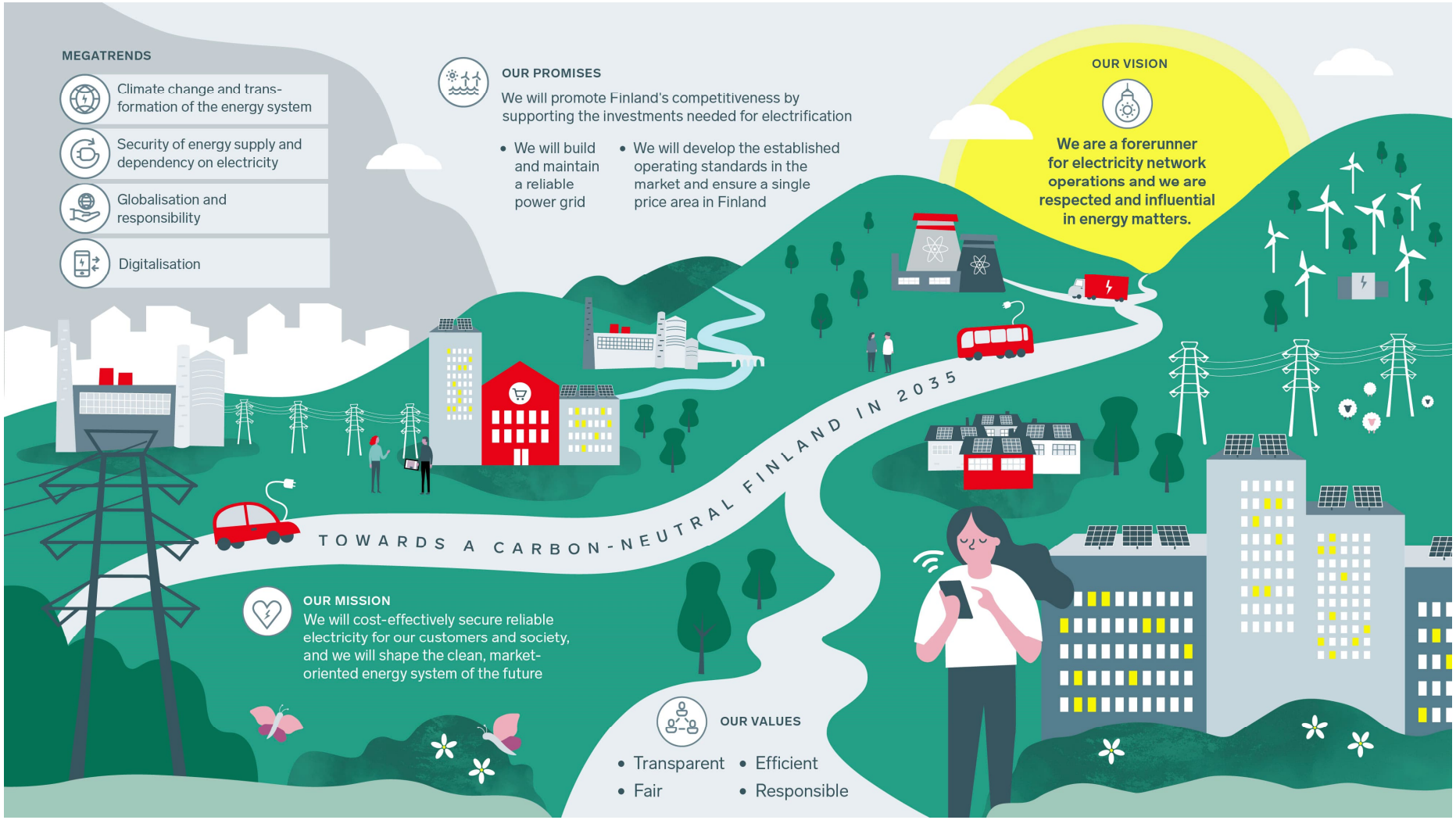
31.10.2022 / Jussi Matilainen

Research, Development and Innovation in Fingrid

Statnett's RD&I Conference, 25th October 2022

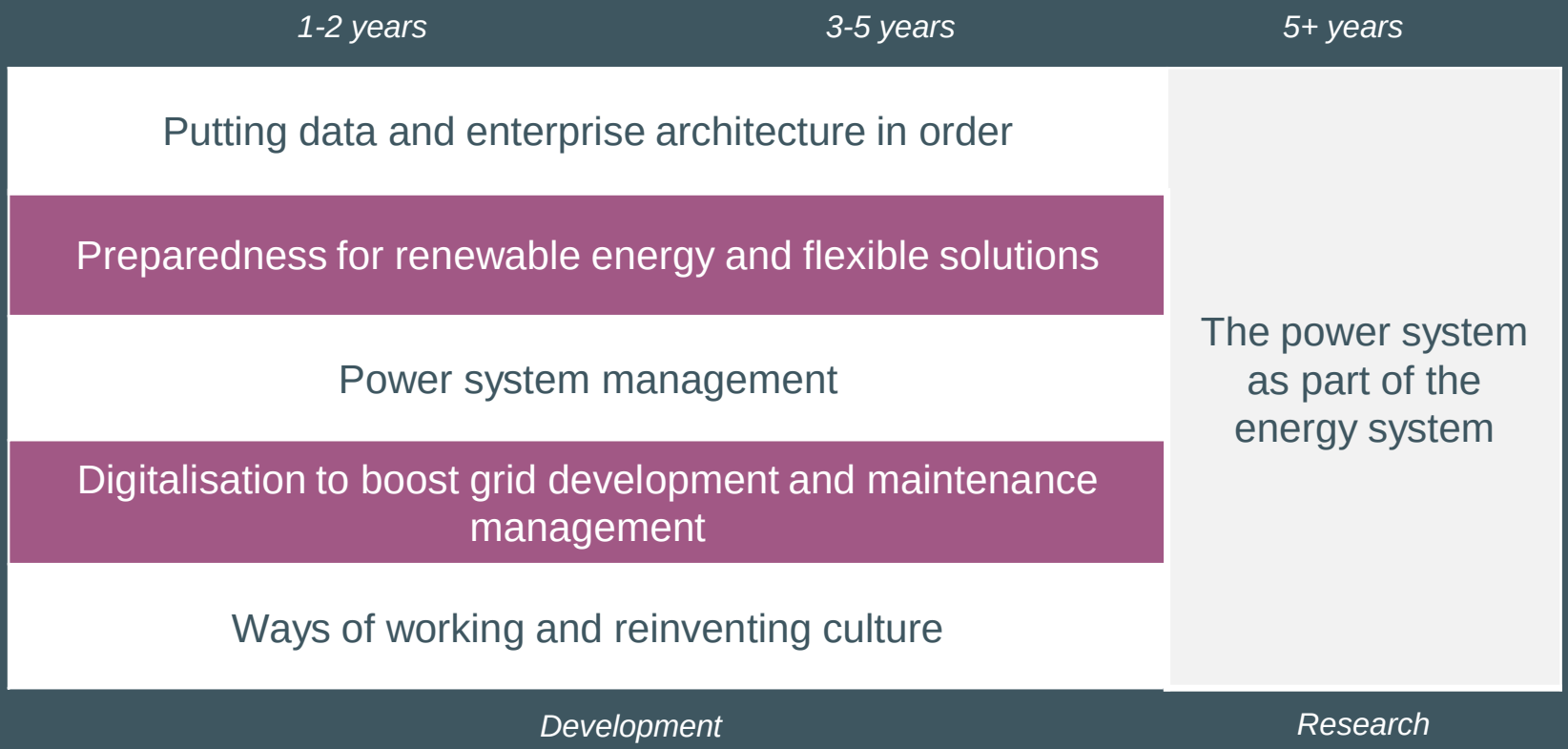
FINGRID

Fingrid's strategy



FINGRID

Corporate strategic themes of development



FINGRID


R&D facts
3,0 M€
R&D in 2021
40-50
Projects running annually
17,6 FTE
Fingrid R&D in 2021
1 % of turnover
Innovation incentive ~ 11 M€ in 2021
84
Persons at Fingrid participating R&D
64 %
Share of outsourced work

R&D governance

- Hybrid management model: top-down and bottom-up approaches
- R&D steering/coordination team (Top down)
  - Coordinates external project proposals and manages project portfolio
  - Defines focus areas (part of the corporate strategy as common strategic themes of development)
  - Together about 0,6 FTEs/ 6 persons
- Centralised tool to manage all development projects via one tool (https://thinkingportfolio.com/)
- Business units / business area steering groups (bottom-up)
  - Decides the budged for their R&D activities
  - Decides which projects to start (gate decision system)
  - Projects not belonging to strategic themes allowed if well justified

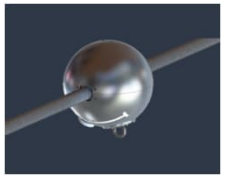
Some examples of R&D projects…

FINGRID

Dynamic Line Rating in Fingrid

Securing transmission capacity

- **DLR-pilot project (v. 2019-2021)** It was found that **the average DLR values are about twice that of the SLR** and that there is a clear positive correlation between the amount of wind power and the DLR, which increases the benefits of the DLR in high wind power situations.
- The pilot project eventually investigated the operation of four different DLR systems
  - Lindsey Manufacturing (Lindsey). *Sensor based*
  - Ampacimon. *Sensor based*
  - DTN. *Weather based without sensors*
  - Heimdall Power (Heimdall). *Sensor based*



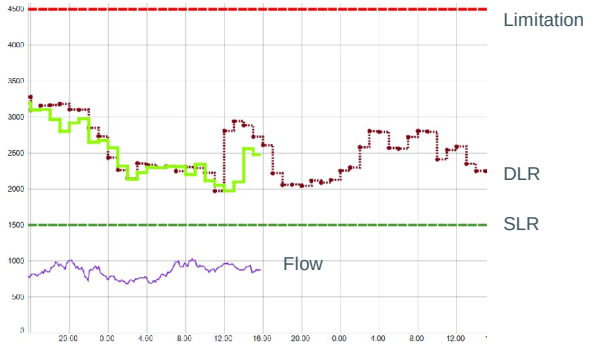
- Also, we developed our own in-house weather-based system
- **DLR-project (v. 2021-2022)** In the first phase of deployment, we apply DLR calculation method, based on DLR calculations and open meteorological data from the Finnish Meteorological Institute.
- DLR results are integrated into three different systems
  - Scada, PI-Vision and Power PI
  - Dynamic Line Rating realtime, transient 15min, forecasting values and power system limitations
  - **Currently for operational use**. No additional capacity to market in this project

DLR Dynamic Line Rating

- Dynamic load capacity of the cable, the determination of which takes into account the actual environmental conditions

SLR Static Line Rating

- Static load capacity of the line, assuming conservative standard conditions (Fingrid: wind speed: 0.6 m / s (perpendicular to the line), outdoor temperature: 30 ° C, radiation intensity: 1 kW / m2)



FINGRID

Gasgrid & Fingrid joint hydrogen economy project – sector integration in action

- The companies explore together the potential of hydrogen economy and networks in a joint R&D project
  - Stakeholder interviews done in fall 2021
  - Scenario development done in spring 2022 with stakeholder consultation over the summer period
    - https://gasgrid.fi/wp-content/uploads/Gasgrid-Fingrid_hydrogen_economy_draft_scenarios.pdf
  - Value chains in hydrogen economy studied in more detail in collaboration with LUT university in fall 2022
  - Hydrogen network construction costs will be evaluated in detail in case studies
  - Final report & seminar in 2023
- **The aim of the project is to support joint planning and development of Finnish energy infrastructure and cross-border connections** → Proactive development and planning of energy infrastructure can enable investments throughout value chains enabling achievement of carbon neutrality and reduction of fossil energy usage
  - The project has received Business Finland R&D funding and is done as part of larger HYGCEL collaboration

The situational awareness system

The Situational Awareness System) is a web-based tool for power system management. Operation of the main grid requires interpretation of information from multiple different systems and processes. It helps to visualize the operation of the main grid by gathering and condensing the existing information from different processes and applications into a single view.

The system is structured like a bulletin board (or card board), where each card represents a part of the situational awareness of the main grid. The order and colours of the cards change according to how critical the situation is in comparison with the metric set for it. The system issues warnings and alerts when action is required. Users can click on cards to open a more detailed view of the subject, such as graphs, maps, history data, and forecasts.

Securing system operation

Securing system operation

Power System Restoration After a System Level Blackout

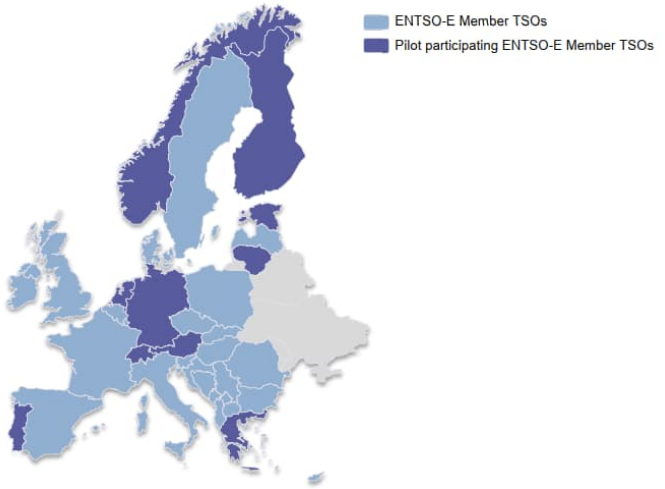
- D.Sc. (tech.) thesis (Tampere University) focusing on system level blackouts and consequent black-start and bottom-up restoration. Available at: https://urn.fi/URN:ISBN:978-952-03-2507-7
- Focuses on voltage management during the transmission network energization/restoration and aims for increasing the speed and robustness of the bottom-up restoration in a weak system.
- **Presents methods and measures to identify and avoid overvoltages** due to electrical resonances and black-start generator self-excitation during the early stages of system restoration.
- **Proposes an interative restoration planning process** and presents recommendations for both restoration planning and control centre tools during restoration.
- **Shows that restoration field-tests should be a mandatory part of restoration planning** and simulation models for normal system operation are not sufficient for restoration planning.
- No external funding. The research was performed as a part of Fingrid's internal project.
- Project started in 2016 and the dissertation was succesfully pre-examined and defended in 2022.

Flexibility – a tool for an efficient power system

- Both the energy transition and EU regulation are driving grid operators to use flexibility in the future as a part of their operation
- This requires new market structures and information exchage for the coordination between grid operators
- Fingrid has been developing these in two EU funded projects, INTERRFACE and OneNet
- **The projects aim to create a platform that implements the new functionalities and demonstrate them in practice – how can the TSO and DSOs use the same location-specific flexibility in a most efficient way**

Transmission line monitoring using space-based technologies

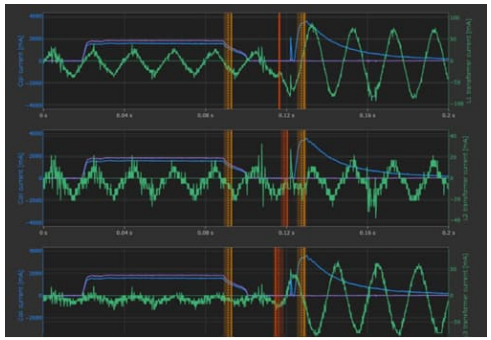
- The aim of the project is to establish services based on the space-based technologies for transmission line monitoring
- Three one-year demonstration projects regarding Vegetation Management, Change Detection and Disaster Management Service
- Three service providers develop and demonstrate their solutions
- ESA (European Space Agency) supported project
- ENTSO-E along with its member TSOs (10 utilities) are supporting the conduct of demonstration projects by giving the end user point of view (requirements) and data for the demonstration projects
- Project started 2021. The first demonstration project almost completed, other two will be completed H1/2023.



Digital condition monitoring for asset management

- Project was started 2016 and **target is that monitoring systems are utilized widely in substations by end of 2025**
- Provides different **IoT-based monitoring systems** for analyzing condion of primary components at substations
- Fingrid's internal project without external funding

1. *Securing grid quality.* Better understanding of the assets condition, possibility to foresee development of defects.
2. *Improving grid availability*. ***Reducing the amount of outages for asset monitoring***
3. *Improving cost effectiviness*. Maintenance work will be allocated on need basis, based on the sensor data.



Thank you!

Fingrid Oyj
Läkkisepäntie 21
FI-00620 Helsinki
P.O.Box 530
FI-00101 Helsinki, Finland
Tel. +358 30 395 5000
Fax. +358 30 395 5196

FINGRID