

The renewable energy potential and locations with the criteria in the Keminmaa municipality

30.5.2025



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Pictures on the cover page: Lapin materiaalipankki and Digipolis.

1. INTRODUCTION

This study is part of Invest in Veitsiluoto project. The aim of the project is to attract new industrial activities to Kemi, Keminmaa and Simo areas and to support new project operators. The industrial cluster in Meri-Lappi (Sea Lapland), located near Finland's northernmost port, offers ready infrastructure and diverse areas for industrial activities in the region.

This study maps potential large-scale industrial locations in municipality of Keminmaa, examines suitable industrial technologies for these areas, and creates an overview of the potential of the identified areas for industrial operations and energy production. The study provides an expert view of the suitability and limitations of the identified areas for industrial operations. This study includes an overview of the current zoning situation and an examination of the suitability of zoning designations for different technologies. The final output includes site descriptions of the potential areas and a roadmap for the next stages of further planning for the industrial development of the area. The key method in the study is spatial data analysis.

2. CURRENT STATE AND PREMISES

The aim of this study is to provide information on the potential and locations of renewable energy. The examination of the potential of renewable energy is based on the protection zones of significant sites and areas as well as the placement criteria that is defined in this work. During the study, the location of the Nordic Hydrogen route in the municipality of Keminmaa, has also been taken into account.

As the output of the study, thematic maps and other material has been created based on spatial data analyses regarding various factors that limit renewable energy (including residential areas, nature reserves, landscape areas, groundwater areas, etc.) and enabling factors (electricity transmission, proximity to water resources, secondary land use areas, etc.).

The following factors have been considered in the study as factors preventing or limiting the investment in renewable energy:

- residential areas and secondary homes / zoning plans
- nature reserves / valuable bird areas
- Natura2000 areas
- nationally, regionally and locally significant landscape areas
- nationally, regionally and locally significant built cultural environments
- groundwater areas

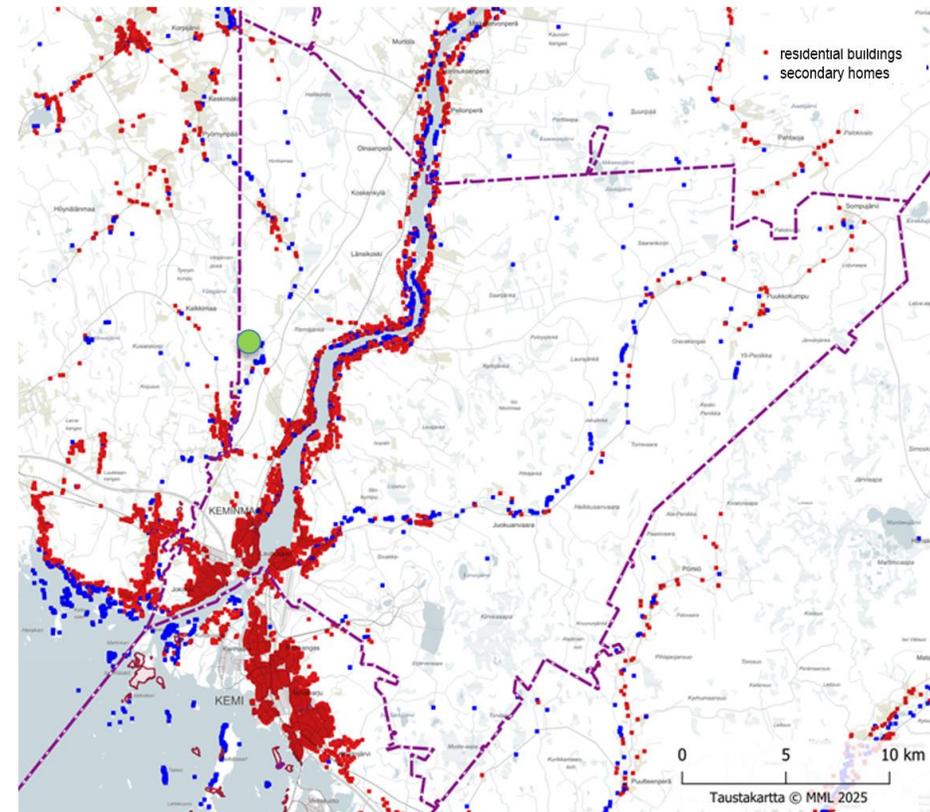
The following factors have been considered as enabling/supporting factors for investment:

- electricity transmission and distribution network
- grid development plan 2024–2033 (Fingrid)
- proximity to the railway network
- proximity to the highway network
- proximity to water resources
- secondary land use areas; former peat production areas, wastelands
- planning situation, projects in neighbouring municipalities

The current state and premises are described below by theme.

Residential areas

The majority of the habitation in Keminmaa is located near the center and along both sides of the Kemijoki river. There is also elongated settlement of permanent and holiday housing along Kivalontie road and Akkunusjoki river. A large part of the municipality’s area outside the riversides and road network, particularly in the eastern and northern parts, is completely uninhabited. According to the criteria for wind power placement in Keminmaa municipality (municipal council 8.5.2025 § 48), the minimum distance to permanent and holiday housing is at least 2 kilometers.



Residential areas in Keminmaa. Mykänmaa substation is marked with a green dot.

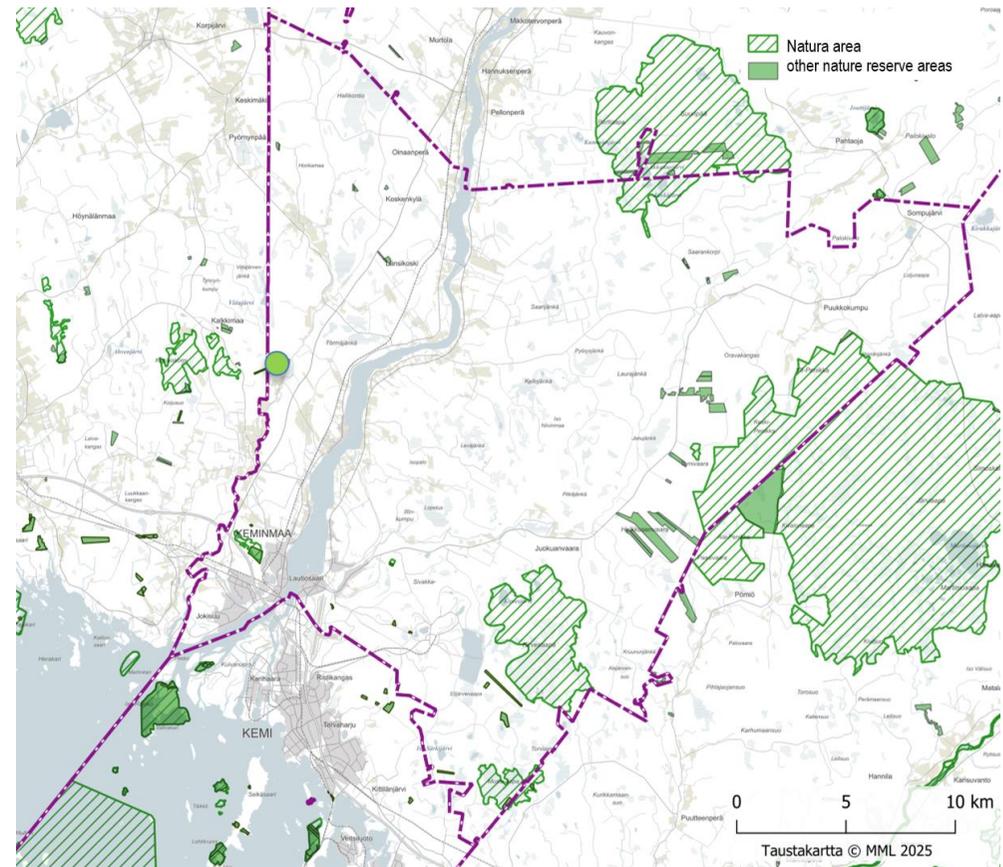
Nature and environment

Following Natura areas are located (at least partially) in the municipality of Keminmaa:

- FI1300507 Musta-aapa SAC
- FI1300501 Kallinkangas SAC
- FI1300505 Kirvesaapa SAC/SPA
- FI1301602 Martimoaapa - Lumiaapa - Penikat SAC/SPA
- FI1301811 Suuripään alue SAC/SPA

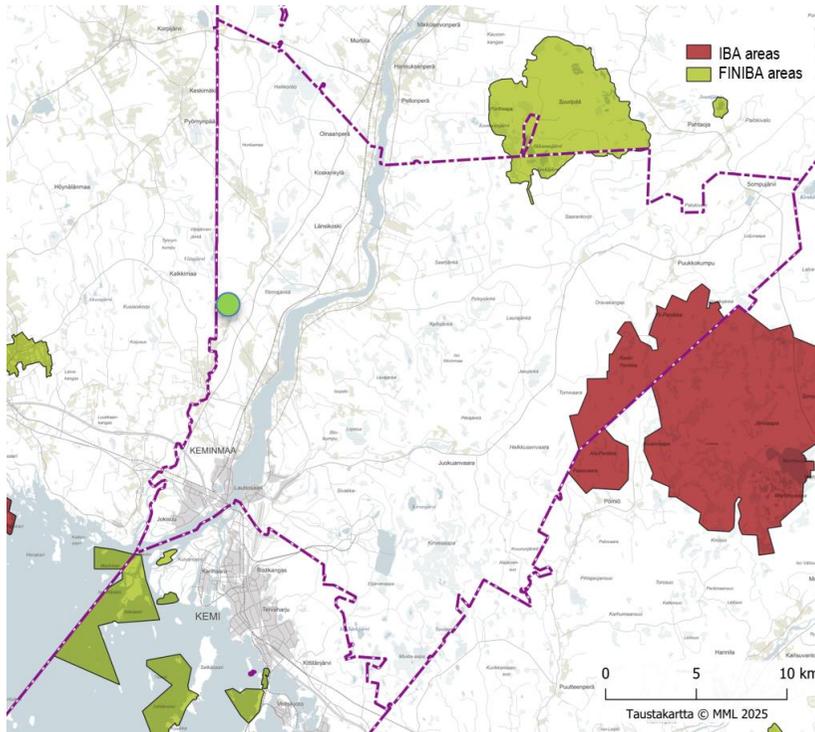
In Keminmaa there are also several areas under the grove protection program and several nature conservation areas located on private lands. The municipality's area contains, wholly or partly, several groundwater areas, four of which are important for water supply. Two of the groundwater areas (Jouttiaapa 1284553 and Saarenkylänkangas 1224150) are important for water supply, with surface water or terrestrial ecosystems directly dependent on their groundwater.

There are also several nationally and regionally valuable cultural environments in Keminmaa, mainly located along the Kemijoki river.



Natura areas and other nature protection areas in Keminmaa. Mykänmaa substation is marked with green circle.

Keminmaa has one IBA (Important Bird Area) area valuable for its birdlife, Martimoaapa-Lumiaapa-Penikat, and one FINIBA (nationally important bird area), Suuripää-Joutsijärvi.



IBA ja FINIBA areas in Keminmaa. Mykänmaa substation is marked with a green dot.

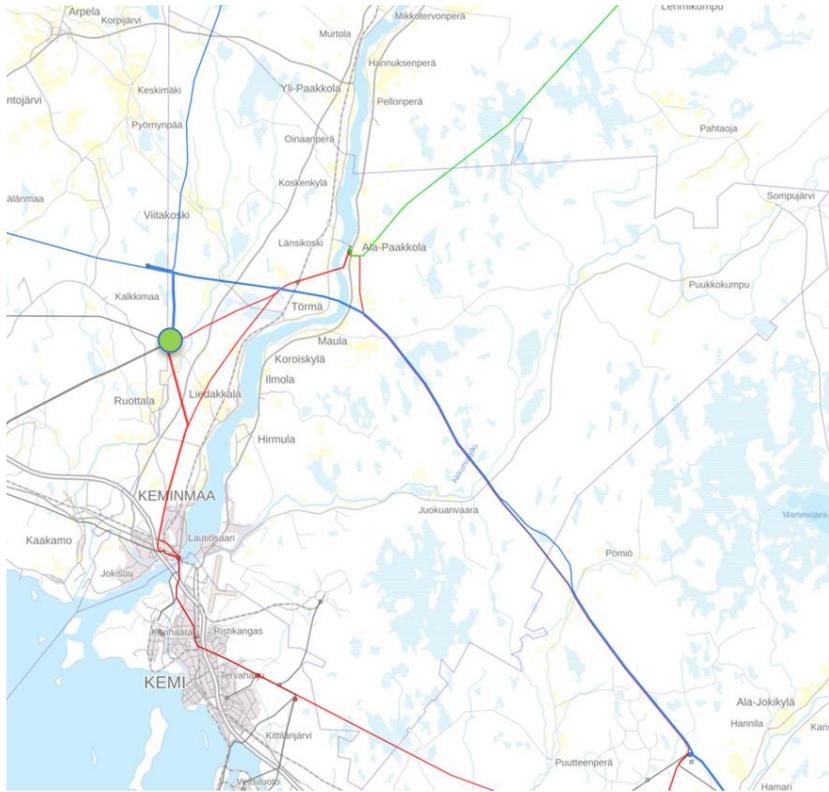
Electricity transmission and hydrogen pipeline

Electricity transmission consists of the national grid maintained by Fingrid and the distribution network managed by electricity grid companies. In Keminmaa, the local grid company is Keminmaan Energia Oy.

Key power line connections located in the municipality:

- Keminmaan-Pikkarala (400kV)
- Viitajärvi-Simojoki (400 kV)
- Keminmaa-Viitajärvi (400 kV)
- Djuptjärn-Keminmaa (400 kV)
- Viitajärvi-Petäjäskoski (400 kV)
- Taivalkoski-Simojoki (110 kV)
- Taivalkoski-Keminmaa A (110 kV)
- Taivalkoski-Keminmaa B (110 kV)
- Keminmaa-Isohaara A (110 kV)
- Keminmaa-Isohaara B (110 kV)
- Keminmaa-Isohaara C (110 kV)
- Ossauskoski-Taivalkoski (220) poistuva

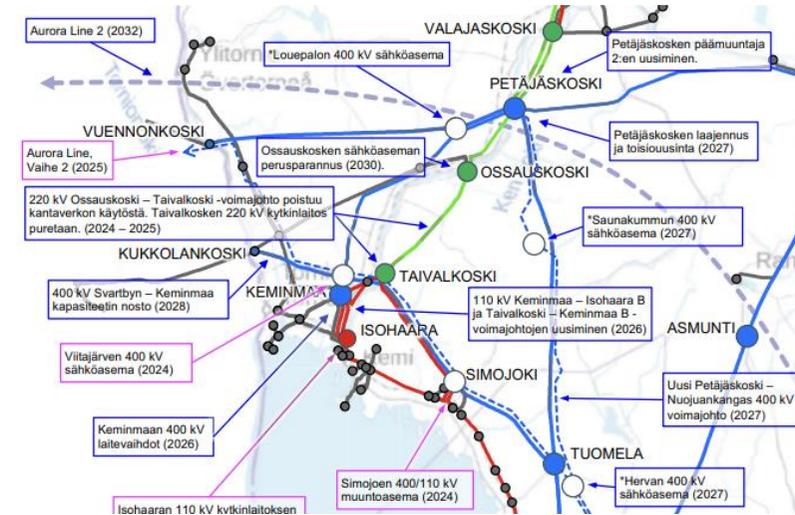
The existing substations in the area are located in Elijärvi (Elijärvi mine), the Keminmaa centre, Mykänmaa, and Alapaakkola.



The electric grid in Keminmaa. Blue 400 kV, green 220 kV, and red 110 kV power lines. Mykänmaa substation is marked with green dot.

The development plan for the main grid 2024–2033 (Fingrid) includes several measures for the Keminmaa area. A new cross-border transmission line, Aurora Line, is under construction between Finland and Sweden, to increase electricity transmission capacity between the countries. In Finland, Aurora Line runs from the Pyhänselkä substation in Muhos through the Simojoki substation to the Viitajärvi substation in Keminmaa, and then to the border via Ylitornio.

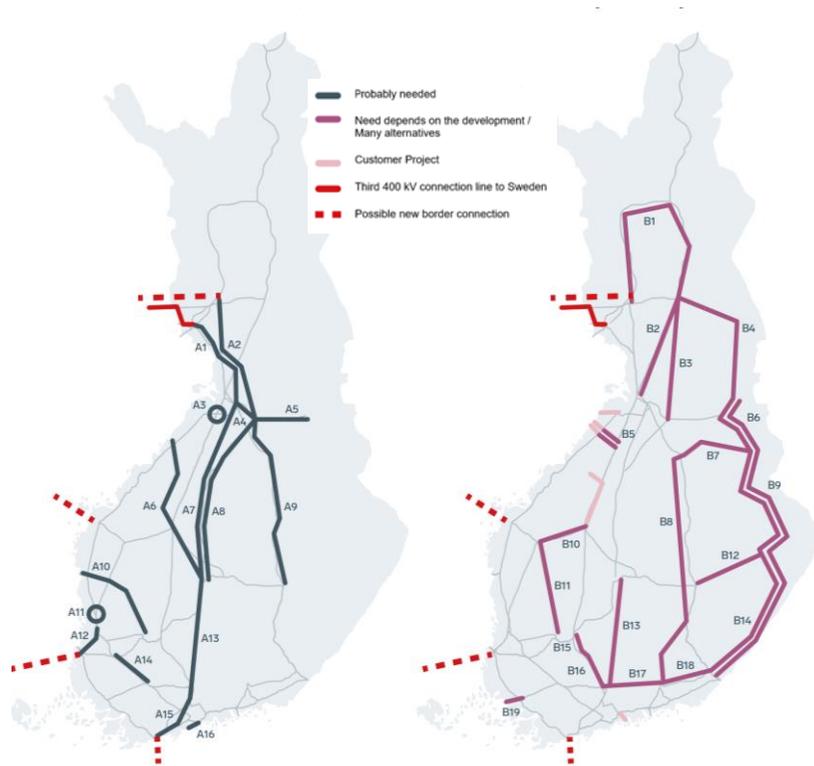
Provisions have been made for increasing capacity with Aurora Line 2, which is scheduled for implementation in Fingrid’s development plan for 2032.



Excerpt from the main grid development plan 2024–2033 (Fingrid).



Power lines in the landscape (photo: Päivi Keisu).



Excerpt from Fingrid's grid vision. Overview of identified grid reinforcement needs for the year 2035. The line routes illustrate the need for electricity transmission between substations and may not necessarily correspond to actual transmission routes.

The national hydrogen network is being developed by Gasgrid Finland. In the national hydrogen pipeline network plan, the hydrogen pipeline route (Nordic Hydrogen Route) runs along the west coast. According to the preliminary plan, the hydrogen pipeline will run near the central area of the municipality of Keminmaa, following the coastline.



Kuva: Lapin materiaalipankki / Photografix.

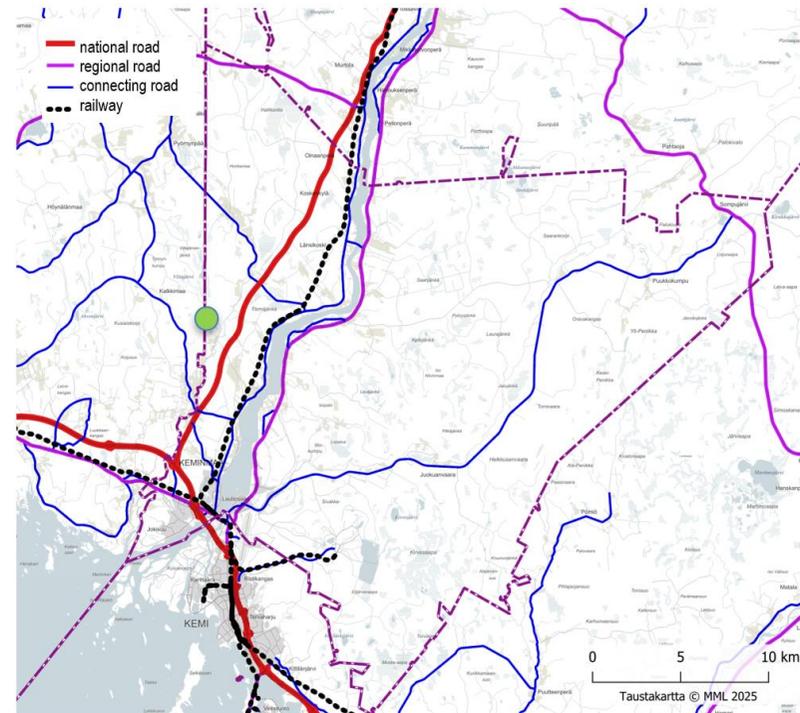
Traffic and transportation

The municipality of Keminmaa has good transport connections. National road 4, which is also part of the European TEN-T road network, passes through the municipality. Heading north from the central area of Keminmaa, national road 4 continues towards Rovaniemi, while national road 29 extends towards Tornio. From Tornio, there is a road connection to Sweden and north towards Kilpisjärvi and all the way to Tromsø via national road 21 and European Route E8.

Other road connections serving local traffic in the municipality include regional road 926 (Tervolantie) running along the east side of the Kemijoki River, connecting road 9262 (Kivalontie) running from the center to Sompujärvi, and regional Road 923 (Kiviojantie-Alaniementie) in the eastern part of the municipality.

A main railway line runs through the municipality. The railway branches off at Laurila, heading north to Rovaniemi and west to Tornio, from where there is a connection to Sweden as well as north along the Tornio river to Kolari. There is currently an unused spur line from the main railway to the Elijärvi mine.

Kemi-Tornio airport is located on the other side of the Kemijoki River, approximately 3.5 km by road from the center of Keminmaa. Port of Kemi is located less than 20 km by road from the center of Keminmaa.



Transportation network in Keminmaa. Mykänmaa substation is marked with a green dot.

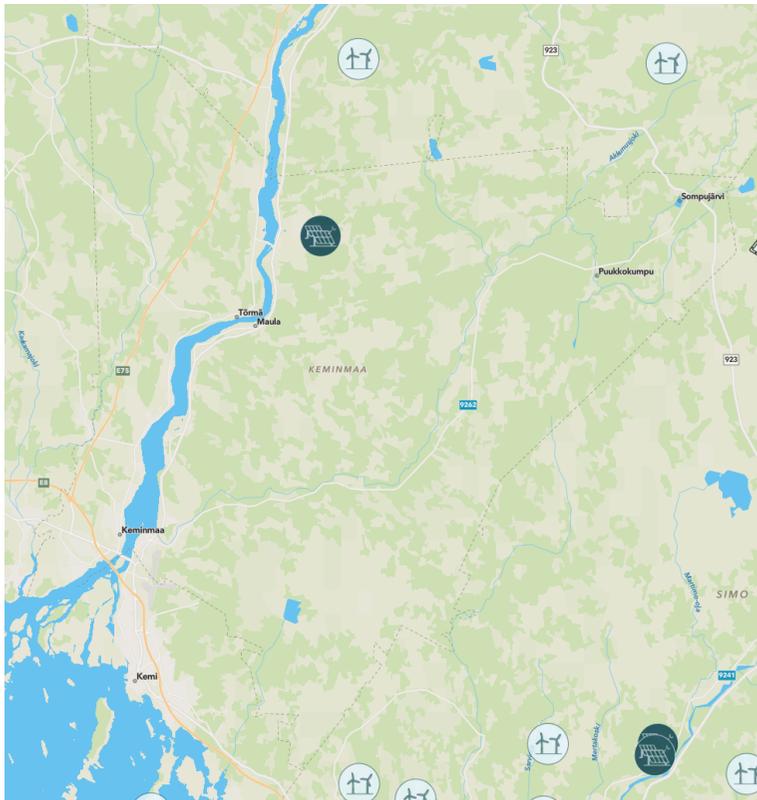


Photo: Lapin materiaalipankki / Petri Teppo

3. CURRENT SITUATION

Status of renewable energy production

Keminmaa has one permitted solar power area, Tompseli, with a planned capacity of 85 MW. The area covers 112 hectares. It is also possible to place a 30 MW battery storage on the site.



Status of renewable energy production in Keminmaa 5/2025. (source: Suomen uusiutuvat ry).

There are currently no wind power projects in the municipality. The municipal council of Keminmaa decided (8.5.2025 § 48) on the principles of wind power placement. According to the decision:

- The distance from permanent and holiday residences must be at least 2 kilometers. Minimum distances will be reviewed in project-specific noise and flicker modeling.
- It is prohibited to build wind turbines in Kivalot, namely the area south of Kivalontie, from Lautiosaari to the Sompujärventie intersection.
- Wind power areas can't be built on groundwater areas.
- In the vicinity of nature trails and riverbanks, visual representations by virtual photos are required, and distances will be determined in the planning process.



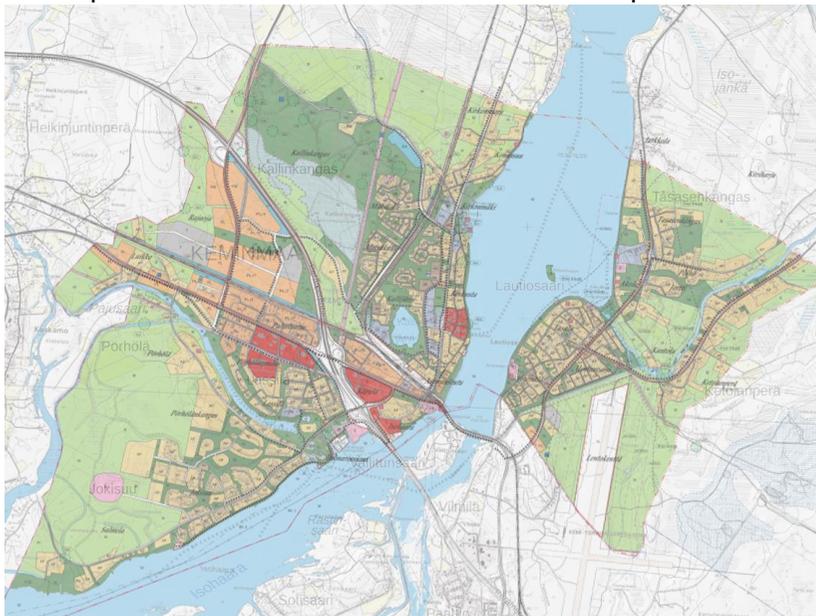
Photo: Lapin materiaalipankki / Nina Susi.

Planning situation

Master plans and local plans

In Keminmaa, areas with local plans include the central area, its surroundings, as well as the Lautiosaari and Pölhö areas.

A legally effective master plan for the central area of Keminmaa is in force. Master plan was confirmed on 13.11.2003. Local plans have already been made for the most of the planned construction areas in the master plan area.

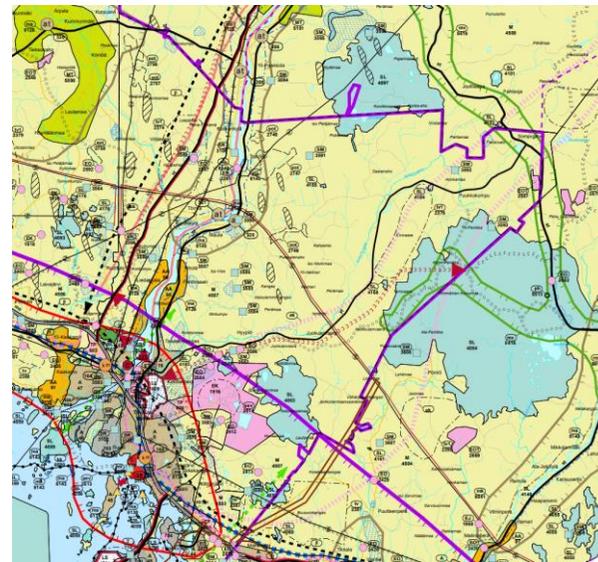


Keminmaa's master-planned area, which has a legally effective master plan for the central area (source: Keminmaa map service).

Regional plans

The Western Lapland regional plan is in effect in the Keminmaa area. The Regional Council of Lapland approved the regional plan on 26.11.2012. It was confirmed by the Ministry of the Environment on 19.2.2014 and entered into force on 11.9.2015.

Additionally, the Lapland security and transport phase regional plan 2050 is ongoing. The regional plan has been initiated on 24.1.2025. The phase regional plan deals specifically with issues related to transport systems and safety, but also indicates key areas for large industrial or warehouse buildings.



Excerpt from the Western Lapland regional plan.

4. RENEWABLE ENERGY POTENTIAL AND THE FACTORS TO BE CONSIDERED IN PLACING

The following describes the forms of renewable energy considered in the study and examines factors related to their placement.

Solar power

There are relatively few specific restrictions on the placement of solar power. From a land use and sustainable development perspective, it is good to place solar power in secondary land use areas, as well as in abandoned land areas or existing open terrain. It is good if the removal of existing trees is as minimal as possible.

In the solar and wind power study 2023-2024 conducted by the Regional Council of Lapland, two potential solar power areas were identified in Keminmaa. One area is 251 hectares east of Itäkoski, and the other is 161 hectares around Mykänmaa on the west side of national road 4 and the Kemijoki river.

Areas that are generally suitable for industrial-scale solar power plants include, for example, the following:

Description of the area	Definition
Areas outside intensive land use or areas that have ceased to be intensively used	Road and railway side areas, road and aircraft noise zones, disused agricultural areas, disused peat production areas, disused gravel extraction areas, contaminated land areas, landfill and filling areas, covered dump sites (gas tightness requirement to be considered)
So-called brown field areas	Disused industrial areas
Existing building stock	By placing solar panels in connection with the building stock or in existing areas, improving the use of the built environment and saving natural areas.
Water areas created by human activity	Dam basins, artificial lakes and other water areas created by human activity. Solar energy production area with floating foundation structure.
Power line routes	Construction on power line routes is limited, but possible. In principle, a structure placed on a power line route can be a maximum of 2 meters high and must be located outside the building restriction area, taking into account the safety distances to power line poles and maintenance routes.
Wind power areas	Wind and solar energy complement each other. The area has an existing service road network and electricity connection. Ice falling from

	platforms and shading from turbines affect the placement of panels.
Areas with high energy consumption	Areas with large industries or areas close to them. The proximity of energy consumption contributes to the profitability of solar panel investment.
Accessibility	Areas that are easily accessible (near roads) and have no obstacles to cable trenches
Connection to the electricity grid	Regionally significant solar energy production plants are in principle connected to the 110 kV grid, at a maximum distance of approximately 15 km (the technically and economically reasonable distance depends on the capacity of the production plant). Other decentralized energy production in the area (wind power, solar energy) may affect the possibilities of grid connection. In principle, wind and solar power can be combined.
Locality	Areas where the generated electricity can be utilized to the maximum extent (industrial plants and commercial areas) or property networks where electricity can be transferred via internal electricity transmission within a property or group of properties.

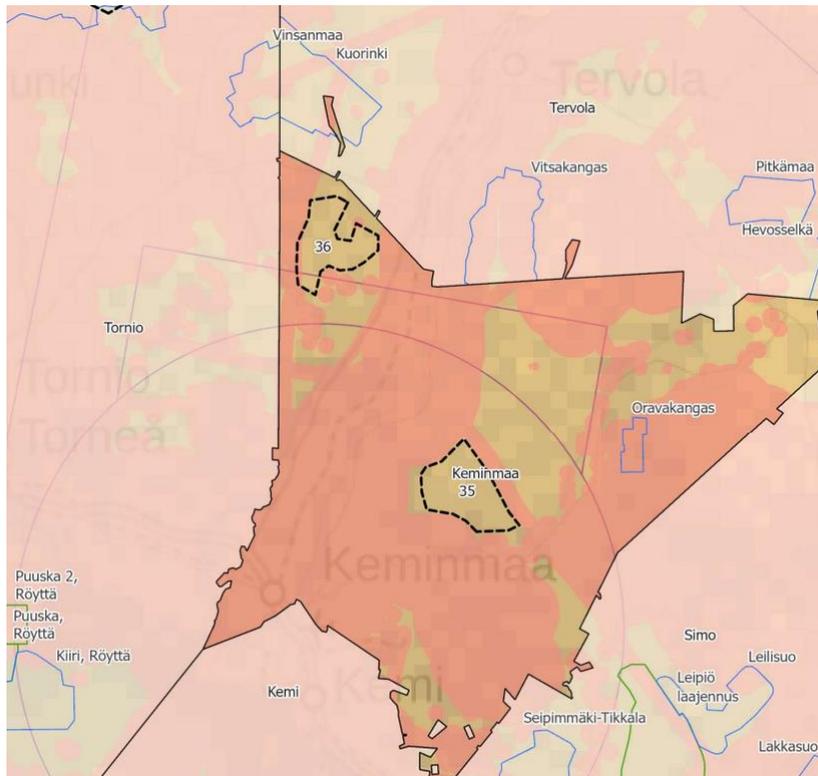
Source: EMMI project (Council of Northern Ostrobothnia).

Wind power

Restrictions on the placement of wind power production are primarily due to residential buildings and secondary homes (due to noise impacts, among other things), valuable natural and landscape areas, and the location and capacity of the electricity transmission network. The proximity of Kemi Airport limits the placement and height of turbines in the southwestern part of the municipality.

In the Western Lapland regional plan, two areas in Keminmaa have been designated as suitable for planning regionally significant wind power production. One is located near national road 4 in the northern part of the municipality, and the other is near Kivalontie close to the Penikat area. Other than regional scale wind farms can also be located outside the areas designated for wind power in the regional plan.

In the Lapland solar and wind power study 2023-2024 conducted by the Regional Council of Lapland, two other potential wind power areas have been identified in Keminmaa: Järvenpalo and Honkamaa. The Järvenpalo area is located in the northwest part of the municipality, west of national road 4, near the Tervola border. Honkamaa is in the central part of the municipality east side of the Kemijoki river. These areas could accommodate approximately 30-40 wind turbines in total.



Potential wind power areas identified in Keminmaa in the Lapland solar and wind power study 2023-2024.



Photo: Lapin materiaalipankki / Nina Susi.

Green hydrogen

In the green hydrogen production process, water is split into oxygen and hydrogen molecules using electricity. The electricity used in green hydrogen production is generated from renewable energy sources, such as solar or wind power. Another way to produce ecologically sustainable hydrogen is to use biomethane from biogas in an electrolysis process.

The placement of hydrogen facilities requires proximity to electricity generated from renewable energy sources, an electricity transmission network, water resources, and a gas pipeline or transportation network (road or rail) for hydrogen or its derivatives. To utilize waste heat, it would be beneficial to have a district heating network or other operations that can make use of the waste heat nearby.



Photo: Lapin materiaalipankki / Marko Junttila.

5. POTENTIAL AREAS

Mapping of key areas for industrial activities and renewable energy began by determining areas where such activities cannot be located. By taking these areas into account, significant environmental impacts can be minimized. Based on spatial data analysis, "no-go" areas were mapped. These are areas where the placement of renewable energy on an industrial scale is primarily not possible.

In the analysis, the absolute "no-go" areas are primarily:

- Immediate proximity of residential areas and secondary homes (approx. 500 m)
- Nature protection areas, Natura2000 areas
- Nationally significant built cultural environments (RKY)
- Valuable landscape areas
- Valuable bird areas

Also factors that do not prevent industrial operations but need to be considered in project planning were mapped. These factors include groundwater areas, soil conditions, existing planning status (regional, master, and detailed plans), land ownership, restrictions imposed by air traffic, and terrain topography.

The study also examined factors whose proximity would benefit several industrial technologies. Such factors include proximity to fresh water, proximity to the national and lower-level electricity transmission network and transformers, considering known future network visions, good logistical accessibility, existing industrial areas, other brownfield areas, air traffic, ports,

railway networks, and existing municipal infrastructure. Regarding the electrical grid, available capacity must also be considered, although it has not been examined in detail in this study.

Location review of potential areas

Following the "no-go" area analysis, potential areas for renewable energy were mapped. The starting point was the location of existing power lines and transmission lines. Potential locations were particularly sought within maximum distance of approximately five kilometers from the Keminmaa substation. The analysis highlighted the Mykänmaa area north of the substation. Additionally, it included the industrial area, and its surroundings located in the northwestern part of the central area of Keminmaa. Although this area is more than five kilometers from the substation, it was included due to its accessibility and nearby infrastructure.

Solar power location review

Possible locations for solar power were assessed within a 2.5 kilometer radius from substations and 110 kV power lines. While there are suitable sites for solar power located farther from power lines, the cost of constructing transmission lines often becomes a threshold factor in these cases. Therefore, the maps only show the most potential areas near substations and power lines.

A report of the potential and status of renewable energy forms in the Keminmaa municipality (Granlund Oy) was prepared in 2023. This study identified potential areas for solar power using

various criteria. These identified areas are included in the adjacent map.

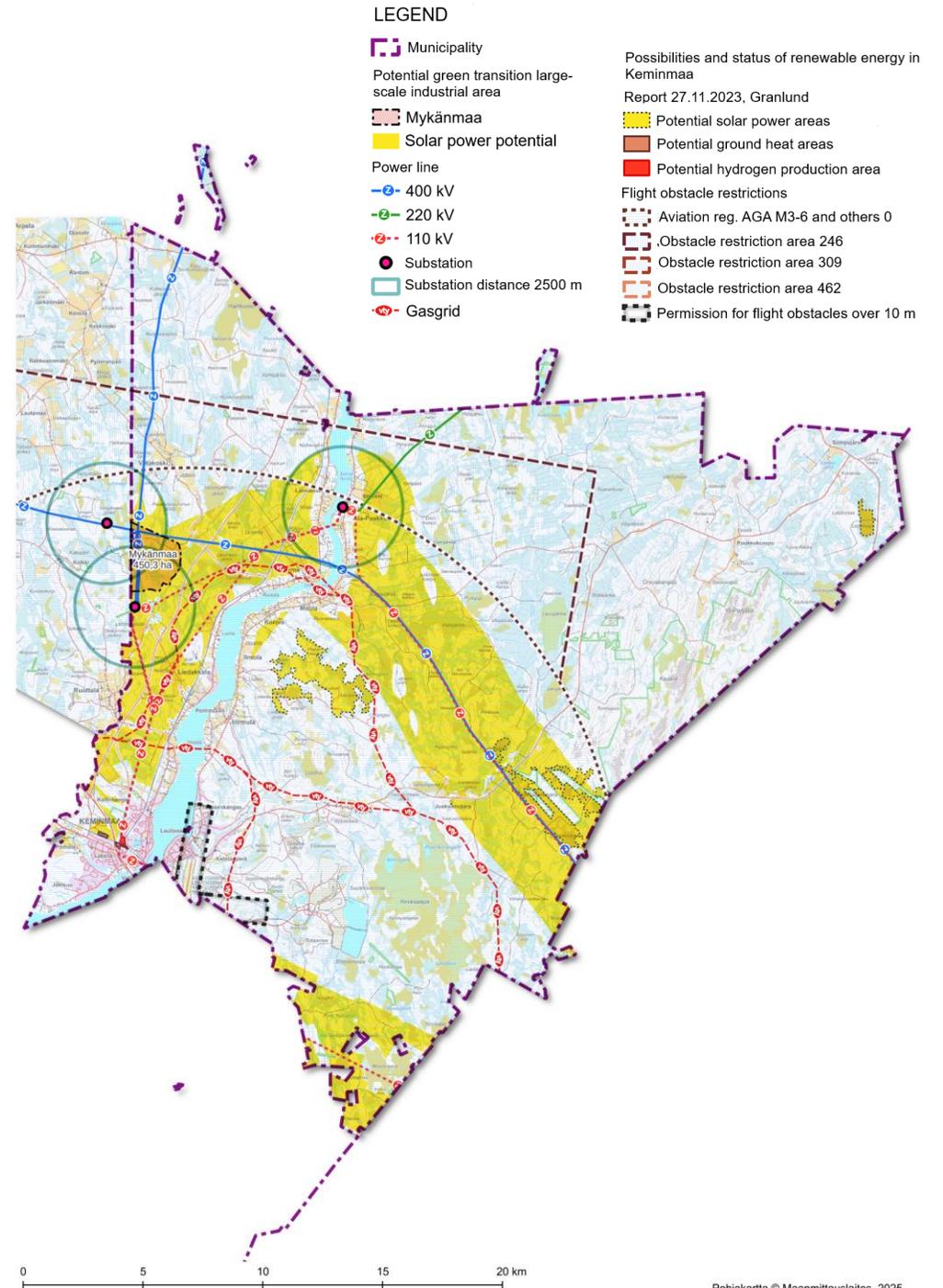


Close-up of a solar power plant. (photo: Lapin materiaalipankki / Photokrafix).



Keminmaa substation (photo: Leena Pehkonen).

On the right: Potential solar power areas, green transition large-scale industrial areas, electrical lines, and planned hydrogen pipeline routing in the municipality of Keminmaa.



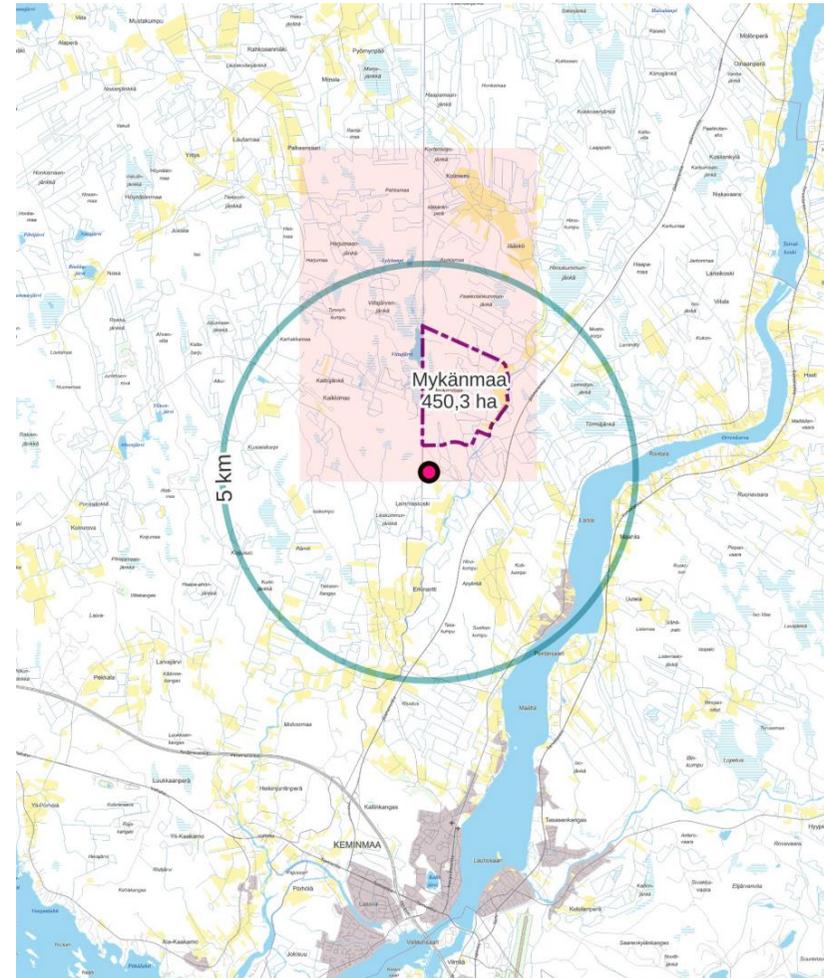
Mykänmaa

The area is located approximately 9 kilometers north of Keminmaa center, south of Fingrid’s Keminmaa substation. The area covers 450 hectares.

Location and accessibility

Mykänmaa is located approximately half a kilometer away from Jäämerentie (national road 4/E75) at closest. There is an access route from Jäämerentie to the substation that is situated south of the area. Forest roads run through the northern part of the area. The Kemi-Rovaniemi railway runs approximately 2.5 kilometers east of the area at its nearest point. Utilizing the area for industrial purposes will require new road connections from national road 4.

The area currently consists mainly of forest and wetland used for economic purposes. There are no residential buildings or secondary homes in the area, but the nearest single residential building is located 500 meters south of the area. The closest residential buildings along the Simojoki river are about 700 meters from the area. The nearest settlements are located east of the area along the Kemijoki river in the villages of Liedakkala and Törmä, as well as north of the area in the village of Viitakoski. Several power lines run through the area, and a substation is located in the immediate vicinity.



The location of the Mykänmaa area in relation to the center of Keminmaa and the Keminmaa substation.

Planning situation

The area does not have a master plan or detailed plan. In the Western Lapland regional plan, the current Keminmaa substation with its power lines is indicated in the area. National road 4 is marked as a road with a need for significant improvement. Additionally, the area near the main road and railway is designated as a nationally important international transport corridor, known as the Barents Corridor. A need for a snowmobile route connection along the main road is also indicated.

The Kalli-Lautamaa ski trail runs through the area from north to south, with the Mykänmaa hut located along the trail. The ski trail connects the center of Keminmaa, Liedakkala, Viitakoski, as well as Arpela and Karunki in Tornio. There are no groundwater areas within the site, but the nearest ones are approximately 100 meters away to the west (Hannumatinmaa) and north (Pahkamaa). The nearest nature reserve is located 500 meters south of the area. The closest nationally significant built cultural environments (RKY) are situated along the Kemijoki River, about 4 kilometers away. The area spans over 16 different properties.

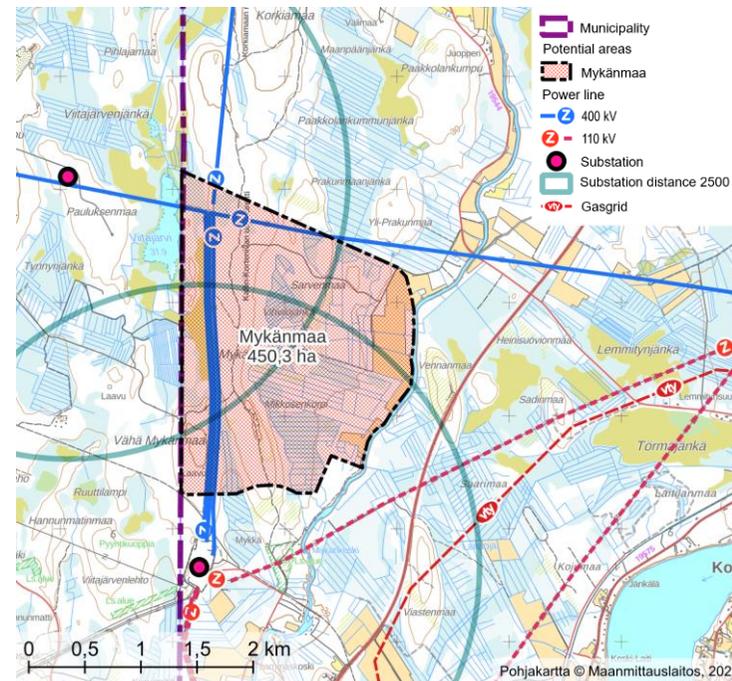
Availability of network-based utilities

The area is excellently positioned in relation to the existing electricity network. Fingrid's Keminmaa substation is immediately south of the area. The 400 kV national grid power lines run along the western and northern edges of the area, and there are also 110 kV power lines of Fingrid and other operators nearby. The planned Gasgrid hydrogen pipeline route passes close to the area.

Recommended actions and suitability of the area

The area can accommodate activities that require a significant amount of energy. Power lines running through the area should be taken into account in detailed planning. The recreational trails that run through and near the area should be considered and their routes adjusted if necessary.

Depending on the activity to be located, a master plan or local plan can be prepared for the area, especially if industrial activities and multiple different functions are to be established. Zoning is not required solely for solar power or battery storage.



An examination of the potential Mykänmaa area in relation to power lines, the preliminary alignment of the hydrogen pipeline, and substations.

Rajakangas-Rajaoja

The criteria for mapping potential areas required a maximum distance of 5 kilometers from the Keminmaa substation. As an exception to this criterion, Rajakangas-Rajaoja is included as a potential area due to its good transportation accessibility, existing municipal infrastructure, and zoning readiness for industrial activities. This area was also identified in the 2023 study on the potential and status of renewable energy forms in Keminmaa (Granlund Oy).

In the Western Lapland regional plan, the Rajakangas and Rajaoja areas are designated as employment areas. In the current master plan, they are designated for services and industry. On the Rajakangas side, the eastern part of the area already has detailed plans for an industrial area, which is currently mostly undeveloped.

Its location at the intersection of national roads 4 and 29 and alongside the railway makes the area the most accessible in the municipality. There is existing municipal infrastructure in and around the area, including a district heating network that can be used for waste heat utilization. Several 110 kV power lines from Fingrid and other operators run nearby, and Fingrid's Isohaara substation is approximately 1.5 kilometers away.

Dense urban settlement is located fairly close to the area, at a minimum distance of approximately 500 meters.



Excerpt from the current master plan.

6. CONCLUSION AND RECOMMENDATIONS FOR NEXT STEPS

Promoting projects in the Keminmaa municipality requires detailed planning and adequate studies. The planning of projects that require zoning is carried out in accordance with the Land Use Act. To promote clean transition projects, the municipality can prepare master plans and local plans, thereby increasing the zoning reserves that facilitate industrial-scale activities within the municipality.

All the areas presented are sufficiently large for large-scale industrial activities and energy production. When planning these areas in greater detail, there may be needs to consider the natural environments, which can likely be preserved due to the size of the areas studied here. In most cases, utilizing these areas will require zoning, although Rajakangas already has zoning readiness for industrial placement.

Areas containing natural values or those nearby (including groundwater areas) should be given special consideration and designated only for activities that do not endanger these natural values.

Areas close to residential areas are beneficial for industrial purposes (workplace areas) within the community structure, but the proximity to housing must be considered when placing industrial activities (e.g., noise, landscape impacts, and risks from accidents). When planning these areas, future land reservations

and other needs for residential and recreational areas should also be considered.

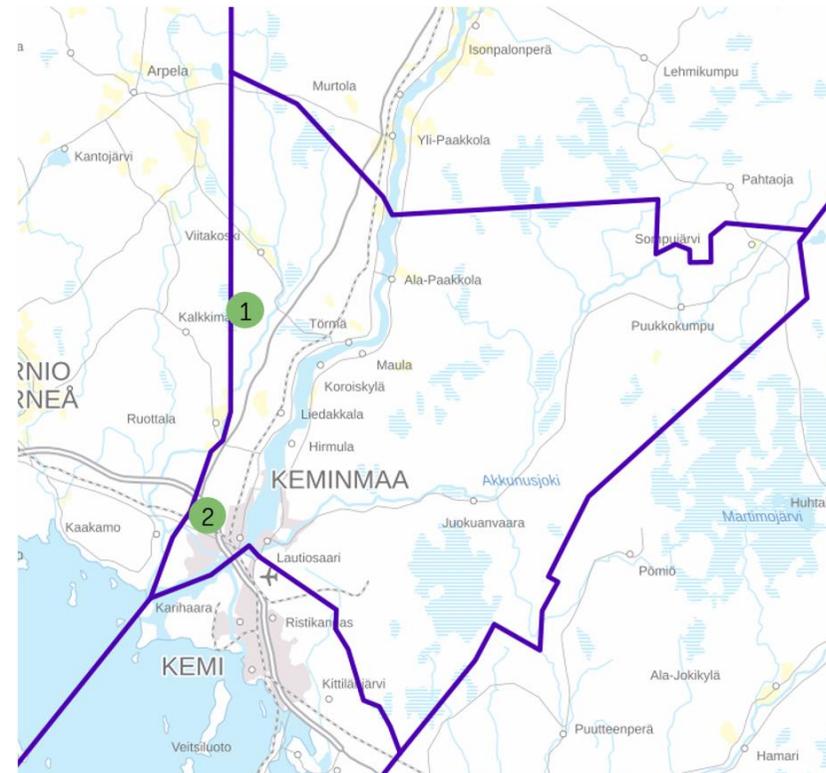


The Keminmaa business center is located in the immediate vicinity of the Rajakangas-Rajaoja, which has been identified as potential area. Photo: Lapin materiaalipankki / VisitSeaLapland.

Accessibility plays a significant role when planning extensive industrial zones. The area around the Keminmaa substation is fairly accessible in terms of transportation, although the areas situated near the center of Keminmaa are superior in this regard.

The importance of power transmission networks must be considered, but new power lines can also be implemented if the activities require them. The current capacity of the electricity

networks must be examined in detail. According to early 2025 data, Fingrid's Keminmaa substation has a production connection capacity of 910 MW at 400 kV and 130 MW at 110 kV. Consumption capacity is correspondingly 500 MW (400 kV) and 300 MW (110 kV). The Viitajärvi 400 kV substation near the Keminmaa border on the Tornio side has a connection capacity of approximately 1000 MW. Taivalkoski 110 kV substation has both production and consumption connection capacity of 100 MW. Additionally, the Isohaara switchgear can accommodate about 200 MW of consumption connection.



1. Mykänkangas ca. 450 ha
2. Rajakangas-Rajaoja ca. 100 ha