TYRÉNS

GREEN TRANSPORT IN THE BARENTS REGION

FINAL REPORT

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ABSTRACT

The aim of this report is to increase the understanding of the green transport concept, and how transport planning in the Barents Euro-Arctic Transport Area can support development of green road transport.

A unanimous definition of green transport has not been found. Instead a definition of green transport seems to include all measures aimed at reducing greenhouse gas emissions from the transport sector. In the study, three main elements that relates to green transport have been identified: reducing travel need, modal shift and increased share of zero or low emission vehicles or renewable fuels.

The countries of the Barents region all have ratified the Paris Agreement, but the strategies aiming to fulfill the commitment differ between the countries. Norway, Sweden and Finland all have strategies and targets for emission reductions from the transport sector in place. These strategies all include different levels of reducing travel need, modal shift and increasing the use of green vehicles and renewable fuels. The Russian strategy is more focused on adapting to climate change rather than reducing emissions.

The current vehicle fleet of the Barents region is dominantly fossil fueled. New car sales, however, indicate that the national strategies have had an impact. While diesel and gasoline vehicles still constitute 76% of new sales, electrified vehicles constitute 24%. Thus, the transition process is mainly driven by new electrified vehicles and primarily by the Norwegian regions. The new car sales share of other green vehicles is less than 1%. The green infrastructure (i.e. charging stations and renewable fuel filling stations) is unevenly distributed in the region. Most green infrastructure is concentrated to the Nordic countries and primarily to the transport corridors E6 and the Bothnian Corridor between Oulu and Umeå.

The main conclusion is that there is a need to adopt a joint strategy on green transport in order to create green cross-border mobility in the Barents region. The study recommends eight actions based on adopting a common definition of the green transport concept, raising public awareness and making use of existing national strategies. To create an early functionality of green transport electrification and supporting charging infrastructure seems to be the preferred choice, even though it is important to continuously observe the relatively rapid technology development in green vehicles and infrastructure. It is also important to create a close cooperation with the commercial sector since it plays a supporting role in realizing green infrastructure. On basis of the recommendation in the study, a way to strengthen the development of Green transport in the Barents region would be to include the outcome of the recommendations in the Joint Barents Transport Plan together with a supporting monitoring scheme that enables evaluation of joint goals and targets for development of the Green transport concept.

INNEHÅLLSFÖRTECKNING

ACRONYMS AND ABBREVIATIONS

BEV	Battery Electric Vehicle
BRTL	Barents Region Transport and Logistics-project
CNG	Compressed Natural Gas
CO2e	Carbon Dioxide Equivalents
E85	Ethanol
ETS	Emissions Trading System
EV	Electric Vehicle
FCEV	Fuel Cell Electric Vehicle
GHG	Greenhouse gas
HEV	Hybrid Electric Vehicle
I2V	Infrastructure-To-Vehicle technology
ITS	Intelligent Transport Systems
JBTP	Joint Barents Transport Plan
LNG	Liquified Natural Gas
MaaS	Mobility as a Service
PHEV	Plug-in Hybrid Electric Vehicles
TEN-T	Trans-European Transport Network
TTW	Tank To Wheel
UN-SDG	Unite Nations Sustainable Development Goals
V2I	Vehicle-To-Infrastructure technology
V2V	Vehicle-To-Vehicle technology
VAT	Value Added Tax
WTW	Well To Wheel
ZEV	Zero Emission Vehicle

1 INTRODUCTION

1.1 BACKGROUND

Global warming and the effects of climate change are global challenges that the world needs to unite behind in order to find solutions. Global warming is caused by emission of greenhouse gases (GHG) being released into the atmosphere from different sectors world-wide like agriculture, production, transport etc. There are important global actions being taken, aiming at fighting global warming, like the Paris Agreement and the united nations sustainable development goals (UN-SDG) and the European level by the EU.

The Paris Agreement is to be considered a tool that the nations of the world can unite behind and counteract global warming. It builds on and further expands the general international framework in the field of climate change and reinforces the realization of the UN Climate Convention. The agreement states that global warming is to be kept well below two degrees Celsius and efforts should be made to keep the increase below 1,5 degrees Celsius compared to pre-industrial level. The UN-SDG is a resolution adopted by the UN general assembly. It functions as a framework to ensure a global and enduring sustainable development of the planet where sustainable development is defined in seventeen goals of a wide spectrum. The thirteenth goal aims at fighting climate change by taking urgent action to reduce climate change and its impacts (United Nations 2020).

At the European level the EU and its member states have ratified the Paris agreement and considers the agreement to be a central part of its climate strategies and policies. The EU works to implement climate actions by legislations and policy directives. The EU have recently launched a reformed growth strategy called the Green Deal as a response to the global challenge of global warming and climate change. It aims at transforming the EU into a fair and prosperous society by creating a resource efficient economy which does not generate any net emissions of GHG's by 2050 (European Commission 2020). This goal is to be implemented by legislation as a 'climate law' to be presented in March 2020.

National and regional transport plans are in many cases the foundation for decision-making within the transport sector. As a result of the need for cross-border cooperation in the transport sector, the Joint Barents Transport Plan (JBTP) has been developed within the Barents cooperation (The Barents Euro-Arctic Region 2019). The first draft plan was presented in 2013, and it has since been updated two times and was recently revised in 2019. In the revised version, one of the four pin-pointed areas are related to reducing emissions of greenhouse gases (GHG). Thus, the JBTP acknowledges the need to reduce the harmful effects of transport on climate and ecology.

Furthermore, the need for measures aimed at reducing emissions of GHG and promotion of a low-carbon economy by unifying transport plans across the border, and by implementing ITS-solutions is also stressed in the Second Edition of the Action Plan on Climate Change for the Barents Cooperation (International Barents Secretariat 2017). Already in 2004, the Arctic Climate Assessment report (ACIA) pointed out the impacts of climate change in the arctic environment (ACIA Secretariat 2004).

In order to facilitate the implementation of the JBTP, the Barents Region Transport and Logistics-project (BRTL) was launched. BRTL aims to create a better understanding of the logistics- and transport systems in the Barents region. The project is funded by the Kolarctic program. As part of the BRTL-project, the Swedish administrative boards of Västerbotten county (Länsstyrelsen Västerbotten) and Norrbotten county (Länsstyrelsen Norrbotten) have commissioned this report on green transport in the Barents region.

1.2 AIM AND OBJECTIVES

The aim of this report is to increase the understanding of the green transport concept, and how transport planning in the Barents Euro-Arctic Transport Area can support development of green road transports.

The objectives of the report are to:

- Present each country's political framework for green transport (in relation to the Paris agreement)
- Survey how the concept of green transport is defined in each country and whether there are existing strategies supporting the implementation
- Describe how each country are working to expand charging infrastructure and access to biofuels
- Chart the existing network of charging infrastructure, filling stations for alternative fuels and rest areas for heavy trucks
- Identify good examples of green transport-projects within the Barents-region and how they are connected to ITS-technology
- Propose recommendations for how the implementation of green transport can be coordinated between the Barents countries

Figure 1. Overview of the Barents region

2 GREEN TRANSPORT

Transport accounts for about 23% of the CO_2 global emissions (IPCC 2014). The pattern is the same at the EU level, where the transport sector's share of the total CO_2 emissions was 22% in 2017. (International aviation and maritime emissions excluded). In 2017 CO_2 emissions from the transport sector in the EU increased by 2,2% compared to 2016 (European Environment Agency 2019). In order to achieve the Paris agreement targets, there is a need for the transport sector to develop more sustainable and energy efficient transportation alternatives.

2.1 DEFINITION OF GREEN TRANSPORT

Since the transport sector is responsible to a relatively high share of GHG-emissions the need of more sustainable transports has been highlighted. It is also often referred to as *green transport* or the greening of the transport sector.

In this report the concept of green transport involves measures aimed at lowering CO_2 emissions produced by the transport sector. Decreasing CO_2 emissions from the transport sector is divided into three main areas: reducing travel need, promoting modal shift and supporting green vehicles and renewable fuels.

The green transport concept is applicable to all forms of transport. In this report however, the focus area will be road transport.

2.2 REDUCING TRAVEL NEED

The principle of reducing the need to travel is often misunderstood. Though some travel is undertaken for its own sake, much travel is necessary simply because the things people need to reach – work, shops, schools, health or leisure facilities – are so

far away.

If services and amenities were located closer to people's homes, people could walk or cycle or travel there more easily by public transport. Reducing the need to travel means reducing the number or length of journeys or both. It does not mean reducing the freedom to travel. In economic theory the total number of transports performed is based on collective transport demand and the supply (cost) of transportation. Hence, the demand for transport could be said to be determined by consumer income, the prices of related transports, consumer preferences and transportation cost. This also implies that the total transport demand could be affected by measures aimed at either the demand or the supply side.

In statements of policy, the words 'reducing the need to travel' are often qualified e.g. 'by car' or 'especially by car'. At present this often means locating development near public transport, not in order to reduce the need to travel, but to enable more journeys

to be made by public transport. This implies that it does not matter how much travel occurs, as long as less of it is by car. An essential purpose of reducing the need

to travel or reducing journey length should be to allow more journeys to be made on foot or by bicycle.

Carpooling, mobility management campaigns and application of technology like on-line meetings are examples of measures that are applicable in order to lower the amount of transports being conducted. In cities a sustainable land/transport planning aimed at shortening everyday travels is an important measure which enables more journeys to be made by public transport, bike or walking. This is closely linked to the concept of modal split and modal shift described in chapter 2.3.

2.3 MODAL SHIFT

Modal share can be defined as the share of people, or freight, using a particular mode of transport (including cycling and walking) within a particular area (from the urban scale to the national and international ones). Modal shift is by definition creating a change in the current modal split. In general road transport are considered to have a higher climate impact compared to rail and sea transports. Despite this, road transport is often the preferred choice to passenger and goods transport, in particular for short transport distances (Pastori, E et al. 2018).

Three determinants play a decisive role for an individual when choosing transport mode. Socio-demographic factors (age, gender, education, occupation, income, population density, household composition, car availability), journey characteristics (reason for travel, distance, travel time and costs, departure time, trip chaining, weather conditions, information, interchange availability) and spatial patterns (urban and rural density, diversity, proximity to infrastructure and services, frequency of public transport, availability of parking) (Pastori, E et al. 2018).

According to a study carried out for the European Commission, 11 service characteristics can be identified as being decisive for modal choice, particularly between road transport and intermodal transport (RAND Europe 2003). Those are cost, travel time, reliability, flexibility, tracing of freight, use of infrastructure, scale/volume, service of terminals, legislation, safety and security.

A modal shift in passenger traffic supporting green transport implies an increased use of public transport, cycling and walking in nodes while increasing the use of rail and public transport in regional, national and international transports. Examples of measures are mobility management actions, parking policy, implementation of MAAS (Mobility As A Service) solutions, providing competitive public transport and biking alternatives.

To reach a modal shift in freight it is important to reduce costs for and increase effectiveness in multimodal solutions, increase the density and quality of intermodal and multimodal terminals and invest in multimodal infrastructure.

Naturally national policy and incentive structures also play a central role to create a modal shift in both passenger and freight transport.

2.4 GREEN VEHICLES AND FUELS

While reducing travel need and creating a modal shift are important contributions to lower the CO_2 emissions from the transport sector, it is important to develop more fuel-efficient vehicles and/or to make a transition towards using renewable fuels. This concept is defined as *green vehicles and fuels*.

When it comes to energy efficiency and sustainability of fuels, EU legislation regulates target values for vehicle emission of CO_2 equivalents (CO_2e) in grams per kilometer. These target values are for Tank To Wheel emissions (TTW) (i.e. emissions generated from combustion). The EU target level of CO_2 emission per kilometer is currently set at 130 grams, a target that was reached already in 2013 (two years ahead of schedule). In 2018 the average CO_2 emission from the EU-fleet was 120,4 grams. From 2021 a new target value of 95 grams per kilometer will be adopted for the EU-fleet. The EU has also implemented a credit system supporting development of zero- and low-emission cars emitting less than 50 g/km through a "super credits" system. Manufacturers exceeding the target level of 95 g/km must pay a progressive penalty tax based on excess emissions in order to operate on the European market (European Commission 2019). This regulation applies to the EU-market and car manufacturers operating on the market must fulfil the requirements or be subject to progressive penalty taxes.

Since a *green vehicle* ("eco-friendly" or "environmentally friendly") should correspond to relevant target values, it must be defined as a road motor vehicle that produces less GHG-emissions compared to traditional combustion engines running on gasoline or diesel. Furthermore, green vehicles will use alternative fuels such as electricity, hydrogen, biofuel or synthetic fuels.

The Swedish Energy Agency (2019) have compiled average estimates of energy efficiency of vehicles running on different fuels and emission of CO_2e per kilometer. The result is summarized in *table 1*. The CO_2e are to be thought of as Well To Wheel emissions (WTW) (i.e. total emissions from production of fuel and combustion).

Table 1 Energy use (kWh/km) for an average passenger car in Sweden and the associated emission factors per fuel and km. Source: Swedsh energy agency (2019)

Fuel	kWh/km	g CO_2e/km
Gasoline MK 1	0,57	186
Diesel MK1	0,53	147
FAME-100 (biodiesel)	0,53	61
HVO-100 (biodiesel)	0,53	17
E85	0,65	113
Biogas	0,66	39
Electric	0,15	7

Electric vehicles (EVs) is by far the most energy efficient vehicle fuel type. Ethanol (E85) and biogas are least energy efficient, while gasoline, biodiesel and diesel are slightly more efficient.

Regarding emissions per kilometer, EVs are by far emitting the least amount of CO_2e/km, followed by biogas and biodiesels. Gasoline produces the highest amount of CO_2e/kilometer. The emission factors are based on average values for an average passenger car in Sweden and may differ between the countries depending on how the fuel/electricity is produced.

The CO_2 emissions of EVs are dependent on the sustainability of electricity generation per country. This varies between the Barents countries, where Norway has the least emissions from electricity production and Russia has the highest.

The different levels of sustainability in electricity production between the countries of Barents implies that an average electric vehicle charged in Norway will have the least environmental impact while an EV charged in Russia will have a higher impact (*table 2*).

Table 2 Emissions factors for an average electric personal vehicle if the vehicle refuels in the countries in the region. Source Swedish energy agency (2018) and Moro and Lonza (2018)

Sweden [gCO_2e/km]	Finland [gCO_2e/km]	Norway [gCO_2e/km]	Russia [gCO_2e/km]
7,1	31,7	1,4	77,6

Production of biofuels (biogas, E85, biodiesels) can be made from either crops or from residues and waste. When produced from crops the emission factors include the climate impact of producing the crop which is not the case when biofuel is produced from residues or waste. Due to lack of data, no comparison has been made of how emission factors for biofuels differ between the countries of Barents.

In this report we define a green vehicle as following:

A Green vehicle is any form of vehicle that uses renewable or regenerated energy. With a basic premise in sustainable and renewable fuels, green transport has a low or zero climate impact and little or no negative environmental impact in general.

2.5 NATIONAL STRATEGIES ON GREEN TRANSPORT

This section describes national strategies aimed at implementing green transport for the member states of the Barents region.

2.5.1. NORWAY

Norway has committed to the climate mitigation goals in line with the Paris agreement and have adopted the targets outlined by the European commission regarding sectors outside the emissions trading system (ETS). The national GHG emission target is to reach a 40% reduction in emission of GHG emissions by 2030 compared to 1990 levels.

The Norwegian climate strategy for 2030 (Klima- og Miljødepartementet 2017) and National transport plan 2018-2029 (Samferdseldepartementet 2017) builds the framework of the Norwegian climate strategy for the transport sector. The Norwegian Government's main climate and environmental objective for the transport sector is to reduce GHG emissions, to implement a transition to a low-carbon society and to reduce other negative environmental impacts.

The strategy concludes a commitment to 35-40% reduction of greenhouse gas emissions by 2030 in relation to 2005. The overall national target is a carbon neutral society 2050, which implies that the transport sector will have to be emission-free by 2050.

DEVELOPMENT OF ZERO AND LOW EMISSION TECHNOLOGY

An intermediate milestone is that by 2025, all new sales of passenger cars and light trucks, should be zero emission vehicles (ZEVs). City buses should be ZEVs or run on biogas. In 2030, 50 percent of new sales of heavy trucks, 75 percent of new long-distance buses and 100 percent light trucks should be zero emission vehicles (Klima- og Miljødepartementet 2017).

The focus on ZEV (i.e. EVs and FCEVs – fuel cell electric vehicles) in Norwegian climate/transport strategies have generated various incentives to enhance the implementation of these vehicles. The tax incentives for ZEVs include exemption from value added tax (VAT) and vehicle purchase tax (based on curb weight as well as CO_2 and NOx emission rates), exemption from annual road tax and reduced company car tax. In addition, ZEV incentives include lower toll fees on ferries, access to bus lanes and lower parking fees (Norsk Elbilforening 2019).

As for charging infrastructure, the government policy is to ensure a rapid expansion in the whole country in a combination of government incentives and market-based solutions (Samferdselsdepartementet 2019). Through the government enterprise Enova SF, it is possible to apply for funding aimed at building alternative fuel infrastructure.

REDUCING TRANSPORT NEED AND MODAL SHIFT

The Norwegian climate strategy states that one important part of addressing emissions from the transport sector is to reduce transport need and to enable a transition to more environmentally friendly modes of transport. By combining land use planning and mobility planning there is a possibility to increase public transport, walking and cycling in the cities (Klima- og Miljødepartementet 2017).

One of the measures highlighted in the strategy is "Bymiljøavtal/byvekstavtal". This is a type of agreement between larger cities/Fylke administrations and the Norewgian government. The state offers funding for public transport, walking and cycling measures while the cities commit to a land use planning focused on densification and transit-oriented development, as well as facilitating public transport, walking and cycling and restrict car parking (Klima- og Miljødepartementet 2017, Regjeringen 2020).

SHIFT GOODS TRANSPORT FROM ROAD TO RAIL AND SEA

Transition of goods transport from road to rail and sea is another cornerstone of the climate strategy. The government has set a goal that at least 30% of transport kilometers from road transport on distances over 300 km should be shifted to rail and sea by 2030. The target value for 2050 is 50% (Klima- og Miljødepartementet 2017).

USE OF BIOFUELS

One part of the Norwegian strategy is aimed at increasing the use of biofuels. Biofuel admixture to gasoline and diesel fuels sold in Norway is mandatory (Samferdselsdepartementet 2019). The current level of admixture is that 20 percent of all sold fuels for road transport must be biofuels (Miljødirektoratet 2020).

2.5.2. SWEDEN

Sweden has committed to the goals for climate mitigation set in the Paris agreement. Swedish policy is aligned with the EU climate action targets and transport sector reductions. In 2017 the Swedish government implemented a climate law stating that Sweden should not be a net contributor of GHG emissions to the atmosphere by 2045 and thereafter generate negative emissions. A milestone regarding emissions of GHG from domestic transport (road and shipping, excluding aviation) is to reduce emissions by 70 percent up to 2030 compared to 2010 levels (Regeringskansliet 2017a).

In order to achieve this target, the Swedish government have prioritized a transition to a transport efficient society (with greater modal share for public transport, walking and cycling), promotion of renewable and sustainable fuels. Transition to fossil-free and energy efficient vehicles, and a larger share of transports made by rail and shipping are also key ingredients (Regeringskansliet 2018). The Swedish Energy Agency has been commissioned by the government to coordinate the transition to a fossil-free transport sector. The assignment is called SOFT (Energimyndigheten 2017) and involves the Swedish Transport Agency, the Swedish Transport Administration, Transport Analysis, the Swedish Environmental Protection Agency and the National Board of Housing, Building and Planning. The assignment is based upon the finding that key factors to reach set goals are the share of electrified vehicles, energy effectiveness, the share of renewable fuels and produced traffic kilometers (Government bill 2019/20:65) is concretized in three parts.

A TRANSPORT EFFECTIVE SOCIETY

Community planning and physical planning is highlighted as a key instrument to promote sustainable solutions for passenger and freight transport. A well-planned society makes it easy for individuals and companies to choose a sustainable transport and / or travel behavior, thus enabling modal shift. Social planning is seen as a long-term measure to achieve a transition towards green transport. There is a focus towards urban areas where a modal shift from car transport to public transport, cycling and walking is sought. This is supported by a reform named “Stadsmiljöavtal” which allows public actors to apply for co-financing for up to 50% of the investment cost in infrastructure measures supporting public transport and cycling. Stadsmiljöavtal is managed by the Swedish Transport Administration and is funded through the national transport plan (Government bill 2019/20:65).

The main effort on goods transport is focused towards a modal shit from road to rail, sea and an increased multimodality of transport. This is supported by several measures aimed at strengthening the competitiveness of rail and sea transport, but also by creating a road network supporting a new heavier truck size (BK4) allowing 74-ton trucks where rail or sea transport is not an alternative (Government bill 2019/20:65).

Furthermore, the use of digitalization and innovation is identified as important areas supporting a transport effective society (Government bill 2019/20:65).

ENERGY EFFICIENT AND NON-FOSSIL VEHICLES

As Sweden is an EU-member state, and hence subject to EU legislation, an overall strategy is to influence the EU to include target levels supporting a climate-effective transformation of the vehicle fleet over time (Government bill 2019/20:65).

Sweden also uses incentives to accelerate the transition process towards greener vehicles. Among others this includes a bonus malus taxation system of vehicles and premium on electric buses. The bonus malus system is applied on top of the existing vehicle tax on vehicles registered after 1 July 2018. The system includes passenger cars and light trucks and buses up to 3.5 tonnes. Battery electric vehicles (BEV) and hydrogen vehicles receives the highest possible bonus set at SEK 60,000. The monetary bonus then decreases for every extra gram of CO_2e emitted up to emissions of 60 g/km. All gas vehicles receive a fixed bonus of SEK 10,000. Vehicles with emissions ranging between 60–95 g CO_2/km are not affected by the bonus malus reform. Vehicles emitting above 95 g/km receives a progressive penalty tax (malus) increased vehicle tax for three years (Regeringskansliet 2017b). The premium on electric buses (includes fully electric, charging hybrids, fuel cell and wire buses) supports introduction by subsidizing 20% of the cost of a vehicle. The premium is administered by the Swedish Energy Agency and is valid until 2023 (SFS 2017:1341).

The Swedish Transport Administration (Trafikverket 2020b) also conducts tests of electrified roads supporting heavy trucks to be used as a complement to fossil fuels. Tests of different methods are performed at four locations (Visby, Lund, Sandviken and Arlanda).

AN INCREASED SHARE OF RENEWABLE FUELS

In Sweden there are two programs supporting renewable fuels: "Klimatklivet" and "Ladda bilen". Klimatklivet is an investment program supporting local and regional measures aimed at lowering GHG emissions meanwhile contributing to use of innovative technology, market introduction, improving health, occupation and other environmental goals. The total budget in 2020 is 2,4 billion SEK. All actors except individuals can apply for support. Supported measures are concrete climate initiatives in, for example, transport, industry, housing, premises, city building and energy. Klimatklivet is administered by the Swedish Environmental Protection Agency (Naturvårdsverket 2020a).

Ladda bilen is an investment support program aimed at developing charging infrastructure administered by the Swedish environmental protection agency. Individuals, housing cooperatives, businesses and public actors at the local and regional level can apply for funding up to 50% of the total cost or maximum of 10 000 SEK per property (Naturvårdsverket 2020b).

There are also taxes and legislation aimed at lowering GHG emissions. Swedish fuel taxes include CO_2 tax, energy tax and VAT (Regeringskansliet 2019).

Biodiesel admixture to gasoline and diesel fuels sold in Sweden is mandatory by law (SFS 2017). The law implies that fuel companies are obliged to reduce greenhouse gas emissions from gasoline and diesel by mixing fossil fuels with biofuels. As of 2019 the levels of biofuel mix were 2,6% for gasoline and 20% for diesel.

The Swedish pump law states that filling stations that sell more than 1,000 m^3 of gasoline and diesel a year are obliged to sell renewable fuels such as E85, biogas, HVO100 and B100. Charging infrastructure cannot replace the requirement to sell renewable fuel, however HVO100 can replace ethanol or B100 (SFS 2005).

2.5.3. FINLAND

Finland has committed to the goals for climate mitigation set in the Paris agreement. The country is in line with the EU targets for climate action and emission reductions in the transport sector. In 2017, Finland adopted a general climate mitigation target aiming at achieving net carbon neutrality by 2035 and to be carbon negative thereafter. For the transport sector, the goal is to reduce emissions by 50% to 2030 compared to 2005 levels. In the National Energy and Climate Strategy for 2030 (Ministry of Economic Affairs and Employment of Finland 2017) a strategy for the transport sector is outlined.

The measures are focused at road transport, which is described as having the greatest potential for emission reductions.

The strategy is divided in three categories: improving the energy-efficiency of the transport system, improving the energy-efficiency of vehicles and replacing oil-based fossil fuels with renewable and/or low emission alternatives.

IMPROVING THE ENERGY-EFFICIENCY OF THE TRANSPORT SYSTEM

In the Finnish strategy there is a clear focus on replacing "self-service market" with a "service market" for mobility. The main instrument for achieving this is Mobility as a Service (MaaS) with the aim to reduce the number of solo car journeys. In addition to this, it is also highlighted that transport and land use planning need to be coordinated and that the conditions for walking, cycling and public transport will need to be improved. The goal is that the number of journeys taken by walking and cycling should increase 30% by 2030 (Ministry of Economic Affairs and Employment of Finland 2017).

IMPROVING THE ENERGY-EFFICIENCY OF VEHICLES

In regards of energy-efficiency of vehicles, the main strategy for Finland is to influence EU legislation. Finland wants to influence the threshold values for average CO_2 emissions of cars and light trucks sold in EU, as well as for heavy trucks. The aim of this is to lower emissions and increase the number of EVs.

The strategy also identifies that the average age of Finnish cars is increasing and acknowledges this as a problem, since older cars have higher average emissions than newer cars. Therefore, the Finnish strategy includes a focus on speeding up the replacement rate of the vehicle fleet (Ministry of Economic Affairs and Employment of Finland 2017).

REPLACING OIL-BASED FOSSIL FUELS WITH RENEWABLE AND/OR LOW EMISSION ALTERNATIVES

Biofuel admixture is one of the measures aimed at replacing fossil fuels. A goal is set that 30% of the content of all fuels sold in 2030 will be biofuel energy. According to the strategy, the possibilities of creating a joint Nordic biofuel market should also be examined.

Green transport infrastructure (i.e. gas and hydrogen stations and EV chargers) is mainly to be built on market terms. In the strategy, though, it is pointed out that the central government must ensure that there are enough vehicles for creating a well-functioning market. The goal to ensure this is to have 250 000 electrified vehicles (EVs, HEVs and PHEVs) and 50 000 gas-fuelled vehicles in 2030 (Ministry of Economic Affairs and Employment of Finland 2017).

Even though the deployment of green vehicles is to be achieved on market terms, there are incentives in Finland as well.

The Finnish fuel tax consists of energy content tax, CO_2 tax and a strategic stockpile fee, which is an earmarked tax-like payment made to the National Emergency Supply Fund. Fuels are also subject to VAT which represents around 19% of the retail price and is paid for the full price of the fuel, including fuel tax. CO_2-tax on biofuels as bio-gasoline and biodiesel is graduated based on the EU sustainability criteria (OECD 2019a).

Incentives for battery electric vehicles (BEVs) are offered in the form of a €2000 purchase subsidy from the Finnish government (applies to both purchases and long-term leases) (Traficom 2020).

The Finnish government also offers incentives for building EV charging infrastructure. Grants for public fast charging stations are offered up to 35 percent of investment costs. There are also tenders for alternative fuels infrastructure including biogas vehicle refueling and electric vehicle charging up to a total of €3 million. Subsidies are also offered to housing companies building EV charging infrastructure.

Finland has a biofuel admixture policy, stating that fuel suppliers are obligated to blend their road transport fuels with at least 15% biofuels in energy content. A fuel supplier that fails to fulfil a quota obligation must pay a penalty of € 0.04/MJ, i.e. €0.84/l for ethanol and €1.32/l for biodiesel (IEA Bioenergy 2018).

2.5.4. RUSSIA

Russia ratified the Paris agreement in October 2019. The Russian goal is to reduce greenhouse gases to a level of no more than 75 % of the 1990 (Soviet era) levels (Russian Government 2019a). In December of 2019, Russia approved a national action plan for adaptation to climate change until 2022 (Russian Government 2020). As of February 2020, no clear climate change mitigation strategy has been adopted by the Russian government.

No cohesive climate change mitigation strategy has been developed for the transport sector. However, there are different strategies that involve different parts of the transport sector that could affect CO_2 emissions from transport.

In 2018, the Russian government adopted a strategy for development of the automotive industry until 2025. Although the focus of the strategy is on strengthening the Russian automotive industry, the strategy also acknowledges the rising number of EVs. Possible incentives such as tax exemptions and subsidies for charging infrastructure are presented in the strategy and proposals are to be reported from the ministries to the government (Russian Government 2018, Russian Government 2019b).

The partially state-owned company Gazprom has a strategy to increase the use of natural gas in vehicles which could substitute gasoline and diesel use (Gazprom 2020).

As for tax incentives, Russia has an excise tax on transport fuel which applies to gasoline and diesel, where gasoline is taxed higher than diesel. Other fuels for road use are untaxed (OECD 2018).

In Russia the regional level has possibilities to implement other incentives. This is especially true for the larger cities such as Saint Petersburg and Moscow. As an example, electric car owners will be exempted from vehicle tax in Moscow (Moscow Mayor 2019) while Saint Petersburg offers free parking for electric cars (Saint Petersburg City Administration 2016).

In 2015 the Russian parliament passed a legislation requiring filling stations to offer charging stations for electric vehicles. So far though, only a small number of filling stations (mostly in Moscow and Saint Petersburg) have adhered (Bellona 2019).

3 GREEN TRANSPORT IN BARENTS

Following the previous chapter on international and national climate agreements and strategies this chapter presents a status report on conditions for green transport in the Barents region. The chapter will examine different aspects necessary for understanding the premises for developing green transport in the region and what consequences the countries' different strategies have led to in terms of green vehicles, infrastructure for green transport, rest areas for heavy trucks and case studies of ITS green transport projects.

3.1 CROSS BORDER TRANSPORT STRATEGIES

Cross border transport is considered an area of interest in national plans, strategic and bilateral studies. The following examples are a selection of strategic approaches supporting cross-border transports in the Barents region.

3.1.1. JOINT BARENTS TRANSPORT PLAN (JBTP)

Increased cooperation and alignment of individual transport systems are a foundational matter in the joint Barents action plan. The Barents Euro-Arctic Transport Area (BEATA) presents a plan aimed at developing an efficient cross-border transport system in the Barents region. The objective comprises good internal connectivity between Barents countries and well-functioning external links to world markets in designated transport routes like the TEN-T network. Prioritized areas are environment, accessibility and traffic safety. The plan has been updated in 2015, 2016 and revised in 2019. JBTP identifies and suggests measures in the areas of climate and transport by developing a cross-border transport systems that accounts for mitigation and adaptation of climate change in infrastructure, fuels and vehicles (The Barents Euro-Arctic Region 2019).

3.1.2. TRAFFIC STRATEGY FOR THE E12 REGION

The E12 region consists of Nordlands fylke, the couny of Västerbotten and the county of Österbotten. The traffic strategy aims to create joint priorities and thus an active cooperation on short- and long-term development of the cross-border transport system of the region. An idea is that a common vision of how the cross-border transport system should be developed in a cross-border perspective strengthens region´s ability to obtain funding for strategic investments. This is done based on an observation that border-regions many times are disfavored regarding investments, planning and other priorities. The strategy includes joint areas of cooperation in infrastructure development, cross-border infrastructure planning, environment and social sustainability. The cooperation areas are broken down to goals and related measures. An underlying aim is to change the approach of infrastructure planning away from the existing strong national focus towards a widened cross-border planning system (E12 Atlantica Transport 2018).

3.2 VEHICLE FLEET OF THE BARENTS REGION

3.2.1. PASSENGER CARS

The total number of passenger cars in the Barents region amounts to about 2 055 500, of which 46 percent are registered in the Nordic regions and 54 percent in the Russian regions (Statistics Norway 2018a, Transport Analysis 2018, Traficom 2019b, Federal State Statistics Service 2019b, Autostat 2018).

In the North-western Federal District, which includes the Russian Barents regions of Murmansk, Arkhangelsk, Komi and Nenets, the average age of the car park is 13 years (Autostat 2019). In the Swedish and Norwegian parts of Barents, the average age is 12 years, while it is 13,5 in the Finnish regions (Statistics Norway 2018b, Regionfakta 2011a & 2011b, Traficom 2018).

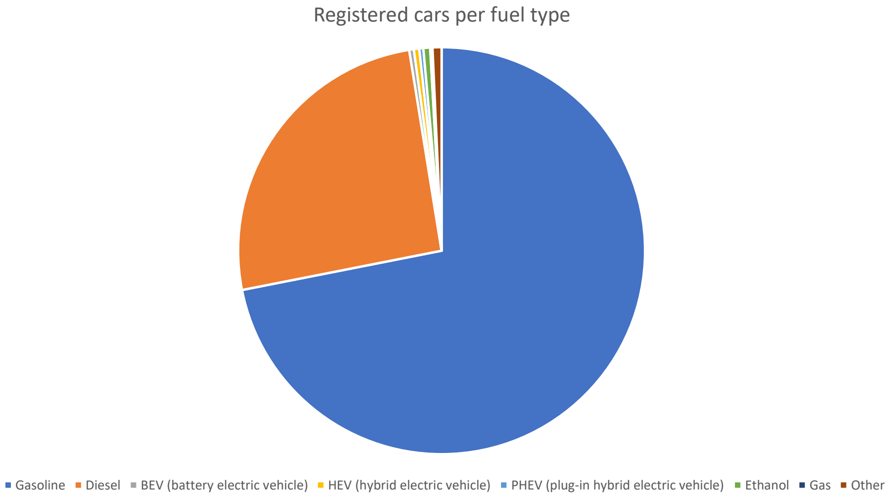

*Figure 2. Registered cars by fuel type in Barents. Sources: Statistics Norway (2018a), Transport Analysis (2018), Traficom (2019b), Federal State Statistics Service (2019b), Autostat (2018) *For Murmansk, Arkhangelsk, Komi, Karelia and Nenets, data was only found for gas and total number of cars. Numbers for the other fuel types have been estimated based on a national average of Russian fuel types.*

As *figure 2* shows, in the Barents region, the dominant fuel types for registered passenger cars is gasoline (72%) and diesel (26%), while EVs, hybrids, gas, ethanol and others amount to a small fraction (less than 3%). A break-down of the numbers per region can be seen in *figure 3* below.

Diesel cars are generally more popular in the Norwegian and Swedish regions, while gasoline is the major fuel type for passenger cars in the Finnish and Russian regions. The greatest share of alternatively fueled cars is to be found in the Norwegian regions of Nordland and Troms as well as in the Swedish regions of Västerbotten and Norrbotten. The number of EVs, BEVs and plug-in hybrids (PHEVs) are greatest in the Norwegian regions, while ethanol cars are mainly found in the Swedish regions. In Russia the main alternative fuel is gas (i.e. natural gas – CNG/LNG), while electric cars only amount to about 0,1 percent nationwide (Autostat 2020).

New car sales can act as an indicator of how the vehicle fleet is changing and can be seen in *figure 4*. Since no data was found for the Russian regions, the data only represents new car sales in Nordland, Troms, Finnmark, Västerbotten, Norrbotten, Northern Ostrobothnia, Lapland, Kainuu and North Karelia. Most new car sales in the Nordic part of the region are gasoline (47%) and diesel (29%). Electrified cars represent 24% of new car sales, while gas, ethanol and others amount to less than 1%.

Electrified cars are most common among new cars in Norway (*figure 5*). For example, 59% of new cars in Nordland and 48% in Finnmark were electrified. In the Finnish regions, gasoline was the major fuel type for new cars, while 4-5% were electrified. In Sweden, diesel was most popular among new cars and electrified cars represented 20%.

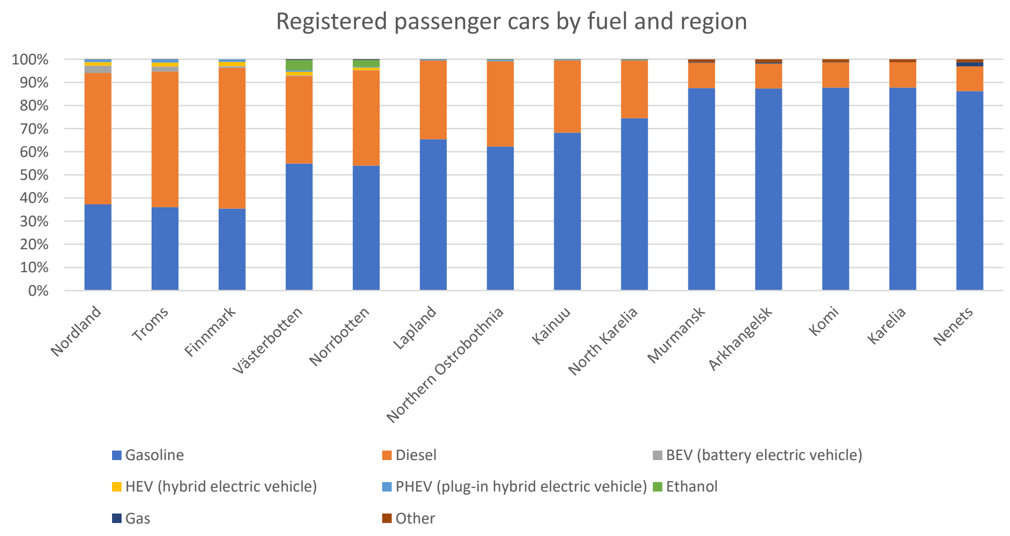

*Figure 3. Registered passenger cars by fuel type and region. Sources: Statistics Norway (2018a), Transport Analysis (2018), Traficom (2019b), Federal State Statistics Service (2019b), Autostat (2018). *For Murmansk, Arkhangelsk, Komi, Karelia and Nenets, data was only found for gas and total number of cars. Numbers for the other fuel types have been estimated based on a national average of Russian fuel types.*

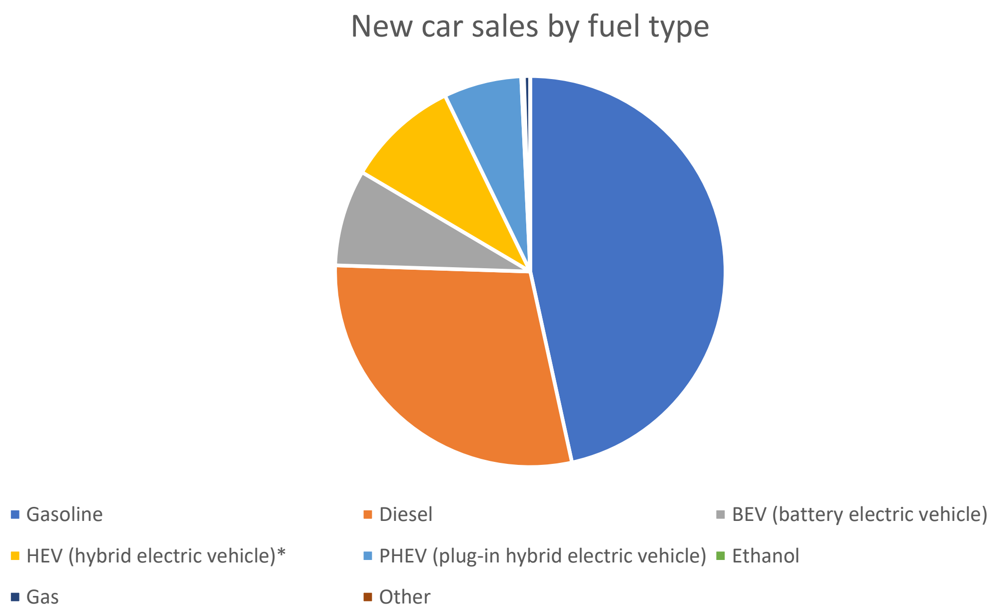

*Figure 4. New car sales by fuel type in the Norwegian, Swedish and Finnish parts of Barents. No data were found for the Russian parts. Sources: Transport Analysis (2018), Traficom (2019a), OFV (2019). *Traficom doesn't report HEVs separately, so this fuel type might be included in gasoline/diesel data for the Finnish regions.*

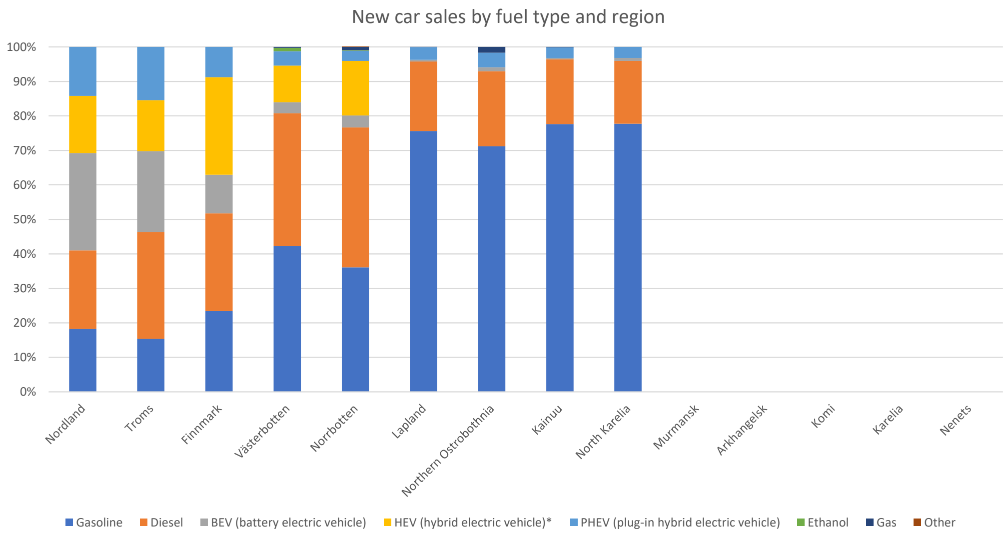

*Figure 5. New car sales by fuel type and region. No data were found for the Russian regions. Sources: Transport Analysis (2018), Traficom (2019a), OFV (2019). *Traficom doesn't report HEVs separately, so this fuel type might be included in gasoline/diesel data for the Finnish regions.*

3.2.2. HEAVY TRUCKS, LIGHT TRUCKS AND BUSES

Based on data from Norway and Sweden, diesel is the dominant fuel type for heavy trucks, light trucks and buses (*figure 6*).

Diesel amounts to 97% of registered heavy trucks, 93% of registered light trucks and 95% of registered buses in Nordland, Troms, Finnmark, Västerbotten and Norrbotten. Gasoline represents 3% of heavy trucks, 7% of light trucks and 1% of buses. Less than 1% of heavy trucks and light trucks run on other fuels than diesel or gasoline. About 4% of buses run on other fuels than gasoline and diesel; 1% of buses are electrified (i.e. battery electric, hybrid or plug-in hybrid) and 3% run on vehicle gas.

In the Russian Barents regions of Karelia, Komi, Arkhangelsk and Murmansk the total number of heavy trucks is 14 867, out of which 69 percent run on diesel, 28 percent on gasoline, 3 percent on gas and 1 percent on other fuel types (Federal State Statistics Service 2019a).

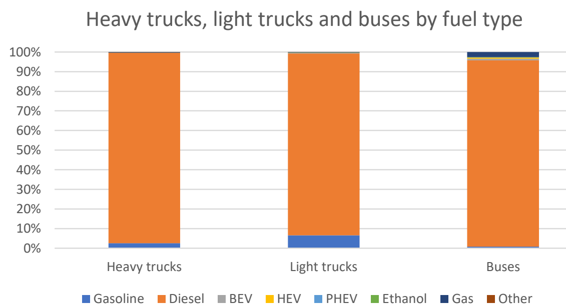

Figure 6. Registered heavy trucks, light trucks and buses by fuel type in Norwegian and Swedish Barents regions. Source: Traffic Analysis (2018), Statistics Norway (2018a).

3.3 INFRASTRUCTURE FOR GREEN TRANSPORT

This section presents an overview of EV charging and renewable fuels infrastructure in the Barents region.

3.3.1. CHARGING INFRASTRUCTURE

Today's battery electric vehicles have a range of up to 600 km. Driving ranges differ between models, and there are several models with shorter driving

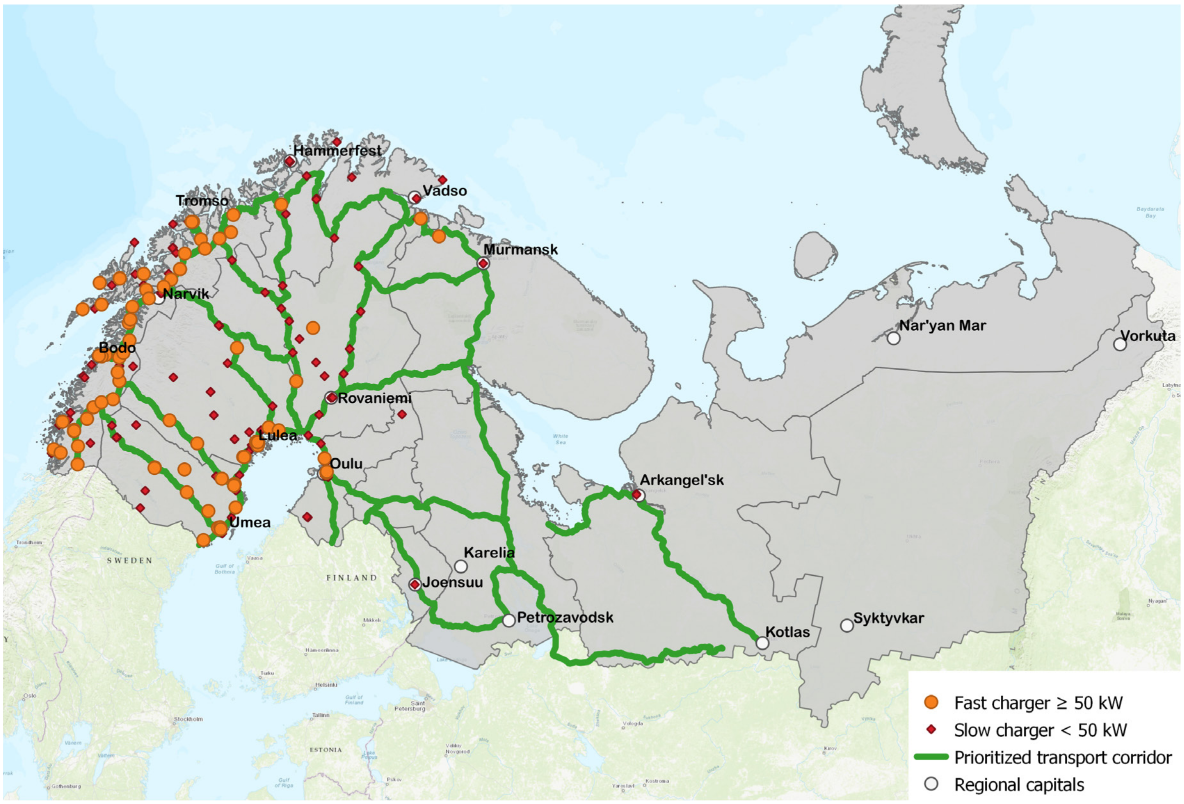

Figure 7. Public fast-charging infrastructure for EVs in Barents. Source: Illustration by Tyréns AB, processed information from Nobil (2020).

range. In a report from the Swedish Transport Administration (Trafikverket 2018), a recommendation is that there should be a public charging opportunity every 100 km on the main road network. There are different types of EV charging stations. In this report, the focus will be on publicly available chargers, and the charging points will be differentiated between fast chargers (≥50 kW) and slow chargers (<50 KW). The infrastructure for EV charging is unevenly distributed in the region (*figure 7*). The most extensive network of public fast charging stations is to be found in Norway and Sweden.

Norway is the country with the most charging stations. A developed charging network for EVs is found along E6 (the main road passing through Nordland, Troms and Finnmark). However, there is a concentration to Nordland and Troms and the charging infrastructure is more sparse in Finnmark.

The cross-border corridor with the most well-developed EV infrastructure is the Bothnian Corridor between Sweden and Finland from Umeå to Oulu. Other than that, there are existing chargers along some of the other cross-border corridors, as well however these are mainly

chargers with lower charging capacity (<50kW).

In Sweden, charging infrastructure is rather evenly distributed between Norrbotten and Västerbotten although it is concentrated to the coastal regions.

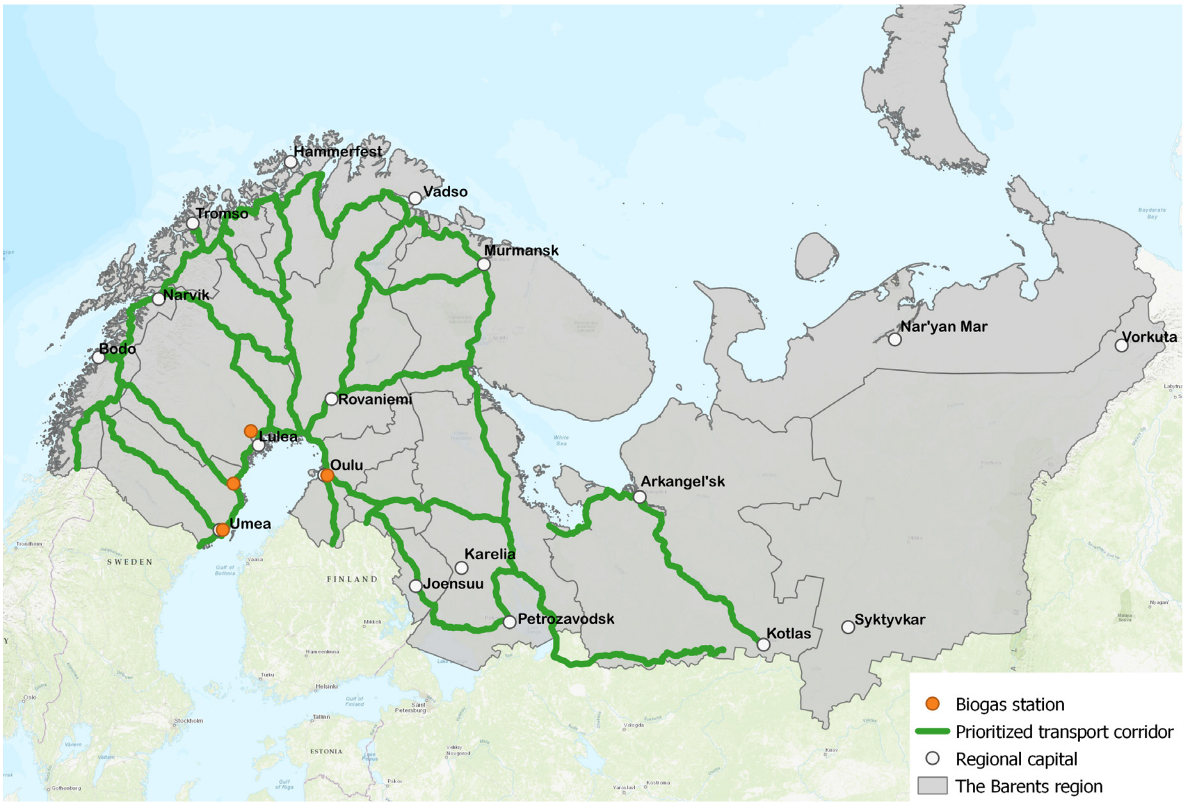

Figure 8. Biogas stations in Barents. Source: Illustration by Tyréns AB, processed information from Biogas 2020 and Jeppo biogas (2020).

In Finland the chargers are mainly focused to Northern Ostrobothnia and to some extent Lapland while it is sparser in North Karelia and Kainuu.

The least developed infrastructure for EV charging is found in the Russian regions of Barents. There is only one public fast charger available, a 50kw charging point located in Zapolyarny near E105 between Murmansk and Kirkenes. Other than that, it is possible to charge electric cars at one spot in Murmansk and two in Arkhangelsk, though these are not fast chargers.

3.3.2. BIOFUEL

There are different types of biofuels available at the market and the industry is growing. In this report, regional infrastructure for three types of biofuels are examined: biogas, E85 (ethanol) and biodiesels (e.g. HVO-100).

Filling stations for biogas (*figure 8*) is largely absent in the Barents region. The existing network is entirely focused around the Gulf of Bothnia, with biogas stations at four locations between Umeå and Oulu. Biogas passenger cars typically have a range of between 400-600 km but most also have the opportunity to run on gasoline thus doubling their effective range (FordonsGas 2020).

There are no biogas filling stations located in the Russian parts of Barents. The infrastructure for natural gas vehicles is under development however, and

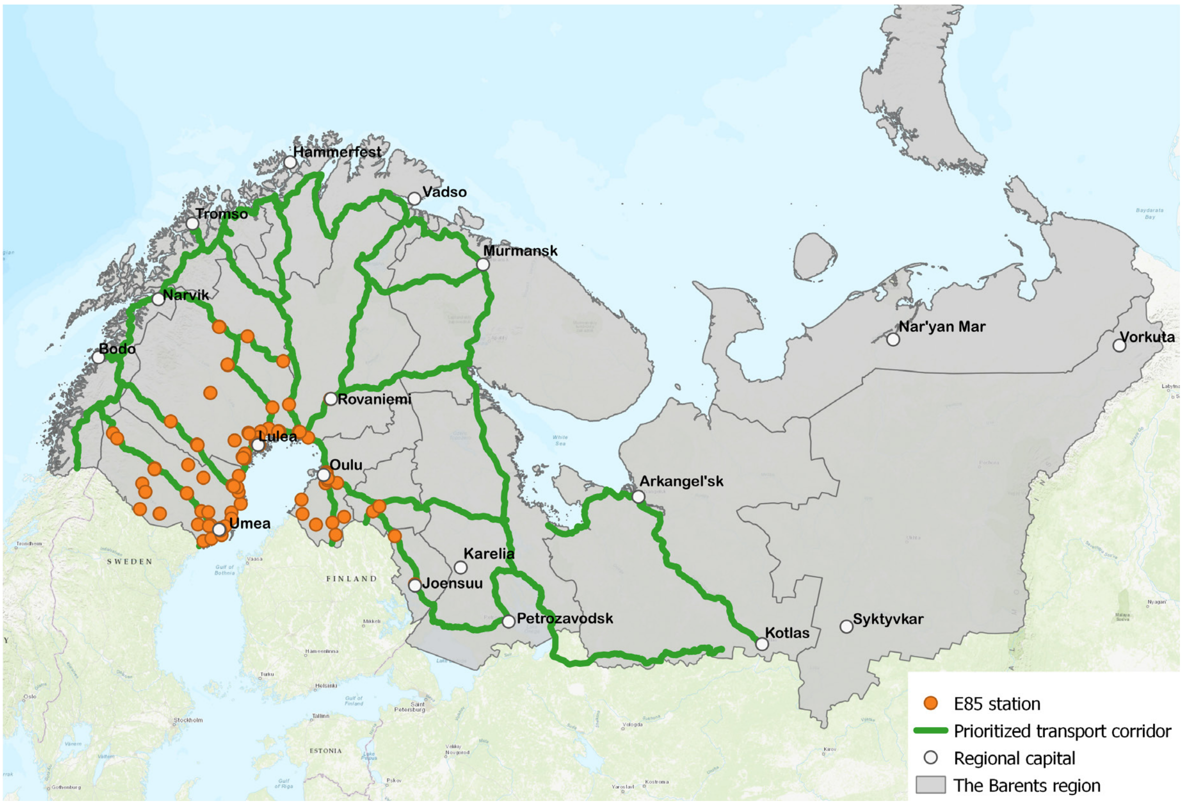

Figure 9. E85 stations in Barents. Source: Illustration by Tyréns AB, processed information from Etanol.nu

there are a few stations in Komi and one in Karelia (Petrozavodsk) (Gazprom Agnks 2020).

The fueling possibilities for ethanol (E85) are entirely concentrated to Sweden and Finland (*figure 9*). In Sweden E85 is supplied by all the major fuel-distributors, especially in more populated areas and along the country's main road network.

In Finland, access to E85 is distributed on all St1 and ABC filling stations, as well as selected Shell stations on main transport routes. The highest number of filling stations is found in Northern Ostrobothnia around Oulu and along E8 northwards to Tornio.

Outside of the coastal regions, the availability is limited to a few stations in Kainuu and North Karelia.

Biodiesels such as HVO-100 is available at a few filling stations, primarily in the Swedish parts of Barents. However, the European strategy for admixture of biodiesel means that most of the HVO-100/FAME-100 supply will be blended with conventional diesel fuels and not sold separately.

3.3.3. OTHER ALTERNATIVE FUELS

Hydrogen fuel cells is a technology that has yet to gain traction. The market for passenger cars has been slow, but in recent years manufacturers of heavy trucks have started to take interest in the

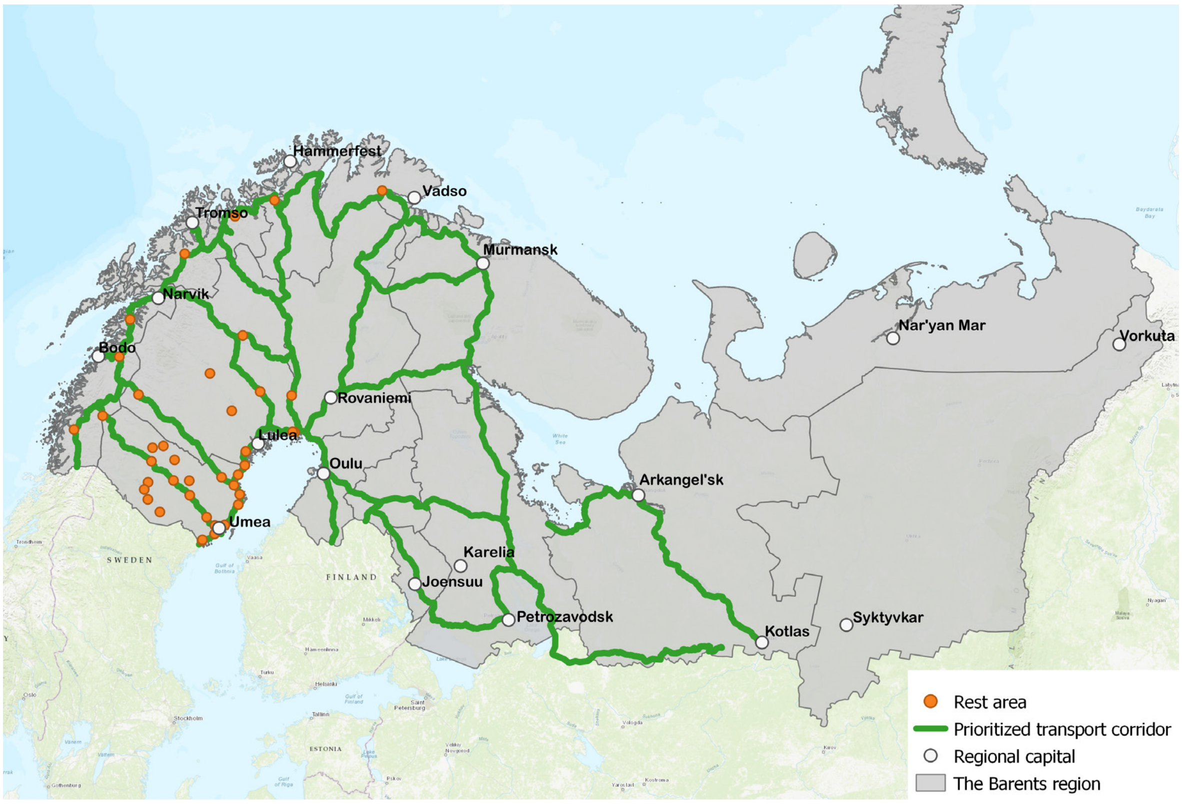

Figure 10. Rest areas for heavy trucks. Finnish data not separated between general rest areas and rest areas designated for heavy trucks. No data was found for the Russian Barents regions. Source: Illustration by Tyréns AB, processed information from NVDB, Statens Vegvesen (2020) and Väylä (2016).

technology. As of February 2020, the only hydrogen fueling station in Barents is located in Umeå, Sweden.

3.4 REST AREAS FOR HEAVY TRUCKS

There is no common definition of rest areas for heavy trucks among the Barents countries. A common trait seems to refer to different levels of parking areas, with elemental parking lots, not suitable for larger quantities of heavy trucks. The other level refers to larger parking areas with more capacity for heavy trucks and in some cases supporting facilities such as toilets, diners etc. *Figure 10* shows an overview of available rest areas. The available data does not include commercial rest areas. No data was found for the Finnish and Russian regions.

3.4.1. NORWAY

The Norwegian transport authority describes a concept of 24-hour rest areas for heavy trucks that have been established to meet statutory requirements for driving and rest time. The 24-hour rest areas are well marked with signs on the main road. The sites are usually located in the immediate vicinity of food service and fuel sales companies. All spaces include a shower, toilet and lighting in the parking areas. With some exceptions, there is also access to a 220V power supply for cooling units.

In anticipation of day-resting places being better developed along the national road network, many of the resting places with restrooms can also be used for day-rest and reduced weekly rest in addition to breaks. Some of these are closed during the winter.

Table 4. Existing and planned rest areas for heavy trucks in Nordland, Troms amd Finnmark (Norway). Source: Statens Vegvesen (2018)

	Nordland	Troms	Finnmark
Existing rest areas	E6 Mosjøen E6 Fauske E6 Innhavet NR 80 Bodø harbour	E6 Buktamoen E6 Circle K Storslett	E6 Shell Talvik E6/E75 Tana bru
Planned rest areas	E6/E12 Mo i Rana, E6 Ballangen E6 Narvik E6/E10 Bjerkvik E10 Storeidøya	E6/E8 Skibotn E8 Tromsø NR 83 Harstad	E6/rv 94 Skaidi E6 Lakselv E6/rv 92 Karasjok E6/E105 Kirkenes NR 93 Kautokeino NR 94 Hammerfest

Existing and planned rest areas in Nordland, Troms and Finnmark can be seen in *table 4*.

3.4.2. SWEDEN

The Swedish Transport Administration provides comprehensive rest areas along the roads located in the Barents area. These are generally intended for both passenger cars and trucks. In most of these rest areas there are designated areas for heavy trucks. Resting at these areas is free for 24 hours, for periods exceeding 24 hours a special permit is required. The rest areas in Västerbotten and Norrbotten can be seen in *table 5*.

3.4.3. FINLAND

No data was found regarding rest areas for heavy trucks in the Finnish regions of Barents.

3.4.4. RUSSIA

No data was found regarding rest areas for heavy trucks in the Russian regions of Barents.

3.5 CASE STUDIES – GREEN TRANSPORT ITS PROJECTS IN BARENTS

Table 5. Existing and planned areas for heavt Trucks in Västerbotten and Norrbotten. Source: Trafikverket (2019)

	Västerbotten	Norrbotten
Existing rest areas	E4 Lögdeälven E4 Rödviken E4 Åhedeån E4 Täfteböle E4 Sävar E4 Ljusvattnet E4 Tjärn E4 Byske E12 Tallbacken E12 Blåviksjön E12 Buktes E12 Swedish-Norwegian border E45 Meselefors E45 Vojmån 95 Bastunäs 1132 Sejaur 363 Enebacken E45 Sorsele 363 Beukaforsen 90/92 Åsele	E4 Jävre E4 Harrbäcken E4 Törefjärden E4 Aavajoki E4 Keräsjoki E10 Lansjärv E10/E45 Lappensuando E10 Bessejohka E10 Stenbron E45 Ljusselforsen E45 Polar circle – Jokkmokk E45 Porjus E45 Suptallen 95 Polar circle – Silvervägen 99 Kattilakoski 97 Edefors
Planned rest areas	90/92 Åsele 92 Braxele	-

One of the measures highlighted in the Second Edition of the Action Plan on Climate Change for the Barents Cooperation (International Barents Secretariat 2017) is the promotion of intelligent transport system technology (ITS). In this section three different ITS projects more or less focusing on green transport in the Barents region is presented. The selection of case studies has been made with the criteria that they should be projects within the Barents region, utilizing ITS technology. There is generally a lack of project that fulfills these criteria and that focus on green transport in a cross-border perspective.

3.5.1. E8 - BOREALIS

In a joint project between the road authorities of Finland and Norway, self-driving trucks are being tested between Skibotn in Troms and Kilpisjärvi in Lapland. Along a section of road E8, equipment with connected-ITS technology make wireless communication possible for vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I) and infrastructure-to-vehicle (I2V) technologies (ITS Perception 2018). The segment is one of five Norwegian road sections selected as pilots to develop and test ITS solutions in Norway. The route is selected because of its socio-economic significance and its demanding winter conditions, and with a high proportion of heavy traffic. 26 per cent of the traffic on this road is heavy traffic. The proportion has increased by more than 70 per cent since 2010, making the need for future sustainable solutions important. In context the application of ITS consists of technology and computer systems that could aid road users and transport operators e.g. real-time information about the weather, road surface conditions and traffic accidents, automatic scanning of the vehicle's brakes, and warnings of wildlife or other obstacles on the roadway. The project includes testing of systems for self-driving vehicles in platoon and rows. The row of vehicles utilizes a lead-vehicle where other vehicles follow like drones. Initial testing utilizes a regular driver in the leading vehicle, but a goal is to implement total driverless and autonomous driving (Väylä 2016).

3.5.2. ITS UMEÅ

Poor air quality has for a long time been a problem for central Umeå, Västerbotten. The problems are due to local transport emissions in combination with unfavorable weather conditions in wintertime. As a way of reducing local traffic during days of air quality problems, Umeå Municipality and the Swedish Transport Administration installed variable message signs in 2014 at the four entrances to Umeå along E4 and E12. The signs are connected to air quality monitors in the city center. When air quality is bad, messages are shown on the signs to encourage road-users to choose alternative routes (i.e. the city ring road instead of routes through the city center) (Umeå Municipality 2015).

There are two different messages depending on how bad the air quality is: "For better air in the center of Umeå, choose ring road E4 / E12" appears at the first level. "Low air quality in Umeå center, choose ring road E4 / E12" is displayed when the values are higher. When the signs show no environmental message, the air quality is below the limit values. The road signs are part of a joint strategy for the Swedish Transport Administration and the Municipality of Umeå to improve the air environment in central Umeå (Umeå Municipality 2015).

On days that the signs are not in use for communication about air quality, they can be utilized for other types of information like roadworks or events that can affect traffic.

3.5.3. ROAD STATUS INFORMATION (RSI)

The Swedish transport administration and the Swedish innovation agency Vinnova initiated the RSI system project. RSI is short for Road Status Information, a system that demonstrates ways of integrating different types of information sources and information generation for contractors and road administration. The information that the system generates is presented in a specific application, which functions as a support system aimed at maintenance and operating contractors during winter conditions. The information can also be used by the Swedish Transport Administration for follow-up and evaluating purposes. The primary information processed and presented in the system among other are air temperature, road conditions, residual salt levels, action proposals. The application also has the function of receiving and presenting feedback from contractors on executed measures. The project demonstrates ways of how ITS can help for example in keeping roads open to traffic in challenging winter conditions or increasing traffic safety in general (Trafikverket 2018).

4 ANALYSIS

The global level act by setting long term goals and targets to lower CO_2 emissions and counter global warming. Countries ratifying the agreements have a high degree of freedom in designing the execution and implementation of measures at the national level. EU operates by setting objectives and enact legislation that applies to its member states. As Sweden and Finland are members of the EU they also fall under EU-legislation. Norway normally follows the EU directives closely, but do not have to submit to EU legislation. Since all the Barents countries have ratified the Paris agreement there is a consensus in the region that climate change is an important issue. The Nordic countries have strategies in place to mitigate greenhouse gas emissions, while the Russian strategy so far is more concerned with adapting to the effects of climate change. When it comes to reducing emissions from transport, the countries of Barents have chosen somewhat different strategies.

There are several similarities between Norway, Sweden and Finland in that their strategies all contain some elements of reducing transport need, modal shift to more sustainable transport modes and increasing the use of green vehicles and fuels. Measures in line with these elements could be said to constitute green transport (i.e. measures aimed at reducing CO_2 emissions from the transport sector).

The Norwegian strategy puts the clearest emphasis on implementing new technology for zero emission vehicles (mainly electric vehicles) while Sweden presents a more mixed strategy where urban planning and modal shift are key measures. Finland has set goals for green vehicle deployment, but the strategy is mainly market based. In addition, Finland emphasizes Mobility as a Service as a way to reduce solo car journeys. The Nordic countries have different level of biofuel admixture policies in place. Sweden and Finland are trying to influence EU vehicle efficiency standards through their memberships in the EU. The Russian strategy for reducing CO_2 emissions from the transport sector is less articulated, but elements include substituting gasoline and diesel for natural gas. Regarding heavy transport, Norway and Sweden emphasize shift to rail and sea from road transport, while the Finnish strategy is more focused on high-capacity transport as a means of reducing transport need.

The current passenger car fleet of the Barents regions is fossil based with a 97% share of diesel and gasoline vehicles. The share of *green vehicles* (biofuels/EVs) constitutes less than 2%, indicating a need to speed up the transformation process towards green transport. This is also the case for trucks and buses where diesel is the dominant propellant. There are visible differences in fuel type composition between the regional fleets inside the Barents region, reflecting national prerequisites and policies. New car sales could be said to be an indicator on the transition pace of alternative fuels. Statistics reviewed on car sales in the Nordic Barents regions show that diesel and gasoline constitute 76% of new sales. Noteworthy is that electrified vehicles constitute 24% of new car sales while others amount to less than 1%. Thus, it seems like the transition towards green transport is mainly driven by electrified vehicles. Since no Russian data on new car sales was found, and Russian cars constitute 54% of the Barents vehicle fleet, it is risky to place too much weight on the conclusion regarding the Barents region as a whole. A key conclusion is that a purposeful commitment pays off which seems to be the case in Norway.

While a pattern is emerging for new passenger car sales, the market for green heavy trucks is more unclear. So far, most heavy trucks and buses are diesel and there are few options on the market. However, vehicle technology is under rapid development in the field of heavy transport. The main green fuel type options being developed for heavy trucks include battery electric, hydrogen fuel cell and vehicle gas. It is too early to say which direction the industry will take, and new vehicles may bring new requirements for fueling or charging infrastructure.

From the findings in this report, a clear link between national policy, the development of alternative fuel infrastructure and the share of vehicles using alternative fuels is apparent. An overall observation is that a well-developed network of charging stations exists in countries promoting a policy framework such as Norway, Sweden and western Finland. Charging stations seem to be focused in the vicinity of population-dense areas and the primary road network. Biogas filling stations are relatively rare and exists exclusively around the Gulf of Bothnia. Russia's current focus on enhancing natural gas vehicles may bring an opportunity to expand biogas filling stations in the region and to the Russian regions as well.

Green transport infrastructure (i.e. fast-chargers, biogas stations etc.) is often built and financed by commercial actors. Market demand has initially been low due to the low number of EVs and gas vehicles. (Which in turn may be low due to the lack of necessary infrastructure.) In order to stimulate the market for green vehicles, the Nordic countries have implemented a range of incentives and subsidies (e.g. tax exemptions for vehicles and funding for infrastructure). Interactions between public and private sector like this will be important to enable the type of rapid implementation of green transport that is necessary to meet climate mitigation targets. In the initial stages of transition to green transport, market failures are likely to be a threshold due to high initial costs and low demand. In the more sparsely populated areas of Barents this is likely to persist.

Rest areas along primary roads could potentially be used as nodes for charging/filling stations. Commercial rest areas connected to conventional filling stations is quite common. If charging/filling opportunities for green transport is to be deployed at public rest areas this will require close cooperation between public and private actors. In this report, data could only be found for public rest areas in Sweden and Norway, and no data was found for commercial rest areas.

ITS technology could potentially facilitate green transport implementation. The E8-Borealis project is perhaps the most interesting example in the Barents region where transport efficiency and emission reductions were achieved using ITS as a support system for automated platoons of trucks. Another possible application for ITS could be as a supportive instrument to create a user platform displaying information on the possibilities to travel between destinations in the Barents region with green vehicles. Although ITS could enhance efficiency or implementation of green vehicles, it is most likely on the margin and should be seen more as supporting measures for green transport rather than the main strategy.

Cross-border cooperation is important to enable a common green transport infrastructure throughout the Barents region. The existence of cross-border strategies is a prerequisite and international strategies or plans such as JBTP and Traffic strategy for the E12-region should prove to make excellent instruments of coordination if used wisely. Even though the JBTP sets a framework for cooperation in the fields of environment and transport, there is a need to further develop common strategies and measures for the implementation of green transport. The different directions of national policies could risk creating asymmetries in the infrastructure. Finding a more common ground in terms of definitions, goals and measures for green transport is likely the best way to ensure a functional cross-border network of green transport.

5 RECOMMENDATIONS

Based on the analysis in the previous chapter, eight main recommendations are proposed. All recommendations are aimed at concretizing how the Barents region should proceed in order to support an efficient and fast transition towards green transport and hence lowering emission of GHG in the transport sector.

5.1 ADOPT A COMMON DEFINITION OF GREEN TRANSPORT

Through adopting a common definition of green transport shared by all Barents countries the basis for further collaboration in the field would be stronger. If green transport is to be thought of as measures that reduces CO_2 emissions from the transport sector, as we have proposed in this report, then there are three main categories of measures that can be implemented. These are: measures that reduce travel need, measures that promote modal shift and measures that support green vehicles and renewable fuels.

Adopting a definition in line with this opens for a clearer focus in coming revisions of JBTP. The cross-border perspective of the Barents cooperation is important and implementing similar measures in the different regions of Barents makes it easier to get functional transport corridors for all transport modes and fuel types.

5.2 RAISE THE AWARENESS OF GREEN TRANSPORT

Awareness of, and knowledge about, green transport is unevenly distributed within the region and between sectors. Sharing information between different actors is key to get a basis for smart decision making in the public and private sectors, as well as to influence consumer demand. The regions with the most experience and most mature markets in the field of green transport should be able to transfer knowledge to regions with less developed markets. There are also commercial actors who possesses valuable information that could increase the understanding of potential obstacles to implementation which in turn could be used to direct public incentives more efficient.

One way of increasing consumer awareness and demand for green transport could be to use ITS technology to create an information platform on which fuels are available at what locations in the region. This could help guide drivers to where the next charging station or filling station is or help them plan their journeys based on this information.

5.3 USE EXISTING STRATEGIES TO UNIFY EFFORTS IN THE BARENTS REGION

There are many similarities and some smaller discrepancies in the composition of existing strategies to reduce GHG emissions originating from the transport sector. Existing strategies are mainly focused on creating a transport efficient society, energy efficient and non-fossil vehicles and an increased share of renewable fuels.

Thus, the significant similarities present a good opportunity to create a joint effort on basis of the existing national strategies in the Barents region.

5.4 MAKE ELECTRIFICATION A TOP PRIORITY

The available range of different green transport fuel types makes it possible to choose different directions or consider using a mix. For a fast transition towards green transport however, investments and funding should initially be concentrated on the assignment of making one fuel type viable in the region. As seen in chapter 3, the existing infrastructure supporting electric vehicles is more extensive than for example biogas. The strong position of electrified vehicles among new car sales, the rapid technological development and low to zero GHG emissions puts electrified vehicles at the forefront of the field. Norway is leading the way, with Sweden and Finland following. Russian efforts to deploy charging infrastructure along the main roads should be a priority. In order to get the full benefits of electrification the Barents region should also strive towards low or zero emissions from electricity generation.

For heavy trucks and buses, it is less clear what path to choose. The market is still very much under development with new types of vehicles such as battery electric, hydrogen fuel cell and vehicle gas. Here the recommendation is to keep updated with the way the market develops and adjust policy instruments accordingly. The focus of the national strategies to release biofuels for heavy transports by a transition towards renewable fuels in the passenger car fleet would be a short-term action. Opportunities to use commercial and public rest areas to support green transport should be explored in more depth. It is recommended to conduct a survey of public and commercial rest areas and what uses can be found.

5.5 SET COMMON GOALS FOR DEPLOYMENT OF GREEN TRANSPORT INFRASTRUCTURE

To achieve a basic functionality in the green transport infrastructure (ensuring the possibility to get from point A to point B within the region), goals should be set for the primary road network. Based on average operating range of EVs and gas vehicles, standard requirements could be set. As an example, the Swedish national strategy on deployment of fast-charging infrastructure states that public fast-charging possibilities should be available every 100 km along primary roads. Setting these target values also enables to identify where necessary infrastructure is absent, thus enabling a feedback to national levels on need of policy incentives.

5.6 IMPLEMENT PUBLIC INSTRUMENTS THAT ENABLE COMMERCIAL INFRASTRUCTURE DEPLOYMENT

Most infrastructure supporting charging and filling is built and operated by commercial actors. Still, the public sector plays a supportive role in realizing the infrastructure through instruments such as incentives or legislation. The national level can use taxes, regulations and funding opportunities as main drivers. The local level can implement measures aimed at building an initial demand for green transport and green vehicles by public procurements to be applied by local/regional public actors. The city level has access to tools such as local traffic and parking regulations (e.g. reduced parking fees, access to bus lanes etc.).

In order to provide favorable conditions to commercial actors constructing green transport infrastructure it is vital to identify the central needs of the commercial sector and implement relevant supportive measures throughout the Barents region.

5.7 INCLUDE THE OUTCOME OF THESE RECOMMENDATIONS IN JBTP

The recommendation is to update JBTP with a joint definition and goals on green transport as described above. Using JBTP as a facilitator to create a common ground among the stakeholders in Barents region streamlines a future implementation. A key challenge though, is that transport policy traditionally is a national interest. In order to use the JBTP as an effective cross-border instrument in developing green transport, all countries involved will in practice need to decide and finance the measures in their respective transport policies. A joint plan creates a necessary basis for an efficient cross-border development in the field of green transport.

5.8 MONITOR GREEN TRANSPORT MEASURES

In order to evaluate the development of green transport in Barents and adopted objectives, there is a need to make relevant regional data available. Once available, it is possible to create an appropriate monitoring scheme providing updates on the development of green transport in the Barents region. A monitoring scheme also provides a basis for communicating status and needs between local, national and international stakeholders.

During this study an overall lack of Russian data has been identified. In the case of the Nordic countries, the availability of green transport data is relatively good, but the accessibility of regional data could improve. In addition, there is a need to refine some data, for instance regarding rest areas, which does not include commercial rest areas and in the Finnish case does not separate designated rest areas for trucks from road-side parking. Thus, making it difficult to analyze the potential for combined green transport use. Furthermore, a detailed description of attributes of rest areas can support identification of improvement needs and need of harmonization of the current network both out of a green transport perspective but also a traffic safety perspective. It can also be used to analyze and propose suitable locations of new rest areas that enables a good coverage in the main cross-border road network. Such data would altogether provide a solid baseline for a joint strategy on the development of rest areas and usage of resting areas in the Barents region.

A recommendation is to create an open data platform in cooperation with the national statistic authorities in the Barents region. This platform could also be used in interaction with ITS-technology both to store collected data on green transport related variables, but also to simplify analysis of the development of green transport.

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