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Alternative transport fuels infrastructure

Finland's National Plan

MINISTRY OF TRANSPORT AND COMMUNICATIONS

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Ministry of Transport and Communications

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MINISTRY OF TRANSPORT AND COMMUNICATIONS

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Abstract
Directive 2014/94/EU of the European Parliament and of the Council on the deployment of alternative fuels infrastructure entered into force in October 2014. According to the Directive, all Member States must draft a national policy framework for the development of an alternative transport-fuel market and deployment of a related infrastructure by November 2016. The national policy framework must specify the alternative transport fuels and their distribution infrastructure targets for 2020 and 2030 as well as the measures by means of which the targets will be achieved.

The Finnish Government accepted the National Alternative Fuels Plan in February 2017. According to the plan, the distribution station network of different fuels and the public charging points required by electric vehicles be built in Finland primarily on a market basis. Commercial operators, such as energy companies, shopping centres and parking operators, would primarily be responsible for construction of the infrastructure. The most profitable areas, i.e. large and medium urban regions, would be built first. Other areas and measures for their construction will be assessed by no later than 2020.

It has been estimated in Finland, that even if the distribution network were to be constructed on a market basis, numerous new measures would have to be taken in order to open alternative fuel markets. The most important of these measures are amendments to the Act on the Promotion of the Use of Biofuels for Transport, the use of existing economic instruments (e.g. car, motor vehicle and fuel tax, energy subsidies), a procurement subsidy for new technologies, developing the taxation of company car benefits, making use of public procurements, developing information guidance, exerting influence at the international and EU level as well as research and development.

This is the English version of the Finnish report number 4/2017.

Contents

Abstract

Directive 2014/94/EU of the European Parliament and of the Council on the deployment of alternative fuels infrastructure (the AFI Directive) entered into force in October 2014. Under this Directive, all Member States shall draft a national policy framework for the development of an alternative transport fuel market and deployment of the related infrastructure by November 2016. The national policy frameworks must contain both targets for alternative transport fuels for 2020 and 2030 and the measures necessary to ensure that these targets are reached.

Finland's national target for road transport in 2050 is near-zero emissions. The target for shipping is a 40% reduction in greenhouse gas emissions by 2050 as a result of LNG and biofuel use and other measures. In aviation, the target is to bring the share of renewable or other emission-reducing solutions up to 40% as minimum by 2050.

Finland's target for vehicles using alternative fuels is that all new vehicles sold in Finland are compatible with alternative fuels already in 2030. Vehicles that can be powered by either electricity, hydrogen, natural gas/biogas and/or liquid biofuels, also in *high concentrations,*[1] will be included in the target. The target for 2025 is that 50% of new cars and vans could be powered by an alternative fuel, and the goal for 2020 is a 20% share of these vehicles. The target set for heavy-duty vehicles is that 60% of new trucks and buses would be compatible with an alternative fuel by 2025, with a 40% share already in 2020.

The AFI Directive recommendation is that one recharging point accessible to the public should be provided for every ten electric vehicles. The recharging point network in Finland will be proportioned for some 20,000 electric vehicles in 2020 and for a minimum of 250,000 vehicles in 2030. Consequently, a minimum of 2,000 recharging points accessible to the public should be provided in 2020 and 25,000 in 2030.

The target for gas-powered vehicles is set at a minimum of 5,000 vehicles in 2020 and 50,000 in 2030. The number of gas refuelling points (natural gas and biogas) would be some 50 points in 2020. The number of hydrogen refuelling points would total around 20 in 2030. The number of hydrogen-powered vehicles would be included in the target for electric vehicles.

For liquid natural gas and biogas, the target is that refuelling points for LNG or LBG would be available in all TEN-T Core Network ports (Hamina-Kotka, Helsinki, Naantali and Turku) at the latest in 2025. In addition, bunkering facilities will be available at the LNG terminals of Pori and Tornio as the terminals are completed. The target for inland waterways is that the potential needs for LNG/LBG of vessels navigating in the Saimaa deep-water channel would be covered by a mobile bunkering point or similar located in Mustola, Lappeenranta, no later than 2030.

[1] Current cars powered by petrol or diesel are not included in the target, as under valid standards, they can only use biofuels to a limited extent. If, in the future, these vehicles are built and type approved to run on biofuels also in high concentrations of up to 100%, they can be included in the target. Of heavy-duty vehicles, approximately 30% of all trucks and buses in Finland already are such vehicles.

In the aviation sector, the objective is to turn Helsinki-Vantaa Airport into a Green Hub airport with a special focus on alternative fuel use, where renewable jet fuel would be available for all airlines by 2020. At a Green Hub airport, the use of alternative power sources would also be strongly promoted in the airport's terminal traffic.

The distribution station network of different fuels and the recharging points accessible to the public required by electric vehicles will be built on market terms in Finland. Existing EU and/or national support forms of different types can be utilised in the building. The network will mainly be built by various energy companies and other commercial actors (including shopping centres, parking operators etc.) In the beginning, the network would cover the most profitable areas, i.e. large and medium urban sub-regions. Other areas and measures for extending the network to them will be assessed by no later than 2020.

While the network will primarily be built on market terms, a number of new measures will be required to achieve the objectives. These could include updating the Act on the Promotion of the Use of Biofuels for Transport, the use of existing economic instruments (e.g. car, motor vehicle and fuel tax, energy grants), a procurement subsidy for new technologies, modifying the taxation of company car benefits, making use of public procurement, developing guidance by information, exerting influence at the international and EU level as well as research and development.

Rather than being expected to build or fund the construction of infrastructure for alternative fuel distribution themselves, municipalities will be tasked to participate in the planning of such infrastructure where necessary and ensure that it is linked to the rest of the transport network at the local level. Distribution network solutions required for public transport subjected to competitive tendering by the municipalities/public transport authorities may be an exception (e.g. recharging infrastructure for electric buses). The municipalities shall also ensure that the areas needed for distribution infrastructure are set aside in land use planning and zoning.

1. Introduction

In October 2014, the European Council adopted new EU emission reduction targets for 2030, according to which the EU's greenhouse gas emissions will be reduced by 40% by 2030 (compared to their 1990 levels). This means reducing emissions by 43% in the emissions trading sector and by a total of 30% in the effort sharing sector from the 2005 levels. The Commission issued a proposal on specific targets for each Member State in the effort sharing sector in 2016. According to this proposal, Finland should reduce its emissions by 39% in the effort sharing sector. This target is one of the most stringent in the EU; it is only exceeded by the targets proposed for Sweden and Luxembourg.

Finland also has highly ambitious national targets for reducing greenhouse gas emissions. According to the Government Programme of Prime Minister Sipilä, the use of imported oil in Finland should be cut by half by 2030, and the share of renewable transport fuels should be raised to 40% within the same period. According to initial assessments, these goals are at least as ambitious as the obligations imposed on Finland by the EU.

Greenhouse gas emissions from domestic transport were some 11 million tonnes of CO2 equivalent in 2015. Transport emissions constitute approximately one fifth of all greenhouse gas emissions in Finland, and some 40% of emissions in the non-emissions trade sector. After the downturn in the early 1990s, greenhouse gas emissions from domestic transport increased until 2007. Since 2008, emissions have mainly been declining. From 2005 to 2014, greenhouse gas emissions from transport have dropped by some 1.8 million tonnes in total, or by 14%.

Some 90% of emissions from domestic transport are produced by road transport. Approximately 58% of road transport emissions are produced by cars, 37% by vans and trucks, and the remainder by buses, motorbikes etc. The share of rail transport in emissions is about one per cent, the share of aviation some two percent and the share of shipping some four per cent.

Unlike many other sectors, the transport sector remains highly dependent on fossil oil as its energy source. Apart from electric rail transport, the majority of transport in Finland is powered by hydrocarbon fuels processed from crude oil. The most common transport fuels are petrol, diesel oil, light fuel oil, heavy fuel oil and jet fuel (kerosene).

In order for Finland to meet its long-term climate targets for transport, however, fossil fuels in the transport sector should be replaced by either renewable alternatives or, at the very least, with lower-emission power sources. These include electricity, hydrogen and [liquid] biofuels, as well as methane (natural gas) and biogas. Alternative fuels produced from domestic raw materials will not only cut emissions in the air from transport but also reduce Finland's dependence on crude oil and the cost of purchasing it, as well as creating employment and new export opportunities.

A transition from conventional fossil oil based fuels to other alternatives has already begun in Finland. The most popular alternative fuels currently are liquid biofuels (ethanol and renewable diesel). The total blending ratio of biofuels made from renewable raw materials in petrol and diesel for road transport currently is over 10%, and this ratio is constantly increasing. Natural gas and biogas are used to some extent as road transport fuels in Finland, and natural gas is also used in shipping. Electricity is gradually making headway as a road transport power source.

As far as it is known at the moment, meeting the entire energy needs of transport with a single alternative power source or fuel will not be possible. The suitability of various alternative power sources for different modes of transport also differs. In aviation, liquid biofuels currently appear to be the only realistic alternative to fossil oil. The number of options for shipping, heavy-duty vehicles and cars is increasing. The largest number of alternatives is available for cars, which can run on all of the aforementioned power sources. The potential for reducing emissions is also the greatest for cars.

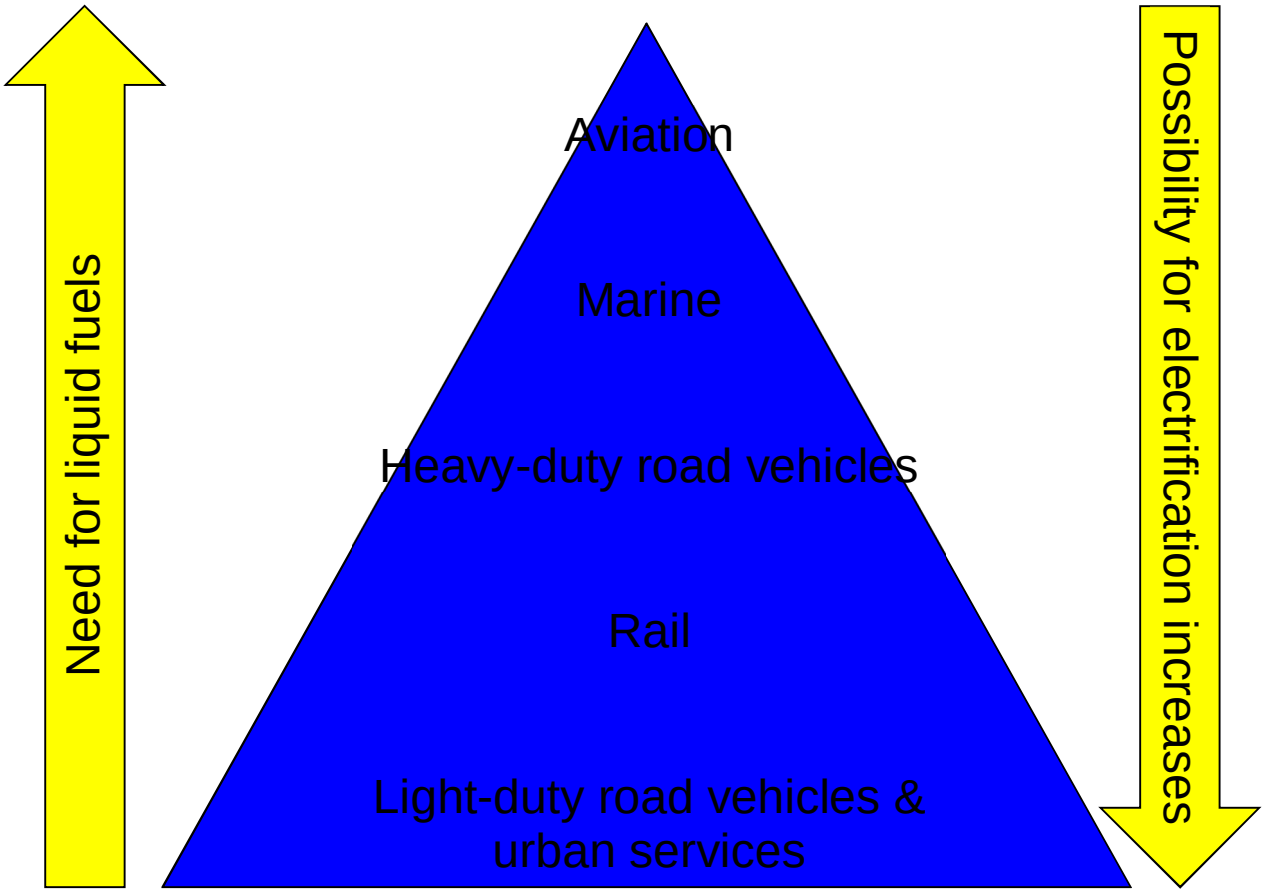

Figure 1: Suitability of various fuels for different transport modes

2. Alternative transport power sources – current state

2.1 General points

The principal road transport fuels in Finland are currently petrol and diesel. About two billion litres of petrol were sold in 2015, which was slightly less than in the year before. Petrol consumption has been declining in Finland over a longer period, while the consumption of diesel oil has increased. Almost three billion litres of diesel oil were sold last year. The number of diesel cars in Finland has shown an increase as a result of a car taxation reform carried out in 2007. However, heavy-duty vehicles and commercial transport have so far been the major diesel users.

Under Finnish legislation, fuel distributors have an obligation to supply a volume of renewable transport fuels that increases ever year. The volume of bioethanol in the Finnish 95 E10 grade petrol may vary, at a maximum amounting to 10% by volume. In 98 E5 grade petrol, the maximum ethanol content may be 5% by volume. The ratio of biofuel in diesel oil varies by fuel grade. In most Finnish diesel grades, the biofuel component comprises hydrogen-treated, renewable diesel oil from domestic refineries, for which no maximum ratio has been specified. Diesel oil in which the biofuel component comprises so-called first-generation biodiesel (FAME), the ratio of which has been limited to 7% by volume, is also available in the market to a lesser extent.

Rail traffic is powered by electricity and light fuel oil. Rail network electrification was initiated in the late 1960s, and currently 55% of the network has been electrified. Most rail traffic runs on electrified rail sections, and electric trains account for almost 90% of traffic.

Ships are today mainly powered by heavy fuel oil (HFO) or intermediate fuel oil (IFO). Previously, the drawback of heavy fuel oil was its relatively high sulphur content, which has been found to have negative effects on air quality and human health in coastal areas. In SOx Emission Control Areas (SECAs) approved by the International Maritime Organisation IMO (including the Baltic Sea), the maximum permitted sulphur content of fuels was reduced to 0.1% at the beginning of 2015. The maximum permitted sulphur content of fuels used in other sea areas will be reduced to 0.5% in 2020 – 2025. The consumption of conventional heavy fuel oil bunkered in Finland has been declining in recent years both in domestic and international traffic. It has been replaced by new low sulphur content marine fuels and liquid natural gas (LNG).

In small ships and in the auxiliary engines of large ships, light fuel oils are used, including marine diesel oil (MDO) or marine gas oil (MGO), whose sulphur content is significantly lower than that of heavy fuel oil. Pleasure craft are also powered by diesel and petrol. In terms of their production, marine petrol and diesel are of the same origin as road transport fuels, and the shares of biofuel in them are thus similar.

The principal aviation fuel used in Finland is jet fuel, or kerosene. The total sales of jet fuel amounted to almost 907 million litres last year, which is approximately 2.8% more than in 2014. Almost 90% of the jet fuel is used by international traffic.

Means of transport

In July 2016, there were some 2.7 million cars on Finnish roads in total. On average, 135,000 new cars a year were sold in 2000 – 2008, whereas the number of new cars purchased since 2008 has dropped clearly, only amounting to some 110,000 cars a year. Compared to other European countries, Finnish motorists drive older and larger cars on average. The average age of Finnish cars has increased since 2008. In 2015, it was approximately 11.7 years. The average age of cars that are scrapped has also increased year by year, being over 20 years in 2015, while the EU average was some 15 years. The replacement rate of the Finnish car fleet has traditionally been slow, on average only once every 20 years.

The share of diesel cars in the Finnish car fleet currently is some 23%. The share of diesel-powered cars in new cars saw a dramatic increase in the aftermath of the car tax reform of 2007 (28.5% -> 49.6%). Since then, this share has declined somewhat and has in recent years been around 35%. The share of diesel vans in the entire fleet of vans is approximately 95%, and the share of diesel-powered vehicles in all heavy-duty vehicles is even higher; almost 100%.

The share of vehicles running on alternative fuels in all cars and vans remains modest at approximately 1%. In the heavy-duty vehicles sector, the situation is better: almost 30% of new trucks and buses are compatible with renewable diesel, even in concentrations of up to 100%.

Fuel distribution infrastructure

At the end of 2015, there was a total of almost 1,900 service stations and unmanned stations that distributed petrol and diesel oil in Finland. There also were over 670 distribution points for heavy-duty vehicles. The total number of fuel stations has changed little in recent years.

The existing fuel distribution infrastructure has mainly been suitable for the distribution of biofuels without modification. The shares of biofuels have increased and will increase further as a result of the statutory distribution obligation. The existing distribution infrastructure can also be used flexibly in the future for the distribution of new fuels with higher biofuel ratios. The changes required in the distribution system are mainly technical updates that can be carried out as part of the normal cycle of basic improvements.

2.2 Electricity

2.2.1 Electricity as a transport power source

In July 2016, there were about 3,500 rechargeable vehicles in Finland. Of these, 2,250 were electric vehicles (707 fully electric cars and 1,543 rechargeable hybrids). There was a total of 153 electric vans, 6 electric buses and 1 electric truck. The number of other rechargeable vehicles (electric mopeds, motorcycles, working machines etc.) was approximately 1,100 in total.

The share of electric vehicles in the trade of new vehicles was some 1% in January 2016. The share of electric cars in the entire car fleet was approximately 0.07%.

Table 1: Numbers of electric vehicles in Finland on 30 June 2016

	Number
Electric vehicles	2,250
Electric light goods vehicles	153
Electric heavy-duty vehicles	1
Electric buses	6
Electric motorcycles	31

The total number of recharging points accessible to the public in Finland was some 630 in September 2016. Of these, 50 were fast recharging points. It may be presumed that the number of domestic recharging points equals the number of electric cars. No official statistics exist on the domestic recharging points.

Table 2: Recharging points for electric vehicles in Finland on 1 September 2016

Recharging points accessible to the public (slow or basic recharge)	634
Fast recharging points accessible to the public	50
Private recharging points (slow or basic recharge)	~2,400?
Private fast recharging points	5 (Tesla)

Up-to-date information on public recharging points in Finland and their locations can be found at the following sites: www.sahkoinenliikenne.fi, www.plugshare.com and www.chargemap.com.

Why should we have more electric vehicles?

The advantages of electric vehicles include their high energy efficiency, emission-free operation and low noise levels. In ideal conditions, the energy consumption of electric vehicles is within the range of 0.15 – 0.25 kWh/km, depending on the size of the vehicle and the efficiency of charging. The efficiency of an electric vehicle with batteries is 50-70%, whereas this figure for a vehicle with an internal combustion engine is less than 25% at best[2]. Electric ve-

[2] Source: Future of electric vehicles in Finland. Electric vehicles in the transport and climate policy context. Publications of the Ministry of Transport and Communications 12/2011.

hicles thus have an important role in reducing not only transport emissions, but also transport energy consumption.

The total emissions of a fully electric car over the well-to-wheels energy supply chain in Finland based on the average emissions from electricity generation are as little as approx. 28 g/km (see Appendix 1; this figure is based on emissions from electricity generation in 2013). The specific CO2 emissions of electricity generation in Finland already are very low (97 g/kWh in 2015),[3] and guided by the emissions trade, they will be reduced further (30−45 g/kWh in 2050). When operating on wind and solar power, the electric vehicle is fully emissions free.

The sufficiency of energy supply will not emerge as an obstacle to the wider spread of electric vehicles in Finland. Using electricity as a transport power source will also not result in significant needs to increase the electricity generation capacity insofar as the recharging of electric vehicles mainly takes place during off-peak times of electricity consumption (at night). In the future, smart recharging will make it possible to control the recharging times of batteries, thus creating significant potential for demand flexibility in the electricity market.

A relatively extensive electricity supply network already exists in Finnish car parks. In Finland, electricity is used to preheat vehicle engines in the cold season, and the heating power points can with certain reservations or alterations be used for the slow recharging of electric vehicles, at least in the early phase of development.

Global vehicle manufacturers have considerably increased their investments in developing electric vehicles, which is manifested as a larger supply of both rechargeable hybrids and fully electric vehicles. The global market growth created by vehicles powered by electricity will also boost the growth and employment outlook of the Cleantech export industry in the electrotechnical sector that is vital for Finland.

2.2.2 Electric machinery and goods vehicles

Finnish ports and airports already use some electric machinery and goods vehicles, including forklifts, container cranes, aircraft pushback tractors etc. Electric machinery and equipment are highly suitable for use in ports and at airports as the transport distances are short and recharging is easy to arrange. The machinery differs from passenger vehicles in that they are in continuous use, which sets requirements on their usability and reliability. The use of electric hybrid mechanisms, in particular, significantly reduces the consumption of fossil energy by utilising energy recovery during work cycles.

There are goods vehicle manufacturers of global significance in Finland whose products include forest machines and material handling equipment, such as straddle carriers and forklifts. The supply of electric machinery is likely to expand by degrees in future as manufacturers develop their products and user experience of their reliability is accumulated.

2.2.3 Shore-side electricity supply in ports

Of the Finnish ports, Helsinki, Oulu and Kemi offer their customers the possibility of using shore-side electricity supply. Shore-side electricity can be used to meet the ship's power

[3] http://pxweb2.stat.fi/sahkoiset_julkaisut/energia2015/html/suom0011.htm

needs while in port, eliminating the need to run the vessel's main or auxiliary engines. Shore-side electricity in ports is an emission and noise free alternative. A large passenger ship providing hotel services needs significant amounts of electric power. Problems are also caused by differences in shore-side electricity interface cables and voltages in different ports. A cooperation agreement was signed between the ports of Helsinki, Turku, Stockholm and Tallinn in September 2016 under which these passenger ports undertake to promote the use of shore-side electricity on the Baltic Sea by offering 11kW and 50 Hz interfaces in their new shore connections, also encouraging other ports and shipping companies to follow this model and recommendations for shore-side electricity standards. Finishing touches are currently being put on the ISO and IEC standard "ISO/IEC/IEEE 80005-1 Cold ironing – Part 1: High Voltage Shore Connection (HVSC) Systems – General requirements".

For a list of ports offering shore-side electricity supply, see http://wpci.iaphworldports.org/onshore-power-supply/ops-installed/ports-using-ops.html.

2.2.4 Electricity supply for stationary airplanes at airports

When stationary, jet aircraft use 400 Hz, 115 V electricity supply. Turbo propeller planes, on the other hand, need 28 V DC. The 400 Hz electricity supply interfaces are either fixed installations or mobile supply equipment that can be connected to a 400 V, 50 Hz, 125 A socket. 28 VDC equipment mostly use 63 A attachment plug connections. In parking bays where fixed ground power equipment or sockets are not available, diesel-operated ground power units may be used.

Of the Finnish airports, Helsinki-Vantaa offers the most comprehensive range of ground power. In practice, the airport provides all permanent bays with a fixed 400 Hz ground power interface, as well as 400/50 Hz sockets to which mobile 28 VDC ground power equipment can be connected. The airport operator also offers mobile equipment.

Of the other Finnish airports, bays with a passenger boarding bridge in Oulu and Rovaniemi offer a fixed 400 Hz system. Other bays at these airports have underground installations or power supply centres with sockets to which the ground handling operator can connect a mobile electrical ground power unit. Other Finnish airports use similar arrangements. Installing fixed ground power systems at the very smallest airports would not be economically justified.

2.2.5 Rail transport and electricity

In rail transport, the use of electricity as the power source is very advanced. Almost 90% of rail transport in Finland today is managed by electric trains, whereas at the turn of the millennium, this share was some 70%.

Of the state-owned rail network, 55% is electric. In addition to the state network, there are private lines, including industrial and port rail yards, most of which are not electrified. The loading rails of freight handling yards of the state network are also not electrified. There remains good potential to increase the share of electric rail transport further by means of rail network electrification.

The overhead line network in Finland is owned by the Finnish Transport Agency, a government agency that operates in the administrative branch of the Ministry of Transport and Communications. The right to use the rail capacity includes the operator's right to connect to the overhead line network in order to obtain the power needed by electric traction equipment.

All operators conclude their own agreements with electricity suppliers on the supply of electricity for the rail network. The operator can thus select electricity produced from renewable sources.

2.2.6 Electric solutions for waterborne transport

Hybrid and electric solutions are likely to have a role in boating in future. The use of electric motors rather than internal combustion engines, or hybrid systems in larger boats, is seen as an environmentally friendly solution for the future, especially if the electricity is produced from renewable sources. Depending on its weight, size, speed and battery capacity, a boat powered by electricity can have a range of tens or even hundreds of kilometres.

Reliable electric motors using lithium batteries and their power generation systems for new sailing boats and the replacement engines of old boats have been developed in Finland. The new electric propulsion systems can be used as power sources for boats, and they can also recharge the boat's batteries while it is sailing. This is a useful feature, especially when sailing long distances and facing a need to maintain the electrical equipment with the propulsion batteries for a lengthy period. Long-life and energy efficient lithium batteries can also be used outside the boating season.

The first electric ferry is to be deployed in Finland in 2017. In the future, Finnish cable ferries could also be powered by electricity.

2.3 Natural gas and biogas

2.3.1 Natural gas and biogas as transport power sources

In July 2016, there were some 1,940 vehicles powered by compressed gas (CNG, CBG) in Finland, and the first liquid gas vehicles (LNG, LBG) had also arrived on the Finnish roads.

The share of gas fuelled vehicles in the sales of new vehicles was some 0.14% in January 2016, while their share in the entire vehicle fleet was approximately 0.005%.

Table 3: The number of gas fuelled vehicles in Finland on 30 June 2016

CNG/CBG fuelled cars	1627
CNG/CBG fuelled light goods vehicles	227
CNG/CBG fuelled heavy-duty vehicles	77
CNG/CBG buses	42
LNG/LBG fuelled light goods vehicles	3
LNG/LBG fuelled heavy-duty vehicles	2
LNG/LBG buses	3

The total number of refuelling stations for compressed gas was 24 at the beginning of 2016. Drivers of gas fuelled vehicles have the choice between natural gas or biogas at filling stations. The majority of gas refuelling stations in Finland are connected to a natural gas supply network to which biogas is currently fed from four locations (Kouvola, Espoo, Lahti, Virolahti). There also are four gas refuelling stations accessible to the public that are not connected to the gas supply network in Laukaa, Forssa, Joutsa and Uusikaarlepyy. These stations only provide biogas. The share of biogas in all gas used to refuel gas vehicles was some 40% in 2015.

In addition to public filling stations, some private or semi-public gas refuelling points are available, connected either to the natural gas supply network or to a biogas plant.

The first public refuelling stations of liquid gas for heavy-duty vehicles in Finland will open in Helsinki and Turku in autumn 2016. Several other LNG stations are being planned. LNG terminals built for shipping needs can also serve heavy-duty vehicles in the future.

Table 4: Numbers of refuelling stations for gas fuelled vehicles in Finland on 1 September 2016

CNG/CBG refuelling stations (public)	24
CNG/CBG refuelling stations (private)	15
LNG/LBG refuelling stations (public)	2 (building in progress)
LNG/LBG refuelling stations (private)	0

For up-to-date information on the gas refuelling stations accessible to the public and their locations, visit www.vihreakaista.fi/ajakaasulla .

Why should we have more gas fuelled vehicles?

The carbon dioxide emissions of natural gas are within the same range as those of diesel but lower than emissions from petrol. Replacing petrol by natural gas in transport will reduce CO2 emissions by some 25%. An even greater emissions reduction can be achieved by using biogas. Depending on the gas production plant, the logistics chain, the vehicle and the selected calculation method, the CO2 emissions from a biogas fuelled car over the well-to-wheels supply chain are 0-30 g/km (see Appendix 1).

Renewable gas that is suitable for transport use can be produced from a number of different sources. In addition to biogas produced from waste (biodegradable waste, waste waters, slurries, manures), renewable gas can also be produced from field and forest biomass, either by fermentation or thermal gasification. Using electrolysis and methanisation processes, renewable transport gas can also be produced from renewable electricity (so-called Power-to-Gas / P2G concept). The raw materials of renewable gas are usually domestic, and decen-

tralised production creates jobs locally. Renewable gas can also be made from raw materials that are not equally well suited for the manufacture of liquid biofuels (including waste water).

Depending on the intended use, a vehicle can be fuelled with either compressed or liquid gas. In cars, distribution vehicles, waste disposal trucks and city buses, the gas is typically stored in a compressed form (CNG or CBG), while in heavier long-distance vehicles, a liquid form is used (LNG or LBG). When the gas is liquefied, its energy density increases, making it possible to cram about three times as much energy in the same volume compared to compressed gas, thus giving the vehicle a longer operating range.

The use of LNG in heavy road transport is rapidly progressing in the EU area. Commercial vehicles are available from a number of different manufacturers (such as Volvo, Scania, Iveco), and technical development related to these vehicles has advanced considerably in recent years (incl. energy efficiency, engine power ratings etc.). The purchase prices of heavy-duty vehicles are expected to go down as production volumes increase and LNG fuelled vehicles become more common.

Cars and smaller goods vehicles have “bi-fuel” systems; in other words, they can be refuelled with petrol as well as with gas if needed. Heavy-duty vehicles representing ”dual-fuel” technology have also come onto the market. The main fuel of these vehicles is natural gas or biogas, while diesel oil is used as the ignition fuel. Depending on the technical solution, the vehicle can run exclusively on diesel oil if necessary. In the future, the alternative fuel in a gas fuelled vehicle may also be renewable diesel, ethanol etc. Electric hybrid technologies may also be used in power train solutions.

2.3.2 LNG and LBG in waterborne transport

The first LNG fuelled ship in Finland, Viking Grace, started operating on Baltic Sea passenger services in 2013. Turva, the Border Guard’s LNG-powered ship, has been deployed in various patrol and SARS missions in the Baltic Sea since 2014. Around ten other LNG ships are either in service or on order in Finland: icebreaker Polaris, Tallink Megastar, two ships for ESL-shipping, and six ships for Containership.

A network of LNG terminals with a relatively wide coverage will emerge on the Finnish coast in the Bay of Bothnia and Gulf of Finland over the next few years. The first terminals are being built in Pori (completed in autumn 2016) and Tornio (due for completion in 2018), and the following ones probably in Hamina and potentially also in Rauma. While the new terminals will cater to different regional needs, by means of tank trucks, rail transport and bunkering vessels they may serve industries, energy plants and ships within a 300 – 500-kilometre radius. The technical solutions at the terminals in Pori and Tornio will also allow direct bunkering.

The aforementioned four projects have received a conditional energy grant decision from the government. Grants have also been applied for by the builders of three other terminals, but these plans have not yet been finalised.

Table 5: LNG/LBG refuelling points in Finland on 1 September 2016

LNG/LBG refuelling points in ports	1 (+1 in progress)
LNG/LBG refuelling points in inland ports	-

Why should natural gas or biogas be used in shipping?

New regulations on fuel sulphur content in Emission Control Areas, or the Baltic Sea, the North Sea and the English Channel, the North American control area and the US Caribbean control area (the so-called SECA areas) entered into force at the beginning of 2015. Fuel SOx content in these areas may not exceed 0.1%. At the global level, the maximum limit for sulphur content will be 0.5% from 2020 or 2025 depending on the results of a review of fuel availability, which is to take place in 2018. Outside the SECA areas in the EU, the limit specified in the amended Directive on the sulphur content of marine fuels (2012/33/EU), or 0.5%, will enter into force in 2020. By using LNG, a ship can meet all current sulphur content regulations and those due to enter into force in the near future.

The International Maritime Organisation IMO has also reached an agreement on restricting nitrogen oxide emissions in certain particularly vulnerable zones (so-called NECA areas). The North American NECA area (US and Canadian coastline) entered into force on 1 January 2016. The Baltic and North Sea states submitted an application for designating the Baltic Sea and the North Sea as NECAs to the IMO in summer 2016. The IMO's Marine Environment Protection Committee will start processing the application in October 2016. In NOX Emission Control Areas (NECAs), ships shall reduce their nitrogen emissions by 80%, which can be managed either by installing a catalytic converter (cf. cars) or using liquid natural gas (LNG) as the fuel. The NECA regulations will only apply to new ships built after the regulations' entry into force. The Baltic states have proposed that the Baltic NECA area enter into force on 1 January 2021.

In 2012, the IMO also agreed upon rules that concern the energy efficiency of new vessels (EEDI). The EEDI rules will, over the long term, reduce the engine power of ships with the gradual market entry of newbuildings. These requirements will enter into force stepwise in 2013-2025. Both new and old ships must also have a Ship Energy Efficiency Management Plan (SEEMP). The energy efficiency of LNG fuelled ships is mainly in the same range as that of ships powered by diesel engines, and at best even higher.

In April 2015, the EU adopted a Regulation on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport (the MRV Regulation, 2015/757EU). IMO has also agreed upon a system for gathering information on CO2 emissions, the final adoption of which is to take place in October 2016. The EU's MRV system is also to be incorporated in the IMO's system. This information on CO2 emissions can be used in the future, should the IMO reach an agreement on restricting CO2 emissions. By using LNG as its fuel, a ship can reduce its CO2 emissions by some 25% compared to heavy fuel oil. Over the longer term, the deployment of LNG as a marine fuel and the building of LNG infrastructure will also create good preconditions for the deployment of liquid biomethane (LBG) and even greater reductions in emissions from shipping.

As LNG is a liquid, its volume is six hundred times smaller than the volume of the gas in its natural state. For this reason, it can be stored and transported across long distances over land or across the sea. Building a specific LNG terminal in each port is thus not necessary, and the terminal does not need to be located in the immediate vicinity of the port that is its main user. When operating in the Baltic Sea, for example, LNG fuelled ships can be refuelled from LNG tank trucks, LNG bunkering vessels, fixed LNG bunkering tanks, or even by replacing LNG transport containers.

2.4 Hydrogen

In late 2015, there was one hydrogen-powered car and two hydrogen refuelling points in Finland. One of these points was located in Vuosaari port in Helsinki and the other in Voikoski, Southern Savo. Both of these are compliant with the general hydrogen refuelling point standards with their fuelling pressures of 350 bar and 700 bar.

International maps of refuelling points are maintained by Ludvig-Bölkow-Systemtechnik GmbH. They can be accessed at www.h2stations.org. In Finland, information on refuelling points is provided on the website of Oy Woikoski Ab (www.woikoski.fi).

Why should hydrogen be used in transport?

In addition to electricity, hydrogen is the only energy carrier that enables completely CO2-free transport, provided that no fossil energy has been used to produce the hydrogen. The CO2 emissions of a fuel cell vehicle over the well-to-wheels supply chain are as low as 5-8 g/km at best (see Appendix 1). As a by-product of the Finnish industries, a quantity of hydrogen is currently produced that would be enough to meet the energy needs of some 10,000 cars. Hydrogen could also be produced from biogas or natural gas by steam reforming, from water by electrolysis, or in the future, as so-called on-site production from renewable sources. Hydrogen can be produced inexpensively with surplus energy from renewable sources, including solar and wind power, by means of electrolysis (power-to-gas), where hydrogen serves as an energy store and, in the most advantageous case, a transport fuel.

In road transport, hydrogen can be exploited in so-called fuel cell electric vehicles (FCEVs). FCEVs have both a fuel cell and an electric motor. The fuel cell converts hydrogen and oxygen from the air into electricity and water in a pollution-free process. Storing energy in hydrogen is, in principle, less complicated than storing it in batteries. The operating radius of hydrogen cars is within the same range as that of petrol and diesel fuelled cars, or approximately 500-600 km. Refuelling takes little more time than filling up a petrol or diesel car. Hybrids between a fuel cell and electric car, where both hydrogen and electricity can be used as a power source, are becoming more common. Cars powered by this technology are called ”range extenders”, as they extend the range of an electric car by using hydrogen.

Hydrogen is considered a promising power source for cars, buses and distribution vehicles in particular, but so far, its development is limited by the price of purchasing these vehicles and the scant distribution network. As volumes grow, the prices will decrease considerably, approaching an affordable level. The markets for electric fuel cell and electric/hydrogen hybrid buses are currently being opened in Europe through European Commission’s funding support and a joint European fuel cell bus procurement coalition (the FCH JU – Fuel Cell and Hydrogen Joint Undertaking instrument). Almost one hundred fuel cell/hybrid buses are already in operation, and the goal for 2020 is 1,000 buses. Finnish cities are also beginning to wake up and actively take part in the coalition.

2.5 Liquid biofuels

Finland has extremely ambitious targets for promoting the use of advanced biofuels in transport. Under the Finnish Act on the Promotion of the Use of Biofuels for Transport (446/2007), the calculated share of biofuels in the total energy content of the petrol, diesel oil and biofuels that a distributor of transport fuels supplies for consumption must be at minimum 20% by 2020. The minimum share was 6% in 2011 – 2014 and 8% in 2015. This share

should be a minimum of 10% in 2016, 12% in 2017 and 15% in 2018. The objective of the act to reach a calculated share of 20%, was already achieved in 2014.

Energy produced from wastes, residues and cellulose and lignocellulose from non-food crops gets preferential treatment in calculations related to fulfilling the biofuel distribution obligation in Finland (in other words, biofuels that do not compete with food production). These can be counted twice towards the obligation (so-called double credit scheme). A strong interest in promoting advanced biofuels qualifying for double credit has emerged in Finland, as the use of conventional biofuels is associated with too many unresolved challenges (including the use of conventional biofuels is associated impacts on food price, indirect land use impact etc.) The majority of all biofuels used in Finland already qualified for the double credit in 2014. Taking the double credit scheme into account, the real share of biofuels in replacing fossil fuels was approximately 12.5% in 2014 and 2015.

Biofuels are used in Finland not only blended with fossil fuels without a specific distribution infrastructure or dedicated vehicle fleet but also as higher-concentration blends that require separate distribution. In fuel blends, the so-called “conventional,” or blend wall biofuels, have blending limits determined by technical reasons that are specified in fuel quality standards (EN 228 for petrol and EN 590 for diesel). Under the Fuel Quality Decree and according to the standards, the maximum ethanol blending ratio is currently 10% by volume for petrol and 7% by volume for diesel. The so-called drop-in biofuels, on the other hand, may be blended with fossil petrol or diesel even in high concentrations without blending limits.

Finland introduced E10 grade petrol as the first EU Member State in January 2011, on which date this became the dominant grade in the entire distribution system. The share of E10 grade petrol is currently some 65% of petrol sales. 98 E5 grade petrol is distributed as a so-called protection grade, or petrol that is compatible with all petrol engines.

Biofuels produced in Finland and their use

Many different biofuels are manufactured and used in Finland. These include waste-based ethanol that qualifies for double credit, ethanol diesel and hydrogen-treated renewable diesel. The volumes of conventional biodiesel (FAME) manufactured or used in Finland are almost non-existent.

Ethanol and ethanol diesel

Domestic ethanol that qualifies for double credit is manufactured in Finland with biowaste from the food industry, shops and households. Finnish ethanol can either be used as a biocomponent of ordinary petrol grades within the aforementioned blending ratios or as E85 fuel, which requires separate distribution and vehicle fleet. The Finnish E85 grade fuel contains 80–85% of ethanol. It can only be used in a so-called flexfuel vehicle (FFV) specifically designed and manufactured to run on ethanol. Considering the renewable raw materials of the fuel, the emissions of flexfuel vehicles can be up to 80% smaller than those of similar petrol fuelled vehicles.

There currently are approximately 6,000 flexfuel vehicles in Finland. The sales of these vehicles have been declining in recent years. While in the peak year of 2010, over 1,000 flexfuel vehicles cars were sold, in 2015 this figure was only around 100. The reasons for this probably include the number of available vehicle makes and models. The number of flexfuel vehicle makes and models manufactured in Europe has declined in recent years. The CO2 limit values applicable to EU vehicle manufacturers fail to take fuel renewability into account and thus do not treat flexfuel cars preferentially. Partly for this reason and partly because of the

high age and slow replacement rate of the Finnish vehicle fleet, the conversion of old cars into flexfuel cars has been facilitated in Finland (so-called ethanol conversions). However, accurate data is not available on the number of converted flexfuel vehicles.

There currently are some 100 fuel stations in Finland that offer E85 fuel, and the station network covers the entire country. E85 is sold at St1, Shell and ABC service stations.

A waste-based ethanol diesel for heavy-duty vehicles has also been developed in Finland. ED95 ethanol diesel is suitable for certain Scania heavy-duty vehicles. ED95 ethanol diesel has been tested in the Helsinki Metropolitan Area in Scania's ethanol diesel engines in distribution and waste disposal use with encouraging results. The energy consumption of ethanol diesel vehicles is similar to that of diesel vehicles, and their small particle emissions are approx. 80% lower compared to the average for Euro V trucks. The use of waste-based ethanol diesel reduces fossil CO2 emissions by up to 90%.

So far, ethanol diesel has not been publicly available in Finland. The two refuelling points in Finland are found in the depot areas of private companies.

Renewable diesel (HVO)

Large quantities of renewable diesel, which qualifies for double credit, are manufactured in Finland. Neste's renewable diesel is made from waste fats, residues and vegetable oils, whereas UPM's renewable diesel is made from pine oil that is a residue from pulp production. Under EU directives, hydrotreated vegetable oil (HVO) is not biodiesel but a synthetic fuel, or paraffinic diesel. In the interest of clarity and to keep it separate from biodiesel, this fuel is called "Renewable Diesel" in Europe and Northern America.

Research on new raw materials for HVO is being carried out continuously. The selection of raw materials is already quite extensive and includes vegetable oils, animal fat residues and waste flows from vegetable oil production. In particular, wood-based raw materials, non-food vegetable oils and algae and microbe oils offer interesting possibilities as new raw materials of the future.

In principle, renewable diesel is suitable for all diesel engines. The Fuel Quality Directive and the diesel standard do not restrict the HVO content of diesel, as long as the other numeric quality requirements are met. In practice, HVO can be used in blends with concentrations of up to 30–50% by volume, depending on the properties of the fossil diesel. A precondition for exclusive HVO use is that the vehicle has been type approved as HVO compatible. The use of renewable diesel brings significant climate benefits; it reduces the vehicle's greenhouse gas emissions by up to 90% compared to conventional fossil diesel. At the same time, it considerably reduces other harmful exhaust gas emissions, including nitrogen oxides and small particles.

It is likely that the use of unblended renewable diesel will become more common in the near future, as a European standard (EN 15940) was approved in summer 2016 that specifies the quality requirements and testing methods of synthetically manufactured or hydrogen-treated paraffinic diesel fuel. This standard will make it easier for vehicle manufacturers to give vehicles their approval and guarantee for the use of unblended paraffinic diesel fuel.

A significant share of Finnish trucks and buses are already compatible with 100% renewable diesel. Currently (in September 2016) the following makes and models have been approved for 100% HVO use: DAFs from Euro III up, MANs from Euro V up, many Euro VI Mercedes-Benzs, all Renaults with a Volvo engine, Scanias from Euro V up as well as all Volvos. The

number of these vehicles in Finland at the moment already is nearly 30,000 (some 27% of all buses and trucks). Many machine manufacturers and the first European car manufacturers (Peugeot and Citroën) have also recently given their approval for 100% HVO use.

Today, renewable diesel is blended with fossil diesel and distributed together with it. Neste, a Finnish fuel sector operator is, however, planning to bring 100% renewable diesel into the market at selected fuel stations in Finland at the turn of the year.

Why should we use biofuels in road transport?

In global terms, Finland is a pioneering country in the development and manufacture of high-quality biofuels. Finland has excellent starting points for the manufacture of biofuels due to our technological know-how and versatile raw materials, as well as our ability to apply competence in traditional sectors in new ways.

Advanced biofuels are a ready-made and cost-effective solution to reduce our dependence on oil and emissions from transport. By using biofuels made from domestic raw materials, we can reduce our dependence on crude oil and the cost of buying crude oil in our trade balance of energy. Other advantages of liquid biofuels include the fact that their use does not require changes in our current distribution infrastructure (drop-in fuels), or the changes are minor (high-blend ethanol etc.)

The significance of advanced biofuels is further underlined by the possibility of also using them in those modes of transport where the use of such power sources as electricity is not currently considered possible. Biofuels are particularly important for trucks and long-distance buses in the medium term, and later perhaps also for aviation. Additionally, advanced biofuels are well suited for emergency stockpiling as part of preparedness for crises and emergencies of different types.

2.5.1 Renewable aviation fuels

Biofuels for aviation are not currently available at Finnish airports. However, good opportunities exist in Finland for introducing renewable aviation fuel, for example at Helsinki-Vantaa airport. The Finnish Neste Oyj is part of an international consortium (Initiative Towards Sustainable Kerosene for Aviation; ITAKA) that is striving to promote the use of and also to produce renewable aviation fuel. The renewable aviation fuel produced by Neste is a so-called drop-in fuel that does not require alterations to the aircraft or its engines. The fuel quality meets the requirements of the international ASTM D7566 standard, and its suitability for aviation use has already been tested on over 1,000 commercial flights.

Why should we use biofuels in aviation?

At its assembly in 2013, the International Civil Aviation Organisation ICAO agreed upon global targets and actions aiming to reduce aviation emissions by 2050. The targets comprise an annual improvement of 2% in fuel efficiency, and from 2020 on, carbon neutral growth in international air traffic. The longer-term goals also include halving the emissions of international air traffic from their 2005 levels by 2050, despite a strong increase in air traffic. Three main means will be used in attempts to reach the targets. These include the introduction of new technologies that improve aircraft fuel efficiency, development of operative activities, and deployment of biofuels. Other measures include introducing so-called Global Market Based Measures (GMBM), the purpose of which is to safeguard the carbon neutral growth of air traffic until significant reductions in the emissions become possible, in particular through wider use of biofuels.

In the future, the emissions trade system for air traffic may also support the introduction of aviation biofuels. Air traffic was included in the EU's emissions trading system at the beginning of 2012. The EU system applies to all flights departing from and arriving at EEA airports, unless they have been excluded from the scope of emissions trade on specific grounds. In 2013—2016, however, the emissions trade only applies to internal flights in the EEA area. The Commission has announced that it will make a proposal concerning the continuation, scope and possible coordination with the global system of the EU mechanism after the ICAO assembly (October 2016). It is also possible that the EU emissions trading system will be dropped if the ICAO system enters into force.

2.5.2 Renewable fuels for rail transport

Today's diesel engines used in rail transport are powered by light fuel oil. This oil can be blended with a biofuel, similarly to the diesel fuel for road transport.

Under the Railway Act (304/2011), a railway undertaking or a company or other association providing railway services must offer services that are associated with the possibility of using the rail network to railway operators. One of the services to be provided is refuelling equipment. In practice, all operators who use the refuelling equipment refuel their engines with the same liquid fuel found in the system, which currently is light fuel oil.

The light fuel oil used by today's diesel engines can be replaced by a second-generation renewable liquid biofuel in concentrations of up to 100%.

3. Finland’s national targets for alternative transport power sources

3.1 Power source targets

Finland’s national target for road transport in 2050 is near-zero emissions. The power source for cars and vans would either be electricity and hydrogen produced with renewable (or emission-free) raw materials, or different biofuels (liquid biofuels and biogas). Their share in the total energy consumption of road transport would approach 100%. In 2030, the share of alternative fuels in road transport energy consumption would be 40% as minimum. In 2020, this share will be 20% (including double credits for biofuels).

The target for shipping is a 40% reduction in greenhouse gas emissions by 2050 (compared to 1990) as a result of LNG and biofuel use and other measures.

In aviation, the target is to bring the share of renewable or other emission-reducing solutions up to 40% as minimum by 2050.

3.2 Infrastructure targets

Finland's national target is that by 2020/2030, distribution networks meeting the recommendations of the AFI Directive for transport electricity, gas and hydrogen will have been built in Finland. The distribution infrastructure for biofuels requiring separate distribution would also be expanded. The new refuelling stations and recharging points would mainly be built on market terms.

For electricity, Finland’s national target is a minimum of 2,000 recharging points accessible to the public by 2020. Of these, 200 would be fast recharging points. The target for the recharging point network is covering all municipalities and cities, transport hubs, TEN-T Core and Comprehensive Network ports, railway stations and airports as well as the road network down to the secondary roads. The network of recharging points accessible to the public refers to not only the points located in public places but all stations that are available for vehicles in general. For more details on the recharging infrastructure, see Appendix 2.

Considering the targets for vehicles, the goal for 2030 is a minimum of 25,000 public recharging points.

The number of hydrogen refuelling stations in 2030 would total around 20, ensuring that the distance between stations would be approximately 300 km, and that each station would serve its area within a radius of 150 km. There would be a station in each one of the bigger cities. For more details on the distribution infrastructure, see Appendix 2.

For natural gas and biogas (CNG, CBG), the objective is that refuelling stations would be found in the largest urban sub-regions and on all main thoroughfares, some 50 stations in total in 2020. For more details on the distribution infrastructure, see Appendix 2.

For liquid natural gas and biogas, the target is that Finland would have a network of LNG fuelling stations with national coverage for the needs of heavy-duty vehicles in 2030. In all

TEN-T Core Network ports (Hamina-Kotka, Helsinki, Naantali and Turku), refuelling points for LNG or LBG would be provided by 2025 at the latest. In addition, bunkering facilities will be available at the LNG terminals of Pori and Tornio as the terminals are completed. The target for inland waterways is that the potential needs for LNG/LBG of vessels navigating in the Saimaa deep-water channel will be covered by a mobile bunkering point or similar located in Mustola, Lappeenranta, no later than in 2030. For more details on the distribution infrastructure, see Appendix 2.

In the aviation sector, the objective is to turn Helsinki-Vantaa Airport into a Green Hub airport with a special focus on alternative fuel use, where renewable jet fuel would be available for all airlines by 2020. At a Green Hub airport, the use of alternative power sources would also be strongly promoted in the airport's terminal traffic.

In the distribution of liquid biofuels, the target is that in 2030, all refuelling stations would offer a high-blend biofuel as part of their product range (including 100% HVO, RE85 or ED95). The main grade would be e.g. E20/25 petrol. The existing distribution infrastructure is be flexible enough to allow development once its maintenance and investments in basic improvements are managed appropriately. The 98 E5 petrol, which is today distributed as a so-called protection grade, will be dropped relatively soon, and this will help to free up storage and distribution capacity, for example for high-blend transport fuels.

We may estimate that the HVO100 product would be distributed at around one half of all refuelling stations, similarly to E85. The number of ED95 ethanol diesel stations would be around 250.

3.3 Targets for vehicles

Finland's national target is that the country's entire car fleet would consist of near-zero emission vehicles in 2050. As the replacement rate of the Finnish vehicle fleet has previously been very slow, or only about once in 15—20 years, the target is that all new cars and vans would be compatible with alternative fuels[4] as early as in 2030. The target for 2025 is that 50% of new cars and vans could be powered by an alternative fuel, and the goal for 2020 is a 20% share of these vehicles.

[4] The alternative fuels referred to here are those defined in the AFI directive: electricity, hydrogen, natural gas and biogas as well as liquid biofuels in high concentrations.

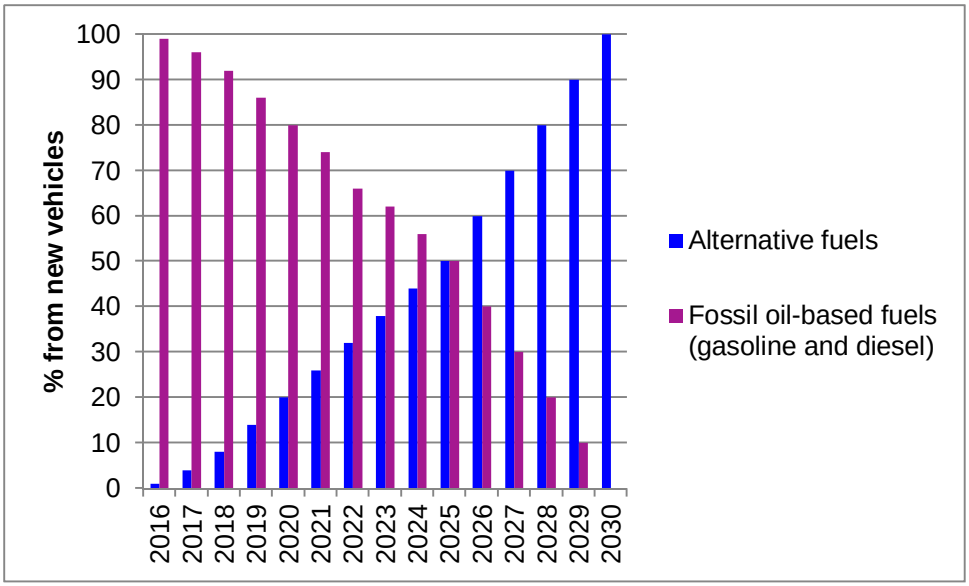

Figure 2: The proportion of new cars compatible with alternative fuels leading up to 2030

The target for heavy-duty vehicles is that all new trucks and buses would also be compatible with some alternative fuel by 2030. The target for 2025 is that 60% of new trucks and buses would be compatible with an alternative fuel, and the goal for 2020 is a 40 % share.

These figures include trucks and buses that also use biofuels in high concentrations. These vehicles have been type approved to run on concentrations of up to 100% of biofuel. Some 30% of the trucks and buses in Finland are already vehicles of this type.

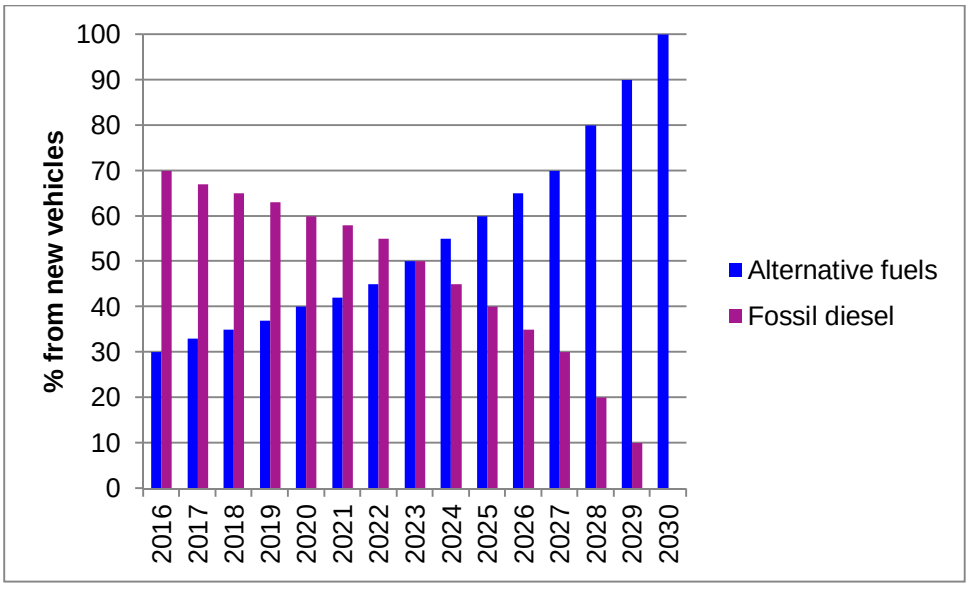

Figure 3: The proportion of new trucks and buses compatible with alternative fuels leading up to 2030

Table 6: Proportion of new vehicles sold in 2020-2030 compatible with alternative fuels; target

Vehicles compatible with alternative fuels*	Proportion of new vehicles sold, %		
	2020	2025	2030
Cars	**20**	**50**	**100**
Vans	**20**	**50**	**100**
Trucks**	**40**	**60**	**100**
Buses**	**40**	**60**	**100**

***Electric and hydrogen and gas powered vehicles and vehicles that can run on liquid biofuels also in high concentrations (cf. for example today's petrol cars that under current standards cannot use biofuels in concentrations exceeding 10% by volume) (renewable diesel can be used up to a concentration of 100% in cars type approved to run on such fuels) (in autumn 2016, these fuels were not yet available in Finland)**

****The figures include trucks and buses that have been type approved to run on high concentrations of biofuels of up to 100%. Some 30% of trucks and buses today already are such vehicles.**

Table 7: Number of vehicles in 2020-2030; target (NB! The figures in this table are targets rather than predictions! Major uncertainties are associated with both. There are considerable differences between the predictions for different technologies depending on their source.) (Basic prediction of VTT Technical Research Finland at http://lipasto.vtt.fi/aliisa/aliisa_tulokset.htm)

Vehicles compatible with alternative fuels	Number of vehicles		
	2020	2025	2030
Cars			
Alternative fuels, total	60,000	300,000	750,000
- of which electric cars *as minimum*	20,000 (cf. VTT's prediction: 18,402)	100,000 (cf. VTT's prediction: 58,439)	250,000 (cf. VTT's prediction: 120,017)
- of which gas fuelled cars *as minimum*	5,000 (cf. VTT's prediction: 3,621)	15,000 (cf. VTT's prediction: 7,373)	50,000 (cf. VTT's prediction: 13,105)
Vans			
Alternative fuels, total	6,000	30,000	75,000
- of which electric vans *as minimum*	2,000 (cf. 811)	6,000 (cf. 2,922)	13,000 (cf. 6,496)
- of which gas fuelled vans *as minimum*	800 (cf. 377)	2,000 (cf. 865)	3,000 (cf. 1,551)
Trucks			
Alternative fuels, total	28,000	36,000	48,000
Buses			
Alternative fuels, total	4,500	5,800	7,900

3.4 Other targets

The target is that the largest Finnish ports would offer facilities for using shore-side electricity supply at the latest in 2030.

Terminal traffic in ports and at airports should be approaching zero emissions by 2050. The target is that all new machinery and equipment would be compatible with an alternative fuel from 2030 on.

In rail transport, the target is that by 2050, the transport output would almost fully rely on electricity.

Boating would be nearly emission free in 2050. All new boats would be compatible with alternative fuels [biofuels also in high concentrations, gas, hydrogen and electricity] in 2030.

4. Measures needed to reach the national targets

4.1 Act on the Promotion of the Use of Biofuels for Transport

Finland's national targets regarding the shares of transport biofuels by 2020 are specified in the Act on the Promotion of the Use of Biofuels for Transport. Under this act, the share of biofuels in the total energy content of the petrol, diesel and biofuels that a distributor of transport fuels supplies for consumption must be a minimum of 20% by 2020. This share had to be a minimum of 6% in 2011—2014 and 8% in 2015. This share should be a minimum of 10% in 2016, 12% in 2017 and 15% in 2018. The target for 2020 clearly exceeds the 10% minimum target set for EU Member States in the RES Directive.

The Government Programme of Prime Minister Sipilä sets Finland's national target for increasing the proportion of transport biofuels to 40% by 2030. This target is based on the assumption that the practice of calculating certain biofuels which do not compete with food production twice could be continued (the so-called double credit rule).

Measure 1: Continuing the implementation of the Act on the Promotion of the Use of Biofuels for Transport beyond 2020. Setting the target for biofuels at 30% by 2030 (without applying the double credit rule). Investigating the potential advantages and disadvantages of also bringing biogas within the scope of the Act.

4.2 Fuel tax

Guided by environmental considerations, the Finnish system of collecting energy tax on transport fuels was reformed in 2011. At that time, an excise tax based on fuel volume was replaced by an energy content tax based on the energy content, or calorific value, of the fuel, and a carbon dioxide tax based on the specific CO2 emissions produced when the fuel is burned. The carbon dioxide tax has three categories on the basis of the life cycle reductions in CO2 emissions that can be achieved by using biofuels and bioliquids as compared to fossil fuels. Full carbon dioxide tax related to their energy content is payable on fossil fuels and non-sustainable biofuels. If the biofuel meets sustainability requirements, the CO2 tax is halved, and if the fuel also qualifies for the so-called double credit (produced from wastes and residues, non-food cellulose or lignocellulose), no carbon dioxide tax is payable.

All liquid transport fuels (both fossil and renewable fuels) are thus taxed fairly on the basis of their energy content and emissions. The taxation of other transport fuels/power sources differs from this model, however. A lower tax rate applicable to heating fuels is payable on natural gas, biogas is exempted from tax, and electricity tax is payable on electricity at a lower rate than the rate paid on transport fuels. However, the lower tax rate of other power sources is balanced out by the power source tax included in the annual vehicle tax.

Measure 2: Continuing the development of the current fuel taxation based on environmental considerations to treat all transport fuel alternatives objectively and as fairly as possible.

4.3 Car and vehicle taxes

Car tax is payable when a car is put onto the road or registered in Finland for the first time. Car tax is also charged when significant changes are made to the structure, purpose or ownership of the vehicle. The taxable value for car tax purposes equals the general retail value, or consumer price, of the vehicle in the Finnish market.

The tax rate applicable to cars and vans is staggered based on the carbon dioxide emissions that correspond to the vehicle's fuel consumption. The tax rate is determined by the CO2 emissions reported by the manufacturer in connection with the vehicle's type approval that correspond to its combined specific fuel consumption in city and open road driving. The lowest tax rate (4.4%) applies when the vehicle's CO2 emissions are 0 grams per kilometre. The highest tax rate (50%) applies when the emissions are 360 g or over. The lowest tax rate will be reduced to 2.7% in 2019.

If the vehicle is compatible with two different fuels (for example, both gas and petrol), two different CO2 values are specified for it, and the tax rate is determined by the lower figure. The lowest tax rate laid down in the legislation is applied to electric cars.

Vehicle tax consists of a basic tax and a power source tax. Basic tax is payable on a car, van, camper van and certain special vehicles entered in the Vehicle Register. The basic tax is determined on the basis of the CO2 emissions reported by the vehicle manufacturer in connection with the type approval for cars put on the road after 2001-2002 or vans put on the road after 2008. The basic tax of other vehicles is determined by the vehicle's total weight.

The lowest amount of basic tax currently is EUR 106.21 a year. The lowest tax rate applies when the vehicle's CO2 emissions are 0 grams per kilometre. The highest tax amount is EUR 654.44 a year, and it applies when the vehicle's CO2 emissions are 400 grams per kilometre or more. The basic tax of an electric vehicle is the lowest rate in the excise duty table.

Power source tax is payable on cars, vans, trucks and special vehicles entered in the Vehicle Register that run fully or partly on fuels other than motor petrol. In other words, the power source tax also applies to electric and gas powered vehicles. No power source tax is payable on FFVs that run on E85. The purpose of the power source tax is to level the prices of transport fuels subject to a lower tax rate with petrol prices, meaning that the tax burden with an average driving performance is in line with the environmental model of energy taxation.

From the beginning of 2012, the power source tax has been staggered based on the vehicle's power source. The daily power source tax is 0.5-5.5 cent for each one hundred grams of total weight or part thereof, depending on the power source.

Measure 3: Reducing the car tax in 2016 – 2019 as agreed in the Government Programme. Improving the steering impact of emissions-based taxation further.

4.4 Support for purchasing new technologies

Different types of support for market entry of new transport technologies have been introduced in many EU countries. There has been a clear need for these forms of support, as the average price of vehicles with emission levels of less than 80 g/km remains considerably higher than average vehicle prices. Consumers' enthusiasm for purchasing vehicles that represent new technologies is curbed by lack of information on the maintenance and running

costs of the vehicle and uncertainty as to whether or not the vehicle will maintain its trade-in value. The low number of vehicles slows down the creation of the distribution and recharging infrastructure they need. There also is little experience of the trade-in market for these vehicles.

In order for the recharging point/refuelling station network to be built on market terms, a functional market needs to be created for the new power sources. To accelerate the wider spread of the more expensive low-emission vehicles that run on alternative fuels, financial support for low-emission technologies will be necessary until the market share of the vehicles is adequate. Support from society and financial incentives that steer demand will reduce the financial risks of alternative technologies for consumers in the market entry phase. They will also significantly promote the market-driven creation of distribution infrastructure.

Measure 4: Carrying out an experiment that targets vehicle purchases in order to create a market for new technologies.

4.5 The Transport Code

The Finnish Ministry of Transport and Communications is working on a project aiming for a comprehensive transport market reform. The revolution of the transport market will be promoted by reforming and relaxing the current legislation on the transport market. These provisions will be collected in a coherent Transport Code, one objective of which is to reduce the need for owning private cars and replace private car use by car sharing and pooling, hired cars and other vehicles in entrepreneurial use. The share of vehicles in entrepreneurial use would accelerate the replacement of the vehicle fleet and the spread of new technologies in the fleet.

Measure 5: Implementing a legislative change related to the transport market (the Transport Code).

4.6 Changing the tax treatment of company cars

Financial steering related to company cars is a vital factor for the properties and replacement of the vehicle fleet in Finland. As the purchasing prices and running costs of cars are relatively high in this country, company cars are a popular way of purchasing and owning a car. There are some 80,000 company cars in Finland, about two thirds of which are leased cars. Roughly one third of the cars registered for the first time are owned by companies or otherwise used as company cars.

Company cars offer a natural way of promoting the wider spread of the new, more expensive vehicle technologies, as a company car driver does not need to worry about the car's trade-in value and the trade-in market when making decisions about purchasing a car in the same way as an individual household. Company cars typically are more expensive than the average new car, and their standard of equipment is better. The average service life of company cars is some three years, after which they return to the consumer market as second-hand cars.

The determination of company cars' taxable value clearly directs the selection of these cars, and changing the tax treatment of company cars would be a highly efficient method of promoting the use of alternative power sources in Finland. A company car is regarded as a tax-

able benefit when an employee or their family also use the car for private journeys. The taxable value of the company car benefit is calculated on the basis of the purchase price of a new car (capital benefit) and its running costs. The purchase price of a new car is determined based on the list price published by the car's importer or wholesaler. The running costs, on the other hand, are a calculated average amount. It is not associated with the actual accurate running costs of different car models or the distances driven. The calculated value of the company car benefit is added to the employee's gross pay, and tax is paid at the employee's normal residual tax rate.

A taxation model where the vehicle's CO2 emissions influence the taxable value of company cars has been introduced in the Netherlands. While the taxable value of a company car is 25% of the car's general retail price, a lower taxable value is applied to low-emission cars. Until 2015, the taxable value of vehicles with emissions of less than 50 g/km was zero euros in the Netherlands. This taxable value was increased to 4% in 2015.

In Finland, the CO2 emissions affect the rates of car and vehicle taxation among other things. These factors also influence the selection of company cars.

Measure 6: Investigating the possibilities of reforming the current system of taxing company cars so that companies would be encouraged to increasingly choose cars with new technologies and/or running on alternative power sources for company cars.

4.7 Promoting the deployment of new technologies by means of public procurement

A Government Resolution on the promotion of so-called cleantech procurement in the public sector was adopted in Finland in 2013. The objectives of the resolution include that company cars procured by central government organisations for ordinary use, shared vehicles for official use and rental vehicles shall, on average, produce no more than 100 g/km in carbon dioxide emissions or the percentage of new motive power solutions used (e.g. electricity, ethanol, natural gas or hybrid) shall account for at least 30% of all vehicles in use. This resolution is binding for government procurement units and a recommendation for municipalities.

The Act on Consideration for the Energy and Environmental Impact of Vehicles in Public Procurement (1509/2011) also obliges public procurement units to take into consideration the energy efficiency, carbon dioxide emissions and regulated exhaust emissions of motorised road transport vehicles in the procurement of vehicles and passenger transport services.

The energy efficiency of public procurement is promoted by means of a government-funded advisory service. Motiva procurement service has assisted public contracting units in solving questions related to sustainable procurement since 2008. Motiva produces procurement criteria and guidelines for central and local government procurement units, advises and consults, informs and networks. Procurement advice is also provided online (www.motivanhankintapalvelu.fi). In the provision of advisory services, transport service and vehicle procurement in the public sector have been taken into account to some extent, but this area could be developed further in the future.

In some areas, environmentally friendly public procurement is also supported financially in Finland. Helsinki Region Transport (HSL), for example, has introduced a flexible and cost-effective model of giving operators credit for measures that reduce CO2 and local emissions. Through this environmental bonus, operators can be given credit for emission-reducing

measures taken in addition to contractual obligations. In 2016, HSL has reserved EUR 1.25 million for implementing the environmental bonus model.

Measure 7: Increasing cleantech procurement in the public sector. Encouraging joint municipal authorities and other public sector actors to introduce different financial incentives for increasing the share of alternative technologies in procurement.

Measure 8: Ensuring the availability and impact of advisory services related to energy efficient public transport and vehicle procurement from 2017 on.

4.8 Guidance by information

Under the Consumer Protection Act and a Government Decree issued in 2000 (938/2000), the fuel consumption and CO2 emissions of new cars must be advertised in vehicle dealerships and marketing material. Under the Consumer Protection Act, the fuel consumption and emission data comprises essential information on the features of the vehicle that must be provided when marketing a specific model of a new car.

Major investments have also been made in Finland in advisory services that guide consumers in selecting vehicles. Basic information on different power source alternatives is provided on the website focusing on car choices maintained by the Finnish Energy Information Centre Motiva. The website of the Finnish Transport Safety Agency Trafi also offers a service for comparing the energy efficiency and CO2 emissions of different car makes and models. An energy label system similar to that used in household appliances has additionally been developed for cars in Finland. Labels exist and can be printed out for all new cars and, for models from 2001 and later, also for old car makes on the website of the Finnish Transport Safety Agency (http://www.trafi.fi/autoilu/vertaa_autoja/vertaile_autoja). Some car dealers use these labels in their activities.

Instructions have also been issued recently for builders of distribution stations/recharging points in Finland. In 2015, the guideline “Public recharging points for electric cars – a report and recommendations” was prepared for the builders of public recharging points and those dealing with permit issues in municipalities. Dedicated instructions were provided for property owners and housing companies: ”Installing recharging points at properties” (2016). The Finnish Natural Gas Association has compiled its own instructions for builders of natural gas and biogas refuelling stations.

Measure 9: Continuing and intensifying guidance by information related to consumers’ vehicle choices.

Measure 10: Continuing the production of requisite guidelines and recommendations for the builders of recharging points and refuelling stations.

4.9 Energy grants

The Ministry of Economic Affairs and Employment can give discretionary energy grants to specific investment projects and studies carried out by companies, municipalities and other organisations that promote the production or use of renewable energy, energy savings or the more efficient use or production of energy, or that reduce the negative environmental impacts

of energy production or use. The particular objective of energy grants is to promote the deployment and market entry of new energy technologies.

Some 400-500 energy grant decisions are made each year, the majority of which concern non-emissions trading heat production (e.g. small regional heating plants), small-scale electricity production (e.g. solar panels, small hydro power installations) as well as the energy efficiency investments of companies within the scope of the energy efficiency agreement scheme. In the transport sector, grants have in recent years been allocated especially to the transport use of biogas. In 2011–2016, a total of 20 biogas projects received energy grants, and in 16 of these projects, biogas is utilised either partly or fully for transport needs. The total grant amount has been some EUR 30 million, and it has been used to launch biogas projects with a total value of approximately EUR 110 million. When completed, these biogas plants will produce around 210 GWh of transport biogas. Individual demonstration projects related to liquid biofuels have also been supported with energy grants. Only some of these projects have progressed further. A total of some EUR 10 million has been granted to support electric transport. These grants have been directed to electric cars and charging solutions through the EVE project administrated by Tekes. Additionally, four electric bus demonstration projects were supported with EUR 5.3 million in early 2016. In these projects, the Cities of Turku and Tampere, and the City of Espoo together with Helsinki Region Transport, procured a total of 22 electric buses and 34 recharging points.

In addition to energy grants, the Ministry of Economic Affairs and Employment has provided LNG terminal grants for the building of four LNG terminals in Tornio, Pori, Rauma and Hamina. The purpose of this grant programme was to build an LNG network in Finland and, in particular, enable the use of LNG as a shipping fuel. The total grant amount was approximately EUR 93 million.

A decision has been made to allocate a total of EUR 100 million of energy grants to investments in renewable energy and new technologies in 2016–2018. These grants contribute to implementing the key project related to the bioeconomy and clean solutions cited in the Government Programme of Prime Minister Sipilä.

Measure 11: Promoting the production and availability of alternative transport power sources in a technology neutral manner through national energy grants.

4.10 Rural business and energy support

Business support under the Rural Development Programme may be granted for small rural enterprises' development and investment projects. Micro and small enterprises located in rural areas as well as farms engaging in non-agricultural business may apply for support for such purposes as starting an enterprise or the design and commissioning costs and investments related to substantial expansions.

Startup grant amounts are EUR 5,000 - 35,000, and the support rate is 100% of total eligible costs. The support may, for example, be used for expert costs and startup phase payroll costs. On the other hand, for investments in buildings and equipment of plants, applications may be made for investment support under business support for rural enterprises. The maximum support rate is 30% of eligible total costs. Within the limits of the applicable terms and conditions, rural enterprise support may also be granted to assist small rural enterprises that produce and sell renewable energy, including biogas.

The support rate of rural investment support for farm energy plants (heating plants, biogas plants etc.) is 40%, and only plants producing energy or fuel for the use of the farm's own production are eligible. The energy is, in that case, regarded as part of the production process of rural produce. Fuels that are within the scope of the Act on the Promotion of the Use of Biofuels for Transport are not eligible for rural enterprise and energy support.

Measure 12: Supporting the production and distribution of biogas and other renewable power sources to which the Act on the Promotion of the Use of Biofuels for Transport is not applicable intended for transport and machinery use by investment support for rural enterprises and farms.

4.11 Promoting the use of biofuels in aviation

Finland has excellent preconditions for introducing biofuels in more extensive continuous use in air traffic and turning Helsinki-Vantaa Airport into a Green Hub. A company that has developed globally unique technology for manufacturing biofuels for air traffic operates in Finland. Continuous availability of biofuels at Helsinki-Vantaa Airport, and the "Helsinki Green Hub" concept based on this, would support the recognisability and attraction of the airport as an important hub between Europe and Asia and could have a positive effect on transit traffic and passenger numbers.

The greatest issue to be resolved is the profitability of biofuel use, as biokerosene is currently clearly more expensive than fossil aviation fuel. It is important to consider how the additional costs of biofuel use can be covered and what type of new business biofuel use will create. A possibility of potentially reducing the additional costs lies in the introduction of a biofuel whose maximum blending ratio would be clearly lower than the current 50%. While this fuel has not yet been internationally approved for aviation fuel, the approval process is under way.

Measure 13: Urgently investigating different funding and/or other operating models for ensuring the availability of biofuels at Helsinki-Vantaa Airport.

4.12 Promoting natural gas and biogas use in waterborne transport

An LNG action plan has been formulated and introduced in Finland to promote the use of liquid natural gas (and biogas). The action plan was prepared by a number of different authorities together with companies and lobbying organisations relevant to the sector as part of the efforts of the working group on Future Transport Power Sources[5]. In addition, key steps that Finland should take in order to promote the use of LNG as a marine fuel in the Baltic Sea area and to facilitate the preparation of a regulatory framework and guidelines in the EU and IMO were also collated in this document.

A precondition for the use of liquefied natural gas, or LNG, as a marine fuel is that its supply and distribution can be assured in Finland and across Europe. For use in the Finnish

[5] Future Transport Power Sources. Working group final report. Publications of the Ministry of Transport and Communications 15/2013.

transport sector, LNG-powered ships and LNG tankers must also be suitable for winter conditions. Due to the global nature of shipping, regulatory decisions aimed at ensuring the safe transport and use of LNG need to be made in international forums: the IMO and EU. The establishment of LNG infrastructure calls for cooperation at EU level, particularly as regards funding. At the same time, permit processes affecting the setting up of the necessary infrastructure, preparedness for accidents, and training require examination at national level.

Measure 14: Continuing the determined implementation of the Finnish LNG action plan.

Measure 15: Investigating the possibilities of also using biogas as a marine fuel and implementing the required measures.

Measure 16: Investigating the need of using LNG in inland waterway transport and the possibilities of increasing the offer of liquefied gas for the needs of vessels navigating in the Saimaa deep-water channel.

4.13 Promoting alternative energy use in ports and at airports

In airport traffic and in ports, the distances travelled are short and recharging infrastructure is easy to implement, and existing technologies would already enable a transition to electric terminal traffic. It is also important to promote the use of other power sources in ports and at airports.

Electricity supply to stationary airplanes at airports may reduce fuel consumption and noise, improve air quality and reduce the impact on climate change. Shore-side electricity in ports, on the other hand, can contribute to reducing the environmental impact of sea-going ships and inland waterway vessels.

Electricity taxation is one of the factors that have an impact on the attractiveness of shore-side electricity. In Finland, electricity users are divided into two tax categories: electricity tax class 1 includes households, or the majority of electricity consumers. Electricity tax class 2 may include industrial manufacturing companies and farms with greenhouse cultivation. The ships using shore-side electricity in ports pay the household tax rate for their electricity consumption. In Sweden and Germany, shore-side electricity users qualify for tax relief.

Measure 17: Investigating the possibilities of promoting the use of alternative power sources in Finnish ports and at airports. Introducing the most promising techniques at the latest in the early 2020s.

4.14 Using EU financial instruments in building distribution infrastructure

The distribution networks required by the new transport power sources will mainly be built on market terms in Finland. However, many existing EU financial instruments, including European Structural and Investment Funds, the Connecting Europe Facility (TEN-T) and Horizon 2020 framework programme, may be used to support these projects.

The European Structural and Investment Funds (ESI Funds) are the most important investment policy instrument of the EU. In 2014-2020, their budget amounted to EUR 454 billion. By 2023, the ESI Funds will accelerate investments in key EU priority areas (including ener-

gy and climate), respond to the needs of real economy by supporting job creation and get the European economy growing again in a sustainable way.

Under the Connecting Europe Facility, support may be granted for introducing new transport technologies and innovations in the TEN-T Core network, including infrastructure for alternative clean fuels. Financing under the Facility may also be granted for creating infrastructures for alternative clean fuels to achieve a wider and more comprehensive network through public procurement and financial instruments, including project bonds.

The EU's Horizon 2020 instrument can also offer funding for promoting alternative transport power sources. This instrument is intended for SMEs seeking strong international growth that have high market and growth potential. Funding may be granted for projects associated with the themes of pillars 2 and 3 of the Horizon programme (Industrial Leadership and Societal challenges). The budget of this programme will amount to almost EUR 80 billion in 2014-2020.

Measure 18: Using different EU financial instruments in the building of the distribution network in Finland as far as possible.

4.15 Influencing EU objectives and actions

Ending oil dependence is a strict condition for meeting the EU's long-term climate targets. Over the longer term, most transport should be powered by renewable and/or carbon-free energy. Sufficiently ambitious EU targets should thus be set for renewable transport fuels. This objective should also be extended to EU level legislation, for example as part of the Renewable Energy Resources Directive (RES) or the Fuel Quality Directive (FQD). As one possibility, an obligation could be imposed on EU fuel suppliers to ensure that a certain share of all transport fuels supplied by them would be renewables. This would be in line with the model used in Finland and promote the possibilities for Finnish export companies to operate in the EU internal market.

In order to expand the use of alternative power sources, another key EU level policy measure is binding CO2 threshold values set for car manufacturers after 2020. Finland is in favour of setting threshold values for cars and vans, also after 2020, and considerably more stringent target levels for these values. Finland supports setting threshold values for trucks and other heavy-duty vehicles as well. In these values, the g/km emissions of alternative fuels over the entire life cycle of the fuel or power source should be taken into account, however not forgetting the perspective of energy efficiency. The threshold values should also not impede the use of vehicles with sizes and weights approved for use in goods transport in Finland that are greater than in other EU Member States.

The use of liquid biofuels at the global level could also be promoted through fuel quality standards. The standards define minimum requirements for guaranteeing that the fuels work without a hitch. European standards are formulated by the technical committees of the European standardisation organisation CEN. They are prepared by experts in cooperation with different stakeholders, including fuel producers and engine manufacturers. Quality standards are valid in Finland as SFS-EN standards. Quality standard SFS-EN 228 sets out the requirements for motor petrol, while standard SFS-EN 590 specifies the requirements for diesel oil. A European standard for paraffinic diesel fuel (EN 15940) has also been completed recently. This standard is an important step towards the more extensive deployment of 100% biofuels, including hydrotreated vegetable oil (HVO) and alternative fuels. Up to now, different concentrations of biofuels have mainly been used in fuel blends, but the new standard

will make it easier for car manufacturers to give their approval and guarantee for the use of unblended paraffinic diesel.

A standard is also being prepared in the EU that, when completed, would allow the use of an ethanol ratio of up to 20% in petrol. Completing the E20 standard as soon as possible will create an opportunity for car manufacturers to launch E20 compatible petrol cars in the market. Even today, a large share of new petrol cars can technically use E20 grade petrol without any problems. Due to the increasingly stringent local emission requirements, the sales in smaller car segments in particular are likely to focus on petrol fuelled cars in the future, and for this reason, accelerating the completion of the E20 standard is important in order to achieve the 2030 targets.

Measure 19: Influencing the drafting of EU policies on renewable energies as far as possible. The objective is that regulation would in this respect continue to be based on EU legislation also after 2020.

Measure 20: Participating actively in the work aiming to set binding CO2 threshold values for cars, vans and heavy-duty vehicles. Highlighting the life cycle emissions of the different power source options when specifying the threshold values.

Measure 21: Participating actively in the preparation of standards that promote the use of alternative transport power sources. Investigating the possibilities of introducing a national E20 standard.

4.16 Influencing international objectives and measures

Both air traffic and shipping are distinctively global modes of transport. Their development is guided by global regulation and development, and there is little national room for manoeuvre. The targets for reducing greenhouse gas emissions from international air traffic and emission-reducing mechanisms are set out by the International Civil Aviation Organisation ICAO. The targets for reducing greenhouse gas emissions from international shipping and the emission-reducing mechanisms are specified by the International Maritime Organisation IMO. Efforts to promote the use of alternative energies in international traffic should primarily take place through these organisations.

Measure 22: Participating actively in the work carried out within the ICAO and the IMO with the aim of promoting the use of alternative power sources in Finland, in the EU and globally.

4.17 Research, development and innovations

The transition from fossil oil-based fuels to new alternatives in transport can be supported by active research and innovation activities. The future focus of both national research resources and those available in the EU should be on low-emission transport fuels and their deployment. Research and development are needed with respect to all new power source options. Resources should also be reserved for implementing various trial and demonstration projects at the national level.

Measure 23: Channelling both national research funding and funding potentially obtained from the EU to projects that support the expansion of alternative power source use in

transport. Initiating different demonstration and trial projects associated with alternative energies in cooperation with various parties, including Finnish municipalities.

4.18 Legislative changes

Under the AFI Directive, technical specifications set out in Annex II to the Directive shall be complied with when building recharging/refuelling points for alternative energy forms. They mainly concern the recharging point socket outlets and the dispensing equipment at the refuelling points, tanks and quality of the fuel (purity). The Directive also requires that consistent and clear information be offered for consumers, for example on what fuel or power source their vehicles run on (labelling rules, standards and possible graphic expression; the same information must be found both on vehicles and at refuelling stations/recharging points). Consumers shall also be offered information on the price of the fuel or power source offered and the locations of the refuelling stations/recharging points. There currently is no legislation in Finland that would directly apply to the transport fuel market as a whole and into which the points cited in the directive could be incorporated.

Measure 24: Drafting a national act on the alternative transport fuel market. The act will include the technical specifications contained in the AFI Directive for the distribution of new transport power sources in Finland, such as electricity, gas and hydrogen, and the requirements of informing consumers about the locations of refuelling stations and recharging points as well as the price and other details of different fuels and power sources. Amending existing legislation so that it is compatible with the new act.

4.19 Monitoring

A monitoring/steering group should be appointed to monitor the numeric targets proposed for alternative energies, the impact of promotional measures as well as changes in markets and prices and to evaluate the implementation of the national distribution network plan measures and propose new solutions. The monitoring group would have both a short and long term focus in its work (2020 & 2030), and it could meet a few times a year to assess the situation. The steering group would operate under the Ministry of Transport and Communications.

Measure 25: Convening an informal monitoring group that would meet a few times a year to monitor the achievement of the targets set for distribution infrastructure and vehicle numbers in the national distribution network plan.

5. Finland as part of the TEN-T network – designated areas and networks

The AFI Directive obliges the Member States to designate the urban/suburban agglomerations, other densely populated areas and networks which, subject to market needs, are to be equipped with recharging points accessible to the public. The urban/suburban agglomerations, other densely populated areas and networks which, subject to market needs, are to be equipped with CNG refuelling points accessible to the public must also be designated. The areas and networks designated in Finland's national plan cover those urban sub-regions and municipalities in Finland that already have recharging points for electric vehicles or refilling stations for transport gas in their areas.

5.1 Designated areas in 2020: electricity

For recharging points accessible to the public, the current status information shown on the map and listed in the table shows the existing recharging points. There already are more than 600 recharging points and some 215 recharging points accessible to the public in Finland. This information was obtained from the electric transport recharging point database.

The target is that by 2020, the recharging point network will cover all municipalities and cities in Finland, transport hubs, TEN-T Core and Comprehensive network ports, railway stations and airports as well as the road network down to the secondary roads. The network will mainly be expanded on market terms. The target is that there would be over 2,000 public recharging points in Finland by 2020. The number of recharging points in 2020 (Map 1 and Table 1) has here been estimated on the basis of the population in Finnish municipalities rather than the plans of the recharging point network builders. At this stage, those urban subregions and municipalities in Finland that have recharging points for electric vehicles accessible to the public in their areas will be designated for the TENT-T network.

See Map 1 and Table 1 in Appendix 2.

5.2 Designated areas in 2020: natural gas and biogas (CNG, CBG)

The refuelling points of CNG and CBG accessible to the public in 2016, and the targets for 2020, were obtained from gas sector actors. Currently, there are 24 refuelling stations in Finland, while the target for 2020 is 55 stations. The figures are based on the gas sector's plans concerning the number of stations required. At this stage, those urban subregions and municipalities in Finland that have refilling stations for transport gas accessible to the public in their areas will be designated for the TENT-T network.

See Map 2 and Table 2 in Appendix 2.

5.3 Designated areas in 2030: hydrogen

The AFI Directive does not oblige the Member States to designate trans-European areas and networks for hydrogen refuelling stations. However, there already are two hydrogen refuelling stations in Finland, and the target is at a total of 21 stations by 2030. The information/plans on Map 4 and in Table 2 were obtained from a Finnish hydrogen sector actor (Woikoski Ab).

See Map 4 and Table 2 in Appendix 2.

5.4 Designated areas in 2020: liquid biofuels requiring a separate distribution network

The AFI Directive does not oblige the Member States to designate trans-European areas and networks for liquid biofuels requiring a separate distribution network. However, Finland aims to increase the use of advanced biofuels in transport, and certain advanced biofuels requiring separate distribution are also manufactured and marketed in Finland. These include E85 and ED95 made from ethanol and HVO100. Maps 5 and 6 describe the current and planned future distribution infrastructure of these fuels in Finland (in 2016 and 2030). The figures are based on the biofuel sector's plans concerning the number of stations required.

See Maps 5 and 6 in Appendix 2.

6. Conclusion

6.1 Objectives

Finland’s national target for road transport in 2050 is near-zero emissions. The power source for cars and vans would either be electricity and hydrogen produced with renewable (or emission-free) raw materials, or different biofuels (liquid biofuels and biogas). Their share in the total energy consumption of road transport would approach 100%. In 2030, the share of alternative fuels in road transport energy consumption would be 40% as minimum. In 2020, this share will be 20% (including double credits for biofuels).

The target for shipping is a 40% reduction in greenhouse gas emissions by 2050 (compared to 1990) as a result of LNG and biofuel use and other measures.

In aviation, the target is to bring the share of renewable or other emission-reducing solutions up to 40% as minimum by 2050.

Infrastructure targets

Finland's national target is that by 2020/2030, distribution networks meeting the recommendations of the AFI Directive for transport electricity, gas and hydrogen will have been built in Finland. The distribution infrastructure for biofuels requiring separate distribution would also be expanded. The new refuelling stations and recharging points would mainly be built on market terms.

For electricity, Finland’s national target is a minimum of 2,000 recharging points accessible to the public by 2020. Of these, 200 would be fast recharging points. The target for the recharging point network is covering all municipalities and cities, transport hubs, TEN-T Core and Comprehensive Network ports, railway stations and airports as well as the road network down to the secondary roads. The network of recharging points accessible to the public refers to not only the points located in public places but all stations that are available for vehicles in general. For more details on the recharging infrastructure, see Appendix 2.

Considering the targets for vehicles, the goal for 2030 is a minimum of 25,000 public recharging points.

The number of hydrogen refuelling stations in 2030 would total around 20, ensuring that the distance between stations would be approximately 300 km, and that each station would serve its area within a radius of 150 km. There would be a station in each one of the bigger cities. For more details on the distribution infrastructure, see Appendix 2.

For natural gas and biogas (CNG, CBG), the objective is that refuelling stations would be found in the largest urban sub-regions and on all main thoroughfares, some 50 stations in total in 2020. For more details on the distribution infrastructure, see Appendix 2.

For liquid natural gas and biogas, the target is that Finland would have a network of LNG fuelling stations with national coverage for the needs of heavy-duty vehicles in 2030. In all TEN-T Core Network ports (Hamina-Kotka, Helsinki, Naantali and Turku), refuelling points for LNG or LBG would be provided by 2025 at the latest. In addition, bunkering facilities will be available at the LNG terminals of Pori and Tornio as the terminals are completed. The target for inland waterways is that the potential needs for LNG/LBG of vessels navigating in the

Saimaa deep-water channel will be covered by a mobile bunkering point or similar located in Mustola, Lappeenranta, no later than in 2030. For more details on the distribution infrastructure, see Appendix 2.

In the aviation sector, the objective is to turn Helsinki-Vantaa Airport into a Green Hub airport with a special focus on alternative fuel use, where renewable jet fuel would be available for all airlines by 2020. At a Green Hub airport, the use of alternative power sources would also be strongly promoted in the airport's terminal traffic.

In the distribution of liquid biofuels, the target is that in 2030, all refuelling stations would offer a high-blend biofuel as part of their product range (including 100% HVO, RE85 or ED95). The main grade would be e.g. E20/25 petrol. The existing distribution infrastructure is be flexible enough to allow development once its maintenance and investments in basic improvements are managed appropriately. The 98 E5 petrol, which is today distributed as a so-called protection grade, will be dropped relatively soon, and this will help to free up storage and distribution capacity, for example for high-blend transport fuels.

We may estimate that the HVO100 product would be distributed at around one half of all refuelling stations, similarly to E85. The number of ED95 ethanol diesel stations would be around 250.

Targets for vehicles

Finland's national target is that the country's entire car fleet would consist of near-zero emission vehicles in 2050. As the replacement rate of the Finnish vehicle fleet has previously been very slow, or only about once in 15—20 years, the target is that all new cars and vans would be compatible with alternative fuels[6] as early as in 2030. The target for 2025 is that 50% of new cars and vans could be powered by an alternative fuel, and the goal for 2020 is a 20% share of these vehicles.

The target for heavy-duty vehicles is that all new trucks and buses would also be compatible with some alternative fuel by 2030. The target for 2025 is that 60% of new trucks and buses would be compatible with an alternative fuel, and the goal for 2020 is a 40 % share.

These figures include trucks and buses that also use biofuels in high concentrations. These vehicles have been type approved to run on concentrations of up to 100% of biofuel. Some 30% of the trucks and buses in Finland are already vehicles of this type.

Other targets

The target is that the largest Finnish ports would offer facilities for using shore-side electricity supply at the latest in 2030.

Terminal traffic in ports and at airports should be approaching zero emissions by 2050. The target is that all new machinery and equipment would be compatible with an alternative fuel from 2030 on.

In rail transport, the target is that by 2050, the transport output would almost fully rely on electricity.

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[6] The alternative fuels referred to here are those defined in the AFI directive: electricity, hydrogen, natural gas and biogas as well as liquid biofuels in high concentrations.

Boating would be nearly emission free in 2050. All new boats would be compatible with alternative fuels [biofuels also in high concentrations, gas, hydrogen and electricity] in 2030.

6.2 Proposed measures

1. Continuing the implementation of the Act on the Promotion of the Use of Biofuels for Transport beyond 2020. Setting the target for biofuels at 40% by 2030 (taking the double credit rule into consideration). Investigating the potential advantages and disadvantages of also bringing biogas within the scope of the Act.

2. Continuing the development of the current fuel taxation based on environmental considerations to treat all transport fuel alternatives objectively and as fairly as possible.

3. Reducing the car tax in 2016 – 2019 as agreed in the Government Programme. Improving the steering impact of emissions-based taxation further.

4. Carrying out an experiment that targets vehicle purchases in order to create a market for new technologies.

5. Implementing a legislative change related to the transport market (the Transport Code).

6. Investigating the possibilities of reforming the current system of taxing company cars so that companies would be encouraged to increasingly choose cars with new technologies and/or running on alternative power sources for company cars.

7. Increasing cleantech procurement in the public sector. Encouraging joint municipal authorities and other public sector actors to introduce different financial incentives for increasing the share of alternative technologies in procurement.

8. Ensuring the availability and impact of advisory services related to energy efficient public transport and vehicle procurement from 2017 on.

9. Continuing and intensifying guidance by information related to consumers' vehicle choices.

10. Continuing the production of requisite guidelines and recommendations for the builders of recharging points and refuelling stations.

11. Promoting the production and availability of alternative transport power sources in a technology neutral manner through national energy grants.

12. Supporting the production and distribution of biogas intended for transport and machinery use by investment support for rural enterprises and farms.

13. Urgently investigating different funding and/or other operating models for ensuring the availability of biofuels at Helsinki-Vantaa Airport.

14. Continuing the determined implementation of the Finnish LNG action plan.

15. Investigating the possibilities of also using biogas as a marine fuel and implementing the required measures.

16. Investigating the need of using LNG in inland waterway transport and the possibilities of increasing the offer of liquefied gas for the needs of vessels navigating in the Saimaa deep-water channel.

17. Investigating the possibilities of promoting the use of alternative power sources in Finnish ports and at airports. Introducing the most promising techniques at the latest in the early 2020s.

18. Using different EU financial instruments in the building of the distribution network in Finland as far as possible.

19. Influencing the drafting of EU policies on renewable energies as far as possible. The objective is that regulation would in this respect continue to be based on EU legislation also after 2020.

20. Participating actively in the work aiming to set binding CO2 threshold values for cars, vans and heavy-duty vehicles. Highlighting the life cycle emissions of the different power source options when specifying the threshold values.

21. Participating actively in the preparation of standards that promote the use of alternative transport power sources. Investigating the possibilities of introducing a national E20 standard.

22. Participating actively in the work carried out within the ICAO and the IMO with the aim of promoting the use of alternative power sources in Finland, in the EU and globally.

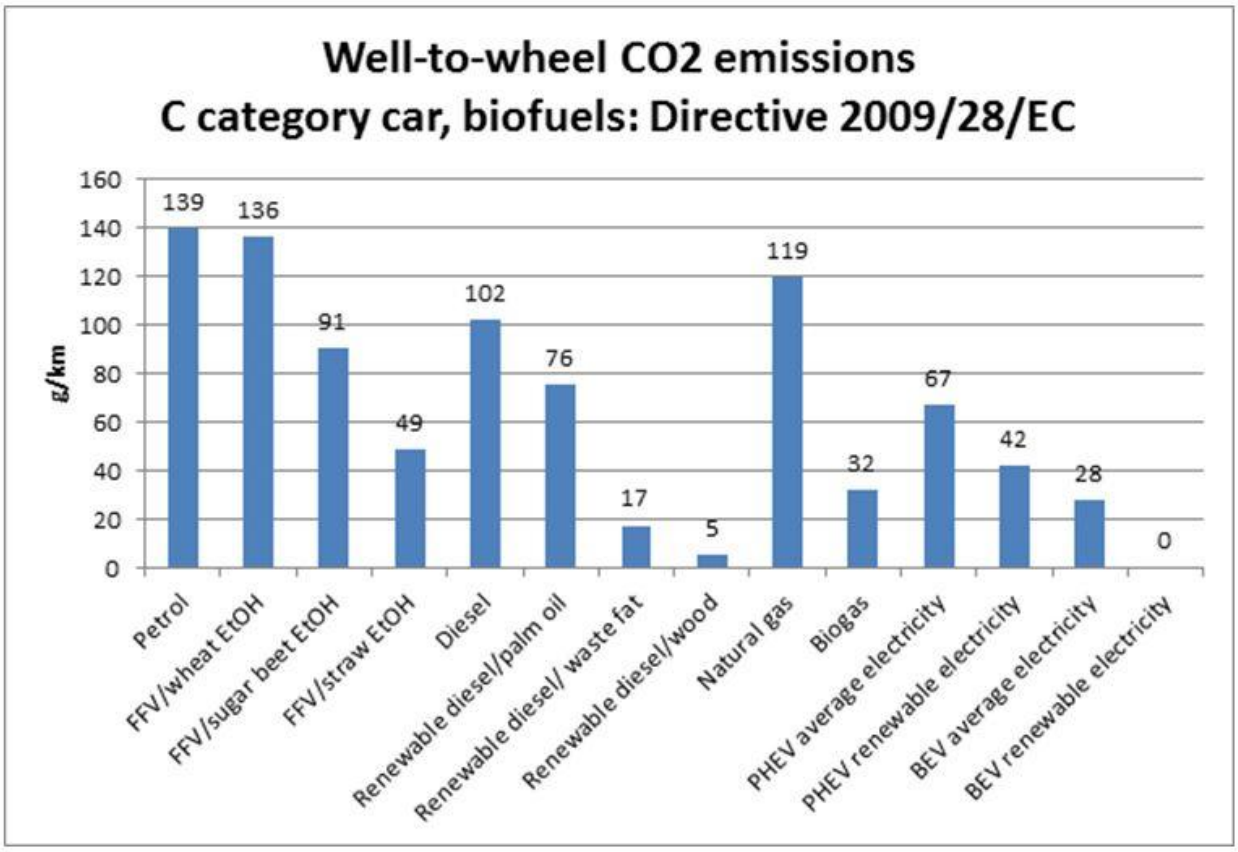
23. Channelling both national research funding and funding potentially obtained from the EU to projects that support the expansion of alternative power source use in transport. Initiating different demonstration and trial projects associated with alternative energies in cooperation with various parties, including Finnish municipalities.

24. Drafting a national act on the alternative transport fuel market. The act will include the technical specifications contained in the AFI Directive for the distribution of new transport power sources in Finland, such as electricity, gas and hydrogen, and the requirements of informing consumers about the locations of refuelling stations and recharging points as well as the price and other details of different fuels and power sources. Amending existing legislation so that it is compatible with the new act.

25. Convening an informal monitoring group that would meet a few times a year to monitor the achievement of the targets set for distribution infrastructure and vehicle numbers in the national distribution network plan.

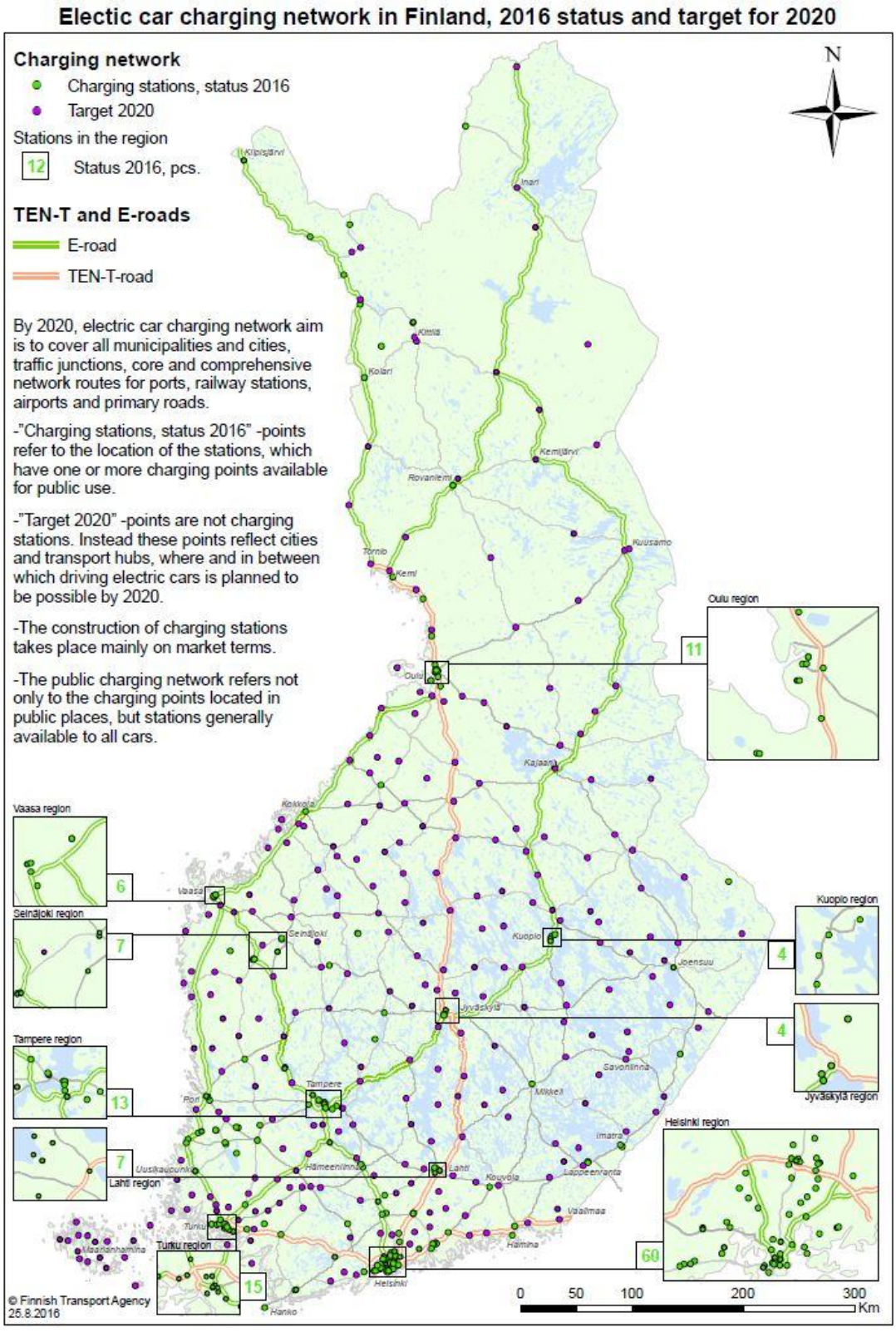
APPENDIX 1

Well-to-wheels emissions of different technologies (source: VTT Technical Research Centre Finland, 2015)

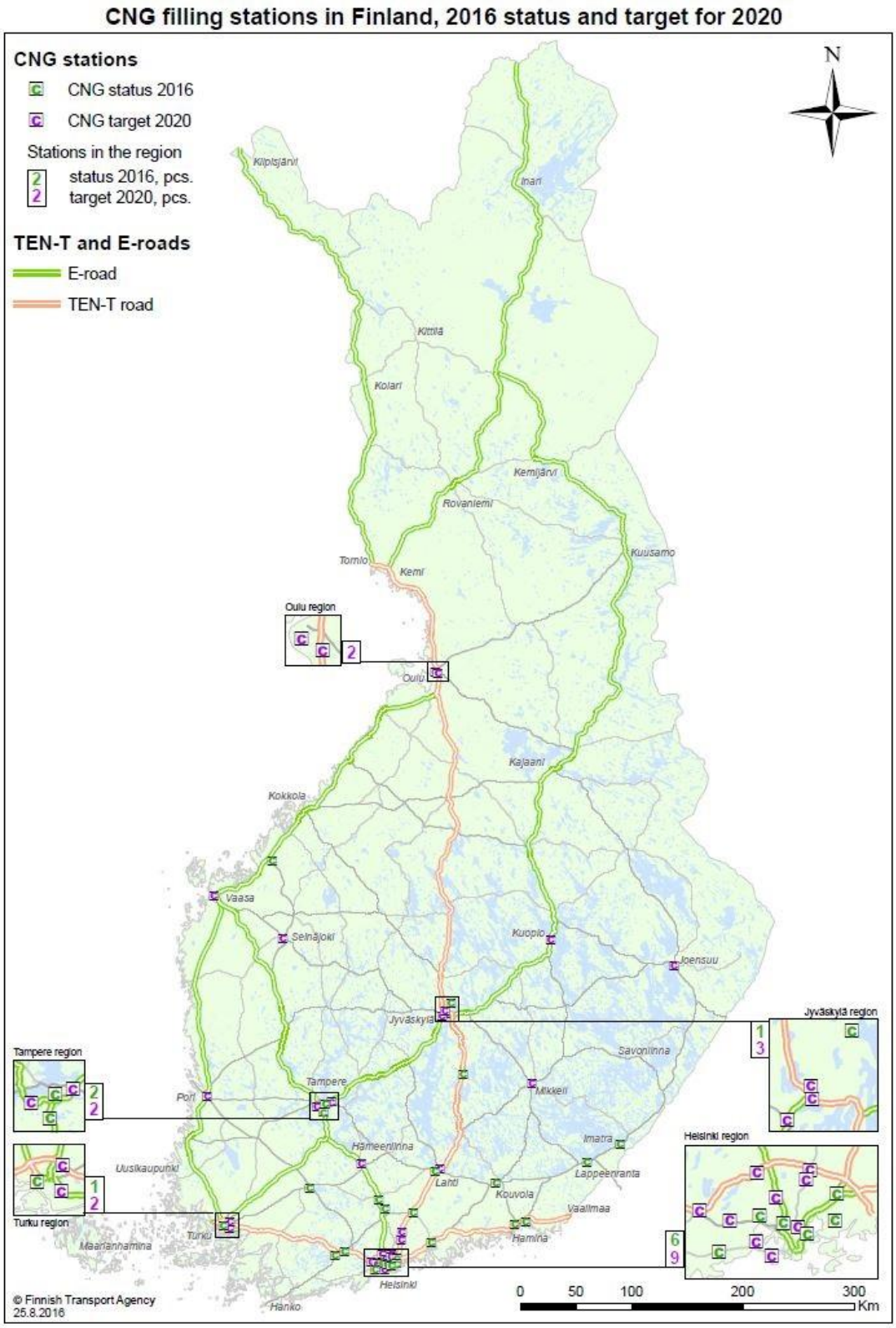


APPENDIX 2 Maps and tables

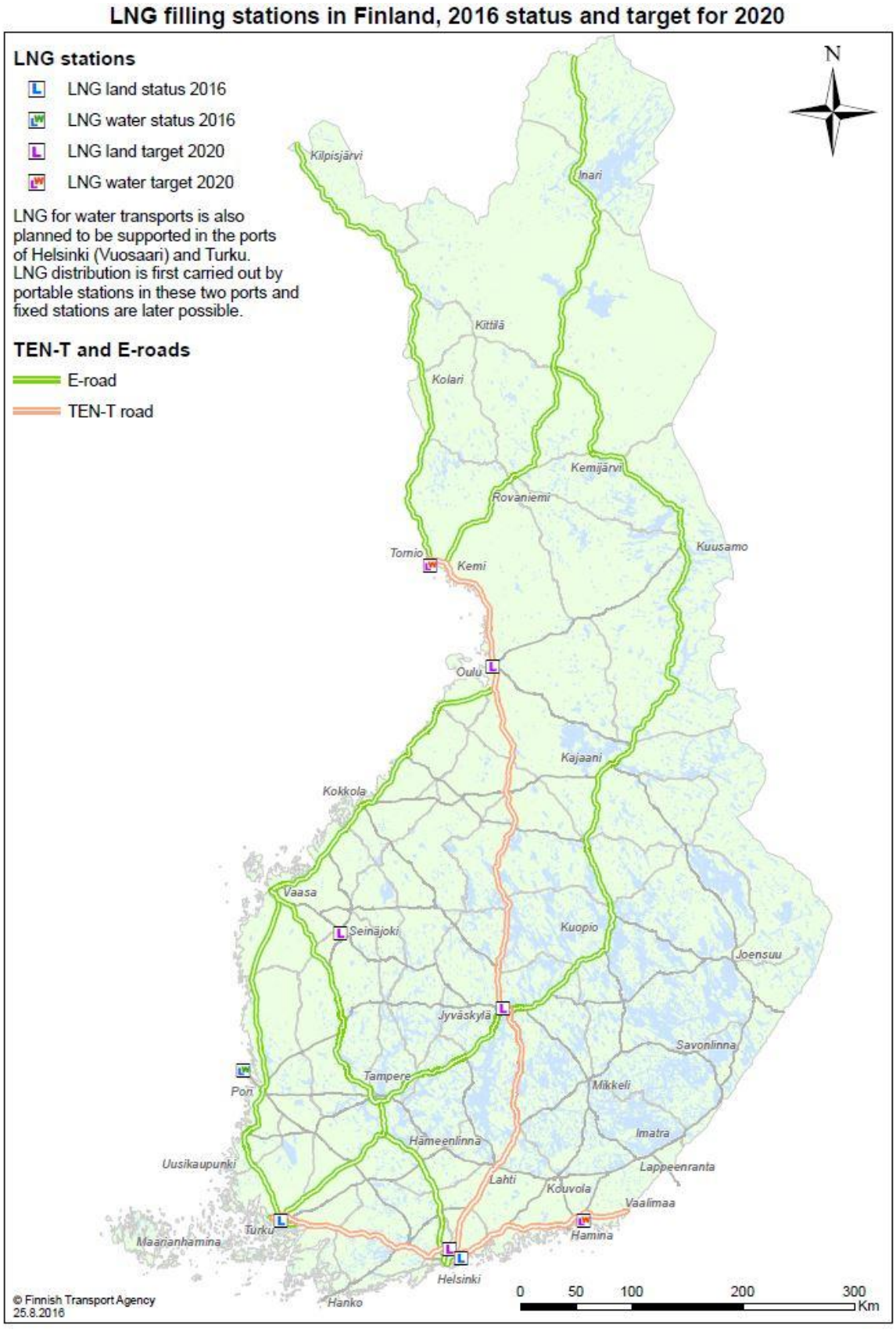
Map 1: Electricity in 2016 and target for 2020



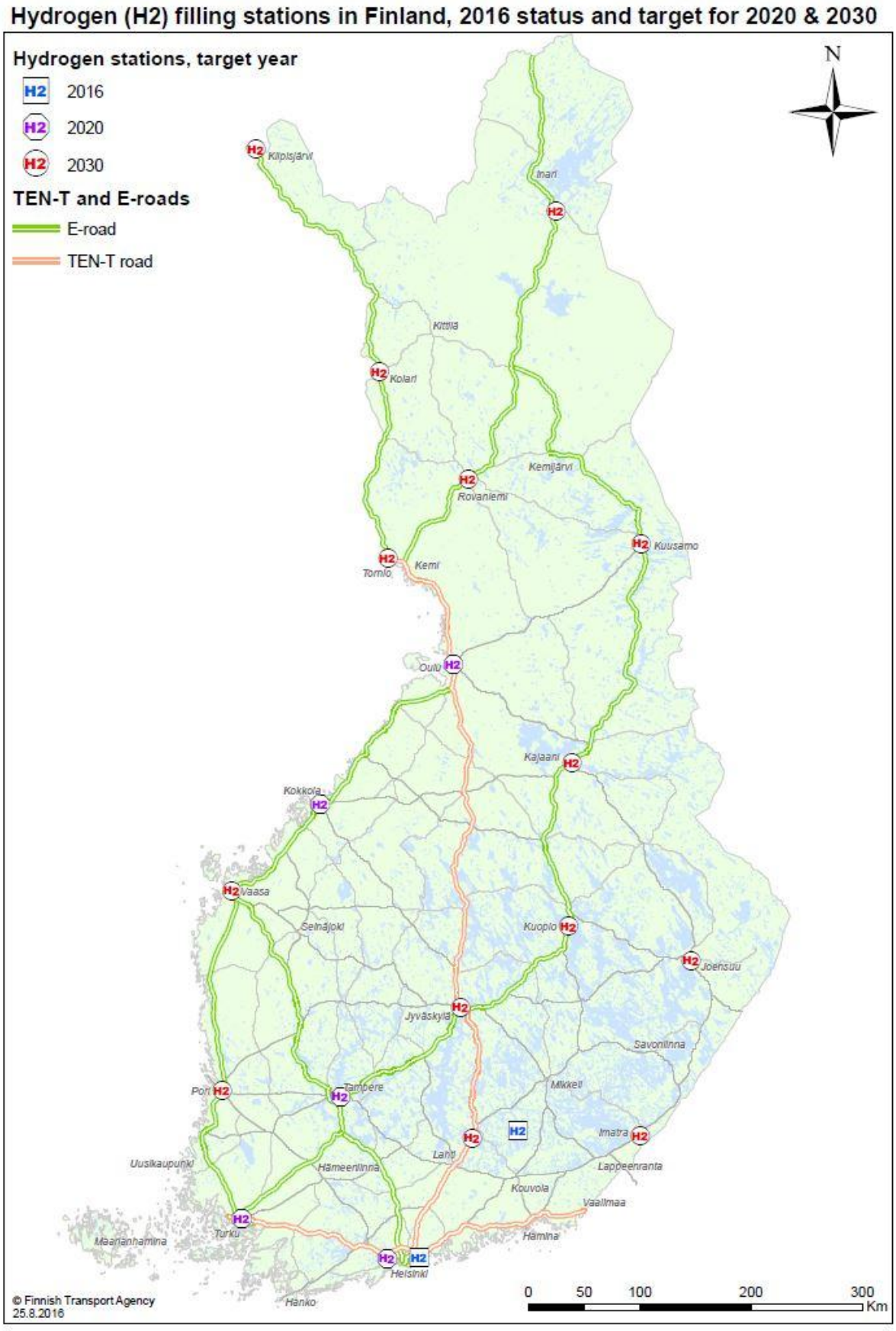
Map 2: CNG in 2016 and target for 2020



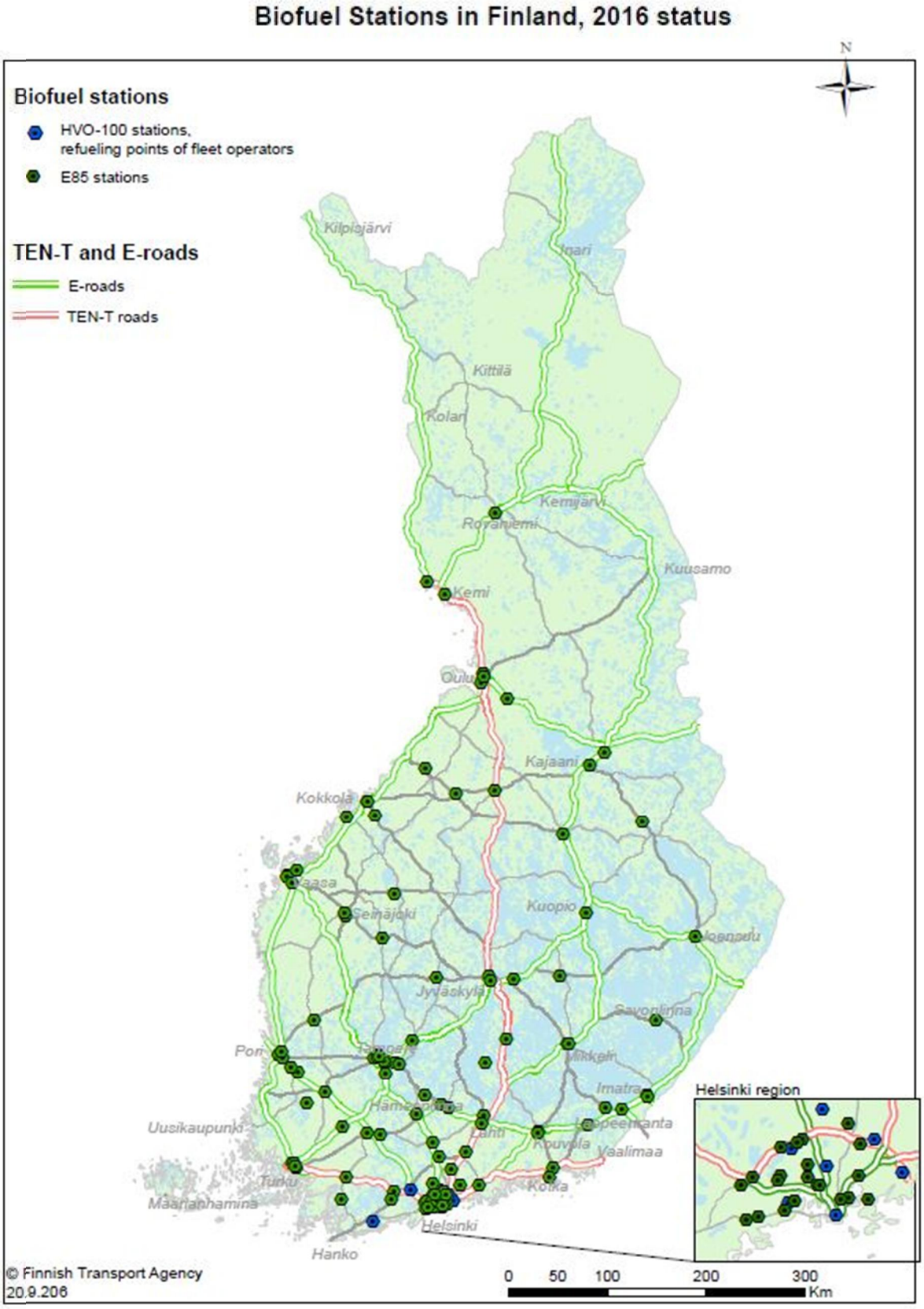
Map 3: LNG in 2016 and target for 2020



Map 4: Hydrogen in 2016 and targets for 2020 & 2030
Map 5: Biofuels requiring separate distribution, including E85 and HVO 100%, situation in



2016


Biofuel Stations in Finland, 2016 status
N
Biofuel stations
HVO-100 stations,
refueling points of fleet operators
E85 stations
TEN-T and E-roads
E-roads
TEN-T roads
Kilpisjärvi
Inari
Kittilä
Kolari
Kemijärvi
Rovaniemi
Kuusamo
Kemi
Oulu
Kajaani
Kokkola
Vaasa
Seinäjoki
Kuopio
Joensuu
Jyväskylä
Savonlinna
Pori
Mikkeli
Imatra
Hämeenlinna
Lahti
Lappeenranta
Kouvola
Vaalimaa
Uusikaupunki
Turku
Kotka
Maarianhamina
Helsinki
Hanko
Helsinki region
© Finnish Transport Agency
20.9.206
0 50 100 200 300
Km

Map 6: Biofuels requiring separate distribution, including E85 and HVO 100%, target for 2030

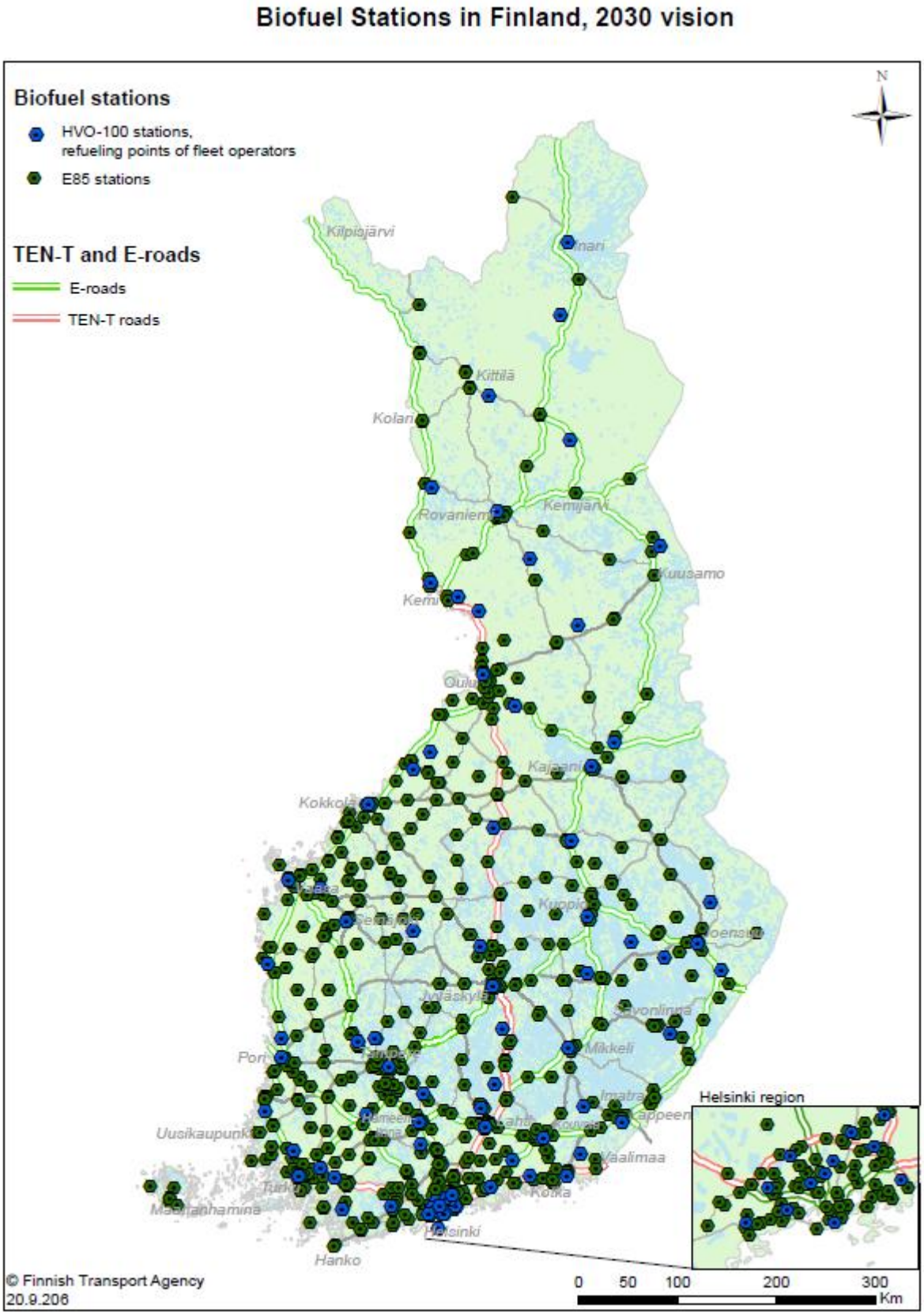


Table 1: Electricity recharging points in 2016 and target for 2020

Municipality	Municipality code	Population	Recharging points 2016 (approximately)	Recharging points to be built by 2020 (an estimate proportionate to the number of inhabitants in municipality)	Total number of recharging points by 2020
TOTAL:		5,487,308	634	1396	2030
Akaa	020	17,043	1	4	5
Alajärvi	005	10,006		2	2
Alavieska	009	2,687		1	1
Alavus	010	12,044	3	3	6
Asikkala	016	8,287		2	2
Askola	018	5,104		1	1
Aura	019	3,986	1	1	2
Brändö	035	470		1	1
Eckerö	043	935		1	1
Enonkoski	046	1,473		1	1
Enontekiö	047	1,861	6	1	7
Espoo	049	269,802	30	67	97
Eura	050	12,128	6	3	9
Eurajoki	051	5,938	4	1	5
Evijärvi	052	2,576		1	1
Finström	060	2,522		1	1
Forssa	061	17,422		4	4
Föglö	062	554		1	1
Geta	065	500		1	1
Haapajärvi	069	7,438		2	2
Haapavesi	071	7,167		2	2
Hailuoto	072	993		1	1
Halsua	074	1,225		1	1
Hamina	075	20,851		5	5
Hammarland	076	1,537		1	1
Hankasalmi	077	5,240		1	1
Hanko	078	8,864	1	2	3
Harjavalta	079	7,296		2	2
Hartola	081	2,982		1	1
Hattula	082	9,747		2	2
Hausjärvi	086	8,729		2	2
Heinola	111	19,575		5	5
Heinävesi	090	3,574		1	1
Helsinki	091	628,208	91	156	247
Hirvensalmi	097	2,290		1	1

Hollola	098	23,915		6	6
Honkajoki	099	1,793		1	1
Huittinen	102	10,473	4	3	7
Humppila	103	2,388		1	1
Hyrynsalmi	105	2,422		1	1
Hyvinkää	106	46,463	4	12	16
Hämeenkyrö	108	10,667		3	3
Hämeenlinna	109	68,011	5	17	22
Ii	139	9,663	2	2	4
Iisalmi	140	21,945		5	5
Iitti	142	6,910		2	2
Ikaalinen	143	7,207	2	2	4
Ilmajoki	145	12,159	1	3	4
Ilomantsi	146	5,336		1	1
Imatra	153	27,835	4	7	11
Inari	148	6,804	2	2	4
Inkoo	149	5,541		1	1
Isojoki	151	2,123		1	1
Isokyrö	152	4,785		1	1
Janakkala	165	16,853		4	4
Joensuu	167	75,514	1	19	20
Jokioinen	169	5,425		1	1
Jomala	170	4,648		1	1
Joroinen	171	5,110		1	1
Joutsa	172	4,688		1	1
Juankoski	174	4,804		1	1
Juuka	176	5,034		1	1
Juupajoki	177	1,988		1	1
Juva	178	6,548		2	2
Jyväskylä	179	137,368	6	34	40
Jämijärvi	181	1,948		1	1
Jämsä	182	21,542		5	5
Järvenpää	186	40,900	2	10	12
Kaarina	202	32,590	4	8	12
Kaavi	204	3,194		1	1
Kajaani	205	37,622		9	9
Kalajoki	208	12,621		3	3
Kangasala	211	30,607	2	8	10
Kangasniemi	213	5,628		1	1
Kankaanpää	214	11,769	1	3	4
Kannonkoski	216	1,462		1	1
Kannus	217	5,590		1	1
Karijoki	218	1,369		1	1
Karkkila	224	8,969	1	2	3
Karstula	226	4,268		1	1

Karvia	230	2,475		1	1
Kaskinen	231	1,285		1	1
Kauhajoki	232	13,875		3	3
Kauhava	233	16,784		4	4
Kauniainen	235	9,486		2	2
Kaustinen	236	4,305		1	1
Keitele	239	2,379		1	1
Kemi	240	21,758	2	5	7
Kemijärvi	320	7,766		2	2
Keminmaa	241	8,388		2	2
Kemiönsaari	322	6,909		2	2
Kempele	244	17,066	1	4	5
Kerava	245	35,293	2	9	11
Keuruu	249	10,117	1	3	4
Kihniö	250	2,038		1	1
Kinnula	256	1,745		1	1
Kirkkonummi	257	38,649	1	10	11
Kitee	260	10,832	1	3	4
Kittilä	261	6,416	5	2	7
Kiuruvesi	263	8,600		2	2
Kivijärvi	265	1,200		1	1
Kokemäki	271	7,591	1	2	3
Kokkola	272	47,570	1	12	13
Kolari	273	3,848	4	1	5
Konnevesi	275	2,757		1	1
Kontiolahti	276	14,827		4	4
Korsnäs	280	2,201		1	1
Koski Tl	284	2,399		1	1
Kotka	285	54,319	3	14	17
Kouvola	286	85,855	2	21	23
Kristiinankaupunki	287	6,793		2	2
Kruunupyy	288	6,682		2	2
Kuhmo	290	8,806		2	2
Kuhmoinen	291	2,334		1	1
Kumlinge	295	317		1	1
Kuopio	297	112,117	5	28	33
Kuortane	300	3,715		1	1
Kurikka	301	21,734	5	5	10
Kustavi	304	895		1	1
Kuusamo	305	15,688		4	4
Kyyjärvi	312	1,379		1	1
Kärkölä	316	4,604		1	1
Kärsämäki	317	2,658		1	1
Kökar	318	250		1	1
Lahti	398	118,743	21	30	51

Laihia	399	8,090		2	2
Laitila	400	8,520	2	2	4
Lapinjärvi	407	2,774		1	1
Lapinlahti	402	9,982		2	2
Lappajärvi	403	3,215		1	1
Lappeenranta	405	72,875	5	18	23
Lapua	408	14,609		4	4
Laukaa	410	18,865		5	5
Lemi	416	3,073		1	1
Lemland	417	1,991		1	1
Lempäälä	418	22,536		6	6
Leppävirta	420	9,953		2	2
Lestijärvi	421	798		1	1
Lieksa	422	11,772		3	3
Lieto	423	19,263		5	5
Liminka	425	9,937		2	2
Liperi	426	12,338		3	3
Lohja	444	47,353	2	12	14
Loimaa	430	16,467		4	4
Loppi	433	8,175		2	2
Loviisa	434	15,311	2	4	6
Luhanka	435	761		1	1
Lumijoki	436	2,076		1	1
Lumparland	438	398		1	1
Luoto	440	5,147		1	1
Luumäki	441	4,860		1	1
Luvia	442	3,349		1	1
Maalahti	475	5,545		1	1
Maarianhamina	478	11,461		3	3
Marttila	480	2,028		1	1
Masku	481	9,706		2	2
Merijärvi	483	1,134		1	1
Merikarvia	484	3,185		1	1
Miehikkälä	489	2,085		1	1
Mikkeli	491	54,665	3	14	17
Muhos	494	9,063		2	2
Multia	495	1,710		1	1
Muonio	498	2,358	4	1	5
Mustasaari	499	19,302		5	5
Muurame	500	9,791		2	2
Mynämäki	503	7,859		2	2
Myrskylä	504	1,969		1	1
Mäntsälä	505	20,685	8	5	13
Mänttä-Vilppula	508	10,604	2	3	5
Mäntyharju	507	6,159		2	2

Naantali	529	18,961	2	5	7
Nakkila	531	5,651		1	1
Nivala	535	10,876		3	3
Nokia	536	33,162	2	8	10
Nousiainen	538	4,859		1	1
Nurmes	541	7,996		2	2
Nurmijärvi	543	41,897		10	10
Närpiö	545	9,387		2	2
Orimattila	560	16,326		4	4
Oripää	561	1,377		1	1
Orivesi	562	9,408		2	2
Oulainen	563	7,610		2	2
Oulu	564	198,525	181	49	230
Outokumpu	309	7,139		2	2
Padasjoki	576	3,143		1	1
Paimio	577	10,620	3	3	6
Paltamo	578	3,488		1	1
Parainen	445	15,457		4	4
Parikkala	580	5,235		1	1
Parkano	581	6,766		2	2
Pedersören kunta	599	11,129		3	3
Pelkosenniemi	583	958		1	1
Pello	854	3,623		1	1
Perho	584	2,931		1	1
Pertunmaa	588	1,817		1	1
Petäjävesi	592	4,008		1	1
Pieksämäki	593	18,801		5	5
Pielavesi	595	4,740		1	1
Pietarsaari	598	19,436		5	5
Pihtipudas	601	4,221		1	1
Pirkkala	604	18,913		5	5
Polvijärvi	607	4,556		1	1
Pomarkku	608	2,240		1	1
Pori	609	85,363	5	21	26
Pornainen	611	5,125		1	1
Porvoo	638	49,928	20	12	32
Posio	614	3,477		1	1
Pudasjärvi	615	8,257		2	2
Pukkila	616	1,971		1	1
Punkalaidun	619	3,049		1	1
Puolanka	620	2,776		1	1
Puumala	623	2,260		1	1
Pyhtää	624	5,321		1	1
Pyhäjoki	625	3,211		1	1
Pyhäjärvi	626	5,505		1	1

Pyhäntä	630	1,587		1	1
Pyhäranta	631	2,136		1	1
Pälkäne	635	6,676		2	2
Pöytyä	636	8,562		2	2
Raahe	678	25,165		6	6
Raasepori	710	28,405	3	7	10
Raisio	680	24,290	7	6	13
Rantasalmi	681	3,733		1	1
Ranua	683	4,020		1	1
Rauma	684	39,809	3	10	13
Rautalampi	686	3,303		1	1
Rautavaara	687	1,737		1	1
Rautjärvi	689	3,537		1	1
Reisjärvi	691	2,894		1	1
Riihimäki	694	29,269	5	7	12
Ristijärvi	697	1,351		1	1
Rovaniemi	698	61,838	3	15	18
Ruokolahti	700	5,312		1	1
Ruovesi	702	4,623		1	1
Rusko	704	6,110		2	2
Rääkkylä	707	2,349		1	1
Saarijärvi	729	9,915		2	2
Salla	732	3,727		1	1
Salo	734	53,890	2	13	15
Saltvik	736	1,829		1	1
Sastamala	790	25,220	1	6	7
Sauvo	738	3,019		1	1
Savitaipale	739	3,613		1	1
Savonlinna	740	35,523		9	9
Savukoski	742	1,061		1	1
Seinäjoki	743	61,530	3	15	18
Sievi	746	5,124		1	1
Siikainen	747	1,527		1	1
Siikajoki	748	5,466		1	1
Siikalatva	791	5,677		1	1
Siilinjärvi	749	21,794		5	5
Simo	751	3,238		1	1
Sipoo	753	19,399		5	5
Siuntio	755	6,182		2	2
Sodankylä	758	8,782		2	2
Soini	759	2,224	3	1	4
Somero	761	9,093		2	2
Sonkajärvi	762	4,278		1	1
Sotkamo	765	10,523		3	3
Sottunga	766	99		1	1

Sulkava	768	2,724		1	1
Sund	771	1,031		1	1
Suomussalmi	777	8,336		2	2
Suonenjoki	778	7,390		2	2
Sysmä	781	4,040		1	1
Säkylä (Köyliö)	783	7,070	2	2	4
Taipalsaari	831	4,815		1	1
Taivalkoski	832	4,199		1	1
Taivassalo	833	1,633		1	1
Tammela	834	6,280		2	2
Tampere	837	225,118	32	56	88
Tervo	844	1,608		1	1
Tervola	845	3,195		1	1
Teuva	846	5,482		1	1
Tohmajärvi	848	4,738		1	1
Toholampi	849	3,311		1	1
Toivakka	850	2,431		1	1
Tornio	851	22,199		6	6
Turku	853	185,908	29	46	75
Tuusniemi	857	2,719		1	1
Tuusula	858	38,459		10	10
Tyrnävä	859	6,793		2	2
Ulvila	886	13,352		3	3
Urjala	887	4,928		1	1
Utajärvi	889	2,861		1	1
Utsjoki	890	1,250	2	1	3
Uurainen	892	3,666		1	1
Uusikaarlepyy	893	7,564		2	2
Uusikaupunki	895	15,510		4	4
Vaala	785	3,074		1	1
Vaasa	905	67,619	10	17	27
Valkeakoski	908	21,332		5	5
Valtimo	911	2,324		1	1
Vantaa	092	214,605	47	53	100
Varkaus	915	21,638		5	5
Vehmaa	918	2,276		1	1
Vesanto	921	2,191		1	1
Vesilahti	922	4,489		1	1
Veteli	924	3,302		1	1
Vieremä	925	3,757		1	1
Vihti	927	28,919		7	7
Viitasaari	931	6,666		2	2
Vimpeli	934	3,073		1	1
Virolahti	935	3,347		1	1
Virrat	936	7,002		2	2

Vårdö	941	441		1	1
Vöyri	946	6,714		2	2
Ylitornio	976	4,291		1	1
Ylivieska	977	15,039	1	4	5
Ylöjärvi	980	32,738	1	8	9
Ypäjä	981	2,411		1	1
Ähtäri	989	6,068		2	2
Äänekoski	992	19,646		5	5

Table 2: Refilling stations for CNG/CBG and LNG/LBG in 2016 and target for 2020

	Population	CNG stations 2016	CNG stations 2020	LNG stations 2020
Espoo	269,802	2	5	
Forssa	17,422	1	1	
Hamina	20,851	1	2	1
Helsinki	628,208	4	8	1
Hyvinkää	46,463	1	1	
Hämeenlinna	68,011		1	
Imatra	27,835	1	1	
Joutsa	4,688	1	1	
Jyväskylä	137,368		3	1
Järvenpää	40,900		1	
Kerava	35,293		1	
Kotka	54,319	1	1	
Kouvola	85,855	1	1	
Lahti	118,743	1	2	
Lappeenranta	72,875	1	1	
Lempäälä	22,536	1	1	
Leppavesi	9,953	1	1	
Lohja	47,353	2	2	
Mikkeli	54,665		2	
Mäntsälä	20,685	1	1	
Oulu	198,525		2	1
Pori	85,363		1	1
Porvoo	49,928	1	1	
Riihimäki	29,269	1	1	
Seinäjoki	61,530		1	1
Tampere	225,118	1	4	
Tornio	22,199		1	1
Turku	185,908	1	3	1
Uusikaarlepyy	7,564	1	1	
Vaasa	67,619		1	
Vantaa	214,605		2	1
TOTAL		25	55	9