TRAFIKVERKET

E-MOBILITY IN SPARSELY POPULATED AND BORDER AREAS

THE DEVELOPMENT, CONSTRAINTS, AND OBSTACLES

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Preface

This report is written by WSP on behalf of the Swedish Trafic Authority (Trafikverket), investigating the current status and possible actions to accelerate electrification in rural and border areas in the Nordic countries and autonomous regions.

The assignment is a part of of one of the subprojects in the program ”Accelerated electrification of road transport in the Nordics” during 2021 - 2024, financed by the Nordic Council of Ministers (Nordiska Ministerrådet). The purpose of the subproject is to improve the prerequisites for electrified road transport in rural areas, border areas and on islands.

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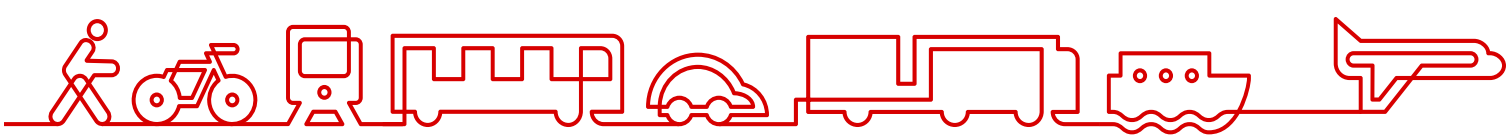
Glossary

Term	Description
EV	Electric Vehicle. Have a battery instead of a gasoline tank, and an electric motor instead of an internal combustion engine
BEV	Battery Electric Vehicle, powered by rechargeable battery packs with no secondary source of power.
PHEV	Plug-in hybrid Electric Vehicle. Combination of gasoline and electric vehicles, with both a battery/electric motor and gasoline tank/internal combustion engine.
Charger – Destination Charger	Aimed for overnight charging at the end of a leg during a multi-day long trip (slow charge), or a couple of hours while being at a destination This can usually be at or near a hotel, shopping mall, tourist site, Airbnb, or a friend's/family's house.
Charger – Fast charger	Aimed for a quick charge at a stop during a journey or outside the home. Enables drivers to recharge on a small break as opposed to being plugged in overnight, or for many hours, for a full charge
EAFO	European Alternative Fuels Observatory. European Commission's key reference portal for alternative fuels, infrastructure, and vehicles in Europe.



Summary

In the face of the current climate crisis, the use of fossil fuels and their adverse effects on the environment are concerning. Electric vehicles (EVs) are a promising alternative to fossil fuel vehicles, to reduce emissions and limit the impact of the transportation sector on the climate. While electrification of cars is growing in cities, adoption in rural areas is lagging.

The present study is led by the Swedish Transport Administration (Tra-fikverket) and forms a part of the Nordic Council of Ministers' implemen-tation of the Accelerated Electrification of Road Transport project in the Nordic region. It aims to collect feedback and lessons learned from stakehol-ders in the eight Nordic countries and autonomous territories – all of which have large sparsely populated areas – to better understand which challenges they face and thus suggest measures to foster electrification in rural areas. Through interviews with stakeholders and analyzing data and reports on the topic, a comprehensive picture of challenges and possibilities in the region emerged. The present report summarizes these findings and provides re-commendations going forward.

Overall differences were identified between the Nordic countries. Norway has spearheaded the global adaption of EVs, and thus face different issues than the other countries. The Faroe Islands and Åland are smaller commu-nities with archipelagic geographies, having different needs for and uses of vehicles. Greenland stands out with colder climates and different economical drivers, thus the views on EVs differ.

Many actors point out that the charging landscape is changing rapidly and that adaption of EVs has "skyrocketed" . Many note increased interest from the population and improvements in knowledge and awareness of e-mobility. According to some, this trend can be explained by rising fuel prices for fossil cars linking the segment growth to increasing economic benefits of EVs.

Economics largely impacts the development. Purchasing costs of EVs is cited as a central barrier to adaption, most often more expensive than a fossil fuel car. This is difficult to for many overcome in the absence of financial support or a used vehicle market that increases EV accessibility. This issue is however seen as a general phenomenon and not isolated to rural areas.

Rural areas face specific challenges such as lack of charging infrastructure and lack of willingness to install chargers in areas with low potential profits. Stakeholders mentions the "chicken and egg problem" - the difficulty to attract investors without an underlying market, but market growth is unlikely to pick up if the infrastructure is limited. Some actors mention governmental financial support as a key solution to this.

In rural areas, drivers usually travel long distances to reach their destination. Charging at home can often be sufficient to complete a round trip, without need for intermediate charging and increased range of vehicles has somewhat dampened the need for public charging. Many emphasize the importance of home charging as an enabler but many users are unaware the sufficiency of home charging. Thus, many interviewees emphasize the importance of increasing awareness on that topic.

Even so, the installation of fast chargers and destination chargers remains a necessity. Stakeholders emphasize that charging point density is a major factor in the decision to purchase EVs. People need to feel "safe" while on the road and not worry about charging availability. Furthermore, as e-mobility grows, queues at charging stations can become more frequent and absence of enough charging points a rising issue.

Providing charging opportunities can increase profits for the infrastructure owners but also local businesses. Attracting more potential customers if located near charging stations, this is especially true in tourist areas – e.g. Norwegian tourists driving to rural regions of Sweden, Denmark, and Finland

Other barriers largely follow regional trends with different issues in each country. While not as common, some regions acknowledge that there are still knowledge gaps about e-mobility, where many potential buyers doubt the ability of electric cars to operate in rural areas with difficult weather conditions. There are also doubts about the performance and range of EVs for heavy load transport or towing, which is a common use of cars in most rural areas of the Nordic countries. Most of these issues could be mitigated by increased awareness and knowledge as many barriers are based on false beliefs.

The benefits of increased awareness and visibility could be seen for instance in several countries with what stakeholders called the "spreading effect" – the threshold of adaption among the population where it becomes cumulative. Communication can be an effective tool to increase awareness and influence change in the right direction. The recommendations in this report focus on that aspect. A key aspect of effective communication is the active participation of public authorities in knowledge sharing. Communication to residents in rural areas can advantageously be done via municipalities or other local actors.

Public authorities and governments are important stakeholders in the transition. They provide the tools needed for planning, juridical and practical issues. Not least – they provide economical support for investments and substitutions. But they also have the capacity to spread knowledge, both through global and local communication actions.Several important issues will most likely not be solved through communication, for example economics, law, and energy issues. Communication efforts should therefore be seen as an important complement to other types of measures.

1. Introduction

As e-Mobility develops in the Nordic countries, cooperation has the potential to increase efficiency and pace of change. Since the Nordic regions consists of large areas that are sparsely populated, cars are likely to remain an important means of transport, stressing the importance of electrification to achieve lower environmental impact in the sector.

Electrification is an important strategy for the transport sector becoming fossil-free. The roll-out of EV:s proceeds at a rapid pace. As the number of vehicles increases, charging infrastructure needs to be expanded The development reinforces cross-functional cooperation between the energy and transport sectors, creating new collaboration areas between vehicle manufacturers, charging infrastructure operators, transporters, transport buyers, electricity grid companies, municipalities, regions, and ministries.

1.1. Purpose

In 2020, the Nordic Council of Ministers approved the implementation of the Accelerated Electrification of Road Transport project in the Nordic region. The project aims to increase the efficiency and pace of the transition process to an electrified road transport system by complementing the Nordic countries' own initiatives.

The project is set against the backdrop of two significant barriers to increased electrification. The first is a certain general perception that electrification of the transport sector is primarily an urban solution. The second is the perception that payment for EV charging is cumbersome. The project is led in its entirety by the Swedish Energy Agency, divided into two sub-projects

- Subproject 1 is led by the Swedish Transport Administration and includes information and knowledge-raising initiatives on electrified travel and transport in sparsely populated areas and border regions.
- Subproject 2 is led by the Swedish Energy Agency and aims to create increased Nordic consensus regarding payment solutions for charging.

This assignment, subproject 1, consists of a description of the current situation and analysis of obstacles and conditions for accelerated electrification in the Nordic countries - in border areas, sparsely populated areas, and on islands. This includes the eight countries/islands presented in Figure 1.

1.2. Delimitations

All Nordic countries are equally important in the assignment. Given the ambition to focus on how electrification of vehicles in rural areas can be accelerated, the description of the current state and the analysis will be conducted at a general level. The assignment will not go into detail e.g. on how attitudes and conditions in the form of infrastructure vary between different regions in each country.

Instead, an overview is given of available support in each country, general conditions for expanding charging infrastructure, and the level of knowledge and attitude of e.g., private individuals, landowners, traffic planners, and transport companies. In addition to passenger cars, the assignment touches upon electrification for heavy freight transport, long-distance (road bound) public transport, and conditions for electric bicycles / mopeds / motorcycles.

The assignment does not cover bus traffic in cities nor electrification in metropolitan areas, as circumstances differ, and the pace of development is already rapid. The assignment does not include hydrogen vehicles or PHEV hybrids.

Several actors in each country have been contacted for discussions and subsequent interviews on the different topics of the report. This does not, however, include all stakeholders in the field, and the findings do not suggest that this is a comprehensive view of all actors related to the field of e-mobility in the studied countries.

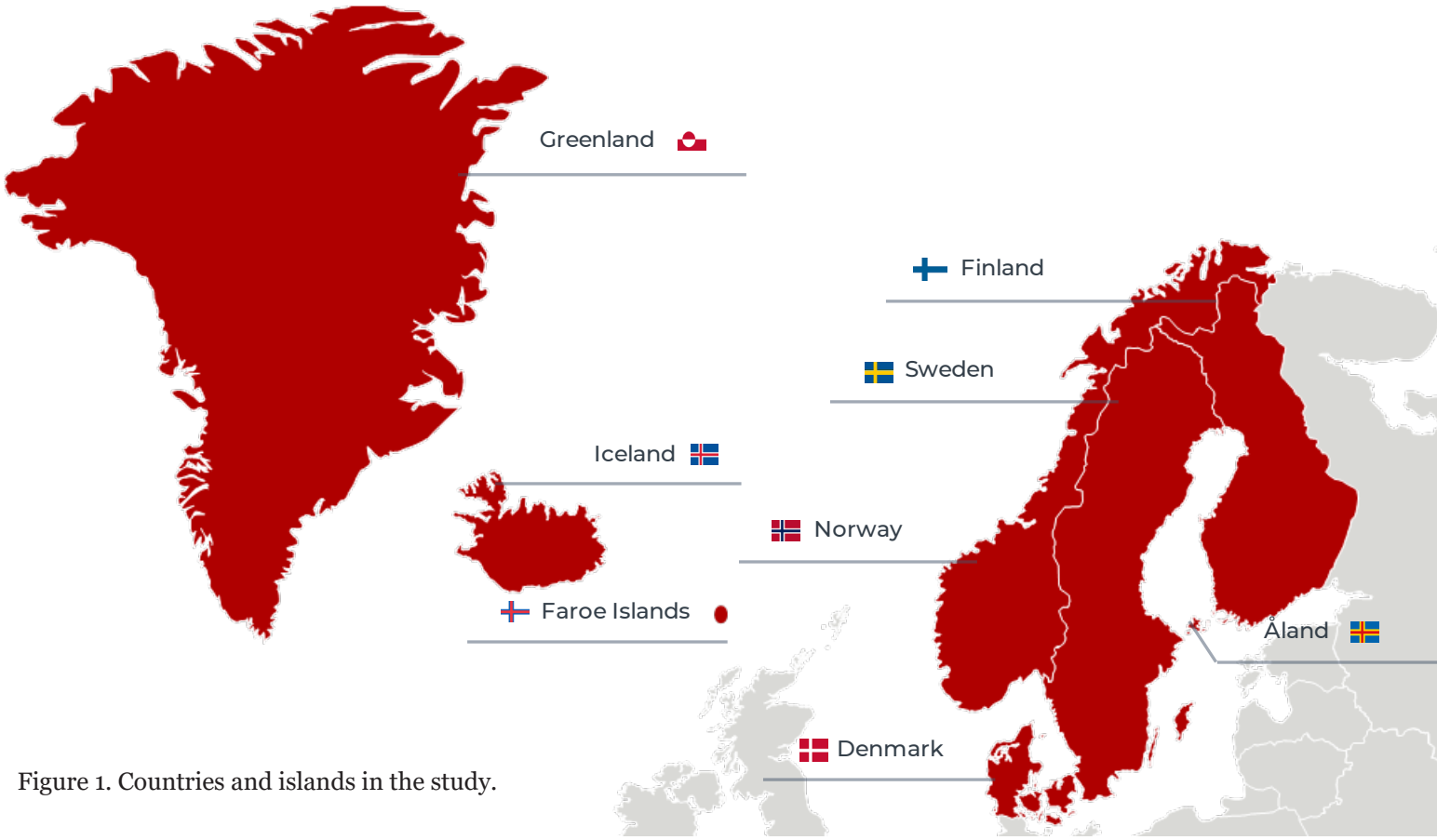


Figure 1. Countries and islands in the study.

1.3. Methodology

The study was divided into two parts – a review of relevant literature for the study and a qualitative collection of information on e-mobility in the countries, through interviews with relevant actors in the field. This chapter details the approach and methodology of the study.

1.3.1. General approach

Interviews provide this assignment with in-depth knowledge by understanding different stakeholders' interpretations and views on specific issues or opportunities. Additionally, the purpose is to gather more information and get a better understanding of the constraints, possibilities, and challenges within the topic of study.

Different groups of interest were identified, presented in Figure 2. This includes actors who have diverse responsibilities, interests, and points of view.

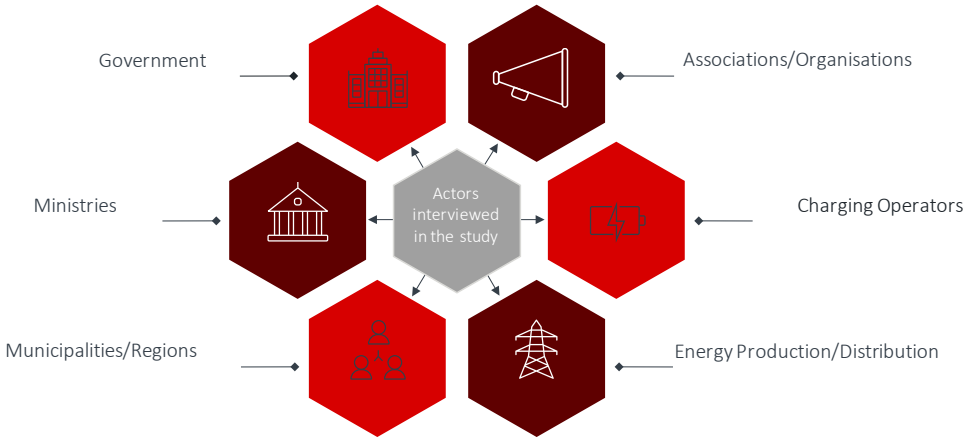


Figure 2. Groups of actors interviewed in the study.

The range of interviewees was intended to encompass all the groups of interest that were identified. In addition to covering as many of the different stakeholders as possible, the selection was made to cover as large geographical areas as possible. Since all the countries and islands were to be treated equally, the selection aimed to get a similar number of interviews from each country/island.

The selection was also based on having at least one interview in each country/island with a person with insight into how the overall development of EV proceeds, and at least one interview in each country/island with a person who has a local/rural perspective.

The interviews were chosen to be semi-structured since that format can widen the scope of knowledge by enabling new topics and questions to arise during the interview. A list of topics was prepared with associated questions, which allows for a more flexible dialogue between interviewee and interviewer. This enabled the stakeholders to elaborate more in-depth on their perspectives and gave us more flexibility to follow up with spontaneous questions during the conversation.

A literature review was conducted as a complement to the interviews. The aim is to help strengthen the validity of the interviews by comparing and validating the answers about some of the most frequently discussed matters. The literature review also provides a context for this report within the research field. The literature review isn't an exhaustive account of everything published on the topic, it is rather a compilation of some of the relevant documents identified through the study.

1.3.2. Proceeding

Interviews

The stakeholders interviewed were primarily found through the reference group from the Nordic council of ministries, internal contacts, internet research, or recommendations from other interviewed stakeholders. The selection of actors does not claim to be comprehensive, but should rather be seen as a few, small case studies within the topic.

A total of 25 interviews were carried out between 2022-04-26 and 2022-05-10. The interviews were approx. 30 min long and were held on Teams. In some of the interviews, two or more persons from the organization participated.

The same interview guide was used for all the interviews with small changes depending on the stakeholders' interests, knowledge, and experiences. A list of the interviews is presented in Table 1 (see appendix).

The map in Figure 3 shows the areas in which the actors who have a local or regional belonging operate. Actors who operate on a national level (except for the Faroe Islands and Åland) are not shown on the map.

Literature review

The selection of reports to review in the present study was mostly made on the recommendation of contacts with knowledge of relevant documents existing in each country. Others were found through referring reports. Table 2 (See appendix) briefly introduces the resources reviewed.

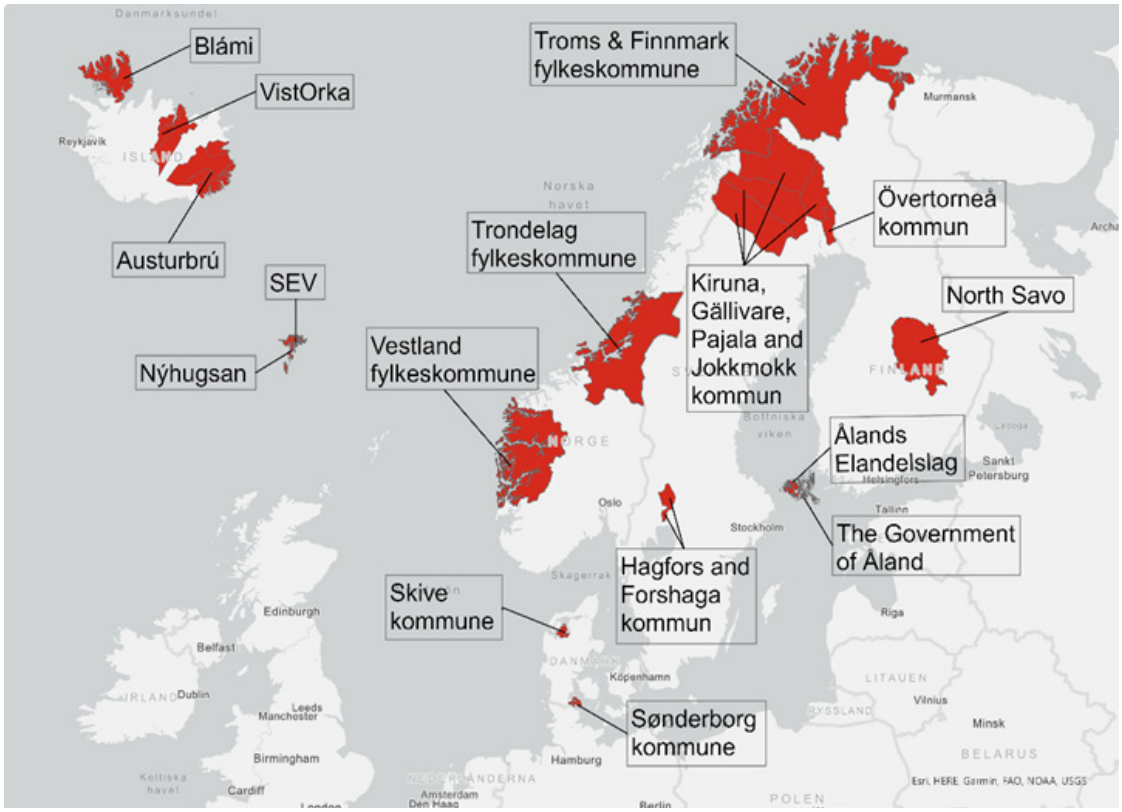


Figure 3 - Areas for actors with a local or regional geographical belonging

1.3.3. Discussion and limitations

Qualitative methods are used to find the answer to questions with depth rather than breadth helping the reader form a more profound understanding of the development of E-mobility and its role in rural and border areas.

The interviews will not create a comprehensive picture of electrification in rural and border regions but instead be seen as several case studies. This method enables depth through understanding a limited context, but the conclusions from the analysis are less generalizable as they can originate from specific circumstances within the case. One must be careful when comparing answers from the interviews as the different stakeholders have different roles and relationships with the subject.

Different perspectives enable a broader understanding of the topic, one of the strengths of interviews.Since no systematic approach was used to search through every piece of literature written on the subject, the review should be seen as a selection of relevant reports. It should also not be overlooked that the assortment is based on personal perceptions and knowledge of reports written on the subject, which makes the selection subjective.

No relevant documents have been found in Greenland or the Faroe Islands, probably due to language barriers and fewer documents within the matter. This makes these countries excluded from the literature review, which is a limitation. The field develops at a rapid pace, meaning that the results should be seen as a snapshot of the current state of affairs in spring 2022. Despite this discussion on identified limitations of the method, the chosen approach considers fulfilling the purpose of the study in terms of giving a deeper understanding of e-mobility in sparsely populated and rural areas.

2. Background - The development of e-mobility in the Nordics

This chapter aims to give the reader an understanding of the development of e-mobility in rural areas in the chosen countries. Looking into available data sources from relevant actors, the chapter aims to describe the development of electrification of transport, how different countries are progressing, and highlight possible differences within the Nordics.

2.1. Geographical distribution of EVs

The Nordic countries are all embarking on a process to electrify the transport sector, with EV adaption rising to a varying degree in the studied countries. In general, Norway leads the electrification with new registrations of EVs reaching 83% of all sales in March 2022 (Norsk elbilforening 2022).

The share of BEV for newly registered cars (the year 2021) in each country can be seen in Figure 4. The map shows the data region-wise in Sweden, Denmark, Norway, and Finland and country-wise on the islands. The sources of the data are shown in Table 3.

Table 3. Sources for data of car fleet composition.

Country	Source	Link
Sweden	Trafikanalys	https://www.trafa.se/vagtrafik/fordon/
Norway	Norsk Elbilförening	https://elbil.no/om-elbil/elbilstatistikk/
Finland	Traficom	https://trafi2.stat.fi/PXWeb/pxweb/fi/TraFi/TraFi__Liikennekaytossa_olevat_ajoneuvot/040_kanta_tau_104.px/
Denmark	Danmarks Statistik	https://www.statistikbanken.dk/statbank5a/default.asp?w=1920
Iceland	Samgöngustofa	https://bifreidatolur.samgongustofa.is/#tolfraedi
Greenland	Grönlands Statistik	https://stat.gl/dialog/main.asp?lang=da&version=202101&sc=EN&subthemecode=O1&colcode=O
Åland	Ålands statistik och utredningsbyrå, Fordonsmyndigheten	https://www.asub.ax/sv/statistik/motorfordon-2021, https://www.fma.ax/fordon/fordonsstatistik/fordonsbestand
The Faroe Islands	Akstovan	https://akstovan.fo/akstovan/hagtoel/hagtoel-yvir-akfoer-greina%C3%B0-a-drivmegi

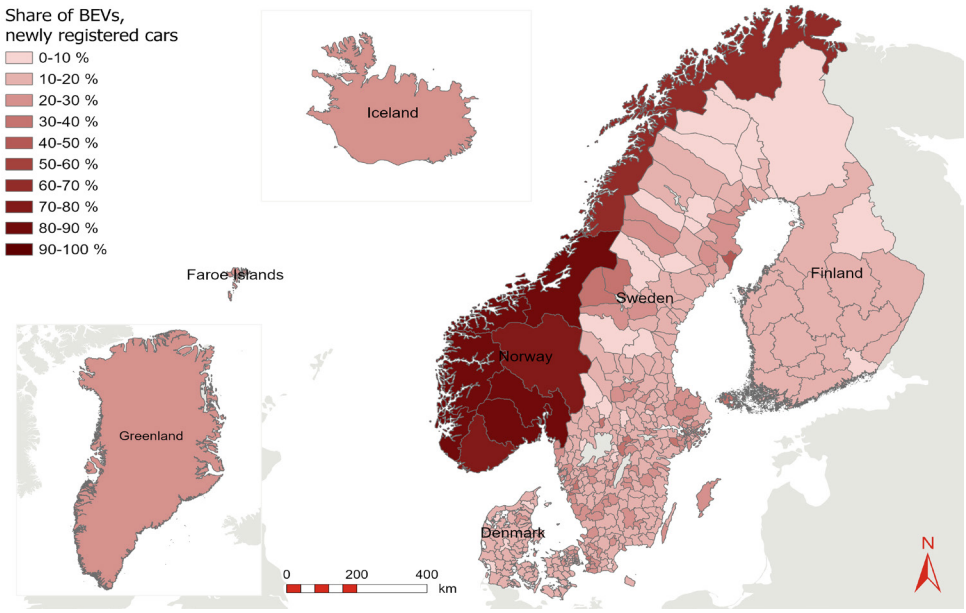


Figure 4 Share of BEV, new registerations, 2021. Country-wise on the islands, region-wise in Sweden, Denmark, Norway, and Finland. Company car leases are often registered where the main office is located.

Figure 5 shows the share of electric cars per country/island. The map shows the data region-wise in Sweden, Denmark, Norway, Iceland, and Finland and country-wise in Åland, the Faroe Islands, and Greenland.

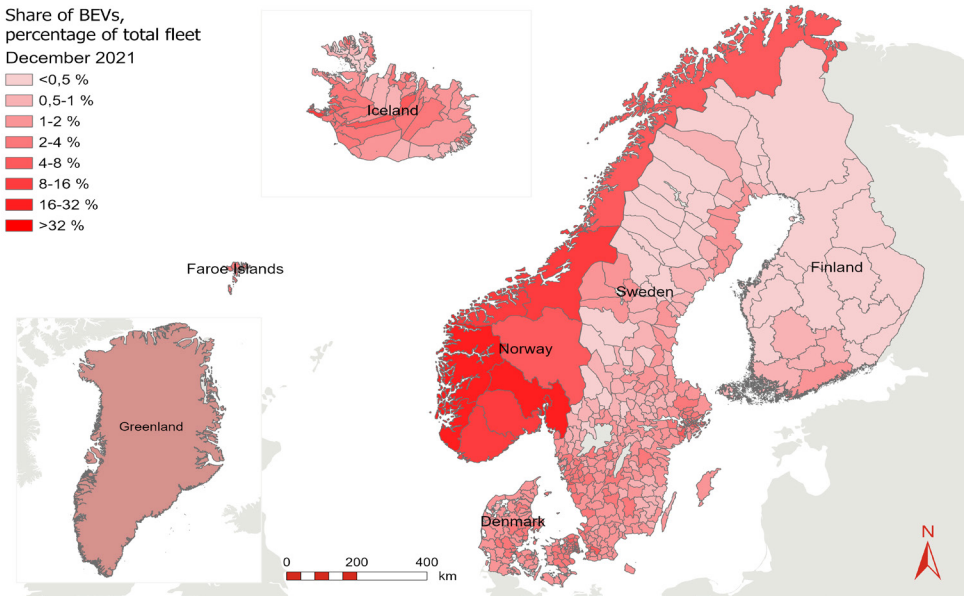


Figure 5. Share of electric cars (BEV) (percentage of total registered fleet, December 2021. Country-wise on the islands, region-wise in Sweden, Denmark, Norway, Island, and Finland. Company car leases are often registered where the main office is located

Norway is leading the development with the highest share of electric cars (BEV) in the passenger car fleet. The map illustrates how the share of electric cars is generally higher in metropolitan than in more sparsely populated areas. Finland stands out as a country with a relatively low share of electric cars. Greenland has a

surprisingly high share of BEVs. Since the number of cars in Greenland is low, the number of EVs does not need to be high to generate a high share.

Figure 6 shows EVs as a share of newly registered cars from 2017 until today for each country. No data was found for Åland, The Faroe Islands or Greenland. For Iceland, no data where to be found before 2019. The sources for the data are the same as shown in Table 3.

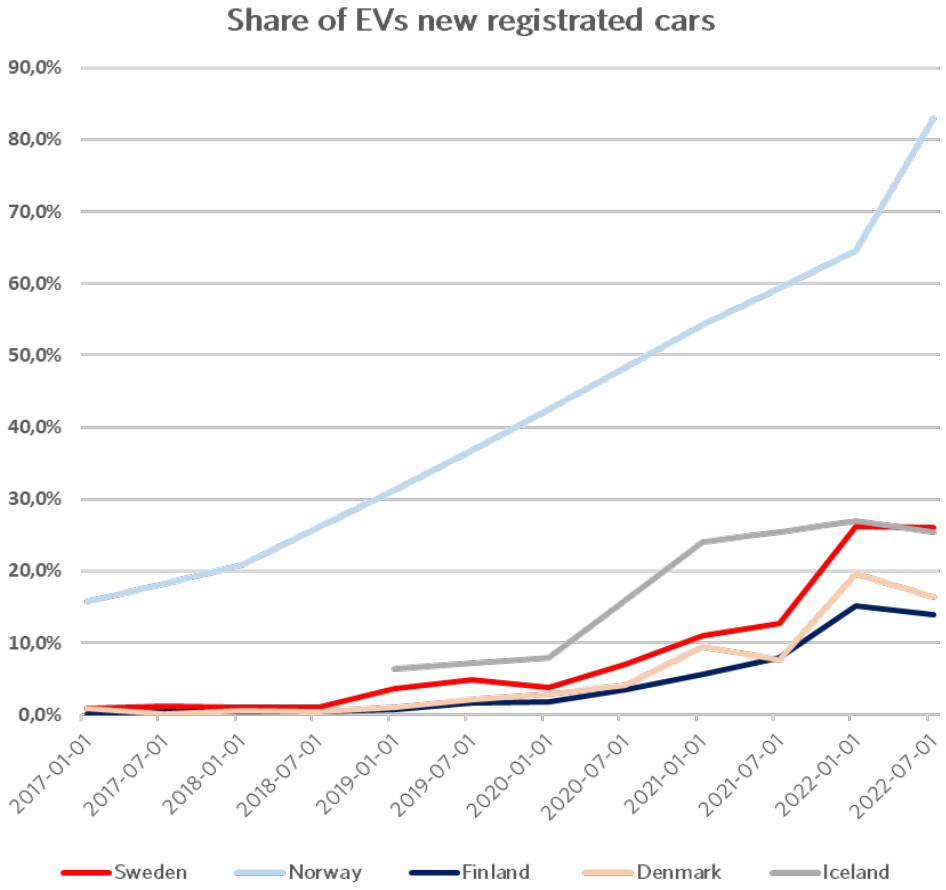


Figure 6 Share of EV, newly registered cars

Norway has constantly had the leading position regarding the share of EVs amongst newly registered cars with steady growth over the past years, As of 2020, a clear increase in share of newly registered EV:s can be noted in Iceland. After that, the share of EVs has remained at around 25-30% for the past 18 months. In Sweden, Denmark, and Finland, some upturn of the curve can be seen in late 2021. Amongst these three countries, Sweden has seen the strongest growth in EV, and today (July 2022), Sweden has just overtaken Iceland by a small margin and is in second place with 26 %. Denmark places below Iceland with 17 %, and Finland below Demark with 14 %.

Both Sweden, Denmark, Finland, and Iceland have had a decrease in the curve comparing the second half of 2021 and the first half of 2022. It is probably no coincidence that all four countries see a halt in development at the same time. Possible explanations for why the share of newly registered EVs has decreased could be due to delays in deliveries, component shortages, higher electricity prices, or a reduced propensity to invest in expensive purchases, which in turn

could be due to inflation, the covid-19 pandemic or the conflict in Ukraine. However, this is not noticeable in Norway, which instead had the opposite effect in the first half of 2022 with high growth.

2.2. Country-wise data

The data regarding incentives is from the European Alternative Fuels Observatory (EAFO 2022) , as it makes it possible to compare the countries of the study. As they have compiled similar data to what this study seeks, similar data points can be measured.

All data inin the tables in this chapter (2.2) is from the European Alternative Fuels Observatory (EAFO 2022) unless stated otherwise.

2.2.1. Norway

Environmental and climate obligations

Norwegian law states that the aim is that the greenhouse gas emissions in 2050 are reduced by around 80-95 % from the emission level in the reference year 1990. Through the climate agreement with the EU, Norway has committed to working with the EU and Iceland to reduce greenhouse gas emissions by at least 40 % by 2030 compared to the 1990 level (Oljedirektoratet 2020). According to the 2017 Klimameldingen, the Norwegian Government aims for Norway to achieve a 35-40 % reduction in greenhouse gas emissions within the transport sector by 2030 compared to 2005 (Statistisk sentalbyrå 2019).

Total fleet and new registrations of passenger cars

Norway is a leader in EV adaption and has arguably made the most headway in shifting the transport sector to electric propulsion. On 30 June 2022, the country counted over 700 000 BEV and PHEV passenger cars, more than 24% of the total fleet. Adaption is dominated by BEVs as 18% of all passenger cars are BEVs alone (Norsk Elbilforening 2022). This number is likely to increase rapidly, as new registrations are also dominated by EVs. At the end of March 2022, more than 88% of new registrations were electric, and over 82% were BEV (Statistisk sentralbyrå 2022).

Overall, the nation had 98 trucks (1% of total fleet) and 546 electric buses (4% of total fleet) at the end of 2021. The adaption of buses has had a steady increase in the last years, increasing from 41 vehicles in 2018 (Statistk sentralbyrå 2022). The number of trucks is the highest in the Nordics, but Sweden takes the lead regarding buses. The relative number of trucks per kilometer of highway is also one of the highest in the Nordics, indicating that the country has relatively good coverage of electric trucks relative to the total length of the road network.

The total number of electric mopeds in Norway was at the end of 2021, 3 488, which is 2,2% of the total fleet (Statistik sentralbyrå 2022). No comprehensive statistics have been found on the total number of electric scooters in Norway, but dockless shared e-scooters in two bigger cities was in Oslo 17 894 pc and Bergen 1958 pc during summer 2022. The number of scooters in Olso is high in comparison to cities in Europe of the same size - i.e. Duesseldorf has 2360 and Stuttgart has 1775 (Li et al. 2022).

Charging Infrastructure

As a global leader in transport electrification, Norway also has many charging points. Aggregated, there were 19 500 public charging points in 2021, corresponding to 27 cars per charging point. This can be put in relation to the EU's (questioned) recommendation on 10 vehicles per charger (Virta 2022). However, it can especially be noted that Norway has almost 6500 high-power chargers, which is by far more than all the other Nordic countries combined. This can be seen as an indicator of how far the development has progressed, as high-power charging facilitates easier recharging of cars overall.

Support Mechanisms

Norway has been mentioned as one of the leading nations, especially when developing incentives for EV adaption, which arguably has worked well as adaption is very high. The Norwegian example for incentives has been largely based on a combination of generous tax exemptions combined with local mechanisms that enables EV owners to enjoy many benefits with the purchase of their car. The incentives are summarized in Table 4.

Table 4. Incentives for electric cars in Norway.

Incentive	Description
Registration Tax Benefits	Registration tax exemption – BEV Being fully exempted from registration tax The deduction rate for PHEVs increased from 15 to 26% of the total weight in 2015.
Other/local benefits	Special number plate gives a possibility to secure local incentives, such as free parking, using bus lanes, free ferry toll, urban toll exemption, and highway toll exemption. Municipalities have the authority to determine fees and exemptions, thus there are different rules in different municipalities, especially for parking.
Ownership Benefits	Circulation tax based on fuel type, PHEV and BEV pays a minimum amount Company car tax reduction of 40% Exemption from 25% VAT on leasing (2015) Fiscal compensation for the scrapping of fossil vans when converting to a zero-emission van (2018)
VAT Benefits	BEVs exempted from VAT since 2001, extended in 2015
Infrastructure Incentives	New buildings have to allocate a minimum of 6% of parking areas to EVs

2.2.2. Sweden

Environmental and climate obligations

The EU has decided on climate targets that apply to the entire Union, including Sweden. The climate goal states that the entire EU must reduce greenhouse gas emissions by at least 55 % by 2030 compared to 1990 emission levels. The long-term climate goal for Sweden is to have no net emissions of greenhouse gases into the atmosphere by latest 2045, meaning that emissions within Sweden's borders must be at least 85 percent lower by 2045, compared to 1990 emission levels (Naturvårdsverket 2022a).

Emissions from domestic transport, apart from domestic flights, must be reduced by at least 70% by 2030 compared to 2010. The climate target for domestic transport concretizes the previous political priority of a fossil free Swedish vehicle fleet by 2030 (Naturvårdsverket 2022b).

Total fleet and new registrations of passenger cars

Sweden had approx. 300 000 BEV and PHEV passenger cars at the end of 2021, corresponding to 6% of the total fleet. More than 2% were BEV, but PHEVs still dominate the EV fleet. High growth in the share of EVs can be expected in the country – 50% of all new registrations were EVs last year. (Trafikanalys 2022). The share of BEV (26 %) in new car sales is increasing and has just overtaken the share of PHEVs (24%) , indicating that BEV will soon be more numerous than PHEVs in the EV passenger car fleet.

For buses and trucks, the total fleet is smaller. In general, the adaption of these vehicles follows a different pattern, as fleets are purchased in bulk by municipalities or regions, resulting in "jumps" in the corresponding year. For trucks, electrification, in general, is not as developed as for passenger cars, which could explain why there are fewer vehiclesl. Overall, Sweden had 72 electric trucks (0,1% of total fleet) and 662 electric buses (5% of total fleet) at the end of 2021. The adaption of buses has followed a steady increase in the last years, increasing from 54 in 2017 (Trafikanalys 2022). According to the statistics, Sweden had the most electric buses in the Nordics by the end of 2021 - both regarding share of total fleet and the total amount.

Regarding electric mopeds, no statistics have been found on the total fleet, but during 2021, there were 3633 new registered electric mopeds, which is 41% of the total new registered mopeds (Moped- och Motorcykelförbundets branschorganisation 2022). The number is high compared to the other countries, as an example, more electric mopeds were sold in Sweden in 2021 than the total amount of mopeds, regarding fuel, that was sold in Norway.

No data has been found on the number of electric scooters. During 2020, the association for micro-mobility operators counted that the total number of trips made on shared scooters was more than 26 million. The number of dockless shared e-scooters in three bigger cities in summer 2021 was; Stockholm 14 405, Gothenburg 355, and Uppsala 2349 (Li et al. 2022).

Charging Infrastructure

The development of charging infrastructure is well underway in Sweden, with almost 14000 chargers in total, approximatley 2000 of them being high-power. This has resulted in the lowest number of cars per charging point (23) in the Nordics together with Finland. The availability of charging points can also be a contributing factor explaining the high adaption rate in the country, something that will be investigated furthermore in the study.

Support Mechanisms

Sweden has a plethora of public support to increase adaption of EVs. Sweden has deployed a combination of purchase subsidies and tax exemptions and a purchase subsidy for home chargers covering parts of investment and installation costs. The incentives are summarized in Table 5 below.

Table 5. Incentives for electric cars in Sweden.

Incentive	Description
Purchase Subsidies	Climate bonus for low emission vehicles (Bonus Malus) Up to 60k SEK for BEVs, PHEV can get 10k SEK. (Climate bonus cannot exceed 25% of new car price. Support removed in Nov.2022 by govermental decision) For heavy electric trucks – a premium is available of up to 20% of the purchase price, but cannot be higher than 40% of the price difference between electric/diesel
Ownership Benefits	Annual circulation tax exemption for low emission vehicles first five years after purchase
Company tax benefits	Reduced value of the benefit from using company cars privately, leading to a reduced income tax. Thus, a monthly lease of an EV is less expensive than for an equivalent Internal Combustion Engines (ICE) car but more expensive for the company. The reduction is calculated in two steps. The benefit is first reduced to the equivalent of a comparable petrol/ diesel car. the benefit value is then reduced by 40% (up to 10,000 SEK). The first reduction is permanent and not time limited.
Procurement	Government mandates adoption of low emission/electric vehicles in public fleet
Infrastructure Incentives	Support for organizations that want to install charging points that will mainly be used by residents or employees (Ladda bilen-stödet). The grant is given as a lump sum with a maximum of 50 % of the eligible costs (no more than SEK 15,000 per charging point) The Swedish Environmental Protection Agency can provide support for public charging where there is a need for more charging stations. Starting 2021, you submit tenders for charging stations in these areas to apply for support. You have the opportunity to receive up to 70 percent of the investment cost. Tax reduction for installation of green technology: Support for home chargers with up to 50% for hardware or installation costs (maximum 50 000 SEK)

2.2.3.Finland

Environmental and climate obligations

The government program for Prime Minister Sanna Marin's government (2019), establishes that Finland must be climate neutral before 2035 and become the world's first fossil-free welfare society (Ympäristöministeriö 2022). Regarding transports, Finland must halve domestic traffic emissions by 2030 compared to 2005 levels. The goal is completely fossil-free transport before 2045 (Ministry of Transport and Communications of Finland 2021).

Total fleet and new registrations of passenger cars

Finland had a total of 120 000 electric passenger cars at the end of June 2022 (4% of fleet), of which only 1,2% were BEV (Traficom 2022). During the first half of 2022, 33% of all new registrations are BEV and PHEV, (same as Denmark). The largest share (20%) of them is PHEV (Traficom 2022).

Finland does have fewer electric trucks and buses than most other Nordic countries, with a total of 16 trucks (0,02% of fleet) and 272 buses (2% of fleet) at the end of 2021. Still, the number of buses more than tripled during the year 2021, increasing from 88 buses to 272 buses which might indicate a rapid change (Traficom 2022). The number of electric trucks is much lower than in Sweden and Norway, indicating that Finland is a bit behind not only regarding personal vehicles.

There were 3068 electric mopeds in Finland at the beginning of 2022 (Traficom 2022). No comprehensive statistics have been found on the total number of electric scooters in Finland. But the number of dockless shared e-scooters in three bigger cities was during the summer of 2021 as follows; Helsinki 7913 %, Tampere 2058 % and Turku 2030 % (Li et al. 2022).

Charging Infrastructure

Finland has more charging points per EV than other studied countries, with 23 vehicles per charging point -lowest in the Nordics tied with Sweden. In total, Finland had 4361 charging points, of which 724 were fast chargers.

Support Mechanisms

Overall, Finland has fewer incentives in total but focuses on support for capital expenditures on new vehicles combined with deduction of some taxes. All incentives are summarized in Table 6 below.

Table 6. Incentives for electric cars in Finland.

Incentive	Description
Registration Tax Benefits	Registration tax reduction for BEVs (5%)
Ownership Tax Benefits	The minimum CO2 tax rate for electric vehicles –only 5% tax rate
Procurement	Subsidies for direct purchase of a BEV costing less than 50 000€. Subsidy amount of 2000€ but ended in November 2021

2.2.4.Denmark

Environmental and climate obligations

In 2020, the Danish Parliament adopted the Danish Climate Act. The aim is that Denmark reduces emission of greenhouse gases by 70 % in 2030 compared to 1990 levels, and becomes a climate-neutral by 2050. The Climate Act, makes the reduction targets legally binding (Energistyrelsen 2022).

No concrete goals for the whole transport sector in Denmark regarding the reduction of emissions have been found. However, there are certain goals and targets from the government on specific measures within the sector. For example, a target of stopping sales of new petrol and diesel cars from 2030. The Government also has a goal that from 2035 there will not be any new PHEV for sale (Regeringen 2018).

Total fleet and new registrations of passenger cars

Denmark had 185 000 electric passenger cars at the end of June 2022 which corresponds to almost 7% of all passenger cars in the country. The share of electric vehicles in new registrations during the first half of 2022 was the same as in Finland, with 33% of all new passenger cars sold being either PHEV or BEV. There were slightly more BEVs amongst the newly registered cars than PHEVs.

For buses and trucks, there were 309 buses at the beginning of 2022, (3% of total fleet) which is a bit behind Sweden and Norway, but ahead of Finland. The number of electric buses grew rapidly in 2021, from 92 buses to 312 in only a year. For trucks, only data on “other fuels” is available for the beginning of 2022, which says that there are 319 trucks that are not petrol or diesel trucks (Danmarks Statistik 2022).

No statistics have been found on the number of electric mopeds or electric scooters in Denmark. But the number of dockless shared e-scooters that were allowed in 2021 in Copenhagen was 3200 (Eltis 2021).

Charging Infrastructure

Denmark had 29 cars per charging point, with a total of 4172 public chargers installed in the country in 2021, whereof 724 were fast chargers.

Support Mechanisms

Denmark has a comprehensive program for incentivizing electric vehicle adaption, with several types of possible deductions, ownership benefits as well as support for procurement. All incentives are summarized in Table 7 below:

Table 7. Incentives for electric cars in Denmark.

Incentive	Description
Registration Tax Benefits	Registration tax exemption – BEV Being fully exempted from registration tax in 2015, there is a gradual ramp up to standard tax, corresponding to 65% in 2021 and 90% in 2022 Energy consumption tax deduction – Energy consumption is the basis for further tax deductions, which are calculated from the theoretical fuel consumption equivalent and electricity consumption Temporary registration deduction – In 2020, there was a temporary tax deduction of up to 40k DKK and possible elimination of minimum tax for BEVs Storage capacity deduction – Possible tax deduction of 1700 DKK per kWh battery capacity until the end of 2022
Other financial benefits	Parking fee exemption – Electric cars are exempted from parking fees up to 5000 DKK per year
Infrastructrure Incentives	Commercial Charging tax exemption – Possible tax exemption for commercial charging 2017 – 2019. Favorable tariffs for bus charging extended until 2024
Ownership Benefits	Lower circulation tax as it is based on fuel consumption, thus BEVs pay the minimum amount
Procurement	Local support for electric vehicle procurement – Financial support for municipalities/companies purchasing electric cars for their fleets. Aim for 100% electric buses in Copenhagen by 2031

2.2.5.Iceland

Environmental and climate obligations

Iceland has a goal of a 40% reduction in greenhouse gas emissions in 2021-2030 compared to 1990 levels and achieving carbon neutrality in 2040. (Ministry for the Environment and Natural Resources 2021). With actions in the climate action plan Aðgerðaáætlun í loftslagsmálum (Ministry for the Environment and Natural Resources 2021) road transport emissions in 2030 will decrease by 21% compared to 2005. The action plan highlights that since emissions from road transport have increased a lot in Iceland in recent years, it's a total of 37% reduction compared to the emissions of 2018.

Total fleet and new registrations of passenger cars

Iceland had a total of 33 000 BEV and PHEV passenger cars in August 2022, corresponding to 12% of the total fleet. Around 5 % are BEVs, which means that there are slightly fewer BEVs than PHEVs. For new registrations, electric cars had just over 50 % in August 2022, with 25% being BEV and 28% being PHEVs (Samgöngustofa 2022). For buses and trucks, Iceland had only 1 truck as of 2021 and 14 electric buses in 2020,(Samgöngustofa 2022).

Iceland had 245 electric mopeds in July 2022 (1 % of the total fleet). In 2021, 57 % of the newly registered mopeds were electric. (Samgöngustofa 2022). According to Nordic Road Transport Research (2022) 12 % of all households in Reykjavik have a privately owned electric scooter (No data have been found on shared scooters for rental).

Charging Infrastructure

Iceland ranks last among studied countries in cars per public charging point with 39, having a total of 685 chargers whereof 125 are fast chargers.

Support Mechanisms

Iceland has a combination of different tax benefits to incentivize electric car ownership in the country, with VAT and registration tax benefits combined with local incentives. Support mechanisms are summarized in Table 8 below.

Table 8. Incentives for electric cars in Iceland.

Incentive	Description
Registration Tax Benefits	Registration tax reduction – Based on CO2 emissions, the tax rate is 0% for BEVS and PHEVs at registration.
VAT benefits	VAT exemption for BEV purchase up to 1 440 k ISK per vehicle (BEV) and 960k ISK (PHEV) – exemption is made for the first 15 000 vehicles of each type Full VAT refund for purchase/ installation of home charging stations
Ownership Benefits	CO2 based ownership tax – BEV/PHEV taxed at a minimum rate
Local incentives	Available grants from the city of Reykjavik for multi-apartment buildings installing home charging, Free parking for BEVs in Reykjavik and Akureyri

2.2.6. Greenland

Environmental and climate obligations

In November 2021, Greenland's government announced that they had the ambition to join the Paris Agreement. Thus, Greenland will not commit to any specific targets for reducing emissions, its government said in a statement (Reuters 2021).

Total fleet and new registrations of passenger cars

Greenland counts 841 BEVs and 554 PHEVs at the end of 2021, which is 24 % of the total car fleet. This means that the share of electric cars is as high as in Norway. BEVs are more common than PHEVS, representing 13 % of the total fleet. No data has been found on the share of new registered EVs, but looking at the total fleet between 2017-2021, the amount of BEVs has grown with around 90 -160 cars per year (Grønlands Statistik 2022).

No statistics have been found on buses or trucks for Greenland.

In Greenland, it does not seem to be any dockless scooter-sharing system today. No statistics could be found for mopeds or e-bikes in Greenland either.

Charging Infrastructure

Data on charging points in Greenland has not been found.

Support Mechanisms

Greenland's support mechanisms are summarized below:

Greenland:

Incentive	Description
Import Duties, VAT Exemptions	PHEVs and EVs have been exempted from import duties for many years. But from 2023, the exemption will disappear. In addition, the yearly taxes on PHEVs will gradually increase in the years 2023-2026 from today's 500 DDK to 13 000 DDK.

2.2.7. Åland

Environmental and climate obligations

Except being a part of both EUs and Finland's obligations and goals, Åland's aims for a 60% reduction of CO2 emissions from 2018 – 2030 (Government of Åland 2017).

Total fleet and new registrations of passenger cars

Åland had a total of 305 BEVs and 110 PHEVs registered at the end of June 2022, representing 1,6% of the total fleet (Fordonsmyndigheten 2022). This is the lowest amongst the compared countries in this study. No data has been found on the share of new registered EVs, but the amount of BEVs have grown with around 50 % per year since 2018 (Fordonsmyndigheten 2022).

At the end of June 2022, Åland had 52 electic vechiles within the category buses/trucks/vans (0,8 % of all vehicles within that category). However, the public transport supply program for Åland says that "In urban traffic, electric power is the obvious choice in procurement requirements in the future, electricity must be guaranteed to be renewable" (Trafikförsörjningsprogram för Åland 2022-2030, 2020).

In Åland, it does not seem to be any dockless scooter-sharing system today. No statistics could be found for mopeds or e-bikes in Åland either.

Charging Infrastructure

Åland had a total of 16 public charging points in 2021, at least two of them being fast cargers.

Support Mechanisms

Åland's support mechanisms are summarized below:

Åland:

Incentive	Description
Infrastructure support	Owners of real estate (one of more dwellings) can receive 50% of installation costs for home charging, up to 1000 €. Multi-person dwellings can receive additional support of more parking spaces receive charging availability.

2.2.8. The Faroe Islands

Environmental and climate obligations

The political goal in Faroe Islands is becoming completely independent of fossil fuel for power production in 2030 (State of Green 2017).

Total fleet and new registrations of passenger cars

The Faroe Islands count 858 BEVs and 284 PHEVs at the end of July 2022, together representing 4% of the total fleet, which puts the country at the same level as Finland. No data has been found on the share of new registered EVs, but looking at the total fleet between 2017-2021, the amount of BEVs has doubled every year. For example, it has increased from 307 at the end of 2020 to 603 at the end of 2021 (Akstovan 2022).

In July 2022, the Faroe Islands had 1 electric bus but no electric truck (Akstovan 2022). The Faroe Islands had 45 electric mopeds at the end of July 2022 (Akstovan 2022). There's also one operator for a dockless scooter-sharing system with 50 electric scooters in the capital, Torshavn (Dimmalætting 2022).

Charging Infrastructure

The Faroe Islands had 11 public charging points in 2021, the majority of them being fast chargers.

Support Mechanisms

The Faroe Island's support mechanisms are summarized below:

Faroe Islands:

Incentive	Description
VAT Exemptions	"If you buy an electric, hydrogen, or plug-in hybrid car, you can reclaim VAT. If you buy the car in 2021 or 2022, you can reclaim up to DKK 70,000, and in 2023 and 2024, you can reclaim up to DKK 35,000, provided that the car is registered at the latest 31 December 2024."

3. Literature review

This section contains results from the literature review divided into four themes. The compilation gives an overview of some reports investigating similar issues as this study.While not comprehensive, it serves as an introduction, placing the report in a larger context.

3.1. Challenges to adopting electric vehicles

A challenge identified in the literature review concerns knowledge spread and cooperation in the EV field. Two views, sometimes contradictory, emerge from interviews with stakeholders in the comprehensive analysis performed by the Swedish National Road and Transport Research Institute (VTI, RISE 2021). On one hand, many express a significant need for more knowledge on EVs. On the other hand, many express that most knowledge already exists, and that other factors can be more of a barrier. This division largely follows the position of different stakeholders in the "value chain" – actors investing/using the technology are largely focused on the need for increasing internal knowledge. Infrastructure actors are to a larger extent focused on the lack of knowledge on a systemic level and the need for cooperation to increase diffusion of knowledge across the system. Many public actors both expresses the need for increased or expanded knowledge and the need for better cooperation (VTI, RISE 2021).

Another challenge identified in several reports concerns the economy. VTI & RISE point out that average income and average driving distances are factors that largely impact the adaption of EVs in a rural setting. In municipalities where incomes are lower and driving distances are longer, the adaption of EVs is lower. VTI & RISE note that people do not generally substitute cars with other modes of transport when costs rise. This may be because traveling by car is often a necessity in rural areasa as public transport is less available (VTI, RISE 2021). A similar point is made in Åland's Energy and Climate Strategy (The Government of Åland 2017), noting that the need for private cars on the islands is high due to their geography and lack of public transit.

Elaborating on the economy of vehicles, VTI & RISE suggest that the high purchase price of EVs is a general issue that is reinforced in rural areas, as many people have two or more cars and thus have less money to spend on each of them. In cases where people spend more money on a car, additional features such as towing capacity or other upgrades to handle challenging activities are often motivating factors (VTI & RISE 2017). According to The Climate Council of Denmark, the purchase price of EVs is often associated with the risk that electric cars will quickly lose value as new and better ones are constantly emerging. This, according to the Council, constitutes a significant barrier (Danish Council on Climate Change 2020).

VTI & RISE in its report concludes that there is clear evidence that the economy has a large impact on the adaption of electric vehicles, thus suggesting that potential policy instruments should target economic incentives in addition to information campaigns (VTI & RISE 2017). Using incentives as leverage is also suggested in the Klimakur 2030, the report emphasizing a need for new laws or other incentives to force the development of EVs in the right direction since adaption is slow (Norwegian Environment Agency et al. 2020).

The Swedish Electrification strategy highlights the increased coexistence between a considerably expanded electricity production on the one hand, and other interests central to the electrification strategy in the future. In practice, this means that dialogue to identify actions that can enable a sustainable readjustment of society through electrification needs to be compatible with other interests such as secure electricity supply, the Swedish total defense, an attractive living environment in rural areas, cultural environment and nature conservation. The focus should be put on identifying and handling conflicts between different goals through different actions (The Government of Sweden 2022).

The power grid companies can accelerate the development of charging infrastructure, by simplifying connection processes for instance and securing sufficient grid capacity for charging infrastructure. According to EU Directive on Common rules for the internal electricity market, grid owners are not allowed to own or operate EV charging infrastructure themselves, but the directive allows for exemptions if a transparent tender procedure has been conducted and no other actors have answered. This can be one way to foster the implementation and expansion of charging infrastructure where there are limited market mechanisms in place – e.g., where the lack of revenue perspective does not motivate companies to invest in infrastructure - to reach rural areas for instance or facilitate the electrification of heavy transport (The Government of Sweden 2022).

The lack of charging infrastructure is often mentioned as a significant disadvantage for car owners (Danish Council on Climate Change 2020). In rural areas, the lack of charging infrastructure is closely related to spatial geography. As pointed out by VTI and RISE, low density in many Swedish rural areas does mean that public charging points are less widespread than in their urban counterparts (VTI & RISE 2021). Yet, as pointed out in the Klimakur 2030 report, access to public charging throughout the country – Norway in that case – and along important roads with a lot of traffic, is crucial (Norwegian Environment Agency et al. 2020). The Ministry of Transportation and Communication of Finland (2021), also identifies the lack of home charging infrastructure as one of the most common bottlenecks for electrification. People who cannot charge at home will probably not buy an EV.

A lack of infrastructure may also lead to increasing charging queues at existing charging stations. As EVs, even with fast charging, require a longer time to charge than it would take to fill a vehicle with petrol or diesel, queuing at charging stations becomes critical and can be a major obstacle. In a phase where the number of EVs on the road is increasing, there will be places where the number of available charging stations goes from being sufficient to way too few (Norwegian Environment Agency et al. 2020).

The Icelandic Climate action plan raises the special circumstances in the country regarding half of the cars belonging to car-rental companies. Two of the obstacles they highlight are the lack of public charging, and the lack of organization and infrastructure at the international airport. However, they also see opportunities in it when former rental cars become domestic cars in the secondhand market (Ministry for the Environment and Natural Resources, Iceland 2020).

Finally, sustainability is a challenge raised by the Government of Åland in its Energy and climate strategy report. The report emphasizes a need for better charging infrastructure and increase use of renewable energy sources. Yet, one of the obstacles in developing a more sustainable charging infrastructure, e.g., powered by wind and solar cells, is its high investment costs (The Government of Åland 2017).

3.2. Knowledge and attitudes

Key conclusions from the VTI & RISE investigation in rural areas is the need for increased diffusion of information on the features of EVs, especially when it comes to range and economy. A suggestion in the report is to spread knowledge with the help of the Municipal energy and climate advisors, which are officials at the municipalities in Sweden with responsibility for advising residents on energy and climate issues. Overall, the communal decision-makers are seen as central stakeholders, “leading by example” by implementing EVs in their operations, in addition to facilitating the expansion of charging infrastructure and sharing knowledge. Local energy companies also have a role as a possible enabler of simpler solutions for home charging (VTI, RISE 2021).

There is a lot of uncertainty expressed by stakeholders interviewed by VTI & RISE and this is largely linked to a lack of knowledge. The emerging system and the responsibility amongst different parties are, in particular, a large source of uncertainty, as subsystems have mutual dependence on different degrees of innovation. The lack of knowledge is expressed on different levels and is often linked to understanding the roles and systems of the actors involved. In this regard, there is a large need to share knowledge on the basic function of each subsystem. There is also a need for practical knowledge on the implementation of new technical solutions and experiences from that, as the whole field is novel and many actors “don’t know what they don’t know” (VTI & RISE 2021).

Most actors know electrification through BEV and stationary charging, not seldom through their own experience or through monitoring the development through networks. Indeed, many give a higher level of detail when answering about batteries and mostly discuss that topic, as opposed to electric roads and fuel cells about which the answers are more generic. Industry organizations also note that the level of knowledge varies largely between actors, but that most uncertainties are related to practical issues such as grid capacity or charging patterns and the impact it has on their operations. However, the emerging view is that most uncertainties and lack of knowledge can be resolved through targeted information actions, and many companies work proactively in this regard (VTI & RISE 2021).

The government of Åland points out that there is interest among professional drivers to try EVs, which could help speed up the development (The Government of Åland 2017). In Norway, Klimakur says that behavioral barriers such as habits, lack of knowledge, and experience with the use of electric cars, both among consumers and dealers, must still be addressed. For consumers, the limited driving range has been an important barrier to the transition to electric cars - not least in winter. With increasing battery capacity and more users sharing their own experiences, this barrier is gradually reduced (Norwegian Environment Agency et al. 2020).

Habits influence behavior and can often lead to choosing the ”known” alternative, such as a known car manufacturer, model, or characteristics. One possible behavioral barrier that is relevant to electric cars is when individual users drive on long trips a few times a year, with a trailer, possibly combined with limited time available, and hence for which there is a disadvantage with longer stops than with those for which it only takes a minute to fill a tank of gasoline (Norwegian Environment Agency et al. 2020).

3.3. Potential and barriers for use of E-bikes

The benefits from increased cycling, such as increased health and decreased emissions, are well documented and this applies to rural as well as urban areas. E-bikes have the potential of widening the use of bikes for transport purposes across both social groups and across and geographies. The sale and use of e-bikes have been increasing steadily for several years all over Europe, the Nordic countries included. Early adopters of e-bikes have primarily been older and disabled people with a desire to keep being active despite their disabilities. Over time the use of e-bikes has become more widespread and research shows that increased use of e-bikes has potential of decreasing car usage and thus CO2-emissions in both urban and rural areas. (Cherry & Fishman 2021, Rérat 2021).

Studies from the Netherlands cited by Clark & Nilsson (2014) shows that e-bike users living in rural areas bike longer distances than e-bike users living in urban areas. On the opposite, regular cyclists living in rural areas bike shorter distances than cyclists living in urban areas. On average e-bike cyclists in the Netherlands travel 31 kilometers by bike per week and cyclists using regular bikes travel 18 kilometers by bike per week.

A study of the behavior of e-bike users in Sweden indicates that the potential for e-bikes to replace car trips is as great in rural areas as it is in urban areas. The same study also shows that people in rural areas use e-bikes as a substitute to a regular bike to a lesser extent than people in urban areas (Winslott Hiselius & Svensson 2017).

There is no accessible e-bike sales statistics on distribution between different parts of the Nordic countries. In the evaluation of the national e-bike subsidy in 2018, the Swedish Environmental Protection Agency presented statistics on disbursement distribution. Figure 7 shows the distribution of disbursements (per 1000 capita) between metropolitan, dense and rural municipalities. The statistics shows that the disbursements were relatively evenly spread with very remote rural municipalities as an exception. This group is 15 municipalities (e.g. Jokkmokk, Övertorneå and Pajala). Other municipalities in the interview study are classified as dense municipalities near larger city (Forshaga), dense remote municipalities (Gällivare and Kiruna) or rural remote municipalities (Hagfors).

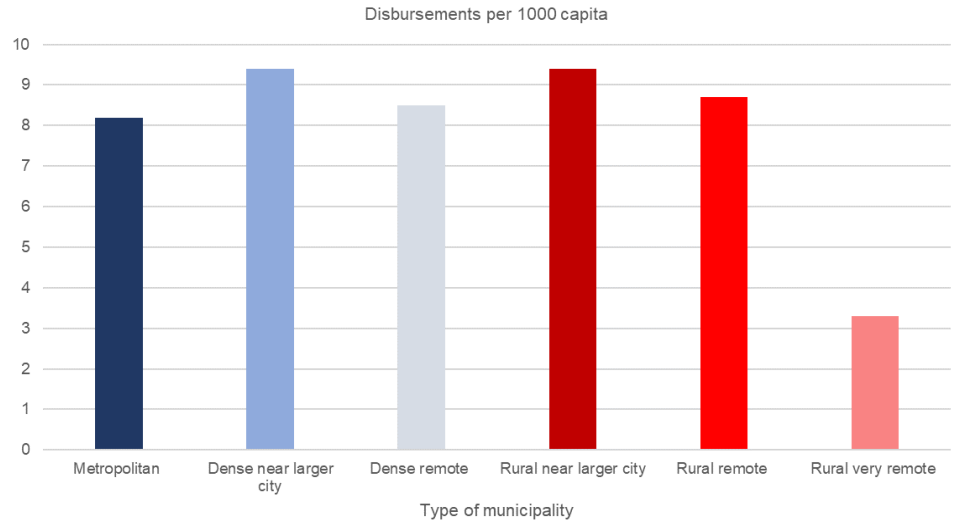


Figure 7. Disbursements per 1000 capita from the national e-bike subsidy 2018. Source: The Swedish Environmental Protection Agency (2019).

The advantages and limitations of e-bikes for different user groups are explored by Plazier, Weitkamp & van der Berg (2018), listing distance, connectivity, flexibility and affordability as advantages for rural residents. E-bikes can bridge longer distances with less physical effort than regular bikes and thus increase accessibility by bike in rural areas as well as connectivity to public transport. E-bikes can also provide more flexibility compared to public transport with low frequency in sparsely populated areas at a more affordable cost than cars. Distance and lack of cycling facilities is on the other hand a limitation for increased used of e-bikes in rural areas. Rural residents travel longer distances than urban residents and are more reliant on cars. The lower speed of a e-bike might be a barrier to increased e-bike use by car and public transport users in areas with long distances between destinations. Separated cycling facilities is especially important along rural roads with higher vehicle speeds, more heavy vehicles and a lack of such facilities may discourage the use of e-bikes even on shorter distances.

3.4. Governments & municipalities

In its comprehensive report, VTI & RISE points out that cooperation between actors involved in the e-mobility ecosystem (e.g., grid companies, municipalities and charging operators) is seen as central to increasing knowledge, securing that it reaches more stakeholders. This could be done in many forms, such as projects, pilots, or networking. Many uncertainties are also related to lack of experience, and many believe they will be resolved as the industry becomes more mature. The central government can provide support through incentives to enable more actors to gain experience. Many raise that it is difficult to navigate in the emerging landscape and that a checklist could be useful. Examples of uncertainties and lack of knowledge that many point out concern how electrification will impact their own operations in practice and if they need to change their behavior, in addition to general uncertainty on electricity prices and charging patterns (VTI & RISE 2021).

As many have started their electrification journey, many have also discovered that cooperation is the most useful way forward, leading to joint work between actors that otherwise may have been competitors. In practice, cooperation through networks, conferences, or seminars is seen as useful, but could also be more concrete, working jointly on pilot projects for instance. In this regard, many see the central government in Sweden as a central actor that could be more active, but many also see the installation of Elektrifieringskommissionen [Electrification Commission] as useful as they can work towards a coherent plan for expanding the system (VTI & RISE 2021).

The Swedish electrification strategy takes a holistic approach to increase the development of electrification of the societal sector, discussing in particular grid issues as the basis for much of the development of electrified transport. In this regard, the strategy mentions several public actors that are relevant to the development: The state, the regions, and the municipalities, which have different roles and responsibilities for societal planning. Cohesive planning within the energy sector, starting from the electrification of society, needs to be firmly established both in local, regional, and central societal planning (The Government of Sweden 2022).

In Sweden, the municipalities are responsible for planning for land and water, according to plan- och bygglagen [planning and building act]. The regions are responsible for regional development according to lagen (2010:630) om regionalt utvecklingsansvar [Act (2010: 630) on regional development responsibility], which, among other things, gives regions responsibility for regional growth as well as for establishing and deciding regional plans for transport infrastructure. The regions are also responsible for planning and implementing regional public transport services. In Stockholm municipality and Skåne region, the region is also responsible for regional physical planning according to 7 kap. plan- och bygglagen. The state is responsible for exercising authority related to societal planning processes (The Government of Sweden 2022).

It can be challenging for municipalities to work with EVs. One example is procurement, where additional economic and staff resources are needed to analyze the needs of the municipality and to what extent EVs can satisfy these. Many municipalities have limited resources to work with this. VTI & RISE also note that this extends to the central government, which has a large signal value by dictating the direction going forward. The state also directs economic support, which, according to VTI &RISE, has been largely directed towards urban areas but could be improved for rural parts of the country. A central measure to accelerate the development towards electrification found in the rural study is the establishment of a more active second-hand market, as many cars are purchased used rather than new. This can also help overcome the issue of high purchase prices for EVs (VTI & RISE 2021).

VTI & RISE note that there are generally suitable preconditions for electrified transport in rural areas, as most people dwell in houses with private parking opportunities suitable for home charging, making the longer driving distances less of an issue, also noting they drive long distances yearly opening for more possible savings on the car. The driving distances are however not long per trip, suggesting that an EV with a smaller battery can still cover most commuting needs. This has not impacted adoption much and information efforts could be beneficial in this regard (VTI & RISE 2021).

Short distances on the Åland islands give good conditions for EV:s. The public sector can also demand fossil-free public transit (The Government of Åland 2017). Kilmakur in Norway say municipalities may be missing the capacity to carry out climate actions under their mandate or be able to sufficiently facilitate the implementation of measures by other actors. In many cases, there are also additional financial costs associated with investments and operation of solutions with lower greenhouse gas emissions. Limited competence and perceived uncertainty about what constitutes good climate choices can be a barrier to climate measures (Norwegian Environment Agency et al. 2020).

3.5. Actions and recommendations in the literature

Analyzing the Swedish electromobility landscape in rural areas, VTI & RISE note that the development of e-mobility is accelerating quickly and that more EVs can be sighted across the country. The development is still largely concentrated in urban areas with need for electrification in rural areas, as fewer sustainable mobility alternatives are available (VTI & RISE 2021). VTI has also made a comprehensive qualitative analysis of the Swedish electromobility landscape, noting that lack of knowledge is an overall issue. While improvement of battery technology is central, VTI & RISE suggest a broader perspective on innovations is required, especially for heavier transport applications where battery electrification is suboptimal.

- VTI & RISE suggest that, to increase knowledge, there is a need for working at several levels to gather information as well as facilitate sharing of data, as many actors note that lack of transparency is a barrier.
- There is a need for concrete information campaigns to share experiences and "bust myths". In this regard, developing and sharing guides is also a suggested action.
- Involve regional and local actors in discussions and forums to increase the diffusion of knowledge
- Create clearer incentives for actors, as many perceive the current system as fragmented and difficult to understand.
- Secure competence long-term, especially by developing education at universities and colleges to satisfy the needs of the energy market (VTI 2022).

4. Findings & results - interviews

This section presents findings and results from the interviews divided into five major themes with sub-themes. The findings are also discussed in the Analysis & Discussion chapter. Themes were identified based on both differences and similarities in perspectives among stakeholders.

4.1. Catalysts in the development

By identifying the major forces behind the development, it is possible to reduce the risk that they will be inhibited or hindered, and instead understand what measures are needed for them to continue to exist and operate. By mapping who, and what different actors see as driving forces, it is also possible to understand which actors are not perceived to drive the change as much.

Several of the stakeholders mention the spreading effect as an important enabler for e-mobility in society, particularly in sparsely populated areas. An interesting observation is that different stakeholders mention the effect at different geographical scales.

Additionally, a large driver in the overall movement towards electrification of vehicles that is mentioned by several actors in the interviews is the intrinsic momentum from businesses involved in the area. This concerns many types of companies – from car retailers to energy companies and charging infrastructure operators.

4.1.1. The spreading effects

On the most local level, Vestland Fylkeskommune suggests that the number of EVs in a neighborhood can quickly grow and spread throughout the area when more and more neighbors decide to buy an EV.

Vestland Fylkeskommune also describes the spreading effect at the regional level. First off, inhabitants in their biggest city, Bergen, bought an EV, quickly followed by the surrounding municipalities with a lot of commuting connections to Bergen. The latest to adopt the trend were municipalities the furthest from Bergen, with less population density. This phenomenon is also described by the representative from Danish E-mobility who observes that development is pursued from Copenhagen and spread throughout the country.

This view is also partly shared by charging point operators. The Finnish operator VÄRE, in particular, highlights the spreading effects from urban to rural areas. In general, this can be described as a "wave" of adaption starting in cities and then diffusing into sparsely populated areas each year.

The view of a general development where increased adaption creates momentum and thus strengthens the overall development is also pointed out by Troms and Finnmark Fylkeskommune. While being one of the regions in Norway with the lowest adaption, the county mentioned the "snowball effect" of EV adaption as a prerequisite to the development of surrounding infrastructure, such as charging stations.

Nevertheless, Nýhugsan says that the decentralized spreading effect is also supported by incentives from public actors, which together increases the likeliness of adapting EVs. Nýhugsan also emphasizes that the relatively small size of the Faroese community simplifies the communication with decision-makers, making it easier for them to pick up on opinions and ideas from the citizens.

The spreading effect can also be seen in the spread of municipalities' efforts to develop strategies and action plans in Värmland, Sweden. The municipality of Hagfors started developing an action plan toward public destination charging, during the process the neighboring municipality Forshaga got inspired and started their own process. Shortly afterward the municipality Munkfors also decided to follow. The municipality next door does not want to be less good.

4.1.2. Business as a driving force

Public energy company SEV depicts businesses as central to the electrification on the Faroe Islands, being a smaller community. As they are the stakeholders that can provide the necessary infrastructure, they are a major driver of the development. Nýhugsan also highlights that as The Faroe Islands is relatively small, channels from the civil society to decision makers are short, and local business can have a relatively large impact on decisions.

The central role of businesses in the sector is also depicted by charging point operators. VÄRE elaborates on the topic, explaining how large actors in the retail market in many countries have come a long way in developing charging networks nationwide, thus continuously becoming important stakeholders with a big impact on both adaption and overall development.

Finnish energy also concurs in this explanation, noting how companies within retail have made substantial investments in fast chargers, thus becoming a major driving force.

The same topic is highlighted in discussions with Greenlands Ministry of Housing and Infrastructure, but the lack of actual driving forces in the country is mentioned as an intrinsic challenge to overcome to increase electrification.

Danish e-Mobility emphasizes in particular the important role of charging companies. As traditional refueling stations for petrol and diesel are seeking to make a transition from an emitting industry to a sustainable one, they have a large impact on the development of both sustainable practices and charging opportunities, as they currently operate much of the infrastructure that can be relevant for electric vehicles. The central role of refueling companies together with charging point operators is also highlighted by Ålands Elandelslag as a major business force shaping the development.

Swedenergy – representing energy providers in Sweden – also shares the view of market-driven development. Like Danish e-Mobility, they also point out that companies owning and operating refueling stations are one of the stakeholders establishing chargers, having both ambitious plans for greening the sector and a suitable position to accelerate charging infrastructure development. On top of this, companies within retail are also shaping the development, not least since they want to offer charging as a service to their customers, but also seek ways to become more sustainable in their operations.

Norway's Ministry of Transport point out that most of all political will and concrete actions in the form of beneficial incentives have largely driven the development Nevertheless, they point out that interest organizations are "strong" thus shaping future development and also notes how car retailers have a large influence on adaption, as many retailers to a larger extent turn to sell EVs only.

On a local level, businesses are mentioned by Skive Kommune as central actors involved to increase development. In this context, continuously discussing with local business actors is mentioned as an important action. Within Project Zero in Sønderborg kommune, different stakeholders such as car retailers, operators, energy companies and local businesses regularly gather for discussions about e-Mobility. This is a good way for the local businesses to solve different problems, to network, and have a platform for discussion. Project Zero sees local businesses truly engaged and interested in the electrification issues.

Hagfors kommun and Forshaga kommun in Sweden also touch upon the subject but from the other end, noting how the willingness of local businesses to become sustainable and use EVs becomes a driver for the electrification of transport in the municipality.

This is partly problematized by the representative from Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun, who points out that the underlying market is so small in rural areas, limiting the impact that businesses have. They thus see public actors and government incentives as more important to development going forward. Nevertheless, heavy industries in their region, such as mining, still largely impact development, not least if they electrify vehicles in their operations – using for instance electric trucks.

Swedenergy also notes that energy companies – especially grid owners – have a central role, as key enablers both in terms of grid connection and electricity supply. On the other hand, Ålands Elandeslag, while still considering them as central stakeholders, wonders whether these companies should not take responsibility for the development.

4.2. Charging

Charging infrastructure is a much debated issue in society regarding EVs. Since the differences in how you refuel a fossil-fueled car and an electric car are major, it is no wonder that the question is recurrent. It requires a certain adjustment to other types of habits and a new way of driving cars. In addition, a whole new type of infrastructure must be built along the roads and in people's homes, which is not done completely without obstacles.

> Home charging was discussed with several of the actors, all of whom emphasized the need for it – but also pointed out the problems associated with relying solely on it.

An interesting recurring theme in the interviews is the low willingness to invest in public charging if there are low profits, while the growth in profits largely depends on the willingness to invest. Many actors touch upon this subject and note that it is an issue.

Another often recurring theme in the interviews is the possible issue with grid capacity and sufficient electricity production. The degree to which actors perceive this as a problem varies somewhat between actors and across regions, where some see it as a big concern while others do not.

4.2.1. Home charging as a main enabler

Vestland Fylkeskommune, who has been relatively successful in the public charging area, emphasizes that home charging is very important. The representatives also point out that this type of charging is more suitable in rural areas, not least since many people live in houses, rather than condominiums. In rural areas, adequate home charging might be sufficient, as the demand for destination chargers is not as significant as in urban areas.

This also echoes with the reasoning from Danish e-Mobility, which notes that home charging is not a big issue if living in a house but can be more problematic if living in a city where one must sometimes park on a public street. Troms and Finnmark Fylkeskommune also notes that home charging is a necessity in a rural area, while public charging is more suitable in an urban environment, thus making it easier overall to have an EV in a city. This is a view that is shared by The Government of Åland, which sees that people living in rural areas – in the Åland case, the smaller islands of the nation – must largely rely on home charging.

Nýhugsan has similar reasoning in the Faroese context as home charging is often easier to install when living in a house. On the Faroe Islands, economic subsidies are available for these types of installations, given that you own the property where it is installed. This type of charging is also promoted by energy companies in the region.

This echoes the reality in Greenland, where the Ministry of Housing and Infrastructure notes that home charging is most common. However, installations might be lagging behind the demand to some extent: charging cables have been seen hanging out from balconies in several instances.

Some actors elaborate on how home charging can work in different forms of housing. According to VÄRE, housing cooperatives are often well suited for home charging as they have the financial means and decision-making power to install equipment. However, the decision-making process may take time, as some inhabitants within the condominium may not be willing to adopt electric chargers - even though most are interested. VÄRE has tried different measures to overcome that, such as information campaigns and webinars. However, VÄRE reports that the measures haven't had the effect they initially hoped for.

Swedenergy in Sweden points out that the installation of home chargers in apartment buildings must be facilitated to foster electrification. One of the messages to deliver to property owners is that the value of a property with home chargers increases, which thus benefits all the residents. Still, Swedenergy points out that the administrative process for a condominium to make such installations is quite heavy. This is also mentioned by Ålands Elandelslag, which sees the increase in property value as a major argument for installing home chargers. Overall, Ålands Elandelslag notes that the limited ability to charge a car when living in an apartment is a major obstacle.

In the Finnish context, Finnish Energy sees a possibility to build upon the currently well-developed installations of engine heaters at parking lots to add or turn some into charging stations. The Centre for Economic Development, Transport and Environment in North Savo also mentions the financial support from the Housing Finance and Development Centre of Finland towards housing cooperatives as an opportunity for accelerating installations of home charging points.

Övertorneå kommun in Sweden points out that home charging, to a certain extent, cannot fulfill the needs of their inhabitants. Due to the region's spatial geography, one can drive 200 kilometers one-way for grocery shopping, which isn't possible with home charging alone.

4.2.2. Public charging in rural areas

According to Troms and Finnmark Fylkeskommune, a well-developed public charging network can impact the decision to move to EVs and is a prerequisite for continued adaption. Discussing the typical customer, they emphasize that charging point density in the county is a major factor when deciding to buy electric vehicles.

However, the fact that the EV traffic volume is significantly lower in rural areas makes it difficult to make charging profitable. It raises then the question of subsidies, and specifically what level of subsidies should reasonably be provided for fast chargers in rural areas, given the limited underlying market. Many actors, such as Finnish Energy, note that the underlying issue of low demand and thus small possible profits from fast chargers is an intrinsic problem and is difficult to mitigate. This is also a view that is communicated by the Centre for Economic Development, Transport and Environment in North Savo.

This analysis of low market potential in rural areas is also shared by charging station operators such as VÄRE, also noting how the limited market potential in rural areas limits infrastructure there. Furthermore, the fact that the EV charging industry is rather new makes investments in more lucrative areas more rational. On top of this, the infrastructure is costly, not only for the charging stations themselves but also for related renovations and upgrades of the electricity grid that are often needed. This is also related to the company's size. Investing large amounts is easier for large retail companies but may be more challenging for most other businesses if they do not benefit from significant funding support. While trying to expand a public charging network, VÄRE notes that the earnings potential is too small, at least short-term, to make it reasonable.

This issue is also discussed by InCharge, who notes that many smaller actors in the emerging market focus on investment costs, and do not have a clear picture of operational costs coming afterward. In this respect, it could be advantageous for InCharge to be a part of a larger company, such as Vattenfall, with the possibility of having business targets over a longer period.

Trondelag Fylkeskommune elaborates on the topic, explaining that, in Norway, the bottleneck is not the investment cost, as installing the equipment is to a large extent subsidized, but rather the operational costs when the charging point is installed.

Public perception and the novelty of EV:s are mentioned by some actors as current limiting factors. Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun discuss how many people are "stuck" in the idea that public charging stations along roads are necessary for having an EV, while in practice, it does not have to be the case. As a largely rural region, they also see as many other actors that the current problem is not the investment cost, which often can receive substantial investment support, but rather that the operating profits are too small if any at all. Seeing interest from some actors to establish charging in their area, the lack of possible profits is seen as a significant obstacle for investing.

Orkusetur, Austurbrú, and Blámi also raise concerns about who should be paying for the infrastructure and emphasize that a functioning network is important both for the local citizens, other Icelanders, and tourism. Orkusetur mentions, as several of the other stakeholders across countries, that people need to feel "safe" while out on the roads, even if they do not necessarily use the infrastructure themselves on the way. Therefore "the way to go" is perhaps to "overinvest" in charging stations so that people do not worry about not being able to charge, according to Orkusetur. Blámi also points at one of the main issues within this matter, that a charging point with low usage costs more than anyone can earn from it.

The "safety" perspective is also mentioned by the representative from Project Zero in Søndeborg kommune. Yet, in contrast to many of the other stakeholders, they have not experienced problems with operators who do not want to invest in public charging due to low profitability. This might be explained by the fact that rural area in Denmark isn't as sparsely populated as in Norway, Sweden, and Finland.

In Åland, the relatively small size of the nation is also a limiting factor for public charging, as there just isn't that big of a need for it, as pointed out by Ålands Elandelslag. They also point out the inherent problem of small profitability for charging stations as operating costs must cover both grid fees and energy costs, which quickly accumulate even though the installation of the charger might be subsidized. On the other hand, The Government of Åland points out that the relative coverage of public charging points is relatively high in Åland.

The limited number of users also limits the interests of private companies on the islands, something that is noted by SEV. They point out that the reason that there are no private charging companies is that the number of users is just too small, an analysis that many actors present regarding areas with a small number of EVs.

The same "chicken and egg" problem that other actors mentioned is also highlighted by Skive kommune. In that case, the municipality concluded that the infrastructure must largely be installed before electric cars, as the perception of "safety", meaning the ability to charge the car if buying an EV, is important for adaption. Skive kommune has not been able to make much of the plans for infrastructure that has been set up, noting that it is a large amount of work and difficult to get going, in addition to the overall cost of such an undertaking.

While also noting that the chicken and egg problem is a complicating factor, Danish e-Mobility points out that there are several funding opportunities for actors looking to invest in Denmark, something that might make actors more willing to invest even though the market is still small.

The three Icelandic stakeholders Orkusetur, Austurbrú, and Blámi agree that more public charging is needed in rural areas. Austurbrú says that comprehensive planning isn't something that the market is likely to take care of itself, and therefore the government, and municipalities need to be more involved and plan both at a regional and national level. Still, Austurbrú thinks that the business and market should be the driving forces concerning the investments and distribution where it is at all possible.

Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun also note that to really make charging useful for EV owners, the ability to sync the charging with other errands is a key issue to resolve going forward. In their case, they point out that many of the "white spots" in charging infrastructure are those where there is a lack of other things to do. While emphasizing the difficulty in resolving such a problem, they propose to require charging operators to construct charging points in an "unattractive" area for each point that is established in an attractive one.

Vestland Fylkeskommune describes how they have worked systematically to facilitate conditions for more fast chargers in their region, one of the chief reasons why adaption has been high. Looking ahead, they see a market for fast chargers, which largely depends on charging operators seeing this as a future business opportunity. Noting many possible customers in their region, private actors are showing a lot of interest. Vestland Fylkeskommune also emphasizes the "chicken and egg" problem as a complicating factor. Vestland Fylkeskommune has started to notice that the increased range of the vehicles has dampened the need for public charging somewhat. The county also anticipates that as EV adaption continues to increase, s.c. "destination chargers" will become more important, as people can do other things such as eating or shopping while charging. Going forward, they plan to continue the roll-out of more charging stations in their area to satisfy the increasing demand. They also seek to make the chargers themselves more efficient to avoid queues that have started to become a problem for them.

Finland's Ministry of Transport and Communications notes that the development of charging infrastructure helps accelerate adoption in rural areas, meaning that when people see and become aware of charging points in their vicinity, they might become more likely to buy an electric vehicle. Troms and Finnmark Fylkeskommune also mention the awareness and spreading effect – people being more likely to buy an EV if they see charging points in their everyday life – and link it to the need for expanding public charging infrastructure, noting that historical evidence has shown that a major obstacle for EV adaption has previously been the lack of public charging stations.

Nýhugsan notes that in the Faroe Islands, energy companies has been promoting home charging rather than fast chargers, as these will be less of a strain on the electricity grid. Also, the Faroe Islands are relatively small with short driving distances, limiting the need for public charging stations but fast charging stations have been installed at strategic locations such as airports.

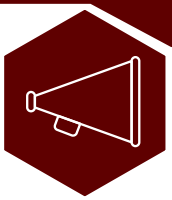
4.2.3. Capacity in grids and production of energy

In Sweden, InCharge notes that capacity constraints in the grid and the cost of electricity as one of the biggest concerns for future development. Swedenergy also discusses this but from another point of view, noting that as charging infrastructure is so important, it is imperative to plan it in a good way so that it can support the energy system long term and be more persistent. They see how many companies are facing problems with land access and lack of capacity in the grid, but that investments in upgrading the grid are costly and take time. InCharge emphasizes the urgent need for authorities to realize that the capacity constraints in the grid are a major issue.

Swedenergy also discusses this, but specifically, emphasizes the importance of municipalities taking charging infrastructure into account in urban planning. This is done by ensuring that there are suitable places for the required infrastructure and also having a dialogue with the local electricity network company.

On a regional level, both Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun, and the representative from Övertorneå kommun note the national issue of limited energy supply to meet the increasing electrification. Increasing production is key for the future. However, the Energy and Climate consultation does see that many people are opposed to the construction of power facilities in the region, such as wind turbines or wind farms, not least since the region already stands for much of the nation's electricity supply.

Orkusetur and Austurbrú describe that a distribution obstacles in Iceland is that there isn't any power grid in the Highlands. Generally, people do not need to go there since no one lives there, but they are popular for leisure trips and tourism, so energy must come from batteries to supply the demand. Austurbrú and Blámi also mentions lack of grid capacity along mountain roads between villages. There is a fear that a lot of power is used in the wrong places at the wrong times. Blámi is concerned that the power grid capacity isn't sufficient in some places, for example, In Flókalundur, which would strategically be a great location for a fast charger.



On the islands of Åland and The Faroe Islands, the electricity grid looks somewhat different. In the Faroese case, SEV sees how the grid operates as a sort of microgrid where they control the distribution of energy. For them, regulating the charging to work with the overall grid is seen as key. Similarly, in Åland, Ålands Elandelslag seeks to keep control of where fast chargers are placed so that they work with the overall power grid. Ålands Elandelslag also aims to encourage people to charge during low-demand hours, preferably during the night, so that the grid is not overloaded during peak hours.

In Finland, the Ministry of Transport and Communication does not see the capacity of the distribution network as a problem. However, VÄRE does point out that grid owners must take more responsibility and encourages local grid owners to work closely with them. Finnish Energy shares the ministry's view, noting that Finland has a strong distribution grid in general with some spare capacity, not least compared to other Nordic countries.

As in Finland, Norway's Ministry of Transport does not see grid capacity and production as a major problem going forward. In Denmark, Project Zero Søderborg kommune, does not see any problem with the capacity in the grid either for the time being. If problems arise in the future, energy companies would be able to handle them.

4.3. Authorities roles

A major topic that was discussed with actors was the role and responsibilities of different authorities in the respective countries, which varies across regions. The municipalities and regions have different roles, making them significant players in some countries, and less important organizations in others. Related to the question of municipalities is the work of the central government, which in many cases has taken an active role, but to a varying degree in the different countries.

4.3.1. Responsibilities for the government

Representatives from all countries, except Norway, wish for the government to take more responsibility in general.

The country where the actors seem to raise their voices highest on the government's lack of responsibility is Iceland. VistOrka has a clear view that the government and ministries are not doing enough. A general feeling is that there is a lack of planning, communication, and instruments that could enable faster development. The government should plan for completing the network of public charging stations, additionally to handing out money to actors. According to VistOrka, there seem to be many obstacles in some governmental authorities, perhaps because they have not been directly "summoned" to be a part of the solution.

VistOrka would like to point out that the state signs obligations for Iceland but that it is to a large extent the municipalities that have to act, e.g., for the deployment of charging stations. The state advertises a subsidy for the installation of charging stations through the Energy Fund, but no one is forced to apply. If no one applies at a certain location, then nothing is done there.

Austurbrú agrees with VistOrka on the need for a strategic approach to the overall picture of the future charging station network for the whole country. They argue that the plan needs to be organized locally for each region and that the state should be more aware of the need to support regions in the analytical work. The basic Orkustofnun funding support system must not stagnate but develop and meet e.g. needs for analysis and planning. Otherwise, parts of the country could be left out of the development.

Blámi also agrees with the other actors in Iceland that an overarching plan is needed. They also argue that the state should be paying for the needed local connections to the grid and that the development can stop just because it isn‘t profitable, which is a question of where the state has to take its responsibilities. Orkusetur also points out that the government should take responsibility for Iceland becoming independent in the production of energy needed for transportation in the country. The government also has the responsibility to take action in regards to its commitments to the Paris agreement etc.

In Denmark, Danish e-Mobility sees that there is political awareness where the government has realized that they must act but has not reached an overall decision on what should be done precisely. In general, Danish e-Mobility notes that there has been more communication than concrete action in this regard. Project Zero in Søderborg argues that the government must put more focus on rural areas. At the same time, Project Zero emphasizes that the government already does a lot. But there is still a long way to go.

This is much like the view VÄRE expresses in Finland and Orkestur expresses in Iceland, where they point out that the government must take more responsibility for renovating grids and building new connections if the electrification of vehicles in rural areas is to succeed.

In Sweden, actors also call for more governmental ambitions in the area. Swedenergy sees positively the extended responsibilities that the Swedish Energy Agency is getting through the electrification strategy on knowledge-sharing measures. Hagfors kommun and Forshaga kommun are expressing thoughts along the same line, suggesting that relevant ministries should provide a web page with up-to-date information that is simple to refer to. Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun shares this view and would like to see the government more involved in leading the development, also in terms of judicial tools. Suggesting that more laws and regulations should be implemented to accelerate change, they see that many businesses do not have the incentives to contribute to the development in rural areas otherwise.

On the Faroe Islands, Nýhugsan mentions the issue of a lacking environmental policy and related goal for the government. From Nýhugsan’s perspective, the government should take a more active role, for example by providing investment support. Currently, they are delegating much of that responsibility to the energy companies in the country. SEV does however point out that the government has decided to exempt EVs from sales tax.

The picture is similar in Åland, where Ålands Elandelslag explains that the government has high ambitions, but that lack of knowledge is an obstacle. They also see the lack of laws and regulations as an area where the government could do more. The Government of Åland does concur with the view that the nation has high goals and that Åland has a high sustainability profile. They note that there is financial support accessible for public charging, home charging as well as charging in popular touristic areas.

In Greenland, the actors depict a different picture. An issue that is pointed at is that the nation has not signed the Paris agreement. There is however a new political coalition in place and a government plan to undertake a study on e-mobility, but there is still uncertainty if that is going to be done. The Ministry of Housing and Infrastructure do see a need for more cooperation between the government, their executive branches, and the energy companies, as they note that the political will overall is very important. Some suggestions on how the government could take a more active part in electrification were, for instance, subsidizing purchases of EVs, or more detailed suggestions such as having car inspections that could encourage people to switch to electric vehicles.

In the Norwegian case, many actors express how active the government has been with far-reaching electrification. Troms and Finnmark Fylkeskommune notes that the Norwegian government made big investments in public charging, which helped resolve the issue of charging availability that existed beforehand. The county feels that this has made it possible to travel between all urban centers in Norway without risking running out of power. Overall, they feel that it makes sense for the government to take a large share of the responsibility for going green and for the associated electrification. Vestland Fylkeskommune also shares this analysis, highlighting how the economic incentives (verkmedel) have been directed to a large extent towards their intended receiver. This is also expressed by Norway's Ministry of Transport, which emphasizes that the economical actions taken have had positive effects and worked very well.

Another actor central to the development mentioned by many Norwegian stakeholders is Enova – the Norwegian innovation agency – which works by directing support to different actors and has played a crucial role in the development in Norway.

4.3.2. Different roles for municipalities & regions

Looking at the responses from the actors who have a broader national perspective, the responsibilities for municipalities and regions seem to differ a lot between countries. Regions can introduce certain local requirements in Sweden, which, according to InCharge, is why there are ten times more electric buses than electric trucks in Sweden. However, Swedenergy notes that municipalities today are proactive to different degrees, as there are differences between them, for example regarding how they handle building permits for charging infrastructure.

In practice, some municipalities have come a long way when it comes to planning for charging stations. In the end, Swedenergy points out that municipalities working more interrelated, using the same methods, and being proactive, are key factors going forward.

In Denmark, Danish e-Mobility notes that while it is not an obligation, the municipalities can connect spots for charging stations in the city with spots outside the city boundaries. This means that the companies must put up chargers in rural areas if they put them up in the city. Overall, the municipalities are responsible for defining locations and setting an agreement with charging companies, which is central to the development. In Finland, the Ministry of Transport and Communication considers the issue of home charging in areas where it is not possible to build an own charging station in the backyard to be a matter that must be dealt with by municipalities.

In Iceland, Austurbrú managed to provide the first basic network with a station in every village/town in their region. Austurbrú's representative says that it was an effort to get the municipalities involved but that it isn't realistic nor fair for them to operate charging stations that are not profitable but are necessary for the network. Austurbrú also mentions that small municipalities do not have the resources to analyze and plan for a network and then pay the majority of the costs for the charging stations.

Nýhugsan points out that on the Faroe island, the municipality owns the power grid, and energy companies largely promote home charging to control the levels of peak demand. Overall, the relatively small size of the Faroese society impacts the relationship between the citizens and legislators, as people and businesses can have a more direct influence on the decisions made regarding many questions.

In Åland, actors point out that there is limited room for municipal actors to act. The Government of Åland notes that there is no formal role for municipalities, and Ålands Handelslag questions whether this should be the case, as they often do not have the resources nor knowledge to make this a logical focus area

In discussions with the municipalities and regions themselves, a recurring theme was the lack of resources to do as much as they would like to. Many of them have high ambitions and strong political will, but time, money and knowledge are sometimes limited. For example, Skive kommune describes how the municipality planned the infrastructure but had difficulty implementing it, as there was limited time and mandate to act on the plan, which is linked to overall limited financial means. Municipally owned areas have direct mandates to make installations.

On the same theme, Hagfors kommun and Forshaga kommun note that smaller municipalities can act to a certain extent but often do not have the time, knowledge, or resources to do much. The lack of resources can in practice mean that there isn't enough manpower to search for substitution for instance. There is a strong political will, but there is a need to set priorities going forward.

This view is shared by VistOrka, a company that assists municipalities in northern Iceland on energy issues. VistOrka thinks that municipalities need to be more involved, but that the lack of knowledge, money, and manpower makes it difficult. They also argue that too much responsibility should not be placed on municipalities, but that the state should make a plan for the whole country first.

Orkusetur suggests that municipalities in Iceland contribute to the investments and maintenance of public charging to a certain extent. There is a lack of common planning and dialog between the state and municipalities. Orkusetur also argues that it would be better if the municipalities worked together and offered similar support e.g., chargers in the apartment buildings.

This view is somewhat contrasted in discussions with the Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun, which believe that municipalities should have greater responsibility for the development, especially regarding local climate targets and concrete resource plans. However, they see political will and overall knowledge to be a barrier to this, and that it would place more burdens on the municipalities.

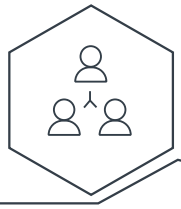
Although there seems to be a lack of resources to carry out some measures, many municipalities and regions highlight the initiatives and actions they have already taken so far. All the three regions interviewed in Norway especially highlighted the region's role in the local development.

Troms and Finnmark Fylkeskommune sees no formal role for them as regional actors, but the county is exploring different opportunities to be proactive in electrification. One example is the introduction of more electric buses, which goes hand in hand with an expansion of the infrastructure. The county also has ambitions to install more public charging points at their own facilities, such as ferry docks.

In another region, Trondelag Fylkeskommune, the county has taken a seemingly more active role, deciding on an obligation for taxis to drive only zero-emission vehicles starting in 2025. The county also grants economic support (stötteordning) for fast chargers as well as charging stations located in areas with limited underlying market potential. The county also suggests that a concrete step to make municipalities more active is to raise awareness of what actual economic support currently exists.

Vestland Fylkeskommune has come a long way in its electrification journey. The county sees that one reason for this is that the role of the Fylkeskommune (Norwegian regional municipality) is relatively large in the administration of EV development. The county representatives also stress that political will, in general, is important, although they also note that it can change quickly. In practice, Vestland Fylkeskommune has also decided that taxis must be emission-free from 2026, which they also see as a poignant signal to private vehicle owners that the future is electrified. Vestland Fylkeskommune has also made significant investments in fast chargers, which they see as a key measure for the future.

In Denmark, Project Zero in Sønderborg kommun has involved local stakeholders in discussions about suitable placing for charging stations. The project has also asked citizens where they would like to see charging stations, by using social media. Skive kommun also stresses that it is important that municipalities discuss these issues with local businesses.



Hagfors kommun and Forshaga kommun believe that municipalities can help citizens by facilitating and encouraging home charging, especially by increasing awareness and spreading knowledge. This is currently being done, but there has been a limited response.

Övertorneå kommun points out that they need to take a more active part in the development, and, for example, have EVs in their car fleet. This will show inhabitants that EVs are a good option and encourage them to take the plunge and buy one themselves. The representatives of the municipality also mention that Övertorneå is an “eco-friendly” municipality, which gives them another reason to engage in this issue.

Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun do see that involving the energy and climate advisors to a larger extent in municipalities could be useful. This could make citizens feel more supported and contribute to the diffusion of knowledge. Another action highlighted was a possible potential requirement to install charging stations at “white spots” – where demand is often low – as a result of some sort of municipal requirement.

4.4. Societal & individual circumstances

Knowledge and attitudes towards e-mobility are crucial to the pace of development. Progress has at times been fraught with prejudice among the public, and an important question is therefore how EVs are perceived in rural areas today.

The question of how electrification has developed in rural and urban areas was discussed with the interviewees, a question that many links to socioeconomic aspects and that often comes down to considering the travel conditions of different social groups.

One aspect that is hard to affect, but is important, is the money it takes to invest in a new car, and more precisely in an EV. Most of the actors interviewed mention private economy as one of the biggest obstacles to getting people to buy an EV. The lack of a used vehicle market, together with the high costs of buying a new car and the long delivery times, are recurring themes in almost all the discussions with actors.

Another topic that frequently arises in the interviews is related to the user-friendliness of solutions – or lack of it. This point was also discussed concerning how to successfully adapt to new technologies in general.

4.4.1. Attitudes and knowledge

While there has been inherent skepticism about the emerging field of e-mobility, some actors see that many of the early problems such as lack of knowledge and general pessimistic views are fading.

The Finnish Ministry sees how fast the whole segment is growing, with a very steep increase in adaption, although it is still seen as a fairly new phenomenon. The fact that electrified vehicles have become more commercially viable has had a great impact according to the ministry. VÄRE shares this view and notes how the adaption curve has shifted from early adopters to the phase where larger parts of the population are starting to adapt. However, they still see that range anxiety is a hurdle to adaption in general.

Skive kommun in Denmark has seen a steep increase in the number of EVs in the last year and notes that the change is happening so fast that the last months only have seen rapid changes. The county representatives also note that EVs and electrification are generally viewed positively by politicians and the public, and that the effects have been notable, especially in the last year. They mention that a reason for reluctance has historically been the perception among people that many public charging stations are needed, but that many are realizing that home charging often is sufficient for their daily trips.

The representative from Project Zero, Sønderborg kommune, states that people need to act differently when owning an EV compared to a fossil fuel car. There's still some fear about range, but people generally have a big interest in EVs. EVs are a popular topic of debate in various contexts, even among people who still doubt EVs can be a proper alternative to fossil fuels. Such interest and discussions can be seen as a good sign for increasing curiosity and acceptance.

In Sweden, Hagfors kommun and Forshaga kommun have seen an increase in overall interest and more people willing to both own and facilitate conditions for EVs, including politicians. Fewer and fewer people doubt range and capacity - even though some still do.

In Norway, the Ministry of Transport describes how the country, to a large extent, has moved beyond skeptical attitudes, and that e-mobility is something that is widely accepted. This is also acknowledged by Trondelag Fylkeskommune, who still points out that range anxiety and practical issues might prevail in some cases. Vestland Fylkeskommune sees how electric vehicles have become something of a household item, but also notes that the vehicle range is an issue in some areas.

The Faroe Islands have seen a radical shift in attitude and adaption of EVs during the last year. According to Nýhugsan, almost all people who seek to buy a new car consider buying an EV. This is also pointed out by SEV, who notes that the shift has been dramatic and that it is currently difficult to sell a fossil fuel car on the second-hand market.

While many actors report that problems with attitudes and knowledge dissipate quickly, some others do not share this view. For example, the Ministry of Housing and Infrastructure in Greenland points out that many people express reluctance about the relevance, or even feasibility, of using an electric car in their environment.

The view of the "boom" in electric car adaption is also particularly contrasted by the views of the Centre for Economic Development, Transport and Environment in North Savo, noting a very limited discourse on both electric cars and charging in their region. They see that many people are still prefer gas or bio-gas-driven cars, the latter having been historically held up as an environmentally friendly fuel. This now puts bio-gas cars in competition with EVs, where many are more confident in the idea of a car powered by some type of gas than electricity. Centre for Economic Development, Transport and Environment in North Savo also highlights the ambiguity on the overall environmental performance of an EV compared to other propulsion systems, as the environmental performance of the battery industry has been questioned. They also mention that people might fear that electrification is "just another trend", being reluctant to invest given that electric vehicles are novel, and have not really been established as a dominant design for sustainable vehicles. This could also be amplified by the fact that people often invest in a car with a long-term investment horizon.

Elaborating on the topic, the Centre for Economic Development, Transport and Environment in North Savo points out how many of the attitudes towards electrification of vehicles are deeply rooted, something that can also be caused by a lack of knowledge. One example is the common perception that the EV range isn't enough for commuting to work, which possibly is reinforced by the feeling that there are not enough charging stations. The interviewees also mention that many people doubt how long the lifespan of the EV's battery would be and are worried about what it may cost to fix a broken one. Another common concern is the overall geographic reality in the region, as the weather is cold, and many roads are in poor condition, which makes many citizens reluctant to use EVs as they are not considered as long-lasting as the traditional alternatives for those conditions.

This has similarities with the case of the Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun, which sees attitudes as the main current obstacle, along with lack of political will. This also applies to Övertorneå kommun, even though they have a certain political will.

The actors in northern Sweden see that the derived demand for transport often includes the ability to tow heavy objects or drive long distances, when necessary, which often makes people reluctant to use electric alternatives. Such needs may be occasional, but even if they occur once or twice a year, people want a vehicle that can cope with them. This also partly relates to the premise of northern Sweden, where distances are long and people consider driving a "way of life", even though they often drive short distances on a daily basis. Övertorneå kommun also mentions the fear of a battery that cannot handle the cold weather.

This picture is somewhat similar to Troms and Finnmark Fylkeskommune. As a region with longer distances to drive and colder weather than in the rest of the nation, the issue of range and durability has more impact on overall attitudes. Many times, people want the flexibility that a fossil fuel car can provide. The county notes a difference in attitudes between urban and rural areas in this regard. They partly link this to the special circumstances in the area, where vehicles are often expected to handle towing snowmobiles or driving long distances due to heavy snowfall on some roads.

The discussion in Iceland is similar to what is being discussed in several other countries, with several actors mentioning that the attitude is generally positive, but that there is still some fear of long distances and lack of public charging stations. Blámi and Austurbrú mention the country's mountain roads without sufficient infrastructure and the harsh weather that often occurs. Austurbrú also points to the potential for families owning two cars to have one EV, and one fossil fuel "winter car". According to Austurbrú, knowledge needs to be built up, not only about cars or charging stations but also about car repair shops and maintenance for EVs. They also see a need for local knowledge on how to set up charging stations at home.

The fear of an of lack of public charging stations is also common according to Blámi, both in terms of the risk of queues at popular destinations and of a weak grid with a long distance to drive to the next charger if the first one is out of order. Blámi also mentions the bad weather and the fear of shorter range in a cold climate. Many of their citizens own big jeeps with the capacity to pull a camper and drive in bad conditions. No EV is close to the function of a Jeep as it is today. Even though Orkusetur agrees with the other Icelandic stakeholders' point of view, they also want to draw attention to the fact that the people with the most negative view about these issues are also often the loudest. Blámi also noticed that there are many EV advocates among the locals and that the skepticism is shrinking.

The range anxiety is also a factor that Danish e-Mobility points to as a reason why many people are reluctant to switch to an electric car, in addition to the fact that batteries often do not have the power to tow heavier devices, such as a camper van, without significantly reducing range. However, Danish e-mobility noted that the perception of EVs in Danish society and among politicians is good.

In Åland, public actors also see the fear of shorter vehicle range as an obstacle to adaption, even though the possible driving distances in the nation are short. Ålands elandelslag sees this as one of the most prominent misconceptions on electric vehicles, but considers that attitudes are slowly but steadily getting better. The Government of Åland notes that the increasing prices of fossil fuels have made many people change their attitude toward EVs.

A factor mentioned by the Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun is that many citizens feel that, historically, northern Sweden has been "used" by the rest of the country for its resources, which adds to a reluctance to follow central government directives such as those on the type of cars that should be used in the region.

The issue of landownership and the need to obtain the consent of landowners to build infrastructure on their land has been raised in Sweden. InCharge does however point out that this phenomenon is evenly distributed nationwide and does not correlate with urban or rural areas. Swedenergy also points out that energy companies and the transportation sector have not had many touchpoints in the past, but that this is something that is needed going forward.

4.4.2.Demographical circumstances

Danish e-Mobility finds a clear difference between urban and rural areas in the numbers of EVs in use, but this, according to them, is also largely explained by factors such as income, education level, and interest in sustainability, rather than the geographic region. This is also an explanation given by Skive kommun, which notes that the lower number of people with higher education in the region could be an explanation for slow adaption.

Centre for Economic Development, Transport and Environment in North Savo also acknowledges this and points out that, in many discussions in rural municipalities, there is seemingly no will at all to adapt to e-mobility. Finnish Energy also finds a clear difference between urban and rural areas, where the rural population is more skeptical, something that they link to less experience with that type of vehicle as well as a generally skeptical view of relatively unproven innovations. The Ministry of Transport and communications of Finland elaborates on the concept of the car as a deeply embedded part of a person's identity, not least when it is used frequently, which may explain the different levels of adaptation.

Greenland's Ministry of Housing and Infrastructure also points at income and education as the explanatory factor for different paces of adaptation. Vestland Fylkeskommune has seen a difference in generation and age, with younger people being the first to buy an EV. The parts of the region with the highest share of EVs are the commuting suburbs around their bigger city, Bergen. This could be explained by education and income.

Finnish energy gives a similar explanation but believes that this pattern will be less prominent with time. The effect of time seems to already be observed in Norway, as the Ministry of Transport points out that differences in attitudes were greater a few years ago, but that they have become more even. The Ministry also problematizes the issue of difference in attitudes by pointing out that it differs based on many more parameters than just rural/urban areas, and that it can be dangerous to single out certain groups as having reluctant attitudes on that basis.

Övertorneå kommun does however see a big difference between rural and urban areas. The municipality mentions that people in urban areas are more educated, which makes them more resistant to stereotypes. The explanation according to them could also be that people living in urban areas get more benefits from electrification, such as less noise and pollution. Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun touch upon this topic as well, noting that larger cities have problems with noise and pollution that they, as a rural region, do not have, which contributes to more positive attitudes to EVs in cities.

Troms and Finnmark Fylkeskommune notes that demography is an important aspect and that the even distribution of population in the country as compared to, i.e., Sweden, has been a factor in attitudes. Project Zero in Sønderborg kommun also raises how citizens in rural areas generally having longer daily trips as being a big difference between rural and urban areas.

The Faroe Islands and Åland seem to share the same experience on this topic. Both Nýhugsan and Ålands Elandelslag mention that the distances are so short on the islands that the rural aspect isn't really a problem, and that elder men are the hardest ones to convince. According to SEV, inhabitants of the Faroe Islands are relatively wealthy, and the class differences are small. Therefore, it is difficult to differentiate between various groups in society.

4.4.3. Private economy

All interviewed municipalities in Sweden point out that EV prices are probably the biggest constrain and that a used vehicle market is needed. InCharge suggests that it should be more attractive, in terms of the private economy, to own and drive an EV. This view is shared by the Energy and Climate Consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun which also believes that a lot of people have the money that it takes to buy an EV but just need to be convinced.

Both VÄRE and Finland's Ministry of Transport and Communications touch upon this topic, pointing at price and long waiting time for delivery of EVs as obstacles. The Region of North Savo also mentions that inhabitants in their part of Finland usually do not have as much money as people in the rest of the country, which gives them a disadvantage. A lot of people also do not think about the lifespan expenses of the car and its operating costs, which are often lower for an EV. The region suggests that it would be good to show people concrete examples of what an EV costs compared to a fossil fuel vehicle. VÄRE believes that more and more people start to see the benefits of owning an EV due to the rapidly increasing prices of fossil fuels.

In Iceland, Orkusetur suggests that one of the most effective ways to encourage people and companies to buy electrical cars is to subsidize new cars. With the current prices, wealthier people are more likely to buy an electric car. Not much can be done about it, but overinvesting in the charging system can help, as this would facilitate the use of used cars with a lower range. Austurbrú does not see much discussion about the fact that EVs are currently more expensive than fossil fuel cars, but since they are subsidized today, this could change if the financial support gets canceled. Austurbrú also raises the need for a used vehicle market.

Ålands Elandelslag, The Government of Åland and SEV agree that high prices and long delivery times are a big obstacle. Ålands Elandelslag also explains that it isn't common for a car to be owned by a company and leased by a private person, therefore it must be private individuals and not companies that invest. The same applies to the Faroe Islands, according to SEV.

In Denmark, there isn't any second-hand market except for a small one with vehicles imported from Germany, according to Danish E-mobility. Skive kommun captures the core of the issue when stating "It is still difficult to buy a used e-car for reasonable money for an average person in Skive. And obviously these people who don't earn that kind of money can't, you know, gain entrance to the club". In contrast to this, Project Zero in Sønderborg kommun does not think that price is an issue but raises the problem of long waiting times.

In Greenland, cars do not need to pass regular technical inspections to validate that the vehicle is in good enough condition to operate. This means that people do not change their car very often, as they can keep driving it even if they are in poor condition. Greenland, therefore, does not have a large car turnover, and inhabitants rarely buy new cars.

The only country that is united in stating that price is not a problem in Norway. According to the Ministry of Transport and Vestland Fylkeskommune, it is relatively cheap to buy and drive an EV nowadays compared to a couple of years ago, which is one of the major driving forces behind the EV market expansion. If one is to buy a new car from the premium segment, an EV is many times cheaper than a fossil fuel one.

While Vestland Fylkeskommune does not see price as the biggest obstacle today, Trondelag Fylkeskommune believes that a lot of people want to buy an EV but cannot afford one, mainly because they cannot afford a car in the premium segment to which almost all of the EVs belong. However, there is now a well-functioning and relatively big second-hand market for EVs in Norway, something that enables more and more people to buy one.

In Norway, EVs are exempt from several of the fees that a fossil fuel car must pay such as free parking at different places, half the price on ferries, and no congestion charge. This is mentioned as an important enabler by both The Ministry of Transportation and all the three Fylkeskommuner. Trondelag Fylke discusses this in terms of rural and urban areas and points out that people in urban areas have more to gain from these benefit

4.4.4. User-friendly solutions

Both operators interviewed, InCharge and VÄRE, agree that the many alternative ways to pay for charging and the resulting problems cannot be solved by another app as this would make things more complicated. According to Danish e-Mobility, some charging operators in Denmark have “all-inclusive” arrangements. This means that the customer must find a certain operator, which is an obstacle to a smooth user experience. Finland’s Ministry of Transport and Communication also thinks that more user-friendly payment methods are needed.

Trondelag Fylkeskommune asks for standardization for charging. As it is today, there is not enough coordination between different operators and charging solutions. For example, there can be two different chargers placed next to each other with no way of knowing which one is the fastest and/or the cheapest. Charging an EV needs to be as simple as refilling a fossil fuel car.

According to InCharge, people tend to be stuck in an old “gas station” mindset, which means that the customer thinks that refueling petroleum and charging electricity should be done in the same way regarding the location of the station/charger, time consumption and facilities near the station/charger, which is not necessarily the case. Charging an EV is different because, for instance, electricity has different pricing at different places. InCharge also argues that people who own an EV often do not see charging as a problem, but it is mostly people who have never driven an EV who think it is complicated.

Several initiatives aim at making it easier to own and drive an EV. Finland’s Ministry of Transport highlights an initiative initiated by Sähköinen Liikenne ry coordinated by Korkia Consulting Oya, who produced a guide to make it easier to own an EV. Swedenergy has just conducted a project aiming at facilitating the payment when charging an EV[1]. Ålands Elandelslag currently runs a website with information for the general public about EVs. The website is highly appreciated by the population. Still, the company wished that they had more time to invest in making it up to date and increasing its relevance. Project Zero in Sønderborg kommune distributes a newsletter on the topic, updates social media with posts about EVs, arranges events on the matter, and has brochures for those interested in EVs.

Another point made by Ålands Elandelslag is that one cannot get a Tesla repaired on the island, which is something people consider before buying one.

Norway’s Ministry of Transport also mentions that some groups in society are less comfortable with digitalization than others. Actors must think about them too when designing payment methods. Not everyone can pay with an app or a credit card.

4.5. Country borders & other vehicles

The main topic discussed regarding borders was related to how tourism affects charging infrastructure and local business. One thing that was mentioned by almost every actor addressing this topic was that the public charging is more often serving tourists than residents.

As with private cars, different countries are at different stages of development when it comes to other vehicles such as trucks and freight transport. Most actors seem to agree that the question is not whether electrification of road transportation will happen, but rather when and how it will happen. Other vehicles were mentioned during the interview in addition to private cars and freight transport. These vehicles are discussed in the present chapter.

1 En branschöverenskommelse för publik snabbladdning - Energiföretagen Sverige (energiforetagen.se)

4.5.1. Tourism

Sweden, Finland, and Denmark are all experiencing a demand for public charging from Norwegian tourists.

Danish e-Mobility says that there's a higher request for destination chargers in northern Denmark, which is a popular tourist destination for Norwegians, than in the rest of the country. Sønderborg kommune, located in southern Denmark, also sees strong demand for public charging stations from Norwegian (and German) tourists.

Finnish Energy explains that there's surprisingly good coverage of fast chargers in the northern parts of Finland, a likely explanation for this being Norwegian tourism.

InCharge mentions that they see a higher level of knowledge and interest in e-Mobility in municipalities close to the Norwegian border. Hagfors and Forshaga kommun mention that a lot of Norwegians have summer houses in their municipality, which increases the demand for charging stations. Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun also note that Norwegians have great purchasing power, which makes them important for local businesses, which makes charging infrastructure crucial close to those businesses. Övertorneå kommun agrees with such a statement and states that the municipality needs to keep up the pace with charging stations to keep attracting tourists. The general perception in Övertorneå kommun is that Finland is more advanced in the development of EV infrastructure, and that the municipality, therefore, needs to keep up with them to maintain businesses and tourists.

The representative from Project Zero, Sønderborg kommune, also mentions the difficulties of not knowing how to find and pay for charging in a new country. Living in a region with a lot of connections to Germany, these problems are highly relevant. Commuters often figure these things out, but less frequent travelers can be afraid of this unknown factor.

Related to tourism is demand for charging stations in rural areas from people coming urban parts of the country. The Centre for Economic Development, Transport and Environment in North Savo mentions that tourist destinations within their region will probably be the first ones that have to build more charging stations since they attract people from other parts of Finland where EVs are more popular. They note that there are more discussions about EVs in towns crossed by one of the main national roads, and in the smaller towns that attract a lot of tourists such as Lieksa, Nurmes and Rantasalmi. The debate is mostly about travelers' need for charging rather than EVs becoming popular among the people that live there.

This view is also shared by Hagfors kommun and Forshaga kommun noting that, in their case, there is a significant volume of tourists crossing the region when going to Sälen or Trysil, driving the demand for fast charging. Thus, fast chargers might not mainly serve the native population, but rather be an enabler for continued profits from tourists in the area. Danish e-Mobility concurs with this, saying that there are few incentives for municipalities to invest in fast chargers for their own inhabitants since the fast chargers are mainly used by people passing by.

This point is also made by the Government of Åland, which mentions that public charging stations are mostly used by tourists. On the Faroe Islands, Nýhugsan mentions that some remote areas attract tourists and need an "emergency" charger, so that tourists do not get stuck in inaccessible places. There's also a need for destination charging stations next to their most popular tourist attractions.

In Norway, Troms and Finnmark Fylkeskommune have not seen any problems with borders or tourism. The county mentions a collaboration with Sweden to increase the public charging opportunities between Sundsvall and Trondheim. This improved the conditions for charging in Åre, a popular tourist destination. InCharge mentions that tourist destinations within Sweden, for example, skiing resorts such as Åre, see a relatively high demand for charging infrastructure due to tourists visiting from bigger cities.

In Iceland, car rentals for tourists is an important business. Orkusetur points out that almost 50 % of the new car registrations are done by rental firms, stressing the importance to convince rental companies to invest in an electric car fleet. Blámi says that car rentals must both allow and facilitate driving an EV in the Westfjords but fears that the Westfjords will not have enough charging stations if all rental cars become electric, which will make tourists travel to other parts of the country. Austurbrú shares this fear of the Eastern part of the country possibly missing out on tourism if the charging station network is not good enough. Austurbrú also argues that the tourism industry itself could offer charging stations at popular destinations and other arrangements that facilitate EV rental. During the covid period, temporary schemes were used to encourage companies to set up stations. That has encouraged the tourism industry to participate in taking responsibility to offer chargers.

4.5.2. Road transport & Freight

According to the Ministry of transport, electrification of road transport and freight is one of the current questions discussed within the transport sector in Norway. The "natural" step after electrification of the passenger car fleet is freight, since the politicians need to plan for reducing emissions within the transportation sector. Trondelag Fylkeskommune states that the future contains electrified road transport and that it is just a matter of time.

While the development of charging infrastructure on the one hand is a question of business logic and market, some actors discuss charging in a wider context. Swedenergy highlights that there are a lot of things happening in the sector with many new entrants in the business.

However, there are many parameters to take into consideration. Using the example of heavy transport, Swedenergy emphasizes that installing charging points at rastplatser [rest areas] – central to the operations of logistics – is key to enabling the electrification of heavy vehicles. However, the process for this is time-consuming in Sweden, especially compared to other Nordic countries. The fact that there are over 100 grid operators (at a local level) makes it complicated. Pressure on network capacity will also increase when chargers for heavy transport are to be installed.

In Sweden, InCharge has noticed that vehicle manufacturers and dealers are increasingly interested in electric freight transport but are still a few steps behind passenger cars. Both Övertorneå kommun and the Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun mention electrification of the vehicles used in mining. This could, according to the energy and climate consultation, affect the citizens' willingness to buy an EV. Övertorneå kommun is generally positive towards development and considers investing in electric trucks for municipal use. The municipalities of Hagfors and Forshaga do not consider freight transport in their electrification plan. Still, they believe electrification of freight transport is a valid question and will raise the topic within another of their plans, the comprehensive plan, even though they admit that it isn't a prioritized question at the moment.

In Iceland, Blámi mentions that they wish for a plan to handle the transportation of fish over long distances without stopping to charge on the way.

In Denmark, Finland, Åland, and the Faroe Islands, electrification of trucks isn't discussed at the moment according to Danish e-Mobility, Finnish Energy, the Government of Åland, and SEV.

Danish e-Mobility tries to raise the issue from time to time, but there isn't any solid ground for discussion yet. Skive kommune has started a dialogue with a local business that generates a lot of transportation to get a grasp of their needs and options for alternative fuels. Electrification is one of the alternatives discussed but is not seen as the most natural option compared to hydrogen and other alternative fuels.

The electrification of freight transport seems to be facing more constraints than passenger cars. The Norwegian Ministry of transport mentions that freight does not benefit from the same economic advantages as passenger cars, since price incentives like reduced fees (free from VAT) do not apply to freight. The ministry also mentions that the technology still has some way to go.

Both Norway's ministry of transport and Swedenergy discuss how to solve the problem of charging for freight transport. Swedenergy thinks that one of the main issues is that electrification challenges the whole logistics chain and the way to think about transportation.

Producers, users, and distributors all need to realize that a whole mindset needs to be changed. Trucks might need to divide their routes into shorter pieces to enable charging, and infrastructure is needed lengthwise along the highways. Both stakeholders also raise the issue of borders, stressing that systems need to work across borders. There are, according to Swedenergy, discussions about whether the EU will issue requirements for charging infrastructure on given corridors. However, Swedenergy believes these would probably be the minimum requirement level and the market will expand beyond that as the demand rise.

4.5.3. Ferries, planes, buses and others

Public transport seems to have come the furthest after passenger cars when it comes to electrification. InCharge has noted that the development of electric buses has outpaced that of electric trucks. One of the main explanations for this is probably that the regions or authorities in charge of public transit require operating companies to procure and drive EVs, which puts pressure on the whole business.

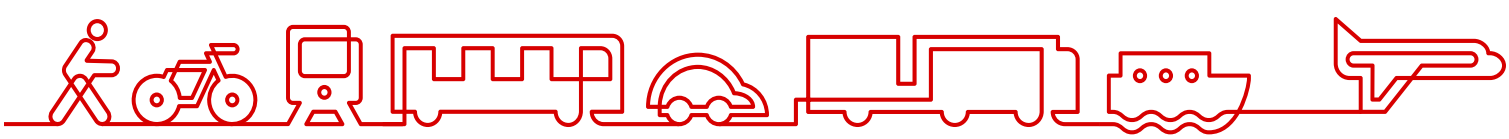
Both Troms & Finnmark Fylkeskommune and Vestland Fylkeskommune mention that electrified buses operate within their bigger cities and that this is one of their main tools for affecting development. Ålands Elandelslag argues that buses and taxis can be a part of the solution for more beneficial chargers if they share chargers with passenger cars. Buses can, for example, pay a locked fee and be the main source of income. On the Faroe Island, discussions have been ongoing about the electrification of buses, but, according to SEV, this would cost too much at the moment. Trondelag and Vestland Fylekskommune have both decided on a zero-emission requirement for taxis from 2025 respective 2026.

Since all the countries count a lot of islands and archipelagos, ferries – and especially car ferries – were mentioned by several stakeholders. In Greenland, the only way to travel between cities is by boat or plane, which makes the electrification of boats an important matter according to the Ministry of Housing and Infrastructure. It is very common to own a boat for traveling, actually more common than owning a car. Greenland had planned to develop a strategy to enable the electrification of ships and planes, but a change in coalition put this project on hold.

In Åland, ferries between the island are a major source of emission, probably emitting even more greenhouse gas than cars, according to Ålands Elandelag. It is therefore relevant to look into the electrification of ferries, and the question is extensively discussed at the moment. The Government of Åland also agrees on the significance of the matter and adds that providing big cruise ships calling at the harbor with electricity will be a big business in the future.

In Norway, Vestland Fylkeskommune has electrified their car ferries and has noticed a growing market of electrified smaller leisure boats. The county, therefore, implemented a system that combines the charging of cars and smaller boats along the quays. Troms & Finnmark's county is involved in a project to develop boats running on alternative fuels, for example, electricity. They also point out that there are a lot of electric car ferries today, but that they are not that suitable for operating in their region. The circumstances regarding weather, waves and distances are a bit different from, for example, the inner Oslo fjord.

On the Faroe Islands, SEV says that there have been discussions about the electrification of ferries, but that they're just not there yet.



5. Analysis and discussion

This chapter contains a discussion and analysis based on the findings from the interviews. The matters discussed below should be seen as a selection of interesting themes identified from the results since all the topics covered within the interviews are not included. As the report results in recommendations concerning communication (see section 6), an extra focus has been put on elements that can be influenced by communication as a tool in this chapter.

5.1. Adaptation for each country

The Nordic countries have many similarities, and many of the insights in this report are valid across national and regional borders. Despite this, the countries differ on several important points. An obvious difference is that the countries are at different stages of electrification. Relevant measures in one place may not be relevant until several years later or earlier in another location. The clearest example is Norway, arguably several years ahead of all other countries in vehicle electrification.

Another important difference is the difference in geography, topology, and climate between the nations. Driving in the Danish plains, between the Åland archipelago islands, in the Icelandic highlands, and through Swedish forests sets different requirements for what is expected of a car. Driving patterns and opportunities for suitable infrastructure are very different, even within the borders of a country. As many of the nations in the study are characterized by archipelagos and long driving distances, many express views that the electrification of car ferries and planes is almost as relevant as the electrification of cars.

Another aspect is that all countries have different climate and environmental goals, affecting the incentives to change the vehicle fleet. Having high climate goals and a policy that strives for fossil-free vehicles is an important factor in this context. The view among actors on the role of the state also differs between different countries. For example, all actors in Iceland agree that the state should work on a national, comprehensive plan, while in Sweden many mention that the state must focus on solving problems related to the production and distribution of energy.

The measures need to be shaped based on different locations and local conditions. By acknowledging that there are differences between regions and countries, better adjustments can be made, which in turn gives better results.

5.2. Perspective on attitudes and knowledge

Whether there are problems with knowledge and attitudes depends mostly on who you ask. However, it is possible to see a pattern depending on the setting and geographical level in which the actors operate. Those with a more global perspective at a higher geographical scale (national, Nordic) tend to find that attitudes are not a prohibiting factor, while actors operating on a lower geographical scale (municipal) tend to think that it is.

The interviewees who mostly experience attitudes and lack of knowledge as an obstacle are representatives at municipal and regional levels in the most rural areas in Finland, Sweden, and to some extent Iceland. These actors are closer to the inhabitants and tend to understand what hinders development at a very local scale right here and now, while actors with a more Nordic and global perspective look at the overall picture and weigh other obstacles as more impactful than attitudes.

Based on the findings from the interviews, it can be stated that negative attitudes and lack of knowledge exist to a fairly large extent in the most sparsely populated areas in the Nordic region. The interviews also point to some reasons why attitudes are different in sparsely populated areas compared to urban areas, something that is important to understand when working on the development of e-Mobility in rural areas.

- People living in rural areas generally drive longer distances more frequently. A fear that the car will not be able to handle those distances, combined with the fact that public charging infrastructure is much less developed, makes people more skeptical.
- Weather conditions are usually more challenging in these areas. The fear that the car will not be able to cope with the weather is more obvious, as the weather hazards can lead to dangerous situations, especially in these sometimes quite isolated areas.
- Cars in rural areas are used for much more than just passenger transport. Towing a snowmobile or a trailer is an important part of a car's tasks. There is a fear that an EV will not be able to do this.
- The benefits of reduced noise and pollution are not as significant in sparsely populated areas.

The fears and skepticism that residents experience in these areas are to some extent real limitations of EVs and should be taken seriously, and, even though an EV would be suitable in almost all situations, an adjustment could be required for people with certain types of driving patterns.

Just as it is important to understand that there is a reason why attitudes are different in rural areas, it is important to understand that there are other socio-economic aspects that distinguish urban and rural areas. e-Mobility is not the only new technology for which development and adaptation are slower in sparsely

populated areas. For less affluent groups, both within the cities and in sparsely populated areas, investing in an EV is a large financial expense, which means that they need to be even more confident in their decision. The respondents also express that among some rural residents there is a strong identity and belonging to a certain car culture, which can be a hindering factor for the inclination to change to a fossil-free vehicle.

Although some actors believe that it can be dangerous to make too many distinctions between groups, it is important to recognize that differences exist to be able to implement targeted measures. At a more global scale, i.e. at the national and Nordic level, knowledge and attitudes do not appear to be as significant a barrier to electrification, and therefore implementing global awareness measures for most of the Nordic population would probably not have the desired effects. By acknowledging that there are differences between urban and rural areas, direct efforts can be targeted where it makes the most difference.

5.3. Local involvement & government support

There seems to be some consensus that companies and businesses are essential actors in the transition, as financial investment from private actors is crucial and gains from electrification are potentially high. Electrification can also have a ripple effect, attracting potential buyers and increasing tourism and commerce, which then benefits local business, which benefits other industries and types of business on top, etc. In concrete terms, it is essential to increase the interest of businesses in e-Mobility, to make different types of industries aware of the benefits they can gain from this development, and give them a reason to actively participate in progress.

There is a similar consensus that the state must be more actively involved and facilitate or create the conditions for the development to take place. This can mainly be done through financial and legal efforts, but also by putting more focus on electrification in general planning documents. If the state does not provide the right kind of incentives and tools, it will be difficult for the businesses to carry out their part of the transition in a desirable way. This also becomes evident in discussions with Norwegian actors, who all point to the active role of the state as an explanation for rapid development.

Although more responsibility is generally demanded from the state and national authorities, it is also possible to conclude that development must be locally rooted and locally driven. E-Mobility gets a strong position in society as the local actors drive the development forward. Residents would rather listen to and trust representatives who are closer to them geographically than senders who speak in front of an entire nation. Explanations for this may be that residents feel a stronger connection with those who live and work in the same circumstances as themselves, but also that residents want to contribute to their community by being proactive and taking advantage of the benefits that come with new developments.

Municipalities and regions in the larger countries have an important role to play. Partly as a sender of messages to residents and local businesses, but also by working proactively with the development of e-Mobility. Like the state, they have a role to play in enabling economical and legal development. This was also emphasized in interviews with Norwegian stakeholders, who highlighted the regions' (fylken) commitment as an important success factor.

A major challenge is that smaller municipalities and regions often do not have enough capacity and resources to be proactive. Although there seems to be a great willingness to do more among politicians, businesses, and representatives from municipalities, there is a lack of time, competence, and finances for it. If municipalities and regions actively commit to the transition, there is a lot to be gained, just as commitment from the local business community seems to be a factor for success. However, this requires the state to enable development through clear financial incentives and other instruments.

5.4. How to solve the lack of public charging?

The underlying issue for public charging infrastructure in sparsely populated areas is the difficulty to make a profit from charging stations, as demand is too low. There is low profitability for a company to build the infrastructure required in a place where too few people will use it. This in turn leads to reluctance or inability for people to drive an EV, as the charging stations are too few.

This is highlighted as one of the biggest challenges for e-Mobility in sparsely populated areas by several actors, especially in Finland and Sweden. There are simply no incentives for companies to invest in something that will most likely not turn any profit. Although governments often support the construction of stations in different ways, operating costs are expenses that are usually not covered by the revenues generated.

The issue is also amplified by the fact that the public believes that there must be an abundance of charging points to drive an EV. Even though people know they can go a certain distance without charging, many feel that charging infrastructure along the road is required, at least to be safe. Without that safety, people do not want to or dare to drive an EV.

- In the future, fast charging for heavy transport may be combined with charging for passenger cars, to improve profitability.
- More government support and subsidies can increase incentives for companies to invest in places that currently have low profitability.
- People must trust that home charging is sufficient in most cases, and thus choose an EV over a fossil-fuel car. Which will increase the number of EVs and create greater demand. Something that, for example, can be influenced through information and awareness campaigns about how far it is possible to drive on a "full tank".
- Charging stations can be even more visible to the public. With large signs, arrows, and advertising along the roads, people who currently drive fossil-fuel cars will be exposed to the fact that there are charging stations along the route. If charging points are only marked out in an app, it is difficult for those who do not drive an EV to know that charging stations exist.
- Businesses or popular destinations generating a lot of traffic in rural areas (larger department stores, ski resorts, airports) can invest in charging stations along roads where they generate traffic. As a customer, one could for example charge at a discounted price. This would be a method for businesses to contribute to the transition and electrification while taking greater social responsibility.

There is no obvious answer to how this problem should be solved, but it is possible to tackle it from two directions. Either by increasing the supply and ensuring that more charging infrastructure is built, or by increasing the demand and getting more people to drive an EV.

To increase the supply, the investment must be profitable. To create greater demand, more people must want to charge vehicles in rural areas. Some of the ideas on how to do this arising from the interviews were:

5.5. How to utilize the potential of e-bikes

From the literature review it is clear that e-bikes have a potential to replace cars for transportation in rural areas as well as in urban areas. The statistics from the national e-bike subsidy in Sweden also indicate that e-bikes are as widespread in rural areas as in dense urban areas. The limitations and barriers towards a greater use of e-bikes among rural residents mentioned in the studied literature are longer distances and lack of cycling facilities.

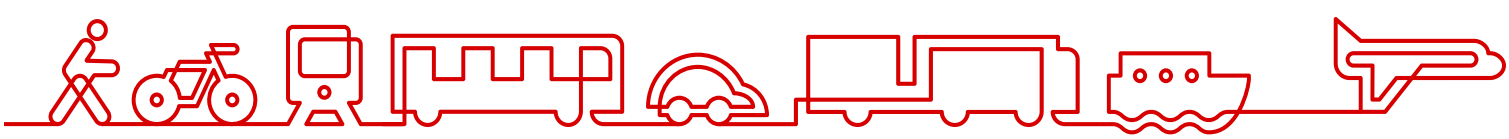
These barriers could be bridged with an expansion of cycling networks in rural areas and an emphasis in municipal planning on de centralization of citizen service and workplaces. This require significant infrastructure investments as separate cycling infrastructure in many cases is a scarcity in rural areas. Promotion of increased use of existing paths with potential for increased cycling could to some extent contribute to a greater utilization of e-bikes with lesser need for investments.

5.6. Some things are part of a bigger problem

E-mobility in the Nordics is not isolated from the rest of the world. Many challenges identified in this report also apply to many other regions of the world. An example of this is the long delivery times of EVs mentioned by many interviewees. This is a major problem related to materials and component shortcomings that affect the entire industry.

Another important aspect is that socio-economic conditions affect the possibility to participate in the development of new technologies and make expensive purchases. This phenomenon is not unique to e-Mobility but also affects many other parts of society. The social dimension is a difficult but important issue to bear in mind in the development of e-Mobility.

Another problem arising from the discussion is the unwillingness of politicians and those in power to get involved in the climate issue. Clearer directives and greater efforts at a national and global level are in some cases needed. This can also be seen as a part of a larger global problem with too little ambition and too little action to address climate change within some sectors.



6. Recommendations

All the recommendations proposed in this chapter focus on addressing problems related to knowledge and attitudes through better communication and awareness-raising. Problems with knowledge and attitudes are just one of many challenges identified as obstacles to development in the present study. Communication can be used as a tool to address these issues but is unlikely to solve the identified problems on its own. Therefore, it is recommended that other measures be considered to complement the ones proposed in this chapter.

6.1. Why communication?

For communication to work as intended, it needs to adapt to both the sender and the receiver. As noted in previous sections, communication can be an effective tool for raising awareness of certain issues and influencing change in the right direction. Since the interviews gathered many different types of actors, it is possible to get a sense of the type of communication and information needed for each target group.

Communication must also be adapted to the country or the region's conditions. Different types of information are needed in different phases of development. In addition, information must be adapted and designed so that the actors who take part in it feel that it is also directed at them. If the information is adapted to the conditions on-site, it will be more credible and relatable.

Well-designed and well-targeted communication can have great effects.
But just as several actors highlighted, other measures could also make a big difference. Several important problems will most likely not be solved through communication, for example, economics, law, and energy issues. Communication efforts should therefore be seen as an important complement to other types of measures.

6.2. Communication with residents

At a national and Nordic level, according to the actors interviewed in the present study, residents do not seem to need targeted efforts regarding communication. However, the discussions concluded that there may be a need for increased knowledge in some of the most rural parts of the Nordics.

Communication to residents should come from local actors, such as the municipality or local interest groups. If local actors are used as messengers, the context will be more adapted to the recipient, while taking into account the demographic and social dimensions. There is also a point in not only focusing on rural areas but also on social groups such as the elderly, people with a lower level of education, or people who do not speak the local language on a more global scale.

When communicating with residents, it is also important to bear in mind the fears and prejudices that exist. If one does not consider the fact that there are real problems with, for example, weather and long distances, the information may be perceived as less credible.

Communication with residents should also include information on alternative means of transport for those who live in sparsely populated areas, for example electric bicycles, mopeds and moped cars can be a good alternative for those who make many short or medium-long trips but do not have the finances to buy an electric car.

The knowledge gaps identified through the study, and which should thus be addressed, are as follows:

- The benefits of home charging
- How far it is possible to drive on a full tank
- How weather affects electric cars
- The ability to tow a trailer
- The economic benefits of electricity instead of fossil fuels
- The lifespan of an electric car
- Answering questions about long waiting times
- Information on EU requirements, fit for 55[2], and that vehicle manufacturers have a stop date for fossil-powered cars.

2 EU Member States committed to turning the EU into the first climate neutral continent by 2050. To get there, they pledged to reduce emissions by at least 55% by 2030, compared to 1990 levels. In order to align current laws with the 2030 and 2050 ambitions, the EU is working on the revision of its climate, energy and transport-related legislation under the so-called 'Fit for 55 package' (https://www.consilium.europa.eu/).

6.3. Local stakeholders are good messengers

Local actors are important messengers for communication measures. The interviews have shown that many local initiatives already exist, not least on the islands. Maintaining and supporting local actors in their work with advocacy is probably a good way to go. In places where there is already an established channel for communication and advocacy, it is unnecessary to create a new one. By utilizing and providing support for the initiatives that exist, one also encourages a strong local connection. One measure should therefore be to map the initiatives that already exist in rural areas and look at the possibility of communicating through these. It is also possible for ministries to produce and distribute material that is easy for local organizations to use.

Communication with local businesses can increase interest in EVs, thus accelerating the transition. The communication with businesses should highlight what gains the company can make from investing in and promoting e-Mobility. This may, for example, be about restructuring their own vehicle fleet or investing in charging infrastructure next to a site operated by the company. Benefits from this can be tourism, new target groups, and a strong environmental profile. The communication can advantageously be led by the municipality, the region, or local business organizations.

With property owners, tenant-owner associations, and housing cooperatives, it is important to communicate about how and why the property should be equipped with chargers. This is an important piece of the puzzle in the development, as home charging can be seen as a prerequisite for having an EV. Individual residents in apartment buildings often have a limited ability to influence. Therefore, the manager and owner of the houses must take responsibility for establishing places to charge an EV. Communication should be about the importance of being proactive, as demand will increase rapidly in the coming years, and the fact that chargers will increase the value of the property.

6.4. Governments create prerequisites for municipalities and regions

There is a lot to be gained for societies that have municipalities and regions involved in the issue, as they can have a direct impact on the local population. However, it is difficult for municipalities and regions in sparsely populated areas to make large investments in e-Mobility, as there are limitations with knowledge, funding, time, and resources. There are benefits in the government taking some responsibility both arguing for why municipalities and regions should get involved in the issue and helping them with guides on how they should do it the best way.

In some countries and places, municipalities and regions are more involved and take greater responsibility than in other places. Regardless of the formal role that a municipality and region have, it is possible to promote a commitment to the extent that suits best the specific context. Communication to municipalities and regions should come from authorities such as ministries or the government, and focus on what gains there are for a municipality and region to engage in the matter. This should address:

- The benefits of acting now and not waiting for the future.
- Benefits of investing in charging infrastructure. For example, tourism.
- How to engage your local business in the issue.
- What support is available, financially, and practically?

The guide on how to engage should include simple, concrete measures that are possible for a municipality and region to implement, for example:

- How to enable charging on their own land
- Information about building permits
- How to proceed with comprehensive planning and strategies
- How to encourage and set the frame for discussions and networking among local stakeholders and business
- Arguments to change car fleets to EVs
- Information on how to communicate through social media
- How to set up charging stations for employees at the city hall, hospitals, schools, etc.
- How important it is to advertise the charging stations that already exist. Not least to show people who drive fossil-fuel cars that there are charging stations and therefore that it is possible to drive an EV.
- How to implement regulations for taxis, buses, etc.
- How to implement free / discounted parking for EVs.

There's a need to show some good examples of municipalities and regions that have proceeded with these measures and succeeded. It is also important to communicate about what advantages EVs have specific to rural and sparsely populated areas. There are things that people living in these places generally can benefit from more than people living in cities. For instance:

- It is easier to install home charging since it is more common to live in a house.
- EV operating and driving costs are lower, which people who drive long distances will benefit from.
- Branding as a "green" and environmentally friendly location, is important for sites that are depending on nature tourism.

6.5. The government needs to show what measures are being taken

Many actors think that the state is not doing enough. It could therefore be an idea for the state and authorities to be clearer in their communication about what they have done so far, what they are doing today, and what they plan to do in the future.

7. Conclusion

This report has contributed to mapping obstacles for adaptation to EVs in sparsely populated areas in the Nordics. Even when bearing in mind the different paces of change amongst the countries, it is still clear that there are certainly major challenges to overcome in some of the most sparsely populated areas in the Nordics. Still, the challenges differ slightly between the countries, primarily because of politics, geography, environment, and infrastructure – which is something to bear in mind when designing and implementing measures.

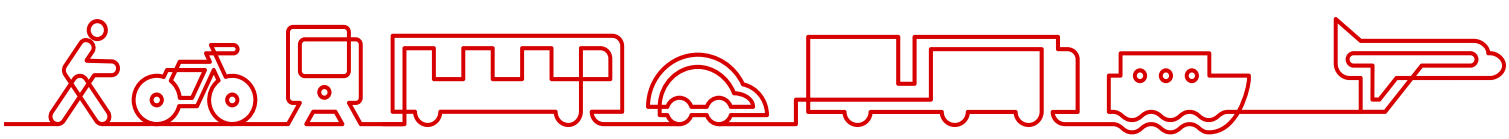
The authorities' and governments' roles are important in the transition to enable other stakeholders' contributions. They provide the tools needed for planning, juridical and practical issues. Not least – they provide crucial economical support for investments and substitutions.

Access to public charging and home charging are key measures to increase adaptation, a conclusion that can be drawn from the fact that a lot of the identified obstacles derive from that. Several challenges to expanding access were identified, including low profits, constraints in the power grid, juridical issues, and resistance to the necessary investments.

There is much to be gained from getting local actors such as municipalities and local businesses involved. Increased interest and resources in these types of institutions are therefore needed, which, according to the results of this study, is to some extent the government's responsibility.

The recommendations in this assignment focus on how to increase knowledge and change attitudes amongst inhabitants of sparsely populated areas, and how this can be remedied through communication. Some knowledge gaps were identified, as well as common misapprehensions. Recommendations on who should be the messenger to each receiver of the communication measures were also provided.

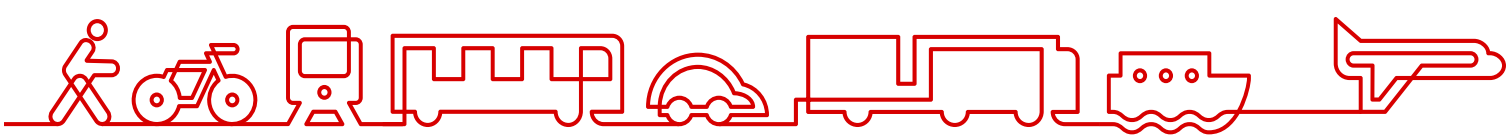
If there are both benefits to driving an EV and disadvantages to not doing it, compared to a fossil fuel - car, people's willingness to consider one will increase. As it is today, the results of this study show that knowledge of the existing benefits is low, and the actual benefits are too few in sparsely populated to convince some groups of people to switch to EVs.



7.1. Further research

The submission of this report has prompted reflections on what the next step of research within the field should be. A lot of the material gained from the interviews has been excluded from the report since it concerned topics too far from the core issue of this assignment. Discussions with stakeholders, however, helped envision other detailed studies which could be carried out within the current topic, and what could be done in contiguous research fields.

- There is a need to further investigate the barriers and possibilities to the electrification of other travel means in sparsely populated areas since they also are an important part of many people's daily transportation besides cars. This includes for instance car ferries, planes, mopeds, four-wheelers, and snowmobiles.
- A more in-depth study is needed for road transport and freight since the topic is only superficiality covered in this report.
- Many of the obstacles identified cannot be addressed with communication alone as a measure. In fact, according to the results of this study, economics, comprehensive planning, and juridic tools seems to have a decisively impact. Recommendations regarding these issues should be considered.
- People living in rural and sparsely populated areas are not the only ones lagging slightly behind when it comes to electrification of transport and driving EVs. Other societal groups, like the elderly, also seem to have a harder time keeping up with the development. Future research should focus on obstacles faced by other groups whose circumstances are also less favorable for owning an EV.
- Highlighting good examples in the Nordics, especially Norway, would be a good source of inspiration and knowledge through the development.
- In-depth research and insights into the behaviors and attitudes of target groups. This should be done with targeted questions, clear demarcation and a relatively specific purpose.



List of references

Akstovan (2022). Hagtøl yvri akfør greina á drívmegi https://akstovan.fo/akstovan/hagtoel/hagtoel-yvir-akfoer-greina%C3%B0-a-drivmegi (downloaded 2022-08-09)

Cherry, C R & Fishman, E (2021). E-bikes in Europe and North America in Cycling for sustainable cities / edited by Ralph Buehler and John Pucher

Clark, Anna & Nilsson, Annika (2014). Trafiksäkerhetsaspekter av ökad användning av elcyklar i Sverige

Danish Council on Climate Change (Klimarådet) (2020). Kendte veje og nye spor til 70 procents reduktion https://klimaraadet.dk/sites/default/files/downloads/70_pct_analyse.pdf (downloaded 2022-07-07)

Danmarks Statistik (2022). Transport https://www.statistikbanken.dk/statbank5a/default.asp?w=1920 (downloaded 2022-08-07)

Dimmalætting (2022). El-rennihjólini aftur á Havnargøtum https://www.dimma.fo/grein/el-rennihjolini-aftur-a-havnargotum (downloaded 2022-07-07)

Energistyrelsen (2022). Dansk Klimapolitik https://ens.dk/ansvarsomraader/energi-klimapolitik/fakta-om-dansk-energi-klimapolitik/dansk-klimapolitik (downloaded 2022-08-12)

Eltis (2021). E-scooters allowed back into Copenhagen, although with restrictions https://www.eltis.org/in-brief/news/e-scooters-allowed-back-copenhagen-although-restrictions (downloaded 2022-07-06)

European Alternative Fuels Observatory (EAFO) (2022). Road https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road (downloaded 2022-07-08)

Fordonsmyndigheten (2022). Fordon per bränsle https://www.fma.ax/fordon/fordonsstatistik/fordon-bransle (downloaded 2022-08-12)

Government of Åland (2017). Energi- och klimatstrategi för Åland till år 2030. https://www.regeringen.ax/sites/www.regeringen.ax/files/attachments/page/lr_energi_klimatstrat_2030.pdf (downloaded 2022-07-07)

Government of Sweden, Infrastructure department (2022). Nationell strategi för elektrifiering – en trygg, konkurrenskraftig och hållbar elförsörjning för en historisk klimatomställning https://www.regeringen.se/4999ce/contentassets/87619734132041 21b91d01089fbd1e91/nationell-strategi-for-elekrifiering_2022_webb.pdf (downloaded 2022-07-07)

Grønlands statistik (2022). Antallet af registrerede personbiler stiger fortsat https://stat.gl/dialog/main.asp?lang=da&version=202101&sc=EN&subthemecode=O1&colcode=O (downloaded 2022-08-10)

Li, A., Zhao, P., Liu, X., Mansourian, A., Axhausen, K. W., & Qu, X. (2022). Comprehensive comparison of e-scooter sharing mobility: Evidence from 30 European cities. Transportation Research Part D: Transport and Environment, 105, 103229.

Ministry for the Environment and Natural Resources, Iceland (2020). Aðgerðaáætlun í loftslagsmálum https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/Adgerdaaetlun%20i%20loftslagsmalum%20onnur%20utgafa.pdf (downloaded 2022-07-07)

Ministry of Transport and Communications of Finland (2021). Fossiilittoman liikenteen tiekartta https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/163258/LVM_2021_15.pdf?sequence=1&isAllowed=y (downloaded 2022-07-07)

Moped- och Motorcykelförbundets branschorganisation (2022). Svårtolkad statistik över antalet nyregistrerade mopeder och motorcyklar under 2021 https://mcbranschen.se/wp/wp-content/uploads/2022/01/12-Nyregistrering-till-och-med-december-2021.pdf (downloaded 2022-07-06).

Naturvårdsverket (2022a). Hur bidrar Sverige till Parisavtalet? https://www.naturvardsverket.se/amnesomraden/klimatomstallningen/det-globala-klimatarbetet/parisavtalet/hur-bidrar-sverige-till-parisavtalet/ (downloaded 2022-08-12)

Naturvårdsverket (2022b). Sveriges klimatmål och klimatpolitiska ramverk https://www.naturvardsverket.se/amnesomraden/klimatomstallningen/sveriges-klimatarbete/sveriges-klimatmal-och-klimatpolitiska-ramverk/ (downloaded 2022-08-12).

Nordic Micromobility Association (2022). Ny statistik visar minskning av andel olyckor med elsparkcyklar https://news.cision.com/se/nordic-micromobility-association/r/ny-statistik-visar-minskning-av-andel-olyckor-med-elsparkcyklar,c3563043 (downloaded 2022-07-07).

Nordic Road Transport Research (2022). https://nordicroads.com/the-rapid-increase-of-e-scooters-translates-into-more-accidents/ (downloaded 2022-07-06)

Norsk elbilforening (2022). Statistikk elbil https://elbil.no/om-elbil/elbilstatistikk/ (downloaded 2022-08-09)

Norwegian Environment Agency, Norwegian Public Roads Administration, Norwegian Coastal Administration, Norwegian Directorate of Agriculture, Norwegian Water Resources and Energy Directorate and Enova (2020). Klimakur 2030. https://www.miljodirektoratet.no/globalassets/publikasjoner/m1625/m1625.pdf (downloaded 2022-07-07)

Oljedirektoratet (2020). Norges miljø- og klimaforpliktelser https://www.npd.no/fakta/publikasjoner/rapporter/rapportarkiv/kraft-fra-land-til-norsk-sokkel/2---utslipp-til-luft-fra-petroleumssektoren/norges-miljo--og-klimaforpliktelser/ (downloaded 2022-08-12)

Regeringen (2018). Sammen om en grønnere fremtid https://www.regeringen.dk/media/5791/klimaministeriet_klimaogluftudspil_digital.pdf (downloaded 2022-08-12)

Patrick Rérat (2021). The rise of the e-bike: Towards an extension of the practice of cycling?, Mobilities, 16:3, 423-439, DOI: 10.1080/17450101.2021.1897236

Samgöngustofa (2022). Tölfræði https://bifreidatolur.samgongustofa.is/#tolfraedi (downloaded 2022-07-07)

State of Green (2017). Making the Faroe Islands the World's Greenest Group of Islands https://stateofgreen.com/en/news/making-the-faroe-islands-the-worlds-greenest-group-of-islands/ (downloaded 2022-11-17)

Statistik sentralbyrå (2019). Transport står for 30 prosent av klimautslippene i Norge https://www.ssb.no/natur-og-miljo/artikler-og-publikasjoner/transport-star-for-30-prosent-av-klimautslippene-i-norge (downloaded 2022-08-12)

Statistik sentralbyrå (2022). Bilparken https://www.ssb.no/transport-og-reiseliv/landtransport/statistikk/bilparken (downloaded 2022-08-06)

Swedish National Road and Transport Research Institute (VTI) (2022). Regeringsuppdrag om elektrifieringen av transporter; Samspelet mellan energisystemet och transportsystemet. http://vti.diva-portal.org/smash/get/diva2:1661918/FULLTEXT01.pdf (downloaded 2022-07-07)

Swedish National Road and Transport Research Institute (VTI), Research institute of Sweden RISE (2021). Spridning av laddbara bilar och laddinfrastruktur på landet och i mindre orter. https://www.diva-portal.org/smash/get/diva2:1531306/FULLTEXT01.pdf (downloaded 2022-07-07)

The Government of The Faroe Islands (n.d.). Environmental Protection https://www.government.fo/en/the-government/ministries/ministry-of-environment-industry-and-trade/nature-environment-and-land/environmental-protection/ (downloaded 2022-08-15)

Traficom (2022). Liikennekäytössä olevat ajoneuvot neljännesvuosittain 2008-2021 https://trafi2.stat.fi/PXWeb/pxweb/fi/TraFi/TraFi__Liikennekaytossa_olevat_ajoneuvot/040_kanta_tau_104.px/ (downloaded 2022-08-07)

Trafikanalys (2022). Fordon på väg https://www.trafa.se/vagtrafik/fordon/ (downloaded 2022-07-07)

Trafikförsörjningsprogram för Åland 2022-2030 (2022). https://www.regeringen.ax/sites/www.regeringen.ax/files/attachments/page/tfp_slutgiltig_2021.4.20.pdf (downloaded 2022-07-05)

Valtioneuvosto (2022). ”Suomella on hyvät mahdollisuudet kestävän kehityksen mukaiseen ekologiseen jälleenrakentamiseen” https://valtioneuvosto.fi/marin-in-hallitus/hallitusohjelma/hiilineutraali-ja-luonnon-monimuotoisuuden-turvaava-suomi (downloaded 2022-08-12)

Virta (2022). The state of EV charging infrastructure in Europe by 2030 https://www.virta.global/blog/ev-charging-infrastructure-development-statistics (downloaded 2022-07-07)

Winslott Hiselius, L & Svensson, Å (2017). E-bike use in Sweden – CO2 effects due to modal change and municipal promotion strategies, Journal of Cleaner Production, Volume 141, Pages 818-824, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2016.09.141.

Ympäristöministeriö (2022). Hallituksen ilmastopolitiikka: kohti hiilineutraalia Suomea 2035 https://ym.fi/hiilineutraalisuomi2035 (downloaded 2022-08-12)

Ålands statistik- och utredningsbyrå (2022). Motorfordon 2021 https://www.asub.ax/sv/statistik/motorfordon-2021 (downloaded 2022-07-07)

Table 1. List of interviews.

Country	Type	Name	Native Name	*Information*
Denmark	Municipalities / Regions	Skive kommune	Skive kommune	*Municipality in north west Denmark.*
Denmark	Municipalities/ Regions	Project Zero S ønderborg komune	Project Zero S ønderborg komune	*Project founded by the municipality and private investors.*
Denmark	Associations/ organizations	Danish e-Mobility	Dansk e-Mobilitet	*Asocciation for e-mobility*
Finland	Ministry	Finland Ministry of Transport and Communications	Liikenne- ja viestintäministeriö	
Finland	Municipalities / Regions	Centre for Economic Development, transport and Environment in North Savo	Pohjois-Savon ELY-keskus	*Centre for Economic Development, transport and Environment in North Savo, located in the middle of Finland*
Finland	Associations/ organizations	Finnish Energy	Energiateollisuus	*Association for energy companies in Finland*
Finland	Charging operators and energy production / distribution	VÄRE	VÄRE	*Relatively small company. Operates in Eastern Finland.*
Greenland	Ministry	Greenlands Ministry of Housing and Infrastructure	Naalakkersuisut	
Iceland	Organization/ ministry (organistation financiated by ministry)	Orkusetur	Orkusetur	*Knowledge sharing and impacts in terms of awareness of energy saving and consumption.*
Iceland	Company energy/ municipalities	VistOrka	VistOrka	*Assists municipalities in Nothern Iceland regarding sustainable energy solutions.*
Iceland	Association for municipalities	Austurbrú	Austurbrú	*Accociation for municipalities in eastern Iceland.*
Iceland	Organisation	Blámi	Blámi	*Platform for the national power company, the local power company and the regional development office in the Vestfjords. Works with energy transitions and local innovation projects.*
Norway	Ministry	Norways Ministry of Transport	Samferdseldepartementet	

Country	Type	Name	Native Name	*Information*
Norway	Municipalities / Regions	Troms & Finnmark Fylkeskommun	Troms & Finnmark Fylkeskommun	*Region in northen Norway.*
Norway	Municipalities / Regions	Trondelag Fylkeskommun	Trondelag Fylkeskommun	*Region in the middle of Norway*
Norway	Municipalities / Regions	Vestland Fylkeskommun	Vestland Fylkeskommun	*Region in western Norway.*
Sweden	Municipalities / Regions	Hagfors and Forshaga kommun	Hagfors and Forshaga kommun	*Energy and environment advisors for two municipalities located in western Sweden*
Sweden	Municipalities / Regions	Energy and climate consultation in Kiruna, Gällivare, Pajala and Jokkmokk kommun	Energi och klimatrådgivare i Kiruna, Gällivare, Pajala and Jokkmokk kommun	*Energy and environment advisor that works in four municipalities located in the northern Sweden.*
Sweden	Municipalities / Regions	Övertorneå kommun	Övertorneå kommun	*Municipality in northen Sweden with border to Finland.*
Sweden	Associations/ organizations	Swedenergy	Energiföretagen	*Association for energy companies in Sweden.*
Sweden (operates in Norway too)	Charging operators and energy production / distribution	InCharge	InCharge	*Charging operator which is a part of Vattenfall, a state-owned energy company. Operates in Sweden and Norway.*
The Faroe Islands	Associations/ organizations	Nýhugsan	Nýhugsan	*A digital newspaper, information channel and lobby organization for green energy, e-mobility and electrification.*
The Faroe Islands	Energy production / distribution	SEV	SEV	*Public energy company in the Faroe Islands.*
Åland	Government	The Government of Åland	Ålands Landskapsregering	
Åland	Energy production / distribution	Ålands Elandelslag	Ålands Elandelslag	*Energy company within production and distribution.*

Table 2 . Resource reviewed in the literature review

Swedish National Road and Transport Research Institute (VTI), 2022. Regeringsuppdrag om elektrifieringen av transporter [Government commission on the electrification of the transport sector]. Sweden. The Swedish Government has commissioned VTI to "contribute to the build-up of knowledge about a fast, smart and socio-economically efficient electrification of the transport sector" (Government assignment I2021 / 02212). The assignment is divided into 5 main tasks, focusing on digitalization, the interface between energy and transport systems, costs for different stakeholders, knowledge gaps, and maritime electrification.
Swedish National Road and Transport Research Institute (VTI)/Research Institute of Sweden (RISE), 2021. Spridning av laddbara bilar och laddinfrastruktur på landet och i mindre orter [Deployment of plug-in cars and charging infrastructure in rural and small towns]. Sweden The purpose of the project presented in VTI/RISE's report is to understand the conditions for electromobility in rural areas and smaller towns, ad to identify what opportunities there may be to accelerate the electrification of transport. This has mainly been studied through in-depth interviews with municipal energy and climate advisers, and other people with assignments to promote electromobility, in rural areas in different parts of the country.
Government of Sweden, Infrastructure department, 2022. Nationell strategi för elektrifiering – en trygg, konkurrenskraftig och hållbar elförsörjning för en historisk klimatomställning [National strategy for electrification - a secure, competitive and sustainable electricity supply for a historic climate transition]. Sweden The purpose of the electrification strategy is to lay the foundation for achieving comprehensive electrification in Sweden that contributes to achieving the climate goals. The twelve points of the electrification strategy lay the foundation for intensified work with 67 measures to be implemented during the three-year period 2022–2024.
Government of Åland, 2017. Energi- och klimatstrategi för Åland till år 2030 [Energi and Climate Strategy for Åland, 2030] Åland The government's energy and climate strategy shows how political work on energy and climate will be conducted over the next twelve years to meet the goals of the Paris Agreement.
Danish Council on Climate Change (Klimarådet), 2020 Kendte veje og nye spor til 70 procents reduktion [Known paths and new tracks to 70 per cent reduction] Denmark Direction and measures for the next 10 years of climate action in Denmark

Table 2 . Resource reviewed in the literature review

Norwegian Environment Agency, Norwegian Public Roads Administration, Norwegian Coastal Administration, Norwegian Directorate of Agriculture, Norwegian Water Resources and Energy Directorate, and Enova, 2020. Klimakur 2030 Norway Klimakur 2030 analyses the potential for reducing non-quota emissions of greenhouse gases (transport, agriculture, waste and construction), and measures that increase uptake and reduce emissions from forests and other land use.
Ministry of Transport and Communications of Finland, 2021. Fossiilittoman liikenteen tiekartta [Roadmap to fossil-free transport] Finland According to the Government Programme, Finland will be carbon neutral by 2035. The targets for reducing emissions from transport must be in line with this goal. In line with the Government Programme, the Ministry of Transport and Communications has prepared a Roadmap for fossil-free transport to reduce greenhouse gas emissions from transport.
Ministry for the Environment and Natural Resources, Iceland, 2020. Aðgerðaáætlun í loftslagsmálum (Iceland's Climate Action Plan) Iceland The Climate Action Plan intends to boost efforts in cutting net emissions to meet its Paris Agreements targets for 2030, and to reach the goal of making Iceland carbon neutral before 2030.

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