Management of changing electricity grid
Fingrid's role and duties
Fingrid's role - from electricity production to consumption

System operation
Electricity market
Fingrid also works in these areas

Electricity production
- Nuclear power
- Hydroelectric power
- Fossil fuels
- Biomass
- Wind power
- Other sources of energy

Electricity transmission in Fingrid’s main grid
Fingrid develops the main grid for the long term and transmits electricity reliably.
- Transmission lines
- Substations
- Reserve power plants

Cross-border transmission connections to Sweden, Norway, Russia and Estonia

Electricity transmission in regional and distribution networks

Electricity consumption
- Small consumers
- Industry
Fingrid's business model

**Resources**
- Personal and expertise
- Suppliers and business partners
- Income and financing
- Electricity from power plants and neighbouring countries
- Grid transmission lines, substations and reserve power plants
- Land required for transmission lines; natural resources and materials
- ICT infrastructure

**Business processes**

**Adequacy of the transmission system**
- Grid planning
- Grid building
- Grid maintenance

**System operation**
- Planning of the operation of the power system
- Monitoring and control of the power system
- Managing disturbances and the continuity of the power system

**Promoting the electricity market**
- Ensuring the continuity of the electricity market
- Harmonising the rules of the electricity market
- Increasing the transparency of electricity market information

**Business operations**

**We set ambitious targets.**
Our corporate culture is open, collaborative, renewing and target-oriented and complies with good governance practices. We develop our operations in a balanced way and with a long-term approach, from the perspectives of our customers, society, finances and personnel. We seek efficiency by combining our core expertise with that of the best operators in the industry. This is how we earn the trust of our customers, society, shareholders and the working community.

**Services for customers**
- Electricity transmission
- Balancing services
- Exchange of retail market data
- Publication of wholesale market information
- Guarantees of origin

**Impacts**
- Enabling the transformation of the energy system
- Reliable electricity for society and industry
- Promoting Finland’s competitiveness
- Developing the electricity sector and competence
- Financial benefits for stakeholders
- Major grid investments and employment
- Local changes in land use and the environment and energy losses in electricity transmission
Fingrid has a balanced set of targets

Customers and society
We secure reliable electricity and a well-functioning electricity market for society.
We offer affordable services that meet our customers’ needs.

Finance
We operate cost-effectively and bring value to our owners.

Internal processes
Adequacy of the transmission system
We carry out investments and maintenance safely and efficiently at the right time.
System operation
We operate the national grid proactively and reliably.
Promoting the electricity market
We actively maintain and develop the electricity market.

Personnel and expertise
An open, collaborative, renewing and target-oriented work community.
Finland is part of a wider market area and the Nordic synchronous power system.
Electricity market in the Baltic Sea region

Transmission system operators
System responsibility
- technical use of the power system
- managing power balance
- imbalance settlement and energy reporting

Other obligations
- network connections and responsibility for electricity transmission
- development of the power transmission system
- promotion of the electricity market

Power exchanges
- electricity price formation
- market-based allocation of cross-border transmission capacity
The Nordic grid forms a technical entity

The Nordic electricity grid has a joint frequency and is used according to jointly agreed rules

Basic principles of main grid use:

• It shall withstand a fault in any single component (N-1 principle)
• After a disturbance, operation shall return to normal in 15 minutes
Maintaining the balance between electricity production and consumption

At all times, the same amount of electricity needs to be produced as is consumed. In a balanced situation, the frequency of the grid is 50.00 Hz.

- Electricity market parties plan their electricity production/consumption in advance to be in balance.
- Fingrid balances deviations during each hour of use by utilising both automatic and operator-activated reserves.
- The activation of a reserve changes the electricity production/consumption of a power plant or consumption site.
- Fingrid purchases reserves from electricity market parties.
The changing power system and the main challenges
The changes are driven by climate policy, technology development and integration

The Nordic case:
• The closure of thermal power plants
• The share of wind power is rising
• Swedish nuclear power plants will be decommissioned earlier than initially planned
• The capacity from interconnectors between the Nordic power system and other systems will increase by more than 50 per cent
The old system: seasonal changes

The new system: daily and hourly changes

How to balance the changes?

- hydro power
- thermal power
- hydro and wind power
- thermal, hydro and wind power
- thermal, wind and solar power
The changes challenge the way the system is planned and operated.
Flexibility

- The demand for flexibility is increasing, both in the day-ahead market and in the operational hour.

- At the same time, the flexibility provided by existing hydro plants is limited and the thermal production capacity is declining.

- A risk of having hours without price formation in the day-ahead market.

- Periods of insufficient balancing resources available in the operational hour.

Challenges

1. Ensuring flexible capacity with market signals

2. Lack of adequate assessment and methodologies
Generation adequacy

Forecasted changes in production structure in the Nordic electricity markets

=> There is enough energy but not power

Point of departure for generation adequacy:
• The role of the TSOs is limited, i.e. focus on supporting an efficient market framework
• State aid rules, network codes, and national legislation sets the framework conditions: need to be coordinated to optimize the solutions
Generation adequacy, probabilistic simulation

hours in a year in which generation and import can not cover the load
Transmission adequacy

- The power system needs to withstand any single fault at any given time (N-1 principle)
- It takes at least 10 years to build a new transmission line: need to start early enough
- The transmission needs are identified simulating the needs of the electricity market in different future scenarios: national level, Nordic level, Baltic Sea level, pan-European level
- New connections are evaluated by calculating their market and security of supply benefits
Inertia to support system stability

Challenges

- Having sufficient inertia in the system to ensure operational security
- Lack of minimum requirements i.e. a common understanding of how low level of inertia the system can handle and what is expected in the future Nordic power system

Frequency and power responses after a generator trip. a) Initial frequency and frequency responses after a generator trip with high and low inertia.
Frequency quality to ensure operational security

Challenges

• Larger imbalances caused by ramping

• More unpredictable power generation will increase the forecast errors

• Increased need for, but reduced access to, reserve capacities

• Availability of transmission capacity for frequency and balancing reserves
How to better manage the system
The Nordic RSC will help the TSOs by undertaking operational planning activities related to cross border capacity calculation and outage planning as well as system security analysis.
A roadmap towards a clean power system

- Large market area and strong infrastructure
- Real-time market, incentives for balancing
- Consumer at the centre, price steers consumption
- New solutions for balancing and reserves
But finally it's people that manage the system
Example: Fingrid's core competencies

**Know-how on society**
- Stakeholders
- Legislation
- Climate and energy politics
- Environment
- Markets
- Security

**Know-how on grid business**
- Customers
- Service suppliers
- Business economy
- Finance
- Official supervision of grid operations
- Procurement
- Risk management
- Data systems

**Expert and management skills**
- Communications and negotiation skills
- Work community skills
- Management and Leadership
- Project management

**Know-how on power system**
- Theory of electrical engineering
- Equipment engineering
- Components
- Development of power system
- Maintenance management
- Operation of power system
- Balance of power in grid operations
Different people have different competencies

Fingrid’s specialist career path:
1. Solving problems with special skills
2. Developing, being able to set goals
3. Combining several skills for the above, mentoring others
4. Supporting company level work, e.g. preparing strategic plans
5. Being able to lead the development in a certain competence area nationally or even internationally

And in all levels: sharing knowledge and interacting with stakeholders!
Thank you!