.

benefit to the customer while serving the needs of the entire power system," Talka recommends.

FLEXIBILITY COUNTERACTS PRICE SPIKES

The challenge with weather-dependent forms of energy is that energy consumption rarely adapts to the weather.

When it is very cold, a lot of electricity is needed, but it may not be windy or sunny at that moment. On such days, failures in power plants and transmission links could lead to an electricity shortage, resulting in a price spike for consumers.

In August last year, for example, the electricity price hit a sudden high when planned outages at the Swedish border coincided with faults in parallel lines in Sweden. The cooling system at the Olkiluoto nuclear power plant failed, and planned annual maintenance was taking place at the Loviisa nuclear power plant. On top of all this, the wind did not blow.

Solar power helped in the middle of the day and during the afternoon, but the electricity could not be stored for the hours of higher consumption in the early evening and on weekday mornings.

Weather-dependent forms of energy are challenged by inflexibility. Conversely, a coal-fired power plant has a huge pile of coal that acts as a form of energy storage and provides production flexibility. The power system now needs new energy storage facilities, such as batteries, pumped storage hydro power plants, thermal energy storage, and storage of hydrogen and electric fuels.

In the future, hydrogen may be stored in rock caverns similar to those used for natural gas today. The benefits of hydrogen for storing renewable energy will become increasingly apparent as technology evolves.

A power system dominated by weather-dependent forms of energy also needs more and more flexibility in electricity consumption, as is already the case in industry. Demand-side management occurs naturally in tandem with electricity prices: when electricity is expensive, people use it more sparingly, and consumption falls.

All flexibility and storage that is implemented counteracts price spikes. Large production plants can also earn money by offering demand-side management in the reserve market. Fingrid uses reserves to balance the power system.

Weather-dependent forms of energy can also be flexible. Today, technology can increasingly enable wind and solar power to participate in the reserve market.

SOLAR AND WIND POWER ARE CHANGING THE GRID

When a new power plant connects to the main grid, it undergoes several phases in the connection process in line with Fingrid's grid code specifications.

"The connection enquiries we receive are essential for planning the development of the main grid."

Markus Talka
Customer Manager
Fingrid

The rapid propagation of converter-connected solar and wind power has created various technical challenges that the current demands, technology, and established operating models can no longer address.

For this reason, the grid code specifications for power generating facilities (VJV) and for grid energy storage systems (SJV) will be updated this year. The update will pay greater attention to the technical requirements caused by the increased share of wind power, solar power, and grid energy storage systems.

"The goal is to keep our power system as stable as possible as the number of converter-connected installations increases and the technology and operating models change," Talka says.

The new grid code specifications lay the foundations for the stable operation of power plants under all operating conditions and in the event of disturbances. They require new power plants and operators to have high technical performance, regulation capacity, visibility and foresight. ◆

A BUSY YEAR FOR BALANCING MANAGEMENT

The balancing management reform will boost the efficiency of Fingrid's work in balancing electricity production and consumption. At the same time, several new tools and methods will be introduced, so customers will have a wider range of opportunities to participate in the electricity market.

TEXT VESA VILLE MATTILA / GRAPH LAURA YLIKAHRI

Although electricity market parties plan to balance their consumption and production in advance, it must be possible to balance deviations occurring during operations.

The measures taken to maintain the balance between production and consumption are called balancing management. The Nordic countries are currently in a phased transition to a new balancing model with new tools and methods.

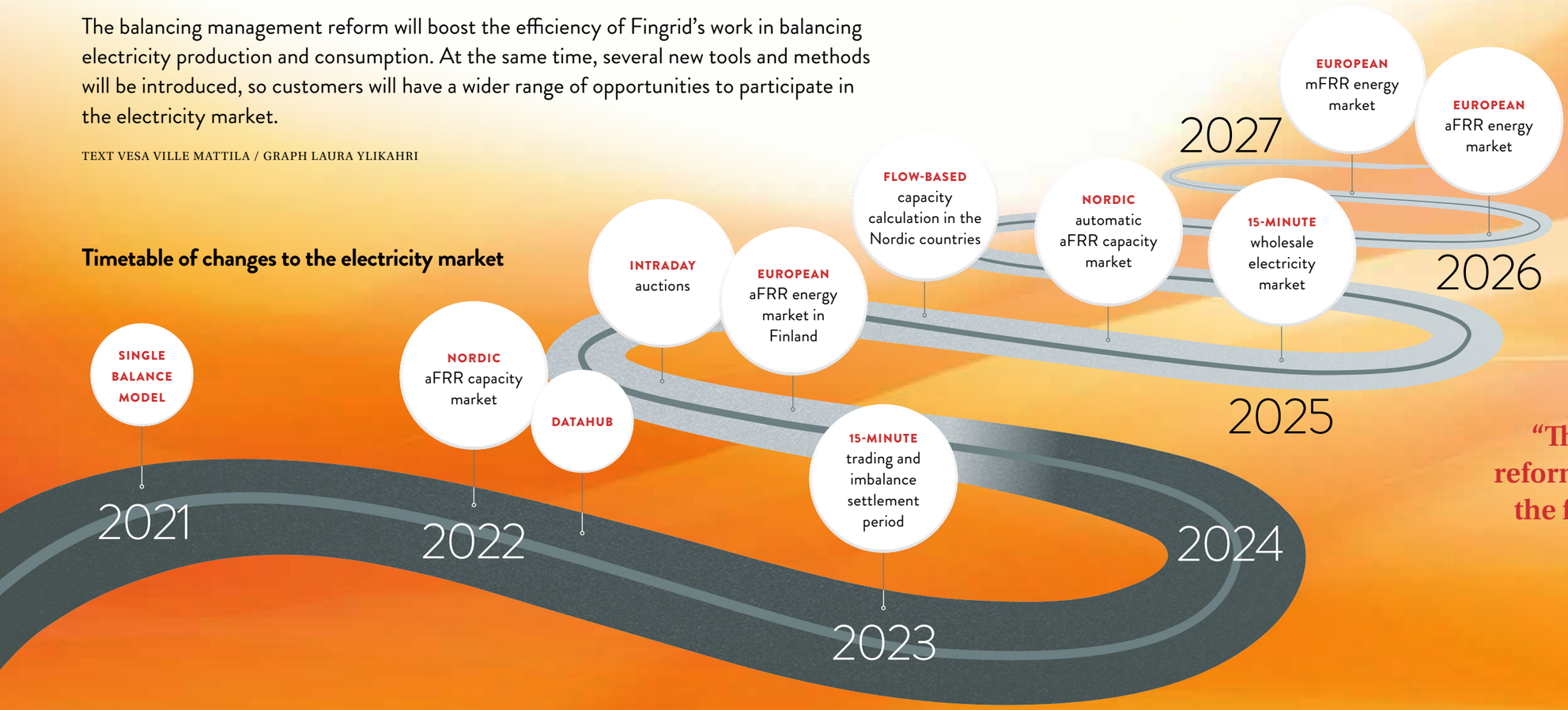
REFORM APPROACHING THE FINISH LINE

The single price model was introduced in 2021. Since then, the Nordic automatic Frequency Restoration Reserve (aFRR) capacity market was opened along with the Finnish manual Frequency Restoration Reserve (mFRR) capacity market.

Fingrid's balancing management reform is now in the home straight.

"The ultimate goal of the balancing management reform is to secure the future functionality of the power system. Expanding the balancing markets will increase the reserves available to

Timetable of changes to the electricity market



"The balance management reform ultimately aims to secure the functionality of the power system in the future."

Karri Mäkelä
Senior Expert
Fingrid

stabilise the power system quantitatively, regionally and geographically," says **Karri Mäkelä**, Senior Expert at Fingrid.

He says the reform will enable Fingrid's customers to participate more diversely in the electricity market. "End users will see the increase in competition in their electricity bills."

The 15-minute period was introduced in Nordic balance management, energy metering and the Datahub in spring 2023.

POWER BALANCE IN 15-MINUTE PERIODS

The emerge of renewable energy generation has led to a decrease in conventional flexible production resources. Consequently, the one-hour power balancing period has become too long.

The transition to a 15-minute trading and imbalance settlement period will increase the precision of forecasts and plans and improve balancing management.

The 15-minute period was introduced in Nordic balance management, energy metering and the Datahub in spring 2023.

The system will transition to imbalance pricing in 15-minute periods once the balancing power price is determined in 15-minute intervals and intraday cross-border trading in the Nordic countries switches to a 15-minute resolution.

CAPACITY MARKET BEFORE THE ENERGY MARKET

Fingrid maintains the Nordic balancing markets with the other Nordic transmission system operators. The capacity market should ensure adequate balancing capacity to maintain a power balance and operational reliability in the grid.

"Trading in the capacity market occurs by auction one day before the energy is delivered and before the rounds of trading on the power exchange," Mäkelä says.

If an operator submits a bid to the capacity market and the bid is accepted, the operator undertakes to submit a corresponding bid to the energy market. The bidder can also trade in reserves directly in the energy market.

PICASSO AND AFRR ENERGY MARKETS

PICASSO is the pan-European marketplace for aFRR energy. Fingrid is joining PICASSO in phases.

First, an aFRR energy market was established in Finland. In 2024, Fingrid will join PICASSO nationally, and the Nordic countries will join together in 2026.

Cross-border trading will become possible when either the Swedish or Estonian transmission system operator joins PICASSO.

Fingrid's customers will not need to take any further action to establish PICASSO connections after the introduction of the Finnish aFRR energy market.

THE MFRR CAPACITY MARKET EXPANDS

A national mFRR capacity market was introduced in Finland in autumn 2022. The mFFR capacity market will expand to a common market covering Sweden and Denmark in November 2024.

In practice, Fingrid will transfer its mFFR capacity market to a Nordic IT platform. Fingrid's customers participating in the capacity market will also need to update their IT systems to operate on it.

"The expansion of the mFRR capacity market will increase the transmission of balancing power and capacity between countries and enhance competition," Mäkelä says.

THE NORDIC MFRR ENERGY MARKET GOES FROM ONE HOUR TO 15 MINUTES

The joint mFRR energy market already in use in the Nordic countries will change when its market time unit switches from 60 minutes to 15 minutes in late 2024.

After the change, mFRR energy bids will be submitted, selected and activated in 15-minute periods.

Introducing the flow-based capacity calculation method in the Nordic countries

THE flow-based capacity calculation method optimises the electricity transmission capacity. It will be implemented in the Nordic countries in October 2024.

The flow-based capacity calculation method facilitates the management of the production and consumption fluctuations inherent in a clean energy system. It takes into account the constraints imposed by the transmission network in the entire market area and allocates transmission capacity primarily where it yields the greatest economic benefit.

"The new calculation method is expected to increase the transmission capacity and trading opportunities between bidding zones. For example, the method may enable more electricity to be exported from Finland to Southern Sweden," says **Meri Viikari**, Senior Expert at Fingrid.

The flow-based method will be introduced initially in the day-ahead market in the Nordic countries. Later, it will also be used in the intraday market and in long-term capacity calculations.

Information system updated and tested

KEMIRA Chemicals' factory in Äetsä, Sastamala, manufactures industrial chemicals. **Petri Kopi**, the company's Electricity Manager, appreciates the aims of the balance management reform.

"A well-functioning grid benefits all market parties. That is why it is important to participate in the electricity market and receive compensation for it."

According to Kopi, the Äetsä plant's processes can easily be made to react to changes in the electricity market. However, the test protocols required before entering the reserve market have proven laborious.

"We have already participated manually in the mFRR capacity market. We will need to update and test our information systems before the transition to the 15-minute market time unit and Nordic trading."

The Nordic transition to the 15-minute market time unit will bring the connection to MARI, the European mFRR energy marketplace, one step closer. However, the change and process coordination still require major alterations to the market process and information systems.

The transition to a 15-minute market time unit in the mFRR energy market will improve the forecasting of consumption and production and the cost-effectiveness of power balancing in the grid.

A 15-MINUTE WHOLESALE ELECTRICITY MARKET

The day-ahead and intraday markets are gradually transitioning to a 15-minute resolution.

In Finland, trading in 15-minute local products on the intraday market began in spring 2023. Intraday cross-border trading on the Nordic countries will be possible on 15-minute resolution in early 2025 after the mFRR energy market goes live.

"The change enables balancing close to the moment of consumption," says Marja Eronen, Senior Expert at Fingrid.

"The 15-minute market time unit will be introduced in the day-ahead market throughout Europe in early 2025. After that, all market parties trading on the electricity exchange will be able to submit bids accurate to 15 or 60 minutes."

However, spot prices will be calculated and published in a 15-minute resolution. ◆

"The 15-minute market time unit will be introduced in the day-ahead market throughout Europe in early 2025."

Marja Eronen
Senior Expert
Fingrid

More activity, closer cooperation

OULU Energia has worked hard to adapt to the changes in the electricity market, including the balancing management reform.

"We have intensified our activities and cooperation with our partners. Nevertheless, the future electricity market is bound to surprise us somehow," says Marko Lehto, Portfolio Manager.

The changes to the aFRR will mainly be visible for Oulu Energia on prices. The transition from a 60-minute market time unit to a 15-minute one in the mFRR energy market will affect the company's practical activities the most.

Lehto states that reacting to fast-paced changes in consumption or production requires systems to support people.

"However, our power plants are well suited to a more active electricity market."

COLUMN

European electricity market reform

AFTER ONE year of negotiations between European Institutions, the reform of electricity market design is about to become effective in all EU countries. The reform aims to reduce consumers' exposure to fossil fuel price spikes, to accelerate investments in renewable energy sources (RES), and flexibility resources, and to enhance prevention of market manipulation.

In response to the extremely high and volatile electricity prices of 2022, EU governments called for structural reforms in the electricity market. These were tabled in March 2023 by the European Commission and politically agreed by the European Parliament and the Council in December last year. The reform covers four main areas:

1. Long-term price signals for generation investments
2. Development of non-fossil flexibility
3. Consumer protection
4. Wholesale markets integrity

One of the key objectives of the reform is to "reduce dependence on short-term market prices, and to accelerate the deployment of renewable energy sources". For this purpose, the new rules aim at increasing the use of long-term contracts by a) incentivising the use of power purchasing agreements (PPAs); b) establishing Contract for Differences (CfDs) as the standard support scheme for new RES and Nuclear generation assets; c) facilitating the introduction of Capacity Mechanisms; and d) reforming forward markets to improve their liquidity and increase cross-zonal hedging opportunities.

The reform seeks to boost the development of "non-fossil flexibility resources".

The reform seeks to boost the development of "non-fossil flexibility resources" – especially demand response and storage. Member States will be required to assess their flexibility needs, to establish indicative objectives for demand response and storage, and to possibly introduce new support schemes for such flexibility resources. The new rules promote demand response also by allowing consumers to use dedicated meters for their Electric Vehicles and Heat Pumps, as well as by facilitating energy sharing.

For what concerns consumers, the reform promotes a wider choice of contracts (both fixed and dynamic pricing), stricter rules on suppliers hedging and suppliers of last resort, and protection from disconnection for most vulnerable consumers. In addition, in case of sharp and prolonged increase of electricity prices, the Council may declare an "electricity price crisis" allowing Member States to take exceptional measures such as regulated prices.

Lastly, the regulation on wholesale market integrity and transparency (known as REMIT) was also updated to enhance prevention of market manipulation. Market parties and marketplaces will be subject to additional reporting requirements, while powers of regulators will be strengthened. In particular, ACER will be able to investigate potential market abuse cases of cross border nature including with on-site inspections. ◆

Marco Foresti
Policy and Market Design Manager
ENTSO-E

THE BRIGHT FUTURE OF SOLAR POWER

Solar production is growing rapidly. The first large solar farms are in operation, and many more are under construction or in the design phase.

TEXT SAMI LAAKSO / PHOTOS MAARIT LAHIKAINEN AND TERO IKÄHEIMONEN

Ilmatar has taken big steps in its solar power projects. The company has over a decade of experience in wind power construction, but it now wants to add solar power to its production mix.

"The demand for emission-free domestic electricity has increased. Solar panels have come down in price, and solar energy production has also become profitable in Finland," explains E**lina Kärkimaa**, Head of Solar Engineering.

She says that solar and wind power support each other: when there is no wind, the sun often shines, and vice versa. Solar and wind power projects also share some similarities.

There are also differences, as solar farm projects usually have a lighter administrative burden due to their lower environmental impacts. For the same reason, solar farms usually do not encounter strong resistance.

BREATHING NEW LIFE INTO A FORMER AIRPORT

Ilmatar's first project is a five-megawatt solar power plant in Joroinen. The vicinity of an airfield provided the required area without any other land use pressure.

According to Kärkimaa, the people of Joroinen have been positive towards the solar farm project, and cooperation with stakeholders has gone well. A further key factor is cooperation with the transmission system operator.

Ilmatar owns its power plant projects from start to finish, throughout the entire life cycle. The company also operates in Sweden, so it has accumulated knowledge from various practices.

Solar power as a reserve

AS the amount of weather-dependent energy production grows, it is increasingly exploited in the reserve market to balance electricity production and consumption.

Solar power can provide down-regulation – in other words, it can reduce the production power it feeds into the grid – without limiting its initial production level. Up-regulation is also possible if the power output can be increased upon request.

Battery energy storage facilities can also be built at solar farms to support flexibility. Providing balancing capacity in the reserve markets can be a good deal for solar power producers. The requirements of reserve markets should be considered at an early stage to ensure that the technical implementation or different production agreement structures do not constrain the plant's reserve capacity.

A former airport in Joroinen is now home to Ilmatar's five-megawatt solar power plant. "The demand for emission-free Finnish electricity has grown," says Elina Kärkimaa, Head of Solar Engineering.

"Wind and solar power complement each other," says Jari Kottonen, Senior Manager at Helen. For example, the Juurakko hybrid plant in Kalajoki produces wind and solar power with a shared electricity network infrastructure.

"In Finland, renewable energy projects are developed in cooperation with network operators. Dialogue is extremely important. The project risks can be reduced when the costs are predictable and we know whether new capacity can be connected to the network or whether other projects will be built in the area."

Kärkimaa also sees solar power as a significant opportunity for Eastern Finland, where there are more restrictions on wind power construction due to airspace surveillance.

Ilmatar has tested technical solutions and gained practical experience in Joroinen. The company's next projects will be much larger, including solar farms rated at over 100 megawatts.

Larger-scale solar power production is a new development for Finland, which is relatively late in adopting industrial-scale solar power by international comparison due to its northern location.

"Connectivity is a key criterion when considering solar farm locations."

Jari Kottonen
Senior Manager
Helen

"Solar power is relatively simple, but it carries its own kinds of risks due to the high number of components – one cannot afford systematic failures. Sustainable exploitation of solar energy requires high quality and good planning. We can benefit from the world-wide solar PV experience here in Finland."

Emission-free electricity

FINGRID estimates that solar power will provide nine terawatt hours of electricity in Finland in 2030. The reform seeks to enhance the development of flexible, fossil-free resources. In 2022, emission-free electricity already accounted for over 90 per cent of the electricity produced in Finland.

The pace of change imposes requirements on the development of the power system. Before a solar farm can be connected to the power system, the capacity of the relevant section of the grid must be studied and plans must be prepared to connect the production to the grid.

According to **Aki Laurila**, Manager, Power System Engineering at Fingrid, solar power plants can be commissioned quickly in some parts of the grid, but additional construction may be required elsewhere.

Laurila emphasises the importance of communication and encourages project developers to contact Fingrid in the early planning stages.

WIND AND SUN IN HYBRID POWER FARMS

Helen is also adding solar power to its production mix. The company already has a 1.5 megawatt peak solar farm in Nurmijärvi, with a 10 megawatt peak solar farm in Lohja and a 206 megawatt peak solar farm in Kalanti still to come.

"Wind and solar power are important aspects of Helen's profitable green transition," says **Jari Kottonen**, Senior Manager.

He also says that wind and solar power complement each other well. The Juurakko hybrid power plant in Kalajoki is a concrete example: wind and solar power are produced using a shared electricity network infrastructure. Helen owns the wind farm in the area, while Solarigo Systems Oy is responsible for the solar power plant.

"Solar and wind power production go so well together that a hybrid plant can be made using a single connection. A hybrid regulator prevents the plant from exceeding the maximum power agreed upon with Fingrid."

Helen's wind farm in Lakiakangas, Ostrobothnia, is complemented by a battery energy storage facility. This combined plant also uses a single grid connection.

Solar farms require open space. However, they cannot be built under transmission lines because there must be unobstructed access for service and maintenance. In addition, there are earth wires under transmission lines.

"Connectivity is a key criterion when considering solar farm locations."

That is why requesting a grid connectivity statement is one of the first steps in such a project. Kottonen says that in practice, they ask Fingrid's contact person for an opinion before the official round of statements. ◆

Pumped storage power plants pump water into a reservoir high upstream when plenty of electricity is available, allowing it to flow back down through a generator into the lower reservoir when less electricity is available.

TEXT MATTI VÄLIMÄKI / PICTURE POHJOLAN VOIMA

Pump up the balancing power

Finland's first pumped storage power station offering balancing power is planned for construction in Lapland. Many such power stations can be found in Central Europe.

The basic idea of a pumped storage power station is simple: when a lot of electricity is available – and the electricity is cheap – water is pumped to a reservoir higher upstream. When less electricity is available, and it is more expensive, the water is released from the upper reservoir and flows through a generator.

Pumped storage power plants consume more electricity than they produce. However, the plant's reserves can quickly provide additional electricity when it is needed. It would also output electricity for much longer than a battery.

For electricity production to be efficient, there must be a large enough elevation difference between the upper and lower reservoirs. In Central Europe, many pumped storage power plants have been built in mountainous areas.

A lot of renewable energy is currently being built in Finland, requiring a lot of balancing power alongside it. Pumped storage power plants have attracted interest as a potential solution in this area.

Kemijoki, Pohjolan Voima and Suomen Voima, a joint venture involving 16 energy companies, have all publicised plans for pumped storage power plants.

The companies have their eyes on Lapland, especially Lake Kemijärvi, which would serve as the lower reservoir for the projects. The lake is large and is already regulated, so the expectation is that the environmental impact would be moderate. The necessary elevation differences also exist in the area.

A pumped storage power plant can quickly use its reserves to generate additional electricity when needed.

KEMIJOKI AIMS FOR EU STATUS

Kemijoki Oy aims to build a pumped storage power plant in Ailangantunturi, Kemijärvi.

Petri Vihavainen, the company's Vice President of Electricity Markets and Strategy, says the plant's power would be 550 megawatts. It could output electricity at a lower power for a couple of days.

"The area of the pumped storage reservoir is about one square kilometre. The tunnel connecting it to Lake Kemijärvi is about 4.5 kilometres long, and the drop is about 200 metres."

The ongoing environmental impact assessment (EIA) should be completed in early 2025.

The pumped storage power plant is intended to be commissioned in the early 2030s.

"The scale of the project is large, and pumped storage power plants are a new thing for Finland, so we are studying the environmental impacts very carefully. At present, we estimated them to be minor because the lower reservoir, formed by Lake Kemijärvi, is so large."

Vihavainen expects funding to be a challenge. The project's budget is between EUR 600 million and EUR 800 million. It aims to secure EU status and European Commission funding.

Kemijoki Oy has other plans for pumped storage power plants in the area which it will announce later.

POHJOLAN VOIMA ALSO HAS A LARGE PROJECT

Pohjolan Voima is planning a 500-megawatt pumped storage power plant in the Askanaapa area of Kemijärvi. Its budget also runs into the hundreds of millions of euros.

Jani Pulli, CEO of PVO-Vesivoima Oy, says that the project is in the feasibility study stage, after which it will progress to an environmental impact assessment. The aim is to commission the plant in the 2030s.

"The naturally bowl-shaped Lake Askanaapa would serve as the pumped storage power station's upper reservoir. Its surface area would be about 300 hectares, its depth would be around 30 metres, and the drop to Lake Kemijärvi would average 150 metres. The power plant would be build into the rock."

Pulli calculates that the plant could produce electricity below its maximum output for up to a week.

SUOMEN VOIMA AIMS FOR SEVERAL SMALL PLANTS

Pekka Saijonmaa, CEO of Suomen Voima Oy, believes that building several smaller pumped storage power plants would be quicker and easier than one large plant.

"The plants are relatively small, so their impact on the environment and landscape is easier to minimise."

Suomen Voima aims to build three pumped storage power plants. The first of them, to be built on Lake Kemijärvi, has advanced to the environmental impact assessment procedure. The aim is for the plant to begin operating before the end of the decade.

"The first pumped storage power plant will produce an estimated 75 megawatts. The total power of the three plants will be between 100 and 200 megawatts. The total budget is EUR 300 million, funded by the companies that own us."

LOTS OF BALANCING POWER NEEDED IN FINLAND

Risto Kuusi, Senior Expert in Strategic Grid Planning at Fingrid, emphasises the need to increase the amount of flexible capacity.

"The need for flexibility and grid energy storage is soaring throughout Europe as the power system grows, production becomes more dependent on the weather, and fossil fuels are phased out. Diverse, cost-effective balancing capacity is also very important for Finland's competitiveness," he says.

Power station specialists also stress that Finland will need a lot of balancing power in the future.

"We need many different means: not just pumped storage power plants but also demand-side management and batteries. However, pumped storage power plants can provide balancing power for much longer than batteries," says Pulli from PVO-Vesivoima Oy.

Vihavainen and Pulli are focusing on their companies' own projects and are reluctant to comment on the potential competition with other projects.

Saijonmaa, on the other hand, believes that the shores of Lake Kemijärvi could accommodate pumped storage power plants with several operators. ◆

Roger Gustavsson, Manager of Balance Management, is on call once every two months. “When I am on call, I am constantly by my phone and never more than an hour away from the Main Grid Control Centre,” he says.

ON STANDBY, READY TO SUPPORT THE MAIN GRID CONTROL CENTRE

Fingrid has employees scheduled for standby shifts, ready to respond to phone calls at all hours of the day. Their task is to support the Main Grid Control Centre in the event of a disturbance.

TEXT MARJO TIIRIKKA / PHOTOS TERO IKÄHEIMONEN

One windy winter’s day, a transmission outage was planned for the electricity network in Northern Finland. Planned outages are not a rare occurrence: about a thousand of them take place every year due to grid construction and maintenance. Transmission outages are planned well in advance to guarantee the security of the electricity supply.

But this time, production was more challenging to control than normal, and the resources started running thin. A fault could have plunged the networking into an unstable state, leading to frequency fluctuations. In the worst case, such fluctuations could have caused the grid to collapse.

The system was becoming increasingly difficult to control, and the team was running out of options. So the Main Grid Control Centre called Fingrid’s standby specialist. This time, **Roger Gustavsson** answered the phone.

Under his leadership, alternative solutions were considered to ensure reliability and keep the lights on in Northern Finland. The regional surplus hemmed in by the transmission outage grew so large that production needed to be reduced substantially.

Transmission outages are planned well in advance to ensure the security of the power system.

Fingrid has precise calculations of how much transmission is allowed. If metered transmissions exceed a certain quantity, system security can no longer be guaranteed, and the grid could go down.

Gustavsson took responsibility for determining whether the transmission limits calculated in advance using the default values differed from the situation in practice.

The most important tools are a computer, phone and the ability to listen: the person on standby organises activities and supports the Main Grid Control Centre in decision-making.

A SOLUTION IS FOUND

Gustavsson contacted the people responsible for system security calculations, and the values were recalculated based on the operating state at the time.

"More transmission capacity was obtained, easing the situation slightly. However, regulation was still necessary, and several specialists addressed the matter over the following few days. Finally, the decision was taken to split the network, which eventually resolved the difficult operating state," says Gustavsson.

This was the most challenging situation he has encountered so far as a standby employee at Fingrid.

Gustavsson began working on standby last autumn when he took up the job of Control Centre Manager in Balance Management. However, he already knew all the ins and outs, having worked at Fingrid since 2006.

Standby employees do their own work as normal but support the Main Grid Control Centre in the event of a network disturbance.

Their main tools are a computer, a phone and the ability to listen. The standby employee organises activities and supports the Main Grid Control Centre in making decisions. If necessary, they travel to the Main Grid Control Centre and set up a support organisation.

"The operators purchase reserves. Standby employees can authorise additional purchases if an operator does not have sufficient procurement authority," Gustavsson explains.

The standby employee is also responsible for communication, writing a news article for Fingrid's website. Fingrid's Communications Unit contributes its expertise in the event of wider-ranging problems.

SEASONS AFFECT DUTIES

Faults in power production plants can cause deviations. The standby employee is often contacted about power adequacy issues or if a major production facility or transmission connection fails.

In the winter, it is important to keep the grid unified. In the winter, it may be necessary to call the standby specialist if a fault arises in a transmission link or the weather conditions affect the transmission network or production facilities.

The Main Grid Control Centre contacts the person on standby if there are concerns about the adequacy of electricity or if a major production plant or transmission link fails.

Some especially challenging situations occurred in the first week of January 2024 when very cold weather led to a high demand for electricity.

Transmission outages are planned for the spring, summer and autumn so that the transmission grid can be maintained and modernised. The challenges in these cases may relate to transmission management and faults caused by lightning strikes. Long spells of hot weather can also cause equipment to overheat.

ONE WEEK AT A TIME, 24 HOURS A DAY

Fingrid has eight standby personnel, each assigned to duty once every eight weeks. A shift lasts one week, from Monday to Monday, 24 hours a day.

When they are on standby, they do their normal work, but at all times, it is essential to remain near the phone and within an hour of the Main Grid Control Centre in case a disturbance arises.

They also need to be reachable during leisure hours and ready to support the Main Grid Control Centre. This means they cannot drive their children to their hobbies, for example. Besides that, being on standby has hardly affected Gustavsson's daily life.

"We cannot go away for the weekend when I am on standby duty, but we do spend a lot of time at home due to children's hobbies."

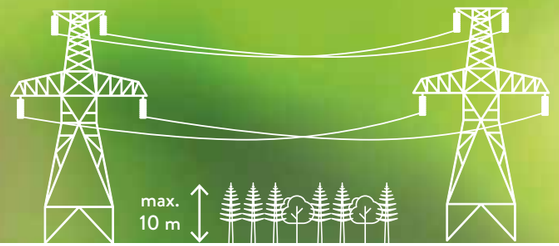
On average, the standby personnel are called upon once per week. The calls have not been too taxing for Gustavsson – at least so far:

"I know that sometimes, a situation might require a lot of work. I have not yet encountered such a situation, and I hope it remains that way." ◆

TEXT MINNA SAANO / PHOTO SHUTTERSTOCK

GREEN CORRIDORS **for flying squirrels**

The flying squirrel is an endangered species. Within the European Union, it can only be found in Finland and Estonia. Fingrid safeguards the breeding and resting sites of the species by establishing green corridors along the transmission line routes required for the green transition.



For green corridors, Fingrid expropriates the right of ownership of the land.

Fingrid has previously erected artificial trees for flying squirrels to jump from, allowing them to glide through transmission line rights-of-way, even if there are several parallel transmission lines.

"In the future, we will establish green corridors for flying squirrels to pass through. These strips of forest will be about 50 metres wide, allowing the squirrels to glide from one side of the transmission line to the other. Our technical solutions make green corridors possible," says **Eeva Paitula**, Expert, Transmission Line Routing at Fingrid.

The technical solutions allow transmission line towers to be built closer to each other than usual. By reducing the spans between towers to 200 metres from the typical range of 250–350 metres, the conductors can be high enough to allow trees to grow naturally, forming a green corridor without any electrical safety concerns.

"The green corridors are treated to form a continuum of young trees of different heights. When trees grow to a height of 10 metres, they are felled and left in the terrain to decompose, thereby promoting biodiversity."

TERRAIN SURVEYS AND LAND EXPROPRIATION

The first green corridors will be established on the transmission line route between Kristinestad and Nokia. Construction is due to begin in 2026, and the 170-kilometre line may have up to 6 green corridors.

"The green corridors will be near the flying squirrel habitats identified by an environmental consultant. The locations are also influenced by surveys based on habitat models from the Natural Resources Institute Finland and the Flying Squirrel LIFE project," says Paitula.

Fingrid is normally assigned the right of use of the land under transmission lines. However, for green corridors, Fingrid expropriates the right of ownership of the land to ensure the preservation and treatment of trees in the green corridor in line with the objectives of protecting the flying squirrel.

Green corridors are built specifically for flying squirrels, but other animals can also benefit from them. ◆

TEXT PÄIVI BRINK / PHOTO LANDSNET

Electricity in the land of fire and ice

The Icelandic transmission system operator Landsnet's grid is a completely independent and self-sufficient electricity grid that serves the population of about 375 300 people of Iceland. Volcanic activity in Iceland's bedrock can damage the grid, but it is also an excellent source of energy.

Volcanic activity has increased in Iceland during 2024. The TSO of Iceland, Landsnet, must be prepared for the seismic activity. Earthquakes have not threatened the grid structures as they are designed to withstand the conditions.

"The recent volcanic activity has created some challenges for us, since we had to modify one of our power lines when lava started to flow under the line. We had to strengthen the foundations of the poles. One of our power stations is three kilometres from the eruption. We had to protect it and the town next to it with new, experimental fencing methods," says **Guðlaugur Sigurgeirsson**, the Head of Asset Management at Landsnet.

The winter conditions also create challenges. Ice and snow build up on the power lines and the strong winds increase the risk of damage.

GEOTHERMAL ENERGY CREATES A FIFTH OF THE ENERGY CONSUMED IN ICELAND

The whole of Iceland is connected to the power grid, which is rated as one of the most reliable in the world. Electricity is comparatively cheap in Iceland.

"Landsnet is responsible for transmitting electricity and securing the supply of energy in Iceland. For generation and distribution, we have several different companies. Our grid is now about 50 years old and we are currently doing maintenance and overhaul work on it. The biggest challenge is getting all the permissions needed for asset management to maintain and build new assets. We also need competent professionals for the maintenance work."

Iceland's grid is not connected to any other grid or electrical system. The country produces all the electricity it consumes.

"We have two major sources of energy: 80% hydro power and 20% geothermal energy. We generate 99% of our electricity from renewable sources. Geothermal energy can be used both to create electricity and to heat our houses. As the demand for electricity is increasing, our first wind farm is currently being tested with promising results," Sigurgeirsson says.

Since the Icelandic grid is a micro grid, it is a perfect testing ground for major energy technology companies.

"We are also global leaders in building digital substations that will be easier and more ecological to maintain than older substations. We cooperate a lot with the other Nordic TSOs, and we share experiences and knowledge with each other," Sigurgeirsson says. ◆

99 %

of the electricity is produced from renewable sources.

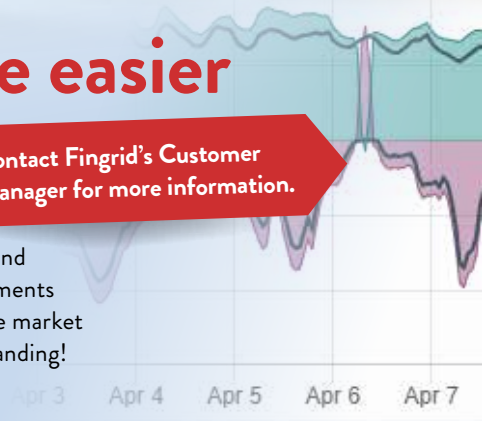
"We are not eager to build underground power cables since lava can melt them in areas where there is a high probability of volcanic activity," says Guðlaugur Sigurgeirsson, the Head of Asset Management at Landsnet.

My Fingrid makes everyday life easier

MY FINGRID is an information resource and online service that makes everyday life easier for companies. My Fingrid offers customers the following information:

- Up-to-date electricity transmission metering and billing information
- Accurate information about disturbances and outages in the main grid
- Communication with customers about network changes, power plant projects, and grid energy storage projects
- Contracts and other documents
- Also reserve market service expanding!

Contact Fingrid's Customer Manager for more information.



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