Harnessing Smart Meter Insights for Enhanced Grid Transparency and Capacity Management at Elektrilevi

Case Study | 2024

envelio.com

envelio

Customer Portrait

Elektrilevi OÜ is the largest distribution grid operator in Estonia and belongs to the Eesti Energia Group. The company maintains and repairs around 64,000 kilometers of power lines and more than 23,000 substations, with its medium voltage and low voltage grid spanning 95 percent of Estonia's surface area. Elektrilevi's grid area comprises approximately 650,000 grid connection points.

Elektrilevi OÜ; elektrilevi.ee

Overview

„From a microproducer's perspective, we can make the validation process faster. In case electrical calculations are ’green‘, this means no thresholds have been exceeded, and we can forward the connection requests directly to project managers for calculating the price and sending out the offer. We expect that this will reduce the decision-making timeframe from around 5 days to 2-3 days.”

Kaido Vaade
Business Project Manager
at Elektrilevi

The issue & what Elektrilevi set out to achieve

For some time now, Elektrilevi has been executing a strategy of deploying digital solutions based on cutting-edge technology in order to make the distribution grid future-proof for the energy transition. The smart meter rollout in Estonia, for instance, is already complete, providing data on consumption and production, as well as on both active and reactive power, for almost all connected users. Given the rapidly increasing numbers of new consumers and distributed generators, the next focus lies on accelerating mass processes in DER connection to the grid and grid planning in order to:

a Speed up the integration of renewables into the grid

b Make sure new connections won't lead to severe grid capacity constraints

c Gain a comprehensive understanding required to identify grid areas where reinforcement and expansion measures are needed most

d Ultimately, cope with a high number of connection requests without the need for additional personnel

Project results

Self-service portal for end customers to perform pre-application research of the available network hosting capacity

The self-service portal encompasses **micro-producers,** with households & larger generation systems to follow next

Together with the nearest favorable connection point, end customers get rough estimations for their

project's duration & costs

based on preset conditions

Background

Renewable energy is experiencing a tremendous boom in Estonia. In 2022, the Estonian Parliament decided to achieve a 100% share of renewable energy in the electricity sector by 2030. The interest in renewable energy is, therefore, noticeably high in the country, and with that, so is the number of connection requests for new distributed generators as well as consumers. Elektrilevi currently has more than 21,000 PV installations in its systems, including 11,000 micro-producers.

As a result, it has become increasingly challenging for Elektrilevi to rely on the existing processes to handle this large number of requests with the current manpower in due time.

At the same time, in some regions, the distribution networks are already reaching their limits. Therefore, it is important for Elektrilevi not only to have current information about the available capacity in the low-voltage network , where a new asset is connected to, but also to consider the impact the new connection will have on the overlaying MV- and HV-grid levels.

Last but not least, especially due to the expansion of renewable energies, grid reinforcement measures are nowadays more required than ever. Ideally, in order to make sound investment decisions, these measures should be defined in conjunction with the connection requests. This way, Elektrilevi can prioritize the locations where network expansion or reinforcement is most urgently needed.

Project objectives

Reducing the number of non-binding requests through the introduction of a self-service portal for microproducers of up to 15 kW

Improving customer service by enabling end customers to get not only the nearest favourable connection point but also estimated project duration and costs

Accelerating the connection request evaluation for micro-producers through process automation with real-time data

Eliminating a bottleneck in the rollout of new consumers and generators through the automation of planning processes en masse – and without the need for additional personnel

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. The focus of our collaboration with Elektrilevi is on grid connection and planning applications.

Basis for the grid connection & planning

Grid Transparency	Providing computable and electrotechnically validated grid models by linking previously isolated data systems and using machine learning algorithms to identify and correct data errors automatically.
Online Connection Check	Customizable customer portal integrated into the grid operator website for fully automated customer feedback on non-binding connection requests.
Connection Request	Digitalizing and largely automating the entire technical evaluation process for new connection requests for power generators and loads.

Application

Grid Transparency & Data Integration

The application Grid Transparency provides an overview about the current grid situation and the available grid reserves – fully automated and with no manual data processing.

Challenges

- The high number of new connection requests requires an increasingly detailed analysis of available grid capacities
- Automation of planning processes that include grid reinforcement and expansion measures requires the incorporation of geographical data
- The increasing likelihood of capacity constraints necessitates an examination of the grid‘s state across both low and medium voltage levels
- Technical evaluation of new connection requests call for a detailed analysis of potential risks for current and voltage limit violations

Problem solving

Integration of smart meter data with grid information data for precise determination of available grid capacities

To enrich the grid model with geographical data, integration with the Estonian Land Board (est: Maa-amet), a geoinformation data provider, was ensured

Creation of a full and central grid model that incorporates both medium and low voltage levels

Data for short-circuit current calculations were provided by Elektrilevi and integrated into the grid model in the IGP to more precisely determine one phase short circuit current limit violations

Smart Meter Data

In the scope of this project, existing smart meter data was made available for grid simulations and all grid planning processes. Based on these and other data, a digital twin of the real grid was created in the Intelligent Grid Platform, which enabled Elektrilevi to achieve a high transparency of the actual conditions in the grid as a basis for all planning processes.

Geographical information was also considered in the grid model and in all planning processes to enable fully automated planning of new connections and required grid reinforcement measures in the future.

The advantage of smart meter data is that they provide high-quality insights due to the sheer amount of valuable information they contain. With the focus on the grid state, this allows to accurately identify what actually happens in the grid at a given moment.

Furthermore, this allows to use the measurements from individual households in the calculations of the distribution grid without the need to distinguish between individual connected elements based on their load type. Knowing actual measurements eliminates the necessity of using synthetic load profiles for individual consumers.

Application

Online Connection Check (OCC)

Customizable customer portal integrated into the grid operator website for fully automated customer feedback on non-binding connection requests.

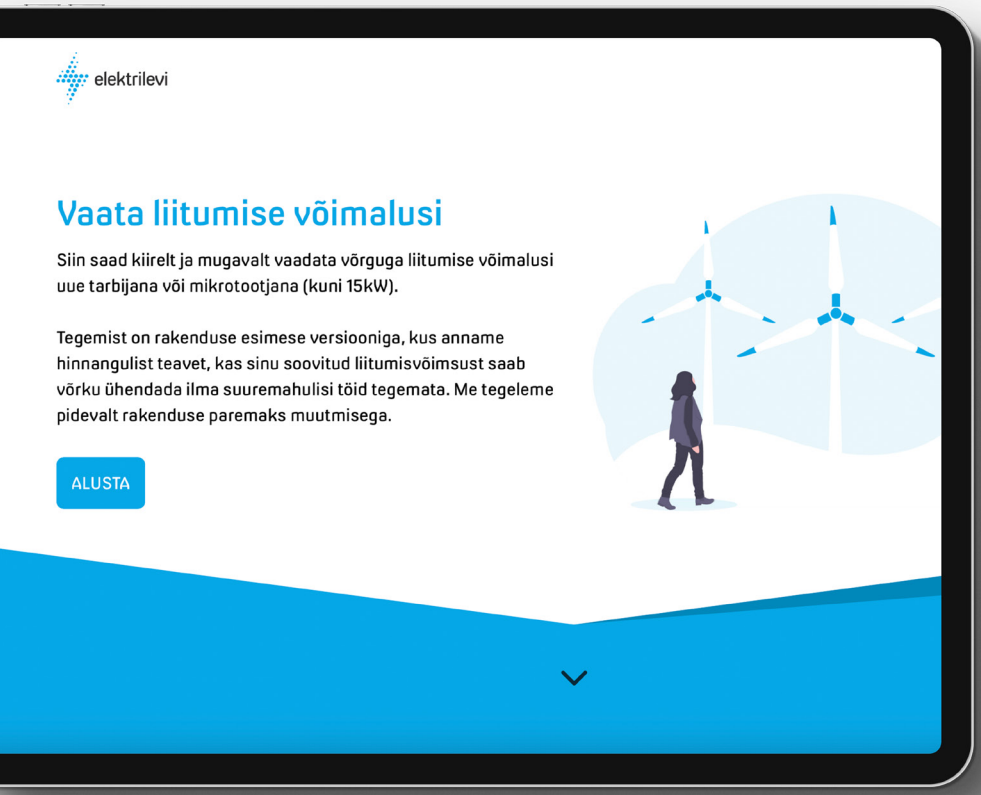
- Prospective connection point
- Rough project duration estimation based on preset conditions
- Rough price indication based on standard connection conditions

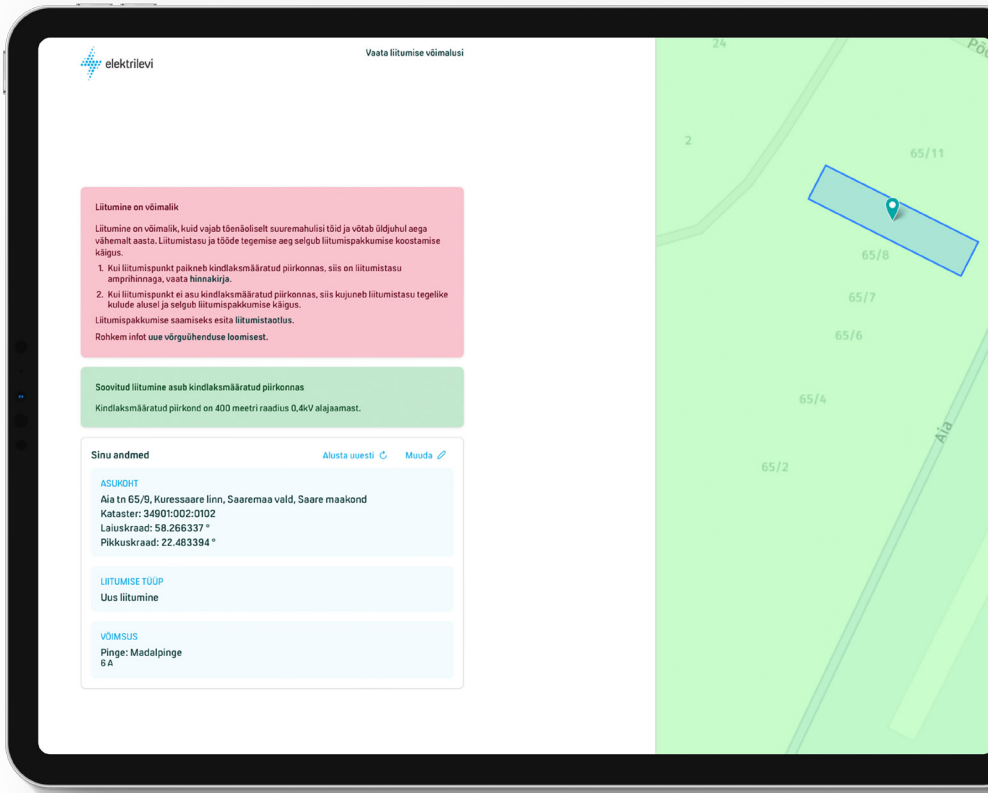
Already within the scope of a non-binding inquiry for small-scale producers, Elektrilevi's customers can not only determine the most favourable grid connection point, but also receive a rough estimation of the project duration and costs.

After determining the next favourable grid connection point via OCC, end customers can request the connection bindingly through the grid operator's internal request submission portal.

Advantage

The implementation of OCC is expected to lead to an improved customer experience and, at the same time, a reduction in the number of connection requests, as only feasible projects are submitted for processing.


elektrilevi
Vaata liitumise võimalusi
Siin saad kiirelt ja mugavalt vaadata võrguga liitumise võimalusi uue tarbijana või mikrotootjana (kuni 15kW).
Tegemist on rakenduse esimese versiooniga, kus anname hinnangulist teavet, kas sinu soovitud liitumisvõimsust saab võrku ühendada ilma suuremahulisi töid tegemata. Me tegeleme pidevalt rakenduse paremaks muutmisega.
ALUSTA


elektrilevi
Vaata liitumise võimalusi
Liitumine on võimalik
Liitumine on võimalik, kuid vajab tõenäoliselt suuremahulisi töid ja võtab üldjuhul aega vähemalt aasta. Liitumistasu ja tööde tegemise aeg selgub liitumispakkumise koostamise käigus.
1. Kui liitumispunkt paikneb kindlaksmääratud piirkonnas, siis on liitumistasu amprihinnaga, vaata hinnakirja.
2. Kui liitumispunkt ei asu kindlaksmääratud piirkonnas, siis kujuneb liitumistasu tegelike kulude alusel ja selgub liitumispakkumise käigus.
Liitumispakkumise saamiseks esita liitumistaotlus.
Rohkem infot uue võrguühenduse loomisest.
Soovitud liitumine asub kindlaksmääratud piirkonnas
Kindlaksmääratud piirkond on 400 meetri raadius 0,4kV alajaamast.
Sinu andmed
Alusta uuesti
Muuda
ASUKOHT
Aia tn 65/9, Kuressaare linn, Saaremaa vald, Saare maakond
Kataster: 34901:002:0102
Laiuskraad: 58.266337 °
Pikkuskraad: 22.483394 °
LIITUMISE TÜÜP
Uus liitumine
VÕIMSUS
Pinge: Madalpinge
6 A
24
2
65/11
65/8
65/7
65/6
65/4
65/2
Aia

Application

Connection Request

The Connection Request application enables users to largely automate the technical connection request process for power generators and consumers.

Microproducer (up to 15 kW)

Challenges

As Elektrilevi receives an extremely high number of requests for new grid connections, particularly for PV systems, the effort required for the evaluation of the available grid capacity and ensuring secure power supply has also increased significantly.

Considering the high number of connection requests, it will also become increasingly important to include already approved but not yet installed assets in future grid calculations for subsequent requests. The reserved connections were, however, saved only in the requests management tool “ELLI” and therefore had to be always manually included in the processing of new grid connection requests.

Furthermore, the sheer number of new connection requests call for an increasingly detailed analysis of available grid capacities. To enable this, Elektrilevi wants to assess the impact of connected micro-producers on potential current and voltage limit violations in the medium voltage grid to avoid potential grid capacity constraints.

i

Due to the solid data foundation, Elektrilevi can directly associate a request for PV connection with the respective household, thereby automatically determining the connection point. This is another factor that allows to completely automate the connection evaluation process, as long as no limit violations are detected.

Problem solving

A complete process integration ensures that connection requests for small generators of up to 15 kW, which are submitted through the request portal, are automatically forwarded to the IGP.

With the Fast-Track function of the IGP, connection requests are then processed automatically. Should any current or voltage limit violations be identified, the responsible network planner is notified so that they can initiate the next steps for the necessary grid expansion planning.

The yet-to-be-implemented connections are imported into the IGP with the “reserved” status, so that the reserved capacity is already factored in during the connection evaluation process. At this point, the IGP helps gain a clear picture of the changes in the grid that arise due to the high expansion of renewable energies and take them into account when calculating the available capacity.

The calculations for the new connection requests are carried out in the IGP across grid levels: not only for the low voltage but also for the overlaid medium voltage grid.

Project highlights & further milestones

Project highlights

The integration of smart meter data for the modelling of the low and medium voltage networks at Elektrilevi

Approved, yet not connected requests are taken into account during the calculation of available grid capacity

Requests evaluation is carried out across both LV and MV grid levels to prevent potential capacity constraints

Utilizing geospatial data to enable automated routing determination for new reinforcement measures

As part of non-binding connection inquiries, end customers get a rough estimation for the project's duration and costs together with the nearest favourable connection point

Further milestones

Thanks to the Intelligent Grid Platform, Elektrilevi has been able to partially automate the approval processes for small-scale PV connections. As a next step, the connection evaluation will be extended to household connections, larger PV projects and wind turbines, battery/power storages etc.

Furthermore, the planning for reinforcement measures in the case of new connections will be fully automated with the Grid Reinforcement Feature of the IGP. By integrating geospatial data into the grid model, construction conventions and restrictions such as streets, roads, nature reserves or bodies of water can immediately be taken into account in the future. This will enable the automated determination of line routing based on specific ‚go' and ‚no-go' areas.

Fully automated grid planning is a key enabler for Elektrilevi's goal to reduce response times for grid connection application from 30 days to mere minutes and thus significantly improve customer satisfaction.

Additionally, Elektrilevi aims to provide precise cost calculations for grid expansion in the price indication for new inquiries, based on the specific required reinforcement measures.

- Extending the self-service portal and grid connection evaluation for demand-side applications
- Extending the cost indication functionality to cover more complex calculations that would e.g. factor in potential grid reinforcement or expansion measures
- Automated calculation of the most favourable route for new grid reinforcement or expansion measures as part of grid planning activities
- The inclusion of short-circuit current calculations to fully automate current and voltage limit evaluations

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

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

This project is supported by the German Federal Ministry for Economic Affairs and Climate Action as part of the Renewable Energy Solutions Programme of the German Energy Solutions Initiative.

MITTELSTAND GLOBAL
ENERGY SOLUTIONS MADE IN GERMANY

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

Implemented by:

dena
German Energy Agency

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