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**Electricity –
more
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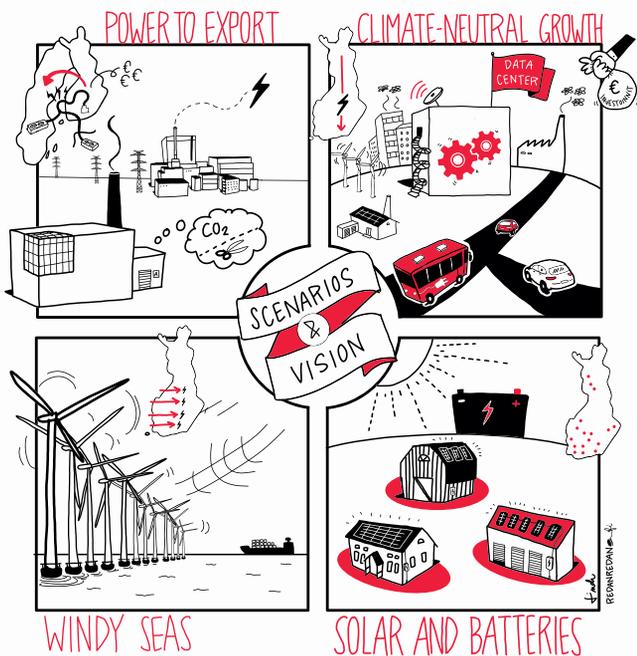
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PHOTO: FINGRID



A wise energy strategist understands things at grassroots level

Finland has set itself a truly ambitious climate target: Finland will be climate-neutral in 2035, and carbon-negative soon after! A key means of reducing emissions is to eliminate the emissions of industry, heating and transport by electrifying them. Electrification calls for large amounts of emission-free electricity in Finland, which is currently heavily dependent on imported electricity. Olkiluoto 3 will help in making a good start in this regard. From there onwards, the 2020s will be a time of major investments in wind power.

Wind power will fundamentally transform energy strategies. In the olden days, it was enough for politicians to produce a “top level” plan for electricity generation by balancing the annual energy outputs of the various forms of generation with a forecast of the electricity consumption. As flexible generation decreases, strategists must get down to the grassroots level. For industry and consumers, it is not enough to offer the average amount of electricity all year round – generation and consumption must be in balance at all times. This requires the power system to offer an entirely new form of flexibility. Active electricity trading on markets with Finland’s neighbouring countries helps to alleviate the problem.

Alongside flexibility, the question of how the generated electricity can be transmitted to industry and consumers needs to be addressed. The power system and transmission capacity are at the core of the issue: the national grid and local electricity networks. The problem is further

complicated by the fact that time and place are interwoven: if bottlenecks arise in the grid, fewer resources will be available to balance out generation and consumption in the “bottleneck area”.

Fingrid is building a climate-neutral Finland. More transmission capacity is coming!

Germany is a prime example of a country where the transmission grid has become the bottleneck in the entire energy strategy. The huge volumes of energy generated by wind power in northern Germany cannot be transmitted to consumers in the south. Starstruck by renewable energy, the country was too slow to react to the problems that had been brewing below the surface in the transmission grid. Finland could soon face a similar problem if the matter is not addressed in time.

As much as 80 per cent of Finland’s electricity consumption takes place to the south of the Cross-section Central Finland (known as cut P1), a critical part of Fingrid’s main grid. The west coast of Finland is currently attracting wind power like a gold rush, drawing investments to the northern side of the Cross-section Central Finland. The electricity generated there must be transferred through the critical cut for consumption in the south. There is the looming threat of Finland falling into the same trap as Germany.

There are two complementary solutions to this problem: Fingrid’s investments in strengthening the main grid between the north and south of the country and the construction of wind power capacity in southern Finland, below the Cross-section Central Finland.

More transmission capacity is coming! The construction of Fingrid’s Forest Line transmission connection from Petäjävesi to Oulu is already in full swing. Immediately after that, the strengthening of the Lake Line from Lappeenranta to Oulu will be prepared.

In addition, new wind power plants are very competitive on the southern side of cut P1. However, the Finnish Defence Force’s radars present an obstacle to the construction of wind power in southern and eastern Finland, as wind turbines disrupt the operation of radar systems. We are talking about two matters of vital significance to Finnish society: the emission-free electricity that climate-neutral Finland will depend upon and the country’s national defence. A balanced solution is required to serve the overall interests of society.

Fingrid recognises the crucial role it has to play in making climate-neutral Finland a reality. We are doing everything we can to ensure that the main grid of 2035 will enable Finland to reach its ambitious targets. Alongside this, we are developing electricity markets that will provide the power system with flexibility on market terms.

Jukka Ruusunen
President & CEO, Fingrid



Construction work on the main grid runs to EUR 100 million annually

Long lines from north to

Fingrid is currently building transmission lines on the main grid on dozens of sites. The company is having a record year in terms of the number of substation modernisations and refurbishments. The main grid needs to expand and develop to meet the needs of the future as society becomes increasingly dependent on electricity. The wind power from the north and imported electricity from Sweden are transmitted to consumers in the south, particularly along the future Forest Line and Lake Line.

TEXTI | PÄIVI BRINK, JUHA-PEKKA HONKANEN

PHOTO | JUHA-PEKKA HONKANEN, ARI NAKARI, ANNA-LIISA PIRHONEN / VASTAVALO, ISTOCK

The electricity market has been completely transformed over the last 20 years, resulting in a reduction in generation at thermal power plants in Southern Finland and an increase in inexpensive and carbon-neutral energy in the north. The hundreds of new wind power plants in Northern Finland and on the west coast were the driving force behind the largest north-to-south transmission line project in Fingrid's history – the Forest Line, which runs over 300 kilometres from Oulu to Petäjavesi in Central Finland.

The Lake Line, a planned transmission line of a similar length running from Oulu to Lappeenranta, is undergoing environmental impact assessments this summer. Work on the 280-kilometre transmission line connection will take place in phases until 2027/2028. The ongoing Oulujoki network development project and investments in the Imatra region are also related to the Lake Line.

Over the next decade, Fingrid will invest EUR 1.3 billion in the main grid, which is over EUR 100 million per year. •



The Forest Line will ensure that Finland remains a single pricing area

The Forest Line, which runs from Muhos near Oulu to Petäjävesi in Central Finland, has been under construction since the autumn of 2019. The line will be completed in 2022, and it will be particularly significant in ensuring that Finland remains a single pricing area. Large, uniform bidding areas promote activity on the electricity market, and retaining a single pricing area is also one of Fingrid's objectives.

The Forest Line's capacity will also be needed to transmit imported electricity when a new cross-border connection to Sweden is completed over the Torniojoki river in 2025.

Work began on the Forest Line in autumn 2019 with tree-felling that will run to tens of thousands of cubic metres. In summer 2020, more than half of the foundations required along the line were complete, and towers will

begin to be assembled on a grand scale in the coming autumn. The majority of the towers and conductors are now arriving on contractors' worksites, and the materials are being taken out to the field. The first tower erection and cabling work is also starting up," says **Hannu Kuikka**, Project Manager at Fingrid.

"Foundations account for a substantial proportion of the financial footprint of construction, and good progress has been made on them. Although soil surveys were conducted, the terrain has not always been exactly as we expected. In the wettest marsh areas, it has been necessary to put some of the work on foundations on hold until the winter. The environmental impact must be kept to a minimum in Natura nature conservation zones, so these areas can only be approached by heavy machinery once we have been through a very cold spell," he says.

The coronavirus pandemic has not held back progress on the Forest Line. In the spring, work-site meetings were held via remote connections, and work has carried on as normal in forested areas, with people working in small teams.

However, the coronavirus did cause some nerves to jangle as a shipment of transmission line towers from a Chinese steel supplier was delayed. In the end, the towers arrived at the Port of Oulu just one month behind schedule. Due to travel restrictions, quality assurance took place via remote connections.

"The trial assemblies were carefully videoed, and the materials are covered by very precise documentation," says **Maria Puhtila**, Project Manager at Destia, a contractor. •

Since this article was written, Puhtila has become a Fingrid employee.



Natura nature conservation zones and a nature reserve

The Lake Line's transmission capacity will double

The work to upgrade the Lake Line from Oulu to Lappeenranta to a 400-kilovolt transmission line began in the summer and autumn with the planning of environmental impact assessments (EIAs). The first projects to be assessed are the Vaala–Joroinen project and the Rovaniemi–Vaala project further north.

The construction of new transmission lines and the expansion of old rights-of-way will inevitably affect natural areas and affect people when they take place close to settlements, impact on businesses and affect places used for leisure activities.

In the summer, biologists went out into the field to plan the environmental impact assess-

ment (EIA) procedure and nature surveys.

“EIA is a statutory procedure, and the survey of environmental impacts will ensure that every stakeholder in the project is involved in planning in order to minimise the potential harm. The opinions of local authorities and residents are of genuine help in planning the route,” says **Satu Vuorikoski**, Senior Expert in Environment and Corporate Responsibility at Fingrid.

Most of the Lake Line, which will be 305 kilometres in length, will be located alongside the existing transmission line. The route passes through a wide variety of types of terrain and natural sites.

Fourteen Natura surveys will be conducted, and statements from the authorities on antiqui-

ties indicate that archaeological inventories need to be taken. Entirely new rights-of-way will account for no more than approximately 12 kilometres.

The terrain surveys and general planning of the Vaala–Joroinen transmission line project will take place between 2021 and 2023. Construction will begin in 2023, and the project should be complete three years later.

THE ROVANIEMI–VAALA ROUTE WILL CROSS WATERWAYS

The transmission line route from Petäjäsoski in Rovaniemi to Nuojunkangas in Vaala is the transmission line that will underpin the Lake Line. It travels alongside the old line for about



Substations are being modernised and built at record pace

Fingrid currently has around 30 substation projects in progress in various parts of Finland. The construction of wind power and customers' connection projects are the driving forces behind these investments. Fingrid's first digital substation is under construction at Pernoonkoski in Kotka.

The substantial need for construction and renovation is due to the energy revolution and the advanced age of the equipment. We need new substations close to wind power plants, and many existing substations have reached an age at which they need modernising. A record number of substation projects are underway, requiring a record investment," says **Daniel Kuosa**, Fingrid's Construction Manager.

CONNECTION OF WIND POWER CALLS FOR MODERNISATION

For example, a large area near the Oulujoki river is being renovated and new construction is underway encompassing the Pyhäselkä, Utanen, Pyhäkoski and Nuojunkangas substations. In the future, the entity will better serve the residents and power plants in the area, as well as the forthcoming Forest Line from Oulu to Petäjavesi and the third cross-border connection to Sweden. When the changes are complete in 2023, electricity will be transmitted more efficiently and less expensively.

The Jylkkä substation in Kalajoki is a good example of new substation construction for wind power connectivity. The substation is currently being expanded to accommodate the needs of local wind power generators, and the project is due to be completed in 2022. Other significant

substation projects that are now ramping up include the large transformer stations in Pysäspärä and Kärppiö, which will also be connected to wind power, thereby enabling improvements to the distribution network.

THE PERNOONKOSKI SUBSTATION IS A DIGITAL PILOT PROJECT

The Pernoonkoski substation near Kotka is a Fingrid pilot project that will be commissioned by the end of 2020. It is a novel digital substation intended for refinement into a digital station concept that could later be replicated elsewhere in Finland.

The main goal is to gain experience and expertise with the technology. The project has now reached the testing phase.

"In Pernoonkoski, two entirely digital fields have been installed alongside a conventional station, allowing old and new systems to be examined side-by-side. Data is transferred along fibre-optic cables between the high-voltage equipment located outdoors and the automation systems indoors. Savings will arise in factors such as the amount of cabling and the use of space," Kuosa says.

"The system monitors itself, and maintenance is based on data, which is conveniently and remotely accessible. This project also involves investments in cybersecurity to ensure that we do not create any new information security vulnerabilities." •

105 kilometres and passes through approximately 168 kilometres of new terrain.

Fingrid's Specialist **Eeva Paitula**, who is designing the route of the line, says that water crossings are an important part of the work.

"Bodies of water hold an important scenic value for many people. People live along the banks of rivers, and lots of people spend time on the water. In the north, the terrain is undulating, so the transmission line has a greater impact on the landscape that it would on flat land. However, there are only moderate elevation differences along the transmission line that is being assessed here."

In addition, a route that bypasses the nature reserve has already been considered in the design at this stage.

Terrain surveys and general planning for the Rovaniemi–Vaala project will take place in 2022/2023, and construction will run from 2024 to 2027. •



Imatra 1929 and 2020

The Imatra hydroelectric power plant began operating in 1929, along with the Imatra substation, which was the first substation on Finland's main grid. The first transmission line on the main grid went from Imatra to Vyborg and onwards to Helsinki and Turku via Hikiä. In 2020, Fingrid commissioned a new substation in Imatra and began modernising the Imatra–Huutokoski transmission line.

TEXT | PÄIVI BRINK

PHOTO | BREEZY.FI

The switching station in the original Imatra substation was refurbished over the course of several years, but it eventually reached the end of its life cycle. The new substation was built next to the old one, and the old one will be demolished. The new substation was inaugurated in the early autumn of 2020. The project's investment costs amounted to approximately EUR 11.5 million.

“The Imatra substation is located in the historical environment of the Imatrankoski rapids, a conservation site. For that reason, we worked closely with the Finnish National Board of Antiquities, the Centre for Economic Development, Transport and the Environment, and the Town of Imatra when we designed the substation and its surroundings. The outcome is respectful of the area's history, although the new substation and its buildings are, in fact, very modern. The substation's portals and the first towers are stylish, landmark towers,” says **Jarmo Henttinen**, Fingrid's Project Manager.

The Imatra substation remains an important part of the electricity transmission network in South Karelia. There is a relatively large amount of industry in South Karelia, which is why the statistics place Lappeenranta as the municipality with the third-highest electricity consumption, behind Helsinki and Tornio.

NEW TRANSMISSION LINE FROM IMATRA TO HUUTOKOSKI

In the summer, Fingrid began working on modernising the 110-kilovolt Imatra–Huutokoski transmission line and building foundations.

“The old transmission line dates back to the 1930s, and its condition has deteriorated over time. We are modernising 130 kilometres of the transmission line and replacing the wooden towers with steel ones. The project has been split into two parts and construction began in the summer. The erection of towers will begin in the autumn,” says Tommi Raussi, the project manager for part A of the project.

The new transmission line is due to be completed in autumn 2022. •

A year full of surprises in the electricity market

In the electricity market, 2020 has been a historically unique year. Several coincidences have combined to create a setting that is highly unlikely to recur.

The Nordic system price started to fall in January when precipitation volumes were very high, and, over the spring, the amount of fallen snow was the largest since measurements began in 1958. Furthermore, temperatures were milder than normal, resulting in lower electricity consumption. When the impact of the coronavirus is also factored in, the set of circumstances has been far from normal.

The average temperature measured by the Finnish Meteorological Institute at its observation station in Kaisaniemi, Helsinki, was +3.0°C in January and +2.4°C in March. From 1981 to 2010, the average temperatures were approximately -4°C in January and -1.3°C in March.

Over the last ten years, temperatures in Europe have followed a rising trend in comparison with the period from 1981 to 2010. In the Nordic countries, mild winters mean wet and windy weather and low electricity consumption. As wind power capacity increases, windy periods will have an increasingly important impact, and price fluctuations will become more apparent. In the first quarter of this year, wind power output in the Nordic countries was about 6 terawatt-hours higher than in the year before.

The hourly spot prices also reveal the extraordinary nature of the previous winter. The system price hit a high of just over EUR 32 per MWh in February, while the Finnish price peaked at almost EUR 200 per MWh on 25 June. Power plant maintenance in Sweden and maintenance of the cross-border links in Norway and Sweden had a bearing on the high price in Finland in June.

Regional price differences have become large, partly due to the melting of the record snowfall in Norway. Indeed, the volume of flowing water has been higher this summer than at any other time this millennium. Furthermore, problems in the Norwegian and Swedish power networks have given rise to constraints in the transmission capacity. The problems are partly temporary and partly permanent.

The transmission restrictions in Sweden were mainly due to decreased nuclear power

generation in the SE3 and SE4 areas. The low nuclear power output has increased the deficit in Southern Sweden, forcing the Swedish transmission system operator to limit the transmission capacity between the north and the south in order to maintain stability in the grid in Southern Sweden no matter what the load on the network. In all likelihood, it will be necessary to build new transmission connections between Northern and Southern Sweden or larger generation and consumption flexibility in Southern Sweden in order to resolve this issue.

The go-live of Olkiluoto 3 and new transmission connections between Finland and Sweden will eventually strengthen the connection between the Finnish and Swedish power systems and contribute to stabilising prices. However, it is important that the Norwegian and Swedish grids are improved in order to reinforce the common Nordic market.

Regional differences in spot prices also have a significant impact on secondary market prices, especially on the balancing power market, which exposes market participants to risks associated with the price of imbalance power. This year, fluctuations in the price of imbalance power in the Finnish pricing area have been particularly pronounced, and uniformity between pricing areas is an important factor for secondary markets. Consumers and producers are exposed to risks associated with the price of imbalance power, both under normal circumstances and in the event of various disturbances, where the risks are an order of magnitude higher.

The imbalance power price risk for Finnish operations is significantly higher than in Sweden. This is largely because we are often a different pricing area from Sweden. In such situations, the most expensive balancing capacity in Finland determines the price of imbalance power. The total energy volumes used for balance power in the Nordic countries and Finland have remained fairly stable over the last few years. However, there is a large price difference in terms of energy-weighted balance prices. In 2018–2019, the average price in Finland was around EUR 115 per megawatt-hour (and approximately EUR 50 per megawatt-hour in the SE3 price area), and in the first half of 2020, the price was approximately EUR 150 per megawatt-hour (and approximately EUR 35 per megawatt-hour in the SE3 price area).

Operators in the Finnish price area are exposed to an imbalance power price risk that is approximately twice as large as in the SE3 price area. During the first half of the year, imbalance power in Finland has deviated from the spot price by approximately EUR 10 per megawatt-hour (or approximately EUR 4 per megawatt-hour in SE3) for buyers of imbalance power and approximately EUR 7 per megawatt-hour (or approximately EUR 4 per megawatt-hour in SE3) for sellers. The situation was very similar in 2018–2019. This year, the price differences between Finland and Sweden have been further accentuated by the low spot prices in Sweden. •



Power-Deriva provides corporate and institutional customers on the wholesale market with portfolio management, derivatives trading, electricity purchasing and consulting services related to the electricity market. In this column, three specialists from Power-Deriva – Mika Laakkonen, Head of Physical Trading, Ville Venäläinen, Head of Analysis, and Antti Martikainen, Analyst – describe how 2020 has been a unique year for the electricity market from their perspectives.

Cooperation is especially important in the event of a disturbance

The coronavirus crisis has highlighted the significance of cooperation and advance exercises in safeguarding the reliability of supply. The energy sector can provide examples of effective practices in this regard.

TEXT | MATTI REMES

PHOTO | LEHTIKUVA



Finlandia mainly transports food products, pharmaceuticals and industrial components to Finland. During the coronavirus pandemic, the transit times for sea freight have lengthened across the board, in exports as well as imports.



afeguarding the security of supply took on a whole new meaning in the spring when the coronavirus crisis struck and it was necessary to secure the distribution of food and medicines alongside other critical functions in society.

Finland dealt with this sudden test rather well, but there is always room for improvement. The lessons to be learnt from the pandemic are currently being analysed by the Council for Security of Supply and Infrastructure, which is chaired by **Jukka Ruusunen**, Fingrid's President & CEO.

"We plan to make proposals for the development of the security of supply function to ensure that Finland is better prepared if a similar situation arises in the future," he says.

The National Emergency Supply Agency's new CEO, **Janne Känkänen**, highlights Fingrid's role in security-of-supply work.

"The reliable operation of the energy supply – particularly the electricity supply – is a prerequisite for the vital functions of the rest of society. As society trends towards increasing electrification and aims to become carbon-neutral, the availability of reliable, sufficient and emission-free electricity is essential," he says.

In his opinion, the key factors that must be assured are an adequate electricity generation capacity, efficient electricity import connections, and adequate capacity during consumption peaks. It is also necessary to ensure the sufficient availability of balancing power to counteract imbalances between supply and demand.

GETTING NETWORKS IN ORDER WHILE TIMES ARE GOOD

The Council for Security of Supply and Infrastructure, which was set up by the Government of Finland, has 26 members from among the

senior management of the largest companies in the sector, business interest groups, trade unions and ministries.

Ruusunen highlights the importance of close long-term collaboration between the public and private sectors in the security of supply. This ensures that if a crisis occurs, the networks, coordinated division of duties and operating models can be put into action immediately.

"During the coronavirus pandemic, companies were keen to offer help to the public sector in areas such as the procurement of face masks."

In Ruusunen's opinion, more attention must be paid to potential disruptions in global supply and value chains in the future. Cooperation is also required to ensure the availability of production and services of essential importance to the security of supply.

"The division of duties between the authorities also needs to be improved. When the pandemic struck, there was a lot of talk of the silo effect where everyone looks after their own duties, but a lot is overlooked. That is why things must be addressed as coherent entities."

GOOD PRACTICES HAVE BEEN DEVELOPED IN THE ENERGY SECTOR

The energy sector has a long history of collaboration in making preparations to combat various disturbances, and operators in the sector can also offer good practices to other areas involved in the security of supply.

"Making preparations for various disturbances is in the DNA of the energy sector. When a fault arises, rectification begins immediately," says **Reima Päivinen**, Senior Vice President of Power System Operations at Fingrid.

He chairs the Power Economy Pool, which is the key collaboration forum for the energy sector in matters relating to the security of supply.

The Pool, which was established in 1956, conducts preparedness and contingency planning activities involving approximately 300 operators responsible for electricity distribution, energy generation, district heating and energy sector services.

According to Päivinen, the voluntary joint body for collaboration between energy companies and the authorities has proven to be an effective way of ensuring nationwide operational readiness in the power supply under normal conditions as well as in the event of severe disturbances and exceptional circumstances.

"The Power Economy Pool creates situational awareness of the security of supply in its sector, and it proposes the development projects that it deems necessary."

PRACTICAL EXERCISES ARE IMPORTANT

Känkänen says that Finnish companies and authorities cooperate in many different ways to make preparations related to the security of supply. Examples include the preparation of contingency plans and reports. It is also essential to develop continuity management tools and rehearse things in practice.

"The exercises receive particularly good feedback from participating companies because they allow the functionality and coordination of contingency plans to be simulated."

In Känkänen's opinion, the regional Jäätyvä exercises regarding the energy supply were a good example of this. These involve operators from the energy sector as well as authorities and the municipalities in the area selected for the exercise.

"Exercises are arranged in several security-of-supply sectors, and it is important for good practices to be shared among different sectors," says Känkänen.

According to Päivinen, the exercises have shown that cooperation is significantly impacted if communications links break down. That is why it is important to plan the coordination of functions and joint operations and to conduct practical exercises in advance.

"It is also important to agree on a division of duties because the subcontracting chains involved in maintaining the power system can be long. In order to rectify technical faults or storm damage, it must be immediately clear who is in charge of resolving the situation." •

"Exercises are arranged in several security-of-supply sectors, and it is important for good practices to be shared among different sectors.

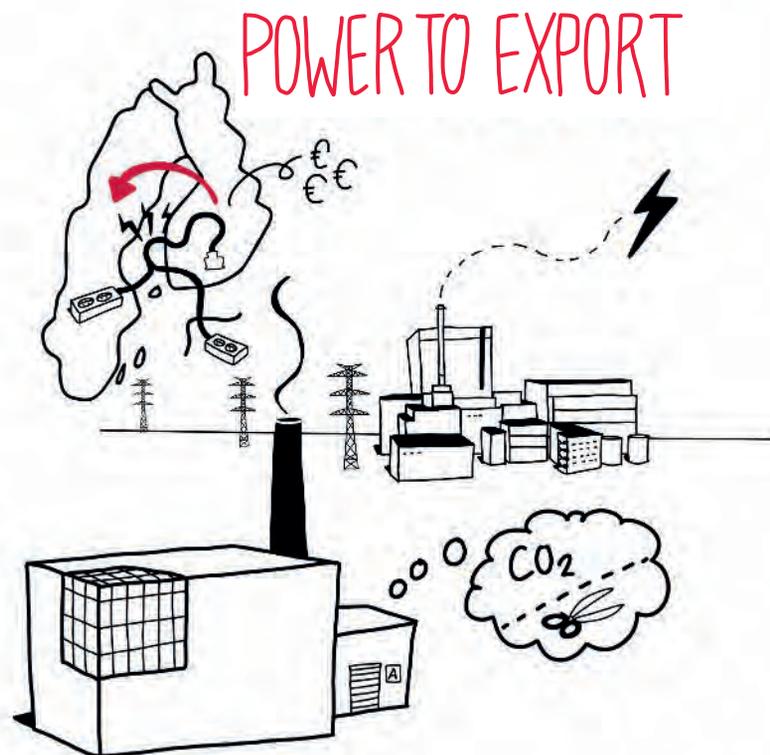
Janne Känkänen, CEO, National Emergency Supply Agency

Main grid, where are you going?

The design of the main grid includes making preparations for a climate-neutral society in which the importance of electricity is constantly increasing. Over the coming decades, the emissions produced by generating electricity must be lowered, and electricity consumers must be offered the best opportunities to obtain clean electricity.

TEXT | PÄIVI BRINK

ILLUSTRATION | LINDA SAUKKO-RAUTA



Fingrid is making preparations for these changes well in advance so that the power grid can offer the correct transmission capacity. It sets out its key design policies in the main grid vision, which examines national scenarios and includes network design collaboration with entities in Europe, the Baltic Sea region and the Nordic region.

The main grid development plan drills down to a more tangible level and considers the next ten-year period. The plan forms the basis for initiating transmission line projects and commencing construction.

NETWORK VISION: EUROPEAN COLLABORATION AND FINNISH CUSTOMERS' COMMENTS

"We prepare forecasts of our electricity transmission needs and monitor forecasts from entities such as the authorities, various interest groups and industrial enterprises. Customers provide their own estimates of their electricity consumption trends and information about their ongoing projects," says **Mikko Heikkilä**, Fingrid's Manager of Strategic Grid Planning.

Fingrid is currently preparing its main grid vision, which examines the electricity transmis-

sion needs in the coming decades. The main grid vision is Fingrid's national vision for Finland, and European collaboration on network planning takes place alongside this. At the same time, alternative scenarios – development trends – are also envisaged.

Stakeholders are invited to contribute to the vision for the main grid.

"We model different scenarios for the power system and prepare a transmission requirement analysis. New transmission lines are not always the only way to address the increasing need for electricity; we also investigate innovative, cost-effective means of strengthening the transmission capacity of the main grid, such as flexible markets. During the preparation phase, stakeholders are invited to contribute," Heikkilä says.

The national main grid vision is published every couple of years. The more tangible main

grid development plan is published at the same frequency and sets out the investments required in the main grid and the associated costs.

THE DEVELOPMENT PLAN IS FLEXIBLE IN PRACTICE, SUCH AS ON THE LAKE LINE

Following the work on the vision, a more tangible planning phase begins for a ten-year period.

"When the likely transmission capacity has been identified on the basis of various scenarios, the actual planning of energy transmission connections can begin. Fingrid works in active co-operation with the regional councils responsible for land-use planning. The regional plans show the transmission lines and substations that the transmission grid will require in the future," says **Aki Laurila**, Fingrid's Manager of Grid Planning.

The environmental impacts of transmission line projects are assessed as part of an Environmental Impact Assessment (EIA), with the Centre for Economic Development, Transport and the Environment acting as the coordinating authority.

"The EIA examines transmission line routes on the basis of feedback from stakeholders such as municipalities and landowners," Laurila continues.

CLIMATE-NEUTRAL energy means that the energy consumed by society no longer increases the concentration of greenhouse gases in the atmosphere and, therefore, does not cause the climate to heat up.

The main grid development plan and, in particular, the schedule for the plan are flexible according to actual needs.

“For example, the need for the Lake Line from Oulu to Lappeenranta has become much more urgent due to the energy revolution since the planning process began. When we worked on Fingrid’s network vision a couple of years ago, we initially anticipated that this line would be needed in the 2030s. However, the rapid increase in wind power construction in Northern Ostrobothnia and the growth in demand for clean energy have accelerated the need for transmission. The Lake Line project is currently in the EIA phase. The aim is to commission the Lake Line in 2026,” Laurila says. •

Electricity consumption increasing substantially

Will we break the 100-terawatt-hour barrier in annual consumption any time soon?

■ Last year, Finland’s electricity generation amounted to 66.1 TWh, and its consumption was 86.1 TWh. Factors that will increase consumption in the future include more widespread use of electric cars, datacentres being built in Finland, industrial enterprises seeking climate-neutral production and the electrification of district heating.

“As people make efforts to reduce their climate impacts, the consumption of clean electricity will increase. The Government’s

goal is for Finland to be carbon neutral in 2035, and a lot more electrical energy will be required to bring this to fruition. We may easily cross the 100-terawatt-hour consumption threshold by 2030, and depending on political decisions, we may go a long way over it. It is by no means inconceivable that Finland’s electricity consumption could double in the coming decades. This would, of course, require a significant strengthening of the main grid,” says Heikkilä. •

By 2030, it is entirely possible that we will break the 100-terawatt-hour barrier in annual consumption.

The growth in wind power took everyone by surprise

The growth in Finnish wind power has been rapid, and it now accounts for about ten per cent of Finland’s electricity generation. Almost 1,000 megawatts of new wind power is being built in Finland every year.

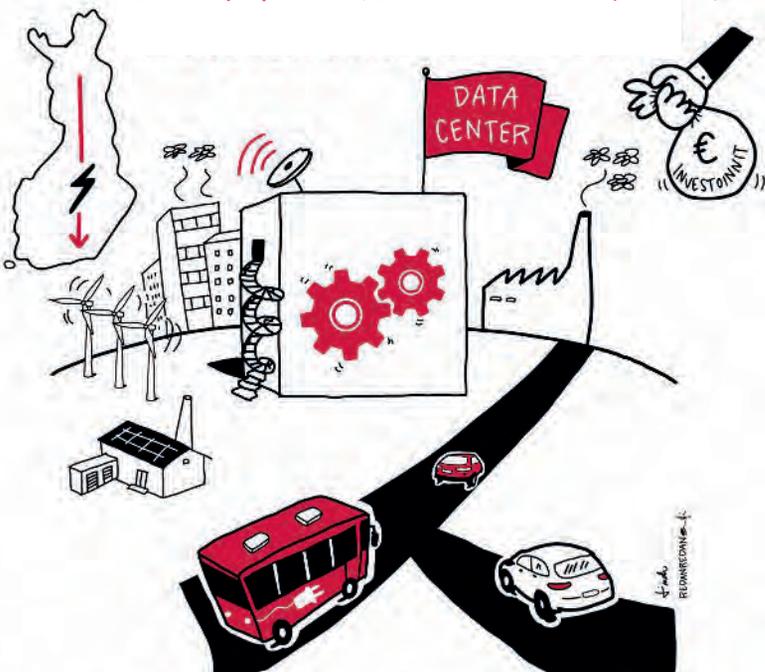
■ In 2019, renewable energy sources accounted for 47 per cent of Finland’s electricity generation, and carbon-neutral sources accounted for as much as 82 per cent. Wind power is forecast to expand particularly quickly on market terms.

“A couple of years ago, we predicted that wind power generation in Finland would increase to 10 terawatt-hours by 2030, but now it is possible that wind power will be used to generate more than 30 terawatt-hours by then,” says Aki Laurila, Fingrid’s Manager of Grid Planning.

At present, the wind power plants in Finland are mainly dotted along the west coast, in Ostrobothnia and Northern Ostrobothnia. Because of this, transmission capacity is required from the north to the south. The construction of wind power in eastern and south-eastern Finland is limited by the radars used by the Finnish Defence Forces. A solution is currently sought to allow wind turbines and radars to operate in the same area.

“From the perspective of the main grid, it would be good if wind power plants could be built evenly around the country. At any given time, there is probably always some wind somewhere in the country, and distributed generation would be good in terms of transmission. If there were any suitable areas for wind power construction in Southern Finland, there would be less need to transmit electricity,” summarises Laurila. •

CLIMATE-NEUTRAL GROWTH



Ilmatar's wind farm enters a whole new size category

Ilmatar Windpower Plc, which has been building wind farms for almost ten years, is taking the wind power sector into a whole new size category with its Pyhäntä and Kajaani wind farms, which are currently under construction. The wind farm comprising 41 turbines breaks all current records, both in terms of the number of turbines and its output.

TEXT | JARI HAKALA PHOTO | ILMATAR



The annual output of the wind farm, which has been built with turbines from Vestas, a Danish manufacturer, will be approximately 700 gigawatt-hours.

“When this output is compared with the total electricity generation figures in Finland for 2019, the Piiparinmäki wind farm in Pyhäntä will generate 11.3 per cent more wind power compared with the previous year’s figures,” says **Juha Sarsama**, CEO at Ilmatar Windpower Oyj.

Long-term Power Purchase Agreements (PPAs) contribute to the construction of wind farms on market terms and have established a stronger foothold in Finland. They ensure that the price for electricity generated by wind farms can be known long into the future.

Piiparinmäki also has a PPA, which Ilmatar Piiparinmäki Oy negotiated with server operator Google before construction began. Google will use 60 per cent of the electricity generated by the wind farm to power its data centre in Hamina. The duration of the agreement has not been made public, nor has the total cost of the wind farm.

VENTURE CAPITALISTS HAVE ENTERED THE WIND POWER MARKET

Venture capitalists are also taking on a greater role as owners of completed wind farms.

CPC Finland Ltd initiated the construction of Finland’s first wind farm built on market terms a

couple of years ago with a project in Lakiakangas in Isojoki, and it sold the wind farm off last spring to Europe’s largest private equity company, Ardian in France.

The Piiparinmäki wind farm is being built as a turnkey project for Glennmont Partners, a fund management company. The latest company to get involved is the Japanese company Kansai Electric Power Company, which recently acquired a 15-per-cent stake in the Piiparinmäki project from Glennmont.

The wind farm is being built on land owned by Metsähallitus and rented by Ilmatar. Ilmatar also acquired construction permits from Metsähallitus, which was also responsible for the preliminary design of the wind farm and the wind measurements.

Ilmatar’s wind farms also generate electricity for households.

“We aim to provide consumers with the option of making choices that can have a positive effect on climate change. We also see consumers as a certain type of PPA, as they help to enable the construction of new wind power in Finland,” Sarsama says.

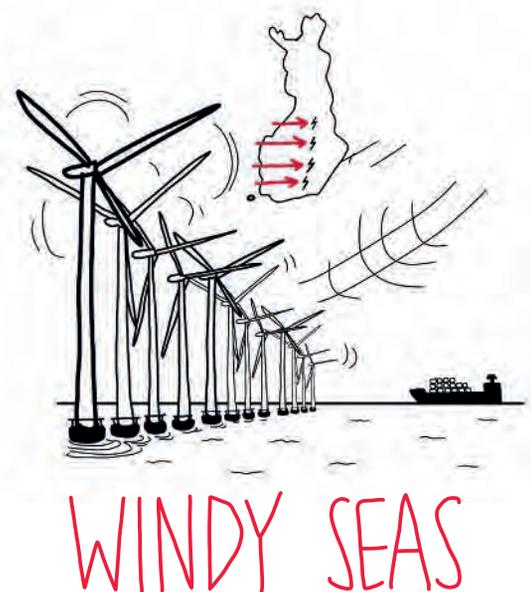
GENERATION COSTS ON THE DECREASE, ALONG WITH INVESTMENT COSTS

The crucial factor in the acceleration in wind farm construction is the decreasing costs of electricity generation. Turbine technology is also advancing constantly.

Juha Sarsama says that PPAs are a prerequisite for the construction of wind power on market terms, as well as the improvements in investment costs that have already occurred.

“Investors have reduced their expected yields and interest rates have remained low, and these factors have increased the rate of investment in wind power.”

Piiparinmäki, on the border between Kainuu and North Ostrobothnia will be completed in two parts. The first part will be completed in the end of the year and the final part of the wind farm will be finished in the autumn of next year. •





PPAs are now in vogue

A corporate PPA is a long-term electricity procurement agreement

PPA = Power Purchase Agreement

- *An electricity user agrees to buy a certain amount of electricity from an electricity producer at a contractual price for a period such as 10–20 years.*
- *The user may be a consumer, energy company or electricity retailer who sells electricity to consumers.*
- *The agreement sets a binding price level, and issues of operational sustainability are also important to many large electricity consumers. PPAs offer low prices due to the long duration of the agreement.*
- *A PPA concerning wind power ensures that the user receives emission-free, renewable electricity.*
- *The electricity producer does not usually sell all of its capacity using PPAs because if the market price rises, the amount of electricity not covered by PPAs can be sold at a better price. However, prices may fall as well as rise.*

Wpd Finland trusts in long-term buyers

Wpd Finland is building its operations on long-term power purchase agreements (PPAs). It follows the same long-term policy in the technical and financial services agreements for wind farms – agreements that cover the entire service lifetimes of the farms.

Long-term PPAs are particularly important when Wpd Finland Oy builds wind farms. Under these agreements, either one large electricity user or a bigger group of smaller users agrees to buy a certain amount of electricity at the contractual price for the stated period of time.

“Wpd has made this type of agreement for its three most recent wind farm projects. One of the wind farms is already complete. The 60-megawatt wind farm that began operating in Kannus in the first half of the year is covered by a PPA with search engine company Google. A power purchase agreement has been made with UPM-Kymmene Corporation concerning the Karhunneuvankangas wind farm, which is currently under construction in Pyhäjoki,” says **Heikki Peltomaa**, the company’s CEO.

Wpd Finland began operating in 2007 as part of Wpd Group, a Germany company that operates or owns well over 200 wind farms in various parts of Europe. Wpd Finland’s business is based on developing, financing, constructing, operating and owning onshore and offshore wind farms in Finland.

LIFE CYCLE SERVICE PACKAGE INCLUDES PRODUCTION MANAGEMENT

Wpd makes a technical and financial services agreement with Wpd Windmanager Suomi Oy to cover the entire service life of each of the wind farms it builds. This also safeguards the amount and quality of wind power generation.

“Windmanager checks that the turbine supplier is operating the wind farm correctly and that the wind farm is outputting the right amount of electricity in light of the wind condi-

tions. At the same time, it also monitors compliance with the maintenance programmes for the wind farms and individual wind turbines, as well as the time spent on maintenance.”

Wpd is responsible for wind power generation throughout the service life of the wind farm, even if the wind farm is sold on to a new owner. The company’s representative is also available throughout the operating period, which runs to several years.

The cooperation between Fingrid and Wpd focuses on technical advice and questions related to connecting wind power to the main grid.

TEN NEW WIND FARMS

Next year, Wpd will initiate a wind farm project based on a PPA with Kesko. The agreement will enable K Group to significantly increase the amount of renewable electricity it produces and procure well over 40 gigawatt-hours of wind power per year.

Peltomaa says that Wpd Finland is also negotiating similar agreements with several other companies. In total, ten wind farm projects are being planned, and the company intends to continue actively developing them.

“Hopefully, we will soon advance to construction. Over the longer term, I also believe that the construction of offshore wind farms will take off in Finland. When this happens, the investments will run into the billions for each project,” says Peltomaa.

Sitra, a think tank, also believes in the potential of offshore wind power, highlighting this area in its rescue package for the coronavirus crisis this year. •

”Over the longer term, I believe that offshore wind farms will take off in Finland. When this happens, the investments will run into the billions for each project.

Heikki Peltomaa, CEO, Wpd Finland

Battery to safeguard a wind farm

TuuliWatti Oy is currently building a mega-sized energy storage facility, the Viinämäki wind farm in Ii. The six-megawatt battery is expected to come online in the autumn.

■ “The battery will enable the power system to be balanced out by providing frequency containment, which is essential as an increasing amount of wind power capacity is connected to the grid. The advantage of the battery is its rapid frequency containment response in comparison with conventional power plants. Speed is critical when an increasing proportion of electricity is generated at plants connected to the grid via transformers,” says Sami Piippo, Team Lead at TuuliWatti Oy.

In the summer, Neoen, a renewable energy company from France, announced its intention to build a battery storage facility of unprecedented size in Yllikkälä near Lappeenranta. The facility, which will become the largest in the Nordic region, will have a nominal output of 30 megawatts when it is completed in the coming months. •

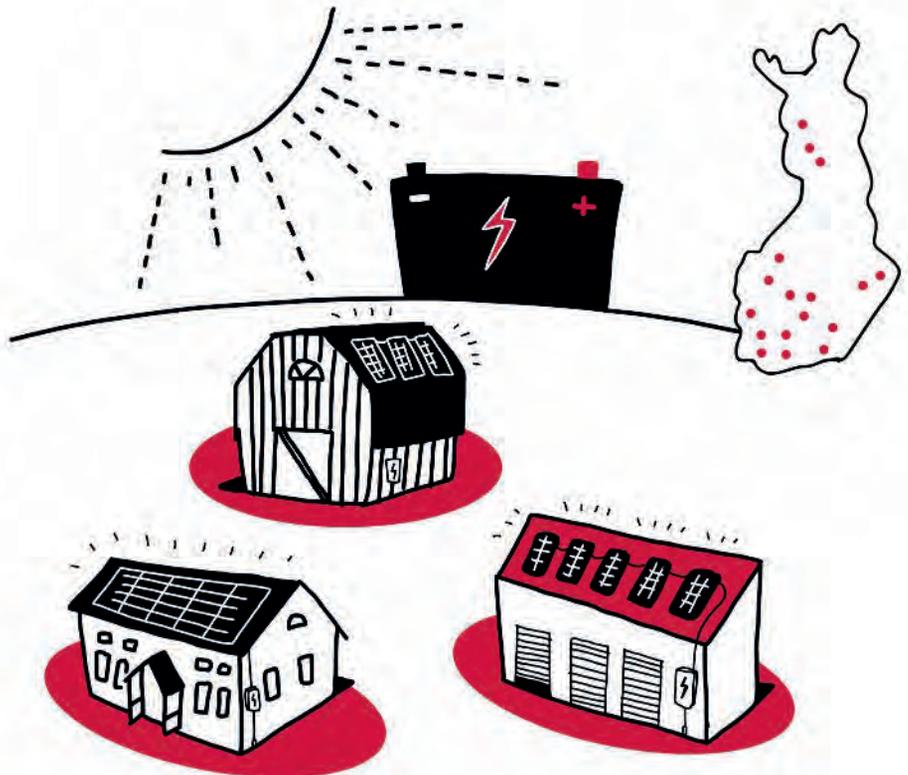
Read more about Neoen: www.fingridlehti.fi/en/biggest-battery-storage-in-nordics/

Do you use the map service or My Fingrid?

The map service and My Fingrid enable users to contact Fingrid and share information with us.

■ Fingrid’s map service at <https://fingrid.navici.com> enables any user to view and comment on construction and maintenance projects on the main grid. Comments can be attached to specific sites on the map. The map service can also be used to submit requests for information concerning projects or activities taking place near transmission lines.

For customer companies, the most convenient way to contact Fingrid is to use the My Fingrid service, which has now been in use for one year. New features are constantly being introduced based on user experiences. My Fingrid is a convenient way for users to provide updated information and report any outages they require, among other features. For further information, please contact your customer manager. •



SOLAR AND BATTERIES

Lots of news on the reserve front

Reserve markets are undergoing a transformation thanks to Nordic collaboration on balance management.

TEXT | ANNELI FRANTTI

ILLUSTRATION | FINGRID

The change in electricity markets has increased the need for a reserve that operates much more quickly than before. The amount of inertia in the power system is decreasing, and this is reducing the system's capacity to resist frequency changes. These changes give rise to a need for a Fast Frequency Reserve (FFR) that can react more quickly than a frequency-controlled disturbance reserve (FCR-D).

FAST FREQUENCY RESERVE FOR MANAGING SMALL-SCALE INERTIA EVENTS

 The new FFR reacts to changes in electricity generation by reducing consumption or increasing generation within about one second.

Nordic transmission system operators began using FFR in spring 2020 for managing small-scale inertia events. Depending on the circumstances, 0–300 MW of FFR is required in the Nordic countries, and Finland should contribute 20 per cent of this capacity. As part of the introduction of the Nordic FFR, Fingrid opened up FFR markets.

FREQUENCY-CONTROLLED DISTURBANCE RESERVE SOON TO BE AVAILABLE FOR OVER-FREQUENCY EVENTS

 In the event of major frequency disturbances, the frequency-controlled disturbance reserve (FCR-D) is activated. At present, 1,450 MW of capacity is maintained as an under-frequency reserve in the Nordic countries, and Finland contributes 290 MW to this.

Fifty per cent of the frequency-controlled disturbance reserve can be activated within five seconds, and the entirety of the reserve is available within 30 seconds. In the future, the frequency-controlled disturbance reserve will

also be used for over-frequency events. According to the plan, this will take place at the end of 2021.

THE TECHNICAL REQUIREMENTS FOR FREQUENCY-CONTROLLED RESERVES ARE UNDER DEVELOPMENT

 The Nordic transmission system operators have been working on updating the technical requirements for the frequency-controlled reserve for normal operation (FCR-N) and the frequency-controlled disturbance reserve (FCR-D). The new requirements seek to address changes in the power system. At present, the new requirements are under further development based on feedback previously received from stakeholders.

GROWING NEED FOR AN AUTOMATIC FREQUENCY RESTORATION RESERVE

 The automatic Frequency Restoration Reserve (aFRR) restores the frequency to its

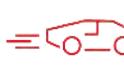
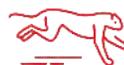
nominal value. The Nordic countries maintain 300–400 MW of aFRR, of which 60–80 MW is in Finland. The need for aFRR has grown in recent years.

THE BALANCING POWER AND BALANCING CAPACITY MARKETS PROVIDE 15 MINUTES OF FORESIGHT

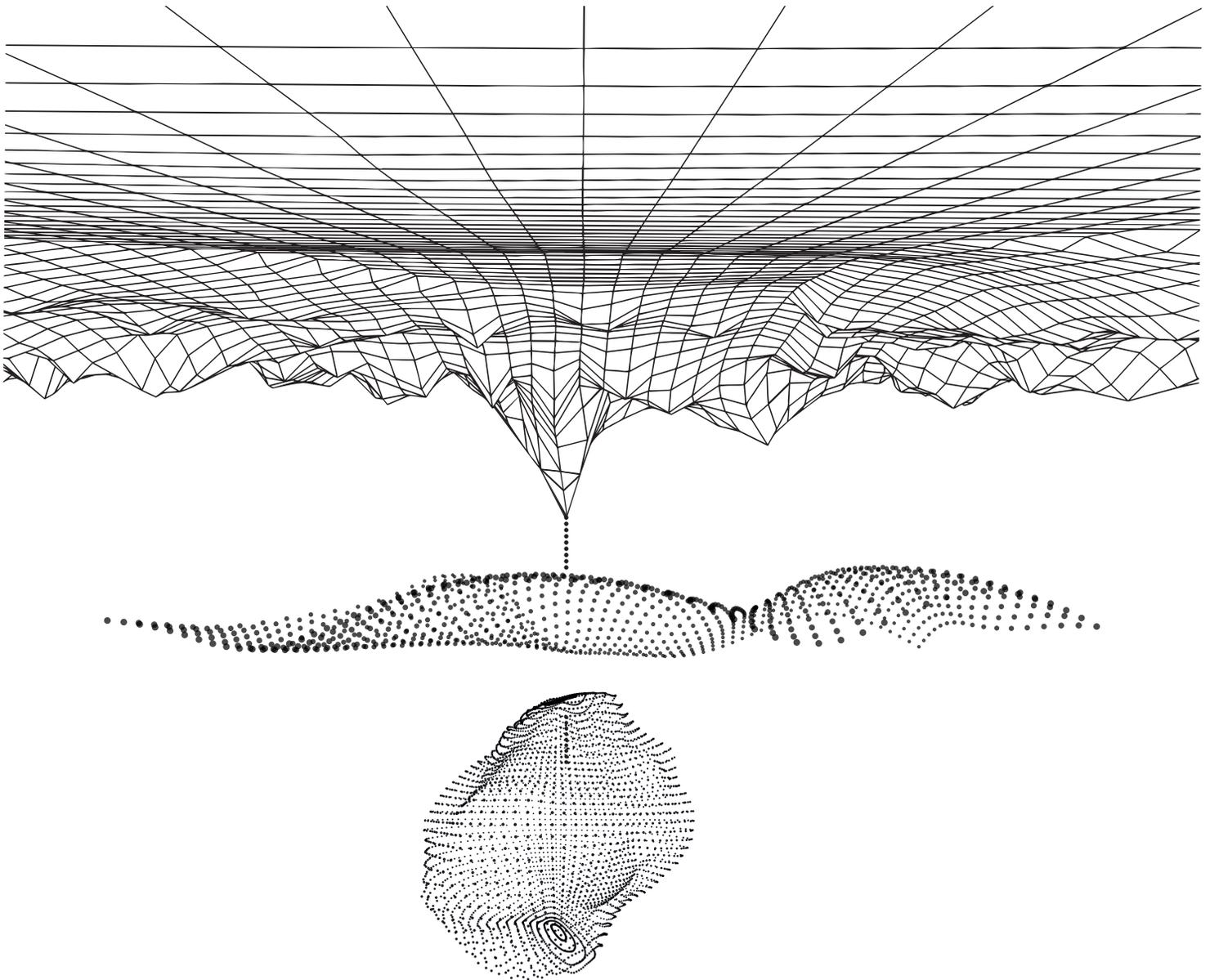
 The balancing capacity market ensures that the reserve available on the balancing power market is enough to respond to the worst individual fault. Fingrid purchases capacity via a competitive bidding process.

Pilot projects are underway on the balancing power markets. The new Nordic mFRR marketplace is expected to begin operating with a 15-minute resolution in 2022. •

Reserve market places in Finland

	FFR	FCR-D	FCR-N	aFRR	mFRR
	Fast Frequency reserve, Finland 20%, In Nordics, total 0-300 MW (estimate)	Frequency Containment Reserve for Disturbances, Finland 290 MW, Nordics total 1450 MW	Frequency Containment Reserve for Normal Operation, Finland 120 MW, Nordics total 600 MW	Automatic Frequency Restoration Reserve, Finland 60-80 MW, Nordics total 300-400 MW	Manual Frequency Restoration Reserve Reference incident + imbalances of balance responsible parties
Activated	In big frequency deviations, In low inertia situations	In big frequency deviations	Used all the time	Used in certain hours	Activated if necessary
Activation speed	In a second	In seconds	In a couple of minutes	In five minutes	In fifteen minutes
					

Various reserves are needed to maintain the balance between electricity generation and consumption.



Research and development has its sights set on the future

Artificial intelligence partners and flexible markets

Fingrid aims to be well prepared for the future. Its research and development projects range from data screening to flexible market pilot projects and bottleneck management.

TEXT | SAMI ANTEROINEN

PHOTOS | ISTOCK ILLUSTRATION | PÄIVI RÜCKER



very year, Fingrid has about 50 different R&D projects seeking innovations to enable the energy revolution. Technology Manager **Jussi Matilainen** says that the company's needs are both strategic – stretching to the long term – and operational – shorter-term solutions.

"Similarly, there are naturally some differences between the sizes of projects, ranging from extensive asset management IoT applications to masters' theses," he says.

The majority of the research and development projects conducted in 2019 fell into four main groups: increasing the market-based flexibility of the power system, safeguarding the supply of electricity under all circumstances, making data available to the people who use it, and boosting the cost-efficiency of asset management.

THE ELECTRICITY SYSTEM – PART OF THE ENERGY SYSTEM

According to Matilainen, Fingrid's R&D operations are currently weighted towards the management of an advanced electricity system, versatile flexibility solutions and the digitalisation of the electricity grid to boost the efficiency of system operation and asset management. These objectives will continue, at least in the coming years.

"The common theme is the 'electricity system as part of the energy system': a mindset with which we are constantly optimising larger entities." This may mean that the interplay between energy generation, storage, transmission and distribution is made constantly more flexible – very often with the help of various digital tools.

"For example, we are using digital solutions to improve our control centre operations. This enables us to forecast consumption and other phenomena trends more effectively."

ARTIFICIAL INTELLIGENCE PARTNERS IRIS AND IGOR

When Fingrid ran its Valvomo2023 project to identify the control centre of the future, it experimented with IRIS^{AI}, a solution developed by a Finnish startup to discover scientific articles related to situational awareness management. The artificial intelligence solution helped to identify interesting articles, but the practical benefits were ultimately limited.

A new attempt was made in 2019 when Findest.eu, a company from the Netherlands, contacted Matilainen.

This startup also makes use of artificial intelligence to seek and refine online information, so Matilainen was sceptical about whether it could be better for our needs than IRIS.

"It soon became clear that IGOR^{AI}, the artificial intelligence developed by Findest, differed from IRIS^{AI} in that IGOR^{AI} searches the internet for technical solutions to predefined problems instead of simply searching for research related to a theme," Matilainen says.

GOLD NUGGETS IN AN AVALANCHE OF DATA

After the keywords and optimisation parameters are set, IGOR goes through thousands of articles, patents and other material, arranging them into logical categories. The people from the startup said that the better a problem can be defined, the more accurate the results will be. In addition, the entire process required the participants to spend less

than one day of working time, so they decided to try out IGOR.

The team led by **Marcin Pohjanpalo**, System Design Expert, challenged IGOR to find out how we could increase the transmission capacity or eliminate bottlenecks. After the first round, Fingrid's panel of judges was presented with 38 technologies identified by artificial intelligence, and nine were selected for inclusion in the next round.

"More detailed information was obtained about these nine technologies, such as the maturity of the technology and the potential suppliers," says Pohjanpalo.

And what happened in the end? – Matilainen and Pohjanpalo say that the results are still under examination, but it is possible to say at this stage that IGOR identified some truly impressive technologies: there are now several routes that can be taken to address bottlenecks.

"This is one of the first applications to really demonstrate how artificial intelligence could help knowledge workers in the future," Pohjanpalo says.

A FLEXIBLE RESOURCE WITH A LOCATIONAL INFORMATION

From Fingrid's perspective, one of the most interesting R&D projects in the industry is the INTERRFACE flexibility market pilot project funded by the EU's Horizon 2020 programme. The INTERRFACE project seeks to make it as easy as possible to offer flexibility for various purposes in such a way that the flexible resources are used where it can generate the greatest value.

Jukka Rinta-Luoma, Specialist who leads Fingrid's part of the INTERRFACE project, states that INTERRFACE is a significant effort by companies in the industry: it involves a total of 42 parties from all over Europe.

"Fingrid is involved in the Finland-Baltic demo, which began at the start of 2019," Rinta-Luoma says. In addition to Fingrid, the demo involves parties such as transmission and distribution system operators from Finland, Estonia and Latvia.

MODERN ICT ARCHITECTURE

Key aspects of the demo include congestion management and connectivity to existing markets. The aim is to create an architecture for platforms that connect different information systems and define products and related processes.

"We will begin piloting in 2021. The actual need for solutions will arise in 2024–2025," says Rinta-Luoma.

Fingrid's INTERRFACE team expects to learn valuable new things from the Finland-Baltic demo once the new market structures of the future are set up. This is no small challenge:

"We aim to find out what ICT systems will be needed to enable sufficient flexibility in the future power system." •

R&D focuses:

1. Management of the power system
2. Diverse flexibility solutions
3. Digitalisation of the electricity network to enhance operation and condition management.



Energy companies take pre-emptive climate action

Energy companies have taken a serious approach to preparations for a carbon-neutral future. Vantaa Energy is seeking to stop using coal by autumn 2022, when the extension to its waste-to-energy plant is commissioned. This action is approximately seven years ahead of its time, as a Government decision calls for the prevention of coal as a fuel for electricity and heating in May 2029.

TEXT | OLLI MANNINEN

PHOTO | VANTAAN ENERGIA / Patrik Rastenberger

At present, coal is used to generate approximately 25 per cent of Vantaa Energy's heat. According to Production Director **Kalle Patomeri**, the EUR 140 million waste-to-energy project currently underway will be a decisive step towards becoming a carbon-neutral, circular-economy energy company.

"The expanded waste-to-energy plant will use commercial and industrial waste as a fuel. These are materials that are currently exported because Finland's waste-to-energy plants have not had sufficient incineration capacity," Patomeri says.

BURNING WASTE FOR CLIMATE-NEUTRAL DISTRICT HEATING

Patomeri says that Finland's cleanest power plant is under construction near the junction between Ring III and the motorway to Porvoo.

"This is the first Finnish power plant to be implemented in accordance with the latest waste incineration regulations. The plant's incineration technology is highly efficient, enabling even very poor-quality reject waste to be incinerated. The impacts of corrosion were taken into consideration in the structure of the combustion chamber."

When the expansion of the waste-to-energy plant enables Vantaa Energy to stop using coal, its carbon dioxide emissions will fall by up to one-third. The company has already reduced its carbon dioxide emissions by almost 70 per cent from the level in 2010.

Vantaa Energy's waste-to-energy plant can incinerate approximately 200,000 tonnes of commercial and industrial waste annually, generating climate-neutral district heating. One-quarter of this heat – approximately 300 gigawatt-hours – is sent to the network of

Helen Oy, an energy company based in Helsinki, accounting for approximately four per cent of Helen's procured heat.

HELEN IS REDUCING ITS EMISSIONS IN PHASES

"Helen has long procured heat from Vantaa Energy. This new agreement is a natural continuation and strengthening of our collaboration," says **Harri Mattila**, Senior Vice President at Helen.

The heat procured by Helen is a substitute for coal generation, and its emissions decrease by approximately 60,000 tonnes per year. This is one of many paths that Helen is taking on its journey to becoming a climate-neutral energy company by 2035.

"In the first phase, the heat generated at the coal-fired plant in Hanasaari will be replaced by a bioenergy heating plant to be built in Vuosaari and by heat pump investments, reducing the use of coal to half the current amount in 2024. At the same time, our carbon dioxide emissions will decrease by 40 per cent from today's levels," Mattila says.

The second phase will see Helen giving up coal entirely by 2029, when the Salmisaari power plant area will stop using coal. Several non-combustion energy solutions are planned to replace the generation in Salmisaari.

"In the third phase, by 2035, we will reach our target of becoming carbon-neutral by reducing our use of natural gas. By then, our emissions will have decreased by 80 per cent from the current level. The remaining 20 per cent of emissions will be offset by various compensatory alternatives, and we will have more detailed information on these in the coming years," Mattila says. •

Vantaa Energy's waste-to-energy plant, which is currently under construction, will incinerate approximately 200,000 tonnes of commercial and industrial waste, outputting 640 gigawatt-hours of district heat per year.

Emissions from the chemical and cement industries used to make synthetic fuels



An industrial-scale production plant planned in Lappeenranta aims to produce 27,000 tonnes of synthetic methanol annually. The carbon and hydrogen required to synthesise methanol are the by-products of the chemical and cement industries.

TEXT | OLLI MANNINEN

PHOTO | LEHTIKUVA

Jarmo Partanen, Professor of Energy Engineering at LUT University, considers the project a highly significant step towards a climate-neutral future and believes that it also has strong export potential. LUT University has been testing the technical functionality of the process since 2017, and it has modelled the alternatives for transforming the pilot project into a profitable production plant.

“Finland has a good head-start in terms of synthesising methanol, as we have a lot of different individual sources of carbon dioxide, and the increase in wind energy enables electricity to be generated inexpensively. Recycling carbon dioxide from industrial emissions offers Finnish companies a major opportunity to make fuel production carbon-neutral,” says Partanen.

Synthetic methanol is created when carbon dioxide and hydrogen are combined in a chemical process. Methanol can be used to manufacture fuels for transportation, such as petrol, kerosene or diesel. These can replace fossil fuels, which cause climate change.

SOLUTION BASED ON POWER TO X TECHNOLOGY

The production of synthetic methanol is based on Power to X technologies that make use of electricity generated from renewable sources when new products are developed. A project is underway to produce methanol using the hydrogen created as a by-product by the Kemira chemical plant in Joutseno and carbon dioxide, which is obtained from the chimneys of Finnsement Oy’s cement plant in Lappeenranta.

“Hydrogen has been produced by electrolysis for more than 100 years, but capturing carbon dioxide from the air is a new approach. From the perspective of a technically and financially feasible production plant, it is essential that the sources of methanol are located in areas where adequate renewable energy sources are available,” says Partanen.

INVESTMENT DECISIONS EXPECTED IN THE AUTUMN

According to Partanen, Finland has a head-start in the production of synthetic fuels compared with many other countries.

“We have a lot of cement factories and pulp mills whose processes give rise to sufficient quantities of carbon dioxide as a by-product. Cost-effective renewable energy is also required, and the excellent wind conditions in Finland are conducive to this,” says Partanen.

The project for a synthetic methanol plant has attracted a great deal of interest. In addition to Finnsement and Kemira, Neste, St1, Wärtsilä, Finnair and the Shell Research Centre Amsterdam (STCA), are also involved.

Premekon, Terästorni, Jotex Works and Redinec, local enterprises in the manufacturing industry, have been involved in financing the exploratory work for the project, as has the City of Lappeenranta.

“The aim for this autumn is to obtain enough research data for analysis to enable industrial enterprises to make their own investment decisions. Everything is going as planned, but we have not yet reached the final phase. So far, the calculations indicate that the project is worth driving forward,” says Partanen. •

Is a negative price the new normal?

For the first time, the price of electricity in the day-ahead market in Finland and Sweden turned negative for a few hours in February 2020 and again in July. On the road towards a climate-neutral power system, it is likely that electricity prices will turn negative again for a few occasional hours.

TEXT | OLLI MANNINEN

PHOTO | LEHTIKUVA

However, the price trends that have occurred this year are not a reliable indication of next year's trends. The market has a way of surprising people, says **Juha Hiekkala**, Fingrid's Manager of Market Development.

WHY DID THE PRICE OF ELECTRICITY TURN NEGATIVE IN THE WINTER?

The factors affecting this were the substantial water reserves available for hydroelectric power generation, a warm winter and increased wind power generation. The long-term price of electricity in the Nordic region remained low throughout the spring. The market has been good for electricity consumers.

WHAT DOES A NEGATIVE PRICE SAY ABOUT THE ELECTRICITY MARKET?

Fluctuations in the price of electricity in the day-ahead market reflect the ongoing energy revolution. In the future, we can expect the

price of electricity to turn negative again for a few occasional hours. However, if the price of electricity remained negative for a long period, it would indicate a lack of efficiency and market failure. Electricity prices should not be negative in efficient markets.

CAN THE PRICE OF ELECTRICITY REMAIN NEGATIVE FOR A LONG PERIOD?

If the market is unable to provide a natural counterbalance to the supply of electricity, a failure will arise on the energy market. In such cases, long-term electricity prices may become negative, at least for a certain time. From one perspective, the renewable energy subsidy mechanism may be a potential root cause of disturbances in the balance of the market.

HOW WOULD THIS AFFECT THE MARKET?

Negative electricity prices are not compatible with market economics and create uncertainty

in the market. Uncertainty increases the complexity of decision-making on an investment-heavy energy market. From the perspective of investments to enable the fight against climate change, it is important for long-term electricity prices to be determined on market times in a predictable way. Healthy markets are the best partner in the fight against climate change.

HOW DOES A LOW PRICE OF ELECTRICITY AFFECT THE MARKET?

If the price of electricity is low over the long term, electricity consumption will increase, and new means of using electricity will be identified. For example, cheap electricity may replace the energy generated using fossil fuels in industry, heating and transport. Cheap electricity thereby induces new demand, which balances out the market. •





3D modelling can be used in project planning and environmental impact assessments (EIA). The model in the image is still a work in progress, and items such as buildings will be added at a later stage.

It used to be just a line on a map. Now, a virtual transmission line runs through the landscape

Constructing a transmission line is a long process, which first sees the light of day on a map, many years before becoming a feature of the landscape. Nowadays, future transmission line rights-of-way can be presented to landowners and partners with the help of 3D modelling.

TEXT | ARI RYTSY

PHOTO | AFRY

The actual future appearance of various structures can be presented on 3D models, which provide a three-dimensional illustration of a selected location. Fingrid is currently piloting this technology in the environmental impact assessments for its Lake Line from Oulu to Lappeenranta project. The 3D virtual model provides a more visual image of the future transmission line than simply a line on a map.

“The 3D virtual model places the transmission line’s towers into a virtual environment,

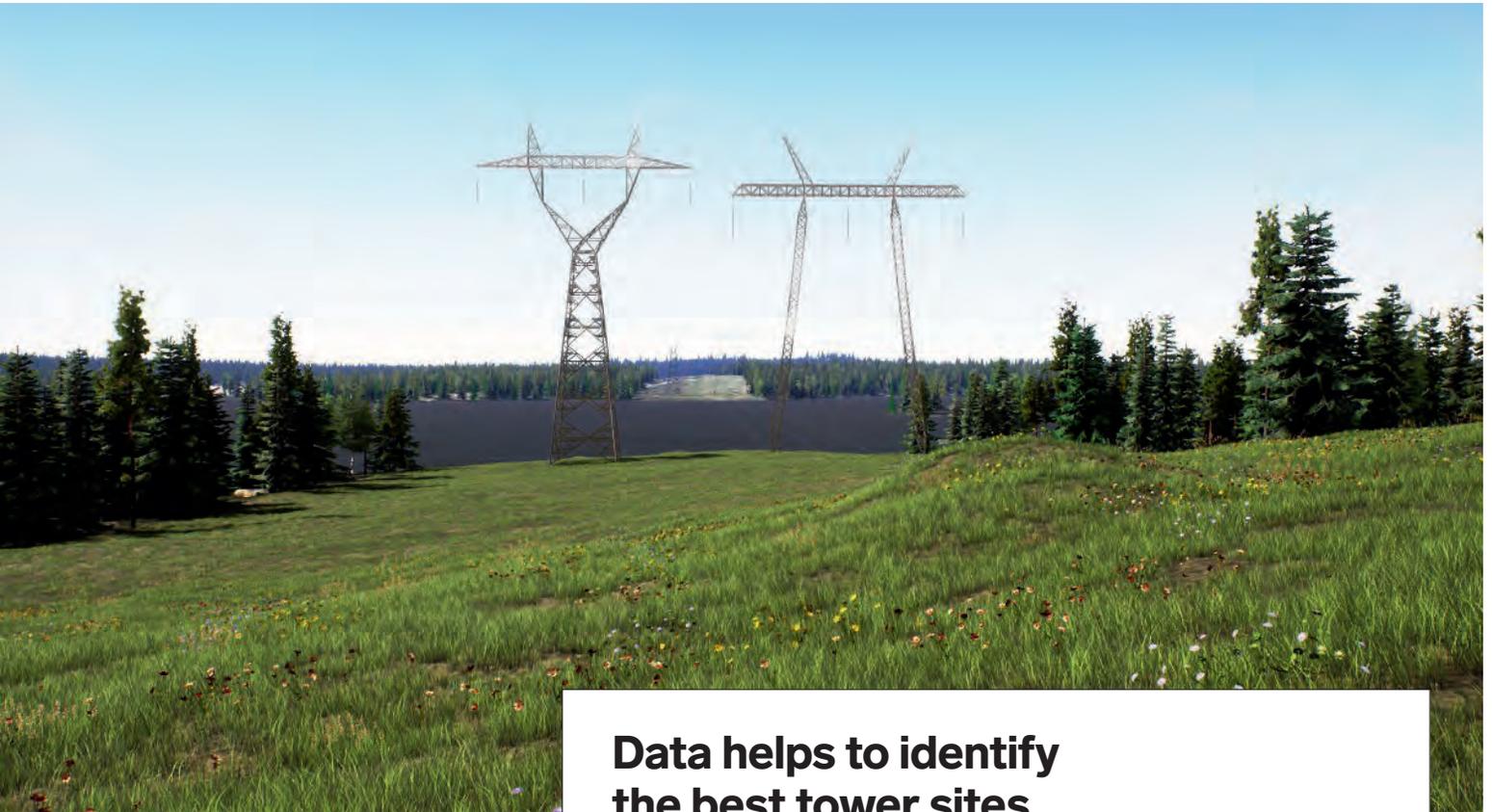
which is brought to life using artificial elements. Combinations of these give rise to a game-like virtual world, where transmission lines and towers of realistic heights can be viewed from locations such as the back yards of nearby houses,” says **Pasi Turunen**, Expert at Fingrid.

As regards tower locations, the 3D virtual model does not entirely correspond to the final outcome, as modelling takes place before general planning begins. The final placement of the towers depends on the soil and a number of technical issues that are not all known at the modelling stage. However, the aim of modelling

is to create as realistic a view of the future transmission line as possible.

BASED ON SOLUTIONS FROM THE WORLD OF GAMING

Modelling takes several hours of work, but it does not require anyone to climb up a mast. The 3D virtual models produced on computers are based on map data that is publicly available from the National Land Survey of Finland. Unreal Engine 4, a game engine, is used to build the virtual model and present the material placed into the virtual world.



Data helps to identify the best tower sites

Datasets are used to examine the potential for construction in different soil types and prepare soil surveys.

Thanks to new electronic datasets, it is possible to prepare more precise estimates of the soil in tower sites.

The construction potential of different types of soil is a critical factor for transmission line towers. Soft, wet marshlands and clayey soils are poor locations for building strong foundations. Rock and moraine, on the other hand, are generally ideal for erecting towers.

It sometimes becomes apparent that the soil quality is not good enough only after the location of a transmission line has been decided. Every situation like this is addressed individually. One option for avoiding a bad tower site is to move it parallel to the line.

It is impossible to assess the construction potential of soil visually, as this does not provide any information about the thickness of the surface layer. For this reason, datasets are used to back up the assessment and create a soil survey. In

recent years, more such electronic datasets have been made publicly available. They enable Fingrid to gain a more accurate understanding of the soil in tower sites.

SOIL INFORMATION FACILITATES THE PLANNING OF TOWER ROUTES

Computer programs are capable of handling large data masses with ease in order to identify good tower sites. An expanded soil survey model of this type is currently being piloted on Fingrid's Lake Line project.

More accurate soil data is useful for the general planning of the project and during construction. It enables tower routes to be planned in advance so that they are optimally able to withstand the weight of heavy lifting machinery.

"Current datasets enable better planning decisions to be made and can help to forecast the forthcoming construction costs. In addition, a precise, on-site soil survey is conducted at every tower site and used plan the tower's foundations," says Pasi Saari, Expert at Fingrid. •

The three-dimensional view brings new landscape aspects to transmission line projects. It is intended for use during the project's planning and environmental impact assessment phases, as well as the related public consultations. 3D material will also be made available on Fingrid's website, which may present key locations along the transmission line in the form of short videos.

"The transmission line will travel approximately 300 kilometres, giving rise to a lot of three-dimensional data that is challenging to distribute in its original format. However, the use of 3D virtual models in our work is still in its infancy, so these things will be given greater consideration as we build up more experience. The 3D material that is made more widely available may include important landscapes and densely populated areas," says Turunen. •

The expropriation procedure takes 3–4 years when transmission lines are constructed

What does the expropriation procedure involve?

Expropriation is a normal means of executing a linear construction project. The procedure begins when the project commences and an expropriation permit application is submitted, and it ends when compensation is assessed and paid following construction work. Landowners have the opportunity to give their views on the transmission line route during the planning phase and the expropriation permit application phase.

TEXT | ARI RYTSY
PHOTO | ISTOCK

Expropriation proceedings based on an expropriation permit issued by the Government confirm the expropriated property and set the amount to be paid for it in compensation.

Construction projects involving infrastructure such as transmission lines, highways, railways and natural gas pipelines often affect dozens, even hundreds, of landowners, so it is impossible for the party executing the project to

reach an impartial agreement with every single landowner. In such circumstances, expropriation proceedings are a common way of resolving the situation.

WHEN CAN EXPROPRIATION PERMITS BE ISSUED?

The party executing the project – which is Fingrid in the case of transmission line projects – applies to the Government for an expropriation permit. At this stage, the landowner may also

issue a statement on the expropriation permit application.

In the following stage, the Government's decision on an expropriation and preliminary seizure permit is sent to the local branch of the National Land Survey of Finland, which initiates the expropriation proceedings.

When the Government has issued its decision, the National Land Survey of Finland arranges the initial meeting to confirm the preliminary seizure and discuss advance compen-

Expropriation procedure

TRANSMISSION LINE CONSTRUCTION

1

Planning a transmission line / Fingrid

Preliminary agreement with landowners on the placement of the transmission line / Fingrid

2

Expropriation permit application / Fingrid

Statement to the authority concerning the permit application by landowners who have not made a preliminary agreement.

Fingrid takes them into consideration

3

Expropriation procedure initiated / National Land Survey of Finland

Kick-off meeting for the expropriation procedure, written invitation to landowners

Advance takeover

Advance compensation / Fingrid

4

Expropriation procedure when when construction work is completed

Compensation claims from landowners

Compensation decisions and establishment of a right of use / Expropriation committee

Payment of compensation / Fingrid

sation. All of the landowners connected to the project are sent a written invitation to attend the meeting. After this, the expropriation procedure is put on hold throughout the construction of the transmission line.

If loss or damage occurs during construction, the landowner informs the contractor or Fingrid directly.

WHEN IS A DECISION TAKEN ON USAGE RIGHTS AND COMPENSATION?

When the construction work is complete, the expropriation procedure is reactivated for the purpose of establishing the right of use and processing and paying compensation. Three to four years have often elapsed by this stage.

The sum payable in compensation is decided by an impartial expropriation committee consisting of an expropriation engineer from the National Land Survey of Finland who is familiar with the assessment of compensation and two trustees selected by the municipal council.

“The National Land Survey of Finland carries official liability for the expropriation proceedings which it conducts in the role of third man. Fingrid

applies for an expropriation permit, builds the power line and pays compensation. The National Land Survey’s expropriation committee handles the case impartially and sets the sum payable in compensation to the landowner,” says **Mauri Asmundela**, Director of Valuation Proceedings at the National Land Survey of Finland.

HOW CAN FINGRID CONTACT LANDOWNERS DURING A PROJECT?

During the transmission line planning phase, Fingrid consults landowners, who have the opportunity to give their opinions on the placement of the transmission line. Fingrid aims to establish contact with landowners at kick-off meetings and strives to keep in touch with them throughout the project. It has taken measures such as setting up dedicated Facebook pages for transmission line projects and communicating on the progress on construction by email and text message.

Fingrid does not own the land under transmission lines. Instead, it uses expropriation to acquire the permanent right to use areas belonging to landowners for transmission line construction and maintenance. The expropriation permit always binds the transmission line project to a specific route, and the right to use it is confirmed by the expropriation proceedings.

HOW DOES THE NATIONAL LAND SURVEY OF FINLAND COMMUNICATE?

As the competent authority, the National Land Survey of Finland has made investments in serving landowners by letter and on the Suomi.fi online service. Usually there are face-to-face meetings related to the expropriation proceedings as well.

“Landowners are our customers, and they all have different backgrounds and objectives. They may include professionals in land-surveying, as well as people who have never dealt with an expropriation procedure before. It is our job to ensure that everyone understands what the process entails and how it will proceed,” says Asmundela.

Most of the construction work and related expropriation procedures for Fingrid’s transmission line projects have taken place in a spirit of good cooperation. Over the last five years, the number of complaints about expropriation procedures can be counted on one hand.

“In my opinion, this shows that the expropriation proceedings are considered a fair process for everyone concerned,” says **Mikko Kuoppala**, an expert at Fingrid. •



Landowners retain the ownership of the land areas, but the expropriation for the transmission line limits the use of the land.

Cooperation on map data ensures access to the latest information

■ It has long been Fingrid’s practice to submit the data generated during the transmission line planning phase to the National Land Survey of Finland, where it is refined into the map data required in the expropriation process and the final map used in the conclusion of the expropriation proceedings.

The current model for cooperation enables maps to be prepared before the Government has decided whether to issue the expropriation permit. This expedites the initiation of the expropriation process.

“The cooperation between Fingrid and the National Land Survey of Finland on matters concerning data sets and scheduling the meetings involved in the expropriation process boost the efficiency and reliability of the process. This eliminates many uncertainties and ensures that landowners always receive reliable, up-to-date information,” says Mauri Asmundela from the National Land Survey of Finland.

Mikko Kuoppala from Fingrid highlights the example of the Forest Line, a project which began last year and will trace a 300-kilometre route across 1,100 properties.

“The preliminary work on map data allowed the expropriation procedure to begin significantly earlier. It was possible to hold the initial meeting less than one month after the Government’s decision,” says Kuoppala. •

Fingrid will gradually replace SF6 with an insulating gas that is less harmful to the climate

A pioneer seeking new insulation solutions

Fingrid is preparing to initiate a project to install 110-kilovolt GIS using a new insulation technology. The vision is for 2025, and all switchgear installed after this date will contain environmentally friendly insulating gases. Switchgear containing SF6 as an insulating gas will be systematically phased out.

TEXT | VESA VAINIO

PHOTOS | LEHTIKUVA, ISTOCK



Somebody needs to be the trendsetter when it is time to transition to a new technology. According to Unit Manager **Janne Eskelinen**, Fingrid is happy to assume this role as SF6, insulating gas that has worked reliably over the long term, must be replaced by a more environmentally friendly alternative.

However, it is not possible to replace SF6 gas without renewing the switchgear, and sets of switchgear will gradually reach the ends of their service lives. A long-term plan and roadmap are currently being prepared.

As a greenhouse gas, SF6 is approximately 23,500 times as powerful as carbon dioxide (CO2). It works superbly under controlled conditions, and it is constantly monitored at Fingrid. New solutions are now being sought, placing the climate first.

“This is a new thing for the industry, and Fingrid has set itself an ambitious target, which we have used as the basis for drawing up a roadmap for the introduction of SF6-free technology. The first pilot project is underway, and our vision calls for all new 110-kilovolt GIS to use the new insulation technology from 2025 onwards.”

The pilot project will be the 110-kilovolt substation in Virkkala, and the project to modernise the switchgear in this station could begin in the autumn of this year.

“The modernisation applies specifically to gas-insulated switchgear in the 110-kilovolt range. There are not yet any commercially available insulation technologies for use at higher voltages.”

ENVIRONMENTALLY FRIENDLY MIXED GAS OR COMPRESSED AIR

Eskelinen says that Fingrid has been in negotiations with switchgear manufacturers throughout



the first half of the year. The industry is fairly centralised, and almost all European manufacturers have taken to the idea in earnest, resulting in considerable development work to replace SF6 gas.

“Different suppliers have different insulation solutions, which are typically new mixed gases or compressed industrial air. The global warming potential of the new technology is almost 100 per cent lower than for SF6 gas.

Fingrid has now examined solutions from various manufacturers, and the most suitable technology will be selected by a public procurement process. Eskelinen admits that the

transitioning to a new technology is a leap into the unknown.

“Being a trendsetter also involves taking risks. We have no experience of the new insulating gases. A rise in costs is foreseeable due to the limited competitive playing field and small group of suppliers.”

This is a global matter, as the discourse around environmental and climate-related matters is taking place on a pan-European level, and the European Union is drafting common regulations. Switchgear using new insulation technologies has already been installed in Central Europe and Norway, so some knowledge is beginning to accumulate.

RELIABILITY UNTIL THE END OF THE SERVICE LIFE

The first high-voltage GIS and SF6 insulating gas entered the market in the 1960s. The combination is still functional and reliable, and Fingrid has no intention of abandoning it overnight. New technologies will become more widespread on the grid in the coming decades.

“The service life of switchgear is 40–50 years, and we make full use of it, which is also makes economic sense. When the equipment reaches the replacement age and the grid needs the switchgear to be modernised, we aim to install SF6-free switchgear.”



An excellent insulating gas, but harmful to the environment if it is released into the air

- *SF6 (sulphur hexafluoride) is a colourless, odourless, non-flammable and non-toxic gas*
- *The compound remains heavier than air and stays in the atmosphere for a long time*
- *A powerful greenhouse gas; approximately 23,500 more powerful than carbon dioxide*
- *A very good, permanent insulating gas, used in switchgears on the electricity transmission grid*
- *Equipment containing SF6 continuously experiences very small losses of 0.1 per cent per year*
- *There is approximately 46,000 kg of SF6 gas in Fingrid’s various pieces of equipment, and leaks accounted for approximately 21 kg last year.*

It is not possible to replace SF6 gas without renewing the entire switchgear. When the switchgear is replaced, reliable suppliers ensure that the SF6 gas is recovered safely and processed appropriately.

“SF6 is under constant supervision. It is released into the atmosphere in very small quantities, and it does not play a large role in our carbon footprint.” •

”Transitioning to a new technology is a leap into the unknown. We have no experience of the new insulating gases.

Janne Eskelinen, Unit Manager, Grid management, Fingrid



Fingrid is taking climate action, including during Climate Week

Finland's Climate Week will take place from 14 to 20 September. The aim of the annual Climate Week is to encourage people and businesses to take tangible climate action.

TEXT | IDA IJÄS
PHOTO | ISTOCK

■ Fingrid's business activities and work towards a cleaner power system have significant positive climate effects. Fingrid is participating in Climate Week by encouraging its personnel to reduce the climate impact of their work in investment projects, main grid maintenance and office work.

"Sustainability is one of Fingrid's values, and it also includes taking care of the environment. For example, we work with modern tools that enable meetings and even large-scale events to be held via remote connections, thereby reducing the amount of unnecessary travel. Climate Week is a great opportunity for us to develop a climate-positive corporate culture at Fingrid and strive to reduce our climate impact," says **Jenni-Julia Saikkonen**, Fingrid's Specialist, who was responsible for planning Fingrid's Climate Week programme.

Climate Week will involve training events related to reducing the environmental impacts of Fingrid's operations. Specialists

from outside Fingrid will also come to the office to speak about climate-related matters.

Riku Lumiaro, a Biodiversity and Communication Expert and the Finnish Environment Institute, will give a speech entitled "The status and future of biodiversity in Finland".

"I will talk about how climate change is already affecting the species in Finland and how Fingrid and other companies can make a difference. If a company is committed to climate action, it is easier for individual employees to consider the climate and biodiversity issues associated with their work," Lumiaro says.

Lumiaro says that the Climate Week is an important reminder of the impact of climate change.

"At this rate, the world will become three to four degrees warmer this century. This would be an enormous change. Climate Week reminds companies and people that we really need to take action. Luckily, plenty of workplaces already have made changes." •

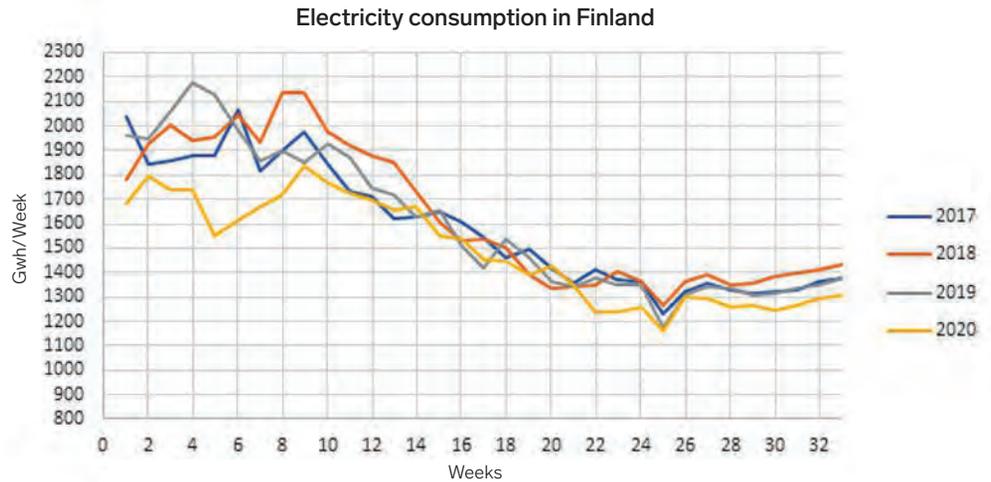


Fingrid's data provides information about the impact of the coronavirus pandemic on electricity consumption

Fingrid's data reveals that the coronavirus pandemic had a delayed impact on Finland's electricity consumption.

■ The low electricity consumption figures at the start of the year can largely be explained by the mild winter and industrial strikes in the first half of the year. The impact of the coronavirus pandemic on consumption became apparent in May, and consumption has remained below the level of the three preceding years since mid-May.

The adjacent graph illustrates weekly electricity consumption in Finland from January to mid-August in the period 2017–2020. •



The data was calculated using Fingrid's generation measurements as follows: Electricity consumption = electricity generation + imports - exports. The proportion of generation for which Fingrid has no measurements has been estimated. The values may differ from Finland's official statistics. Hourly data: data.fingrid.fi/

PHOTO | ISTOCK

The Haapajärvi and Teuva regions are gearing up for wind power

■ New wind turbines and a pumped storage facility are planned in the municipality of Haapajärvi and its surrounding areas. In order to ensure that the projects can be connected to the grid, Fingrid is building the Pysäysperä substation. Go-Live is planned for summer 2022.

The substation will also connect the Forest Line, a transmission line due for completion in 2022, to the distribution network and main grid transmission lines in the area.

Wind power is also planned in the area between Kristiinankaupunki, Vaasa and Seinäjoki. In order to connect wind turbines to the grid, Fingrid is building the Kärppiö substation. The project will be completed in the end of the summer of 2022. •





The installation of sensors for DLR systems on the Isokangas–Pyhänselkä line near Oulu was carried out last spring. Four different sensors were installed on sections that are considered critical in terms of thermal loading.

Measurements to improve transmission capacity

The load capacity of transmission lines varies depending on the weather conditions. Fingrid's Dynamic Line Rating project, which began last year, seeks to measure this load capacity and take all of the available thermal transmission capacity in the built network into use.

Some of the transmission lines on the main grid handle heavier loads than others. For example, Fingrid's 400-kilovolt transmission line Isokangas–Pyhänselkä in the Oulu region has some of the highest loading. The line carries the electricity generated by hydro power and wind power in northern Finland and northern Sweden to the south, where consumption is highest.

Last year, Fingrid began studying various dynamic line rating technologies and finding out how other companies have fared with them. Dynamic Line Rating (DLR) refers to the dynamic loading of transmission lines depending on the prevailing weather conditions, such as temperature and wind. The DLR device measures the loads handled by the line in real time in different weather conditions. When this is combined with a weather service, it becomes possible to forecast the load in the coming hours and days.

The goal of measurement is to increase the available transmission capacity in the places

where lines are heating up, causing them to sag and restrict transmission capacity. Similarly, Fingrid aims to make use of the significant cooling of transmission lines in windy conditions when it determines the transmission capacity.

"The experiences accrued by other operators around the world indicate that DLR is an excellent solution for realising the transmission capacity required to connect wind power to the grid. The capacity required to transmit the regional surplus of electricity arising from wind power generation is greatest when the wind is strongest," says **Antti Harjula**, Fingrid's Planning Manager.

"We expect DLR systems to provide an average of more than 10 per cent extra thermal transmission capacity compared with load capacities based purely on seasons. This will enable us to serve electricity markets more cost-effectively," he continues.

This year, Fingrid is testing three different DLR systems on its 400-kilovolt transmission grid. •

Installing DLR, video: www.fingridlehti.fi/en/measurements-to-improve-capacity



The sensor analyses the sag of the cable and monitors the swaying caused by the wind.

Updated transmission line brochures for landowners

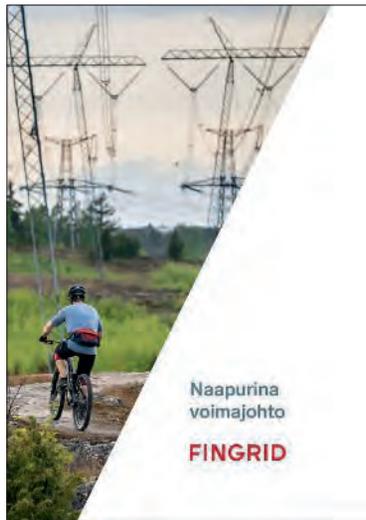
For the landowners, there are now two new brochures. The information in the brochures has also been updated.

■ Fingrid's transmission line brochures for landowners have been updated. There were previously four brochures: two about the construction phase and two for the period after construction. As a result of the update, there are now two brochures.

NEW BROCHURES:



Stages in a transmission line project: This brochure contains information about the construction of a transmission line. Landowners and other interest groups can influence this statutory activity in a variety of ways. The brochure also answers some frequently asked questions about transmission line construction projects – information that was previously in the brochure entitled 'A transmission line on my land'.



Next-door to a transmission line: This brochure contains information and safety instructions that make it safe and easy to live near transmission lines. The brochure also describes how vegetation and border trees are handled in transmission line and yard areas, as well as safety when handling trees and timber near transmission lines. The 'Taking care of the lines' brochure will be discontinued.

The brochures have been published in print and online: www.fingrid.fi/ymparistoestitteet

Pilot project on intraday trading to continue

■ Fingrid's customers and Finnish market participants have expressed a preference for having a possibility for intraday trading close to the start of the delivery hour. Since last January, this has been possible in Finland's bidding area until the time of delivery.

By popular demand, we are extending the pilot project until the end of the coming winter season, i.e. until 31 March 2021. The pilot project focuses on trading on power exchanges, and the experiences it has yielded so far have been positive.

We will evaluate the success of the pilot project and decide whether to introduce the operating model as a permanent service based on factors such as customer satisfaction, trading volumes and Finland's total imbalance. •



Fast Frequency Reserve markets opened

■ In the spring, the Nordic transmission system operators introduced the Fast Frequency Reserve (FFR), a new product for managing small-scale inertia events. As part of the introduction of the FFR, Fingrid opened up FFR markets.

Fingrid purchases FFRs from the markets it maintains once every 24 hours and, if necessary, from abroad. Parties can participate in the FFR market by making a related agreement with Fingrid. Fingrid is obliged to purchase

20 per cent of the total reserve needed in the Nordic region.

Fingrid's online Open Data service provides data on actual FFR purchase volumes, prices and supply volumes, as well as a forecast of the need to purchase FFRs.

For more information, see www.fingrid.fi/FFR





Good decentralisation in the control centre

Control Centre Manager Maarit Uusitalo is responsible for managing the power balance on the main grid and the power system from the office in Käpylä. Uusitalo, who has worked for Fingrid for a long period in several positions, took on the role of control centre manager in March this year.

TEXT | IDA IJÄS
PHOTO | PAULA LEHTO

WHAT DID YOU DO BEFORE YOUR CURRENT JOB?

I graduated from the Helsinki University of Technology in 1992. My first job was at IVO Voimansiirto Oy, which later became Fingrid. Before I began working in my current role as control centre manager, I spent about ten years as the strategic network planning manager.

My career has followed an interesting arc that has taught me a lot: first I got to know the internal network and the system in Finland overall, then the transmission system in the Nordic countries and in Europe as a whole. Strategic planning focused on what the network will look like in 2030 or 2040. The work of a control centre manager concerns what the network looks like now or next week.

WHAT IS HAPPENING IN YOUR WORK AT THE MOMENT?

The most acute matter in recent times has naturally been the coronavirus. In the early spring, we began protecting the critically important control centre and its employees at a very early stage by limiting the number of visits and contacts and by dispersing the control centre activities across several sites. Managed decentralisation reduces the risk of spreading coronavirus infections.

There are plenty of actions underway to improve the operations of the control centre, and processes are being reorganised at a Nordic level. We are involved in various projects, such as the Nordic activities of the operational planning office in Copenhagen. We are also involved in the joint Nordic Balancing Model program.

WHAT IS GOOD ABOUT YOUR JOB?

I have enjoyed my work, and I like working with people. There is a common objective in my work and in the energy sector as a whole: we are working together to ensure that we will have a cleaner power system in the future.

HOW WILL YOUR WORK DEVELOP IN THE FUTURE? WHICH CHALLENGES MAY NEED TO BE ADDRESSED?

The surrounding power system is constantly developing, and this also affects our operating models. As the amount of wind power and solar energy increases, the power system's operations are becoming more unpredictable. At the moment, the system is operated from one hour to the next, but in the future, we will be aiming to bring this down to 15 minutes. This will require operating models to be developed and automation to be increased.

WHAT IS A LESSER-KNOWN FACT ABOUT YOU?

A few years ago, it was a hot summer, and I wasn't able to do any running. That's when I really got into cycling. In the last couple of summers, I've cycled some longer routes, such as the stunning ring route in the archipelago. •



Fingrid initiates discussion on topics related to its industry. In this series, we participate in the discussion by highlighting electric novelties and current phenomena. You can suggest a topic for this page via e-mail: viestinta@fingrid.fi

Ferry makes Nauvo greener

An electric cable ferry travelling to the island of Högsar in Nauvo, Parainen, has brought a splash of green to Finland's diesel-dominated ferry traffic.

TEXT | JARI HAKALA

PHOTO | FINFERRIES

In terms of the environment, electricity is a better alternative to fossil diesel fuel. The new technology is also taking us closer to the Government's objective of becoming emission-free," says **Mats Rosin**, CEO of Finferries, which operates the majority of Finland's commuter ferries.

The technology behind the electric ferry that runs between Grannäs and Högsar in Nauvo is simple. The electric motor on the ferry, which is equipped with a frequency converter, pulls the ferry along a steel cable from one side of the strait to the other. The electricity is supplied by Caruna's distribution network. As the ferry makes progress, the electricity cable is automatically wound up on a coil inside the ferry.

For a couple of years now, the Nauvo electric ferry has served as a longer-term testing site for the increasing electrification of cable ferries. Despite the testing, the ferry provides a normal

service, making around 100 trips per day across the strait, which is approximately 300 metres wide.

Färjerederiet, which operates ferries in Sweden, has substantially increased the number of electric ferries it operates in recent years. Rosin has visited Sweden to witness this himself.

"Ferry traffic is a basic service in Finnish society, so the technology needs to be mature and reliable before it can be adopted more widely. Good piloting is essential to ensure functionality and gain experience in various circumstances. In particular, the technology must be tested in the winter to ensure that it is guaranteed to work."

The Nauvo cable ferry is also equipped with a diesel engine and a normal propeller system so that customer service is assured even in the event of an electricity outage.

"It has been necessary to fall back on the diesel engine from time to time when changes

have been made to the electrical technology. In general, the electric ferry has worked effectively and reliably. The experience has been encouraging."

According to **Sami Sjöman**, who drives the Nauvo ferry, the electric ferry is significantly easier to drive than a diesel ferry. The ferry is operated using a single joystick.

"The ferry is also quieter. In the summer, there have been plenty of passengers," Sjöman says. •

ELECTRIC FERRY:

- Travels from Grannäs to Högsar in Nauvo, Parainen
- The ferry was built by Parkano Oy in 1972
- Electrification was carried out by Suomen Lauttaliikenne Oy / Finferries and Laivasähkö Oy
- The ferry weighs 72 tons and has a draught of 1.8 metres
- The ferry can carry around ten cars, with a weight limit of 44 tons

Start using My Fingrid!

My Fingrid is a digital service for Fingrid's customers. It can be used anywhere at any time.

Handle the following on the service:

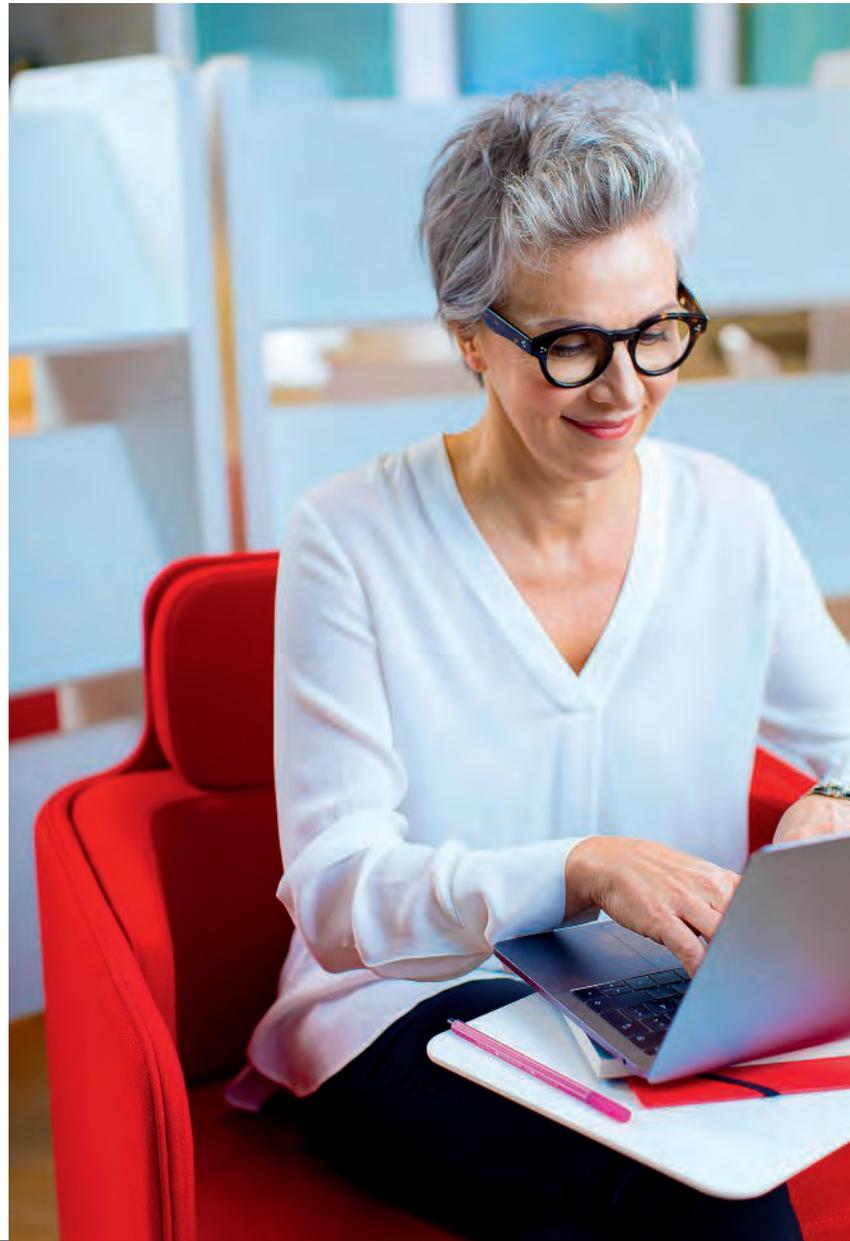
- Review your invoicing and metering data
- View disturbance and transmission outage data
- Report outage requirements
- Monitor and handle the new main grid connection process
- Log in to Datahub services, the online map service and the Restore service for managing reserve data
- Provide and monitor customer network details

Features coming soon include:

- Monitoring electricity quality data (Quality data)
- A document repository (Library)
- An NC ER section
- Lots of new functionality requested by users!

oma.fingrid.fi

Ask your organisation's administrator for a user ID.



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