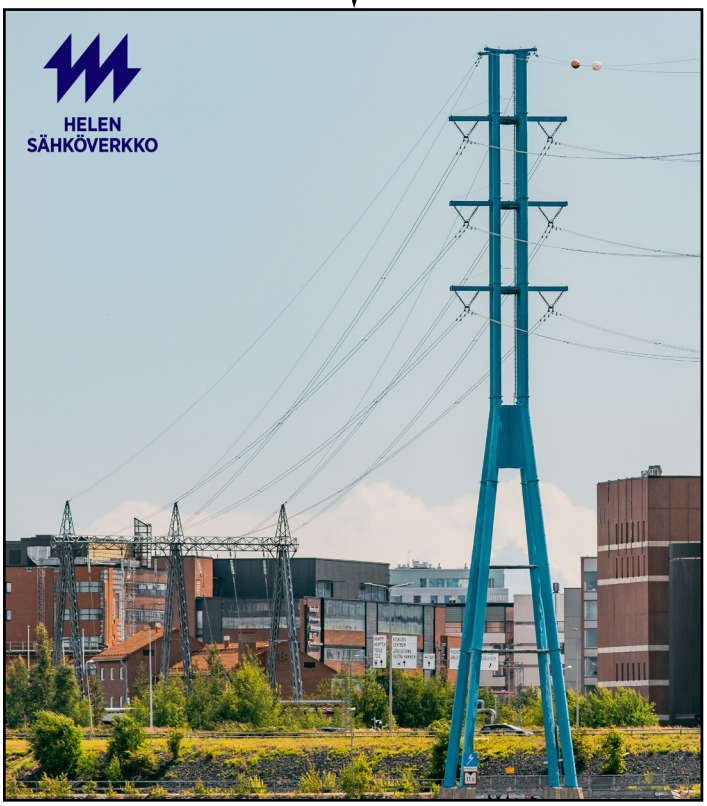
The Road to Net Zero: How Helen Electricity Network is Preparing Helsinki‘s Power Grid for 2030 with the IGP

Case Study | 2024

Customer Portrait

Helen Group, a major player in the Finnish energy sector, is responsible for providing energy and heating services in the Helsinki region. With a power grid serving approximately 410,000 customers, Helen Electricity Network offers an extensive range of energy solutions, ranging from electricity and heating supply to innovative renewable energy technologies. As a municipal company, Helen Electricity Network commits to sustainable development and aims to enable Helsinki to become climate-neutral by 2030. For this, the company relies on a combination of cutting-edge technology and a consistent increase in the share of renewable energies in its portfolio.



Helen Electricity Network; helen.fi

Overview

”Customers‘ new solutions - heat pumps and electric car charging - can challenge the limits of the grid. We need to explore, in different scenarios, how customers‘ electricity use may evolve and affect the grid in the future. This will allow us to target investments more efficiently.“

Juhani Lepistö,
Network Analyst
at Helen Sähköverkko Oy

The issue & what Helen Electricity Network set out to achieve

Due to increasing urbanization in Helsinki and the ambitious goal to make the city CO2-neutral by 2030, Helen Electricity Network expects a significant increase in heat pumps, charging stations for electric cars, and solar systems. Considering this, the Finnish grid operator wants to identify potential grid bottlenecks, which could arise from the increasing electrification in building heating, transport, and industry, early on and take appropriate measures. For this purpose, Helen Electricity Network uses the IGP app Grid Study in order to develop detailed scenarios for future supply tasks.

Project outcomes so far

Successful implementation of a pilot project for selected MV and LV grids

Development of the concept on how current socio-economic trends can be translated into scenarios for the grid studies

Preparation of necessary data and establishment of processes and tools for data merging

Development of the grid model for Helen Electricity Network‘s entire grid area across medium and low voltage levels for the full rollout of the app Grid Study

Background

While Finland aims to be CO2-neutral by 2035, Helsinki has set the ambitious goal of becoming emission-free by 2030. This is not an easy task, as the majority of carbon emissions are caused by mobility and building heating. In addition, Helsinki faces increasing urbanization due to an annual population growth of 6,000 to 8,000 people and an increase of 700,000 to 800,000 m² of new buildings per year. The planned shutdown of large coal-fired power plants by 2025, which requires the use of large electric boilers, adds to the challenge.

The city's climate goals, therefore, pose a massive transformation challenge for the transport and heating sectors. This involves the electrification of heating systems – the transition from district heating and oil heating to ground source heat pumps – as well as an increase in electric vehicles on the one hand and the installation of solar systems on the other.

As the largest energy provider in the region, Helen Electricity Network's electrical network is a crucial factor in this transition. However, this transformation poses a challenge for the power grid and requires extensive studies to better understand the impacts of these changes and prepare the grids for future loads.

Project objectives

Evaluate various grid scenarios for potential future

bottlenecks & limit violations

due to increasing electrification

Determine how probable these bottlenecks and/or violations are and when they will occur

Identify the potential need for grid reinforcement to ensure future supply reliability

Enable the general planning team to synchronize possible grid reinforcement needs with other needs

Derive

data-driven investment decisions

based on the results of the grid scenario evaluations

Intelligent Grid Platform short: IGP

The Intelligent Grid Platform (IGP) is an assistance system that supports a variety of technical processes in the planning and operation of electrical grids. Our collaboration with Helen Electricity Network focuses on planning applications.

Basis for Running Future Energy Scenarios in the Grid

Grid Transparency	The app provides power flow results and short circuit analyses for the entire grid area, which enables high levels of transparency about the current grid situation.
Grid Study	Creation and evaluation of trend scenarios for future supply tasks. The modeling can either be done by specifying general penetration rates for one or more grids or by providing node-specific parameters, which allows for the easy creation of highly customized studies.

Application

Grid Study

The Grid Study application enables an assessment of existing network structures and the execution of various future scenarios to make well-founded decisions for network reinforcement or network expansion.

Approach

Based on the current socio-economic developments, in particular, the increasing urbanization and electrification in Helsinki, Helen Electricity Network has developed three possible scenarios for grid assessment studies:

1. Extreme peak loads caused by high energy demand and low efficiency
2. High energy generation with equally high energy efficiency
3. A realistic combination of both factors

Moreover, Helen Electricity Network wants to evaluate these scenarios for the future timeframes of 5, 10, and 15 years from now.

Helen Electricity Network is now in the process of modeling these scenarios in the IGP app Grid Study to evaluate the potential future grid expansion needs as comprehensively as possible. The calculations will be based on detailed building data as well as precise modeling of the potentials for the development and expansion of heat pumps, solar systems, and electric vehicle charging points.

Problem solving

The development of a digital grid model in the IGP based on topology and assets data from Trimble NIS and smart meter data

Placing the focus on annual simulation as the calculation method: Helen Electricity Network has complete historical time series data across the entire grid and can thus gain a very detailed understanding of the current supply task

Taking into account the actual grid topology, combined with assumptions about future consumption trends, Helen Electricity Network can derive a reliable statement about future changes in consumption patterns and the potential impacts on the grid

Integration of publicly accessible data from the Helsinki geoinformation portal to capture exact locations, sizes, types, and energy sources of buildings

Using this open data, Helen Electricity Network can make realistic estimates for the future number and capacity of heat pumps and charging stations for electric vehicles, as well as the annual generation potential of panels in individual buildings

For these new prospective grid assets, Helen Electricity Network uses characteristic synthetic profiles, which are taken into account accordingly in the annual simulation

Subsequently, Helen Electricity Network can make reliable assumptions about the allocation and the required capacity of each connection point

To incorporate all collected data for future consumption and feed-in potentials in a granular and connection-point-specific manner into the grid studies, Helen Electricity Network will define each scenario through the API of the Grid Study

Project results & further milestones

The successful implementation of a pilot project for a limited grid area of two medium-voltage networks including the subordinate low-voltage networks provided Helen Electricity Network with crucial insights for further scaling. In the next step, a digital twin of their entire grids in the medium and low voltage was created to ensure the full rollout of the app Grid Study. Additionally, as part of the rollout, a regular sync was established, so that grid studies are always conducted on the most current data basis.

Furthermore, Helen Electricity Network developed a concept for transferring current socio-economic trends into grid assessment studies, which will enable more precise modeling of future power grid needs. An important milestone was the preparation of necessary data and the establishment of processes and tools for effective data merging. These steps are crucial for extracting meaningful information from the large data volumes about future trends with regard to the expansion of consumption and generation systems and seamlessly integrating them into grid assessment studies.

The use of the IGP APIs makes it possible to import and calculate individual scenarios with a high level of detail. Additionally, they offer a lot of flexibility in terms of both the manner and the level of detail in which Helen Electricity Network wants to output the scenarios.

In summary, Helen Electricity Network gains the following advantages from using the Intelligent Grid Platform:

Creation of a computational, cross-voltage-level grid model for a detailed evaluation of the trend scenarios for the future supply tasks

Ability to identify future bottlenecks across the entire power grid early on

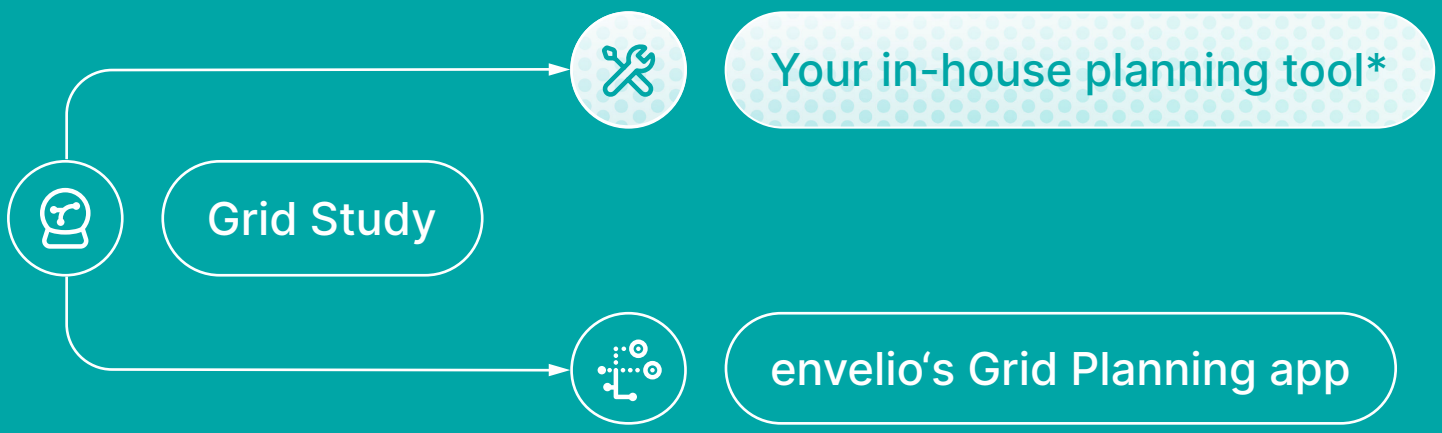
Laying the foundation for robust strategic grid planning and gathering additional data for more comprehensive investment planning

Derivation of future-proof expansion and reinforcement measures for medium-voltage and low-voltage grids

Next steps

- Evaluation of the results of the grid assessment studies regarding future grid bottlenecks and violations across medium and low voltage levels
- Taking into account the resulting consumption patterns as a basis for grid expansion planning in higher grid levels
- Prioritization of grid reinforcement and expansion measures and investment planning
- Deriving specific construction measures in Trimble NIS based on the IGP results
- Evaluation of the options to create an overview of the available hosting capacity at different voltage levels for current and possible new customers

Options for further processing of Grid Study results:



*E.g. Helen Electricity Network is using Trimble NIS for this purpose

Juliane Bednarz
juliane.bednarz@envelio.de
+49 221 222 85 80

Kerem Mermer
kerem.mermer@envelio.de
+49 221 222 85 80

envelio GmbH
Hildegard-von-Bingen-Allee 2
50933 Cologne