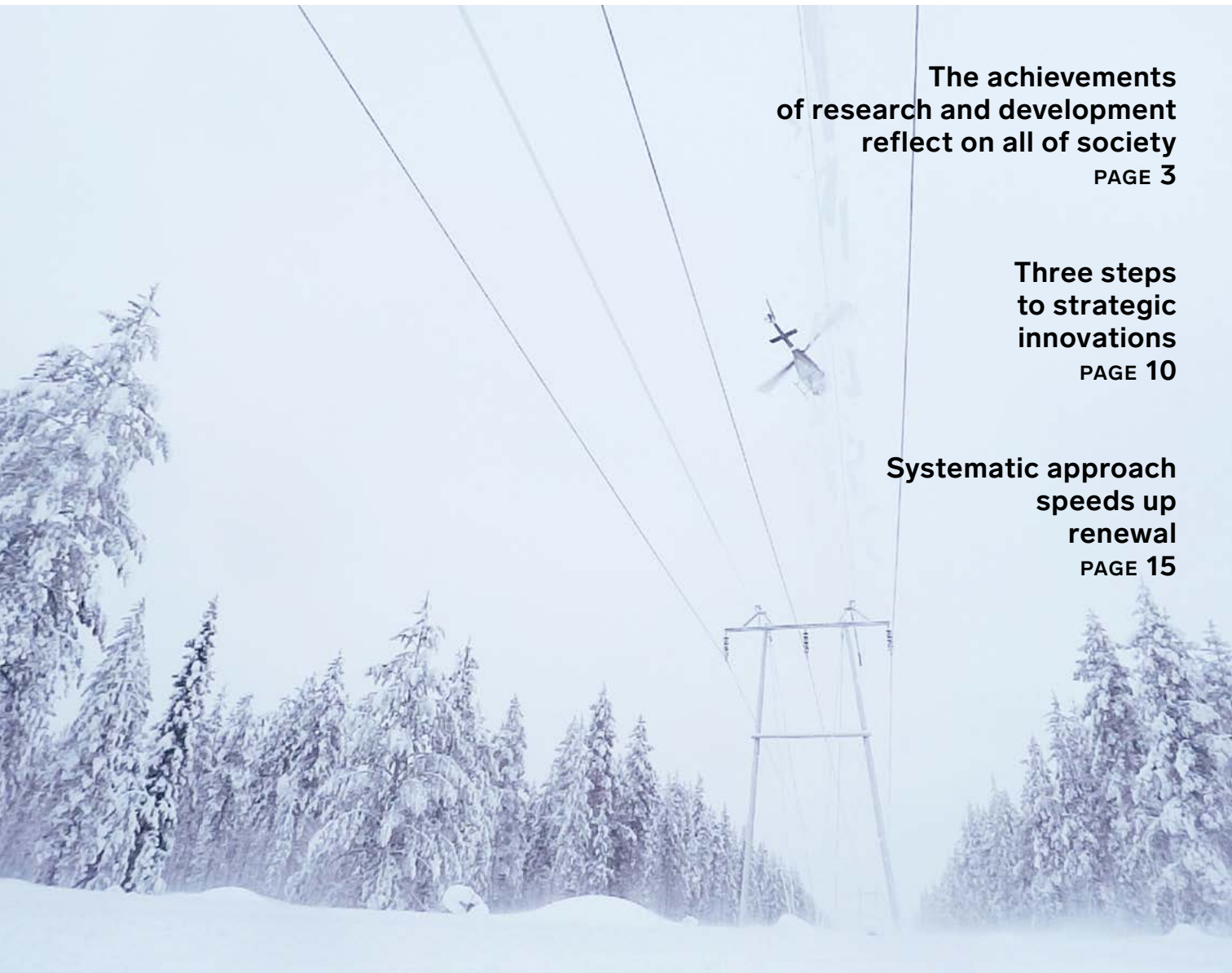
FINGRID

R&D and innovations

2016 • SPECIAL PUBLICATION FOR FINGRID'S RESEARCH, DEVELOPMENT AND INNOVATION ACTIVITIES.



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Fingrid's archive

This is a special publication for Fingrid's research, development and innovation activities. It gives an insight into the past and future RDI operations of the transmission system operator celebrating its 20-year journey this year.

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COVER PHOTOGRAPH: Fingrid's innovations in the 2010s include the removal of hoar frost from overhead ground wires by hanging a 400 kV composite insulator from a helicopter flying along the wire. Jarmo Lahtoniemi came up with the idea. (Fingrid's archive)

FINGRID
R&D and innovations

It takes new ideas to bring about change

We will be involved in one of the biggest changes ever seen in industrial history when the electricity system becomes carbon dioxide-free in the upcoming decades. This will speed up the search for new ideas and operating methods. We need everything from small, everyday changes to breakthrough solutions – and everything in between.

This won't take place at the drop of a hat but something will happen every day. At Fingrid, our role is to explain how the change will affect the electricity power system. Ultimately, we are responsible for balancing production and consumption – and ensuring that households and industry also get electricity when preparing for CO_2-free society.

This story doesn't have only one hero and the change will require an increasing amount of cooperation with other actors in the industry, authorities and politicians – also with those outside Finland. This also represents an opportunity for bold companies that create their own business by working with us.

Fingrid has a solid culture of "better safe than sorry". However, we also have to be aware that, although there are certain areas in which we cannot take risks, sometimes we have to be bolder in terms of experimenting and even prepared to fail on occasion.

These are issues that are being simultaneously dealt with in every corner of the world. We can use the copy-paste approach to get the best practices from Central Europe, which already has a huge amount of renewable energy. We can also learn from other industries.

Such a massive responsibility also involves uncertainty. On the other hand, engineers are at their happiest when developing something new! This spirit can also be seen at Fingrid: we are doing meaningful work.

Jukka Ruusunen,
President and CEO
Fingrid

Risto Jutila

BIG INNOVATIONS
and small improvements

Fingrid's R&D activities have always been driven by the needs of society. Along the way, we have harnessed countless new technologies and methods – and achieved things that reflect on all of society.

»»

Tuomas Mikkonen

Electricity transmission needs can be estimated up to 20 years into the future.

A drastic change rocked the electricity market at the beginning of the millennium. The Nordic markets were opened for competition and integration of the electricity markets meant that transmission system operators also had to adapt to growing uncertainty. New tools had to be rapidly implemented in order to model the market and survey electricity transmission needs in the future.

Various projects have enhanced understanding of the Nordic power system. A variety of scenarios have also been tested by means of simulation.

Climate change has had an impact on Fingrid during the 2000s. This can be seen in efforts to promote the use of renewable energy sources and in the work to reduce greenhouse gas emissions by, for example, focusing on developing gases that are less harmful to the atmosphere.

On the Nordic level, a lot of thought is being put into determining how to maintain power balance in a system where the use of wind and solar power continuously increases while traditional power plants capable of power regulation are simultaneously being phased out.

SIMULATION TOOLS HELP WITH FORECASTING

New simulation tools were implemented in the 2000s. For example, they enable estimating electricity transmission needs up to 20 years into the future and seeing in advance where it is the most profitable to produce electricity at different hours.

The Nordic countries are clearly ahead of the rest of Europe in terms of developing such tools. When the development of simulation tools for market-based grid planning began around 10 years ago in Central Europe, the Nordic countries were able to offer tested solutions for this purpose.

Along with functional tools, forecasting has required process development. Combining grid planning and maintenance of the existing grid into a single process has increased the efficiency of grid construction.

INCREASED TRANSMISSION CAPACITY

Over the years, one focus of Fingrid's R&D has been finding new cost-effective ways to increase the grid's transmission capacity. As a result, the requirements of growing transmission needs have been met faster than they could have by building new lines. A particular target of investments has been developing transmission capacity between Finland and Sweden, an area in which we have seen an increase of approximately 50%.

In practice, transmission capacity was increased by implementing power plant controls and improving the grid's operational performance during disturbances.

Real-time information obtained from the power system plays a key role in maximising transmission capacity. One milestone was the phasor measurement unit (PMU), which enables monitoring the grid's response to disturbances nearly in real-time. Among other things, Fingrid has studied the damping of power oscillations in multi-year projects, which also involved exchanging measurement data with transmission system operators in Sweden, Norway and Denmark.

MAINTENANCE DEVELOPMENT HAS IMPROVED SYSTEM SECURITY

Research and development have improved our understanding of the power system, increased grid reliability and allowed us to further optimise maintenance. Individual projects, one by one, provided solutions to reduce the possibility of disturbances.

Fingrid started using a real-time condition monitoring system that proved its worth right from the start. "The system helped us to detect a few faults in power transformers at a very early stage. Early detection allowed us to react quickly to the situations and, for example, prepare for either changing the transformer or make repairs," says Specialist **Kimmo Nepola**, who runs the Maintenance Management 2020 project.

Continuous monitoring of transformers also makes sense because transformers are the most expensive individual grid components, their delivery times are long, and faults have major impacts. Saving even a single transformer covers the costs of monitoring.

The Maintenance Management 2020 project belongs to Fingrid's R&D focus areas. Over a three-year period, it will cover seven areas, each of which includes several projects. The target is to move from the currently used time-based maintenance towards condition- and risk-based maintenance. In other words, maintenance will be targeted according to the actual condition and importance of equipment.

Although new phenomena such as *data mining*, *smart grid*, *big data* or *Internet of Things* may be over-hyped, they represent incredible opportunities for main grid maintenance management. In the future, for example, grid components may describe their own condition to the system, where the data will be analysed and used to forecast and make decisions about possible

Vesa Tyni / Otavamedia

A discussion paper addresses the concerns in electricity markets

How can we promote general discussion about the problems of the electricity market? Fingrid decided to try a new method: a discussion paper, which would also take a bold stand on energy policy.

'The Electricity market needs fixing – What can we do?', a discussion paper, produced in teamwork with broad input from our staff, presents Fingrid's concrete proposals for restoring the viability of the electricity market. The paper attracted a lot of interest in the industry and public discussion continues, for example, via consultation related to the proposed actions.

Timo Heiskanen

A measurement method helped in raising the limit values

The electricity transmission grid produces an electromagnetic field for which the EU specifies exposure limits. The 2004 directive set the maximum limits for employee exposure as external electricity field values because there was no way to measure the body's internal current density. In practice, the limit values were so low that meeting them would not be possible without replacing existing electricity networks in Finland with new grids.

Fingrid, Fortum and the Technical University of Tampere developed a measurement method, which was able to prove that the limit values were too low in relation to the actual current density. The body's internal current density was calculated by covering a helmet with a metal coating to which the current was induced.

The 2016 directive has higher limit values and Fingrid is able to meet them without difficulty.

maintenance actions.

IMPROVING EFFICIENCY AND PROTECTING THE ENVIRONMENT

Research and development also enabled improving the efficiency of Fingrid's internal activities. Finding better ways to operate can often be traced back to a single observation or question. However, it can be difficult to identify the actual moment that an innovation occurs. Great ideas can come up during a chat in the corridor or in a meeting and they may be considered and refined for a long time before becoming an R&D project.

One of the biggest administrative changes at Fingrid involved harmonising the management models and switching into a matrix organisation, which streamlined activities in many ways. The idea of implementing strategy right down to the individual level in the form of 'My Strategy' development discussions can be considered an innovation in itself.

An innovation by the customers involved deciding to phase out the 'one-door' principle, a change that led to more in-depth customer contacts and mutual learning.

Fingrid's R&D projects have so far provided a great variety of results. Often the projects aimed at getting a broader perspective into technical innovations. Landscape towers, for example, were a unique innovation that utilised the expertise of top industrial designer **Antti Nurmesniemi**.

Many projects originated from environmental impact assessments. Some projects aimed at determining how to secure the routes of flying squirrels when the width of transmission line corridors increases. On the other hand, an idea for an R&D project might also come from a local insect association, which detected an endangered species in a transmission line right-of-way.

With real-time condition monitoring, SF6 gas leaks can be minimised. As an example, the system detected several microscopic SF6 gas leaks, the cause of which turned out to be a type fault in a manufacturer's circuit breakers. The problems were corrected during the warranty period in an environmentally friendly and cost-effective manner.

BENEFITS FOR THE ENTIRE ECONOMY

When trying to estimate the benefits of R&D in monetary terms, the numbers increase very rapidly. For instance, increasing the transmission capacity has produced millions of euros in savings for the entire economy. Along with more reasonably priced electricity, these actions enabled postponing grid investments of the same scale – for many years into the future.

The costs of grid maintenance have reduced without decreasing system security. To a certain extent, this is also risk management. Even when the probability of a disturbance is very small, its prevention is worth investing in if the harmful effects of electricity outages on society are avoided. At the transmission grid level, electricity outages can cost hundreds of millions of euros.

Innovations often produce benefits that last for decades. For example, one of the biggest innovations at Fingrid involved switching to a purchaser-provider model , a move that has cut grid investment costs by an estimated 30%. In practice, this means 100–200 million euros per year. As a result, the competitiveness of many other Finnish companies improved to such an extent that they now have more opportunities in markets outside Finland.

The importance of innovations can be assessed in terms of euros and by means of qualitative indicators. For example, automation has reduced the number of errors and routine work while environment-related R&D has enhanced the public acceptability of Fingrid activities. Of course, in the end, qualitative factors are also below the bottom line.

INTEREST FOCUSES ON THE CONSUMER

In the future, Fingrid's R&D agenda includes projects related to increasing the

Fingrid's archive

Increasing arable area through tower design

Transmission line towers with guy wires are troublesome on the field, because around them an area cannot be cultivated. Another drawback of traditional towers is that working in their vicinity with large agricultural machines is both difficult and dangerous.

"At least once per summer someone collided with a tower so that the tower needed repairs and there were a lot of near misses," says Regional Manager ***Kari Lindholm****.*

Lindholm led an R&D project at Fingrid, which aimed at developing a special transmission line tower suitable for fields.

"The matter had been discussed with farmers every now and then from the 1970s but when it was again brought up a few years ago at an agricultural fair, we decided to have one more look at whether something could be done."

A diverse team, including designers, was convened for the project.

"Engineer-like thinking always goes in the same direction but the design company gave us many different solutions. We selected some and refined them," Lindholm says.

The hardest thing was not developing a tower that is ideal for farming, the difficult part was taking care that constructing the tower and its base would not be too difficult or the damages to farmers unreasonable, or the price astronomical. When it comes to construction, it was also essential that the tower can be built from elements, which can be transported.

After some wild visions, we ended up with a tower standing on four legs, under which there is plenty of space to drive even large machines. The design was such a success that the field tower won the Fennia Design Prize in 2012.

Hundreds of field towers have now been installed in Finland. Even though they are twice the price of traditional transmission line towers, the increase in costs for entire transmission lines is moderate, as field towers are only needed on fields. Most of all, the innovation has brought Fingrid benefits in terms of reputation.

"We can use the field towers as concrete proof that we genuinely try to minimise the harm caused by transmission lines to landowners," Lindholm says.

In the long term, the innovation can also bring cost savings because it can facilitate the permit processes for new transmission lines.

Fingrid's archive

Dealing with geomagnetic disturbances in a field experimenta

When the northern lights glow in the sky, a power grid expert may have reason to worry. The aurora oval, created by solar wind colliding with the atmosphere, can contain a direct current up to thousands of amperes. Elsewhere in the world, the phenomenon has broken transformers.

"Solar wind flows create a DC electrical field on the earth's surface and the direct current can cause a lot of harm in transformers. As a result of this phenomenon, for example in Quebec, a province-wide one-day long blackout occurred at the turn of the millennium," Professor ***Jarmo Elovaara*** *tells us.*

As an R&D project by Fingrid found out, there is no need to worry about the phenomenon in Finland. It wasn't possible to examine the effects of DC magnetisation on a 400 MVA transformer in a laboratory, so a field experiment was arranged; the experiment showed that there is no failure risk in the type of transformer used in Finland.

In the experiment, carried out at Toivila substation, the transformer remained healthy when a direct current of up to 200 A was fed into it. The explanation relates to the structure of the transformer and the adopted acceptance testing procedure. "Due to the soil, the neutral points of our transformers are equipped with current-limiting reactance coils, which limit the amount of direct current," Elovaara explains.

The Toivila field experiment has attracted considerable global attention and the results have been utilised in transformer development. An extensive scientific article on the experiment has also been published.*

*M. Lahtinen, J. Elovaara: "GIC occurrences and GIC test for 400 kV system transformer". IEEE Transactions on Power Delivery, Volume 17, No 2, 2002. Pages: 555–561.

Juuso Paloniemi

Improving material efficiency with a new operating method

When the Waste Act was renewed, Fingrid decided to change its established operating method and launch an investigation into waste utilisation and the related material and financial flows. Now, instead of several contractors and service providers, all waste created on Fingrid's worksites – from southern Inkoo to northern Utsjoki – is managed by one party, which also cooperates with Fingrid in materials efficiency development.

The end of the main grid's life cycle is now under control and waste can be monitored both in tons and euros. Thanks to precious metals contained in demolition waste, Fingrid earns more from its waste than it pays for waste management services.

production of renewable energy, improving the reliability of cross-border transmission connections, and projects related to smart grid solutions. One of the major joint challenges in the power industry involves slowing down climate change, where the key to the solution lies in demand response. If we want to fully exploit renewable energy, the only alternative is to increase power system flexibility and build a smart grid, where it is possible to, for example, quickly control loads.

In terms of future solutions, Finland is a great opportunity because our consumers can already select their electricity supplier and purchase hourly-priced electricity – and nearly every electricity accounting point has a remotely readable meter. Many of Fingrid's ongoing R&D projects are also related to the end customer, who will play an active role in maintaining the power balance.

"We have to find solutions within ten years because the power system is already showing the signs of strain. All the while, the share of variable production increases, which calls for a functional system arising from many small innovations," says Senior Vice President **Jussi Jyrinsalo**.

This system will probably be supplemented by electricity storage, which could represent a solution to the challenges associated with the different timing between demand and renewable energy production.

IS AN ELECTRICITY DATAHUB JUST THE BEGINNING?

The Datahub retail market information exchange service currently being implemented serves to activate consumers. The construction of open interfaces to third parties is also planned and this will accelerate the development of new innovations and services for the market.

Alongside Datahub, a real-time smart grid or "Control hub", is also planned, which would enable managing the system and its decentralised production resources.

"If successful, this will be a huge innovation. We do know that the new energy world will be based on IT platforms, which collect data from many different sources and the system will be controlled according to the situation. This will be harder to manage than the existing system but we do not have any other choice," says Senior Advisor **Risto Lindroos**.

Lindroos believes that the Datahub, now under construction, is only the beginning because in the future similar hubs may be built for several different areas (such as water data or district heating networks). An incredible amount of synergy could then be gained by combining the data from these hubs with other data.

In general, the importance of data will increase in the future and it will be utilised to support decision-making. The Elvis data system, which was one of Fingrid's largest development projects in the 2000s, will also play a key role. It may provide data for very different types of applications and targets in the years to come.

Fingrid's R&D focuses for 2016–2026

- *Developing electronic services for stakeholders*
- *Needs and profitability analyses for grid investments*
- *The environmental perspective (incl. reducing the harmful effects of land use)*
- *Maintenance management*
- *Real-time management of transmission capacity and system security*
- *Preparing for exceptional and extreme situations*
- *Promoting market-based consumption flexibility*
- *Developing an information exchange environment*

Profitability for electricity storage from multi-functional use

Katri Tamminen

In the Kalasatama district of Helsinki, just beside a residential area, the largest electricity storage in the Nordic countries has been constructed. The battery storage, connected to the Suvilahti solar power plant and currently in test use, has a rated power of 1.2 megawatts.

The pilot project was launched about five years ago when Fingrid, Helen, Helen Sähköverkko and ABB together examined the prospects of smart electricity grids. Even though batteries are still too expensive for commercial use, storing electricity was seen as such an essential part of the future electricity markets that the companies decided to try it.

*"We discussed it for quite a long time, considering what we wanted to do with the device because the price was determined based on its features," says Vice President **Markku Hyvärinen** from Helen Sähköverkko Oy.*

The electricity storage acts as a buffer, which can balance electricity production and consumption peaks. If the storage is charged when electricity is cheap and, correspondingly, discharged when the price is high, the storage can be used in the future to make profits, in theory at least.

"The fundamental aim of the pilot is to examine multi-functional use, that is, whether the electricity storage can be simultaneously used for several purposes – and thus increase the profitability of the storage," explains Hyvärinen.

Fingrid will utilise the Kalasatama electricity storage for frequency regulation while distribution network companies are interested, for example, in reactive power production.

During the three-year research period, the aim is to develop regulation and control technologies as well as new business models, for example.

"We may well discover business opportunities here if some sort of progress takes place in battery technology. As a distribution network company alone, it wouldn't be profitable for us at the moment to get involved in something like this, nor do the current regulations applied to grid companies allow it," Hyvärinen says.

The significance of electricity storage may grow in the future as conventional power plants are increasingly replaced by renewable energy production, which isn't flexible in relation to variations in the demand for electricity. In addition to flexibility, storages offer a reserve needed for grid failures.

Fingrid's archive

Demand response taken forward by a pilot project

Can consumers and businesses be encouraged to schedule their electricity consumption so that society could manage with a smaller electricity production capacity? In the past few years, Fingrid has participated in five pilot projects, where demand response was tested in practice together with different stakeholders.

With the SEAM Group, for example, a project examined whether cold storages could serve as a part of the frequency-controlled normal operation reserve. In Prisma stores, on the other hand, electricity consumption control automation was tested for controlling systems like ventilation, outdoor lighting and thermal heat pumps.

In all demand response projects, the idea has been to regulate consumption with control automation while ensuring that the disadvantages caused to users by controlling loads is minimal – or it may even benefit them. Even though experiences have been promising and the projects have even resulted in commercial applications, things have not always gone according to plan. For example, the project with Digita and Enegia found that back-up generators alone cannot serve as frequency-controlled disturbance reserves since they cannot be started up quickly enough.

*"An important point in pilot projects was to show that we are serious about demand response and want to see what the possibilities are. The issue has been in the spotlight recently; even projects that we are not involved in have been launched," says Development Manager **Jonne Jäppinen**.*

Demand response has enormous significance for the entire national economy. It reduces the need to construct new power plants and helps to mitigate climate change.

DISCOVERING

strategic innovations

Influential innovations can be achieved in three steps. However, the first thing that needs to be done is to overcome resistance.

The innovation process has to allow for coincidence, or serendipity, because innovating involves finding things that you never even knew you were looking for. According to **Liisa Välikangas**, Professor of Innovation Management at Aalto University, coincidence has to be accompanied by systematic work so that people actually notice the coincidences when they occur.

Välikangas says that influential strategic innovations can be systematically achieved through three steps. The first, so-called cognitive step involves feeding the innovation process by consciously searching for challenges and sources of inspiration in the world. This means also examining things that do not seem relevant as otherwise there is a risk of always travelling the same paths. Välikangas encourages people to search for 'WOW effects', which may be exciting but can also be frightening at the same time. "It is worth considering why something causes an emotional reaction and what such a very different thing could mean to us. Another company's experiment or new approach can be seen as a strategic lesson that leads you to think about how it could become something meaningful to yourself," says Välikangas.

At this point, the 'WOW effect' could even be a so-called block-chain technology that can change the world as much as the internet once did. "There is a lot of talk nowadays about self-driving cars but how about the idea of cars that own themselves? Although it may not immediately be clear how a block-chain technology will change electricity distribution, it provides important inspiration for innovations. This is a matter of trying to learn about things that have not yet happened. Once everyone already knows about something, we are probably too late," says Välikangas.

> *It is also important to develop things for yourself by doing, not just by learning from others.*

COMBINING EXPERIMENTS PROVIDES IMPACT

After prodding the imagination and looking for ideas, it is time to move onto the next step because an important part of innovation involves developing things yourself rather than simply learning from others.

In practice, this can mean small-scale experiments, which can be used for reducing risks, iterating ideas and obtaining information. "The experiments should be transparent, as it is also important for others to know what the company is doing. Combining different experiments can provide impact," explains Välikangas.

The third step in the innovation process is political: how to get enough competence and money behind promising ideas?

The breakthrough in open innovation means that it is now possible to start on a very small budget and there is no reason to rely merely on the expertise in your own organisation. In addition to cooperation, innovators can rely on services that put hundreds of thousands of professionals to work on problems that their own organisation cannot solve.

After completing these three steps, Välikangas says it is mostly a matter of how fast the innovation process moves forward. The duration of the cycle depends on the industry, so it is essential to compare it with the renewal pace of competitors. In a world where ideas travel in bytes through a network, innovation can be very fast indeed.

Eija Eskelinen

"Innovating involves finding things that you never even knew you were looking for. In order to notice coincidences, we need systematic work," explains Liisa Välikangas, Professor of Innovation Management.

THE THREE STEPS IN THE STRATEGIC INNOVATION PROCESS

1 **COGNITIVE**
Feeding innovations by studying the world and searching for "WOW effects", challenges, etc.

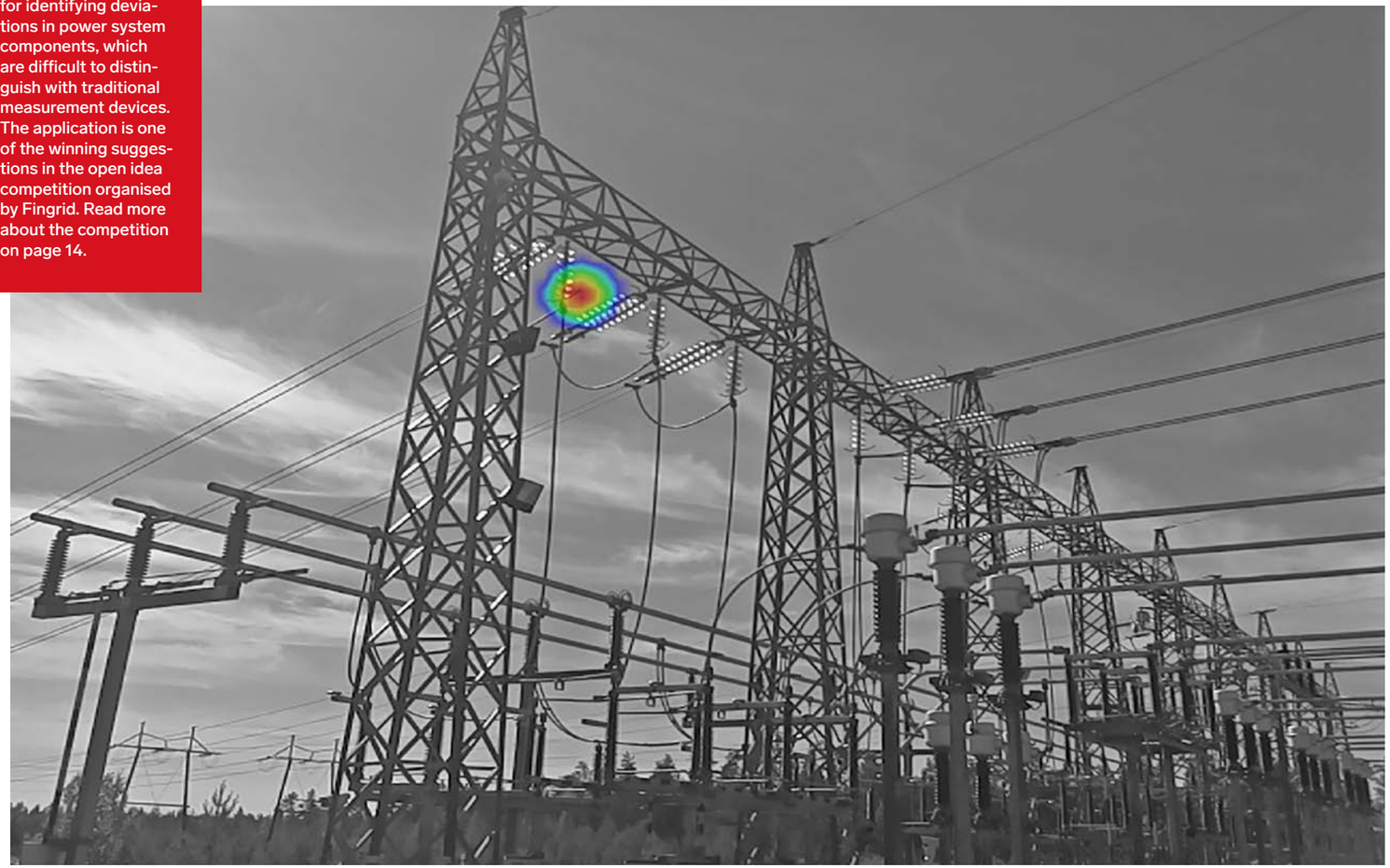
2 **STRATEGIC**
Developing innovations by means of, for example, experiments that can obtain information, iterate ideas and reduce risks.

3 **POLITICAL**
Ensuring that the most promising ideas have sufficient resources to be developed.

Source: Liisa Välikangas

Jonas Nyberg/ Noiseless Acoustics

The Noiseless Acoustics acoustic camera is used for identifying deviations in power system components, which are difficult to distinguish with traditional measurement devices. The application is one of the winning suggestions in the open idea competition organised by Fingrid. Read more about the competition on page 14.



Jonas Nyberg/ Noiseless Acoustics

At the forefront of change

Fingrid looks to the future and wants to be at the forefront of developing the industry.

At Fingrid, development is one element of normal work and a part of every employee's job description. That work may also result in, for example, a piece of software that streamlines an individual task.

The aim is for innovation activities and R&D to always be linked to the future challenges that have been identified. Systematic forecasting ensures that resources are channelled to strategically important projects.

Research and development focuses were set for the different activity areas of Fingrid. This provides the basis for building roadmaps that break the visions down into targets and concrete project ideas. The change in operating environment has been forecast for 25 years into the future.

This systematic approach has produced results. For example, Fingrid lay the foundation for digitalisation years ago while many other transmission system operators are only starting this work now.

From an idea to collaboration

Do you have a great idea? Do you need help implementing it? Send your idea to Fingrid's idea mailbox: idealaatikko@fingrid.fi.

NEW TOOLS – MORE EFFICIENCY

Fingrid has tested a variety of tools and methods in order to increase work efficiency. Examples include crowdsourcing, new meeting practices, idea contests, and mobile applications.

A virtual workshop has been tested as part of strategy work. This gave all Fingrid employees the opportunity to consider changes in the operating environment and the impacts these changes would have on the company. On average, each participant spent only 30 minutes of working time in the virtual workshop as opposed to at least half a day typically spent in a traditional workshop. More than 2,000 assessments were produced during a period of ten days, which would have been impossible using traditional methods.

Fingrid also wants to be involved in creating visions and strategies for the entire industry. One example was developing several scenarios for the future of the smart grid. It is clear that the industry should be developed in cooperation in the spirit of open innovation across organisational boundaries and sharing the best practices and innovations on a reciprocal basis as widely as possible.

BOLD STEPS MEAN PROGRESS

An innovative and healthy working community is written into the Fingrid strategy and the company has been actively developing its innovation culture in recent years. The aim is to create a development-oriented operating model that challenges the staff to reflect on ideas from the "What if" perspective.

At Fingrid, ideas are rarely discarded due to lack of encouragement. People are also aware that experiments and failures are an integral part of life. The earlier principle of "Doing it right the first time" was replaced by "Do not be afraid to make mistakes" thinking – when dealing with matters that do not affect people's health or safety. This has created more openness and lowered the threshold to taking risks, brainstorming and testing ideas at Fingrid.

In many cases, Fingrid still continues to innovate evolutionarily often through small improvements. However, space is gradually being found for radical innovation, which responds to the requirements of the future grid and power system.

LIMITED RESOURCES SLOW DEVELOPMENT

Good innovations can be achieved by simply giving experts the freedom to develop their own work. On the other hand, innovations also require time to be tried and played with. Unfortunately, simply throwing ideas around rarely results in anything.

It takes time and money to turn ideas into reality – and since resources are limited it is clear that not even the really good ideas can be implemented immediately. When implementing ideas, Fingrid often uses outside resources, such as students working on their theses, research institutions, or even startup companies which can develop new products or services for the market.

The European Network of Transmission System Operators for Electricity (ENTSO-E) has estimated that solving the problems of climate change will require investments of some thousand million euros in Europe alone over the next ten years.

WE NEED TO DEVELOP INDICATORS

In international comparisons, Fingrid does so well in many areas that it can be hard to find reference points for developing activities.

One solution could be indicators for R&D and innovation activities, which are needed to manage the activities and optimise using resources. Further pressure for developing indicators comes from the EU, which wants information about results achieved in the projects that it has funded.

Measuring innovation and development projects is not easy. Although we can count the number of ideas and projects, it is much more difficult to assess their impact. Another problem is that the impacts of R&D projects and major innovations are often only realised dozens of years later.

The real-time acoustic camera by Noiseless Acoustics is one of the winning suggestions in the open idea competition arranged by Fingrid. Its resolution begins at the frequency of around 200 Hz. In a substation environment, noise sources are mainly corona discharges related to electricity. In addition to typical disturbance sources, discharges may also appear in faulty components, for whose identification the measuring device offers possibilities.

Jonas Nyberg

New perspectives from open involvement

Open innovation provided good experiences when Fingrid encouraged external parties to participate in an idea campaign for developing transmission grid maintenance. The open idea competition sought ideas on issues such as data storage and mining, neural networks and more durable materials.

In the Innovation Garage Day, arranged in the spring of 2016, providers of the ten best ideas had the chance to pitch their ideas to the jury. Four winning ideas were selected, which will be further developed together. The winning ideas applied augmented reality, new measuring technology, acoustic cameras and data collection based on crowdsourcing to maintenance.

In the best case, the company that presented the idea may create new business for itself with demand also outside Finland.

Imagination leads to radical innovations

When creating something new, it is important to know how to abandon the old – even the things that work well. Rather than settling for small improvements, an innovation expert encourages people to question the present practices and aim for radical innovations.

"The question is not about developing the activities but being bold enough during the development process. Short-sighted development is certain to steer resources away from long-term innovations," says **Jarno Poskela** from Innotiimi.

Poskela, who was a sparring partner during the organisation and development of Fingrid's innovation activities, believes that it is important to find a balance between creative freedom and 'support mechanisms', such as tools for supporting brainstorming.

An imaginary situation can provide a path to something new: What else could be done with the competence at Fingrid if the current business, for one reason or another, came to an end?

Innotiimi-ICG

EFFICIENCY

and agile renewal

There is demand for innovativeness at Fingrid and elsewhere at the moment. Jussi Matilainen, the Chair of iTiimi, the team that coordinates Fingrid's research, development and innovation activities, encourages everybody to develop more radical ideas and to gaze further into the future.

PHOTOS JOHANNA KINNARI

Traditionally, the drivers for innovation in business are the pressure to succeed and maintaining the competitive edge. In a regulated operating environment, the situation is different.

"For us, the drivers of innovation are the cost-efficient tackling of challenges created by climate policies, as well as new possibilities provided by new technologies – and in part, entirely new business opportunities," says Technology Manager **Jussi Matilainen**.

According to Matilainen, R&D and innovation activities in practice comprise predicting changes and coming up with ideas as well as research and development. "Ideas can appear spontaneously or by facilitation, often as a solution to a certain problem or need for improvement. At times, innovations require a research project."

Anticipating changes in the operating environment is necessary so that investments can be targeted at themes with the greatest threats or opportunities. The best result is reached while bearing in mind the long-term objectives.

SYSTEMATIC APPROACH BRINGS PRODUCTIVITY

Fingrid has systematically developed its innovation culture since 2013 when the innovation team iTiimi was established to speed up innovation activities and to coordinate R&D. The operation was launched on a personnel day with a "myth-busting" event.

"One myth or impression that hampered renewal at Fingrid was that the responsibility for the reliability of the power system prevents the testing of new things – or that innovativeness in the electricity industry is somehow stiff," describes Matilainen.

At the same time, the company also launched the browser-based idea platform Orchidea.

Now, three years later, Fingrid per-

**In 2016, the members of iTiimi are Jukka Kantola, Airi Krook, Jussi Matilainen, Markku Piironen, Katariina Saarinen and Joona Säynevirta.*

A large share of new ideas does not come up on the actual idea platform."

sonnel's innovative ability is at a good level, which is evident from the number of ideas created each year. Idea challenges regularly deal with current issues observed in operations and arising from business challenges. Furthermore, the company organises guest lectures looking into the future and idea workshops that aim at coming up with new ideas and scenarios in the operating environment. Innovation together with stakeholders has also been increased.

THERE IS ALWAYS MORE TO DEVELOP

After the charm of novelty wore off, the pace of new ideas calmed down a little. On the other hand, a large share of new ideas at Fingrid does not come up on the actual idea platform.

"The main thing is to come up with new ideas, regardless of the place or method – and that the company has the resources to take the best ideas forward. Only the best ideas can be selected for further development but to maintain motivation, the rejection of an idea must also be carefully justified. Everybody should be aware of the funnel-like shape of the idea process, that is, quantity leading to quality," Matilainen says.

Most of the ideas are small improvements. According to Matilainen, the next step that Fingrid should take, however, is to find the means to dig out radical ideas.

"The need for larger innovations is apparent when you look at the speed at which the operating environment is changing. Radical ideas can be found, for example, by extending innovation activities outside Fingrid, which would give new perspectives on our challenges."

Predictions will have an even larger significance, and in Matilainen's opinion, Fingrid should also regularly look further into the future, from megatrends towards weaker signals. "That is for us the only way to have the time to react to changes, both positive and negative, for example with the help of R&D," he says.

Aim high. The systematic development of innovation culture at Fingrid has borne fruit in the past few years.

"We need new methods that speed us to radical innovations. There is an apparent need for them due to the speed of change in the operating environment," estimates Jussi Matilainen, the Chair of iTiimi.

NEW PATHS THROUGH COOPERATION

R&D and innovation can help reach business targets faster. The greatest challenge is to find sufficient resources to cover increasing R&D challenges.

One way is to increase cooperation with Finnish universities, research institutions and other industry actors, as well as with Nordic transmission system operators.

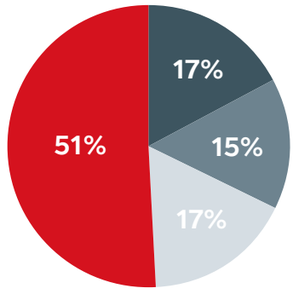
"To enable renewal, we mostly need a new kind of attitude towards ideas and innovations, the readiness for more open cooperation and the exchange of thoughts even across industry boundaries, as well as a brave, open and curious mind," Matilainen says and cites the famous author writing about the creation of innovations, Steven Johnson:

"Go for a walk; cultivate hunches; write everything down, but keep folders messy; embrace serendipity, make generative mistakes; take on multiple hobbies; frequent coffeehouses and other liquid networks; follow the links; let others build on your ideas; borrow, recycle; reinvent."

The greatest challenge is to find sufficient resources to cover increasing R&D needs."

Investments

Breakdown of R&D costs at Fingrid in 2016*



- Adequacy of transmission system
- System operation
- Promotion of market functioning
- Other (e.g. ICT)

*Cost prediction 06/2016

Around 4 million

...euros is the sum being spent by Fingrid on R&D in 2016. It is approximately double the amount of previous years. The Energy Authority regulates how large a share of its turnover a grid company with a monopoly is encouraged to spend on research and development. This so-called innovation incentive rose this year from the earlier 0.5 per cent to 1 per cent.

0.6 ideas

In 2013–2016, an average of 0.6 ideas per person a year have been produced at Fingrid. Before 2013, the corresponding number was about a tenth of this. In reality, the number of ideas is higher, as not all of them end up in the idea management system the statistic is based on.

Fingrid's archive

Geocaches and the route of the Iron Lady

How could the right-of-ways of transmission lines be utilised? Fingrid's idea challenge last spring searched ideas for this. The winning suggestion was geocaching. An honourable mention was given to the suggestion concerning the route of the overhead line called the Iron Lady, which combines history and recreation.

There were

66

R&D projects underway at Fingrid in August 2016. Around two thirds of the projects are outsourced. At Fingrid, one week of work time per person each year is typically spent on R&D projects.

What is an innovation?

Innovation (or 'renewal') is a utilisable piece of information, operating method, product, service or other new combination, taken beyond an idea or invention, containing novelty value and benefiting business, society or well-being.

Fingrid rewards successes

Positive culture can be developed by reporting successes. Fingrid communicates about good ideas and successful R&D projects both internally and externally. Furthermore, the best performances are rewarded, for example with the annual R&D and innovation award, smaller idea challenge-specific awards or personal incentive bonuses. Stakeholders are also rewarded for good ideas.

Comments about Fingrid's R&D&I

We are benchmarking Fingrid in several fields and have received many good practices from them. Cooperation has especially helped us to understand the perspectives of grid life-cycle management"

Markku Hyvärinen,
Vice President, Helen Sähköverkko Oy

Fingrid has been a very active researcher and product developer and has consistently supported long-term research work."

Professor Pertti Järventausta,
Tampere University of Technology

Fingrid is a typical monopoly and engineering company but there has been a large change of direction at the company in the last five or so years in the attitude towards R&D and new things in general. Especially in flexibility products and matters relating to frequency regulation, Fingrid is definitely one of the best in the world, open to discussions, willing to acquire experience and take the larger picture forward."

Professor Jarmo Partanen,
Lappeenranta University of Technology

Innovation at Fingrid has seemed a good and stable activity and the responsible people are enthusiastic. When developing innovative ability, they do not try to take everything at once but proceed in pieces of suitable sizes."

Partner Jarno Poskela,
Innotiimi

Anders Granum

R&D Nordic, a group formed by Nordic transmission system operators, convened at the start of the year in Helsinki to sketch a common Nordic R&D roadmap. (Pictured from the left: Sverrir Jan Norðfjörð (Landsnet), Sonja Monica Berlijn (Statnett), Claes Nielsen (Energinet.dk), Jussi Matilainen (Fingrid) and Göran N Ericsson (Svenska Kraftnät).

Nordic cooperation

R&D Nordic, a group formed by Nordic transmission system operators, convenes regularly to discuss and share information on research and development activities. The aims include sharing information on planned and ongoing R&D projects as well as the best operative practices, receiving synergy benefits from joint development projects, and highlighting Nordic perspectives in European research cooperation. At the moment, the group is working on a common Nordic R&D roadmap and a large number of joint-Nordic research projects.

See also www.fingrid.fi/en ❱ Company ❱ Research and development

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