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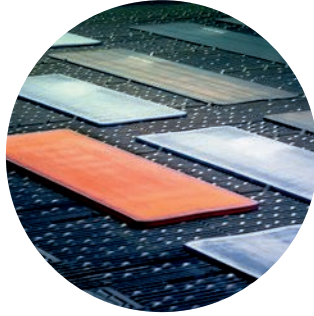
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The Nordic countries respond to the energy revolution



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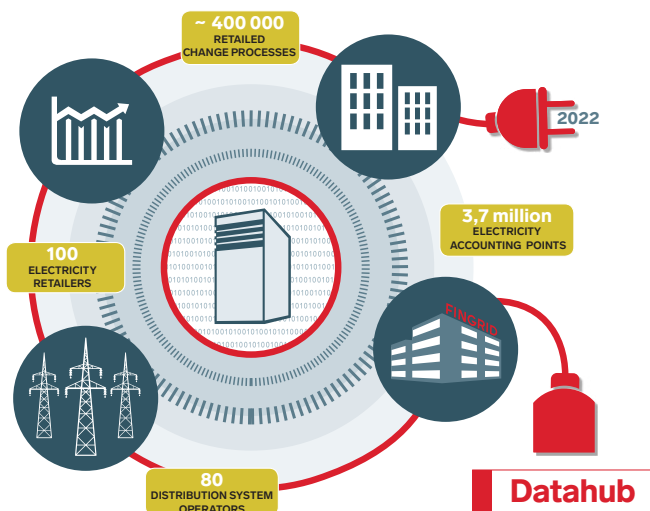
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PHOTO | FINGRID

Markets enable transformation

The current electricity market model was introduced in the Nordic countries in the 1990s. The world was different back then: most electricity was generated by hydroelectric power and thermal power, and a large amount of that was suitable for use as balancing energy. The Nordic electricity markets set a good example for European market models and the related legislation. Joint European markets and increasing transmission connections have bound electricity generators and consumers tightly together, as prices steer generation, consumption and electricity transmission across national borders.

Wind power generation, which originally took off thanks to feed-in tariffs, has undergone rapid growth everywhere, and it is gradually moving offshore. Solar power has become viable further north – capacity and generation volumes are increasing. Clean electricity has displaced fossil-based generation on the market. The types of capacity that are capable of providing balancing energy have exited the market, so the need for balancing energy capacity has increased.

On the electricity market, market regulations and physics must go hand-in-hand. The variability of unpredictable generation volumes has made a one-hour trading period too long. The way towards a 15-minute market has been

paved throughout Europe. Proposals have been made to transition to a 15-minute period on the Nordic intra-day and reserve markets and for imbalance settlement in May 2023.

We are heading towards an even faster-paced market.

It is important for the success of harmonised electricity markets that the cross-border transmission connections are good and that markets are given as much transmission capacity as possible. In the Nordic countries, we have started to develop and implement a new method called flow-based for calculating transmission capacity. The method will ensure a more efficient allocation of transmission capacity when there are a lot of interdependencies between cross-border transmission connections. The method has come in for criticism from market operators who have focused on the lack of transparency and negative impact on the intra-day and derivatives markets. We have taken the feedback on board. These are important issues, and we transmission system operators must resolve them openly, in cooperation with stakeholders.

In addition to shortening the trading period and implementing a new capacity calculation method, the third major change in the coming years will be the expansion of the reserve market. The need to adjust the reserve market is especially related to the growing challenges associated with the real-time management of the power system. Reserves are needed to balance out the power system during operating hours and, in the future, in 15-minute periods. We aim to acquire reserves cost-efficiently and in a volume that is as small as possible but nonetheless sufficient from the perspective of system security. That is why we need wide-ranging, functional markets instead of national markets. The reserve markets will expand according to the Nordic roadmap. They will first cover the Nordic countries, and – according to current estimates, in mid-2024 – we will then connect to European balancing energy marketplaces.

Twenty-five years of open electricity markets have gone by in a flash. The markets have expanded, and marketplaces and connections have improved. We are heading towards an even faster-paced market. The energy revolution will not wait.

Asta Sihvonen-Punkka
Executive Vice President, Fingrid

Nordic Balancing Model brings real-time markets a step closer

The Nordic Balancing Model is an enormous, multi-year development program that is being conducted on a national and pan-Nordic level. The project will have a major impact on Fingrid, as well as all electricity market parties.

TEXT | MARJUT MÄÄTTÄNEN
PHOTO | ISTOCK/OTAVAMEDIA



One of the important tasks of a transmission system operator is to keep the generation and consumption of electricity in balance at all times. Until now, the transmission system operators in Sweden and Norway – known as Svenska kraftnät and Statnett respectively – have handled the balancing of the Nordic synchronisation area, which encompasses Finland, Sweden, Norway and Eastern Denmark, with the help of balancing power markets.

The Nordic Balancing Model will alter the way the region's power system is balanced. The need for this development stems from the energy revolution and the European legislation underpinning it. Weather-dependent electricity generation has made balancing harder than ever, and electricity markets need to modernise to respond to the energy revolution.

“Under the new balancing model, balancing will be handled in various bidding areas. Finland constitutes a single bidding area and, in the future, we will handle balancing in our country's bidding area ourselves in relation to the Nordic bidding areas,” says Executive Vice President **Asta Sihvonon-Punkka**.

The new balancing model is known as the Area Control Error (ACE) model. There are a total of 11 bidding areas in the Nordic synchronisation area.

RESPONSE TO THE ENERGY REVOLUTION

The first significant change to become tangible to stakeholders concerns balance responsible parties during the transition from various generation and consumption balancing and corresponding pricing systems to a single pricing model. The balance responsible parties are responsible for balancing out their customers' power balances – electricity generation, purchasing, consumption and sale.

The single pricing model will be introduced in the Nordic countries in November 2021.

THE 15-MINUTE IMBALANCE SETTLEMENT PERIOD REQUIRES A CHANGE IN MINDSET

The largest change for stakeholders is the switch to 15-minute imbalance settlement period. The 15-minute imbalance settlement period guides market parties to support the power system in 15-minute periods, thereby helping transmission system operators to keep the power system in balance. The 15-minute imbalance settlement period will affect every market party: distribution system operators, balance responsible parties, retailers, generators and consumers, as well as every party involved in energy metering.

ICT suppliers are also among the key stakeholders, as the Nordic Balancing Model is, above all, a massive ICT project.

Program Lead **Maria Joki-Pesola** says that the Nordic Balancing Model will change the operating principles of electricity markets:

“As we head towards real-time markets, market parties are also altering their behaviour and optimising their operations in new ways. The transition from the one-hour system to a 15-minute one will require processes to be automated, as the market is no longer able to analyse or engage in trades in the one-hour world. It is likely that the intraday market volume will increase because it is possible to trade there close to the real time. This has happened in Central Europe, among other areas, where imbalance settlement period and intraday market already operate with 15-minute periods. The changes will present new opportunities, and we may gain new types of operators in the electricity market.” >

According to European legislation, transmission system operators must keep the sector informed of the transition to a 15-minute imbalance settlement period and ensure that there are no delays to the schedule. In order to share information and accelerate change, Fingrid set up a reference group, which market parties are comprehensively represented. The other Nordic countries have followed suit.

The first tangible change will affect balance responsible parties. They are responsible for balancing out their customers' power balances – electricity generation, purchasing, consumption and sale. The single pricing model will be introduced in a year's time.

At present, Fingrid is waiting for the authorities to respond to its request to postpone the go-live date of the 15-minute imbalance settlement period until spring 2023. Similar requests have been submitted in the other Nordic countries.

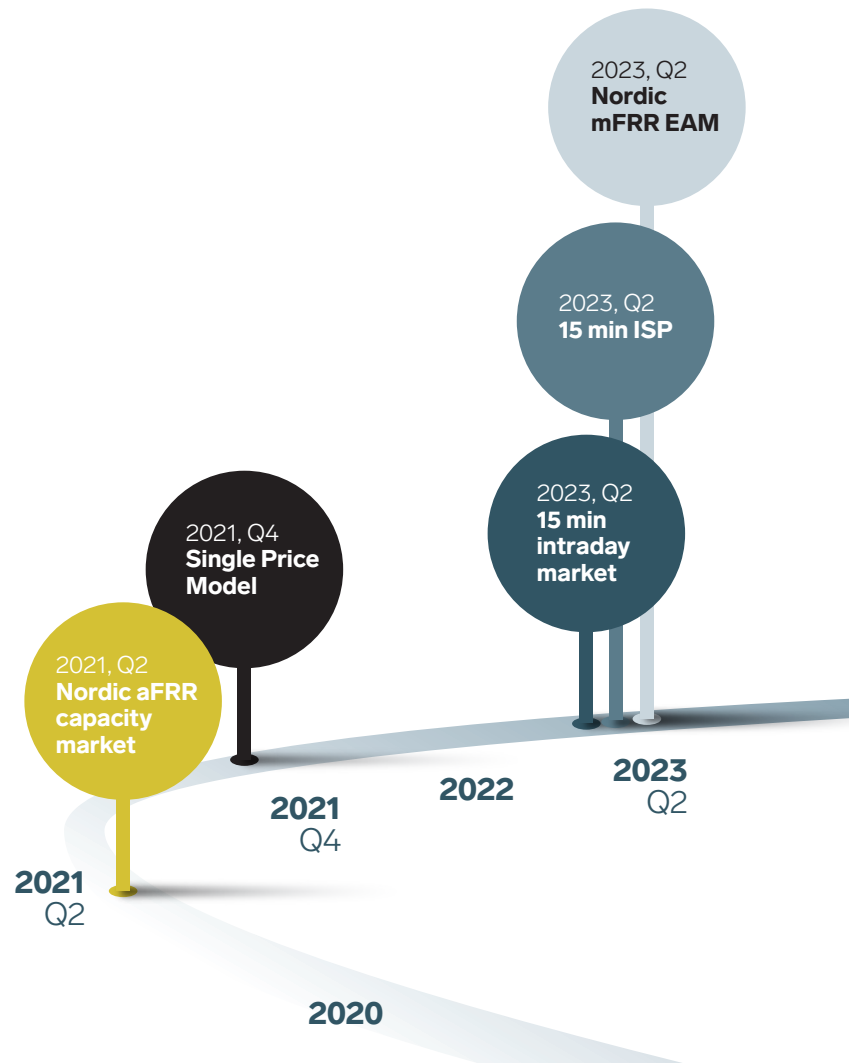
RESERVE MARKETS IN TRANSFORMATION

The Nordic Balancing Model involves building common Nordic reserve markets for the frequency restoration reserves needed for balancing; both automatic and manual reserves. Nordic marketplaces enable less expensive resources to be used as reserves. Although every transmission system operator defines the balancing power it requires in its own area, the reserves used for balancing can be activated optimally via common markets.

The expansion of reserve markets into a European entity will create new opportunities for reserve trading.

“The guideline for electricity balancing sets the constraints for reserve markets. In the future, orders and trading related to frequency restoration reserves will be made for specific bidding areas in European marketplaces. This will also require entirely new operating models, and each transmission system operator will take responsibility for its own bidding areas,” says Asta Sihvonen-Punkka.

As Finland transitions to the new balancing model, there will be a greater need for automatic frequency restoration reserves. •



More responsibility for Fingrid’s main grid control centre

The Nordic Balancing Model is transforming the activities of Fingrid’s main grid control centre.

Fingrid’s main grid control centre has three basic duties: managing the power system, managing the grid, and balance management. The last of these will be fundamentally transformed.

When Finland handles the balancing of the power system in its bidding area itself, it will mean in practice that Fingrid’s operators and control centre will have a greater responsibility for balancing. The frequency must remain constant at 50 hertz, which means that there is as much consumption as generation in the system.

Alongside the new responsibilities, the cycle of operators’ work will also change. At present,

balance management operators work in hour-long periods. One hour is enough for an operator to exercise their own discretion and use the present tools to analyse and evaluate the measures required to manage the frequency. However, when the system switches to a 15-minute imbalance settlement period, the number of periods will increase fourfold, so it will be impossible to take the necessary balancing measures using present methods.

“We are striving to increase the level of automation in balancing operations, so the quality of information systems will be crucial,” says **Maarit Uusitalo**, Control Centre Manager. However, she points out that some kind of back-up will be

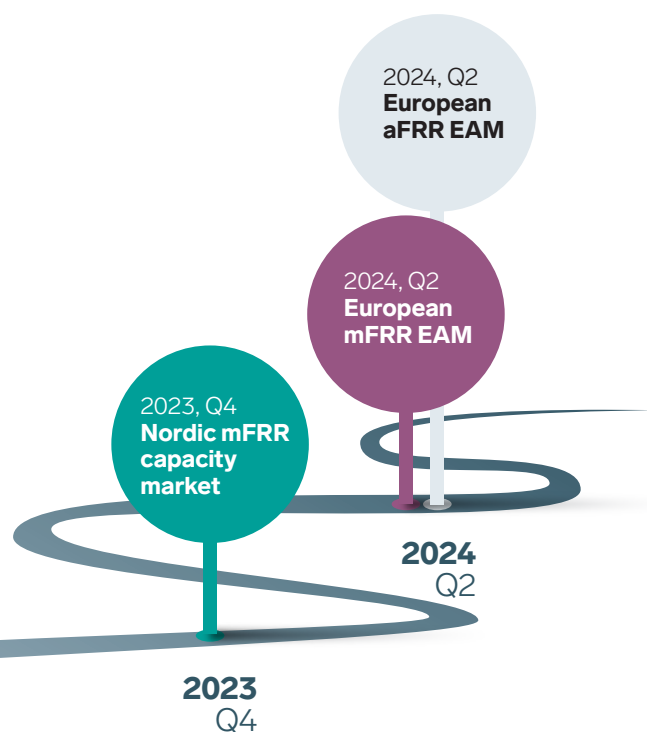
needed – the option for manual control must always be there just in case.

Saku Poikonen, Specialist, is excited about the change in his work: “We have the opportunity to influence what our work and the work of our colleagues will be like in the future. It feels really interesting. It would normally be necessary to switch to an entirely different job in order to be able to take part and implement so many changes,” he says.

He is not worried about the future, although there are some concerns about the transitional phase, as everything needs to work flawlessly, including during the transition. •



Maria Joki-Pesola is Program Lead of the Nordic Balancing Model program.



Nordic cooperation - excitement, plot-twists and, ultimately, three cheers!

The story of the Nordic Balancing Model management project run jointly by the Nordic transmission system operators does not begin with Danish hygge or Swedish café culture. From the very outset, a good dose of Finnish sisu and perseverance is required as Sweden and Norway try to get each other in a headlock. However, despite the sorry start and differences that appeared wider than the Gulf of Bothnia, the group eventually succeed in pinning down their shared objectives and negotiating an agreement that will lay the foundation for fruitful collaboration.

Our joint program is known as the Nordic Balancing Model. The complex entity will bring us closer to the balancing markets for balancing power and reserves, and imbalance settlement of the future. We will need these elements as the power system becomes increasingly dependent on various weather conditions.

The milestones for the Nordic Balancing Model were placed on a timeline so that

every milestone is considered in relation to the other necessary changes and the requirements imposed by European legislation. The implementation involves a diverse network of dependencies, which further increases the challenging nature of the program. Stakeholders have been asked to give their views on the phasing of the roadmap. The first changes to be implemented will be the go-live of the Nordic aFRR capacity market and the change to a single pricing model.

Collaboration on the Nordic Balancing Model is taking place in several levels between many parties. This story, like any compelling thriller, has a number of plot twists. However, these must be turned into mutual benefit and translated into every

Nordic language, as Fingrid's fundamental approach to the program has been to ensure clear, timely communication, transparency and stakeholder cooperation. A shared appreciation of the importance of these aspects has developed as the program has progressed.

However, it is not yet time to shout skål and sip the Akvavit. There is plenty to be done and discussions are ongoing, but the clean energy system is moving into view at the end of the tunnel. It is important for all of the parties involved in the program to keep the lights on in the Nordic region in the future.

This story will have a happy ending. •

Clear, timely communication, transparency and stakeholder collaboration are in everyone's interests.

Comments on electricity markets and the Nordic Balancing Model: Work to be done; efficiency cannot be compromised

We asked four electricity market specialists how they see electricity markets developing and the Nordic Balancing Model progressing as representatives of their organisations. The responses reveal concerns over the continued transparency of electricity markets and the costs of the Nordic balancing model. There is work still to be done, as the 15-minute imbalance settlement period will require a substantial change to electricity metering.

TEXT | ANNELI FRANTTI

PHOTOS | FINNISH ENERGY, NEOEN, ELFI, STORA ENSO

1. Which aspect of the development of electricity markets are you currently keeping an eye on?

2. What are your views on the Nordic Balancing Model, including the transition to a 15-minute imbalance settlement period?

Petteri Haveri, Senior Advisor on the Energy Market at Finnish Energy

1. We are closely monitoring European energy policy to ascertain whether it focuses on mitigating climate change and reducing emissions or whether public funds will be used for investments that can also be made on market terms.

It is vital for market terms to prevail. In Finland and elsewhere in Europe, the amount and proportion of emission-free electricity generation with limited controllability is increasing and will continue to increase. As the generation side becomes less flexible, it is becoming more important for electricity consumption and various new applications to participate in the market and to react to prices. This holds true from the perspective of individual customers as well as the market as a whole.

2. For balancing power and imbalance settlement the switch from an hourly price determination period to a 15-minute period is not a huge one, but a lot of work needs to be done to switch from hourly metering to a 15-minute metering. Good work has been done in Finland to enable the transition to a 15-minute imbalance settlement period, and metering will be switched to the 15-minute period as cost-efficiently as possible, starting with the customers that consume the most energy. Companies have already begun working on this.

The Nordic balance management entity is usually encumbered by

a needlessly technical approach, and there should be greater trust in the power of markets to enable reliable electricity transmission with the help of price signals. Functional electrical markets are the transmission system operator's best friend, and obstacles to trading should be removed rather than added. As the power system becomes more weather-dependent, it is crucial to have the opportunity to trade right up until the hour/quarter-hour of delivery, as well as the possibility to react to the needs of the system during the delivery period. •



Marja Kaitaniemi, Project Development Manager, Neoen Renewables Finland Oy

1. We are monitoring the price of electricity and long-term price trends particularly closely. As almost all of the wind power connection is nowadays based on Power Purchase Agreements (PPAs), we are closely monitoring long-term price trends in PPAs to gauge the types of prices available under such agreements.

Connections to the grid and the costs of connections are also being monitored. In Finland, this works well with Fingrid. This is not the case everywhere in the world. During the project planning phase, it is important to be able to discuss the areas that offer

favourable building conditions with regard to grid connections

2. The transition to a 15-minute imbalance settlement period will certainly have a visible impact on us. We must be able to forecast the generation volumes precisely, and this will be challenging for wind power generators. Overall, this is a fair and sensible policy. We understand it, and we will do all we can to adapt to it.

Balance management agreements are made for long periods, and we know that the costs of balance management will rise. We are actively carrying out forecasts, as other factors will also influence the cost level. On the other hand, the costs of generating wind power will decrease as technology develops. We estimate that the cost change introduced by balance management will not affect investments. •



”Functional electrical markets are the transmission system operator’s best friend, and obstacles to trading should be removed rather than added.

Petteri Haveri, Senior Advisor, Finnish Energy

Pasi Kuokkanen, Managing Director, Association of Energy Users in Finland (ELFI)

1. We are the advocacy organisation for major electricity users, and the majority of our members participate in the demand-side management market. The functionality of electricity markets is a critical matter for us to monitor, as price is always a consequence of market functionality.

The most urgent issue for ELFI is price hedging, which is inextricably linked to electricity purchasing. The EPAD product has not adequately hedged the price of electricity, as the product is not genuinely advanced. The Nordic system price has become too detached from the realistic price level, and it is detrimental for Finnish electricity users. Competition between financial exchanges would sort this issue out.

2. ELFI has been involved in commenting on the Nordic Balancing Model in the EU, the Nordic countries and Finland. There are still a lot of question marks and plenty of room for improvement.

When the Nordic countries integrate more closely with European electricity markets, market structures will also change in Finland. Planning is not always conducted in accordance with the best possible model or legislation; other variables include the size of the market. As a group, the Nordic countries represent a small proportion of consumers in Europe. Will we, therefore, take a more agile approach, or will we follow EU values or go even more slowly?

The Nordic countries have been pioneers of the functionality of electricity markets. The debate has been very open, and Fingrid has played an important role in it. We are increasingly required to use the European models that are handed to us. We are joining the common European market platforms MARI and PICASSO. It would go against the spirit of the common market if we delayed our entry. Delays would not be in the interests of buyers.



It is possible that the electricity market will become more difficult to understand in the future. If the number of bilateral agreements increases, the market suffer from a loss of transparency and liquidity. The transition from the one-hour to 15-minute settlement period will require buyers to do more work than before. This will call for additional resources, thereby increasing the cost of purchasing electricity. In conjunction with this change, buyers will also have to think about whom they collaborate with in these new circumstances. Competition is evolving, and companies’ market shares are changing, but will the market be more efficient for buyers? •

Esa Ukkonen, Energy Director, Stora Enso

1. The security of energy supply and a competitively-priced main grid service play a part in safeguarding the competitiveness of energy-intensive export companies, and will continue to do so. Fingrid’s activities should continue to focus on how these factors can be secured together with national and EU climate goals, the integration of the energy sector and the increasing renewable electricity generation capacity.

2. The transition to a 15-minute imbalance settlement period is doubtless a development path for the electricity market brought on by the introduction of varying renewable electricity generation capacity to the power system. For us, this means that a shorter imbalance settlement period requires more active forecasting of the power balance, as well as balance management measures. On the other hand, this could present us with new opportunities as market participants, for example, via digitalisation. •



New flow-based method for calculating transmission capacity

On the electricity market, the constraining factor for the transmission grid is the amount of electricity that can be transmitted at any one time. The flow-based calculation method enables transmission capacity usage to be optimised according to demand for electrical energy.

TEXT | ARI RYTSY

ILLUSTRATION | ISTOCK/ANNE KIISKI

The European Commission regulation (EU) establishing a guideline on capacity allocation and congestion management requires regionally coordinated calculations of transmission capacity. According to a decision by the Nordic regulatory authorities, calculations related to transmission in the Nordic countries must be made using the flow-based calculation method. At present, this method is due to be used alongside the existing

Net Transmission Capacity (NTC) model for one year beginning in spring 2021. The purpose of the parallel calculation period is to ensure that the new calculation method is at least as effective as the existing NTC method.

“The flow-based method for calculating transmissions will first be introduced on the day-ahead market. Later, we plan to introduce it on the intra-day market and for forward capacity allocation,” says **Timo Kaukonen**, Planning Manager at Fingrid.

FEW RESTRICTIONS TO ELECTRICITY TRANSMISSION

While both calculation methods are used in parallel, the results of the flow based calculations will be compared with the result of the existing method to analyse the benefits that can be realised. It is still only possible to talk about the advantages of flow-based calculation in general terms because implementation is still underway, and there are not yet any fully reliable results. Flow-based calculation takes more effective



account of the constraints set by critical network elements on trades between regions, and it is more effective than the existing calculation method in this regard.

“The new method simultaneously takes into consideration electricity transmissions between different regions and allocates transmission capacity on meshed networks between bidding zones where it can have the greatest economic benefit,” says Kaukonen.

The flow-based calculation is a complex method in which the transparency of the system’s calculation data in relation to the safety requirements guiding the operations of transmission system operators is still seeking its ultimate form. In addition it is still necessary to examine how flow-based calculation on the day-ahead market will affect the functioning of intraday markets.

“On the electricity market, transmission conventionally flows from cheaper to more expensive market areas. Under flow-based calculation, it is possible for a situation to arise in which the direction of flow is reversed i.e. non-intuitive. This could be caused if the highest economic benefit requiring a lot of transmission capacity is realised elsewhere,” Kaukonen states.

SIMULATION DATA IS NEEDED TO UNDERPIN WORK

Matias Kinnunen, Head of Energy Market Analysis at forestry company UPM, and **Jyri Salpakari**, Data Scientist at the same company, say that flow-based calculation will give rise to substantial changes in the electricity market. However, the lack of data is putting the brakes on preparations.

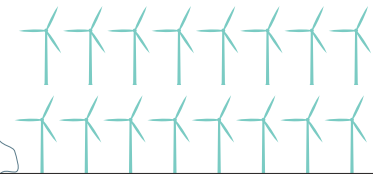
“In the Nordic countries, hydro power plays a major role, and the electricity thereby generated can fluctuate significantly from year to year, as well as within each year. For this reason, there is a greater need for simulation data here than in areas such as Central Europe,” Salpakari says.

Furthermore, with regard to the publication of critical network elements, conflicts have emerged with national legislation in different

Nordic countries. Stakeholders are concerned that the published information is not useful if it cannot be combined with a network topology.

Flow-based calculation may affect the forecasting of prices, as it is difficult to model non-intuitive flows – from expensive areas to cheaper areas. Increasing the uncertainty leads to the risk of market participants dropping out of the market.

“The necessity and benefits of flow-based calculation need to be demonstrated as transparently as possible. For us, it is important that market information is transparent, accurate, clear and available to market participants as soon as possible,” emphasises Kinnunen. •



The flow-based calculation method

A calculation method designed to optimise capacity on the electricity transmission grid by taking into consideration the constraints of the market area as a whole and allocating transmission capacity primarily to places where the greatest economic benefit can be achieved.

■ **One example of the benefits of flow-based calculation** is the integration of renewable energy into the power system. Renewable energy is generated in various different geographical areas depending on the prevailing weather conditions. For example, if it is windy in Denmark, there may be a lot of wind power that needs to be transmitted to other areas. Flow-based calculation enables this energy to be transmitted more flexibly to the other Nordic countries when the calculation offers more capacity to inexpensive wind power.

Climate neutral Finland remains within reach

In June, Technology Finland published its industry roadmap, which supports the goal of making Finland climate neutral by 2035. The key factors will be functional markets, RDI activities and low-emission electricity.

TEXT | ARI RYTSY

PHOTOS | SSAB, TEKNOLOGIATEOLLISUUS, FINGRID, SAMPO KORHONEN

The coronavirus pandemic has led many to consider whether the ambitious environmental goals can be achieved or whether some of them should be abandoned. **Helena Soimakallio**, Executive Director of Sustainable Development at Technology Finland, does not see any reason to set the bar lower.

“Technology Finland has compared six different scenarios for the post-coronavirus era. We consider the most feasible to be ‘digi-green development’, which will boost the economy, employment and the achievement of environmental goals. Growth will be spurred by an EU support package worth EUR 750 billion, a large proportion of which has been earmarked for sustainable development and low-carbon initiatives,” she says.

In Technology Finland’s roadmap, the foundations for a low-carbon Finland will be laid by a stable operating environment that promotes industrial investments, international demand for

new solutions, and research, development and innovation activities. It will also be necessary to have a smart energy system that provides reliable, inexpensive, low-emission electricity.

DIGITALISATION AND THE ELECTRIFICATION OF INDUSTRY WILL INCREASE THE NEED FOR ELECTRICITY

Under the accelerated technological development model, the direct greenhouse emissions

due to Technology Finland’s sectors will decrease by almost 40 per cent by 2035 and by 80 per cent by 2050. This trend goes hand-in-hand with an increase in electricity consumption, as many emission reduction methods are based on electrifying processes and machinery and using digital solutions.

“The amount of electricity needed by the technology industry is expected to increase by 50 per cent by 2035 and by 100 per cent by



“A large proportion of the EU’s EUR 750 billion support package has been earmarked for sustainable development and low-carbon initiatives.

Helena Soimakallio, Executive Director of Sustainable Development, Technology Finland



The technology industry is cutting down emissions by means such as electrifying processes, improving energy-efficiency and introducing digital solutions. SSAB's steel factory in Raahe, pictured here, will significantly decrease Finland's overall emissions when it introduces a revolutionary steel manufacturing process based on hydrogen reduction in the 2030s.



”Finland’s goal of becoming carbon neutral, and the increase in electricity consumption, are focal issues in the current network vision.

Mikko Heikkilä, Manager of Strategic Grid Planning, Fingrid

2050. It is, therefore, no exaggeration to say that electricity will play an instrumental role in achieving the low-carbon goals,” says Soimakallio.

Fingrid has used the roadmaps published so far to help in its strategic network planning. The strategic planning process covers the development of the main grid 15–25 years into the future, and the results are used as the basis for investment plans. Finland’s goal of becoming carbon neutral, and the accompanying increase in electricity consumption, are focal issues in the network vision, which is currently being created.

“We have prepared four different scenarios for the power system of Finland in 2035 and 2045. The estimates for the growth in energy consumption set out in the roadmaps for different sectors were a valuable input for our work,” says **Mikko Heikkilä**, Fingrid’s Manager of Strategic Grid Planning.

Fingrid published the scenarios in August for commenting by customers and stakeholders.

“The vast majority of the feedback we have received has been positive and encouraging.

The scenarios were updated and further developed based on the feedback,” Heikkilä says.

A LARGE CARBON HANDPRINT WILL INCREASE OPPORTUNITIES FOR EXPORT GROWTH

It is important that the various sectors under Technology Finland are activated, as their carbon handprint will be large. ‘Carbon handprint’ refers to the environmental benefits that a company’s products or services generate for customer companies and other groups.

At present, the carbon handprint of export products is estimated to be at least 20 tonnes of carbon dioxide equivalent per year (MtCO₂eq/year), which is four times as much as the carbon emissions from technology industries in Finland. In addition, the low-carbon technologies that are currently under development could increase the handprint by more than 50 MtCO₂eq/year.

Technology Finland has identified about 200 key technologies that will play a key role in the

achievement of Finland’s emissions goals and in expanding the potential for exports.

More than 90 per cent of the technology industry’s emissions are due to metal processing. The largest individual emission reduction in Finland will come to fruition when a steel manufacturing process based on hydrogen reduction, developed by SSAB, is introduced in a few years’ time. This major investment will reduce Finland’s climate emissions by seven per cent overnight.

In addition to the use of alternative reducing agents in metal processing, sector-specific solutions are being sought in areas such as the recovery of waste heat and kinetic energy in the manufacturing industry and in more precise specifications for datacentres and energy-efficient artificial intelligence in the ICT sector. •

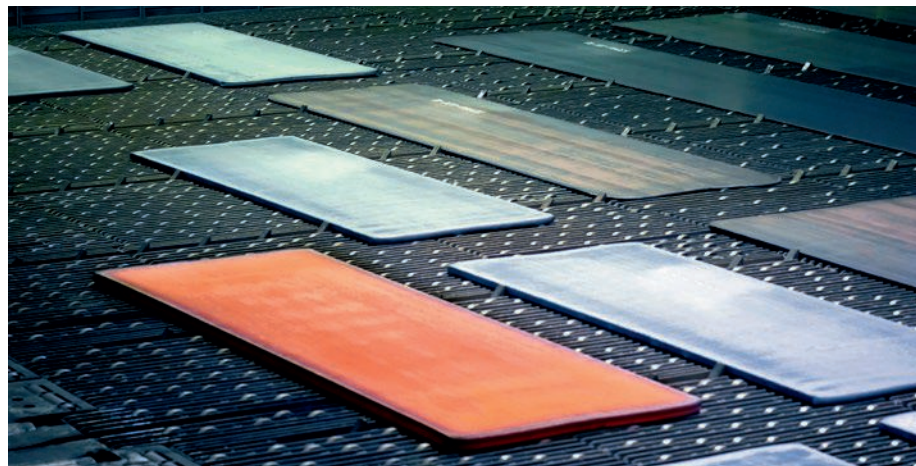


We need ten times as much electricity and a hydrogen ecosystem

Fossil-free steel is on the horizon

Steel company SSAB aims to be the first to market with fossil-free steel in 2026. This is possible using a process developed by the HYBRIT project, whereby in an iron reduction process hydrogen is used instead of coal.

TEXT | ARI RYTSY
PHOTOS | SSAB



Steel is humanity's most important material. Every year, almost 200 kg of steel is used for every person on the planet. Producing one tonne of steel creates 1.6 tonnes of carbon dioxide.

Despite the development of technology and production processes, steel production continues to have a significant carbon footprint. This is all due to change in the future, as SSAB, together with mining company LKAB and energy company Vattenfall, has developed a new production method based on using hydrogen to reduce iron.

Harri Leppänen, Head of Environment, Health and Safety at SSAB, says that the change is based on a growing global awareness of the climate challenge and associated climate policies, as well as an understanding that customers also want to lower their carbon footprints. SSAB's major investment is expected to cut down carbon dioxide emissions by a total of approximately 9 million tonnes a year. This amounts to 7% of Finland's total carbon dioxide emissions and 10% of Sweden's.

"We represent a world-class standard in efficiency when it comes to blast furnace iron-making, but there is little more to be done in this sector. As it is difficult to improve on this technology, we have set our sights on new solutions – in this case, hydrogen," Leppänen says.



SSAB is making its steel factories in Finland and Sweden emission-free with the help of new technology. The new method requires enormous amounts of electricity – specifically carbon-neutral electricity – as the company wants the entire process to be emission-free.



Harri Leppänen, SSAB's Head of Environment, Health and Safety, expects the new technology to gain traction elsewhere in the world, contributing to addressing a global problem.

NEW PRODUCTION METHOD REQUIRES ENORMOUS AMOUNTS OF ELECTRICITY

Finland and Sweden offer good preconditions for industrial-scale hydrogen reduction, as high-quality, easily-reducible iron ore is available in Northern Sweden. A further prerequisite for fossil-free steel is reliable, fossil-free electricity, which will be consumed in increasing volumes as hydrogen reduction takes hold. For example, using hydrogen to produce the same volume of iron as SSAB's plant in Raahе will require about ten times as much electricity as the current process.

"In 2014, Fingrid built a new substation in Siikajoki to act as a hub for the 110-kilovolt network and serve local energy consumers. This reduced the length of the power supply line to SSAB's plant in Raahе by one-third. For the time being, the current 2 x 110-kilovolt transmission lines from Siikajoki to Raahе will be able to transmit enough electricity for the town and for industry. However, major changes are on the horizon," says **Petri Parviainen**, Fingrid's Customer Manager.

SSAB's Raahе plant will begin using its first electric-arc furnace in 2029 and a second one in about 2040, which represents a substantial jump in demand for electricity. For this reason, plans are being made to connect the Raahе plant to the 400-kilovolt network, which has a connecting point about 30 kilometres from the plant. This is an enormous project, but there are no alternatives for meeting the increasing need for electricity.

"The network to the Raahе plant must be able to withstand very high loads. For the sake of comparison, if we include the production of hydrogen that will be required when the new production method is running at full power, we are talking about the same number of megawatts as the entire city of Helsinki consumes. Such large individual consumption sites are rare on a Finnish scale," Parviainen states.

HYDROGEN EXPERTISE IS NEEDED NOW AND IN THE FUTURE

At the end of August, the HYBRIT project run by SSAB, LKAB and Vattenfall entered the next stage when a pilot plant was opened in Luleå,

Sweden, to test the new production method. The pilot project is intended to run until 2024. In 2025, SSAB will open a new HYBRIT demonstration plant. After that, the focus will shift to the transition to commercial-scale production plant trials and the necessary technological changes. The first fossil-free steel products should be on the market in 2026.

"Trials related to the project are still underway in areas such as storing the hydrogen used for the reduction process. It is very important for us that a dedicated hydrogen ecosystem arises and plays a part in accelerating the project. This type of collaboration will enable new opportunities in the coming years," emphasises Leppänen. •

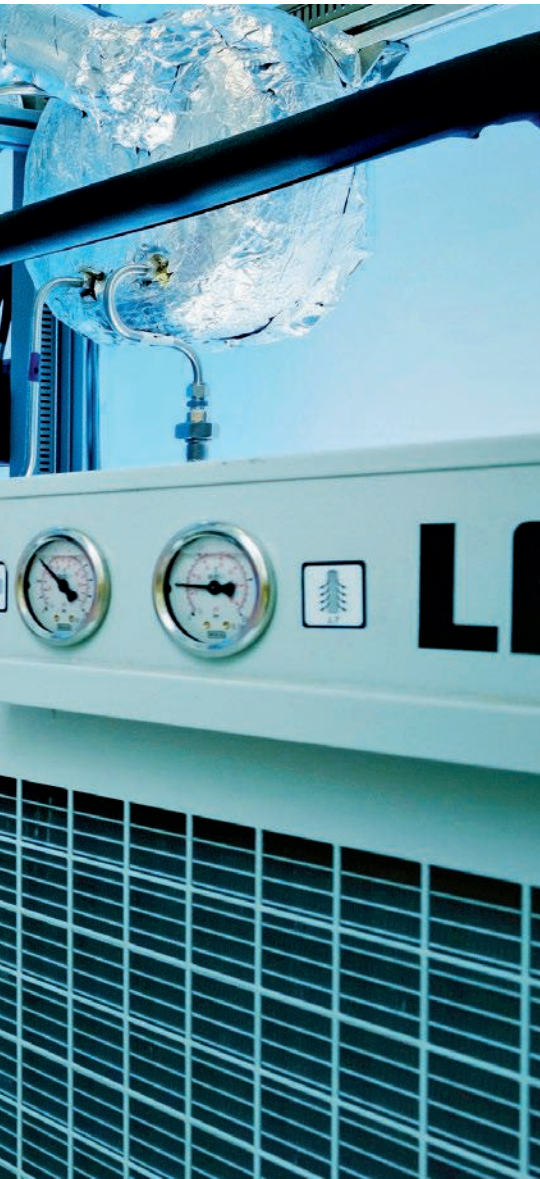


Power-to-X

solutions for energy storage

Solutions that turn electricity into a product – known as Power-to-X solutions – support emission-free, renewable electricity generation and introduce flexibility to electricity consumption. Electricity can also be used to produce carbon neutral or even carbon negative products that can be transported and stored. Fingrid is making preparations for a significant increase in electricity consumption in the coming decades.

TEXT | PÄIVI BRINK
PHOTOS | VTT



VTT's mobile synthesis unit can produce P2X hydrocarbon chains that can be further refined for use in various applications in the chemical industry.

Power-to-X (P2X) means converting electricity into other products, such as energy products, chemicals or even proteins. These solutions are also known by the umbrella term power-to-product. The motivation for developing new P2X solutions is to reduce carbon dioxide emissions and combat climate change.

“There is already a huge demand for emission-free electricity production, and it is increasing rapidly around the world. P2X can provide a transmission and storage solution for this clean energy generation. For example, it enables the electricity from solar or wind parks to be transferred to another time or place. In addition to different energy products, P2X can help to create e.g. carbon neutral products for the chemical industry,” says **Janne Kärki**, Senior Scientist at VTT.

COMPETITION TO DEVELOP HYDROGEN PRODUCTS IS HEATING UP

One of the most significant P2X solutions is to produce hydrogen by water electrolysis. Around the world, substantial sums are now being invested in a variety of solutions that use hydrogen.

“In industry, hydrogen is used for example in producing ammonia and refining oil. The hydrogen used by industry is still based on fossil fuels, but it could be produced from water and clean electricity. Several P2X products combine hydrogen and carbon dioxide, which can be captured from industrial sources or directly from the air,” Kärki explains.

Products that combine hydrogen and carbon dioxide could also be produced successfully in Finland.

“We have an abundance of clean water, which is necessary for electrolysis. At the same time, the process releases oxygen, which can be used for industrial or other purposes. In the

“Products that combine hydrogen and carbon dioxide could be produced successfully in Finland.

Janne Kärki, Senior Scientist, VTT

future, Finland could have combined heat and hydrogen (CHH) plants that produce hydrogen as well as district heating using the waste heat from the electrolysis process. Finland and Finnish companies should get involved in developing hydrogen-based products. The race is on, and now is the time to get ahead,” Kärki says.

THE MAIN GRID WOULD BENEFIT FROM FLEXIBLE OPTIONS

From Fingrid's perspective, the opportunities that P2X presents in terms of energy storage could offer important new methods for maintaining the power balance in the electrical energy system and managing transmissions on the main grid. Alongside sector integration, power-to-product solutions support the main grid when it is subject to fluctuations in electricity generation due to renewable forms of energy.

“The viability of longer-time electricity storage – periods longer than 24 hours – has so far been problematic, so P2X could play a key role in managing the power balance and transmissions in the future. At the same time, sector integration is consolidating the energy sectors, so in addition to the opportunities provided by P2X, it will be possible during windy seasons to charge other energy storage facilities such as the batteries of electric cars and heat storage facilities. On cold, dark winter days and periods without strong winds, P2X products could play a key role in ensuring the supply of electricity,”

says **Tuomas Rauhala**, Manager of Fingrid’s Market Innovations unit.

For example, wind power can produce hydrogen when it is windy and there is excess electricity production in relation to consumption. However, Janne Kärki says that it remains to be seen how many plants will offer balancing energy services over the long term.

“The technology used by electrolysis plants is ideal for rapid balancing energy service. However, P2X production facilities will only be viable investments if they can also be operated during higher electricity price periods. Policy

measures could affect the viability of P2X products. In principle, emission-free electricity must be cheap, and the end product must be valuable enough to make it profitable to make P2X products,” Kärki considers.

Rauhala notes that the structure of energy generation and consumption will change radically.

“New P2X production plants have the potential both to produce and to consume enormous amounts of energy, so electricity will flow in two directions. When there is plenty of electricity on offer during windy and sunny periods, it will be transmitted to places where it can be stored, unless there is a local storage facility. When the output from renewable generation facilities is low, electricity will be taken from storage to consumption.”

From Fingrid’s perspective, P2X offers significant opportunities for storing energy and maintaining the power balance.

Tuomas Rauhala, Manager of Market Innovations unit, Fingrid



VTT’s modular containers can also be used to purify and compress the input gases, in addition to the actual P2X synthesis. The containers are suitable for various industrial environments and demonstrations conducted in them.

FUTURE CHANGES ARE TAKEN INTO CONSIDERATION IN THE PLANNING OF THE MAIN GRID

Risto Kuusi, Senior Expert in Fingrid's Strategic Network Planning unit, states that major investments will need to be made in P2X in order for Europe to become climate neutral in line with the agreed schedule.

"Electricity consumption will increase in any case, because there are no competitive alternatives for emission-free energy generation. The way we plan the main grid is substantially impacted by Finland's share of global P2X investments and the locations in which investments are made. In terms of electricity transmission, it would be most cost-efficient to have production near consumption, but there are several other factors that must be considered when investing," Kuusi says.

"The way we plan the main grid is substantially impacted by Finland's share of global P2X investments and the locations in which investments are made."

Risto Kuusi, Senior Expert, Fingrid

When Fingrid prepares its network vision, it envisages several potential scenarios for the future.

"We are looking for solutions that address the needs of as many different scenarios as possible. The reliability of the main grid cannot be compromised, even though changes occur at a rapid pace," Kuusi says. •

Ministry of Economic Affairs and Employment: Energy sector integration working group initiated

This autumn and winter, the energy sector working group set up by the Ministry of Economic Affairs and Employment will analyse the possibilities and obstacles to sector integration and seek tangible solutions for promoting the issue. The working group is expected to produce an interim report by February and a final report in summer 2021.

TEXT | PÄIVI BRINK

We asked **Juho Korteniemi**, Chief Specialist at the Ministry of Economic Affairs and Employment, to answer some of our questions.

WHAT ARE THE WORKING GROUP'S OBJECTIVES?

The working group aims to promote energy sector integration, including matters such as the development of power-to-product solutions and the hydrogen economy. The working group is taking into consideration the strategies on the energy system integration and hydrogen published by the European Commission in July. The working group's results will also be linked to the preparation

of a national climate and energy strategy. In practice, the working group must analyse the needs, opportunities and obstacles to energy sector integration and present tangible alternatives for solutions.

HOW HAVE THINGS BEEN GOING SO FAR?

The working group and the groups of specialists working with it began their work in August and September 2020. The work has covered matters such as the content of the low-carbon roadmaps for various sectors prepared on the basis of the Government's programme, status of finance and research aspects, and initial discussions on the integration of the urban heating sector.

HOW SIGNIFICANT DO YOU THINK ENERGY SECTOR INTEGRATION WILL BE IN TERMS OF FINLAND'S ENERGY ECONOMY AND COMBATING CLIMATE CHANGE?

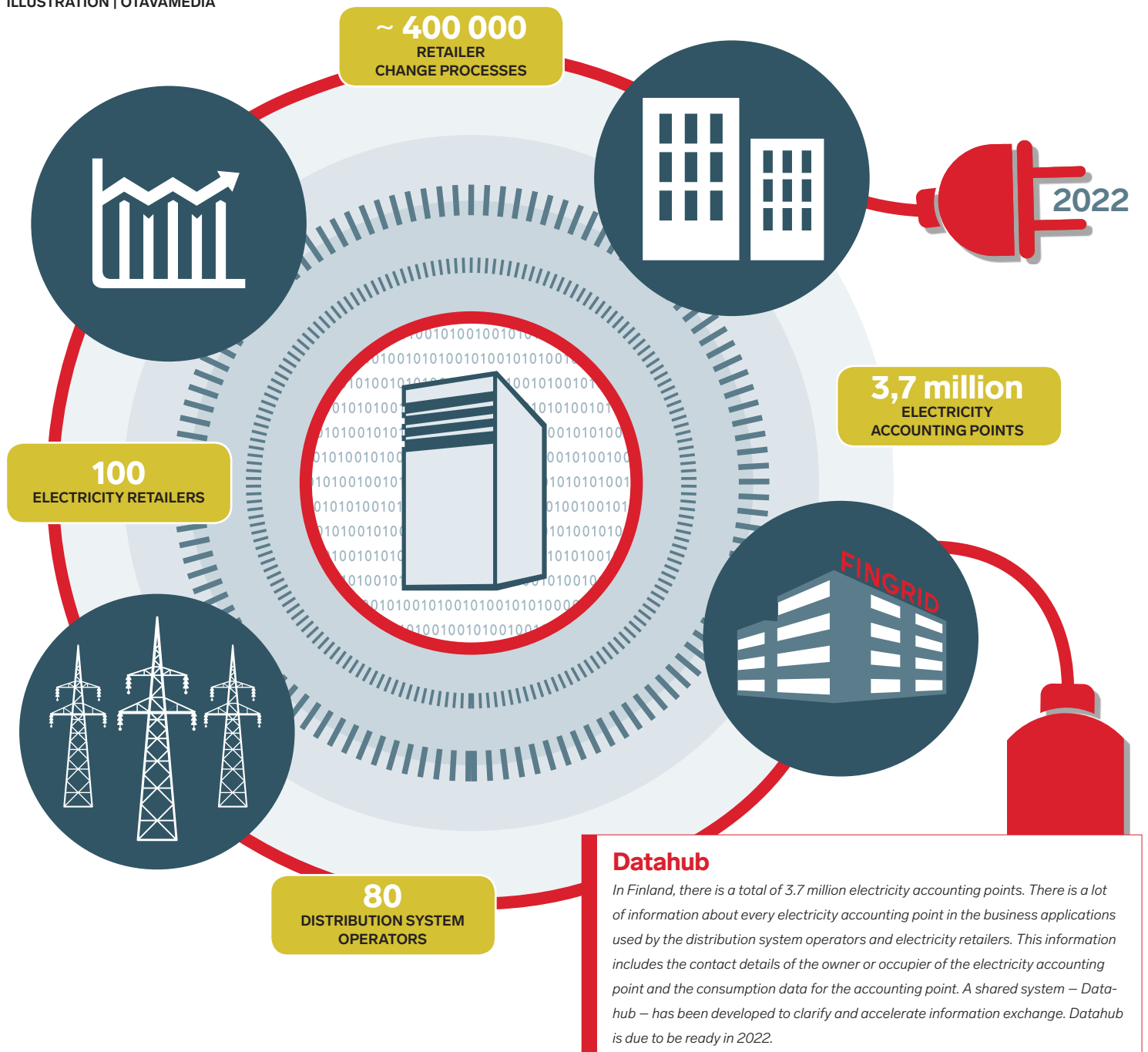
The Ministry of Economic Affairs and Employment considers the matter highly important. In order to reach the goal of becoming climate neutral and improve Finland's competitiveness, we will need to deploy new solutions in every sector with a view to ensuring the cost-efficiency and reliability of the system as a whole. The working group's work is strongly based on stakeholder cooperation, and it also considers the views of Fingrid and Fingrid's customers. Fingrid could be at the forefront of the development of new energy solutions. •

Datahub is ready for test operation

The development of Datahub is about to be finalized and the system was opened to the entire sector for test operation in October. During the testing phase, the quality of the data will be verified, and the market parties will test various functions in phases.

TEXT | PÄIVI LEINONEN

ILLUSTRATION | OTAVAMEDIA





he development of Datahub reached a significant milestone when the functionalities necessary for parties to receive certification were completed

in August. The certification process is provided by the testing and certification service TEPA, which is an application that enables parties to test whether their systems are compatible with Datahub. This autumn, the service was opened up for deployment across the entire sector.

“The service will enable us to test use cases that are as realistic as possible; the service creates situations in which market parties exchange information, just as they will when Datahub is operational,” says **Fredrik Södö**, Expert from Fingrid.

The certification process is complete when the operator has carried out all mandatory use cases on the service successfully. No limits have been set for testing, so the same function can be tested several times. TEPA will also be included in the completed Datahub, and it will be especially useful when new processes are introduced.

Alongside TEPA, the TITTA data migration service is used in the development phase. Data is entered into the TITTA data migration service in the form of files, which TITTA checks before reporting any errors and findings if necessary. The error report helps the user to make the necessary corrections to the data.

TITTA is already widely used throughout the sector, and it enables the business data that must be uploaded when Datahub is deployed to be comprehensively verified before the production deployment of Datahub. The purpose of the data migration service is to ensure a high-quality initial upload to the Datahub, after which the service will no longer be needed.

PILOT GROUP HAS TESTED VARIOUS USE CASES

In the Datahub pilot group, the TEPA service has been used by the energy retail and network

operators Fortum, Caruna and Nivos. The service was opened up to the entire sector for test use in June, and since then, the majority of the system suppliers have been using the service intensively.

Fortum’s contact person for Datahub development work is ICT expert **Laura Koskikallio**.

“We have been able to bring our own insight and experience to the development work in the pilot group. Our main tasks have been to value and prioritise the certification use cases, such as making new contracts, ending contracts, updating customer details, and connection and disconnection processes, and to test the use cases before opening up the testing and certification service to the industry.”

In Koskikallio’s opinion, the deployment of the testing and certification service has gone well.

“There have been some minor technical issues, but they were quickly fixed. We needed to refine some of the use cases because they did not work in the same way on our systems. At the same time, our systems are also developing to suit the new practices.”

TESTING AND CERTIFICATION SERVICE TO HELP USERS

“The purpose of TEPA is to help market parties to operate in Datahub business processes and produce the correct data for Datahub automatically,” explains Fredrik Södö.

”In the future, operators will be able to use clear, browser-based services independently.

Fredrik Södö, Expert, Fingrid

Timetable for Datahub readiness certification

The use cases have been grouped into four categories, the first of which is the most relevant in the operator’s business.

- From October 2020, all parties have the possibility to begin using the testing and certification service
- By 1 December 2020, all parties will have tested the use cases in category one
- By 1 February 2021, all parties will have tested the use cases in category two
- By 7 April 2021, all parties will have tested the use cases in category three
- By 7 May 2021, all parties will have tested the use cases in category four, and certification will be complete

Various use cases have been set up on TEPA for parties operating in different roles in the market. Electricity retailers have dedicated use cases, and network operators and metering data responsables have their own. The service includes a counterparty simulator, which handles the counterparty’s duties in various use cases.

For example, a typical use case for an electricity retailer is to notify a sales contract in the event of a customer move in. The service creates an accounting point in Datahub, sends the customer details to be used in the agreement to the user, and, finally, checks that the agreement was created correctly. The data is transferred from Datahub to the grid access provider, and the TEPA counterparty simulator confirms the contract.

“Ease of deployment has been an important guiding principle for the development work. We wanted to build clear, browser-based services that operators can use independently without Fingrid’s help,” says Södö. •

From the carbon black towards the emission-free sources, a balance must be maintained between demand and supply.

Enough power?

Electricity generation and consumption are two sides of the same coin. People need electricity, particularly on cold winter days – but those are the days when electricity is most difficult to guarantee and supply. Coal is coming to the end of the road, so we need to look for alternatives. The answer increasingly lies in the expanding Nordic and European electricity markets.

TEXT | SAMI ANTEROINEN

PHOTOS | ISTOCK





Reima Päivinen, Fingrid’s Senior Vice President of Power System Operations, notes that the battle against climate change has brought emission-free forms

of energy strongly to the fore, while electricity generation using fossil fuels such as coal has rapidly fallen out of favour.

“Coal played an important role in electricity generation 10–20 years ago, especially in the winter. Times have changed, and as of 2029, it will be forbidden to use coal to generate electricity. Naturally, this is already having an impact.”

Last year, the Government decided to introduce a full-scale ban on using coal as a fuel for electricity or heat generation as of 1 May 2029.

The coal ban is related to the implementation of the national energy and climate strategy, which stretches to 2030. Finland is gradually stopping the use of fossil fuels for energy generation and transitioning to an emission-free energy system; the first fossil fuel to go is the coal used for energy generation. At the same time, Finland is among the first countries in the world to give up on coal entirely.

RENEWABLES, PLEASE!

The replacement is coming – and it has already arrived in many places – in the form of renewable forms of energy such as wind power, biomass and solar power. The aim of the national energy and climate strategy is to increase the use of renewable energy so that it accounts for more than 50 per cent of ultimate energy consumption by the end of the 2020s.

“In this decade, a lot more wind power capacity will be created in Finland,” says Päivinen. He adds that while wind power projects may have been reliant on subsidies in the past, wind power can now be built on market terms.

“This will be a big change, and it will be most apparent on the west coast of Finland.” When wind farms go up in the Vaasa, Oulu and Kemi regions, a new challenge will arise, as the largest centre of consumption is in the south of Finland, far away from where electricity is generated.

“For this reason, we need to ensure that there is enough transmission capacity in the right places at the right times.”

INDUSTRY IS ELECTRIFYING RAPIDLY

A further problem on top of the issue of geography will be the energy transformation taking place in industry. For example, large factories aim to switch from fossil-based energy to electricity generated from green sources.

“If industry demands more emission-free electricity, it will increase the pressure on generators.”

The sun does not always shine, the wind does not always blow – we know this, but we can turn to our neighbours. The Nordic power exchange mechanism sends electricity to Finland if our resources run out. A unique characteristic of the Nordic countries is the strong position held by hydroelectric power:

“For example, the wholesale price of electricity was low last summer because the reservoirs in Sweden and Norway were full.”



THE NORTHERN WAY

According to Päivinen, the Nordic countries have a long tradition of sharing the responsibility for balancing out generation and consumption. “The principle is that consumption and generation are in balance every second of every hour. This relies on effective market rules and marketplaces.”

It is also no secret that the Nordic model is admired all over Europe – and the EU’s electricity vision is drawn up accordingly.

But let’s go back to wind power. Päivinen states that wind power has undergone a breathtaking transformation to become a credible form of electricity generation:

“People were unsure at first, but the development of the technology and the decrease in the cost level have surprised many people.”

The rapid development has made onshore and offshore wind power projects financially viable. “The amount of offshore wind power is increasing, and cost-effective solutions are being found all the time,” says Päivinen. From the perspective of the transmission system operator, all that is needed is a connecting cable from the site to the shore, and the electricity can flow.

POWERED BY HYDROGEN?

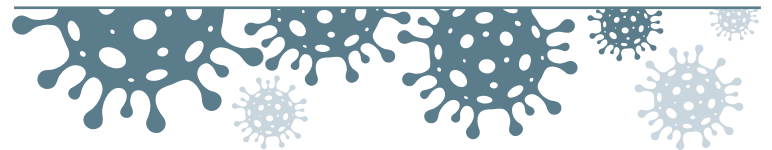
Technology has not yet eliminated every obstacle related to renewables. Päivinen points out that electricity storage remains a challenge that large batteries do not seem able to tackle cost-efficiently.

He says that one noteworthy alternative for consideration is sector integration and various opportunities for promoting the hydrogen economy and Power-to-X solutions. Sector integration involves creating new links between sectors, energy carriers, infrastructures and technologies.

“Converting electricity into hydrogen and back into electricity could be one solution.” •



JACK FROST VS THE CORONAVIRUS



■ Reima Päivinen, Fingrid’s Senior Vice President of Power System Operations, says that peak consumption during winter 2019–2020, which was devoid of snow and record-breaking in terms of high temperatures, was only 12,400 megawatts – the lowest consumption recorded this millennium.

“Preparations are now being made for the coming winter, and peak consumption is expected to increase to approximately 15,100 megawatts if it is very cold. The electricity generation capacity available in Finland has decreased slightly: there is now only 11,400 megawatts of generation capacity.”

There is some uncertainty surrounding consumption: after last year’s mild, rainy winter, will we be struck by a deep freeze that will send electricity consumption rocketing? Or will it be another mild washout? Päivinen says

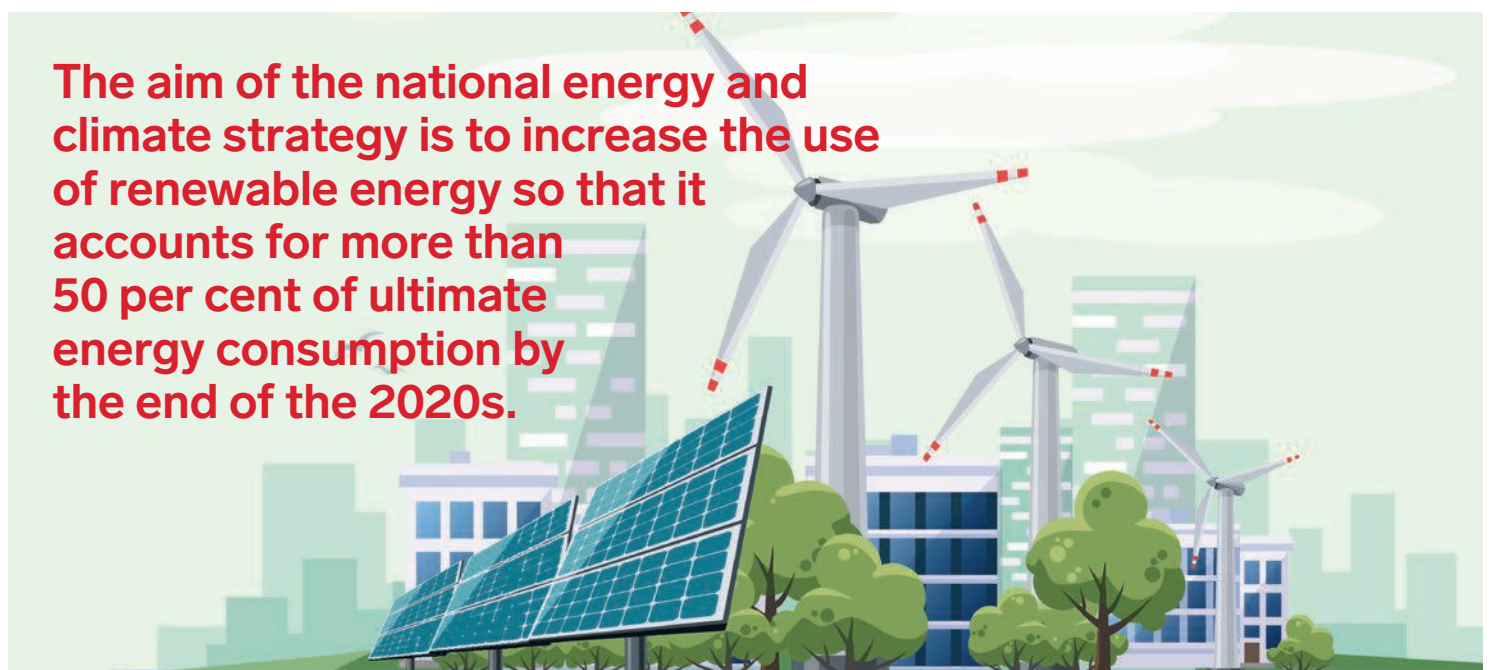
that the coronavirus is an issue in addition to the unpredictable weather conditions.

“Electricity consumption is heavily influenced by whether or not our industrial capacity is running at full steam.” If the coronavirus causes exports to stutter again, factories could easily be reduced to half-capacity for the winter as order books shrink.

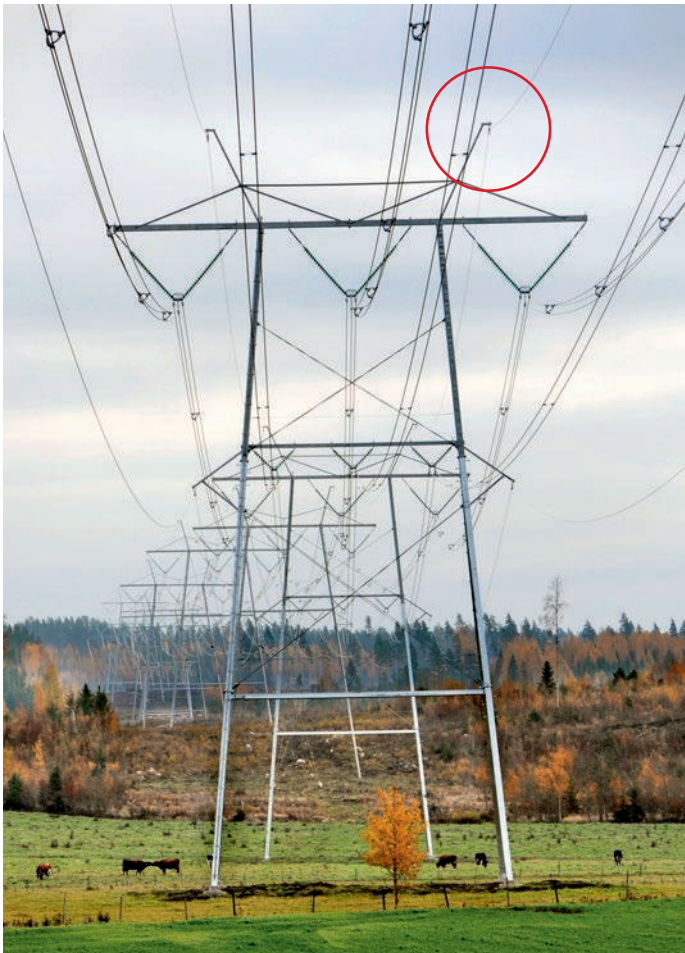
“The closure of the Kaipola paper mill alone will affect the country’s overall electricity consumption – that shows how much of the total consumption is due to industry,” Päivinen says.

If very low temperatures coincide with record production volumes at factories, capacity will really be put to the test.

“In this case, we will need to import electricity – there are no two ways about that.”•



The aim of the national energy and climate strategy is to increase the use of renewable energy so that it accounts for more than 50 per cent of ultimate energy consumption by the end of the 2020s.



Earth wires guide lightning down into the ground and protect the system from disturbances

The earth wires located above power lines transfer fault current safely into the ground via earthing connections. Earth wires may be necessary in areas with less conductive soil.

TEXT | VESA VAINIO

PHOTO | JOHANNES WIEHN

When a thunderstorm strikes, the overhead line transmission network is vulnerable to disturbances. Technical solutions are used to minimise the impact of lightning. One such solution is the earth wire, as described by **Heidi Oja**, Expert at Fingrid.

WHERE ARE EARTH WIRES AND WHY DO WE NEED THEM?

Earth wires are located in transmission lines, above the uppermost phase conductor. When there are three phase conductors, there are usually two earth wires, and there are usually also two on multi-circuit transmission line structures.

Earth wires go from one tower to another, capturing any lightning heading for the transmission lines and directing the current into the tower's earthing connections and onwards into the ground, past the phase conductors.

This prevents disturbances and enables the network to continue operating normally despite the inclement weather.

HOW DO EARTH WIRES WORK IN THE EVENT OF A FAULT?

Earth wires also help in the event of a fault in a transmission line by reducing the impact of the fault. If a fault arises, the lightning lines join the earthing connections on different towers to each other, thereby improving earthing and facilitating the functionality of the protective measures. In addition, the earth wires reduce the amount of detrimental current travelling via the ground by conducting some of the fault current, thereby significantly reducing earthing and induction voltages.

DO SOME AREAS NEED MORE EARTH WIRES THAN OTHERS?

The need depends on the location of the transmission line. In places with poor soil

conductivity, such as on rocky terrain, it may be necessary to add extra earth wires. If there are several earth wires, the tower earthing connections can be joined together more effectively and earthing is more effective. The more earth wires a tower has, the greater the proportion of fault current they conduct, resulting in less current transferred to the ground and ensuring safety.

ARE CONDUCTORS ON THE GROUND DANGEROUS?

Any conductors or earth wires on the ground should be treated with extreme caution – it is highly dangerous to go near them. Do not touch them. Notify Fingrid's main grid control centre, the local electricity network operator's fault reporting service or the emergency services as quickly as possible. •

Better data and customer-oriented services

In its ICT operations, Fingrid is learning to make services that are more effective at addressing the changing needs of stakeholders. The critical nature of data management, which forms the basis for new services, came to light during planning for the digitalisation of substations. In addition, the process to modernise the extranet services for customers led to the creation of a new agile methodology known as DoIT, in which services are developed using cloud services according to the customer's needs.

TEXT | DANIEL PAJUNEN
PHOTO | ROOPE PERMANTO



In recent years, Fingrid's ICT unit has developed wide-ranging solutions in areas such as real-time system control and interconnections between systems, say Kari Suominen, CIO, Nina Kujala, Unit Manager, and Jyrki Pennanen, Information Security Manager.



In recent years, Fingrid's ICT unit has been looking for ways to address the changing needs of the electricity network and sought to understand what the

change will mean for the main grid on a practical level. According to **Kari Suominen**, Fingrid's CIO, most of the new requirements have been identified, and a lot will happen over the next couple of years.

"In two years' time, we will already be in a new world: we will have the systems ready to begin using a 15-minute Imbalance Settlement Period, and the elements for real-time system control will begin to be ready in other regards. The Datahub system, which is Fingrid's largest information system investment, will go live in early 2022."

According to Suominen, the most important insights have been gained in the last two development projects.

EFFECTIVE DATA MANAGEMENT SCREENS OUT THE RELEVANT DATA

"The project to develop digital monitoring solutions for substations forced us to rethink our approach to data. Monitoring solutions that exploit IoT technologies produce enormous volumes of data, and the relevant information must be picked out for the end-user in real time."

Fingrid's ICT unit has recently been focusing on developing data management in order to enable new systems to be developed and operated. One major challenge is to combine the data streams from Fingrid's systems with external systems and provide relevant information in a way that is easy for different stakeholders to understand.

"One major challenge is to combine the data streams from Fingrid's systems with external systems and provide relevant information for different stakeholders.

Kari Suominen, CIO, Fingrid

"In the future, network partners, ranging from operating activities to electricity markets and asset management, will make use of our data platform and the real-time information it can provide."

The development of the data management model for stakeholders has already resulted in higher-quality customer data and better availability of the open data service.

THE DOIT METHODOLOGY ENCOURAGES DEVELOPERS TO ASK THE CUSTOMER

Another project that has driven the ICT operating culture forwards was the project to modernise the service portal for customers.

"The original goal was to replace the old customer extranets with a new user interface. However, when we analysed our customers' needs, we hit upon an entirely new need, which we set out to address. The outage planning service was the first service to be launched on the new customer portal. Development was based on closer dialogue with customers, and the service was made in intensive sprints with external service providers," Suominen says.

Although Fingrid's various units have long used modern service development methods, a tailor-made methodology for the business environment of a transmission system operator was lacking. The DoIT service, which was launched in January and productised on the basis of the lessons learned during the development of service portals, has addressed this need.

"In DoIT teams, services are implemented by collaborating with service providers to address business needs, and the teams make use of the latest cloud technology, among other technologies. We are able to create visible results

rapidly, and the product is constantly evolving, rather than relying on large one-off updates," Suominen says.

According to Suominen, customers have been satisfied with the services created by DoIT, and they have been happy to be included in the development work. Many functionalities were realised in dialogue with customers.

"For example, customers can sign in to our customer portal with their own organisation's user credentials. Information on users' access rights is automatically updated between our systems and our customers' systems, which also improves information security."

ACTIVE DIALOGUE IMPROVES INFORMATION SECURITY

The role of information security as a part of ICT has also changed. According to **Jyrki Pennanen**, Fingrid's Information Security Manager, one concrete example of this is the information security audit. Previously, information security audits were conducted on completed software, but now, information security specialists in DoIT teams – whether internal or external personnel – are included in service development from the very beginning.

"This also makes things easier for the business, as there are no surprises – pleasant or otherwise – in the final stages of the project. In the worst cases, it has come to light that a new system that we have acquired cannot be placed inside our architecture in a way that would ensure information security," Pennanen says.

According to Pennanen, more dialogue is needed with other energy sector parties. The development that is underway in the sector and the consequent interlinking of systems will increase the number of potential security vulnerabilities.

"The operation of the grid is increasingly based on complex technology. When we design new services for the sector, we need to work in cooperation with other operators in the energy sector. We aim to identify systems that are suitable for everyone and, above all, common operating methods to ensure information security in all circumstances." •

DoIT accelerates service development

The DoIT service, which was introduced in January, has made Fingrid's digital service development more agile and increased the cooperation of different parties. DoIT breaks up development work into a series of short, continuous two-week sprints for a high-quality result. The first piloted project was the My Fingrid service for service providers.

TEXT | DANIEL PAJUNEN

PHOTO | NIKO JEKKONEN



Fingrid's ICT unit introduced DoIT – a new application development service – in January. This new method of creating digital services was born of the necessity to rapidly develop solutions that customers need and that are not available on the market.

The team responsible for DoIT is led by Fingrid's Head of ICT Business Services, **Nina Kujala**. She says that DoIT has been distilled from the agile methodologies used around the world and tailored to suit Fingrid's operating environment, which plays a critical role in society. For example, DoIT emphasises information security and 24/7 system support more than conventional agile development methodologies.

RAPID DEVELOPMENT SPRINTS AND SCALABLE TEAMS

The first step in implementing an application with the DoIT methodology is for Fingrid's business to identify the needs of customers and stakeholders.



According to the DoIT team, it is an honour to be involved in implementing services that utilise the latest technology and that support Finland's electricity network. The picture shows the entire team, from left: Nina Kujala, Mikko Poranen, Viljami Rahikainen, Olli Aaltonen and Hannu Sintonen.



"When a need is placed in the DoIT pipeline, a high-quality result is obtained quickly."

Nina Kujala, Head of ICT Business Services, Fingrid

Digital monitoring prevents device breakdowns and provides savings

The development of digital monitoring solutions at Fingrid has proceeded so well that the majority of the company's substations will be brought within the scope of digital monitoring by 2025. Sensor systems that continuously measure data on the conditions of devices will enhance maintenance and ensure the reliability of the main grid. This is a pioneering project on a worldwide scale.

"First, we define the need and the timetable. Next, DoIT allocates developers to the project. The project can then begin quickly, as DoIT has already conducted the competitive bidding process for development agreements, so it is not necessary to request quotes for each individual project. Service providers enable us to scale our project teams rapidly," says Kujala.

Service development work takes place in accordance with the DevSecOps model in short sprints, which usually last a couple of weeks. Once a sprint is over, the team assesses whether the target for the sprint was reached and sets a new target for the next sprint. The team's workload is coordinated by a Scrum Master, who is responsible for the product under development, and the product owner in the business. If there is too much air or pressure at any stage in the work, it is possible to react quickly.

The first service that was implemented – and is still evolving – using DoIT was My Fingrid for service providers. Service providers have piloted the service during development. In line with the DoIT model, once the first version is released, the development team maintains the service and builds upon it to meet the needs of users.

THE NEW MODEL IS SPREADING WITHIN FINGRID

The DoIT concept is being developed based on Fingrid's experiences. According to Kujala, the aim is to harmonise Fingrid's digital development practices and hopefully implement agile methods and tools throughout the organisation.

"When a need is placed in the DoIT pipeline, a high-quality result is obtained quickly. The business is closely involved, so they are up-to-date on the progress of the project. As a result, parties beyond the ICT unit have become interested in DoIT, and we have sparred with our customers on the introduction of agile methodologies. We are happy to help," Kujala says. •

■ Although the security of supply on the main grid is good, the devices in Fingrid's substations occasionally suffer characteristic faults and sometimes even explosions, which disrupt the power supply and give rise to excess costs. In the last five years, Fingrid's grid management, digitalisation and ICT units have joined forces to study ways of improving the reliability of substation equipment using digital monitoring solutions.

"Back in 2016, we noticed that IoT technology had developed to the point that the digitalisation of substation monitoring began to seem realistic," says **Tuomas Laitinen**, Senior Expert at Fingrid and manager of the project to develop a digital monitoring solution for substations.

The benefits, such as boosting the efficiency of maintenance and preventing breakdowns, were clear. The only question was whether the change could be made in a cost-efficient and genuinely scalable way. There were no ready-made solutions on the market suitable for use as substation monitoring systems. Among other means, innovation competitions were used to identify partners to develop a solution.

CRITICAL DEVICES FIRST

Laitinen says that the development work has so far focused on the devices in which problems arise most frequently and which are critical in the event of faults.

"Measurement arrangements were implemented by modernising conventional measurements and including some new methods. For example, audio signals indicating faults were previously detected by the human ear, but, in the future, they will be detected using acoustic sensor systems. The system saves the sound from the device and compares it with the sound profile of a device operating normally," Laitinen says.

In terms of detecting faults due to the explosion of a device, the solution seeks to forecast faults in many ways, including by using sensors

to measure electrical discharges from devices. However, identifying the correct types of sensors and measurement methods is just one aspect of the development work.

"We have improved our methods for data transfer and mining data about the conditions of devices from the mass of data received from substations. In addition, real-time data must be presented to end-users in such a way that they can make the right decisions," Laitinen says.

For certain device categories, the aim is to switch from time-based periodic maintenance to a state when technicians mainly visit substations because a deviation is detected by the automatic monitoring systems.

DIGITAL MONITORING TO BECOME COMPREHENSIVE BY 2025

The first phase in the development of digital monitoring systems was successfully concluded last spring. According to Laitinen, the monitoring system now works as an entity.

"The project is proceeding in phases, and the next thing to do is deploy the systems we have already developed into substations, alongside continuous development. The savings arising from the changes in the maintenance models for certain device categories will cover the costs of updating the monitoring solutions in forthcoming stations."

The aim is to have digital monitoring solutions in use in the majority of Fingrid's substations by 2025. This means tens of thousands of sensors and huge volumes of data will need to be managed.

"We are facing a major change, both on a sectoral level and on an international level. The change will improve the efficiency of maintenance, as well as the availability and reliability of the network. The goal is for us to continuously receive data from all substations on the functionality of devices. This will allow us to learn more about the devices, and thereby ensure the reliability of the network." •

The number of endangered species is increasing, overconsumption remains the trend

The time for climate action is now

In September, Fingrid arranged a climate-themed week for its personnel. Elina Hiltunen, Futurist, and Riku Lumiario, Biodiversity Expert, visited to talk about climate change as a trend, the loss of biodiversity, and what climate action will be required to mitigate and halt the change.

TEXT | IDA IJÄS

PHOTOS | ROOPE PERMANTO, ELINA HILTUNEN, RIKU LUMIARIO



During the climate week, the personnel took part in workshops where they received information about waste sorting and had the opportunity to try converting waste newspaper into a biowaste bag.



Miksi on tärkeää lajitella ja kierrättää?

- Melkein kaikki jäte voidaan uusiokäyttää, kierrättää tai hyödyntää muulla tavalla
- Kierrätys on jätelain etusijajärjestyksen mukaista
- Kierrättäminen säästää luonnonvaroja
- Kierrättämällä säästää jätehuollon kustannuksissa
- Kierrättäminen on osa ympäristövastuullisuutta
- Kierrättäminen on kiertotalouden edellytys
- Tässä lajitteluoheemme sinulle itsenäisesti tutustuttavaksi – ole



By arranging the climate-themed week, Fingrid aimed to raise awareness among its personnel of climate issues and encourage everyone to reduce their climate impact in their private lives as well as at work.

During the week, climate specialists gave speeches at Fingrid's office in Käpylä and via Teams. Workshops were held to practice things like waste sorting under the guidance of Remeo.

IS IT POSSIBLE TO DO GOOD BUSINESS WHILE SAVING THE WORLD?

Futurist and Non-fiction Author **Elina Hiltunen** took a strong stand in favour of climate action.

"Climate change and the pollution of the environment are visible megatrends that will have a powerful effect on the future. However, the future is not set in stone. By anticipating the risks of climate change, we can influence the realisation of these trends," Hiltunen emphasises.

Hiltunen also highlighted the impact of the coronavirus on climate change. The pandemic is expected to reduce global carbon dioxide emissions by approximately 2,000 million tonnes, but even that is not enough. In order to limit global warming to 1.5 degrees as proposed by the IPCC, emissions will need to be cut by 2,800 million tonnes per year.

The third global megatrend – the increase in consumption – will also have a major impact on the climate.

"The coronavirus pushed back the Earth Overshoot Day to 22 August, in practice delaying it by just a few weeks. If everyone consumed as much as Finnish people, we would need four times of our planets' renewable resources created in a year to cover one year's consumption."

In particular, Hiltunen encourages companies to take action for the good of the environment.

"The question is: how can organisations do good business while also saving the world? One principle could be a commitment to the UN Sustainable Development Goals and aligning the business with the realisation of the Goals," Hiltunen proposes.

WHEN THE CLIMATE CHANGES, SO DO SPECIES

Biodiversity and Communications Expert **Riku Lumiaro** says that climate change is causing a significant decrease in biodiversity.

"Climate change is advancing so rapidly that neither nature nor humans can keep up. The eutrophication of the soil and the disappearance of traditional habitats is also affecting species and increasing the number of endangered species. This trend can be observed in Finland and elsewhere in the world," Lumiaro says.

According to an assessment of the threats facing Finland's species, which was published last year, one in every nine of the 22,500 assessed species is endangered. Similarly, every second biotope in Finland is endangered, as are all of the traditional habitats. In addition to the damage wrought by climate change, traditional habitats are threatened by field clearing and especially by overgrowth and eutrophication, as well as construction in some areas. In particular, old forests are rapidly disappearing in southern Finland. The total number of extinct species in Finland is 312, and the majority of these species lived in traditional habitats. Following the 2019 publication of the report, there have now been five reports on endangered species.

"In the 2019 Red List, the yellow-breasted bunting was classified as extinct in Finland. In terms of mammals, we have lost the European mink, garden dormouse and harbour porpoise. Some mosses, lichens, birds and hymenoptera are currently critically endangered. On the other hand, global warming is bringing new species to Finland from Central and Southern Europe, and these are displacing existing species, particularly those that live in harsher conditions," Lumiaro says.

For example, many species of butterfly have moved further north in Finland due to the presence of new species in the south. Among other species, global warming has led to the introduction of new bat and frog species into Finland, as the raccoon may spread from Germany to Finland as an invasive species within 20–30 years. The gold common jackal has already made its own way to Finland, having first been observed here in winter 2018.



"The coronavirus pushed back Earth Overshoot Day in August by just a few weeks.

Elina Hiltunen, Futurist and Non-fiction Author

"Put simply, climate change is altering species, and this is not unequivocally good or bad. It is difficult to forecast changes in species and their habitats, but it is clear that major changes are on the horizon in the coming decades."

Lumiaro also calls for environmental action to mitigate climate change.

"From the perspective of companies, the most important climate action would be to strive for and achieve carbon-neutrality. Just one per cent of the world's companies are taking positive action in terms of biodiversity and climate change, and Fingrid is among them. There is no quick fix for climate change – it requires everyone to be involved." •



"The disappearance of traditional habitats is increasing the number of endangered species.

Riku Lumiaro, Biodiversity and Communications Expert

Survey: customers are happy to recommend **Fingrid**

■ Fingrid's customer satisfaction surveys show that customers are highly satisfied with our operations. The net promoter score is significantly higher than last year's figure. The proportion of promoters has risen by 9 percentage points to 51 per cent. The proportion of detractors has remained stable at 6 per cent.

Customers' confidence in Fingrid has remained strong, and customers consider the fact that Fingrid operates in the interests of society to be a particular strength. We restructured our services last year based on the results of previous satisfaction surveys. Satisfaction with main grid services and electricity market services was good.

In the open-ended feedback, particular praise was afforded to the service attitude and



professionalism of people working in customer-facing roles. Fingrid was also praised for its cooperation in network planning, as well as for the My Fingrid service. The open-ended feedback indicated that areas for improvement include

better coordination of outages occurring for Fingrid's own needs and collaboration between Fingrid and the system suppliers of its customers in relation to Datahub.

The energy sector is undergoing a fundamental transformation, and we hope that our customers will continue to recommend us in the future. We will take the feedback on board when we develop our services, and we will engage in

more detailed discussions with our customers in this regard.

A total of 218 people responded to the survey. •

Reputation matters, and we can influence it

■ In 2018, Fingrid was named the world's best transmission system operator in CHARGE, a brand competition for the energy sector. This year, Fingrid was invited to host a CHARGE webinar on the theme, "Should a monopoly be interested in its brand?"

"Yes, it should," said **Riku Huttunen**, Director-General of the Energy Department at the Ministry of Economic Affairs and Employment, **Simo Nurmi**, Director General of the Energy Authority, and **Simon-Erik Ollus**, Vice President at Forum, together with **Jukka Ruusunen**, Fingrid's President & CEO and **Fridrik Larsen** from CHARGE.

The word "brand" is easily perceived as an unfamiliar construct, something that companies try to build through various advertising and marketing methods. At Fingrid, the brand is defined as the combination of reputation and image in which the reputation is particularly important for describing how company interacts with its stakeholders.

Read the entire article in Fingrid's online magazine www.fingridlehti.fi/en/ or watch a recording of the webinar on **Fingrid's YouTube channel**. •



PHOTO | FINGRID

At the webinar, the relationship between monopolies and brands was discussed by Simo Nurmi from the Energy Authority, Riku Huttunen from the Ministry of Economic Affairs and Employment, Simon-Erik Ollus from Fortum and Jukka Ruusunen from Fingrid.

Fingrid selects a new route for the Huittinen–Forssa transmission line

■ Fingrid is planning a new transmission line between Huittinen and Forssa. In the vicinity of the Huittinen substation, an eastern transmission line route has been selected for further planning, as well as a southwestern route at Minkiö in Jokioinen. The information obtained from environmental impact assessments was used for decision-making.

The transmission line will be approximately 69 kilometres long and will run through the areas of Huittinen, Loimaa, Humppila, Jokioinen and Forssa. The project utilises the rights-of-way of the area's existing main grid transmission lines. Most of the new 400+110-kilovolt transmission line is being planned for construction to the north of the existing transmission lines, and the old 110-kilovolt Kolsi–Forssa transmission line will be demolished. In order to mitigate the impact, several sections of the old transmission line will be moved from their own rights-of-way to the new double-circuit tower structure.

A new transmission line connection is needed between Huittinen and Forssa in order to increase the electricity transmission capacity and maintain system security between the west and south coasts of Finland. The transmission line connection will significantly improve energy efficiency.

The Southwest Finland Centre for Economic Development, Transport and the Environment has stated that the construction of the transmission line is environmentally acceptable. The impacts of the new transmission line on people and the environment, as well as the possibility of mitigating the negative impacts, were investigated as part of the environmental impact assessment (EIA). •

New learning environment in Tampere Practising transmission grid work like in a real substation



Timo Juntunen and Pasi Lajunen from TAKK, Timo Heiskanen from Fingrid, and Jaana Harju from TAKK.

■ The new 110-kilovolt Substation and Transmission Line learning environment at the Tampere Adult Education Centre (TAKK) was opened in September. The environment will enable more skilled transmission grid technicians to be trained in Finland.

The new learning environment, and the surrounding electric field in its entirety, enable learners to practise building and maintaining the transmission grid in a genuine and safe environment. The learning environment is the only one of its kind in Finland, and it is used nationwide.

TAKK's Educator **Jaana Harju** says that area has enabled the introduction of new supplementary training courses. The Substation Fault Detection training course and the Electrical First Aid and Tower Descent training course can strengthen the expertise of professionals already working in the sector.

"Fingrid has provided the project with technical support and funding. We are working with other distribution system operators and contractors to determine what the environment should be like. The electric field also contains some of our decommissioned devices," says **Timo Heiskanen**, Fingrid's Manager of Substation Maintenance. •

The Nordic Balancing Model reference group will begin operating

■ Fingrid is setting up a reference group for the Nordic Balancing Model. The project is a common project throughout the Nordic countries, but the group convened by Fingrid consists of Finnish market participants, and it will focus on the implementation of the project from a Finnish perspective. The group is tasked with identifying the impact of the Nordic Balancing Model on the sector, seeking solutions to support the implementation of the project, and acting as a communication channel with others in the sector.

For the last two years, Fingrid has been assisted on the 15-minute imbalance settlement project by a reference group. The key issues relating to the 15-minute imbalance settlement period have been successfully addressed, and the common viewpoints of the sector have been identified. The new group will discuss the changes that the entire Nordic Balancing Model will introduce to the electricity market, one of which is imbalance settlement with a 15-minute trading period.

The reference group is due to meet for the first time in November. The group will meet about four times per year, and the meeting material will be published on Fingrid's website. The Nordic Balancing Model also includes a reference group representing the sector in all of the Nordic countries. This group's meeting materials and the other project details are available at:

<https://nordicbalancingmodel.net/> •

Predicting the future for a living

Marko Nieminen works as Senior Expert in the Strategic Grid Planning unit. He and his team try to predict what the world and electricity markets will look like decades from now.

TEXT | IDA IJÄS

PHOTO | NIKO JEKKONEN



WHAT IS GOING ON AT WORK AT THE MOMENT?

All sorts of things! One tangible project that we have been working on a lot over the last year is the third cross-border connection to Sweden. We have worked with Svenska kraftnät to plan the construction project and prepare the necessary documents for the authorities.

Over the longer term, the vision for a climate-neutral power system has been keeping us busy. We are working on market modelling. In other words, we are trying to forecast how the electricity market will behave in the future and what this will mean from Fingrid's perspective. We are analysing what the future could hold for us 15 or 25 years from now and what kind of main grid we will need to have in such a world. Some development requirements arise in all of the scenarios, and these are the ones we should begin working on as quickly as possible. For

example, planning and building a transmission line can take five to ten years, so it is important to get started in good time.

HOW DID YOU END UP IN YOUR CURRENT ROLE?

By the time I graduated from the Lappeenranta University of Technology with an engineering degree in the early 1990s, I had already worked for a few summers at Imatran Voima, an electricity generation company. After I completed my thesis, I stayed on to work at IVO, which is now known as Fortum, and I remained there for almost 25 years. When this position opened up at Fingrid, I was wracked with uncertainty about whether to apply. I enjoyed my previous job, but I was also thinking about the kind of work I wanted to do until I reach retirement. I have been at Fingrid for over five years now, and I am glad I applied for the job. My work motivates me in a different way, and I get to do something I find interesting.

WHAT IS GOOD ABOUT YOUR WORK OR THE ENERGY SECTOR IN GENERAL?

Fingrid offers the unique advantage of being able to work in collaboration with other companies. We are able to – and actually, we really should – work with other Nordic and European network operators. This provides an opportunity to consider how to address things together. At the same time, I also get to know international colleagues and receive support from outside Fingrid.

Collaboration is also highly visible within my unit. I have nice colleagues, and we have a good team with a diversity of expertise.

WHAT TYPES OF CHALLENGES COULD YOU FACE IN YOUR WORK IN THE FUTURE?

The climate-neutral power system poses the greatest challenges. It will require more wind and solar power, which fluctuates depending on the weather. At the same time, electricity consump-

Main grid service fees remain unchanged

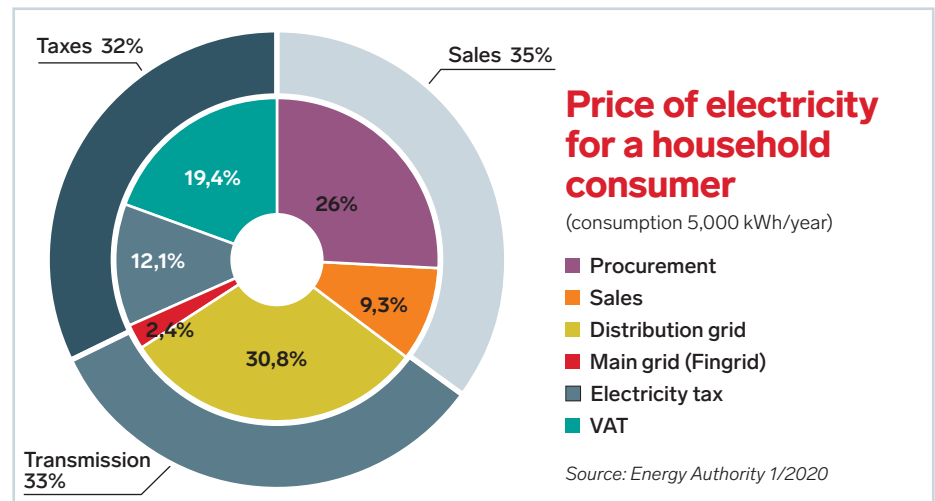
■ Main grid service fees will remain unchanged in 2021. By operating cost-efficiently, we have succeeded in keeping prices low, although the revolution in the power system has significantly increased the need for investments in the main grid. Fingrid has been able to reduce its fees by more than 10 per cent since 2017.

“Fingrid aims to keep price changes moderate in the future with the help of a well-timed, correctly measured investment programme, good management of cash flow and risk, and investments in projects to enhance efficiency. The regulatory model calls for rates of return to decrease year by year, and this is also keeping prices in check,” says CFO

Jan Montell.

“I am highly satisfied that we are able to keep our grid service fees unchanged during these challenging times. While the consumption of electricity is decreasing due to the mild winter and the coronavirus pandemic, we are investing at a rapid pace to address the growing needs of the future,” says **Jussi Jyrinsalo**, Senior Vice President in charge of customer relationships and grid planning.

Despite the cost-efficiency measures, the electricity transmission reliability rate is excellent. The main grid and cross-border transmission connections to Finland’s neighbouring countries operate reliably. •



tion will increase as industry transitions from fossil fuels to green electricity.

When energy generation is more weather-dependent, consumption will need to be much more flexible. Not only will it be challenging to develop the power system of the future, but we must also think about the means and tools we need to model it so that we will also be able to propose the best power grid solutions in the future.

WHAT IS A LESSER-KNOWN FACT ABOUT YOU?

I enjoy reading historical memoirs, and I watch documentaries about various historical events. Historical fiction is also enjoyable, if it is based on facts. I am particularly keen on **Jaan Kross**, an Estonian author whose works of fiction are a good introduction to Estonian history. Kross’ books have helped me to see Tallinn in a new light. •

More news

Now you can also find Fingrid’s magazine online at fingridlehti.fi/en

www.fingrid.fi/en
www.fingrid.fi

Every observation is an opportunity

Positive observations also help us to improve occupational safety.

Safety does not come ready-made; it requires us all to make a contribution. Fingrid will arrange a safety observation campaign for service providers and Fingrid personnel from 1 October to 29 November 2020.

Safety observations and reports of near misses can be submitted on the website and using an app. www.fingrid.fi/havainto



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