1 2024

# FINGRID

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

**MIKAEL SURAKKA, OUTOKUMPU:**
**"We support the electricity market through our operations, because reasonably priced electricity is a necessity for our company"**

**The power system needs more reserves**

**CEO Asta Sihvonen-Punkka's normal week at work**

THE PACE OF WORK GETS EVEN TIGHTER WHEN THE ELECTRICITY WHOLESALE MARKET SWITCHES TO A

**15-minute trading period**

INSTEAD OF THE CURRENT ONE-HOUR PERIOD.

# Finding a balance

The Balance Management Unit at Fingrid's main grid control centre is responsible for keeping the power system of Finland in balance in real time.

Electricity consumption and production must be balanced at all times. The challenge of keeping the power system in balance is revealed by very high or even negative market prices.

"It would be best if all market participants were as active as possible in the electricity exchange. Then, Fingrid would only need to fine-tune the system in the reserve markets," explains **Saku Poikonen**, Expert at Fingrid.

Among other things, the balance management operator analyses the adequacy of electricity in the coming hours and on the next day. His most important tools are various forecasting systems, such as wind power production forecasts and electricity consumption forecasts.

A significant part of the work is preparing for various extreme disturbances, and exercises are regularly held.

"They help us build on competences that I hope will never be needed in real life."

Automatic reserves are the first line of defence against the smallest deviations in the balance of the power system. If larger fluctuations occur, the balance management operator regulates the power of demand facilities and power plants up or down as necessary to balance them out. This is done using slower reserve products in the balancing power market.

"Reserve products are offered on the market from power plants with easily adjustable capacities. On the demand side, an offer could be submitted, for example, for a forestry machine whose owner is willing to stop for a while for compensation."

The reserves also include Fingrid's reserve power plants, which can be started, if necessary, after market-based measures to prevent the electricity system from collapsing. If they are not enough to balance the situation, electricity consumption may be restricted. This would be an electricity shortage. ◆

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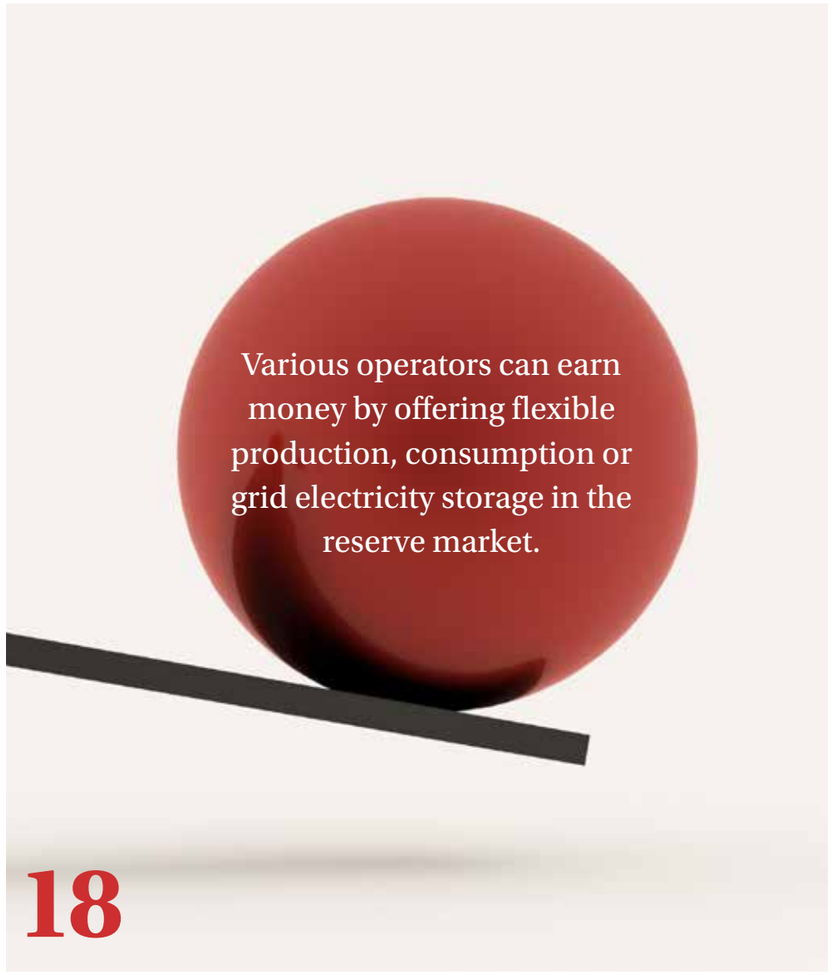
RENEWING
THE ENERGY SYSTEM





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# Active electricity markets = strong system security

**THE ELECTRICITY** market witnessed many highly unusual events and situations last autumn and in early 2024. The power system functioned normally throughout these situations, and the electricity supply was sufficient, thanks to the activity of electricity producers and users, as well as close cooperation and successful communication within the sector.

Less attention has been paid to the fact that the constant fluctuations in the system's power state have become more pronounced in Finland and the other Nordic countries. They have become part of the normal operation of the power system – the new normal.

The larger fluctuations are the result of a dramatic increase in weather-dependent production and the electrification of the energy system. In Finland, the electrification of energy use has become clearly apparent in the main grid as more electric boilers are introduced for district heating and industrial heat production.

Power system reserves are Fingrid's most important tool for managing the power system, and more will be needed as the system changes and evolves. In order to maintain system security, it is vital to incorporate new and existing forms of flexibility in electricity production, storage and consumption into the reserve market.

*Reserves are the most important tool for managing the power system.*

However, it should also be noted that offering flexibility in the intraday market, for example, or otherwise utilising flexibility for purposes such as managing imbalances and forecast errors or price flexibility also supports the fundamentals of managing the power system in addition to various economic opportunities.

The exceptional events that occurred in the power system last autumn and winter highlighted the critical importance of operators in the sector being active in the electricity market and working closely together to maintain the reliability and security of the power system.

Hopefully, closer cooperation and increased activity among market participants will become the new normal as the fluctuations in the power system become more pronounced.

**Tuomas Rauhala**
Senior Vice President,
Power System Operation
Fingrid


FINGRID

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Printed matter 4041-0619
ClimateCalc CC-000101/FI PunaMusta Newa

# Electricity production and consumption forecasts remain largely unchanged

Fingrid has updated the electricity production and consumption forecasts used for main grid planning. The big picture remains unchanged, and Finland's chances of succeeding in the energy transition are promising.

The number of main grid connection enquiries from electricity producers and electricity-intensive industries has continued to rise. Significant construction and development must take place in the main grid to enable growth. ◆

**fingrid.fi/en/prospectsQ12024**

## New transmission line connection to the north

**FINGRID** is building a new transmission line connection from Rovaniemi to Vaala. The connection will increase the north–south electricity transmission capacity and support the existing and future cross-border transmission links. Construction will begin next year, and the transmission line will be completed in 2027. Two new substations will be built during the project.

## Construction begins on a main grid cable connection in Helsinki

**THE** construction of an underground cable connection to the main grid in Helsinki will begin this spring. The joint venture between the City of Helsinki, Helen Electricity Network and Fingrid will cater to the increasing electricity consumption in the capital and promote the green transition. The connection will run from Vaarala in Vantaa to Viikki in Helsinki. It is due to be completed in 2026.

**A RECORD-BREAKING YEAR FOR THE MAIN GRID**

**99.99995 %**

**LAST** year, the transmission reliability rate of the main grid was the highest since records began

**fingrid.fi/en/supply_security_electricity**

**2023**



**PROFILE**

# Data exchange picking up the pace

Erno Paananen works on data exchange for Fingrid. He is employed in a specialist position that suits him perfectly.

TEXT MINNA SAANO / PHOTO SAMPO KORHONEN

**Over a year ago, after I completed my Master's thesis, I became a specialist in Fingrid's Power Control Systems unit. My role is to coordinate real-time data transfer in power control systems between Fingrid and customers.**

**Data exchange covers issues related to grid control and operation and reserve activity. It includes power and voltage data and status information on switching devices.**

**The parties in data exchange with Fingrid are all Finnish energy operators: distribution system operators, the largest production plants and factory operators who use or produce electricity, and reserve operators.**

**The interesting thing about my work is developing solutions that suit every party, considering matters such as which data network and protocol to use for a given task.**

**Little about my work is routine: no two days are alike, and all my tasks are different. There are no quiet moments.**

**It has been surprising to see how many new operators have connected to the main grid over the past year. They include wind power, solar power and, especially, reserve market operators. This year, the pace will only accelerate: new operators are appearing all the time, and data exchange solutions are developed in every area."** ◆

**WHO?**
Erno Paananen

**WORK**
Specialist (Data Exchange Service)

**FAMILY**
Cohabiting girlfriend and cat

**FREE TIME**
Playing the guitar and watching basketball

# Construction begins on the Lake Line

Fingrid has started construction of the Lake Line, the eastern trunk route for electricity transmission, running from Vaala to Joroinen. The Government granted the project an expropriation permit in December 2023, and work is now progressing in several stages along the entire 300 km line.

The Lake Line will enable the connection of renewable energy to the main grid and boost the electricity transmission capacity. The project also includes eight substation expansion and refurbishment projects. The new eastern trunk route for electricity transmission will be commissioned at the end of 2026. ◆

**A RECORD-BREAKING YEAR FOR THE MAIN GRID**

**THE** volume of electrical energy not transmitted for consumption as a result of disturbances in Fingrid's network was smaller than ever before.

**THE** number of electricity supply interruptions (≥ 30 seconds) caused by disturbances per connection point was the lowest ever.

**THE** volume of energy that was not received by the main grid from power plants was lower than ever before.

2023

## Appointments

**TIMO KIIVERI,** MSc (Tech.), was appointed Executive Vice President of Fingrid as of 1 January 2024. Kiiveri has been a Fingrid employee and a member of the Management Team since 2019. He is responsible for the construction and maintenance of the main grid.

**ANTTI KESKINEN,** MSc (Tech.), was appointed Senior Vice President of Electricity Markets at Fingrid as of 1 March 2024. He will also join the Management Team. Keskinen moved to Fingrid from the position of Director of Business Development at Ilmatar Energy. Prior to this, he worked for Caruna and Fortum, among others.



PRACTICAL QUESTION

# What is the dimensioning fault of the power system?

"Advance preparations are made to handle the power system's dimensioning fault. Sufficient reserves and electricity transmission management are the keys to this," says Minna Laasonen, Development Manager at Fingrid.

TEXT MARJO TIIRIKKA / PHOTO SAMPO KORHONEN

**1 What is a dimensioning fault?**

In an electric power system, electricity consumption and production must be balanced at all times. However, there may be a sudden failure of the electrical system, resulting in significantly less electricity, for example. In this case, the electricity consumption and production must be brought into balance quickly so that the power system can continue to operate smoothly. Therefore, it is necessary to determine the maximum permissible power change due to a single fault and prepare for it in advance.

In practice, a dimensioning fault refers to the power change that a system can withstand without compromising system security if the largest single power plant fails and suddenly disconnects from the grid. The largest permitted stepwise power change in the Finnish power system is 1,300 megawatts.

**2 How can Fingrid prepare for dimensioning faults?**

Fingrid prepares for dimensioning faults in two ways. Firstly, we purchase reserves, both nationally and from Nordic countries, to balance electricity consumption and production. In practice, reserves are sources that can adjust their power quickly for the need of the power system. For example, hydro power plants, batteries and wind power, as well as electricity consumption, can produce reserves.

**Electricity consumption and production must be balanced at all times.**

Another important thing to prepare for is transmission management. For example, if a large power plant in Southern Finland disconnects from the grid, most of the replacement power for the first few minutes flows from other Nordic countries via AC connections. As Finland is connected to the other Nordic countries by two AC power lines to Northern Sweden, we need to ensure that these lines have sufficient transmission capacity available to supply the replacement power. We also need to consider power transmission within Finland to compensate for a dimensioning fault, especially between Northern and Southern Finland.

**For example, hydro power plants, batteries and wind power can produce reserves.**

**3 Can a dimensioning fault occur in the power system?**

The power system could suffer a fault leading to a power change corresponding to the dimensioning fault at any time. In Finland, such a dimensioning fault – i.e., 1,300 megawatts – could only be caused by a sudden failure at Olkiluoto 3.

In the future, dimensioning faults could also be caused by the failure of a cable connecting an offshore wind farm to the main grid, for example. We take care to prepare ourselves for a dimensioning fault at all times, so no nasty surprises happen as a consequence of it. The grid operating situation and reserves are designed in such a way that consumers and our customers do not need to worry about it. ◆

# THE NEED FOR RESERVES IS INCREASING RAPIDLY

The energy transition is leading to a huge increase in the need for power system reserves. Regulating capacity has been decommissioned, and the rapid growth of weather-dependent wind and solar power requires contingencies for greater regulating needs than before. In the future, more regulating capacity will disappear from the reserve market, further increasing the need for new production, consumption and storage capacity that can be regulated. In addition, the actual regulation needs may be considerably greater than the presented figures from time to time.

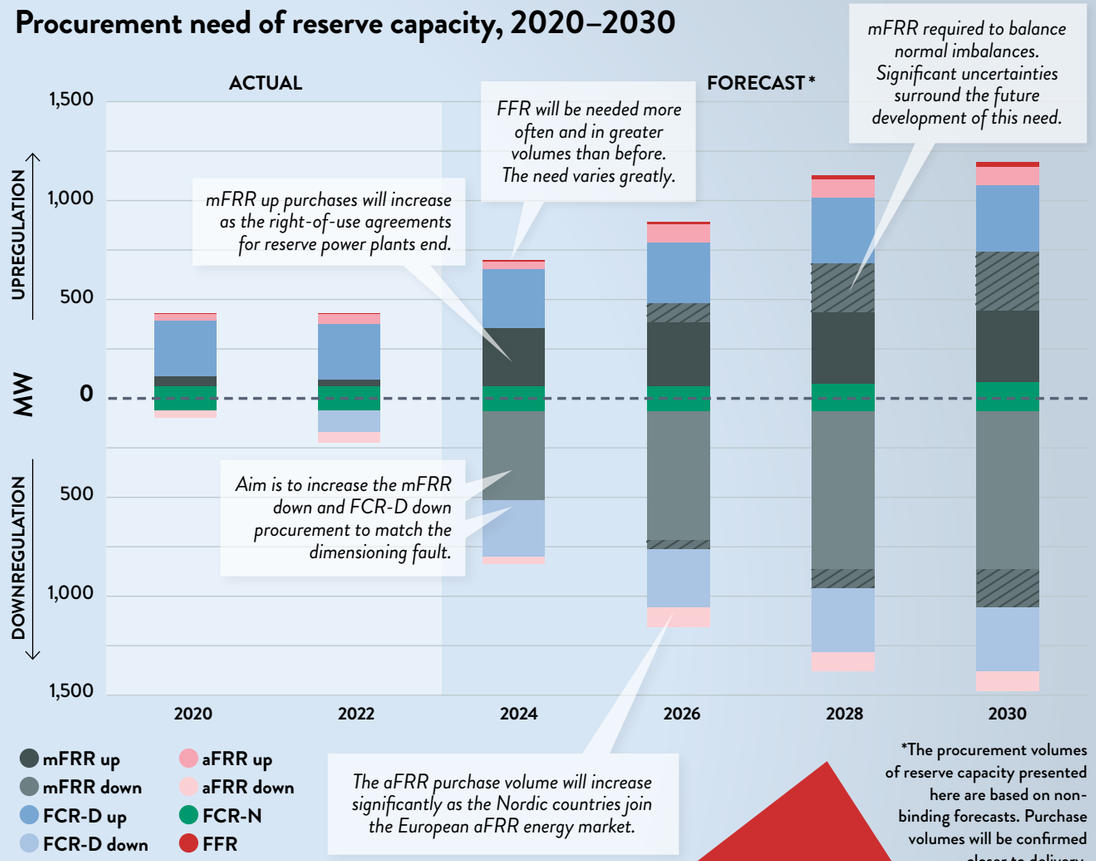
COMPILED BY MIKKO KUIVANIEMI / INFOGRAPHIC BY LAURA YLIKAHRI

## Fingrid's reserve products

| RESERVE PRODUCT | FFR | FCR-D | FCR-N | aFRR | mFRR |
|---|---|---|---|---|---|
| | FAST FREQUENCY RESERVE | FREQUENCY CONTAINMENT RESERVE FOR DISTURBANCES | FREQUENCY CONTAINMENT RESERVE FOR NORMAL OPERATION | AUTOMATIC FREQUENCY RESTORATION RESERVE | MANUAL FREQUENCY RESTORATION RESERVE |
| DIMENSIONING | Power system inertia trends. The need varies greatly. | Volume corresponding to the dimensioning fault in the synchronous area (the largest production unit or HVDC transmission link). | Currently 600 MW. The needed amount will be reassessed in the future. | When the Nordic countries join the European aFRR energy market, the volume shall correspond to the normal, short-term imbalances of balance responsible parties. Significant uncertainties surround the future development of this need. | Volume corresponding to the dimensioning fault and the normal, longer-term imbalances of balance responsible parties. Significant uncertainties surround the development of imbalances. |
| APPLICABLE TECHNOLOGIES | | | | | |

grid energy storage · industrial consumption · small-scale consumption · wind power · hydro power · thermal power · solar power

## Procurement need of reserve capacity, 2020–2030




*The procurement volumes of reserve capacity presented here are based on non-binding forecasts. Purchase volumes will be confirmed closer to delivery.

The need for reserve capacity will increase by

**+134%**

over the next 5 years.

# WELCOME TO THE RESERVE MARKET

TEXT SUSANNA CYGNEL / PHOTOS FINGRID JA SHUTTERSTOCK

The power system needs reserves to keep electricity production and consumption balanced every hour of the day and maintain a stable grid frequency. Fingrid hopes new players will join the electricity reserve markets – now, getting involved is easier than ever.

## – ADDITIONAL EARNING OPPORTUNITIES FOR BALANCING THE POWER SYSTEM

As much electricity must be produced as is consumed at any given moment. To maintain a state of balance in the grid, electricity producers and consumers plan their needs and offerings as accurately as possible in advance and trade on the electricity exchange.

If consumption proves higher than expected or, for example, wind power cannot produce the planned amount of energy, Fingrid keeps the electricity system balanced using the electricity reserves it buys. This final and essential fine-tuning of the power grid is done at the time of use.

"Reserves are also needed to manage disturbances if one of the large power plants or cross-border connections develops a fault," says **Pia Ruokolainen**, Expert at Fingrid.

Reserves are also needed when there is too much electricity in the system and the excess electricity must be removed. This is called down-regulation, and it means reducing production or increasing consumption.

This can happen if, for example, a transmission connection exporting electricity from Finland fails.

**"Consumption reserves could include industrial plants or large greenhouses."**

**Pia Ruokolainen**
Expert
Fingrid

"A reserve is a controllable power plant, consumption facility or grid energy storage facility capable of increasing or decreasing its output according to the power system's needs. For example, consumption reserves can include industrial plants or large greenhouses," says Ruokolainen.

### MORE RESERVES ARE NEEDED ALL THE TIME

Currently, approximately 70 companies participate in the reserve markets. Hydroelectric power has traditionally participated in the reserve markets, and there is still a lot of it. In addition, there are different types of electricity users, different sizes of grid energy storage facilities and other forms of production.

Although the reserve market has become busier in recent years, more reserve units are needed as the energy transition and, in particular, the growth of wind power demands more and more flexibility in the power system.

"In the past, the power system was more even. Production did not vary according to the weather, and consumption was more predictable," says **Jukka Kakkonen**, Expert at Fingrid.

He says that the reserve market would welcome more wind power, consumption, batteries and solar power primarily, but that, naturally, all other types of reserves would also be good.

### RESERVE PRODUCTS WITH DIFFERENT REQUIREMENTS

As the balancing capacity of reserves is used for different needs and in different situations, different reserve market products are needed.

"Some products are intended to rectify disturbances, while others are used to continuously balance the grid. The fastest product has a response time of about 1 second, and the slowest is 15 minutes," says Ruokolainen.

Reserve products are procured in their own marketplaces, and participation is a question of the producer's or consumer's own resources.

In total, there are five reserve products: the Fast Frequency Reserve (FFR), the Frequency Containment Reserve for Disturbances (FCR-D up- and down-regulation products separately), the Frequency Containment Reserve for Normal Operation (FCR-N), the automatic Frequency Restoration Reserve (aFRR), and balancing power and balancing capacity (mFRR reserves).

Each reserve product has its own set of rules and technical requirements, including the speed of power change.

"Different asset types fit into different reserves. For example, a battery can provide power very quickly, but it also runs out quickly. On the other hand, a hydroelectric power plant adjusts more slowly but can be kept active for a long time," says Kakkonen.

The need for certain reserve products is increasing due to the energy transition. In other words, more resources are needed to balance the grid.

"The increase in wind and solar power reduces the power system's natural ability to resist frequency changes, increasing the need for the fast frequency reserve in the future. In addition, it is foreseeable that more aFRR and mFRR reserves →

## How to join the reserve market

1. **CONTACT** one of Fingrid's specialists.
2. **DETERMINE** the technical and commercial issues, the suitability of resources, and data communications connections, and take the necessary measures.
3. **PERFORM** regulation tests (except for mFRRs).
4. **ESTABLISH** a data communication connection to the trading platform and other necessary Fingrid systems.
5. **SIGN** the reserve agreement (on a standardised agreement template with associated appendices).
6. **BEGIN** trading once all the above steps are complete and Fingrid has granted permission to submit bids.

will need to be allocated to manage the power balance," says Ruokolainen.

The need for these reserves will also depend on how well electricity market operators can balance their production and consumption in the future.

**WELCOME TO THE RESERVE MARKETS!**

Fingrid has improved the technical system for the reserve markets, making it compatible with all types of technologies. Fingrid has also reduced the minimum bid size for balancing bids from five megawatts to one, enabling smaller suppliers to join.

"If a plant or company has controllable production or consumption in the megawatt category, it could be a suitable candidate for the reserve market," summarises Kakkonen.

Anyone wishing to become a balancing service provider can contact Fingrid's experts, who will assess the unit's suitability for various reserve markets. The facility's reserve capability must be built and verified before joining or participating in the reserve markets.

Kakkonen recommends that if a company is able to maintain several types of reserves, it is worth acquiring the readiness to provide several products.

**"Many reserve units can participate in more than one reserve market."**

**Jukka Kakkonen**
Expert
Fingrid

"On any given day, one reserve type could be worth more than another, so it is always good to produce the reserve that delivers the best return that day. Many reserve units can participate in several reserve markets," says Kakkonen.

"In general, all new production plants should be designed for flexibility, as flexibility is needed in the electricity markets." ◆

## Reserve products

- **FFR – THE FAST FREQUENCY RESERVE** can be activated within a few seconds and prevents the frequency of the power system from falling too far in the event of a disturbance
- **FCR-D – THE FREQUENCY CONTAINMENT RESERVE FOR DISTURBANCES** can be activated within a few seconds and prevents the frequency of the power system from falling too far in the event of a disturbance
- **FCR-N – THE FREQUENCY CONTAINMENT RESERVE FOR NORMAL OPERATION** continuously takes care of minor changes in the system's balance
- **AFRR – THE AUTOMATIC FREQUENCY RESTORATION RESERVE** continuously takes care of minor changes in the system's balance based on a signal from Fingrid
- **MFRR – THE MANUAL FREQUENCY RESTORATION RESERVE** continuously takes care of minor changes in the system's balance

**Read more: fingrid.fi/en/reserves**

# Wind power is a rapidly adjustable reserve

Fingrid has been running a pilot project called Wind Power for the Reserve Markets over the past year to study the potential for wind power to provide flexibility in the balancing market. The project will continue until June this year.

TEXT SUSANNA CYGNEL / PHOTO CENTRICA ENERGY

**"IN ORDER** to implement the energy transition while ensuring the reliability of the power system in a cost-effective way, all forms of flexibility, including wind power, are needed," explains **Niko Korhonen**, Specialist at Fingrid.

The companies involved in Fingrid's wind pilot project built their wind farms in spring 2023 and worked with Fingrid to resolve the technical challenges related to the reserve markets, such as how to carry out the reserve market approval processes, conduct tests, handle disruptions and trade with entities abroad.

Centrica Energy in Denmark is one of three wind power companies involved in Fingrid's wind power pilot project alongside Prime Capital AG of Germany and Enefit Green of Estonia.

"Thanks to Fingrid's wind pilot project, we have the capability to provide reserves from renewable energy sources. The pilot project will help us open up new commercial opportunities that will ultimately benefit energy consumers and society at large," says Manager, Head of Physical Asset Trading **Thorsten Schuch** from Centrica Energy.

He emphasises that when wind power, or any other form of renewable electricity production, participates in relevant energy and capacity markets, it creates significant commercial opportunities and increases investors' desire to invest in renewable production.

Centrica Energy's primary focus is on its automatic Frequency Restoration Reserve (aFRR) and Frequency Containment Reserve for Disturbances (FCR-D) products. However, the wind power pilot project also inspired it to begin the commercial supply of products in the balancing power and balancing capacity markets (mFRR).

The pilot proved, pleasingly for Fingrid, that wind power is a rapidly adjustable reserve. According to Korhonen, the Fast Frequency Reserve (FFR) requires further development, as the technical requirements proved challenging: based on the experiences gained during the pilot project, it will be necessary to assess whether the requirements could be adjusted to make them more suitable for wind power.

Over the Christmas period, Fingrid issued guidelines for wind and solar power operators on how to join the reserve markets. ◆

**Read more: fingrid.fi/en/guidelines_reserve**

**"Thanks to Fingrid's wind power pilot project, we have the capability to offer reserves from renewable energy sources."**

**Thorsten Schuch,** Manager, Head of Physical Asset Trading, Centrica Energy

# THE RESERVE MARKET

## IS A NETWORK OF MANY TECHNOLOGIES

As much electricity must be produced as is consumed at any given moment. It is a simple equation, but the solution is complex.

TEXT SAMI LAAKSO / PHOTOS SHUTTERSTOCK, FORTUM, TAMPEREEN ENERGIA, SUSANNA KEKKONEN, GASUM

### Reserve markets

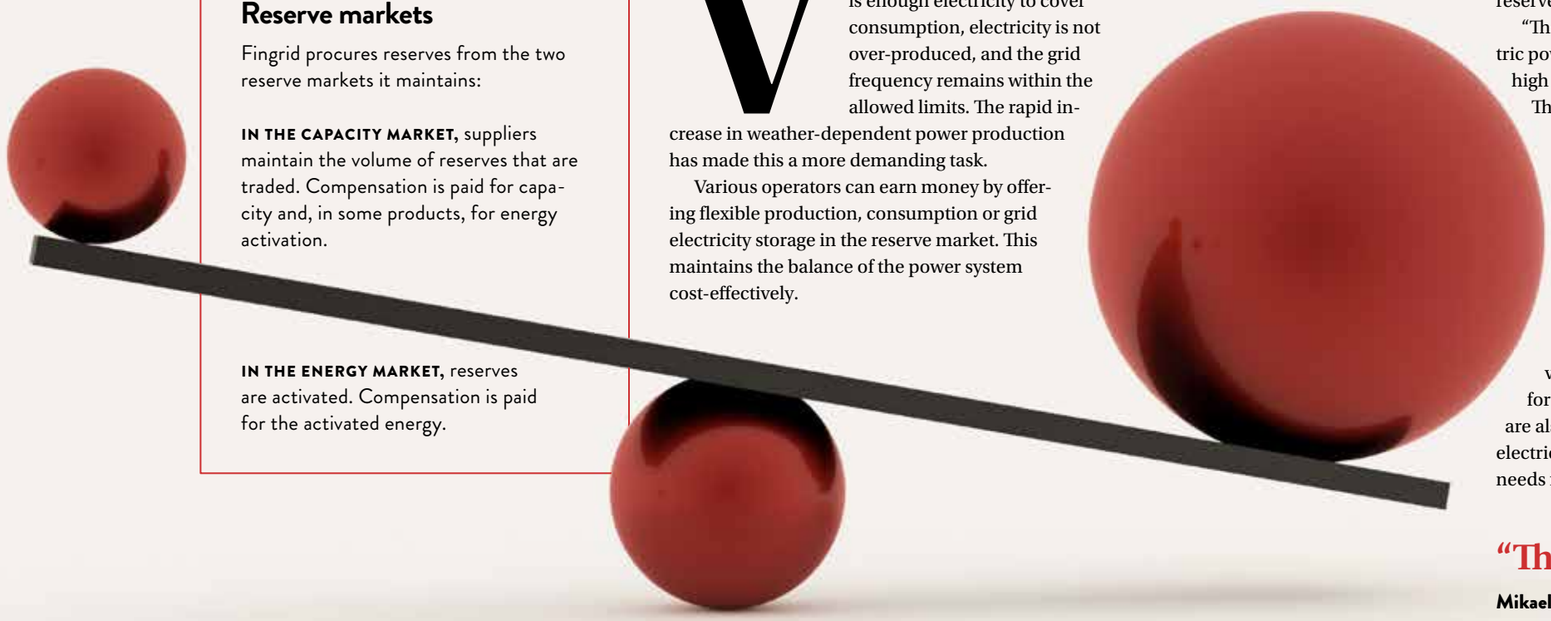
Fingrid procures reserves from the two reserve markets it maintains:

**IN THE CAPACITY MARKET,** suppliers maintain the volume of reserves that are traded. Compensation is paid for capacity and, in some products, for energy activation.

**IN THE ENERGY MARKET,** reserves are activated. Compensation is paid for the activated energy.

Various products are traded in the reserve market to ensure there is enough electricity to cover consumption, electricity is not over-produced, and the grid frequency remains within the allowed limits. The rapid increase in weather-dependent power production has made this a more demanding task.

Various operators can earn money by offering flexible production, consumption or grid electricity storage in the reserve market. This maintains the balance of the power system cost-effectively.



## Hydroelectric power is a natural reserve

**FORTUM HAS** a comprehensive palette of electricity and heat production plants and also participates in the reserve markets.

"In principle, all the capacity that Fortum can use for any market is offered there. We endeavour to deliver maximum added value for society and the company through our capacity," says **Mikael Heikkilä**, Senior Portfolio Manager.

Participation in the reserve market is justified.

"It is in the company's interest that the power system works properly and society can depend on electricity as its main end of use energy source. In addition, we receive financial compensation for reserves," he continues.

Heikkilä is especially familiar with hydroelectric power plants for electricity production and as reserves.

"The volume of water is limited, so hydroelectric power plants sometimes need to be driven at high capacity and sometimes at lower capacity. This is how reserves naturally arise."

The turbines in hydroelectric power plants can be regulated over a large power range, supporting the provision of reserves. Investments in automation also support market participation.

For example, the Oulujoki River has seven hydroelectric power plants and a power regulation capacity of approximately 400 megawatts. The flexibility provided by hydroelectric power is important for the power system, but other technologies are also needed. Heikkilä has his sights set on electricity consumption, as the power system needs flexibility in different situations.

He says that reserve products have improved the quality of electricity in terms of frequency, but the large number of products already leads to fragmentation in the procurement process. Heikkilä also has a development idea:

"Would it be possible to develop a secondary market for reserve capacity? This could ensure that the system is cost-effective and the quality of electricity is good."


Mikael Heikkilä

**"The power system needs flexibility in various situations."**

**Mikael Heikkilä,** Senior Portfolio Manager, Fortum

# Tampereen Energia invests in electric boilers

**LIELAHTI POWER** plant, Naistenlahti biopower plant and Tammervoima, which is powered by the municipal waste of 600,000 residents, are the plants owned by Tampereen Energia which are capable of participating in the reserve markets.

Lielahti burns natural gas and has a net electrical power of 142 megawatts, Tammervoima has 12 megawatts, and the biopower plant has 52 megawatts.

Last year, a 40-megawatt electric boiler in Lielahti was connected to the district heating network.

Senior BI Specialist **Marko Ketola** can see useful features in an electric boiler for emission-free heat production and participation in the reserve market.

"The electric boiler can be adjusted quickly, but the connection to the district heating network causes a slight delay. This affects how the boiler can be used in the reserve market," says Ketola.


Marko Ketola

In practice, when the power to the electric boiler is reduced, the district heating network must make up the difference from other sources. For this reason, the electric boiler can be adjusted by around one megawatt per minute. This constraint is taken into account when participating in the reserve market.

"We offer the electric boiler in the balancing power market, and it will soon be available for the automatic frequency restoration reserve. Additional investment and balancing tests are still required to control the boiler. In addition, we are considering offering the electric boiler to the frequency containment reserve for normal operation."

Any use of the boiler for frequency containment will be based on balancing tests.

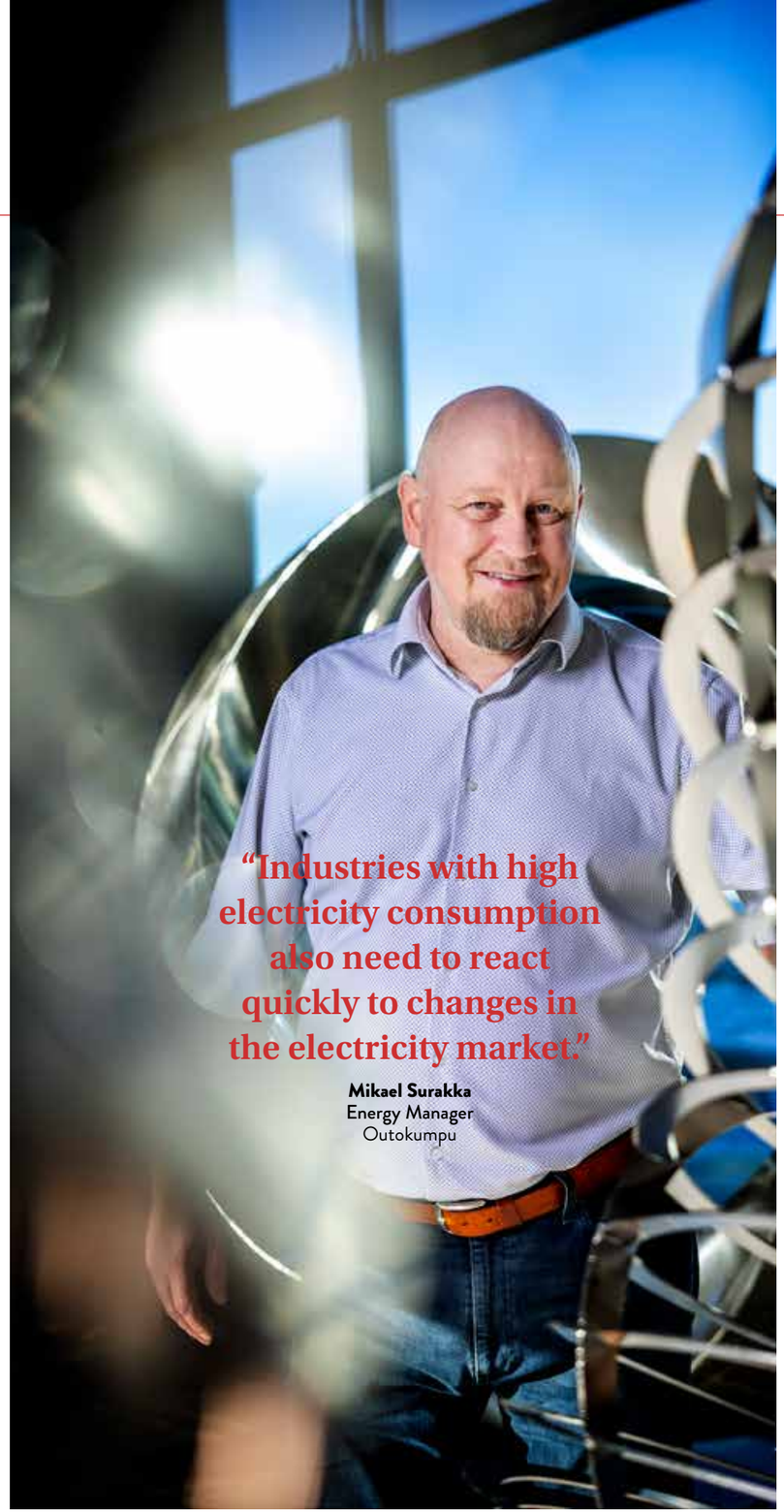
Making contingencies for hybrid threats is also important for Tampereen Energia. The control signal transmitted between the systems of Fingrid and Tampereen Energia must be capable of controlling the electric boiler securely.

The Lielahti electric boiler has been the prime mover, and the company plans to invest in 100 megawatts of additional electric boiler capacity.

"When we have tested the existing electric boiler and determined that everything related to the reserve market works, we can take the action necessary for the next electric boilers during the construction phase."

**"We offer an electric boiler on the balancing power market."**

**Marko Ketola**
Senior BI Specialist
Tampereen Energia




# Production process determines the form of participation

**OUTOKUMPU IS** Finland's largest net user of electricity, so it is natural for the company to participate in the reserve market. **Mikael Surakka**, Energy Manager, reviews the priorities.

"For us, the main business is to make our own product. Our processes and factories have been designed and built for this purpose and were not planned to actively provide demand-side management for various electricity reserve markets."

Consequently, Outokumpu's participation in the reserve market is based on how its production processes can be adapted to suit the rules of the various reserve markets, including factors such as time limits.

The Tornio steelworks has the highest electricity consumption of any single site in the country. Some of the company's processes allow it to participate in the manual balancing power market. Automatic reserve products have also been studied, but they are not yet compatible with the production requirements.

"The processes have some technical constraints, and the possibility of participating in the reserve market always depends on the state of production. We need to bear in mind that individual short-lasting actions can have longer impacts."

Surakka says that in practice, the interplay between the production process and participation in the reserve market requires the continuous monitoring, coordination and response of the process and market. This sets demands on collaboration and information systems in different organisations.

Surakka points out the importance of this matter: Electricity is a necessity in steel production, so the company's priority is to ensure that it is always available at a reasonable price.

"This incentives us to support the electricity market through our operations. The world has changed, and now electricity consumers also need to respond quickly to changing situations in the electricity market."

# Entering the reserve market with Gasum

**GASUM PROVIDES** a wide range of services for the energy market, although many people still perceive it only as a gas company. In the electricity reserve market, Gasum acts as a service provider to its customers.

"We sell our customers' capacity to the reserve market, invoicing the incomes from Fingrid, and compensate it to our customers. This model means that Fingrid does not need to conclude agreements with each reserve unit individually," says **Juha Hietaoja**, Senior Energy Specialist.

Gasum currently has about 20 customers in the reserve market. The capacities of individual units are typically from one megawatt upwards.

They include industries, electricity producers, energy storage facilities and real estate customers. For example, the standby back-up generators maintained by real estate customers in case of power outages can be offered to the reserve market. Wind power operators, in turn, can commit to reducing their power production for a short period to support the power system.

According to Hietaoja, the potential financial gains are the biggest incentive for customers to participate in the reserve market. On the other hand, the technical requirements and complexity of the market raise the bar for participation.

"Of course, from a national economic perspective, it makes sense to have all possible capacity in the reserve market, especially as renewable weather-dependent production increases."

At the outset, Gasum identifies how much a customer could benefit from offering their capacity in the reserve market. After that, the required technical capabilities are determined, and acceptance tests are performed. When operations have started, Gasum's 24/7 control room handles operations in the market around the clock.

"More and more of our customers have the capacity suitable for different markets. We constantly develop our system capabilities and price forecasts for different markets to continuously optimise the market in which capacity should be offered." ◆


Juha Hietaoja

**"We sell our customers' capacity to the reserve market, invoice for the profits, and pass them on to our customers."**

**Juha Hietaoja,** Senior Energy Specialist, Gasum



COLUMN


PHOTO SAMPO KORHONEN

# Clear and timely advice on every aspect

**SINCE THE** energy crisis began, the media has seen to it that Finnish people know the basics of the electricity market. Interest in the reserve market has also grown, and more and more people understand the important role reserves play in the power system.

2024 looks good for the reserve market: The Nordic market is expanding, and we are taking big steps towards a common European market by joining the European aFRR energy market platform. At the end of the year, the automation of the Nordic mFRR energy market automation and the introduction of 15-minute products will enhance the performance of the market and the management of the power balance. We also predict a faster increase in reserve purchases and, hopefully, increased supply.

*The Super Year will require an enormous amount of work in also our customer companies.*

These changes all depend on successful communication. The communication strategy related to reserve markets must be refined. The main grid slang, acronyms and technical jargon we use must be translated into plain language.

This year – the Super Year – will require an enormous amount of work in the transmission system operator and customer companies. No one can remain passive and wait for things to develop; only by actively participating in the market and making the required changes can we unlock the benefits and make the market work.

The much-criticised balance management reform and 15-minute market will facilitate many things. Although the change will increase workloads and complicate existing processes, the shorter market time unit will allow for more accurate production and consumption planning. Planning and trading can take place closer to the time of use, which in turn makes balancing the power system more cost-effective.

An efficient, reliable, market-based power system that incentivises investment in all sectors is in society's interests.

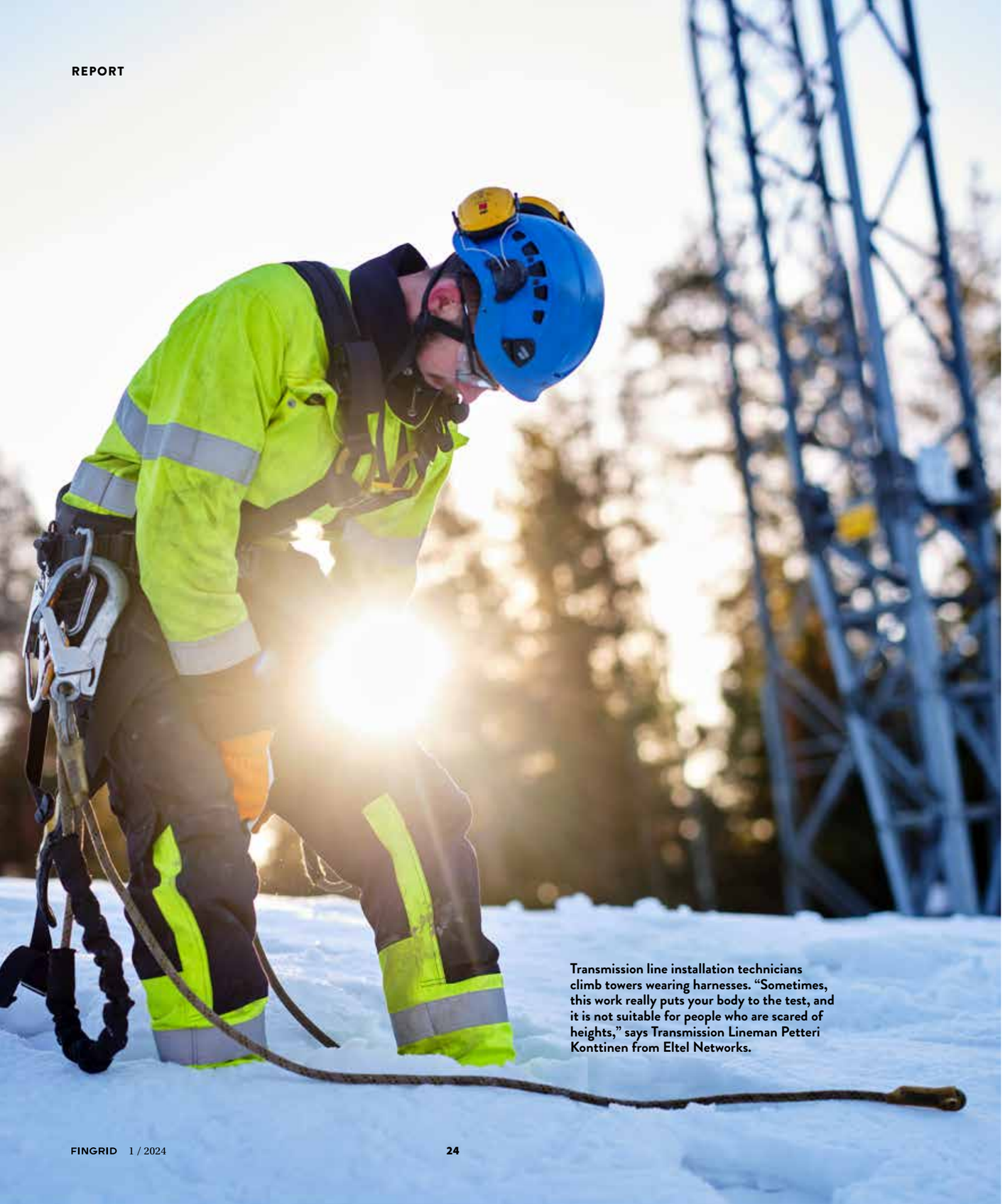
Our customer base has expanded a lot, which is very welcome, as we need a wide range of production technologies and consumers in the reserve market.

Without knowing much about the reserve market, it can be difficult for people to understand the potential of being flexible. The best way to ensure mutual understanding is through discussion, but we have also invested in other communication material. In the spring and towards the end of the year, we will hold several webinars, revamp our website, provide reserve market training for beginners in April, and fine-tune our market-entry and customer-service processes.

In addition, we will remain in close contact with all our customers in the mFRR market this year to ensure that Finland is ready to enter the new mFRR capacity and energy markets.

In June, we welcome all our reserve suppliers to attend our Reserve Market Day. ◆

**Maria Joki-Pesola**
Unit Manager
Fingrid



Transmission line installation technicians climb towers wearing harnesses. “Sometimes, this work really puts your body to the test, and it is not suitable for people who are scared of heights,” says Transmission Lineman Petteri Konttinen from Eltel Networks.

# OUT AND ABOUT WITH A TRANSMISSION LINEMAN

A power lineman’s work does not end when the building of a transmission line is complete – it is just the start. Lines are inspected in the summer, and maintenance work takes place all year round.

TEXT MARJO TIIRIKKA / PHOTOS SAMPO KORHONEN

On a cold winter’s morning, Power Lineman **Petteri Konttinen** opens Fingrid’s power line app to check his to-do list for the day. The app shows the locations where he will be working.

The first job of the day is to replace some detached warning signs.

The journey begins in Rajamäki on the premises of Konttinen’s employer, Eltel Networks, a service provider for electricity and telecommunications networks. Konttinen packs warning signs, fastening screws, a harness, safety goggles and a helmet. He may also pick up drilling screws, C-sleeves, bolts, clamps or lengths of copper wire for earthing. Binoculars are always in his toolbox.

Today will not be a very busy day. But some days are, as maintenance work can be carried out on any part of a line, from foundations to components mounted high on towers. Sometimes, an excavator or crane is called for. The work is diverse, and no two days are alike.

**Maintenance work is done everywhere, from underground cables to the tops of transmission line towers.**

## NO SPECIFIC VOCATIONAL DEGREE FOR THE INDUSTRY

The next thing on Konttinen’s list is to tighten the stay wires that support transmission line towers. Sometimes, he installs new stay wires. Konttinen learned this skill from more experienced colleagues.

Konttinen got into the industry by accident. Fresh out of college with a plumber’s qualification in hand, he could not find a job until he got talking to a neighbour at his holiday cabin. The neighbour was about to retire from Eltel and urged the young man to follow in his footsteps and become a transmission lineman.


**A transmission line installation technician must complete training to earn their safety, first-aid and hot-work permits, as well as inspection licence training.**

"My neighbour was very convincing. I just had to go and see what the job was like," says Konttinen.

There is no direct course of study leading to the job of transmission lineman. However, institutions such as Tampere Adult Education Centre offer courses relevant to the industry as further education. Konttinen learnt to do the job in courses organised by Eltel and Fingrid.

Eltel's orientation includes online training and mandatory courses for linemen, such as safety, first aid and hot work courses. Linemen working for Fingrid must complete Fingrid's online safety training and inspection licence training.

## Maintenance is largely preventive work

**FINGRID** is responsible for keeping the lines in compliance with the electrical safety regulations. In practice, basic transmission line maintenance is done by transmission linemen employed by service providers, around 50 of whom work in maintenance. **Mikko Jalonen**, Manager, Transmission Line Maintenance Management at Fingrid, says that maintenance is based on the observations made by linemen in the summer.

"Transmission linemen observe issues and record them in the system. At Fingrid, we plan which of them to correct at any given time. The service provider decides how to do the work and is responsible for the implementation."

Transmission line inspectors work in pairs, going onto the lines together but handling the walkable parts alone.

Binoculars are vital, as transmission lines are dozens of metres above the ground. Wooden poles and towers are given a tap with a billhook or axe to check the wood is not rotting.

Transmission line inspectors check the conditions of tower structures and conductors and make sure nothing is built too close to the lines. Observations may include broken glass insulators, rotten tower legs or deteriorating foundations.

Inspectors are the eyes and ears of the maintenance team, so they are required to have expertise, a responsible approach to their work, and the ability to make independent decisions.

The most important aspect of transmission line maintenance is preventive work, so hardly any faults affecting electricity transmission arise. In the winter, one preventive measure is to remove the frost accumulating on the earth wires of transmission lines before it can cause electricity transmission disturbances.


A fitness test is also required to confirm the worker's physical and mental capacity — climbing up towers is an important part of a lineman's work.

"The work requires arm and leg strength because you need to climb up towers with a harness quite often. Sometimes, it puts your whole body to the test. This job is not for people who are scared of heights," says Konttinen.

The work is outdoors, and it is good if the lineman enjoys spending time alone in forests, for example. This has felt quite natural to Konttinen – he enjoys hunting and hiking, so outdoor pursuits are his thing.

In the winter, frost or snow can accumulate on earth wires, requiring a helicopter to come and remove them. Konttinen has not yet been on a helicopter, but he would like to try it.

"I have been doing this work for three years, and I enjoy it. I have nice colleagues – that is a big part of it."

Transmission lineman must be willing to travel, as their work is needed all over Finland. Sometimes, they may need to spend a night away from home.

Konttinen says that he often works extra hours to take Fridays off in the summer and enjoy a long weekend. This is more difficult in the winter because the work cannot be done in the dark.

However, he has already banked a few additional hours. Konttinen packs his things in the afternoon and sets off to Hyvinkää, home in time for the weekend. ◆

# RELAY PROTECTION COUNTERS THE ADVERSE EFFECTS OF DISTURBANCES

Finland's main grid is one of Europe's most reliable electricity transmitters. Nevertheless, faults and disturbances occur approximately 300 times a year. However, not all of them need to be repaired on-site, thanks to relay protection in the main grid.

TEXT ARI RYTSY / PHOTO SHUTTERSTOCK

In recent years, there have been 200–350 disturbances in Finland's main grid every year. The most typical causes are natural phenomena and weather conditions that occur all year round.

Many faults are caused by migratory birds in the spring and autumn. In the summer, thunderstorms and falling branches cause problems, while frost and snow burdens are specific to the winter.

"Snow burdens accumulate on earthing wires above the phase wire. When the weight of the snow causes the earthing wire to touch the phase conductor, a fault occurs in the main grid," says **Jari Honkanen**, Expert in Relay Protection at Fingrid.

Similar problems can be caused if migratory birds with large wingspans collide with the wires.

"In addition, large trees can also fall onto transmission lines. These situations are rarer, as transmission line rights-of-way are cleared regularly."

Lightning strikes cause the largest number of disturbances in the main grid.

In a typical case, lightning strikes a main grid transmission line or earthing wire directly. The high current present in the lightning creates a voltage spike in the conductor that discharges across the line insulation, forming an arc. This results in a short circuit between the phases or an earth fault between the phase conductor and the tower.

## RELAY PROTECTION RESPONDS RAPIDLY TO FAULTS

Main grid disturbances rarely cause larger problems, as the grid is equipped with relay protection.

A relay is a device used to isolate a defective line from the rest of the network in the event of a fault. Fingrid uses distance and differential relays to protect the main grid and locate short circuits and earth faults. The location information can be used to isolate the faulty line from the grid in the event of a disturbance.

"Relay protection detects a change in voltage caused by a direct lightning strike on the transmission line and knocks the line off by disconnecting the electrical power from it. Relay protection isolates all short-circuit faults in the 400 kilovolt grid within 0.1 seconds of their onset.

This helps to maintain stability in the main grid," says Honkanen.

When the power is cut, the arc stops, and the relays can then switch the line voltage back on. However, this step must be slowed down, as arc-ionised air can reignite the arc. A full-line disconnection and reconnection event typically takes 1–3 seconds.

Short circuits high in the sky pose no hazard to the environment. However, if an earth fault occurs, the voltage spreading around the tower presents a danger to any people and animals nearby. Therefore, disturbances must be resolved without delay.

"Prolonged faults cause voltage dips in the main grid that affect manufacturing processes, power plants and electricity transmission. In the worst case, prolonged voltage dips could lead to a blackout, which would take down the entire main grid," says Honkanen.

Fortunately, these situations have not been encountered for decades.

"Of course, we have planned the action to take in such an event, and Fingrid practises restarting the main grid based on these plans."

**"Relay protection disconnects a short circuit fault within 0.1 seconds of its onset."**

**Jari Honkanen**
Expert, Relay Protection
Fingrid

## TRAVELLING WAVE MEASUREMENTS REVEAL FAULT LOCATIONS MORE PRECISELY

In addition to relay protection, Fingrid uses travelling wave measurements to reveal the locations of faults and disturbances. Faults can now be repaired more quickly thanks to equipment investments that began in the last decade.

Fault location based on travelling waves works by using sensors in travelling wave meters to measure the current and voltage levels in conductors and react when the permitted thresholds are crossed. The fault is located by an app that calculates the location based on the timestamp provided by the travelling wave meter and the velocity of the travelling wave.

"Previously, the only way to locate a fault was to patrol over several kilometres. Now, travelling wave location enables faults to be located to within a few hundred metres. This allows corrective measures to begin sooner, reduces the costs of patrolling for faults, and improves electrical safety in the environment." ◆

The amount of emissions can be influenced by choosing better materials, such as low-emission aluminium or steel.

TEXT MINNA SAANO / PHOTO SHUTTERSTOCK

# NEW CALCULATION MODEL GUIDES emissions reduction measures

Last year, Fingrid introduced a calculation model that takes into account the greenhouse gas emissions from its own operations and those of its service providers. The results serve as the basis for planning emissions reductions.

For several years, Fingrid has calculated and reported the greenhouse gas emissions caused by its own operations. Last year, a calculation method was developed that incorporates emissions in the value chain for the first time. Value chain emissions are indirect emissions arising from the activities of Fingrid's subcontractors and contractors, such as parties working on main grid investments, network maintenance, waste management and outsourced services.

"The expanded calculation meets the regulatory requirements while also providing more information on where our most significant emissions arise," says **Elina Merta**, Expert at Fingrid.

## WORKING TOGETHER TO REDUCE EMISSIONS

The results of the calculation for last year confirmed the preconception that network investments are a major source of emissions.

"The results can help identify better ways to plan and direct effective emissions reduction measures in the future. It is all about working with our partners," says Merta.

The choice of materials can play a major role in reducing emissions. For example, low-emission aluminium or steel are good alternatives.

Last year, Fingrid joined WWF's Ready for Green Steel campaign. The aim for the committed companies is to demonstrate their willingness to purchase green steel and thus encourage change in steel producers.

Starting next year, the new greenhouse gas calculation model can be used to better assess emissions trends and the impacts of target-oriented climate action on them.

"Emissions may vary sharply each year depending on how many projects are completed in the year. Big projects to develop the main grid and enable the green transition will inevitably result in emissions," says Merta.

With the big picture in mind, Fingrid enables clean power production to connect to the grid and has a significant positive climate impact for society. ◆





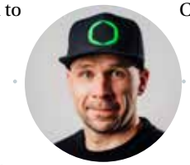
TEXT SAMI LAAKSO / PHOTOS CACTOS OY

# Grid energy storage has a multitude of uses

Grid energy storage facilities can hedge against the highest prices, even out consumption peaks, and ensure a supply of reserve power. They can also be used in the frequency reserve markets.

**Oskari Jaakkola**, CEO of Cactos Oy, says that rapid electricity price fluctuations were the impetus for the company, founded in 2021, to begin manufacturing grid energy storage systems.

In addition to hedging against rapid price changes, grid energy storage facilities can even out consumption peaks and ensure a supply of reserve power. They can also be used to offer reserve products to the transmission system operator.



Cactos began producing grid energy storage units using second-hand Tesla batteries. Demand was strong, so the company could not allow its production to become dependent on the availability of used batteries. To this end, the company developed a product made from new iron phosphate cells. These cells now account for 90 per cent of the company's production.

"The prices of the components in the new batteries have fallen so much that a system built from them is already cheaper than one made from recycled batteries," says Jaakkola.

Grid energy storage systems are acquired by industrial-scale companies with a connection of at least 3 x 63 amperes. Cactos' smallest unit is 100 kilowatt-hours and its largest is 2.5 megawatt-hours.

One large customer group is logistics centres, where cargo-handling equipment and, increasingly, distribution traffic are powered by electricity. Many logistics centres also have solar panels that provide enough electricity to charge grid energy storage systems.

Grid energy storage systems are also being leased for real estate properties, industrial plants, and farms.

"The demand for power in many buildings has surpassed the capacity available from the grid using existing connections, so batteries are needed to even out consumption," says Jaakkola.

Grid energy storage facilities that work with Cactos' cloud service participate in the frequency reserve market, which evens out supply and demand in the grid. To do this, smart grid energy storage systems measure the local frequency and either charge or discharge as required.

"We provide our customers with grid energy storage as a service. Our customers are interested in the reserve market because earnings from it reduce their monthly fee." ◆

Founded in 2021, Cactos Oy has developed grid energy storage systems used in logistics centres and real estate properties, among others.

# A PERFECTLY NORMAL WEEK AT WORK

At the beginning of the year, Asta Sihvonen-Punkka stepped up from the positions of Executive Vice President and Senior Vice President of Electricity Markets to become the CEO of Fingrid. Her new work involves familiar topics, as well as learning new things and having to give up others.

TEXT KATARIINA KRABBE / PHOTOS TERO IKÄHEIMONEN

## MONDAY

### MEETINGS SET THE PACE FOR THE DAY

**Asta Sihvonen-Punkka** arrives at Fingrid's headquarters well before 8 o'clock. It is good to have a little time in the morning to check emails and get oriented for the day. There are many meetings ahead, as usual.

"We have a matrix organisation with a steering group for all the key processes – or perspectives, as we call them. As CEO, I am involved in all of them. There are also a lot of meetings with stakeholders."

**"My strengths include knowledge of the industry, stakeholders, and the company."**

"Since my days are filled with meetings, the challenge is to find time to learn and prepare. In practice, I have to do these things in the evening. There are small breaks in between, and when I go home between four and five o'clock, it marks a clear cut-off point for the day."


## TUESDAY

### CHANGING OF THE GUARD

As Vice President of Electricity Markets, Sihvonen-Punkka was involved in large Nordic projects – there will be a new method for calculating the electricity transmission capacity, an automated balancing power market, and a big push to get the Nordics aligned with the 15-minute electricity market in the rest of Europe.

**Asta Sihvonen-Punkka is often asked to provide expert statements to the media. Interview requests are common – for example, when Fingrid raises its readiness in response to the weather conditions.**

Large reserve market projects are also underway.

"Our goal is to increase the supply and expand the market geographically, as the sellers of reserves would also benefit from having more than one buyer."

"It feels a bit sad to give up my role in this work, as I would like to help finish these critical projects in any way I can. As CEO, I cannot be involved in steering groups because if they had differing views, I would have the casting vote, so I should be impartial. These projects are in good hands: our experts are involved, along with our new Vice President of Electricity Markets, **Antti Keskinen.** The work will go on without me."

"Otherwise, I really like my new role. It is great to see the entire company's operations from this position. A really good strategy was completed last year, giving us clear guidelines. Of course, we need to keep the lights on, but we also need to get our customers involved in the power system transition."

Sihvonen-Punkka states that in addition to developing the transmission grid, Fingrid must be able to use the current network as efficiently as possible.

"In addition, we must continue our work to increase supply in the reserve markets. The power system needs a lot more flexibility. We must also ensure that our own competence and leadership keep pace with the changes. My strengths are knowledge of the industry, stakeholders and our company."

The CEO's work consists largely of various meetings with Fingrid employees and numerous Finnish and foreign stakeholders.

## WEDNESDAY

### INSPIRATIONAL CONVERSATIONS

So far, Sihvonen-Punkka has not had much to do with building the main grid and ensuring sufficient transmission capacity, but steering groups allow her to get involved in these topics.

"This setup works well for us, and I do not need to pick over the details. I want to learn more about this side of things, and people are always happy to share their knowledge. Fingrid has an open and relaxed atmosphere, and I am often inspired by conversations that identify practical solutions to problems."

## THURSDAY

### MEDIA INTERVIEWS

The calendar has been cleared for another interview. In January, Sihvonen-Punkka gave dozens of interviews to various media outlets ranging from Tekniikka & Talous (Technology & Economics) to Me Naiset (We Women).

In her first week at work, she was thrown straight in at the deep end when a long period of very cold weather caused electricity consumption to peak, and Fingrid raised its readiness.

"We published announcements asking people to reduce their electricity consumption, and the media was very successful in taking the message forward. Of course, I was also called for comments many times, but luckily, the people and the topics were familiar to me. I was kept up to date with the situation, which was extremely important."

## FRIDAY

### MANAGEMENT TEAM MEETING AND EUROPEAN AFFAIRS

At the first Management Team meeting of the year, Sihvonen-Punkka is chair for the first time. The meeting discusses Management Team procedures, the implementation of the One Fingrid strategy, information security, and the deployment of artificial intelligence.

The afternoon meeting covers Fingrid's priorities within the European Network of Transmission System Operators for Electricity (ENTSO-E), where Sihvonen-Punkka is Deputy Chair for a two-year term.

"Major themes in the coming years will include offshore wind power and the allocation of costs for the infrastructure it demands, flexibility, the adequacy of electricity, and the need to develop a hedging market. We want to make a difference and be involved in these things." ◆





TEXT KATARIINA KRABBE / PHOTO SHUTTERSTOCK

# Wind power from energy islands

In Denmark, energy islands will produce more wind power than the country's current electricity consumption.

Denmark plans to build two energy islands. In the first project, the infrastructure will be built on the island of Bornholm, and a huge number of wind turbines will appear in the Baltic Sea nearby.

In the North Sea project, the infrastructure will be placed on platforms similar to oil rigs with wind turbines around them. The plan initially called for the construction of an artificial island, but platforms proved a more cost-effective solution.

"The core idea is to concentrate as many wind turbines as possible in the same area so that they can share the infrastructure. This also enables international connections, either from one energy island to another or to a neighbouring country," says **Thomas Dalgas Fechtenburg**, Senior Manager in the Systems Services Department of Energinet, the Danish transmission system operator.

According to the designs, the Bornholm energy island will have a capacity of three gigawatts in 2030. The North Sea energy island project aims to reach three gigawatts by 2033, rising to ten gigawatts in later phases.

"This exceeds Denmark's current energy consumption," Fechtenburg points out.

He believes that Denmark will become a net exporter of electricity and possibly also hydrogen produced by electrolysis.

### COOPERATION IN THE RESERVE MARKET

Wind power production varies depending on the weather conditions. When a large volume of wind power production capacity is concentrated in a small area and there are no weather differences within the area, more attention must be paid to power system reserves.

Denmark and Finland are so far apart that they rarely have the same weather and are unlikely to need reserves at the same time. Consequently, the two countries have begun working together to source power system reserves.

"This form of cooperation is like insuring an entire family at once instead of taking out separate policies for each family member," Fechtenburg compares.

The goal is to mitigate the risk of weather forecasting errors and ensure the reliability of the power system as the share of renewable energy increases. ◆

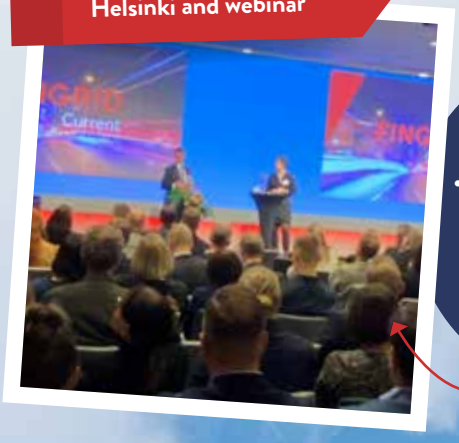
By 2033 The North Sea energy island project aims to reach

**3 GW**

Bornholm is known for its windmills, perhaps the most famous of which is located in Årsdale. Built in 1877, the windmill is still in use.

# Welcome to our spring and summer events!

**Fingrid Current, 24 April**
**Helsinki and webinar**



**THEMES:**
- Customers as enablers of the transition
- Timeline of the electricity market model

**Reserve Market Day, 6 June**
**Helsinki and webinar**


**Suomi Areena, discussion event, 27 June Pori**


**Farmari -agricultural exhibition, 4–6 July Seinäjoki**


**More events:**
fingrid.fi/tapahtumat
*(in Finnish)*

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