

Building wind power: The road operator's perspective



31.3.2023

Tuulivoimarakentaminen tienpitäjän näkökulmasta

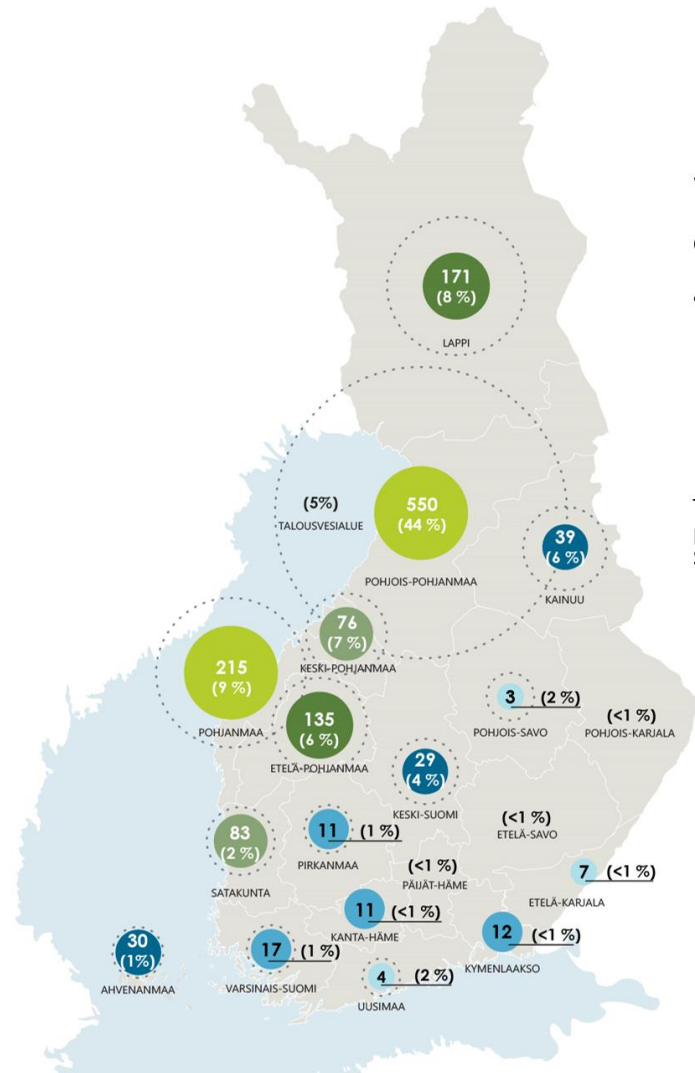


- The publication's permanent address in Doria is <https://urn.fi/URN:ISBN:978-952-398-121-8>

- In addition, the materials in Finnish can be found:

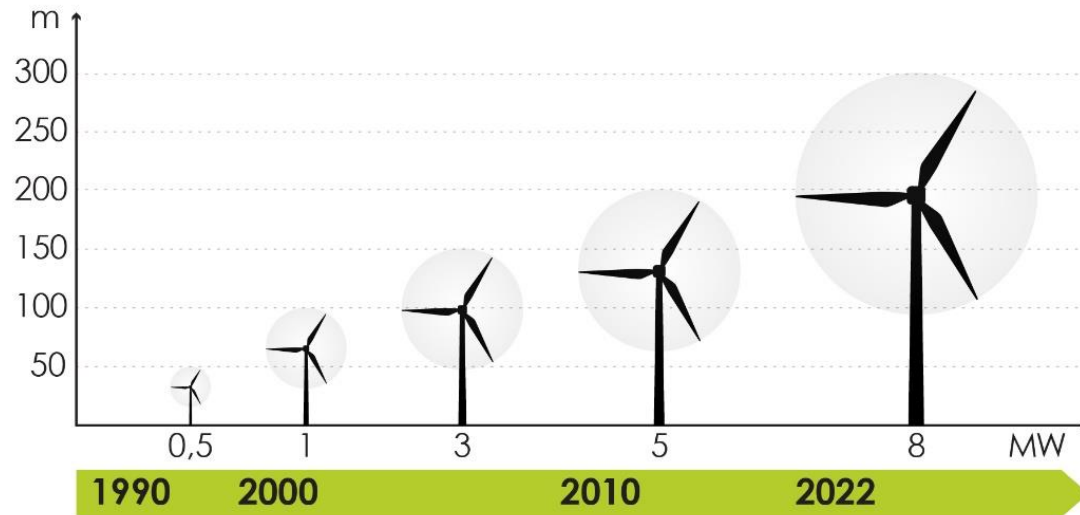
The screenshot shows the ELY-keskukset website. The header includes the logo and navigation links: Ajankohtaista, Asiointi ja yhteystiedot, Elinkeinot, Liikenne, Sivustus, Työ, Ympäristö, and ELY-keskukset. A search bar and language selector (Suomeksi) are also present. The main content area is titled 'Tiehankeet - Pohjois-Pohjanmaa ja Kainuu'. It contains several sections: 'ELY-keskukset' with a sidebar menu, 'Tiehankeet - Pohjois-Pohjanmaa ja Kainuu' with a description of the ELY's role, 'Pohjois-Pohjanmaan tiehankeet (vayla.fi)', and 'Kainuun tiehankeet (vayla.fi)'. A red arrow points to the 'Oikopolut' section, which lists the publication 'ELY-keskuksen raportteja: Tuulivoimarakentaminen tienpitäjän näkökulmasta (doria.fi) - diaesitys (pdf)'. Below it is the 'Muualla verkossa' section with links to 'Hailuodon kiinteä yhteys' and 'Poikkimaantie'.

Building wind power in Finland: overview



- At the end of 2022, Finland had a total of 1 393 wind turbines. Of these, 437 were built in that same year.
- At the beginning of 2023, zoning was under way for some 6000 turbines; another 1800 were in the pre-planning stage.
- Northern Ostrobothnia is the site of most of the country's present – and future – wind turbines.

Building wind power in Finland: overview



- In 1981, a typical turbine had a rotor diameter of 15 metres and a nameplate capacity of 55 kW.
- In 2022, plans allow for onshore wind turbines as high as 300 metres, meaning a capacity in the 8 MW range.
- In 2022 Finland's wind turbines produced 11.5 TWh of electricity, representing some 14 per cent of the country's consumption.

The wind turbine project: transport

Transporting aggregates, concrete and other supplies

- A single wind turbine project involves hundreds, if not thousands of transports of aggregates and concrete. These have significant impacts on the flow of traffic and traffic safety and cause structural stress affecting the roads, especially those in the lower road network.
- The number and direction of aggregate loads and the stress on the road network depend on whether the aggregate is crushed or extracted wholly or partially near the site, where the aggregate has to be hauled from and whether the site has a concrete mixing plant of its own.
- Transport of aggregate, concrete and other materials from beyond the wind farm site typically makes use of a route different from that used for the main wind turbine components.

Material	Number of transports		
	10 turbines (h = 250–300 m)	50 turbines (h = 250–300 m)	80 turbines (h = 250–300 m)
Aggregates * (turbine sites, maintenance roads) * The number of transports and the roads they use vary depending on the usability of the land resources extracted at the wind farm.	500–2 000	3000–10 000	4000–15 000
Concrete (foundations of turbines and maintenance buildings)	1000–1 500	5 000–8 000	8 000–12 000
Other transports and deliveries of goods	100–500	300–2 500	500–4 000
Work equipment and cranes	50–100	200–500	400–1 000

The wind turbine project: transport

Transporting the major components

- Vehicles hauling the blade average 100 m in length.
- The length of vehicles hauling tower sections is 30–50 m, height 5.0–8.5 m.
- The weight of the nacelle may be much as 140 tn.
- The Total weight of large-power transformer with additional towing and pushing units may exceed 400 tn. Large-power transformers are generally in a location different from the wind turbines → often involves a different transport route.
- The power station in a wind farm typically has one or two transformers smaller and lighter than the large-power transformer → generally transported to the wind farm using the same routes used for the main turbine components.

Material	Number of transports		
	10 turbines (h = 250–300 m)	50 turbines (h = 250–300 m)	80 turbines (h = 250–300 m)
Tower (4–8 transports/turbine)	40–80	200–400	300–700
Nacelle (1–3 transports/ turbine)	10–30	50–200	100–300
Blade (3 transports/ turbine)	30	150	240
Complementary components (1–3 transports / turbine)	10–30	50–150	100–300

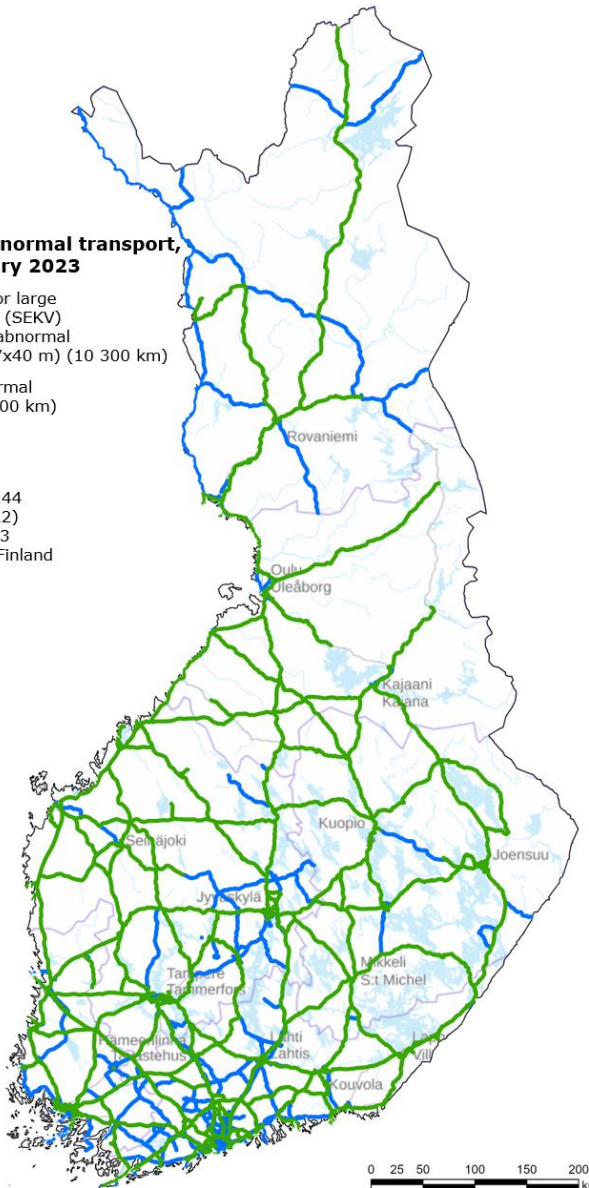


Transport routes

Road network for abnormal transport, as envisaged February 2023

- Network envisaged for large abnormal transports (SEKV) and complementary abnormal transport routes (7x7x40 m) (10 300 km)
- Complementary abnormal transport routes (5 900 km)

Source:
Road register, data type 144
(situation as of March 2022)
Background map NLS 2023
(National Land Survey of Finland)



- Choosing a route when transporting wind turbine components involves many considerations: the load-bearing capacity of bridges, the geometry of the roads, the load-bearing capacity of road structures and the underlying soil, overhead power lines, train and tram crossings, underpasses and width restrictions.
- The function of the Finnish road network for large abnormal transports (SEKV) is to ensure that such transports (7 x 7 x 40 m) are guaranteed at least the basic conditions necessary to operate on the country's road network.
- In transport involving the main components of wind turbines, rotor blades exceed the 40 m desirable maximum set for the envisaged SEKV.

Current challenges

- Dialogue between the wind power operator and road operator takes place late in the going, leaving too little time to arrange the necessary transports (permit process and any planning and implementation contracts).
- Reports on traffic and transportation drawn up in the zoning and any EIA stages do not find their way into later phases of the project. Turnover of wind power operators is common after the project-development phase.
- Inadequate clarification in the zoning and any EIA procedures of the transports and transport routes required by wind power construction, including those for transformers.
- It is unclear what permits and contracts are required for the demanding measures needed to transport wind turbines.
- Similar measures are carried out for the same site under different permits. The route ends up being modified and restored several times.
- When wind turbine transports have ended, restorative measures along the route are carried out later than they should be. This means that roadway illumination is out of service and guide signs are down for a long period of time.
- Challenges in directing traffic caused by wind power transports.
- A wind power operator has usually taken responsibility in financing measures aimed to improve the road network. This is seen most concretely on the lower road network.

Current challenges

- Commitment of resources during construction to the road maintenance contractor's monitoring of bridges. (Utilizing the use of SILLARI is desirable.)
- Investigating the load-bearing capacity data of road bridges and soil requires the cooperation of operators; statements, needs for reinforcement, conditions.
- Wind power transports have short time windows, which means an increase in adverse effects on other road users and those living and working along the transport route. Moreover, the time between the transport of the first and last main component of a wind turbine may be long. This means the modification measures carried out for transports will not be restored to pre-transport conditions in the interim, and temporary arrangements will be the norm on the ground for a long time.
- Foreign operators are not familiar with Finnish practices and conditions such as slippery roads and roads weakened by the spring and autumn thaw.
- The poor condition of the lower road network causes problems with load-bearing capacity, particularly during the spring and autumn thaw but at other times as well.
- Wind power transports may cause adverse effects on the environment (impacting endangered species, valuable landscape areas, natural landmarks, and the like).

Authorities and other parties overseeing wind power transports

Authority or stakeholder	Responsibilities relating to the road traffic system
Regional State Administrative Agency (AVI)	<ul style="list-style-type: none"> Grants environmental permits for wind power projects if a permit is needed. (See "Municipality").
ELY-L	<ul style="list-style-type: none"> Issues statements on zoning and EIA procedures for wind power projects in its area. Responsible for making a planning and implementation contract with the wind power operator for any large-scale measure required by wind power construction. Grants junction permits for highways, main roads and high-traffic regional roads. Issues statements as an affected neighbour on the location of cables and electric lines, for example, as well as on junction permits for the lower road network. Responsible for maintaining the description of the regional abnormal transport network and updating the information in the road information system. Where necessary, sets separate conditions and requirements for measures to be carried out under road work and junction permits. Responsible for compiling the statements on the load-bearing capacity of the roads in its district, for communication within the district and for updating route contracts. Communicates with the municipality about routes for abnormal transports in the street network.
ELY-L Procurement	<ul style="list-style-type: none"> Procures maintenance for highways as well as the related maintenance areas and equipment (maintenance/regional contractor). Serves as the managing authority for highway maintenance contracts. Oversees completion of measures carried out by maintenance contractors under road work, junction, exceptional, siting and corresponding permits. Oversees the functioning of exceptional arrangements caused by transports and restoration of pre-transport conditions. Oversees the completion of any measures to be carried out under an implementation contract.
ELY-Y	<ul style="list-style-type: none"> Issues statements on zoning for wind power projects in its district. Decides on whether an EIA procedure is applied if it is not required by the Act on the Environmental Impact Assessment Procedure Acts as the contact authority in any EIA procedure relating to wind power.

Authorities and other parties overseeing wind power transports

Authority or stakeholder	Responsibilities relating to the road traffic system
ELY-L-KAP (Pirkanmaa);	<ul style="list-style-type: none"> • Issues abnormal transport permits, preliminary decisions on abnormal transport permits, and road work permits. • Issues junction permits for connecting roads and regional roads with light traffic. • Issues permits on siting of electric lines, cables and pipes (depending on the case a siting permit, notification or road work permit).
ELY-Y	<ul style="list-style-type: none"> • Issues statements on zoning for wind power projects in its district. • Decides on whether the EIA procedure is applied if it is not required by the Act on the Environmental Impact Assessment Procedure. • Acts as the contact authority in any EIA procedure relating to wind power.
Traffic director for abnormal transports	<ul style="list-style-type: none"> • Responsible for directing traffic connected with abnormal transports • Ordinarily applies for the abnormal transport permit and, as need and the terms of the contract require, sees to it that the reports, permits and measures that an abnormal transport entails are in order before the transport takes place. • Sees to it that pre-transport conditions are restored following a transport.
Fingrid	<ul style="list-style-type: none"> • Responsible for determining the usability of large-power transformers and coordinating the cooperation needed to ensure the feasibility of the routes. • Issues statements on the impact that a wind power project will have on electricity transmission routes where the national grid is concerned.
Fintraffic Tie	<ul style="list-style-type: none"> • Responsible for changing the variable-message guide signs required by an abnormal transport. • Responsible for maintaining a current picture of road traffic, monitoring traffic, making announcements and managing disruptions.

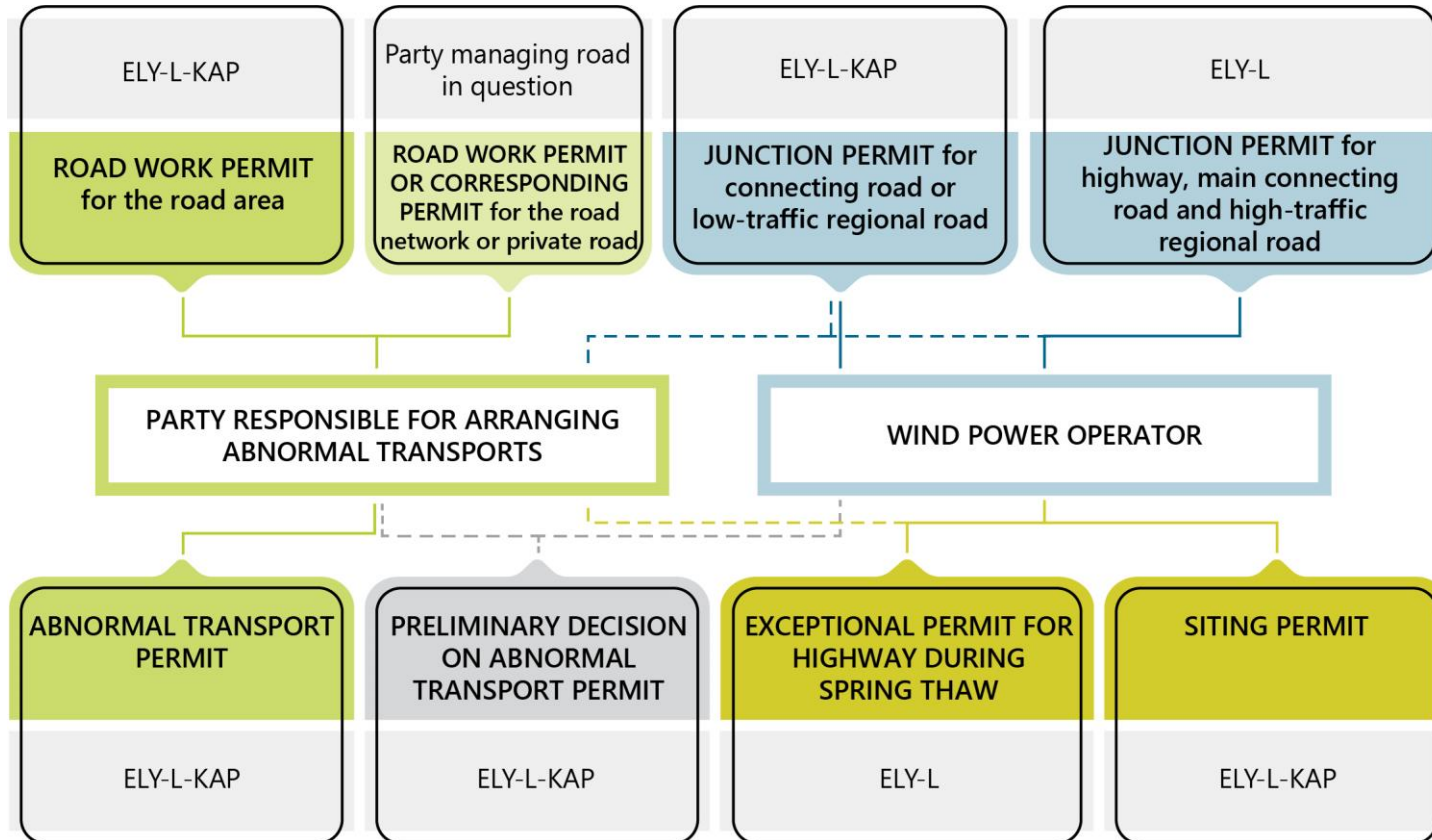
Authorities and other parties overseeing wind power transports

Authority or stakeholder	Responsibilities relating to the road traffic system
Highway maintenance contractor	<ul style="list-style-type: none"> • Carries out the work and maintenance specified in the ELY-L Procurements contract, procures the necessary materials and equipment and is responsible for quality and reporting. • Oversees the conditions of the roads. • Is responsible for bridge monitoring relating to wind power transports.
Transport company	<ul style="list-style-type: none"> • Handles transports taking place in normal traffic or as abnormal transports.
Municipality	<ul style="list-style-type: none"> • Is responsible for drawing up the master or detailed plans for wind power projects. • Grants building or action permits for wind power projects. • Grants environmental permits for wind power projects if limits are placed on the operation of the wind farm when it is in use. • Grants road work permits for measures affecting the road network that are required by abnormal wind power transports. • Issues statements on the impact of wind power projects on human health. • Determines the routes abnormal transports use on the road network. • Informs contractors and the party responsible for maintenance of the maintenance needed on the municipality's own abnormal transport routes.
Finnish Transport and Communications Agency (Traficom)	<ul style="list-style-type: none"> • Carries out a study, upon request, to ascertain that a wind power project will not have adverse effects on traffic and communications networks. • Issues, if necessary, a statement on the zoning for a wind power project. • Issues statements on water traffic for offshore wind farms. • Grants wind power projects permits to set up a facility, building, structure or sign which might cause confusion, interference or hazard to aviation.
Regional Council	<ul style="list-style-type: none"> • Responsible for the regional land-use plan (the plan guiding the building of wind power) • Issues statements on large wind power projects and their siting from the point of view of land use.
Land owner	<ul style="list-style-type: none"> • Leases (or sometimes sells) an area for the purpose of building wind power.
Rescue Authority	<ul style="list-style-type: none"> • Issues statements on wind power projects as they relate to safety concerns in its work.
Finnish Defence Forces	<ul style="list-style-type: none"> • Issues statements on the suitability of an area for wind power production.

Authorities and other parties overseeing wind power transports

Authority or stakeholder	Responsibilities relating to the road traffic system
Finnish Wind Power Association ry	<ul style="list-style-type: none"> In its capacity as a special interest organisation supports the development and operation of the wind power sector in Finland.
Wind power operator	<ul style="list-style-type: none"> Responsible for the work aimed at completing a wind farm, e.g., the zoning initiative, planning needs, building permit, as well as acquisition or leasing of land. Sees to applications for the permits for the measures occasioned by wind power transports as well as any planning and implementation contracts required by large-scale measures. Responsible for construction of the wind farm. Establishes on the basis of maintenance plans and contracts the need for abnormal transport routes as well as possible use of the routes when the wind turbine is operational.
Transport Infrastructure Agency	<ul style="list-style-type: none"> Defines the national target road network for large abnormal transports (SEKV). Provides guidance for wind power construction in the vicinity of transport corridors. Is responsible for matters relating to level crossings and rail lines. Issues statements on the bearing capacity of bridges in the abnormal transport permit process. Issues statements on waterways.

Permits and contracts required for wind power transports



ELY-L-KAP

Most traffic permit matters nationally are processed centrally by the Centralised Customer Services Unit (KAP), which operates under the Traffic and Infrastructure Division at the Pirkanmaa ELY Centre.

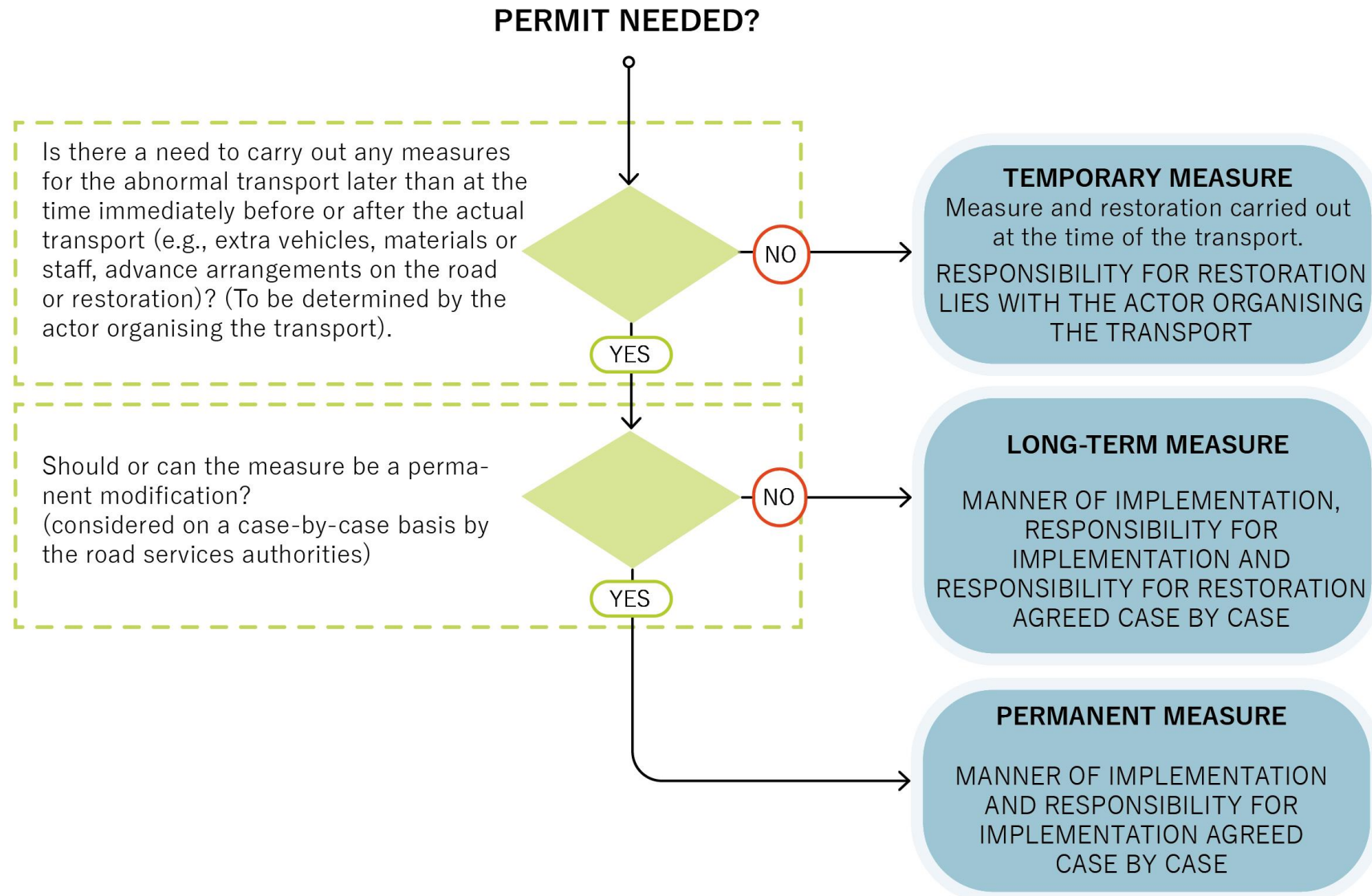
ELY-L

Regional/local unit of the Traffic and Infrastructure Division.

Wind power operator

Term referring to project developer as well as the owner and builder of a wind farm.

Grouping of road network measures



Suggested improvements

Importance of zoning and EIA for wind power transports

- Impacts on traffic should be assessed in greater detail using an **accessibility analysis**, to be drawn up in conjunction with the EIA procedure related to zoning for the project.
- Where modifications to the road network required by wind power transports are determined early enough, measures can be carried out in keeping with regulations and thus without causing delays for the entire project.

Accessibility analysis for wind power projects

Describes the road network around the wind farm and connections to nearby harbours.

Estimates the volume of heavy traffic caused by the project, traffic peaks and time windows for transports.

Estimates the number and size of wind turbines, enabling an estimate of the sizes and masses of the transports for the main components.

Maps out the transport routes for heavy loads for the different transports.

Assesses the need to request a preliminary decision on an abnormal transport permit. This serves to clarify problems with the load-bearing capacity of bridges and soils.

Determines the measures to be carried out on the road network to accommodate transports.

Assesses the need for permit and contract processing.

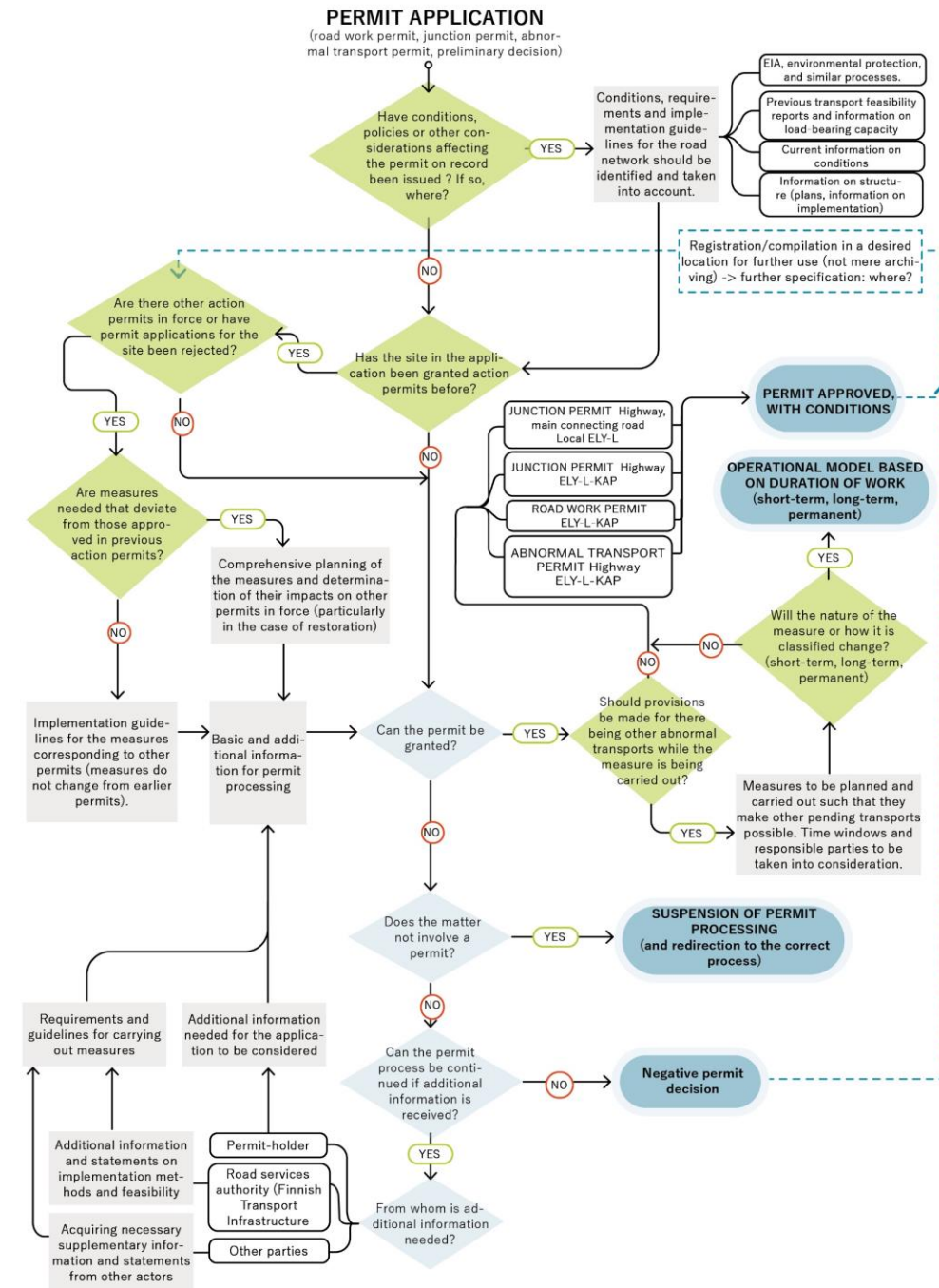
Maps out the groundwater areas and location of water extraction facilities along the potential routes.

Assesses which of the actors will be involved in the transports in the different phases of the project.

Suggested improvements

The permit process

- The permit process should be comprehensive, drawing on a knowledge of previous decisions and matters affecting the permitting process.
- The processing of a given permit should take into account other permit applications and related analyses that will be submitted for consideration during the validity of the permit in question.
- Measures should be planned and carried out to make possible other transports, thus avoiding repeated restoration of pre-transport conditions. Those seeking permits should agree in advance on the division of labour, responsibilities and costs of the measures. After the end of wind power transports, it must be ensured that restorative measures are taken in time, so that e.g. lights and guidance signs are out of use for as short a time as possible.
- An open interface should be set up for permit applicants allowing them to view the status of their existing permits via the HARJA service.
- An application like [Erikoiskuljetusapuri](#) could be created on the ELY website to show the user what permit or contract must be applied for in order to carry out a particular measure, whom the application must be sent to, and how long the process will take.



Suggested improvements

Rules of the road – road work or implementation permit?

- Principles should be established indicating which measures require an implementation contract.
- Measures carried out under an implementation contract should generally be permanent in nature and thus do not require restoration of the site.
- All measures that will be permanent should be documented in the information system.
- A 3rd party will be enabled to carry out the implementation of road improvement measures in a similar fashion as a road maintenance contractor.

Road work or implementation contract?

Measures requiring a road work permit

- Repair of the road base to improve the structure of gravel roads following damage from spring or autumn thaw.
- Constructing or redesigning a traffic island or verge to so that it can be crossed permanently.
- Raising a portal. However, ELY-L-KAP should receive any information on the stability, wind loads, etc. of the portal.

It the case of wind power construction, tasks carried out under road work permits include lifting and detaching electrified traffic control devices and lampposts, removing railings, making changes to intersections, constructing ramps to cross traffic islands, and strengthening the road base. Other such measures are felling trees, removing vegetation and widening the carriageway with crushed aggregate.

Measures requiring an implementation contract

Significant measure which is always a permanent change. These include:

- Building a new road connection
- Building a new intersection
- Changes in road geometry
- Changes in the cross-section of roads
- Building a new bridge
- Improving the load capacity of a bridge.

An implementation contract is made to carry out a measure set out in a road or construction plan. Implementation also requires that ELY-L-KAP has granted a road work permit for the measure.

Suggested improvements

Equipment, machines and supplies

- Continuous and unbroken signage is extremely important for the smooth and safe flow of traffic and is one of the central objectives of a guidance system. → If an existing sign is detached or removed temporarily for a transport, equivalent signage must be arranged immediately in a location readily visible to road users. Road users must always receive the same information from any replacement sign that the permanent sign conveyed.
- A lamppost, railing or the like should not be left near the road area in a location where it could be a hazard to road users. While transport-related measures are being carried out, the overall appearance of the road area should be as unobstructed, clean and well-maintained as possible.

Suggested improvements

Restoration

- Permits and contracts generally contain conditions requiring that a road area be restored to at least its pre-transport condition after a measure has been carried out. Moreover, while transport-related measures are being carried out, the overall appearance of the road area should be as unobstructed, clean and well-maintained as possible. It is important that particular attention be paid to supervision of restoration.
- It is proposed that permit applicants should agree in advance on the division of labour, responsibilities and costs relating to transports. If several road work permits are being issued for the same site, restoration should not have to be repeated after each measure has been completed.
- An open interface should be set up for permit applicants allowing them to view the status of their existing permits via the HARJA service.

Suggested improvements

Documenting measures

- All measures involving permanent changes should be documented in information systems.
- The Velho system, which brings together planning and implementation data for roads, will be used collect route information for abnormal transports as well as data on permanent changes affecting roads.
- When work is finished, the actor carrying out a measure will submit the final documentation and quality management material, compiled into quality folders, in electronic form.
- In the case of measures carried out under a road work permit, information on their completion will be sent when they have been carried out and following restoration of the route to pre-transport conditions.

Suggested improvements

Environmental considerations

- The accessibility analysis for wind power transports and, at the latest, the route feasibility report will indicate whether the route traverses a nationally or regionally valuable landscape area, groundwater areas or water extraction areas.
- Measures may not have adverse effects on groundwater areas or, unless permission has been obtained from the proper authority, endangered species, valuable landscape areas, natural landmarks or the like.

Suggested improvements

Forums for communication regarding wind power projects and transports

- Seminars and events with authorities and actors invited who play a role in wind power transports
- A project's zoning and EIA phase (if needed)
- Municipalities' development discussions according to Land Use and Building Act (municipalities, ELY-Y and ELY-L)
- Website of the Finnish Wind Power Association
- Website of ELY Centre
- Information boards on highways telling about wind power projects and their impact on traffic (low threshold in granting permits for information boards)
- Internal meetings of the road operating authority relating to wind power transports (ELY-L, ELY-L-KAP, ELY-L-Procurement, ELY-Y and the Finnish Transport Infrastructure Agency)
- Collaborative group of different actors to coordinate wind power transports
- Brochures
- Guidelines

Suggested measures by actor

ELY-L

- Will name the wind power coordinator for road services.
- Will comment on a project's accessibility analysis in conjunction with the zoning or EIA procedures.
- Will promote coordination in the scheduling and division of responsibilities for project-related transports and measures.
- Will ensure that the implementation plans are documented in the information systems.
- Will arrange internal meetings of the road services authority relating to wind power transports.
- Will see to it that a collaborative group is set up comprising different actors to support coordination of wind power transports.
- Will establish the abnormal transport needs for wind power and participate in guiding this work.
- Will work to improve recording in information systems of statements on road load-bearing capacity and routes.

ELY-L-KAP

- Will see to it that decisions, plans, policies and materials from earlier processes are introduced as the basis for ongoing permit processes.
- Will promote cooperation in permit processes with regard to how measures are carried out and the responsibilities for implementation and restoration.
- Will expedite the creation of an open interface for permit applicants allowing them to view the status of their existing permits via the HARJA service.
- Will create an application on the ELY website like [Erikoiskuljetusapuri](#) to show the user what permit or contract must be applied for to carry out a particular measure, whom the application must be sent to, and how long the process will take.

Suggested measures by actor

The Wind Power Association ry

- Will provide information on its website on transports for different projects, transport routes and time windows.

Finnish Transport Infrastructure Agency

- Will take responsibility for renewing the operational model for bridge supervision.
- Responsible for clarifying and developing the operating model related to bearing capacity studies

Municipality

- Will see to it that the master plan or EIA procedure includes the accessibility report for a project
- Will inform ELY-L and the Finnish Wind Power Association ry about the building permit for a wind power project.

Wind power operator/permit applicant

- Will enhance dialogue with the road operator on wind power projects.
- Will take responsibility for drawing up the accessibility and route feasibility analyses for a wind farm.
- Will take responsibility for carrying out measures affecting the road, restoring the road, and handling communications in accordance with the instructions in the relevant permits and contracts.
- Should agree in advance on the division of labour, responsibilities and costs relating to transports. If several road work permits are being issued for the same site, restoration should not have to be repeated after each measure has been completed.
- Will contact the municipality to discuss responsibility for the costs of arranging school transportation for schoolchildren if this becomes necessary due to project-related transports.
- Designates a road services coordinator.

Wind power transports: Operator's Checklist

Phase of wind power project	What to do
<p>Before building the project (4–6 years before completion of the windfarm)</p>	<ul style="list-style-type: none"> • Draw up a high-quality accessibility analysis for the project <ul style="list-style-type: none"> → Communicate with the actor drawing up the report → Communicate with ELY-L • Apply for a preliminary decision on abnormal transports <ul style="list-style-type: none"> → Communicate with ELY-L-KAP • Provide a statement showing affected neighbours have been consulted for any new junction <ul style="list-style-type: none"> → Communicate with ELY-L
<p>Building the project (0–2 years before building the wind farm)</p>	<ul style="list-style-type: none"> • Refinement of the accessibility analysis into a route feasibility report <ul style="list-style-type: none"> → Communicate with the person drawing up the route feasibility report → Communicate with ELY-L • Choose the most viable route for transports and determine the modification measures that have to be carried out on the route. <ul style="list-style-type: none"> → Communicate with the person drawing up the route feasibility report → Communicate with ELY-L → Preliminary decision on the abnormal transport permit from ELY-L-KAP • Measures required for planning and road work contracts <ul style="list-style-type: none"> → Communicate with ELY-L • Measures requiring permits <ul style="list-style-type: none"> → Communicate with ELY-L-KAP on the road work, abnormal transport and siting permits, junction permits and abnormal transport permits for connecting roads and low-traffic regional roads as well as preliminary decisions on abnormal transport permits. → Communicate with ELY-L on an exceptional permit for transports under spring thaw conditions as well as junction permits for highways, main connecting roads, heavy-traffic roads and regional roads • Implementing measures <ul style="list-style-type: none"> → Secure the services of a contractor who fulfils the quality requirements (highway maintenance contractor or other) • Approval of a measure <ul style="list-style-type: none"> → Implement as instructed in the permit or contract • Restoration to pre-transport conditions <ul style="list-style-type: none"> → Implement as instructed in the permit or contract
<p>After completion of the project</p>	<ul style="list-style-type: none"> • Need for and possible use of the abnormal transport routes for the wind farm <ul style="list-style-type: none"> → Communication with the abnormal transport liaison at ELY-L.

Conclusions

- The road operator would like to work to slow climate change, to increase the role of green energy and develop its operations collaboratively with other actors. This commitment will create a road network that contributes to an optimal level of service for wind power transports without undue inconvenience for other road users or those living and working along the transport routes
- Transports connected with wind power are challenging in terms of number, size and masses, and finding appropriate routes is difficult without somehow having to modify the road network. This a challenge for all the parties involved and can be best overcome when matters are duly clarified, measures are begun in good time, and work is done collaboratively, with improved communication and interaction.
- Wind power operators have taken responsibility for financing the necessary improvement measures for the road network. This applies to the lower part of the road network near the wind farm. The construction of wind power parks and the related transport places a large strain on the road network, which is already in poor condition from the start. With the current funding, the ELY center has little chance of allocating measures to the lower road network.