1 2023

FINGRID

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

NIINA HAKKARAINEN, FINGRID:
"The Project Manager carries the overall responsibility for substation projects."

The increasing volume of wind power production calls for new solutions for the power system

The commercial sector is focused on energy efficiency, wind power and solar power

One of many

Over the next ten years, Fingrid will execute approximately 180 different substation projects. There will be 45 completely new substations, with a Project Manager responsible for each of them.

One of the new 110-kilovolt substations is called Julmala and is currently under construction in Peräseinäjoki in South Ostrobothnia. The construction project is now complete, and electrical installations will take place in the spring. The substation will be commissioned this summer.

The new substation is needed to improve system security in the region. More wind power will be built in the region, and the Julmala substation will connect the turbines to the main grid.

In substation projects, the Project Manager has overall responsibility from the design phase until the end of the warranty period. The work includes planning procurement, running competitive tendering processes, and making contracts. The project manager is also responsible for ensuring that the project proceeds safely, according to the agreed timetable, scope and budget.

The Project Manager holds the reins of the entire project and works with numerous stakeholders. The external stakeholders include contractors, customers and service providers. The internal stakeholders are Fingrid's specialists, whose expertise is needed in the project design and implementation phase, so the project manager works closely with them. Several dozen people may be involved in the planning and execution of one substation project, depending on its size. ◆

FINGRID WILL INVEST

EUR 3 billion

IN THE MAIN GRID OVER THE NEXT 10 YEARS.

OF THIS SUM,

38%

WILL BE SPENT ON SUBSTATIONS.

Junior Project Manager Niina Hakkarainen from Fingrid is taking care of the Julmala substation project in Peräseinäjoki. Hakkarainen is also responsible for a project to expand the Kontiolahti substation. "Every project is unique, so there is no such thing as a normal working day. No two substation projects are alike."

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RENEWING
THE ENERGY SYSTEM

REGULAR SECTIONS

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What will change when the power system is modernised?

THE POWER SYSTEM is undergoing a dramatic transformation with technical, commercial and legislative dimensions and many more besides.

The transition is usually associated firstly with renewable, emission-free electricity production, which serves to attract industries that exploit it. In this sense, Finland has an incredible opportunity on its hands – and the connection enquiries we receive reflect this.

The key difference between the new power system and the old one is that power production depends on the weather. When it is windy, a lot of electricity should also be consumed. This puts electricity networks under pressure, as production and consumption tend to be located far from each other.

On the other hand, we also need electricity when it is not windy. This emphasises the diversity of the production structure, the flexibility of consumption, the importance of cross-border transmission links, and various forms of energy storage.

Electricity production must match consumption at all times, and in addition to infrastructure, this requires a functioning electricity market. Trading is moving ever closer to the moments where electricity is produced or consumed, incentivising market actors to adapt to the prevailing situation.

This, in turn, calls for ever greater automation, as there is no way a human could handle these near-real-time command chains. The change will impact many areas, from Fingrid's control centre all the way to home automation.

The technical implementation of electricity production is a further major change.

Production plants no longer work in synchronous operation, thus supporting each other.

Instead, they feed power into the grid through power converters. The numerous converters and regulators that control them must work in seamless cooperation to ensure the technical functionality of the whole power system. It is also important to ensure the grid has sufficient inertia and short-circuit power.

It is great to be involved in this type of modernisation – not every generation gets this experience!

Jussi Jyrinsalo
Senior Vice President
Grid Services and Planning
Fingrid

FINGRID

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Lake Line brings vitality to Eastern Finland

Fingrid's Lake Line transmission line from the Oulu area towards Lappeenranta will boost the electricity transmission capacity from north to south. At the same time, it will facilitate wind and solar power projects and industrial investments in Eastern Finland.

The new transmission line will be approximately 290 kilometres long and built mainly alongside existing transmission lines, although the northernmost section will replace an old line. One new substation will be built along the new transmission line, and six existing substations will be modernised.

The Lake Line and associated substations will improve system security in Eastern Finland and facilitate the implementation of transmission outages in the region.

Reinforcing the north–south transmission capacity will also boost the electricity market's efficiency and improve the chances of Finland remaining a single price area in the electricity market.

Construction of the transmission line will begin this year, and the project will be completed in 2026. ◆

Reinforcing the main grid in Northern Ostrobothnia

WE ARE strengthening the main grid in Siikajoki and Liminka in Northern Ostrobothnia. The production capacity of the Siikajoki substation will rise to approximately 600 megawatts as the volume of wind power output increases. The 110-kilovolt network in the main grid must be strengthened from Siikajoki to the north to transmit the energy to consumption facilities.

A new 27-kilometre section of transmission line will be built in place of the existing one. The project will be completed at the end of next year.

BACK IN THE DAY

Iron Lady dominating the landscape

IN THE 1920S, about one in four homes in Finland had electric lighting. Finland's main grid was born in 1929 when the country's first high-voltage electricity transmission line – known as the Iron Lady – was commissioned between Imatra and Turku. Industrial operators built the first 20-kilovolt and 70-kilovolt transmission lines to Southern and Southwestern Finland in the 1920s.

PROFILE

Transmission forecasts for the coming years

Pekko Niemi's work is strongly rooted in data.

TEXT MINNA SAANO | PHOTO SAMPO KORHONEN

I work in strategic grid planning at Fingrid, doing electricity market modelling. I prepare electricity transmission forecasts for internal use, looking two or three years ahead. The forecasts indicate future transmission volumes between Finland and other countries and over the main transmission cross-sections within Finland. The models are used for purposes such as forecasting congestion income and purchasing loss power.

Fingrid has a data management model, and I have various tasks within it: I am one of the electricity market data officers, the technical data officer and one of the analytics officers. I develop the automation of data fed into the market models and the visualisations and reporting of the model results and other electricity market data. In other words, I am involved in lots of data management and processing work.

I have boosted my professional skills by programming an energy bot for Twitter in my spare time. The bot provides real-time information on matters such as wind power production. As the energy crisis rolls on, the bot has gained over 2,000 followers. Discussion focuses on preparing for times of low wind production.

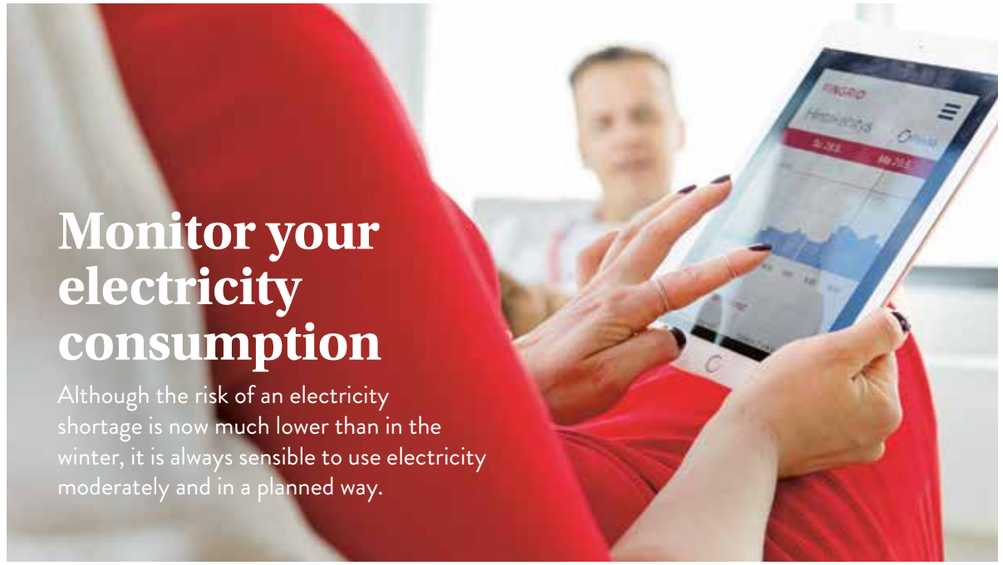
In my free time, sport helps me decompress and take my mind off data. Ball games are a particular favourite of mine. I am often among the first to get involved in sports tournaments between companies. They are always fun events." ◆

twitter.com/EnergiaBotti
twitter.com/PekkoNiemi

WHO?
Pekko Niemi

WORK
Specialist

FREE TIME
Ball games, cycling, IT



Monitor your electricity consumption

Although the risk of an electricity shortage is now much lower than in the winter, it is always sensible to use electricity moderately and in a planned way.

Fingrid's Datahub service enables you to monitor your electricity consumption. It shows how your consumption varies according to the time of day and day of the week and which devices consume electricity. Datahub allows you to compare different periods and see your electricity consumption trends and, among other things, how much electricity you have saved. You can log in to Datahub using your online banking credentials or a mobile certificate.

TUNTIHINTA SHOWS REAL-TIME ELECTRICITY PRICES

Fingrid's Tuntihinta (Hourly Price) app was released in app stores nearly ten years ago. It underwent a renaissance last year as electricity prices began to rise. Last autumn, the app was one of the most popular free mobile apps in Finland.

Tuntihinta shows the real-time hourly electricity price in Finland. Accurate price information helps consumers to schedule the use of energy-intensive devices at times when electricity is cheaper, leading to real monetary savings, especially for users of spot-priced electricity. The service alerts the user if the price surpasses the user's set threshold. ◆

fingrid.fi/en/electricity-market/datahub/
fingrid.fi/tuntihinta (In Finnish)

Electricity network nodes to be modernised

- The secondary systems (protection and control systems) in the Joensuu and Kuopio substations will be modernised. This will improve the system security of the main grid in Eastern Finland. The modernisation will be completed in 2025.
- The expansion of the Utajärvi substation will enable the first solar park to be connected to Finland's main grid. The expansion will be completed in 2024.
- A new substation will be built in Tervakoski to improve system security in the region and support Tervakoski Oy's transition to fossil-free energy at its paper mill. The substation will be completed in 2025.

PRACTICAL QUESTION

Could microreactors become a new export product?

A microreactor is being planned in Lappeenranta. Juhani Hyvärinen, Professor of Nuclear Engineering at LUT University, believes that a new type of nuclear power could work brilliantly as part of a future energy system.

TEXT MARJO TIIRIKKA | PHOTO TEEMU LEINONEN

1 What is a microreactor, and how does it work?

A microreactor is a power plant containing a nuclear reactor with a thermal power of 15–1,500 megawatts. They can be used to generate electricity or heat or to power ships.

Microreactors work in the same way as larger nuclear power plants, and their fuel is based on uranium. A chain reaction inside the nuclear power plant causes uranium atoms to split. The nuclear energy released by this fission is eventually converted into heat. The heat can be sold directly or converted into electricity.

2 Where can microreactors be built?

Anywhere, as long as there are small industrial plots. Our microreactor will be built somewhere in Lappeenranta because it will be connected to the city's district heating network.

A microreactor can be used to generate electricity or heat or to power ships.

We can test a new type of nuclear power as part of a future energy system.

3 What is the aim of the reactor jointly designed by LUT and its US partner?

The main idea behind our research project is to test a new type of nuclear power as part of a future energy system. We are studying the potential applications for a microreactor that produces 15–30 megawatts of heat. We are also paving the way for naturally safe plants that can be placed in urban environments.

The above-ground parts take up as much space as a large garage, and the gas-cooled reactor is underground. A similar power plant is due to start up in Canada in 2026, and ours will come online in 2029.

4 Could microreactors become a new export product for Finland?

Absolutely. Lots of different microreactor projects are underway. Our approach is to procure import technology for Lappeenranta, and Finnish operators can also get involved, for example, with equipment deliveries for the turbine plant.

These reactors could be sold in enormous numbers in Finland and elsewhere in Europe. We burn fossil fuels to generate approximately 1,500 megawatts of district heating. If we want to replace natural gas, coal and peat, we will need 50 reactors, each outputting 30 megawatts. ◆

WHAT IS ELECTRICITY USED FOR IN FINLAND?

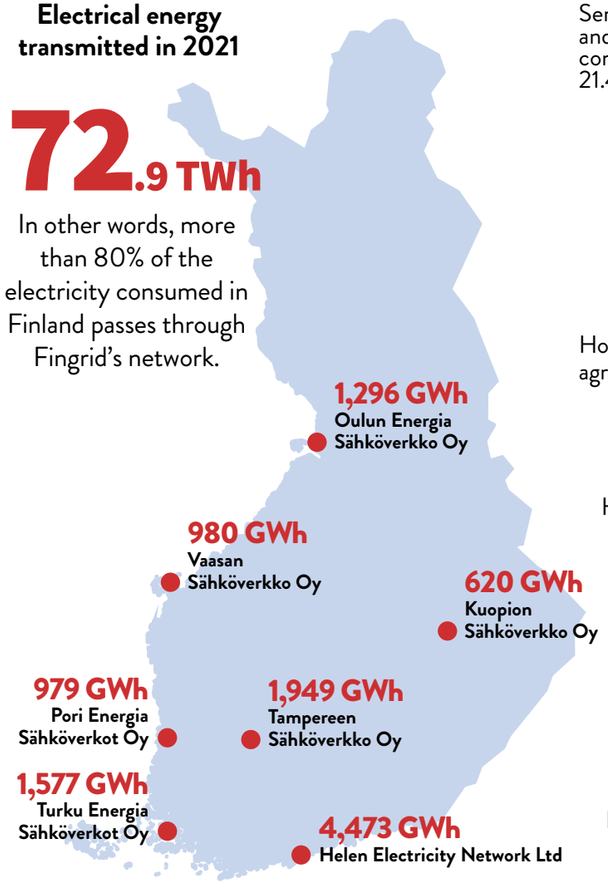
There have been no major changes in electricity consumption in Finland in recent years. More energy-efficient devices reduce consumption, but the electrification of transport and, in particular, industry will increase consumption substantially in the future.

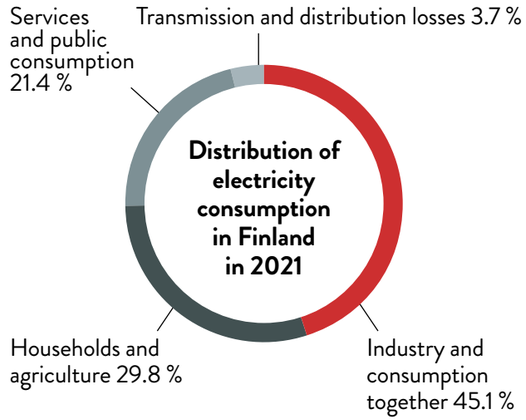
COMPILED BY PEKKO NIEMI / INFOGRAPHIC LAURA YLIKAHRI

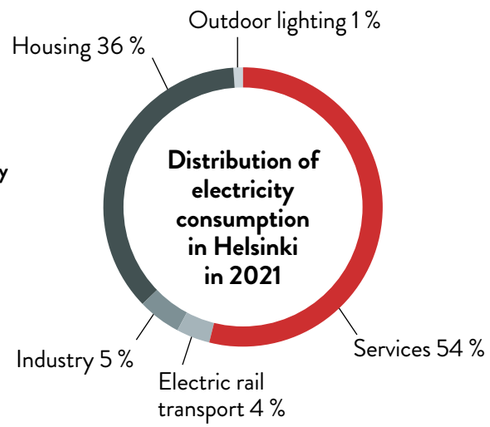
Electrical energy transmitted in 2021

72.9 TWh

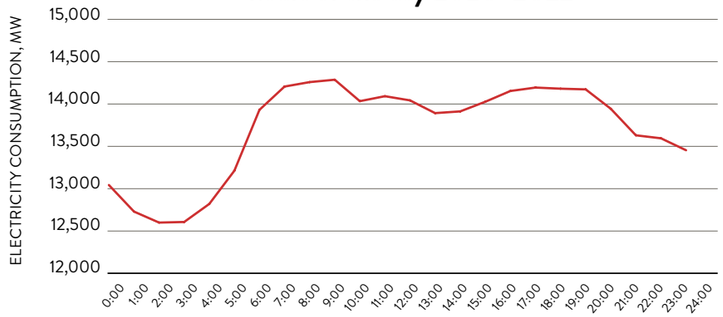
In other words, more than 80% of the electricity consumed in Finland passes through Fingrid's network.







Maximum consumption at different hours of the day 2020–2022



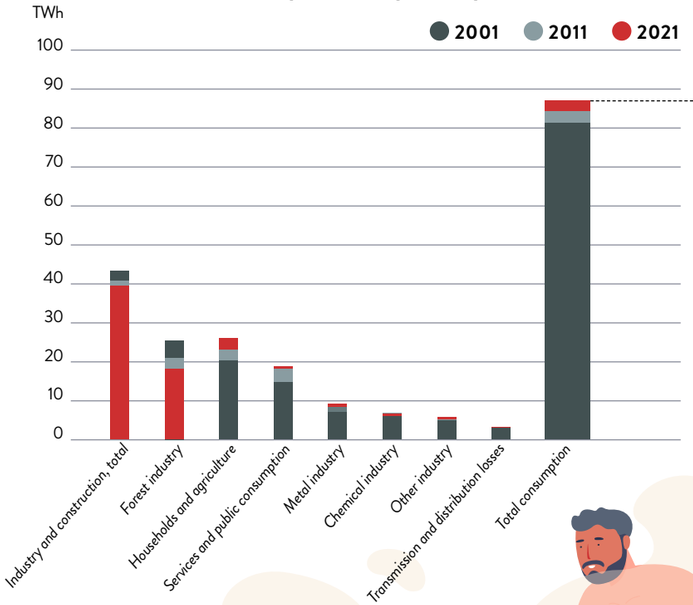
Consumption peaks usually occur on weekdays from

7 to 9 am

and from

16 to 19 pm

Electricity consumption by sector



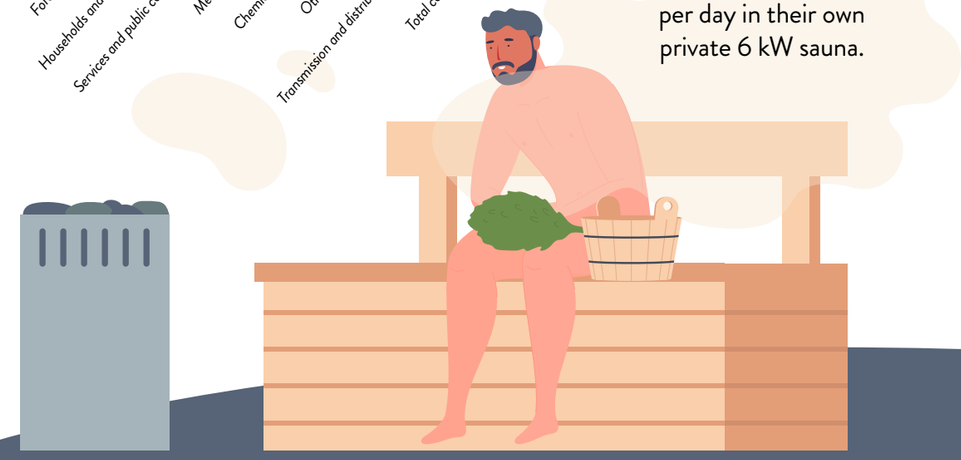
The total consumption in 2021 was

87 TWh

With this amount, everyone in Finland could spend more than

7 hours

per day in their own private 6 kW sauna.



Sources: Energy Authority, Fingrid, Helen annual report, and Statistics Finland

WIND POWER NEEDS BALANCE AND TRANSMISSION CAPACITY

The increase in wind power production is putting the power system to the test. In the future, the grid will need solutions to ensure stability and more transmission line connections.

TEXT VESA VILLE MATTILA / PHOTOS MIKKO VÄHÄNIITTY, FINNISH WIND POWER ASSOCIATION AND FINGRID

Finland has approximately 1,400 wind turbines with a combined output of just under 5,700 megawatts.

Fingrid expects this capacity to quadruple over the next decade. Wind power will then account for as much as 90 per cent of Finland's energy production at times.

Anni Mikkonen, CEO of the Finnish Wind Power Association, points out the other significance of wind power:

"Our wind power market is among the most exciting in Europe at the moment. Wind power is the industry that attracts the largest investments to Finland every year. No other form of electricity production can be built in Finland as quickly and cost-effectively as wind power."

Mikkonen points out that wind power also boosts the vitality of many small communities.

Over the next decade, wind power will account for as much as

90 %

of the energy production in Finland at times.

"Every year, wind power attracts more money in investments to Finland than any other industry," says Anni Mikkonen, CEO of the Finnish Wind Power Association.

Wind turbines are connected to the grid via frequency converters.

FROM SYNCHRONOUS MACHINES TO FREQUENCY CONVERTERS

As wind power accounts for an increasingly large share of energy production, new solutions are required to ensure the functionality of the power system. The method for connecting wind power to the grid differs in a technical sense from the method for conventional power plants.

In hydro and thermal power plants, a turbine rotates a generator at the same pace as the grid frequency. If the frequency or voltage of the grid changes, a synchronous machine naturally resists such changes.

Wind turbines, however, are connected to the grid via frequency converters.

"At traditional power plants, the connection is a physical one. However, at wind power plants, it is a question of programming based on power electronics," says **Antti Harjula**, Head of Power System Engineering Unit at Fingrid.

POWER CONVERTERS FOLLOW THE GRID

The wind power construction boom is displacing the synchronous machines at conventional power plants from the electricity network. However, power converters only follow the grid – as they are programmed to react – and do not stabilise the network as synchronous machines do.

"Power converters lock into the grid frequency and supply power accordingly," Harjula explains.

"The challenges include the interactions between power converters. Production based on power electronics also required more accurate modelling and analysis to ensure the stable operation of the power system."

As power converters do not support the power system like synchronous machines do, power system stability may be degraded. As a result, also transmission system protection and the quality of electricity may suffer. In addition, the power system will become more difficult to manage.

At traditional power plants, the connection is a physical one. However, at wind power plants, it is a question of programming based on power electronics.

SOLUTIONS FROM THE MARKET, WIND TURBINES AND THE GRID

Harjula lists three categories of solutions for boosting grid stability: solutions purchased from the market, implemented into wind power plants, and built into the grid.

Solutions can be implemented locally, regionally or even at the pan-Nordic level.

Transmission system operators around the world research opportunities together with customers and equipment manufacturers.

In the future, Fingrid may buy production from power plants to support the grid rather than to produce energy. An example of market-based solution is the Fast Frequency Reserve (FFR), which is activated in low-inertia situations.

Fingrid will set new requirements for production facilities connecting to the grid in due course. For example, power converters should be capable of creating voltage and maintaining the frequency without an external reference.

Commercial solutions are already available for grid energy storage facilities based on power converters that are grid forming. However, solutions integrated into power plants are still in the development stage, and standards are lacking.

The third category covers devices integrated into the power system. Fingrid can for example install synchronous machines in the grid that work without an energy source.

"Fingrid is responsible for ensuring the overall functionality of the power system in Finland. In time, we will find the most cost-efficient solutions," Harjula says.

In any case, solutions must provide predictability and technical reliability.

STRENGTHENING THE MAIN GRID ON THE WEST COAST

Our wind power production has strong regional concentrations.

As much as three-quarters of wind power production, at present and in the near future, is in the regions of Ostrobothnia. This part of Finland will host a wind power cluster to rival the output of the Olkiluoto and Loviisa nuclear power plants.

"By the end of 2025, the area between Pori and Oulu will contain about 5,000 megawatts of wind power production. In addition, thousands more megawatts of production are planned on land and →

Reserve terms and conditions amended following pilot project

AT THE MOMENT, wind power producers only participate in the mFRR in Finland – in other words, in the balancing energy market.

Based on lessons learned in other countries, wind power could also be used to provide automatic reserve products: the automatic Frequency Restoration Reserve (aFRR), the Frequency Containment Reserve for Disturbances (FCR-D), the Frequency Containment Reserve for Normal Operation (FCR-N), and the Fast Frequency Reserve (FFR).

In 2023, Fingrid will arrange a pilot project on the participation of wind power in the reserve market for automatic products.

The aim of the pilot project is to address issues such as the interpretation of the reserve terms, prequalification tests for specific reserve products, or sending control signals to wind farms. Fingrid will use the lessons learned to develop its reserve terms and conditions.

Fingrid's pilot partners are Enefit Green, Centrica Energy Trading and Prime Capital AG.

The Jylkkä substation will enable significantly more wind power to be transmitted to Finland's main grid and onwards to customers.

at sea," says **Petri Parviainen**, Customer Manager at Fingrid.

Although Fingrid has renewed and strengthened the main grid on the west coast, the transmission capacity is already being pushed to its limits due to the growth in onshore wind power, especially during maintenance and faults. So more transmission line connections are needed in the area.

Fingrid is preparing and conducting environmental impact assessments on a new 400-kilovolt transmission line connection from Kristinestad to Tampere and two similar transmission line connections from Kalajoki to Central Finland. The connections will be completed in 2027 and 2028.

"The new transmission lines will significantly increase the electricity transmission capacity in the region and facilitate the connection of new wind power production to the power system. However, the timetable for building these connections could slow the execution of some wind power projects," Parviainen mentions.

SYNCHRONOUS COMPENSATOR TO BE INSTALLED IN KALAJOKI

Increasing the transmission capacity of the main grid is an important project, but the west coast also needs solutions that can be implemented more quickly.

Fingrid ordered a synchronous compensator – a large synchronous machine – for installation at the Jylkkä substation in Kalajoki. The synchronous compensator will balance the grid without an energy source.

"According to the plans, we will commission the synchronous compensator in 2025. This will make it possible to connect some new wind power to the grid along the Kokkola–Raahe axis," says Parviainen.

Fingrid also intends to deploy Dynamic Line Rating technology on the west coast to provide more accurate data on the possibilities for loads and capacity in the transmission grid in different weather conditions. The technology will provide room for manoeuvre in grid operations. ◆

TEXT VESA VILLE MATTILA / PHOTO SHUTTERSTOCK

Wind power fully enters the reserve market

RESERVES BALANCE fluctuations in electricity consumption and production. Wind power is also needed in the reserve market.

Market parties should match their electricity production for sale and their electricity purchases for consumption as well in advance as possible. If market parties succeed in this, Fingrid will have less work to maintain a momentary balance between consumption and production in the power system.

Fingrid maintains the momentary balance using reserve products purchased in the reserve market. Producers and consumers bear the costs of purchasing and activating reserves.

The rapid increase in wind power production in Finland is leading to occasional shortages of reserves for reducing production – known as down-regulation reserves. Wind power also needs to be fully integrated into the reserve market to ensure the effective, market-based management of the power balance in the future.

So far, wind power producers have had little involvement in the reserve market in relation to their capacity.

NEW EARNING OPPORTUNITIES

In early 2023, Fingrid began purchasing down-regulation capacity in the balancing capacity market to ensure sufficient down-regulation resources.

Alongside the balancing energy market, there is now a capacity market where balancing service providers receive compensation for offers they make the previous day to submit balancing bids. This represents a new earning opportunity for wind power producers.

One wind power producer participating in the reserve market is EPV Energy Oy, which wholly owns EPV Tuulivoima Oy. EPV Tuulivoima's current production capacity of approximately 500 megawatts will increase by one-fifth when three new wind farms are commissioned.

"We have begun offering wind power in the balancing capacity market," says **Mika Luoto**, Operations Center Manager.

"As EPV Energy operates on the Mankala principle, meaning that we produce and purchase energy for our shareholders on a cost basis and do not seek to make a profit, we do not have any long-term customer contracts preventing us from participating in the reserve market."

Luoto says that forecasting production volumes is one of the main challenges of participating in the reserve market. ◆

Gas and electricity on common markets

The energy markets in Finland and throughout Europe are undergoing a transformation. One of the European Commission's proposals is to sever the link between gas and electricity prices.

TEXT TUIJA HOLTTINEN

Over the past 20–30 years, the EU has used energy regulation in an effort to create a more competitive European energy system.

"The priorities for every market participant include the security of the energy system, carbon neutrality, efficiency and customer orientation. There is a great need for joint innovation and development," says **Olli Sipilä**, CEO of Gasgrid Finland.

Gasgrid Finland Oy is the transmission grid company responsible for Finland's gas transmission, the maintenance and development of the transmission infrastructure, and the maintenance of a virtual trading platform for the gas market.

The price of energy is a hot topic. Sipilä says he understands the concerns of consumers who have incurred high and unexpected extra costs for electricity and gas. However, he points out that Finland had the second cheapest electricity in Europe last year.

"Price rises can easily be blamed on the market model. However, it is important to distinguish between two different matters: an acute crisis and the support in response, and the long-term development of the market model." He says that when a major challenge needs to be tackled, the factors causing the crisis must be addressed specifically as required. We should not rush to make any rash changes to the long-term regulation of the market itself or its investment elements and structures.

"If we try to change these factors too quickly, it may have the opposite of the desired effect."

The market changes planned by the European Commission are affecting operations right now. For example, the Commission has proposed severing the link between gas and electricity prices, among other changes to the market model.

"Crises always put the market to the test. Markets have different and complex pricing mechanisms, and interventions such as price caps should be approached with caution. Predictability is extremely important," Sipilä says. ◆

How does the gas price affect Finland's electricity market?

We asked Juha Hiekkala, Market Development Manager at Fingrid:

"LAST AUTUMN, Europe was preparing for an unusual winter, and gas was being stockpiled everywhere. The price went through the roof, but it has come back down quickly.

The Central European winter has been favourable for electricity consumers – mild with strong winds. Natural gas inventories are now replenished, which is a strong basis for us to build on for next winter.

Europe has import capacity, and shipping and terminals are working well. Europe is reducing the need for natural gas in energy and electricity production. In particular, users have taken the initiative and replaced gas with other energy sources.

Finland is in a very strong position, and our energy future looks bright. We have plenty of wind power projects on the horizon, and many companies that use clean electricity in their industrial processes are keen to come to our country."

Our brains are good at saving energy, but not electricity

THE ENERGY crisis made it essential to save electricity in the winter. This required people to change their behaviour – things needed to be done differently.

It may sound easy to change your behaviour, but psychological studies show that it is often very challenging.

A change of behaviour begins with the desire to act differently – a motivation.

People can have different sources of motivation for saving electricity: Last winter, some people were forced to save electricity to stay on top of their electricity bills. This is an external motivation, which can force people to act in critical situations. However, such motivation is likely to subside once the electricity price falls. For others, the desire to save electricity is based on personal values, such as protecting the environment. This kind of motivation is more durable but does not necessarily lead to swift action.

One of the most effective ways of saving energy is to alter the environment so that energy is saved automatically.

Motivation is essential for changing behaviour, but it is not the only thing that is needed.

Firstly, automatic habits make change more difficult. If we stopped to analyse every little thing we do, we would never accomplish anything.

Our brains save energy by taking care of certain familiar actions, such as going for a shower, as if we were on autopilot.

This is convenient in everyday life, but it is hard to change automatic habits when we want to do things differently. For example, although we would like to save energy, the thought may occur to us only after we have spent 15 minutes in a hot shower.

Secondly, the environment and community we live in affect our behaviour. If a change is costly or difficult, or if we do not know how to make the change, it can easily be forgotten. Similarly, if the people around us are resistant to it, we will find it hard to make a change.

It is easiest to change behaviour when there is a strong motivation, no established routines, and the environment and people close to us support the change. The energy crisis will boost many people's motivation to save electricity, but if the other pillars supporting the change are not in place, actual actions to save energy may never come to fruition.

Studies have shown that one of the most effective ways of saving energy is to alter the environment so that energy is saved automatically rather than trying to change people's habits. We could try this, for example, by lowering the temperature of our home slightly or, if possible, renovating our homes to improve energy efficiency.

These things only need to be done once to benefit everything that comes afterwards, even when our brains want to switch back to autopilot. ◆

Nils Sandman
is a Senior Researcher at the University of Turku. His areas of research are health and environmental psychology.

COMMERCE IN THE **GREEN TRANSITION**

Major commerce enterprises focus on energy efficiency, wind and solar power. Significant electricity savings have been made in the unusual winter of 2022–2023.

TEXT MATTI VÄLIMÄKI / PHOTOS LARI LAPPALAINEN, K GROUP AND LIDL

S Group's wind farm in Eurajoki will be completed in 2024. The 13 wind turbines will provide the retail group with as much renewable electricity as it consumes – approximately one terawatt.

"More than 80 per cent of our electricity consumption is already produced with wind power. Our last major investment was a wind farm with 27 wind turbines in Sarvisuo, Simo. On top of this, more than 100,000 solar panels cater for about five per cent of the local electricity demand," says **Mikko Halonen**, Managing Director of S-Voima.

Just over ten years ago, S Group decided to focus on producing electricity itself.

"We chose this path because the hedging options in the electricity market had already become challenging. The situation is even tougher today because of very poor liquidity on the market," Halonen points out.

Next year, S Group will produce the electricity it consumes, amounting to approximately 1 TWh of renewable energy.

At the same time, the retail outlets have boosted their energy efficiency, largely thanks to modernised refrigeration equipment, technical building services and lighting. As a result, the retail group's energy consumption has decreased by 40 per cent since 2010.

"We have replaced 40–50 per cent of our refrigeration equipment with modern, energy-efficient machines using natural refrigerants that are more environmentally friendly than conventional refrigerants. The EU also requires refrigeration equipment to be modernised by the end of the decade," says **Matti Loukkola**, Head of Real Estate Energy Management at S Group.

The aim is to recover the surplus heat from refrigeration equipment and use it in shops. LED lighting is used on a large scale, with fluorescent lighting used to a lesser extent.

S Group aims to make its own operations carbon-negative by 2025.

In addition to its own electricity production, S Group has improved energy efficiency in its stores by modernising its refrigerators, among other things.

K GROUP FOCUSING ON REDUCING EMISSIONS

At the start of this year, Kesko purchased about one-fifth of its electricity under procurement contracts with two wind farms operated by WPD and Gasum. In addition, solar panels on the roofs of shops produced approximately two per cent of the company's electricity. K Group consumed approximately 672 gigawatt-hours of electricity in 2021, up from 645 gigawatt-hours in 2011.

"However, our volumes, service offerings and opening hours have all expanded since 2011. Therefore, our specific consumption per unit of floor area has decreased substantially," says **Antti Kokkonen**, Building Services Manager at Kesko.

K Group has also enhanced its energy efficiency by modernising refrigeration equipment and lighting and utilising waste heat.

K Group uses solar panels to produce about two per cent of the electricity used by its stores. K-Citymarket Tammisto in Vantaa has nearly 1,600 solar panels on its roof.

Approximately

1/5

of the electricity purchased by Kesko is from wind farms.

"Reductions in emissions are more a relevant factor than reduced electricity consumption. For example, heat pumps and charging points for electric vehicles increase electricity consumption but reduce emissions."

Kesko aims to become carbon neutral by 2025 and emission-free by 2030.

LIDL ENCOURAGES SUPPLIERS TO BECOME CARBON NEUTRAL

Lidl consumed 109 gigawatt-hours of electricity in 2021, compared with 33 gigawatt-hours in 2012. The growth is explained by the rapid expansion of the company, a relative newcomer to the market.

Today, Lidl has 202 shops and it invests in energy efficiency.

"All three of our distribution centres and more than 30 of our stores have solar panels, which produce approximately 20 per cent of the energy consumed on these sites annually. We only buy renewable electricity," says **Katri Tuovinen**, Energy Manager at Lidl.

Lidl has also modernised and adjusted its refrigeration equipment and lighting, utilised waste heat, and optimised its technical building services. Lidl's own operations are carbon neutral.

"We are now encouraging our suppliers to become carbon neutral," Tuovinen says.

Solar panels produce approximately

20 %

of the electricity consumed at Lidl's distribution centres and 30 stores.

PREPARING FOR EXTRAORDINARY

S Group, K Group and Lidl made contingency plans to save electricity in this unusual winter and cope with potential electricity shortages.

In-store electricity consumption has been further reduced by means such as lowering the lighting and optimising the automation of technical building services. If Fingrid issues a warning of an impending electricity shortage, even more drastic measures can be taken. For example, in-store bakeries can be closed.

In the event of a power cut, UPS devices allow time to clear the checkout queues and close the stores. The retail enterprises estimate that they could survive a power cut lasting at least one hour without breaking the cold chains of food products. ◆

Solar power plants cannot be built in transmission line right-of-way

PEOPLE have asked Fingrid whether solar panels could be built in sunny locations along transmission line right-of-way. Unfortunately, this is not possible.

"Transmission line maintenance, inspections and possible future expansions require unobstructed access. In addition, possible network faults or lightning overvoltage could damage nearby electrical devices," says **Tiina Koivunen**, Expert at Fingrid.

Lidl has optimised its technical building services and modernised refrigerators, among other things. The retail chain's own operations are carbon neutral.

The voluntary power system support procedure covers flexible capacity equivalent to one nuclear power unit.

TEXT KATARIINA KRABBE / PHOTOS TOMAS WESTERMARK AND STEFAN BERG

GOOD PREPARATIONS FOR ELECTRICITY SHORTAGES

Fingrid developed a voluntary power system support procedure to avoid power cuts due to electricity shortages. The aim is to make use of potential flexibility outside the electricity market of at least one megawatt per operator.

Fingrid sends a text message to the operators involved, asking them to be prepared when an electricity shortage is possible. When the risk of an electricity shortage is high, Fingrid sends an activation request. Finally, Fingrid sends a message to confirm when the situation is no longer a concern.

The procedure is not mandatory at any stage – operators reduce their electricity consumption as much as they can. The procedure involves 50 operators, including real estate companies, industrial operators and municipal entities. Altogether, the flexible capacity is over 500 megawatts, equivalent to the output of one unit at the Loviisa nuclear power plant.

"Some of the parties involved have reserve power units that they can start up if necessary. Others are able to reduce their electricity consumption at critical times. The one-megawatt flexibility target can also be reached by combining both approaches or multiple sites," says **Tuomas Mattila**, Expert at Fingrid.

LOWERING POWER

Boliden, a mining and metals company, is involved in the procedure, offering a total of nearly 20 megawatts of demand-side management at its copper and nickel smelter and copper electrolysis plant in Harjavalta and its Kevitsa mine in Sodankylä. The Swedish company also has a zinc plant in Kokkola, Finland.

Boliden consumes over two per cent of Finland's electricity, amounting to approximately two terawatt-hours a year.

"We have been actively involved in the flexibility market for years – we adjust our consumption when the spot price rises. Our Kokkola plant offers the most potential for flexibility. We also have some irregular consumption patterns that we cannot put on the flexibility market. However, we can commit to a voluntary procedure," says **Mika Lehtimäki**, Energy Manager at Boliden.

Boliden, a mining and metals company, offers a total of nearly 20 megawatts of demand-side management. For example, the Kevitsa mine in Sodankylä adjusts its consumption when the spot price rises.

Boliden's copper and nickel smelter in Harjavalta can reduce the furnace power in a controlled way in the event of an electricity shortage, for example.

For example, the furnace power can be reduced in the event of an electricity shortage, even though this means less production.

"Large processes contain points where the power level can be reduced in a controlled manner. However, the idea of a full power outage is frightening – a sudden stop could damage the equipment, and it takes a long time to restart a continuous process after an unplanned stoppage. That is why we are doing everything we can to prevent power cuts."

MILD DISCOMFORT CAN BE TOLERATED

Antilooppi, a real estate investment firm specialising in business premises, also volunteered to help prevent power cuts. An estimated one megawatt of flexibility is available by reducing the electricity consumed by the company's properties.

"When we were drawing up our contingency plan, we realised how important it is to avoid power outages. For example, illuminated exit signs can work without mains power for about an hour, so people can safely leave the offices, but the electric tilt-up doors in car parks would be problematic," says **Jani Winter**, Associate Director, Facility Management at Antilooppi.

In most cases, ventilation systems can be taken offline for a couple of hours without having a critical impact.

"Mild discomfort is tolerable if you compare the effects with a full-scale power cut," Winter says.

The company's contingencies for electricity shortages have proven useful.

"We thought about how to disseminate information within our organisation and to our tenants, including instructions. It was motivating and challenging for us to expand our knowledge in our own field – now we are better prepared to face other exceptional circumstances," Winter says.

Fingrid is happy with the way the system was received.

"It has been great to see so many Finnish operators taking social responsibility and supporting the power system in its time of need," Tuomas Mattila says.

"In the spring, we will take stock of what we have learned and assess the outlook for next winter. The procedure may still be needed then." ◆

CONTINGENCY PLANNING FOR ELECTRICITY SHORTAGES CONTINUES THIS YEAR

Finland survived last winter's energy challenges thanks to cooperation on many fronts. Operators in the sector are grateful to everyone who saved electricity during critical hours.

TEXT SUSANNA CYGNEL
PHOTOS SHUTTERSTOCK

The importance of saving electricity became a hot topic in Finland towards the end of last summer. Media outlets were filled with threatening images of an energy crisis and electricity shortages.

Russia's invasion of Ukraine and the consequent sanctions had caused uncertainty around the energy situation in Finland and Europe as a whole since the spring. In the summer, the challenges mounted when the commissioning of Olkiluoto 3 did not go as expected.

Operators in the sector, including Fingrid, the Ministry of Economic Affairs and Employment and distribution system operators, began thinking about how to ensure the availability of electricity over the winter and prepare people for the possibility of rolling power cuts.

At the same time, operating models were reviewed in case there was not enough electricity.

"Fingrid has long had strong operating models in case of electricity shortages. However, last year's events required a better capacity to communicate and provide stakeholders with situational awareness if there is a risk of electricity shortages," says **Tuomas Rauhala**, Senior Vice President at Fingrid.

There were no electricity shortages last year, nor was it necessary to use the three-step scale for addressing an impending electricity shortage. In other words, Finnish electricity production and electricity imports covered consumption.

At the most critical moments, it was very important that Finland's domestic production facilities operated at full power, help was received from other countries in the Baltic Sea region, and electricity users reined in their consumption.

"During challenging periods, Finnish consumers saved as much as 1,500 megawatt-hours of electricity in individual hours, which is a really substantial saving. This helped Finland overcome momentary difficulties in the adequacy of electricity. We also received important help from other countries, and the transmission links worked properly," Rauhala says.

JOINT EFFORT TO INFORM CITIZENS

In October, Motiva's Down a Degree campaign inspired citizens to talk about how they save electricity and their goals in doing so.

The campaign was a joint effort by six organisations to provide electricity consumers with important information before the coldest part of the winter.

In fact, the organisations began cooperating closely as soon as Russia invaded Ukraine. Working together was considered important to avoid releasing conflicting information in such a serious situation.

"The organisations shared information openly, so everyone acted and spoke about the same things in the same tone of voice," says **Enni Saikkonen**, Communications Specialist at the Ministry of Economic Affairs and Employment.

In the event of an electricity shortage, the Ministry of Economic Affairs and Employment is responsible for providing the latest information to the populace and all societal actors.

The media is an important route for disseminating information, and numerous briefings were arranged last year to keep the media informed.

"Media operators have a genuine understanding of this issue and have publicised electricity matters in their own channels and answered people's questions at the grassroots level. It was great to see how the newspapers, television, radio and social media spoke and wrote about electrical issues," Saikkonen says.

The media received better service thanks to close cooperation between the organisations.

Whenever necessary, the ministry passed on interview requests to entities such as Fingrid, the National Emergency Supply Agency and the Energy Authority and vice-versa, as the organisations became more familiar with each other's operations over the last year.

PREPARING FOR ROLLING POWER OUTAGES

Citizens were encouraged to save electricity and prepare for power cuts. If there is a risk of an electricity shortage, distribution system operators should notify households and businesses of the need for rolling power cuts by text message, for example.

Distribution system operators play a key role in the event of an electricity shortage because they would implement rolling power outages in accordance with Fingrid's instructions.

For many people, the most valuable lesson has been the importance of contingency planning, in addition to electricity saving.

According to **Henri Heikkinen**, Operations Services Manager at Enerva Oy, which provides distribution system operators with operations services, automation can now be used more effectively to implement power outages and allocate them to various parts of the network.

"We have worked with the distribution system operators to identify the most critical electricity users who must receive electricity under all circumstances. We have also considered how to implement rolling power cuts in a way that minimises the harm to the functioning of society," Heikkinen says.

In addition to saving electricity, the most important lesson for many people is the importance of preparation – understanding the everyday activities or aspects of business operations that could be affected in the event of an electricity supply disturbance.

"Preparing for electricity shortages is nothing new, but the topic has been at the forefront for the last year, and everyone has taken note. Electricity consumers also have a better understanding of the need to be prepared for potential power outages," Heikkinen says.

AFTER THE SUMMER, A NEW WINTER

No electricity shortages occurred last winter, thanks to the expertise of electricity sector operators, effective and consistent communications, and electricity savings by citizens.

Careful preparations have now been made for potential electricity shortages, and last year's work will not go to waste.

We should keep these lessons in mind when the next cold snaps approach.

"Electricity shortages could also occur in the summer if the electricity network suffers several severe disturbances at the same time," Heikkinen points out. ◆

TEXT MINNA SAANO / ILLUSTRATIONS SHUTTERSTOCK

WORKING TOGETHER FOR A MODERN ENERGY SYSTEM

Fingrid works closely with several entities in the energy sector, especially now that the power system is transitioning towards clean energy.

Energy sector operators include the electricity vendors and suppliers trading in the electricity market, as well as the authorities and interest groups.

The relevant authorities are the Ministry of Economic Affairs and Employment, the Energy Authority and the National Emergency Supply Agency.

The interest groups include the Finnish Wind Power Association, Finnish Energy, the Association of Energy Users in Finland and Local Power.

Motiva is a state-owned company that promotes sustainable development by means such as providing energy advice to consumers, municipalities, companies and the public sector.

The big question facing every energy sector operator is how to reduce emissions in line with the targets and make Finland carbon neutral by 2035.

"One important theme is the modernisation of the energy system. This concerns the entire energy sector and, thereby, electricity production and consumption," says **Asta Sihvonen-Punkka**, Executive Vice President at Fingrid.

"The structure of electricity production is changing rapidly, as electricity is produced not only from traditional hydro and nuclear power but also the fast-growing wind and solar power technologies. At the same time, it is important to enable industry, transport, heating and other consumption facilities to switch to clean electricity."

Fingrid works in close and effective cooperation with the authorities and interest groups to address these matters.

"The various parties engage in open dialogue and exchange of information. Our culture has always been one of extensive discussion to identify the common ground and the best way forward," Sihvonen-Punkka says. ◆

THE MINISTRY OF ECONOMIC AFFAIRS AND EMPLOYMENT (MEAE)

MEAE is responsible for preparing national energy market legislation and negotiating with the EU. It also takes care of the reliability of energy provision and the security of supply. The MEAE promotes clean and flexible energy production through investment subsidies and the EU emissions trading scheme.

THE ENERGY AUTHORITY

The Energy Authority is a licensing and regulatory authority that regulates and promotes the electricity and gas markets, emission reduction, energy efficiency and the use of renewable energy. The Energy Authority enforces Finnish and European energy and climate policies and legislation.

THE NATIONAL EMERGENCY SUPPLY AGENCY

The National Emergency Supply Agency maintains and develops the security of supply in Finland and handles national emergency stockpiles and security stockpiles. In addition, it works with businesses, the third sector, and the authorities to ensure that society continues to function in the event of a crisis or disturbance.

FINNISH ENERGY

Finnish Energy is an advocacy organisation for industrial and labour market policy in the energy sector. It represents companies that produce, procure, distribute and sell electricity, gas, district heat and district cooling. The organisation's primary purpose is to build the capacity and competitiveness of its member companies on the road to a climate-neutral Finland.

FINGRID OYJ

Fingrid Oyj is Finland's transmission system operator. Its mission is to safeguard a reliable energy supply under all circumstances and promote a clean, market-based power system.

MOTIVA OY

Motiva Oy is a state-owned sustainable development company. Its key goals are to promote energy efficiency, energy savings and sustainable development solutions among public agencies, companies, municipalities and consumers and encourage the sustainable and efficient use of materials. Motiva coordinates and executes campaigns, the most recent of which was the Down a Degree campaign to save energy.

LOCAL POWER

Local Power is the voice of small and medium-sized local energy companies, an advocate and a business promoter. Local Power represents energy companies that operate close to their customers and significantly contribute to the vitality of their areas. The organisation builds the capacities of its member companies as pioneers of the energy revolution.

THE ASSOCIATION OF ENERGY USERS IN FINLAND

The Association of Energy Users in Finland promotes the position of industry, commerce and service enterprises in the energy market, enhances its members' energy expertise and energy efficiency, and promotes competition and supply in the production, distribution, transmission and sale of energy.

THE FINNISH WIND POWER ASSOCIATION

The Finnish Wind Power Association is an advocacy organisation for the wind power sector. It seeks to enable wind power construction and production in Finland. The association provides information about wind power, compiles statistics, maintains lists of wind power projects under development, and cooperates with stakeholders.

fingridlehti.fi/en/finland-switching-to-15-minute-imbalance-settlement

The 15-minute imbalance settlement period responds to the transformation of the energy system

Finland will transition to a 15-minute imbalance settlement period on 22 May 2023, when the imbalance settlement system will begin using a 15-minute resolution instead of one hour. The centralised information exchange unit, datahub, and most energy metering will also switch to a 15-minute resolution.

TEXT PÄIVI BRINK / PHOTO SHUTTERSTOCK

Renewable energy is leading to a decrease in the amount of electricity production capable of providing regulation capacity. The power system is transitioning to a shorter imbalance settlement period to make it easier to maintain balance in the power system as part of a move towards a more real-time electricity market.

The transition to a 15-minute trading and imbalance settlement period will take place in phases, beginning in May. Finland's imbalance settlement system will transition to a 15-minute resolution on 22 May 2023.

"The sector is ready for the change, as operators have had plenty of time to prepare. Datahub has accepted metering data with a 15-minute resolution since the start of January, and some network operators have already begun submitting 15-minute measurements," says **Meri Viikari**, Project Manager at Fingrid.

The Government Decree specifies the facilities that must be covered by 15-minute metering from May 2023 onwards. The transition period for all other sites is until the end of 2028.

TRADING WILL SWITCH TO 15-MINUTE PERIODS IN THE FOLLOWING PHASES

The electricity wholesale markets maintained by electricity exchanges will switch to a 15-minute trading period in the coming years. The 15-minute trading period will enable more accurate, market-based balancing of the power system.

"When the 15-minute imbalance settlement period comes into force, balance responsible parties will see their imbalances in 15-minute periods. However, the imbalance price will be the same for every 15-minute period of each hour during the first phase of the transition," Viikari says.

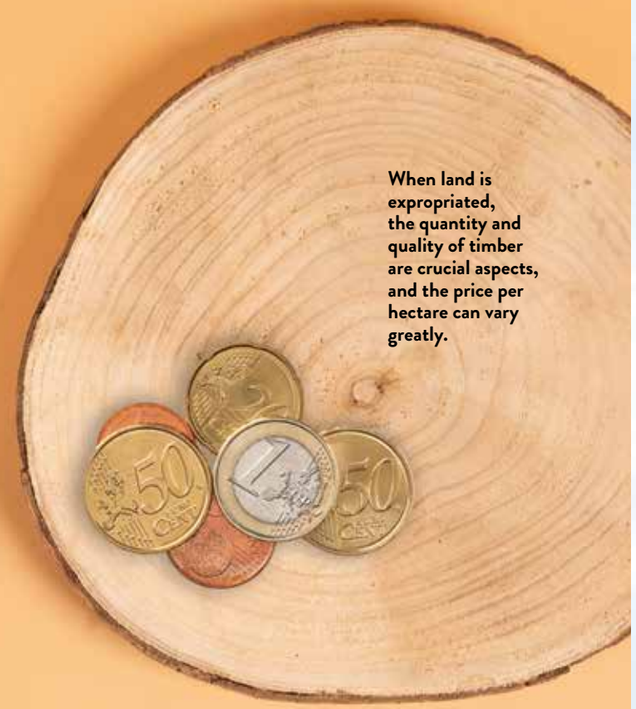
During the transition period, operators will have time to adjust their operations in preparation for 15-minute imbalance pricing and trading periods, which will be introduced later.

"When imbalances are examined in 15-minute periods, operators can improve the accuracy of their forecasts. As a result, maintaining the balance in the power system will become more effective and market-oriented." ◆

Compensation for expropriation IS THE SUM OF MANY PARTS

When Fingrid executes transmission line projects, it redeems the right to build transmission lines from private landowners. The company pay compensation in an amount determined by the National Land Survey of Finland.

TEXT MARJO TIIRIKKA / PHOTO SHUTTERSTOCK



When land is expropriated, the quantity and quality of timber are crucial aspects, and the price per hectare can vary greatly.

Transmission line expropriations are occurring at an accelerating pace, as wind power operators are also expropriating land. Wind farms usually have a connection line to a Fingrid substation.

Wind power operators usually pay more in compensation to landowners than Fingrid.

"We have a public function, regulated by the Electricity Market Act, to keep Finland's power system running. In principle, the legislation should ensure adequate compensation for landowners. Conversely, wind power operators are business entities, so they can determine compensation themselves," says **Mikko Kuoppala**, Senior Expert at Fingrid.

COMPENSATION FOR LOSS, DAMAGE AND HARM

Fingrid pays landowners the compensation required by law, as decided upon by an expropriation committee led by the National Land Survey of Finland. Expropriations always involve loss, and damage sometimes occurs. "Loss, damage and harm are the three factors for which landowners must be compensated," summarises **Mauri Asmundela**, Director at the National Land Survey of Finland.

When land is expropriated, it can contain any kind of standing timber. The quantity and quality of the timber are crucial aspects, and the price per hectare can vary greatly.

If timber is still in the growth phase, the expected value of the timber is paid. If a sapling stand is expropriated, compensation is paid for the saplings and for the planting and cultivation of them.

"Bare soil is a largely theoretical concept. Simply mentioning this idea tends to distort the amounts of compensation. Each parcel of land must be considered as a whole," Asmundela emphasises.

The replacement guarantee must also be effective. In other words, the compensation must enable equivalent assets to be acquired to replace the lost ones.

The most recent research shows that this is effective, but that research was conducted over 10 years ago. Asmundela points out that the forest experts at the National Land Survey of Finland constantly monitor price trends and use the latest forest data for many different purposes.

"The market prices of forests and the price per cubic metre of timber have risen. It is a logical trend. Based on constant analysis, it is fair to say that none of the factors has got out of hand," Asmundela says. ◆

TEXT ARI RYTSY / PHOTO SHUTTERSTOCK

A model of electricity self-sufficiency

Iceland's abundant natural resources and commitment to renewable energy have helped the country become self-sufficient in electricity production. Landsnet, the transmission system operator of the high-voltage network, invests in promoting the flexibility, stability and reliability of the power system.

Iceland has a lot of geothermal energy, which is used to generate electricity and heat homes and buildings with district heating. The country also has substantial hydro power from rivers and reservoirs containing glacial water.

In the future, Iceland aims to produce more electricity from wind power.

In the 1970s, imported fossil fuels still catered for most of Iceland's energy consumption. However, volatile oil prices were too much for the remote island nation and provided the impetus for a green transition.

The change has taken decades and followed a difficult path from the early geothermal systems to the use of drilling technology exploited in the oil industry and systematic drilling and research work.

Iceland uses a Wide Area Monitoring System (WAMS) to monitor and control the operation of its power system.

Birkir Heimisson, Specialist in Digital and Smart-Grid Development at Landsnet, says that the WAMS is much faster and more accurate than conventional SCADA measurements. It is like giving a doctor a digital heart rate monitor instead of a stethoscope.

"The WAMS helps improve the stability and reliability of the power system. It enables grid operators to detect disturbances and react to them in real time. The WAMS also helps in post-fault analysis," says Heimisson.

This technology is increasingly used in Iceland's Wide Area Control Scheme, which is a part of the country's Smart Grid projects. ◆

Fingrid Current

Tuesday 18 April 2023
1pm–4:15pm, Helsinki
Theme: Modernising the Power System

THE EVENT IS INVITATION-ONLY (IN FINNISH), but a virtual broadcast will be made available to everyone. We look forward to welcoming you!

Further details:
www.fingrid.fi/tapahtumat

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