Distribution infrastructure for alternative propulsion systems in transport— monitoring of the national programme 2019

Contents

TO THE READER

Directive 2014/94/EU of the European Parliament and of the Council on the deployment of alternative fuels infrastructure (the 'Infrastructure Directive') entered into force in October 2014. The Directive obliged Member States to draw up by November 2016 a national policy framework for the development of the market as regards alternative fuels for transport and the deployment of the relevant infrastructure. The national policy frameworks were to propose targets and objectives for the organisation of distribution and the measures necessary to achieve them. Finland had finalised its plan by November 2016, and it was submitted to the European Commission at the start of 2017.

According to the Directive, each Member State, once every three years, must submit to the Commission a monitoring report on the implementation of its national distribution infrastructure plan. The first such report has to be sent to the Commission by 18 November 2019.

In April 2019 the Ministry of Transport and Communications set up a working group to draft the plan referred to in the Infrastructure Directive. The working group included representatives from several different ministries, agencies, lobbies and companies. It met seven times in the spring and autumn. The working group completed the monitoring report in early November 2018.

According to its remit, the working group had also to assess the targets, objectives and measures set out in the national plan in 2016 and, where necessary, make proposals to update the plan. This particular task will be completed by the end of 2019.

Päivi Antikainen, Director of Unit

November 2019

1 Introduction

If the long-term climate targets for transport are be reached, fossil fuel in the form of oil in the transport sector must be replaced either with renewable or other zero emission alternatives. These would, for example, be electricity, hydrogen and [liquid] biofuels and biogas. Alternative propulsion systems produced using Finnish raw materials would be a way, not just to cut emissions into the air from traffic, but also to reduce Finland's dependence on crude oil and what it has to pay for it. It would also improve employment prospects and provide new opportunities for exports.

Finland has already begun the switch from conventional fossil fuels to other alternatives. Currently, the alternative fuels used the most are liquid biofuels (ethanol and renewable diesel). At present on the road a biofuel made from renewable raw materials accounts for more than 10% of the fuel when mixed with petrol and diesel, and that share is growing all the time. The use of electricity, natural gas and biogas as fuels for road transport is becoming ever more common, as is the use of gas in shipping. A biofuel quota obligation is being planned for air transport.

It is important to realise that it will not be possible to meet the entire energy need in transport with any single alternative fuel or propulsion system, at least not with the current level of knowledge. The various fuel alternatives also apply to the different transport modes in different ways. Currently, for example, there would only seem to be one realistic alternative to fossil fuel in air transport: liquid biofuels. Furthermore, in maritime transport and heavy duty vehicles (on long journeys) there will be a need for alternative propulsion systems other than electricity, such as methane, even in the long term. That is why measures adopted in Finland and by the EU must safeguard the availability and distribution of all the propulsion alternatives needed.

When policy on alternative propulsion systems is being drawn up, it should be remembered that there should be no competition between the various types of alternative systems. There should simply be renewable, zero emission *alternative propulsion systems* and *fossil fuels*, the use of which should be ended in the longer term.

2 Objectives and targets and their achievement

2.1 Road transport

2.1.1 Objectives and targets for alternative propulsion systems and their achievement

Objectives and targets

An objective of the national distribution infrastructure programme for alternative propulsion systems in transport was that road transport in Finland would be virtually emissions-free by 2050. Passenger cars and vans would run on electricity or hydrogen produced from *either renewable materials or those with zero emissions* or biofuels (liquid biofuels and biogas)[1]. These would account for almost 100% of the energy used in road transport. By 2030, the share of alternative propulsion systems in road traffic would be at least 40% (double counting of biofuels not included). By 2020 it would be 20% (double counting of biofuels included).

Achievement of objectives and targets

The latest statistics on energy consumption in Finland are for 2017. Then alternative propulsion systems accounted for around 11% of the energy consumed in Finland in road transport. Liquid fuels accounted for 10.1% (double counting included gives 18.7%). Electricity accounted for 0.5%, natural gas for 0.1%, and biogas for 0.1%

[1] The target for 2050 does not therefore include all the alternative propulsion systems mentioned in the Infrastructure Directive, but is just based on renewables and emission-free fuels.

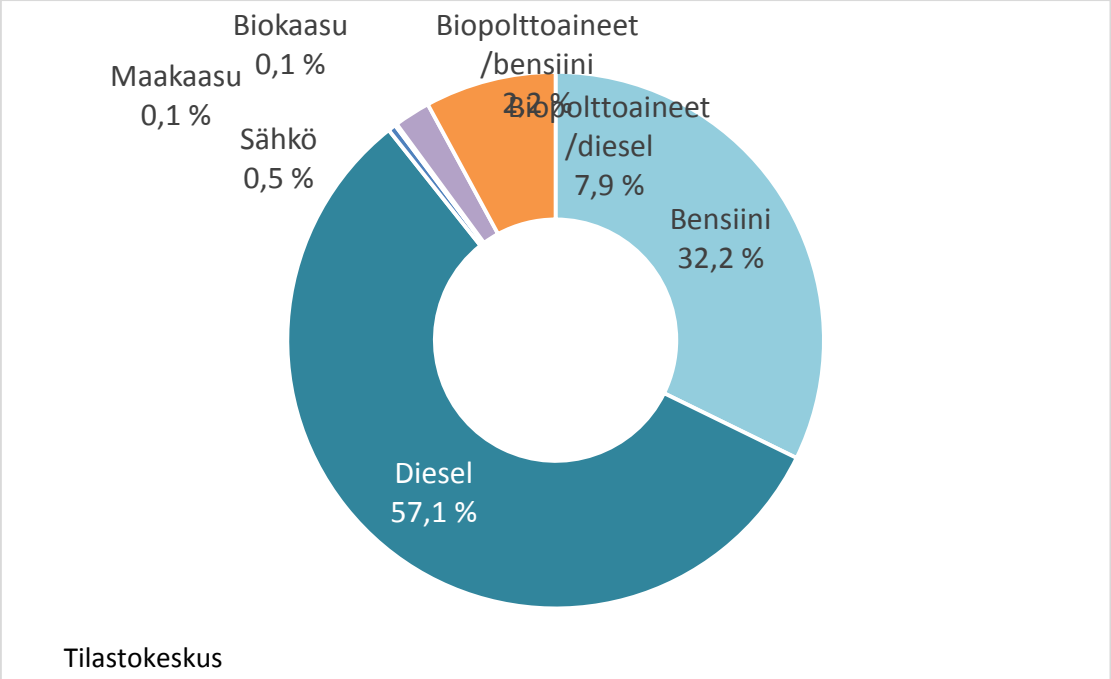

Figure 1: Different propulsion systems accounting for total energy consumption in road transport in 2017 (TJ per annum) (double counting not included).

Key
Biokaasu = Biogas
Biopolttoainreet/bensiini = Biofuels/petrol
Maakasu = Natural gas
Sähkö = Electricity
Bensiini = Petrol

Statistics on liquid fuels and gas are based on the volumes of fuel sold at filling stations. The estimate for volumes of electricity used in transport on the other hand differs from those for other propulsion systems. Vehicles are also recharged at locations other than public charging stations, for example at home or at work, and the amount of electricity used for transport cannot always be separated from the total electricity consumption for a building. For that reason, the consumption of electricity in transport is based on the number of electric vehicles registered in Finland (statistics) and the number of kilometres driven in electric vehicles (estimated)[2]. As for plug-in hybrids, an estimate also needs to be made of the number of kilometres driven on

[2] The number of electric vehicles (pure electric vehicles and plug-in hybrids) in Finland in autumn 2019 was approximately 25 400, and the average distance they travel each year is estimated at 17 300 kilometres (the same as for petrol-driven vehicles).

electricity as a proportion of the total number of kilometres driven[3]. A rough estimate is still a valid approach, since there are not many such vehicles on the road. The assessment method will have to improve as the number of such vehicles and the use of electricity for transport increase.

The predicted trends for 2020/2025/2030

The target for 2020 (alternative propulsion systems accounting for 20% of the energy consumed in road transport, including the double counting of advanced biofuels) is likely to be achieved.

It is possible to reach the target for 2030 (alternative propulsion systems accounting for 40% of the energy consumed in road transport), though no longer solely with liquid biofuels, as with the target for 2020. Liquid biofuels are most likely to account for 30% of the total in 2030, because the target is laid down in legislation, but the rest should be achieved through the increased use of (hydrogen), electricity and gas.

2.1.2 Objectives and targets for vehicles and their achievement

2.1.2.1 All vehicles

Objectives and targets

An objective of the national distribution infrastructure programme for alternative propulsion systems in transport was that all passenger cars in Finland would be virtually emissions-free by 2050. Because the car fleet in Finland has previously been replaced very slowly overall, once every 15 to 20 years approximately, the aim is for all new passenger cars and vans sold in Finland to be able to use an alternative propulsion system by 2030. The target for 2025 is for 50% of new passenger cars and vans to be able to use some alternative propulsion system, and the target for 2020 is 20%[4].

[3] Plug-in hybrids use electricity for an estimated 75% of the total number of kilometres driven in Finland.
[4] These figures would also include vehicles that run on 100% renewable diesel and which do not rely on any special technology to do so. For this reason, the report uses the term *'alternative technologies'* when discussing vehicles that rely on a new

The objective with heavy-duty vehicles too is for all new trucks and buses to be able to use an alternative propulsion system by 2030. The target for 2025 is for 60% of new trucks and buses to be compatible with an alternative propulsion system, and the target for 2020 is 40% [5].

Achievement of objectives and targets

Passenger cars

In 2018, a total of 120 504 passenger cars were registered for the first time in Finland. In all, 5.7% of them ran on electricity, gas or high blend ethanol. Between January and September 2019, 6 499 passenger cars using these alternative technologies were registered for the first time, accounting for around 7.4% of all newly registered vehicles of this type. In 2018, diesel cars accounted for 24.0% of newly registered cars, and between January and September 2019, the figure was 18.9%. Diesel cars can be regarded as contributing to the achievement of the target if they run on 100% renewable diesel.

In recent years there has been a rise in the number of used passenger cars imported into Finland from abroad. In 2018 the figure was 39 700, and for 2019 the automotive industry predicted that that number would increase to around 46 000. Cars are mainly imported from Sweden and Germany.

In terms of the propulsion system used, most were diesel vehicles in the period January-June 2019. They accounted for almost half of the total, although the number was falling. Imports of petrol cars increased and their share of the total rose to 36%. The sharpest relative increase, however, is in plug-in hybrids. The number of these vehicles imported has almost trebled since last year and they now account for 13% of all imported vehicles. Imports of electric vehicles into Finland have doubled, reaching a total of 171.

At the end of 2018 there were 2 696 334 passenger cars in all on the road in Finland. Of these, 71.2% were petrol cars and 27.8% diesel cars. Alternative technologies

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technology to make use of alternative propulsion systems (electricity, gas, ethanol and hydrogen), and the term *'alternative propulsion systems'* where it includes renewable diesel that is suitable as is for normal vehicles.

[5] The target for heavy-duty vehicles is higher than that for passenger cars because a larger number of truck and bus manufacturers (in practice, all) now also allow the use of renewable diesel as is with their new vehicles. The number allowing such use is smaller for passenger cars.

(electricity, gas and high blend ethanol) accounted for just 1% of all passenger cars in the country.

At the end of September 2019, 70.6% of the car fleet used petrol, 28.0% used diesel and 1.35% used alternative technologies.

Vans

In 2018, a total of 15 515 vans were registered for the first time in Finland, 98.2% of which were diesel vans. A total of 96 newly registered vans used electricity or gas, accounting for 0.6% of the total for 2018. Between January and September 2019, 93 vans using electricity and gas were registered for the first time, accounting for around 1.0% of all newly registered vehicles of this type. Between January and September 2019, diesel vehicles accounted for 98.0% of newly registered vans. No vans using high blend ethanol were newly registered in the period 2018-2019.

Towards the end of 2018 the number of vans on the road totalled 325 656. In the period 2008-2018 the number of vans rose on average by 4 000 vehicles per annum. The number of smaller vans on the road has gone down every year, while the number of larger vans weighing more than 2 600 kilos has increased. In September 2019, the number of vans on the road was 337 753.

At the end of 2018, 96.6% of vans on the road were diesel and 3.1% ran on petrol. Around 0.3% of vans used alternative technologies. At the end of September 2019, 3.3% of the van fleet used petrol, 96.4% used diesel and 0.3% used alternative technologies.

Buses

In 2018, a total of 475 buses were registered for the first time in Finland, of which 470 (98.9%) were diesel vehicles, one was electric and four ran on gas. Between January and September 2019, there were 409 newly registered buses in Finland, 34 of which were electric (8.3%), five of which used gas (1.2%), with the remaining 370 (90.5%) running on diesel.

At the end of 2018, there were 12 481 buses on the road in all. At the end of 2018, 99.2% of the buses on the road used diesel, and 0.2% used petrol. At the end of 2018, alternative technologies accounted for just 0.6% of the propulsion systems for buses. At the end of September 2019, the total number of buses in use was 12 841; 0.2% of the buses on the road used petrol, 98.9% used diesel, and 0.93% used alternative propulsion systems (renewable diesel excluded) (56 vehicles using

electricity, three plug-in hybrids, 53 using gas or bi-fuel, three using liquid gas, two using ethanol and two using other systems).

Trucks

In 2018, a total of 3 898 trucks were registered for the first time in Finland, of which 3 805 (97.6%) were diesel vehicles. In addition, there were registrations for 22 (0.6%) trucks running entirely or partly on compressed natural gas (CNG), three plug-in hybrids and one ethanol truck. Between January and September 2019, a total of 3 133 trucks were newly registered, of which 2 957 (94.4%) were diesel, 113 (3.6%) were petrol, 33 (1.1%) used gas, two ran on a fuel with a high ethanol concentration, and 27 (0.9%) used other systems.

At the end of 2018 there were 96 169 trucks on the road in all. In the period 2008-2018 the number of trucks rose on average by 300 vehicles per annum. Around half of all trucks have an overall mass of 3 500-12 000 kilos (vehicle category N2) and half weigh in excess of 12 000 kilos (vehicle category N3). Almost 40% of vehicles in category N3 have an overall mass of more than 24 000 kilos. The number of small trucks in use in Finland is going down gradually, while the number of larger trucks is growing.

At the end of 2018, 98.1% of trucks on the road were diesel trucks and 1.6% ran on petrol. At the end of 2018, alternative technologies accounted for 0.2% of all trucks on the road.

The predicted trends for 2020/2025/2030

Given the number of diesel vehicles in use and the general use of renewable diesel, the targets for 2020 and 2025 are likely to be achieved. For now it is uncertain as to whether the 2030 target will be achieved.

2.1.2.2 Electricity

Objectives and targets

An objective of the national distribution infrastructure programme for alternative propulsion systems in transport was that by 2020 there would be at least 20 000 electric passenger cars and 2 000 electric vans on the road in Finland. The target for 2030 is for at least 250 000 electric passenger cars and 13 000 electric

vans. These targets do not distinguish between pure electric vehicles and plug-in hybrids.

Table: Targets for electric vehicles in the national distribution infrastructure programme (includes pure electric vehicles and plug-in hybrids)

	2020	**2025**	**2030**
Passenger cars	20 000	100 000	250 000
Vans	2 000	6 000	13 000
Trucks	No specific targets	No specific targets	No specific targets
Buses	No specific targets	No specific targets	No specific targets

Achievement of objectives and targets

At the end of September 2019 there were approximately 27 669 plug-in electric vehicles on the road in Finland[6]. Of these, 25 033 were electric passenger cars (4 204 pure electric and 20 829 plug-in hybrids), and thus the target in the national programme for 2020 has already been achieved in this category. Pure electric vehicles accounted for around 16% of all electric passenger cars in Finland. The figure in the international context is around 60%[7]. There were 338 electric vans on the road in total, 59 electric buses and two electric trucks. There were around 2 237 other plug-in electric vehicles in use (electric mopeds, electric motor cycles, electric non-road mobile machinery, etc.).

In the period January - October 2019, electric vehicles accounted for 5.4% of all new vehicles sold.

[6] Traficom statistical database; 4.11.2019
[7] IEA 2018a

The share of pure electric vehicles and plug-in hybrids in all imported used vehicles has increased substantially. Between January and September 2019, 2 605 used plug-in hybrids were imported into Finland. The corresponding number for 2018 (January - September) was 893.

Electric cars accounted for approximately 0.9% of all passenger cars in the country in autumn 2019.

Figure 2: Electric passenger cars on the road in Finland
(Total for passenger cars = approximately 2 700 000)

Key
Täyssähköautot = Pure electric vehicles
Ladattavat hybridit = Plug-in hybrids

Figure 3: Electric vans on the road in Finland
(Total for vans = approximately 326 000)

Key
Täyssähköautot = Pure electric vehicles
Ladattavat hybridit = Plug-in hybrids

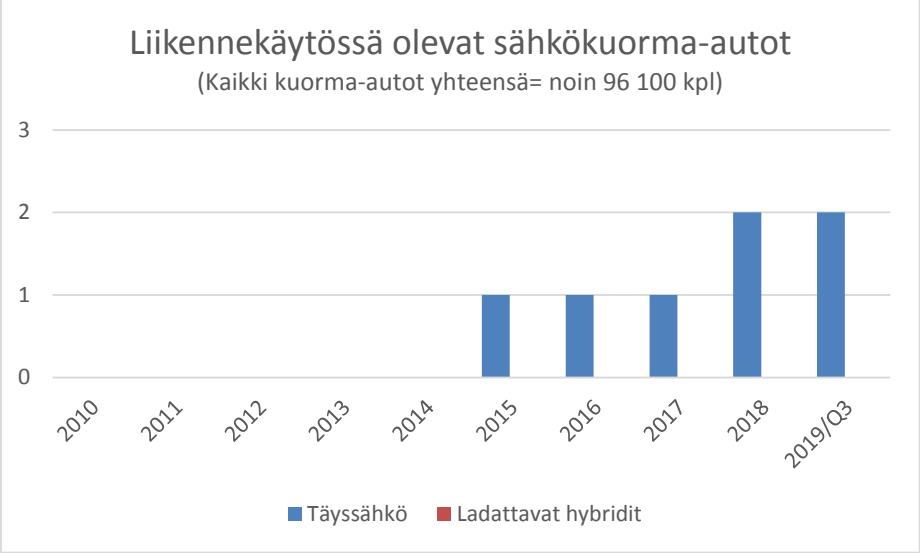

Figure 4: Electric trucks on the road in Finland
(Total for trucks = approximately 96 100)
Key
Täyssähköautot = Pure electric vehicles
Ladattavat hybridit = Plug-in hybrids

Figure 5: Electric buses on the road in Finland
(Total for buses = approximately 12 700)

Key
Täyssähköautot = Pure electric vehicles
Ladattavat hybridit = Plug-in hybrids

The predicted trends for 2020/2025/2030

In the Gaselli research project carried out by VTT Technical Research Centre of Finland in 2018, an estimate was made of the increase in the electric vehicle fleet in Finland up until the year 2030[8]. It would appear that the target in the national distribution infrastructure programme for at least 250 000 electric vehicles by 2030 could now be easily achieved with the current steering instruments in place and the choice of vehicles now available. The Gaselli project predicts that the number of electric vehicles on the road in 2030 will be 370 000. Most of these, some 290 000, would be plug-in hybrids.

[8] https://cris.vtt.fi/en/publications/s%C3%A4hk%C3%B6-ja-kaasuautojen-markkinan%C3%A4kym%C3%A4t-suomessa-gaselli-v%C3%A4liraport

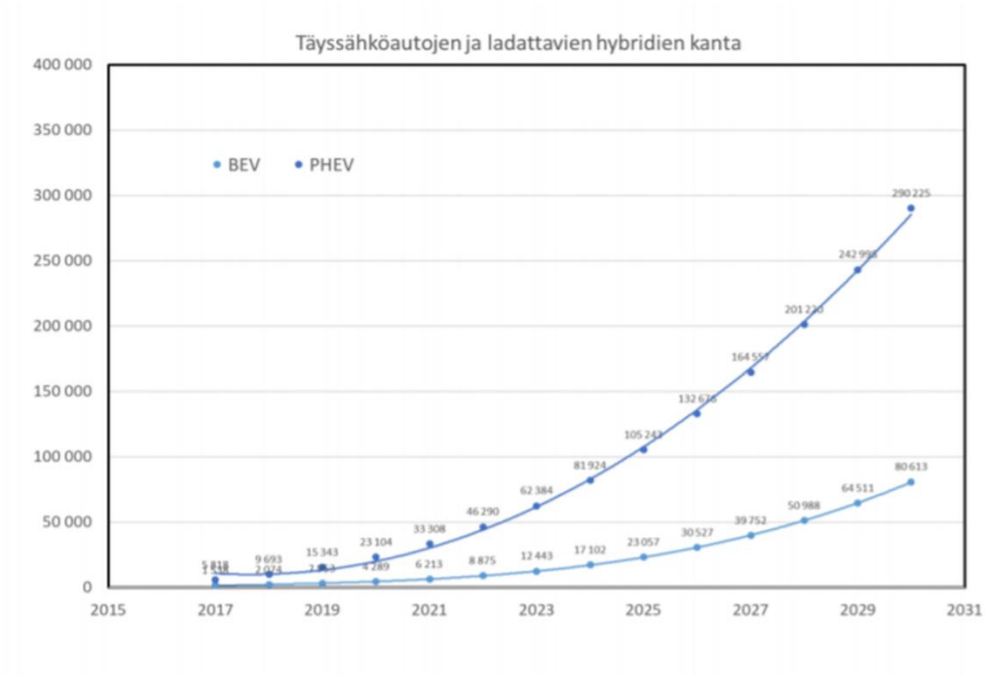

Figure 6: Predicted trend for the number of electric vehicles in Finland with the current instruments in place (VTT Technical Research Centre of Finland/Gaselli interim report 2018)

Key
Täyssähköautojen ja ladattavien hybridien kanta =
Number of pure electric vehicles and plug-in hybrids

In the Gaselli project the number of electric vehicles was also modelled with reference to trends in vehicle models and possible new steering instruments[9]. By 2025 there would be at least 200 new electric vehicle models coming onto the market according to various strategic plans announced by car manufacturers. Longer ranges and the expansion of the vehicle selection to cheaper size vehicles will make pure electric vehicles a more attractive prospect. The purchase price of electric vehicles will probably match that for combustion engine vehicles by 2025. Fairly long delivery times, however, might restrict growth. According to the Gaselli project model, combining several different steering instruments in Finland could result in approximately 300 000 pure electric vehicles and some 230 000 plug-in hybrids on the road by 2030. The model suggested that measures that would affect the number

[9] http://julkaisut.valtioneuvosto.fi/handle/10024/161364

of electric vehicles included at the very least the purchase price (car tax and incentives to purchase such vehicles), the vehicle tax, the promotion of recharging points at home, the promotion of electric company cars, communications and marketing.

In spring 2019, the automotive industry in Finland made its own forecast for the use of different alternative propulsion systems up until 2030[10]. As with the Gaselli project forecast, the automotive industry predicts that the first registration of vehicles will continue in the same way as currently, and motorists will have to pay more or less the same road tax and prices as they do today. In its baseline projection for purchases of electric and gas vehicles, it is assumed that there will be no new incentives for purchasing such vehicles in addition to the current ones. The automotive industry's forecast for numbers of electric vehicles in 2030 is around 360 000. Of these, some 135 000 would be pure electric vehicles and around 225 000 would be plug-in hybrids.

The automotive industry also estimated vehicle numbers in a situation where new steering instruments would be adopted (the 'automotive industry roadmap')[11]. With new instruments in place, the renewal rate for the national vehicle fleet would be speeded up, and alternative propulsion systems would become more widespread. According to the automotive industry road map, the number of electric vehicles on the road by 2030 would be 580 000. Of these, some 230 000 would be pure electric vehicles and around 350 000 would be plug-in hybrids.

The automotive industry's estimate also covered the use of heavy-duty electric fleets in Finland. According to the automotive industry's baseline projection, there will be approximately 1 000 electric buses on the road by 2030 (809 pure electric and 191 plug-in hybrids) and some 2 000 electric trucks (900 pure electric and 1 100 plug-in hybrids). One of the main factors affecting propulsion systems for heavy-duty fleets in Finland (as elsewhere in Europe) is Directive (EU) 2019/1161 of the European Parliament and of the Council amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles adopted in June 2019.

[10] http://www.aut.fi/ymparisto/autoalan_tiekartta_tulevaisuuden_kayttovoimista
[11] http://www.aut.fi/ymparisto/autoalan_tiekartta_tulevaisuuden_kayttovoimista

2.1.2.3 Natural and biogas (methane)

Objectives and targets

An objective of the national distribution infrastructure programme for alternative propulsion systems in transport was that by 2020 there would be at least 5 000 passenger cars and 800 vans running on gas in Finland. The target for 2030 is for at least 50 000 gas passenger cars and 3 000 gas vans. There are no separate targets for heavy-duty vehicles or vehicles using liquefied methane.

Table: Targets for gas vehicles (CNG, CBG) in the national distribution infrastructure programme

	2020	**2025**	**2030**
Passenger cars	5 000	15 000	50 000
Vans	800	2 000	3 000
Trucks	No specific targets	No specific targets	No separate targets
Buses	No specific targets	No specific targets	No specific targets

Achievement of objectives and targets

In Finland at the end of September 2019, there were approximately 9 057 vehicles on the road using compressed gas (CNG, CBG) and, furthermore, the first vehicles running on liquefied gas (LNG, LBG) had started to be used[12]. Gas-fuelled passenger cars numbered 8 106 in total, and there were 680 gas-fuelled vans on the road. The

[12] Traficom statistical database, 4.11.2019

targets for 2020 for gas-fuelled passenger cars in the national programme had therefore been achieved.

In the period January - September 2019, gas vehicles accounted for 1.5% of all new vehicles sold. The number of newly registered gas vehicles by the end of September 2019 was slightly below the figure for 2018. One of the reasons for the decline was probably the availability problems with such vehicles in early 2019 due to the WLTP (Worldwide Harmonised Light Vehicles Test) emissions measurement procedure.

In 2019 a substantial number of gas vehicles were imported into Finland, including used ones, from other countries. Between January and October a total of 1 488 imported gas vehicles were newly registered in Finland. Of that number, 1 342 were passenger cars.

Attempts have also been made to increase the number of gas vehicles in Finland by means of what has been called the 'conversion subsidy'[13]. In all, 102 petrol engine vehicles were converted to gas-fuelled vehicles in Finland in 2018 by means of subsidies paid to their owners. Between January and September 2019, 112 vehicles were converted in this way.

Gas vehicles accounted for approximately 0.3% of all passenger cars in the country in autumn 2019.

Figure 7: Gas-fuelled passenger cars on the road in Finland
(Total for cars = approximately 2 700 000)

[13] See more on the conversion subsidy scheme in section 3.2.3.

Figure 8: Gas-fuelled vans on the road in Finland
(Total for vans = approximately 326 000)

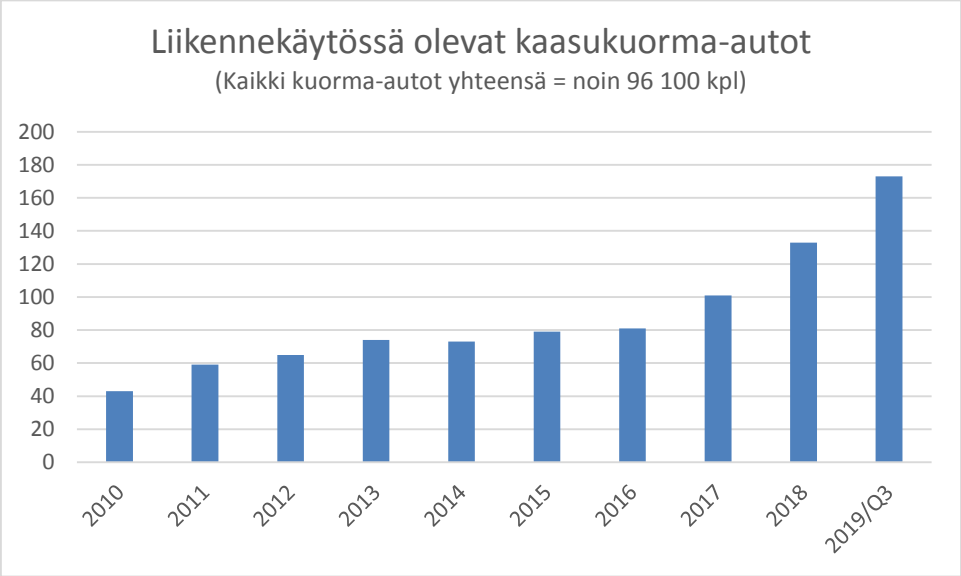

Figure 9: Gas-fuelled trucks on the road in Finland
(Total for trucks = approximately 96 100)

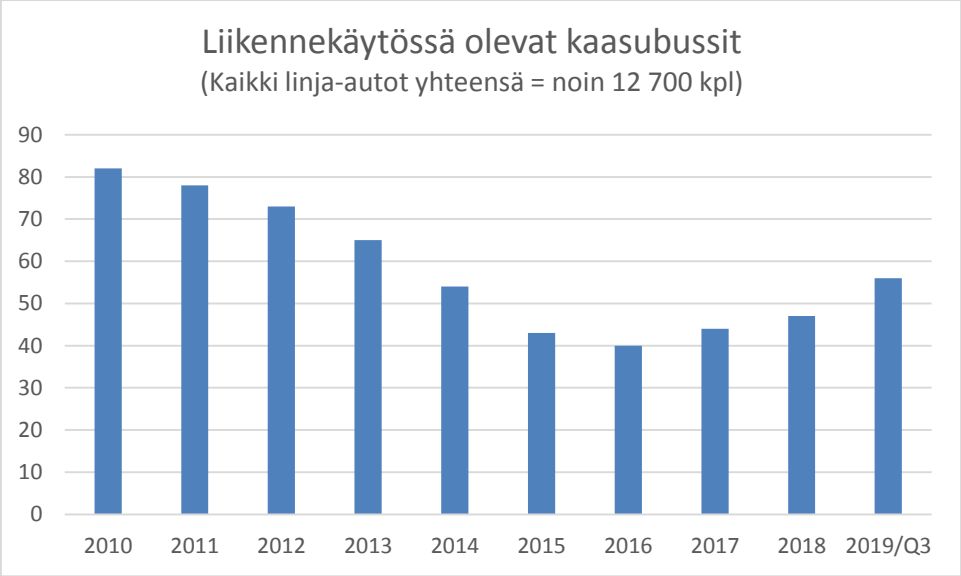

Figure 10: Gas-fuelled buses on the road in Finland
(Total for buses = approximately 12 700)

The predicted trends for 2020/2025/2030

In the Gaselli research project carried out by VTT Technical Research Centre of Finland in 2018, an estimate was made of the increase in the number of gas-fuelled vehicles on the road in Finland up until the year 2030[14]. The availability of gas vehicles and their purchase price are not currently a barrier to acquiring one. The target in the national distribution infrastructure programme for at least 50 000 gas vehicles on the road by 2030 is, according to the assessment conducted in the project, possible to achieve with the steering instruments in place and the present range of vehicles. The main issue with regard to gas vehicles is the need to continue expanding the refuelling infrastructure. Since 2017, two factors that have probably had a favourable impact on market growth is the continuing robust campaigning on the part of a Finnish gas sector operator (campaigns for fixed monthly charges, for example) and cooperation with leasing companies.

[14] https://tietokayttoon.fi/julkaisut/raportti?pubid=URN:ISBN:978-952-287-631-7

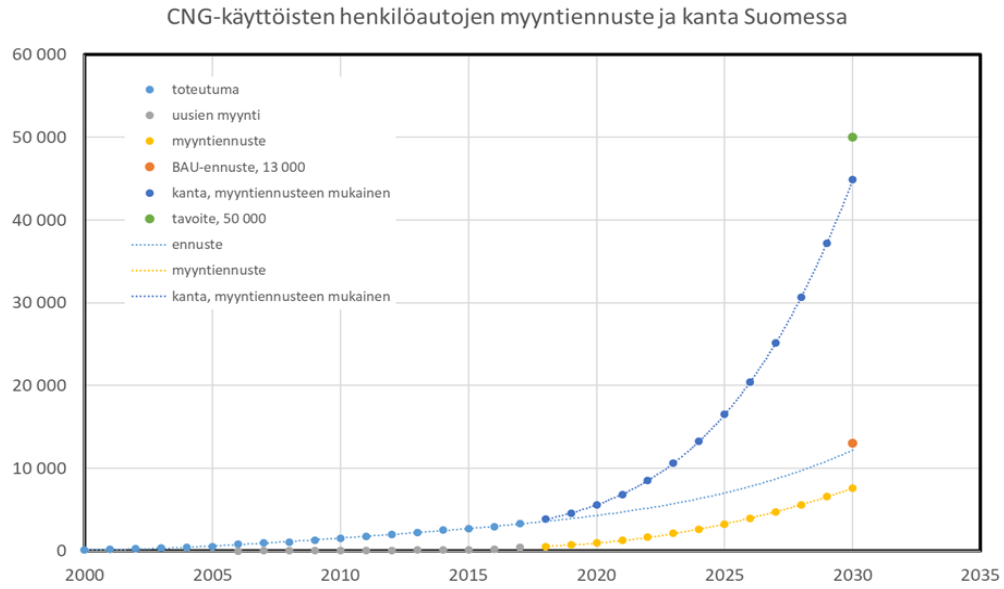

Figure 11: Predicted trend for the number of gas-fuelled passenger cars in Finland with the steering instruments in place (VTT Technical Research Centre of Finland/Gaselli 2019)

Key
CNG-käyttöisten henkilöautojen myyntiennuste ja kanta Suomessa =
Sales forecast for CNG-fuelled cars and their number in Finland
Toteuma = total
Uusien myynti = sales of new cars
Myyntiennuste = sales forecast
BAU-ennuste, 13 000 = BAU forecast, 13 000
Kanta, myyntienusteen mukainen = Fleet according to the sales forecast
Tavoite, 30 000 = Target, 30 000
Ennuste = forecast
Myyntiennuste = sales forecast

The automotive industry's baseline projection for the number of gas-fuelled passenger cars in 2030 is an estimated 43 800 (with current steering instruments)[15]. In the automotive industry's roadmap, which incorporates some new instruments, the

[15] http://www.aut.fi/ymparisto/autoalan_tiekartta_tulevaisuuden_kayttovoimista

number of gas cars would be 57 000[16]. Steering instruments would include at least company car incentives and the scrapping premium.

The automotive industry's baseline projection also looked at trends in the numbers of gas trucks and buses on the road in Finland. There is now relatively comprehensive availability of heavy duty vehicles that run on methane. Buses, trucks used for urban freight distribution, and refuse collection vehicles mainly use compressed gas (CNG, CBG), though for long-distance lorries the gas is often in liquefied form (LNG, LBG). Amending Directive (EU) 2019/1161 on the promotion of clean and energy-efficient road transport vehicles will also increase the number of gas-fuelled buses used for local public transport. It will have no impact, however, on long-distance buses.

The automotive industry's baseline projection suggested that there would be around 1 800 gas-fuelled buses, refuse collection vehicles and trucks on the road in Finland by 2030. If new steering instruments were adopted, the number of heavy duty gas vehicles would rise to around 3 000[17][18].

The future of gas vehicles depends largely on the trend for CO2 limit values affecting vehicle manufacturers in the EU. Current limit values strongly favour electricity. As at present the method for measuring and notifying specific emissions (g/km) does not take account of the fossil content or renewability of used fuel (the emissions are measured from the exhaust pipe, 'tank-to-wheels' [TTW], and not as a fuel lifecycle emission, 'well-to-wheels' [WTW]), the notified gas vehicle emissions always correspond to the emission amount for natural gas (and not biogas). This does little to help vehicle manufacturers reduce the average emissions readings for the vehicles they make. For that reason there is a risk that the supply of gas vehicles in the future will decline rather than grow.

The possible decline in the supply of gas vehicles in the future is a problematic development, especially for the emission reduction targets for heavy duty vehicles. Current levels of expertise, at least, do not allow for heavy duty vehicles to switch completely to electricity, and so other alternative propulsion systems, such as biogas, will be needed. As regards passenger cars, it is hoped that vehicle manufacturers will continue to include technology based on the use of methane, as cars running on

[16] http://www.aut.fi/ymparisto/autoalan_tiekartta_tulevaisuuden_kayttovoimista
[17] The automotive industry's forecast/roadmap does not distinguish between compressed or liquefied gas vehicles.
[18] No specific targets have been set in the national distribution infrastructure programme for heavy duty gas-fuelled vehicles.

biogas generate the same specific emissions as pure electric cars when ‘well-to-wheels’ emissions are measured.

2.1.2.4 Hydrogen

Objectives and targets

There were no specific targets in the national distribution infrastructure programme for numbers of hydrogen vehicles. These were included in the target for electric vehicles (at least 250 000 by 2030).

Achievement of objectives and targets

In June 2019 there was just one hydrogen passenger car on the road in Finland. The number did not change between 2016 and 2019.

The predicted trends for 2020/2025/2030

The generalised use of hydrogen vehicles does not seem to be making any market progress in Finland.

2.1.2.5 Liquid biofuels

Objectives and targets

An objective of the national distribution infrastructure programme for alternative propulsion systems in transport was for all new passenger cars and vans sold in Finland to be compatible with an alternative propulsion system by 2030. The target for 2025 is for 50% of new cars and vans to be able to use some alternative mode of propulsion, whilst the target for 2020 is 20%. These figures also include vehicles that run on 100% renewable diesel and do not rely on any special technology to do so. They also include vehicles that run on high blend biofuels that rely on their own vehicle technology, such as flexfuel vehicles that can use high blend ethanol (‘ethanol-fuelled vehicles’).

The objective for heavy-duty vehicles too is for all new trucks and buses to be able to use an alternative propulsion system by 2030. The target for 2025 is for 60% of new trucks and buses to be compatible with an alternative mode of propulsion, whilst the target for 2020 is 40%. As with cars, these figures include vehicles that run on 100% renewable diesel (diesel-fuelled vehicles) and vehicles that run on high blend biofuels that rely on their own vehicle technology, such as those that use ED95 fuel that can use high blend ethanol.

Achievement of objectives and targets

According to statistics, in autumn 2019 there were approximately 4 300 high blend ethanol (E85) (flexfuel) vehicles on the road in Finland. Ethanol-fuelled passenger cars numbered 4 268 in total, and there were 11 such vans on the road. However, not all flex-fuel vehicles necessarily appear in the statistics. Vehicles that are later converted to ethanol-fuelled vehicles do appear in the statistics but only if, after conversion, they have been inspected and the inspection centre has incorporated this information under ‘vehicle’s propulsion system’ in the vehicle’s registration details.

Not one new flexfuel vehicle was sold in Finland in 2019, as there is no supply of such vehicles at present in Finland or anywhere else in Europe. The legislation on limit values based on TTW (exhaust pipe) emissions hardly encourages vehicle manufacturers to bring flexfuel vehicles onto the market in Europe.

Attempts have been made to increase the number of flexfuel vehicles in Finland by means of conversion subsidies[19]. State subsidies were granted to have 1 268 old petrol vehicles converted to high blend ethanol vehicles in 2018. There were 1 295 such conversions in the period January-October 2019. In Finland, any petrol vehicle can be converted to one using ethanol, but Traficom, the Finnish Transport and Communications Agency, recommends that conversions be carried out only on older vehicles registered before 1 January 2007, in order to ensure that they comply with the earlier emission regulations also after conversion[20]. Traficom’s new draft regulation[21] proposes that that date be changed to 1 September 2009.

[19] See more on the conversion subsidy scheme in section 3.2.3.
[20] In the inspection, a converted vehicle can only pass if it also complies with the exhaust emission regulations in force at the time of manufacturing the vehicle. This is likely with old vehicles, because the earlier regulations were not very stringent. With new vehicles, the regulations are tighter and compliance with them is less certain.
[21] TRAFICOM/194495/03.04.03.00/2019

In Finland a few refuse collection trucks and trucks used for freight distribution run on ED95 ethanol diesel. ED95 is also used to power some ethanol-fuelled buses used in public transport in Helsinki (operated by the Helsinki Regional Transport Authority).

At the end of September 2019 there were approximately 755 000 diesel passenger cars on the road in Finland, accounting for around 28% of all cars. Between January and September diesel cars accounted for 18.9% of all newly registered vehicles. Nearly all heavy duty vehicles run on diesel. The prospects for having a vehicle fleet in Finland that runs entirely on renewable diesel would therefore seem good. The use of renewable diesel is mainly restricted by the limited network of refuelling stations and higher prices than ordinary diesel at the pump.

Its use is nevertheless on the rise in Finland for both passenger cars and heavy duty vehicles. Users include many bus companies, transport companies and taxis. The use of renewable diesel is also increasing for non-road mobile machinery. In the Helsinki metropolitan area, a scoring system used in invitations to tender has promoted the use of alternative fuels in bus transport.

The predicted trends for 2020/2025/2030

Currently, the wider use of ethanol vehicles relies exclusively on conversions. As conversions, at least for now, are mainly restricted to old vehicles, the increase in the number of flexfuel vehicles may come to a halt in a few years unless new flexfuel vehicles enter the market or the guidelines on conversions in Finland change.

The main barrier to any growth in the number of vehicles running on ED96 is the interpretation of the Energy Taxation Directive at national level. The interpretations is that the minimum rate of tax for diesel must apply to ED95. Consequently, the price of the fuel will not motivate transport operators to invest in vehicles that run on ED95.

The number of newly registered passenger cars running on diesel is in decline in Finland, as elsewhere in Europe. Each year, however, a considerable number of used diesel vehicles are imported into Finland from such countries as Sweden and Germany. For that reason, the number of diesel vehicles as a share of the passenger cars fleet has remained fairly high in Finland. In the future, though, it is probable that there will be fewer petrol and diesel cars in the country as the number of vehicles using alternative propulsion systems increases. As for heavy duty vehicles, it is forecast that a large number will continue to run on diesel even in the longer term too.

2.1.3 Objectives and targets for the distribution infrastructure and their achievement

2.1.3.1 Electricity

Objectives and targets

An objective in the national distribution infrastructure programme for alternative propulsion systems in transport was for Finland to build an electrical distribution network for transport that would reflect the recommendations in the Infrastructure Directive by 2020-2030. Given the number of electric vehicles, this would mean at least 2 000 public recharging points accessible to the public by 2020, and at least 25 000 by 2030[22]. Fast charge points should number around 200 by 2050 and 2 500 by 2030.

The network of recharging points would cover all municipalities, cities and towns, transport hubs, ports, railway stations and airports in the TEN-T (Trans-European Transport Network) core and comprehensive networks, and the main road network, including highways.

No specific targets were set in the national distribution infrastructure programme for the recharging or home recharging network for heavy duty vehicles. The plan with regard to the infrastructure for recharging at home has been for every electric vehicle to have its own home recharging point.

Achievement of objectives and targets

According to the industry's own estimates, in autumn 2019 in Finland there were 818 public recharging points and 2 408 standard recharging points accessible to the public[23]. The ratio of public standard recharging points to the number of electric vehicles on the road was 1:9 at the end of September. That number slightly exceeds the recommendation in the Distribution Infrastructure Directive (1:10).

[22] Recharging points accessible to the public do not refer just to recharging points in public places but to points that can be used by all vehicles generally.

[23] AC – Type2 and Tesla Destination Charger

There were 179 public fast charge stations and 211 public fast charge[24] points. The ratio of public fast charge stations to the number of pure electric vehicles was 1:20 at the end of September. That number easily exceeds the recommendation in the Distribution Infrastructure Directive (1:100).

Public recharging stations and points are not evenly spread throughout Finland; most have been established in places that currently have the majority of vehicles. Around 48% of all the recharging stations in Finland are in the Helsinki metropolitan area or in or around Tampere and Turku. There are still major gaps in the recharging network, especially in north-eastern and northern Finland.

[24] DC - CCS, Tesla Supercharger and CHAdeMO

Figure 12: Fast charge stations in Finland 12.6.2019 ((CCS >22 kW)

A network of super-fast charging stations is also emerging in Finland. Fortum introduced Finland's first high power recharging point in Lohja (150 kW to start with, later up to 300 kW), and K-Lataus and IONITY together intend to introduce in Finland recharging stations with a capacity of up to 350 kW along the motorways from Helsinki to Turku, Tampere and Lahti. Tesla is also opening new stations in its Supercharger network in 2019.

The recharging infrastructure for electric buses is for now mainly concentrated in the Helsinki metropolitan area. A pilot scheme for electric buses has been introduced on certain routes in Turku and Tampere, with the number of chargers being specific to those routes.

In the Helsinki metropolitan area there are now seven chargers used for the fast charging of electric buses. Towards the end of 2019 there will be more recharging points in the capital district when the first electric bus routes put out to tender start operating and the recharging service experiment begins.

Other heavy duty vehicles have so far relied on their own on (private) recharging infrastructure. At present in Finland there are only a few individual larger electric vehicles.

Home charging

The typical resident of a detached property can charge his or her vehicle using the electrical supply for the property, and there is nothing to stop residents from making charging arrangements of this kind. A restricting factor, however, is the size of the electrical connection, which with a typical detached home is 3 x 25A. The charging current must always be adjusted to a level where the property's main fuses can also withstand the rest of the property's electrical load.

Organising a recharging point in a housing cooperative depends on how the ownership of the parking spaces has been determined. A decision to introduce recharging points or authorise a shareholder to acquire one will always depend on the owner of the property. Housing cooperatives observe the principle of the equal treatment of their shareholders: shareholders of equal status must be treated in the same way. In housing cooperatives the decision also depends on whether the issue concerns a standard renovation or modernisation. If the change is seen as standard, the unanimous consent of all shareholders is not needed at the AGM, and a simple majority is sufficient. The Finnish Real Estate Federation and the Finnish Real Estate Management Federation recently interpreted the situation as follows: the establishment of recharging points for electric vehicles at parking spaces managed by a housing cooperative may basically be regarded as a standard renovation or modernisation.

The situation, especially with old companies that own blocks of flats in the central areas of cities, is frequently that the company either has no parking spaces at all or there are far fewer parking spaces than shareholders. In such cases, a barrier to organising a home charging facility is that the parking space for which a recharging

point might be acquired is not available, and even if a parking space were available, there would have to be consensus about allocating the parking spaces. In such a case, drivers of electric vehicles might have to use the public recharging network. There are so far few public EV recharging facilities in residents' parking areas and along streets, although there are more and more recharging points in car parks.

According to a survey carried out in 2018 in Finland, approximately 3% of the respondents report that a recharging point or points have been introduced by a housing cooperative either as a special project or as a private conversion project on the part of a shareholder. Two per cent or so of the respondents said that the establishment of recharging points was pending, and some 20% of the housing cooperatives that responded were planning to introduce a recharging point or points in the period between 2018 and 2022[25].

The predicted trends for 2020/2025/2030

The number of recharging points in Finland has risen in response to market conditions and the increase in the number of electric vehicles on the road. The target for 2020 (at least 2 000 public recharging points) has already been achieved. No specific numerical target has been set for recharging points for the year 2025. The achievement of the target for 2030 (at least 25 000 public recharging points) will depend very much on the trend in the overall numbers of (pure) electric vehicles. If more such vehicles are introduced at the current rate, the target will be achieved easily. However, this will not happen if there is no corresponding increase in the electric vehicle fleet.

Use of recharging points

In Finland, electric vehicles are usually charged at night in the location where the vehicle is mainly kept (at home or sometimes at work). Around 80-90% of all the energy required by electric vehicles is charged at night. The 2018 survey suggests that 58% of drivers of electric vehicles in Finland use a household socket to charge their vehicle [26]. According to a current study on recharging options for electric vehicles, 34% of the owners of electric vehicles only charge their vehicle at home

[25] https://cris.vtt.fi/en/publications/s%C3%A4hk%C3%B6autojen-kotilataaminen-gaselli-v%C3%A4liraportti-1

[26] This in spite the fact that in Finland charging a vehicle from a household socket is only recommended as an interim charging arrangement to avoid overheating of the socket.

using a socket, whereas 7% use one occasionally. Around 42% recharge their vehicle using separately acquired equipment, and 9% use a three-phase socket.[27]

The public network of recharging points supplements the use of household sockets and allows electric vehicles to make longer journeys. Pure electric vehicles in particular are dependent on a reliable and comprehensive recharging network. Fast charge stations are there for customers who drive pure electric vehicles. Stores and service companies have become aware of the purchasing potential of motorists that drive electric vehicles and are increasing the number of recharging points that cater to such motorists.

The services on offer have become more professional in nature and their quality has improved. Information on the location of, and access to, recharging points is mainly to be found online on the websites of either the individual owners of recharging networks or enthusiasts. Information can also be found using the applications of recharging service providers, which also provide details on the availability and status of the recharging points.

Recharging at the service operator points can be paid for in a number of ways, using pre-ordered RFID or a one-off payment by text message or with no prior agreement. Some of the recharging points are free of charge, at least for the time being.

The ease of use of fast charge points and their improved reliability enable more and substantially longer journeys in pure electric vehicles and boost the uptake of recharging points. Nevertheless, more recharging points are needed for the fast charge network at certain locations on the most congested routes to address problems relating to long queues and the availability of chargers (which might be out of order). Fast charge points are needed every 130 kilometres or so to ensure a smooth and stress-free journey. The network of fast charge points must be enlarged further, at least in northern and north-eastern Finland.

At present no information is available on the use of recharging points accessible to the public (volumes of energy supplied, number of charges per day, duration of the recharging process, etc.).

[27] Email of 8.11.2019 from Hanna Kalenoja, Finnish Information Centre for the Automobile Sector

2.1.3.2 Natural and biogas (methane)

Objectives and targets

An objective in the national distribution infrastructure programme for alternative propulsion systems in transport was for Finland to build a gas distribution network for transport that would reflect the recommendations in the Infrastructure Directive by 2020/2030 (compressed gas filling stations at least every 150 kilometres, liquefied gas filling stations at least every 400 kilometres).

For compressed natural gas and biogas (CNG, CBG), the objective is for around 50 refuelling stations in the largest urban areas and along all main routes stations by 2020. There are no targets in the national distribution infrastructure programme for numbers of compressed air filling stations by 2030.

For liquefied natural gas and biogas (LNG, LBG), the objective is for Finland to have a network of LNG refuelling stations nationwide for heavy duty vehicles on the highway by 2030.

Achievement of objectives and targets

In autumn 2019 there were 44 compressed gas refuelling stations in the country and three under construction. The target for 2020 (around 50 gas filling stations) will therefore be achieved. In addition to compressed gas stations, there were seven liquefied gas filling stations in Finland in autumn 2019.

The compressed gas filling stations in southern Finland are mainly connected to the natural gas network. Most of the gas filling stations in Finland have either natural gas or biogas, but in the case of some stations that are not part of the gas network only biogas is available. In 2019 biogas accounted for around 50% of all gas used to fuel gas cars in Finland.

In addition to public filling stations, there are private or semi-public gas filling facilities that are connected to the natural gas network or are available at biogas plants.

Figure 13: Compressed natural gas and biogas filling stations in Finland in autumn 2019

Key
Olemassaoleva = existing
Vuonna 2020 = by 2020

Figure 14: Liquefied natural gas and biogas filling stations and LNG terminals (Tornio, Pori, Hamina have bunkering facilities but LNG refuelling is not possible) in Finland in autumn 2019

Key
LNG-terminaali = LNG terminal
Olemassaoleva = existing
Vuonna 2020 = by 2020

The predicted trends for 2020/2025/2030

There are plans to provide several new CNG filling stations in large urban centres and along main routes, for example.

Furthermore Gasum aims to expand its network of filling stations for heavy duty vehicles using LNG, with 50 more stations being built in Finland, Sweden and Norway by the start of the 2020s.

In addition, other operators have plans, or have already started, to build around 20 compressed air filling stations. Six of these were granted a distribution infrastructure subsidy in 2019[28]. In autumn 2019, a new invitation to tender relating to the distribution infrastructure was organised, and a large number of new applications to build gas stations were submitted.

Use of refuelling stations

Information on the locations of gas stations can be found online. The problem with these websites is that the information is not always up to date, and the same map will not necessarily show the stations of all the operators. In Finland a mobile application has been developed to give the location of the nearest gas filling station. Petrol and diesel refuelling stations in Finland can also be found using the same app.

Most gas filling stations accept debit and credit cards and the GasCard can be used at Gasum stations. Some operators also have their own cards and cash payments may also be possible (e.g. at Metener in Laukas).

2.1.3.3 Hydrogen

Objectives and targets

An objective in the national distribution infrastructure programme for alternative propulsion systems in transport was for Finland to have around 20 hydrogen filling stations built by 2030, with the distance between them being approximately 300 kilometres and a radius of influence of 150 kilometres each. The stations would cover the main urban centres.

[28] See more on the distribution infrastructure in section 3.2.5.

Achievement of objectives and targets

In Finland in 2016, at the time over drawing up the distribution infrastructure, there were two hydrogen filling stations, one of which was in the harbour of Vuosaari in Helsinki and the other in Voikoski in South Savo. By 2019 there were no longer any public hydrogen filling stations in Finland.

The predicted trends for 2020/2025/2030

It does not seem likely that the network of hydrogen stations will grow in line with the targets set in 2016.

2.1.3.4 Liquid biofuels

Objectives and targets

An objective in the national distribution infrastructure programme for alternative propulsion systems in transport was that by 2030 all filling stations would include in their range of products a high blend fuel (such as 100% renewable diesel, high blend ethanol E85 or ethanol diesel ED95). The dominant grade would be, for example, E20/25 petrol.

Achievement of objectives and targets

The network of E85 refuelling stations constructed under market terms now has nationwide coverage, with 140 stations (54 St1 and Shell and 86 ABC stations).

ED95 is currently available at one point: at the Helsinki Regional Transport Authority's depot at Ruskeasuo. An ED97 refuelling point for fuel delivery vehicles is under construction at the NEOT Hamina Terminal.

In summer 2019 there were 20 refuelling points for EN 15940 (renewable paraffinic diesel) for heavy duty vehicles (Neste and Teboil self-service) and 34 for all vehicles (Neste service stations and self-service). The product is also supplied to dozens of end customers, such as transport operators or contractors, and is kept in their own storage facilities.

Altogether there are some 1 800 of these fuel distribution stations in Finland, so there is still a long way to go before the target is achieved.

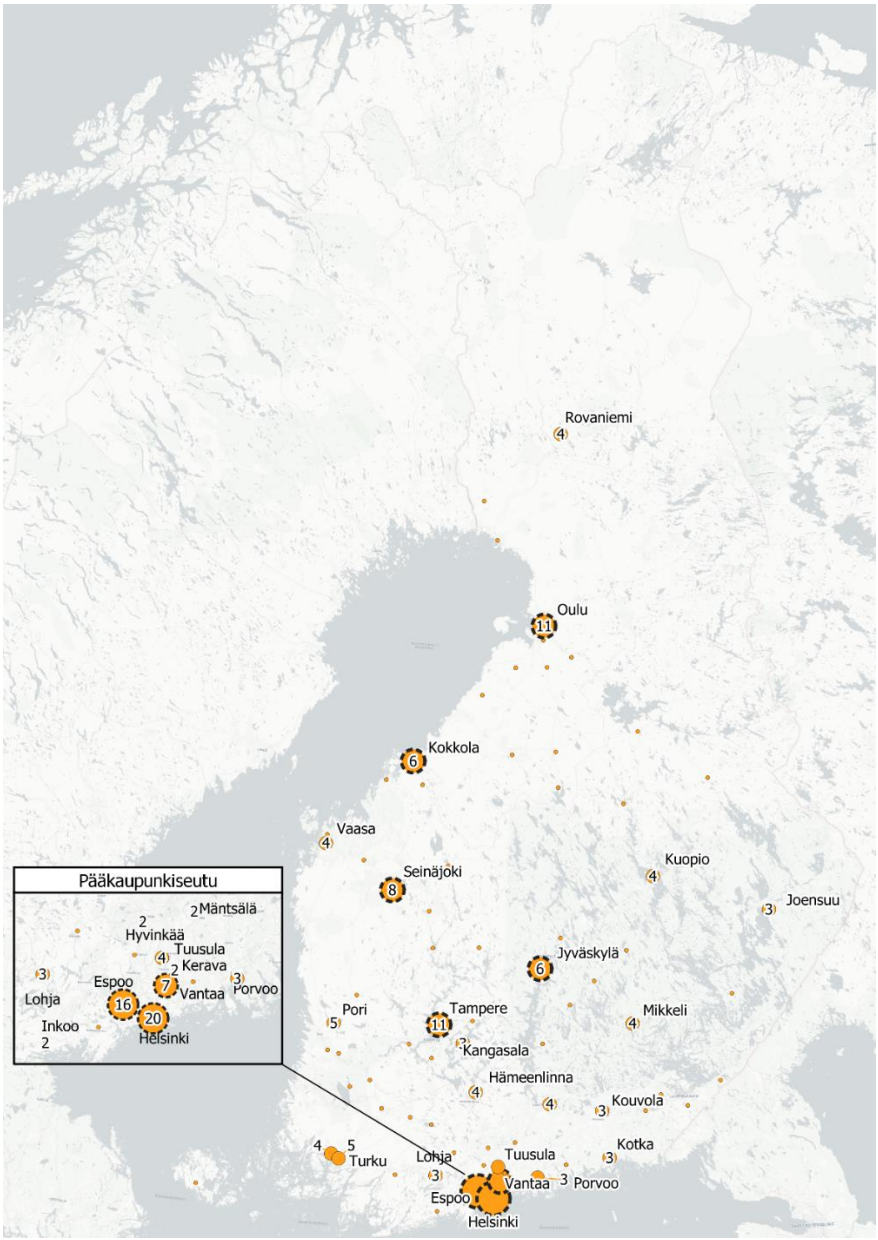

Figure 15: Distribution in Finland of high blend ethanol (E85) specifically, 2019

Key
Pääkaupunkiseutu = Helsinki metropolitan area

Figure 16: Distribution in Finland of renewable diesel specifically, autumn 2019

Key
Raskan kaluston automaatteja – Heavy goods vehicle self-service

The predicted trends for 2020/2025/2030

Ultimately, the trend in the availability of HVO100 renewable diesel and E85 and ED95 fuel will depend on the demand. The network can grow quickly and in response to market demand at any given time, if necessary reaching several hundred stations.

2.2 Rail

Objectives and targets

An objective of the national distribution infrastructure programme for alternative propulsion systems in transport was that rail would be nearly 100% electrified by 2050.

There were no other targets in place for rail.

Achievement of objectives and targets

The use of electricity as the propulsion system for rail has made much progress. Now slightly over 90% of the total distances accounted for by rail depend on an electric traction system. Electric traction systems account for 95% of passenger transport and 78.3% of goods transport. In 2016 the aggregate share was just under 90%.

The predicted trends for 2020/2025/2030

The electrification of the state rail network continues, though fairly slowly. An almost fully electrified network by 2050 is probably possible, at least in passenger transport.

2.3 Water transport

2.3.1 Objectives and targets for alternative propulsion systems and their achievement

Objectives and targets

An objective of the national distribution infrastructure programme for alternative propulsion systems in transport was that greenhouse gases from shipping would decrease by 40% by the year 2050 (compared to 1990) through the use of LNG and biofuels as well as other measures. The national targets for cuts in greenhouse gas emissions from shipping differ somewhat from those set by the IMO (International Maritime Organization). Finland is committed to an ambitious target under the IMO's provisional Greenhouse Gas Strategy for reducing emissions from shipping, and is aiming at similar emission cuts both in international navigation and for maritime transport in Finnish waters. The IMO climate targets are described below in a separate section.

Achievement of objectives and targets

The carbon dioxide emissions from shipping from 2005 to 2017 according to MERIMA (emissions calculation model for Finnish maritime transport)[29] are given in Figure 17. The emissions in the MERIMA model are calculated for an entire journey by sea from a port of departure to a port of arrival, i.e. the calculation is not limited just to Finnish territorial and other waters.

[29] MERIMA – Finnish international maritime transport emissions computer models. Outcomes report 2005-2017 by Ilkka Salanne, Kari Mäkelä, Marko Tikkanen. Trafi publications 14/2018.

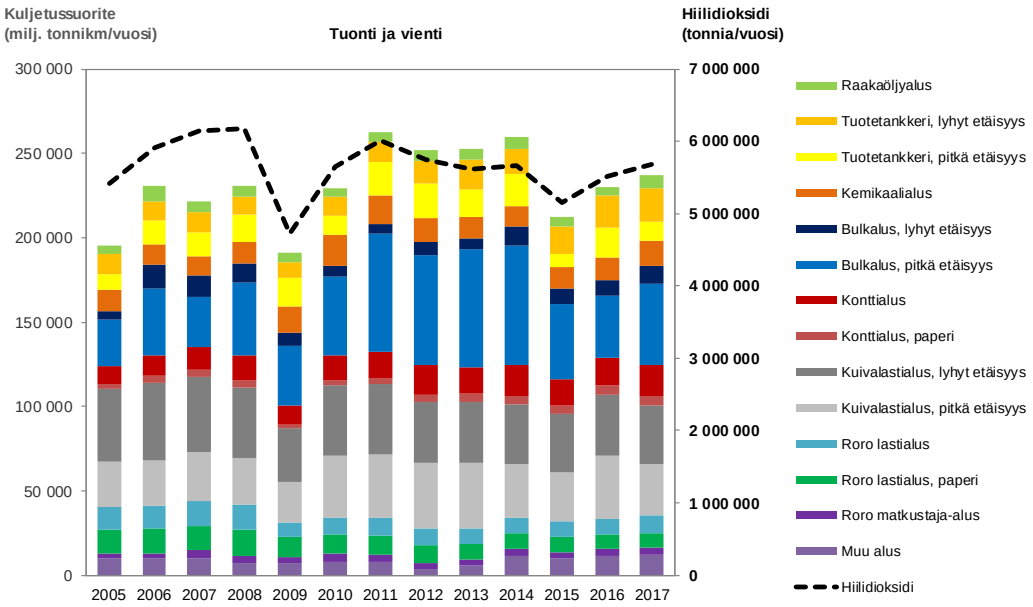

Figure 17: Maritime transport to Finland (tonne-kilometres) and related carbon dioxide emissions according to the MERIMA model.

Key
Kuljetussuorite (milj. tonni/km/vuosi) = tonne-kilometres per annum
Tuonti ja vienti = Imports and exports
Hiilidioksidi (tonnia/vuosi) – Carbon dioxide (tonnes per annum)
Raakaöojyalus – Crude oil vessel
Tuotetankkeri, lyhyt etäisyys = Tanker, short distance
Tuotetankkeri, pitkä etäisyys = Tanker, long distance
Kemikaalialus – Chemical tanker
Bulkalus, lyhyt etäisyys = Bulk carrier, short distance
Bulkalus, pitkä etäisyys = Bulk carrier, long distance
Konttialus = Container ship
Konttialus, paperi = Container ship, paper
Kuivalastialus, lyhyt etäisyys = Dry cargo carrier, short distance
Kuivalastialus, pitkä etäisyys = Dry cargo carrier, long distance
Roro lastatus = Ro-ro loading
Roro lastatus, paperi = Ro-ro loading, paper
Roro matkustaja-alus = Ro-ro passenger ship
Muu alus = Other vessel

Greenhouse gas emission levels for water transport in Finland varied over the period 2016-2018 (Figure 18). In 2018, the aggregate figure for greenhouse gas emissions from water transport (CO_2, CH_4, N_2O) were 1.8% higher than in 2016, but 3.4% lower than in 2015. The figures take account of emissions in the operation of vessels (gross tonnage > 300) between ports and emissions from smaller vessels, including pleasure craft and ferry boats [30]

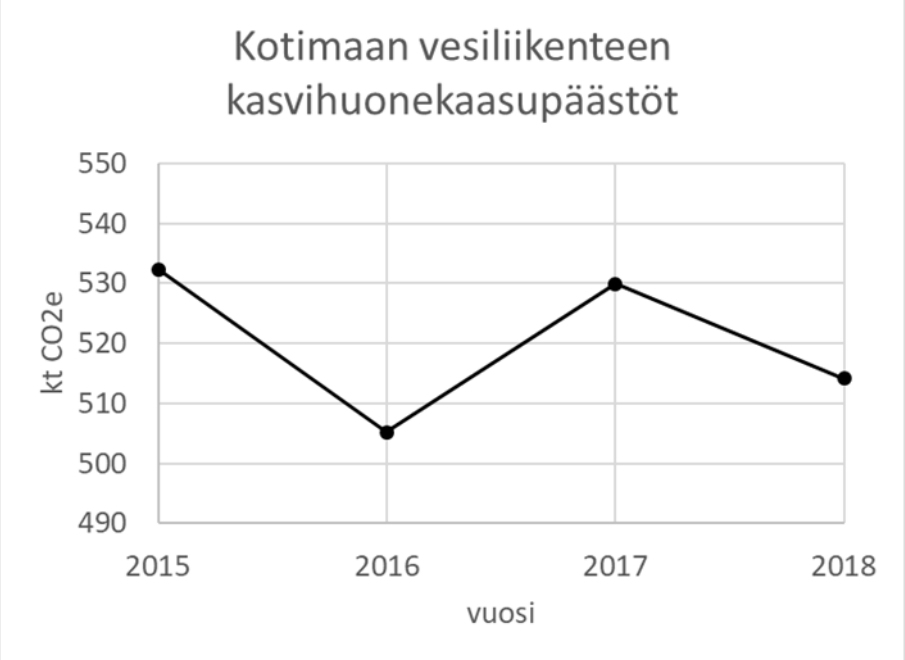

Figure 18: Aggregate greenhouse gas emissions from water transport in Finland (CO2, CH4, N2O) 2015-2018.

Key
Kotimaan vesiliikenteen kasvihuonepäästöt = Greenhouse gas emissions form water transport in Finland

International vessels in Finland's exclusive economic zone cause more than four times the volume of greenhouse gas emissions compared to those for water transport in Finland. International traffic includes vessels coming to Finland within Finland's exclusive economic zone. In 2018, the greenhouse gas emissions from international traffic were 1.9% greater than in 2016 and 7.2% greater than in 2015. [31]

[30] Emission levels lipasto.vtt.fi
[31] Emission levels and the applied calculation model MEERI: lipasto.vtt.fi

Vessels in international maritime transport at present mainly run on HFO (heavy fuel oil) or IFO (intermediate fuel oil). However, the consumption of traditional heavy fuel oil has declined in Finland in recent years. New types of low-sulphur liquid marine fuels and liquefied natural gas (LNG) have replaced them. The main driver for the new fuels in shipping are the more stringent environmental regulations in place in the Baltic Sea[32]. The highest permitted sulphur content of fuels used in other international sea areas will fall to 0.5% from the start of 2020.

The fuel used in small vessels and the auxiliary engines of large vessels is light fuel oil, such as MDO (marine diesel oil) or MGO (marine gas oil), whose sulphur content is much lower than that for heavy fuel oil. Pleasure craft also use diesel and petrol. Petrol and diesel for water transport are produced in the same way as road transport fuels: their bio content is the same. Biofuels accounted for around 10% of these fuels in 2018.

Objectives and targets for limiting greenhouse gas emissions from international maritime transport and their achievement

An objective of the IMO's provisional strategy for cutting greenhouse gas emissions from maritime transport[33] is for the carbon intensity of international shipping to fall,

- with average CO_2 emissions for each international tonne-kilometre being reduced by at least 40% by 2030, after which the target will be a reduction of 70% by 2050 compared to 2008; and

- with greenhouse gas emissions from international maritime transport reaching their peak as soon as possible and annual total emissions going down by at least 50% by 2050 compared to 2008, while simultaneously aiming to eliminate them gradually to reflect the cuts in CO_2 emissions corresponding to the Paris Agreement on climate change targets.

Achievement of the IMO targets

Greenhouse gas emissions from shipping in the Baltic Sea as a whole went down by 6.2% in the period 2008-2018. Furthermore, the operational energy efficiency of vessels in the Baltic is thought to have improved by 20% between 2008 and 2018.

[32] The Baltic Sea is one of the IMO-approved SOx Emission Control Areas (SECAs), where the highest permitted sulphur content of fuels used fell at the beginning of 2015 to 0.1%.
[33] Resolution MEPC.304(72)

This has been partly due to tonne-kilometre increase, new and more energy-efficient vessels, and the lower operating speeds of ships and boats. It thus seems possible to achieve IMO's target for 2030 for the improved energy efficiency of vessels by 40%.[34]

The predicted trends for 2020/2025/2030

International shipping regulations have an impact on emissions from Finnish water transport. An essential factor with greenhouse gas emissions is the Energy Efficiency Design Index (EEDI) defining the energy efficiency of a ship and the more stringent requirements that will be applied in the future[35]. The EEDI describes the carbon dioxide emissions from a vessel in relation to the transport work done by it and it applies to vessels whose gross tonnage is at least 400. Phase 2 of the EEDI starts on 1 January 2020, when the permitted EEDI index will decrease by around 20% compared to phase 0. Phase 3 of the EEDI starts on 1 January 2025, when the permitted EEDI index will come down by 30% compared to phase 0. IMO's provisional greenhouse gas strategy extends to other areas in addition to the EEDI and includes goals whose achievement could reduce emissions by 2030.

When fossil fuels are used, traffic volumes also have a direct effect on greenhouse gas emission levels. The volume of goods transported on Finnish waters and the number of kilometres travelled by passengers using coastal and inland waterway services increased between 2015 and 2017. Passenger numbers and volumes of goods transported by sea on international routes have also increased in recent years. Generally speaking, Finnish exports and imports are predicted to increase by a few per cent annually over the period 2019-2021. [36]

As regards pleasure craft, the (Finnish) Act on the Promotion of Biofuels in Transport (446/2007) and Directive 2013/53/EU of the European Parliament and of the Council on recreational craft and personal watercraft, which entered into force in January 2016, may have an impact on emissions from such vessels. The Finnish Act relates to pleasure craft that use the same fuels as road transport, increasing by degrees the share of biofuels in the energy content of the fuel overall. Directive 2013/53/EU applies to new boats, and only in the long term will it affect emissions from boating, because in Finland boats and engines are replaced overall very slowly. At present

[34] Trend in exhaust gas emissions from maritime transport in the Baltic Sea 2006 – 2018. Published in the HELCOM Maritime 19 meeting document 5-2, Emissions from Baltic Sea shipping 2006 – 2018.
[35] Annex VI to the MARPOL convention
[36] liikennefakta.fi and vm.fi

carbon dioxide emissions from boating activities are low compared to other emissions from water transport. For example, in 2016 they accounted for just around 4%[37].

2.3.2 Objectives and targets for transport and their achievement

Objectives and targets

There were no specific targets set for vessels using alternative propulsion systems in water transport in the national infrastructure programme for alternative propulsion systems in transport. An objective for boating activities was that they should become virtually emission-free in Finland by 2050, and all new boats should be able to be used with an alternative propulsion system by 2030.

Furthermore, harbour terminal traffic should be almost completely emission-free by 2050. The aim is for all new non-road mobile machinery and equipment to be able to be used with an alternative propulsion system from 2030 onwards.

Achievement of objectives and targets

Currently, liquefied natural gas is the fuel used by five vessels flying the Finnish flag: the passenger/car ferry Viking Grace (2013–), the offshore patrol vessel Turva (2014–), the icebreaker Polaris (2016–) and the bulk carriers Viikki (2018–) and Haaga (2019–).

Fuel consumption data for 2018 is available for Viking Grace and Viikki[38] . LNG accounted for 94% of the fuel used by Viking Grace. The figure for Viikki was just 3%. The low amount of LNG used by Viikki is partly due to the fact that the vessel only began operating towards the end of 2018. It was transferred from a Chinese shipyard to Japan, where it was loaded and continued to the Baltic Sea without any opportunities for LNG bunkering.

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[37] Carbon dioxide emission levels from boating: Askola, Takala, Tefke. Boating activity and its economic and environmental impact in Finland. Trafi surveys 4/2017.
[38] According to Regulation (EU) 2015/757 of the European Parliament and of the Council on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, the reporting obligation applies to commercial vehicles above 5 000 gross tonnage.

The patrol vessel Turva and the icebreaker Polaris use LNG and undergo bunkering operations in Finland. Viking Grace undergoes bunkering in Stockholm. Viikki and Haaga sometimes also undergo bunkering operations in Finland, according to Traficom, but they are mainly carried out in Sweden[39]. Foreign vessels also undergo bunkering with liquefied natural gas (LNG) at Finnish ports[4041].

In autumn 2019 there were a few electric vessels operating in Finland. The hybrid-electric ferry Elektra started operating between Parainen and Nauvo in June 2017. In September 2018 a cable reel ferry that uses shore-side power started its service between Nauvo and Högsar. Since its overhaul, from 2018 the marine research vessel Aranda has been capable of making short journeys using battery power alone.

Tallink Silja's vessels Silja Serenade and Silja Symphony providing passenger/car ferry services on the Helsinki-Mariehamn-Stockholm route were fitted for shore-side power in November 2018 and January 2019, respectively [42]. These vessels started to use shore-side power in Stockholm in 2019 [43].

At least four vessels that fly the Finnish flag can use biofuels: the special purpose vessel Meri (2012-), the general cargo vessels Eeva VG and Mirva VG (2016-) and the marine research vessel Aranda (overhauled in 2018). Of the fuel consumption of the Eeva VG and Mirva VG last year, approximately 25%was biooil, which is manufactured in Finland from vegetable fat and fish gut waste[44].

So far there are relatively few boats in Finland fitted with electric or gas motors. In September 2019, according to Traficom's register of boats, there were 184 vessels with an electric motor in Finland (accounting for 0.09% of all boats) and 16 with a gas motor (0.007% of all boats in the country). The register includes watercraft over 5.5 metres long or with motors in excess of 15kW.

The predicted trends for 2020/2025/2030

[39] News report 29.10.2018 https://www.eslshipping.com/en/news/esl-shipping-and-nauticor-sign-long-term-lng-supply-contract-for-the-worlds-greenest-bulk-carriers-haaga-and-viikki
[40] News report 5.9.2019: https://www.gaas.ee/en/eesti-gaas-started-bunkering-lng-powered-ships-in-the-port-of-hanko/
[41] News report 23.9.2019 https://nauticor.de/_upl/de/_d/20190923_unifeeder_port_of_helsinki_nauticor_press_release_first_simops_lng_ship_to_ship_bunker_operation_in_the_port_of_helsinki.pdf
[42] news reports 5.11.2018 and 7.1.2019 https://www.tallinksilja.com/latest-news
[43] news report 27.6.2019 https://www.greenport.com/news101/europe/first-ships-connect-to-stockholm-shore-power
[44] Email 12.9.2019 Jussi Mälkiä, Chairman of the Board, Meriaura Group

The number of LNG-fuelled vessels will increase in the next few years. The main incentive for the growth is the more stringent emission controls. Liquefied natural gas is now the sole available option to help achieve the limits for emissions over the next few years. The availability of other alternative fuels is not sufficient to meet the needs of maritime transport. Moreover, recent and current developments in the LNG distribution infrastructure support the transition to LNG vessels.

By September 2019, five new LNG vessels had been ordered, and these may possibly fly the Finish flag. Three of them, ordered by Bore, are rolo ships for transporting forestry products, to be built in the period 2020-2021. The two others are passenger/car ferries. Viking Line will have a new passenger/car ferry operating between Turku and Stockholm, while Wasaline is to have a new ferry of the same type operating between Vaasa and Umeå in 2021. In addition, Tallink-Silja's new passenger/car ferry flying the flag of Estonia will possibly start operating between Helsinki and Tallinn towards the end of 2021.

The use of biofuels is expected to increase in the next few years. The intention is to increase the ship use of VG Marine EcoFuel, produced in Finland and suitable for ships, by four or five times the current volume of 450 tonnes a year by the end of 2021[45]. A hike in the price of oil would probably increase the use of biofuels. If they are to be used widely, a challenge is the sufficient availability of the raw materials for biofuels.

In a few years' time there will be a new electric ferry operating in the archipelago off Turku. It is possible that Finland will also have new electric cable ferries. There will be an efficient shore-side power connection for Tallink-Silja's new passenger/car ferry [46].

Finnlines has ordered three hybrid ro-ro ships, which are expected to be ready in 2020-2021[47]. The vessels will use conventional fuels and exhaust gas scrubbers. They will also be fitted with batteries that will be charged by diesel electric generators when sailing. The power produced will be used at the ports.

The stock of boats and boat engines and motors in Finland is replaced slowly. The Act on the Promotion of Biofuels in Transport means that the use of biofuels will increase on boats that use the same fuels as road transport. There are also electric

[45] Email 12.9.2019 Jussi Mälkiä, Chairman of the Board, Meriaura Group
[46] https://rmcfinland.fi/fi/rauma-marine-constructions-ja-tallink-sinetoivat-uuden-laivasopimuksen-shuttle-alus-on-toistaiseksi-suurin-tilaus-rmclle/
[47] Press release 3.5.2018 https://www.finnlines.com/fi/uutishuone/finnlines-panostaa-kestavaan-kehitykseen-ja-tilaa-kolme-ymparistoystavallista-roro-alusta

motors suitable for motor boats on the market, but their high cost may prevent the widespread use of electric boats [48].

2.3.3 Objectives and targets for the distribution infrastructure and their achievement

Objectives and targets

An objective of the national distribution infrastructure programme for alternative propulsion systems in transport was that there would be bunkering facilities (LNG or LBG) at all TEN-T core network ports (Hamina-Kotka, Helsinki, Naantali and Turku) by 2025. There would also be bunkering facilities at the LNG terminals in Pori and Tornio once they have been built. The aim for inland waterway transport is for any need for LNG/LBG by the vessels that run along the deep water routes on Lake Saimaa to be met by means of a floating bunkering point, or some such facility at Mustola, near Lappeenranta, by 2030.

Another objective was for Finland's largest ports to have a shore-side power facility by 2030.

Achievement of objectives and targets

The targets for the distribution infrastructure for liquefied natural gas and biogas will be achieved, at least partially. Of the TEN-T core network ports in Finland, LNG bunkering operations are already being carried out in Helsinki. Some LNG bunkering facilities have also been established in Hamina. The Port of HaminaKotka has had talks with companies providing LNG bunkering operations, but no progress has yet been made. There are still no LNG bunkering operations at Naantali or Turku.

In June 2019, Finland's LNG infrastructure grew with the completion of an LNG terminal at Tornio. Therefore there is now a second LNG terminal on the west coast in addition to that at Pori, completed in September 2016. The ports of Turku and Rauma have reserved space for LNG terminals, but their construction plans were put on ice a few years ago.

[48] https://oceanvolt.com/solutions/motorboats/

Apart from the LNG terminals, several internationally active companies offer ships liquefied natural gas bunkering services in Finland. In such cases it is for the Finnish ports to provide a bunkering location and see generally to safety and security matters. Ship-to-ship bunkering is a better option for shipping companies than truck-to-ship, because the former is quicker and allows for greater quantities of the fuel to be transferred, though with trucks it obviously depends on how many vehicles are used (they can hold 40 tonnes).

In autumn 2019 shore-side power is available at the ports in Helsinki, Oulu and Kemi. It is available in Helsinki for two passenger ferries at the quayside in Katajanokka. The shore-side power system there is tailor-made for Viking Line ships and does not adhere to international standards (several connection cables per vessel and low voltage: 400V, 50Hz) [49]. Shore-side power is available to ro-ro vessels at Oulu and Kemi (6.6kV, 50Hz). Besides these, there is, for example, electric power available for freight transport at the port of Turku, although larger vessels that consume electricity cannot be catered for. At the port of Långnäs, in Åland, the ro-ro freight vessel Fjärdvägen uses around 30 MW a month of shore-side power [50].

The predicted trends for 2020/2025/2030

The LNG infrastructure in the Gulf of Finland will be expanded in 2020, when the LNG terminal at Hamina is completed and the new LNG bunker vessel ordered by Eesti Gaas is ready and starts operations in the area. In 2021, on the Turku-Stockholm route, there will be a new Viking Line LNG passenger/car ferry needing a bunkering facility at Turku.

In the longer term, the increase in the number of LNG-fuelled ships used for domestic and international transport will be a factor that supports the development of the LNG infrastructure. Low oil prices might, on the other hand, slow down investment.

As for shore-side power, the development plans over the next few years vary from port to port. For example, at the end of 2017 a decision was taken in Turku not to build any shore-side power systems at the port at Pansio at this stage [51]. The pipelines needed for shore-side power cables to be deployed on the most recently built quay at the Port of HaminaKotka are in place [52]. Shore-side power is planned for

[49] Survey commissioned by the Port of Helsinki on shore-side electric power for passenger vessels at Katajanokka and the South Harbour in Helsinki, 2005
[50] Expert advisor Mats Björkendahl, Finnish Shipowners' Association.
[51] Decision http://ah.turku.fi/rlupalk/2018/0125002x/3658491.htm
[52] HaminaKotka Satama Oy

the new passenger/car ferry between Vaasa and Umeå, available at both ports [53]. The port of Porvoo is possibly planning a shore-side electric power facility for an Aframax-size tanker ordered by Neste. It will require 8 MW for unloading using shore-side power [54]. The Port of Helsinki has several development plans for the use of shore-side power[55]. In 2020 shore-side electricity (11kV, 50Hz) will be introduced at the South Harbour on the quays used by TallinkSilja's Silja Serenade and Silja Symphony. Then there will be a quay for high-speed vessels at Jätkäsaari, in Helsinki, where shore-side power may be used overnight for vessels making longer stops. Shore-side electricity will also be available for cruisers. The first shore-side power connection for cruisers should be in use by 2022. Shore-side power is also being planned for the Port of Helsinki cargo terminals as and when required. It all depends on the cost of equipment, electricity and fuel and possible investment aid.

There are challenges with the supply of shore-side electric power, especially in the case of cruisers. Individual cruisers need a lot of electric power, easily around 15 MW for large vessels. Furthermore, the cruising season is short and the vessel's individual systems differ from one another, as is generally the case in international transport.

One possibility for shore-side energy in the future are mobile shore-side power stations that use renewable energy. An example of a step in this direction may be the barge used at the port of Hamburg. [56]. It supplies electricity produced with LNG to cruisers, for instance and a mobile LNG shore-side electric unit prototype for container ships that was tested in the port of Hamburg in June 2019.

Taxation also has an effect on the wider use of shore-side electricity. In Finland, the use of such power could be promoted through lower taxation on shore-side electricity. The Member States can ask the European Council for authorisation to apply a reduced tax rate to shore-side power in accordance with Article 19 of Council Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity. Sweden, Germany, Denmark and Spain, at least, have taken advantage of this.

The distribution infrastructure for biofuels will probably expand, with several operators supplying customised products to their customers.

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[53] Expert advisor Mats Björkendahl, Finnish Shipowners' Association.
[54] Expert advisor Mats Björkendahl, Finnish Shipowners' Association.
[55] Telephone conversation with Andreas Slotte, Head of Sustainable Development, Port of Helsinki, 20.9.2019
[56] https://www.hybrid-port-energy.com/en/products/becker-lng-power-barge.html

2.4 Air transport

Objectives and targets

The objective for air transport is for there to be a 40% share of renewables or of other solutions to cut emissions by 2050.

Furthermore, airport terminal traffic should be almost completely emission-free by 2050. The aim is for all new non-road mobile machinery and equipment to be able to be used with an alternative propulsion system from 2030 onwards.

Achievement of objectives and targets

As yet in 2019 Finland has no alternative propulsion systems for air transport. The main fuel used in aviation in Finland was kerosene. Total sales of kerosene in 2018 reached around 77 000 tonnes. More than 80% of kerosene was used in international transport.

More and more renewable diesel was being used at airport terminals to take the place of fossil fuels. All of Finavia's diesel vehicles at Helsinki-Vantaa Airport and most of the diesel vehicles of other operators used renewable diesel in autumn 2019. By the end of the year, renewable diesel will be used at all of Finavia's regional airports.

In autumn 2019 around 30% of the non-road mobile machinery used by ground handling companies at Helsinki-Vantaa Airport were electrically operated (some 600 items of mobile equipment, of which around 185 were rechargeable). Around 33% of the non-road mobile machinery used by ground handling companies at regional airports were electrically operated (some 305 items of mobile equipment, of which some 98 were rechargeable). In ground handling, non-road mobile machinery with combustion engines is being replaced with rechargeable equipment at the rate of 5-15% per year.

The inaugural flight of Finland's first electric aircraft, Pipistrel Alpha Electro, took place in summer 2018. Finavia is helping to finance the testing and development of the aircraft in collaboration with the Helsinki Electric Aviation Association. The aim is to acquire knowledge about e-flying for the purpose of planning and developing airports.

The predicted trends for 2020/2025/2030

The following two types of biokerosene have now been approved for commercial use in air transport: 1) synthetic kerosene based on the Fischer–Tropsch (FT) method,

and 2) synthetic kerosene produced using the HEFA (hydroprocessed esters and fatty acids) method. Both of these can be mixed with fossil kerosene to a maximum of 50%.

Antti Rinne’s government programme includes the objective that the blending obligation would allow for sustainable biofuel representing a 30% share of aviation fuels by 2030. No measures have as yet been put in place to achieve the objective.

Finavia predicts that Finland will have pure electric passenger aircraft on domestic routes by the end of the 2030s at the earliest. Electric aircraft are predicted to be used specifically for short journeys, and they are unlikely to replace conventional planes entirely, even in the long term. It is probable that hybrid aircraft (combustion engine plus electric power) will come onto the market first. There are at present dynamic efforts to develop hybrid and electric aircraft by start-ups and the world’s largest aircraft manufacturers, such as Airbus and Boeing.

3 Measures

3.1 Legislative measures

3.1.1 Act on the Promotion of Biofuels in Transport

[Entry in the plan 2017:] The legislation relating to the Act on the Promotion of Biofuels in Transport is to be extended beyond 2020. The 2030 target to be a 30% biofuel share (double counting not included). To examine what benefits and disadvantages there would be if biogas also fell within the scope of the Act.

The Act amending the Act on the Promotion of Biofuels in Transport (419/2019) was adopted in February 2019. The 2030 30% share of biofuel (double counting not included) was made obligatory, as was the 10% share of advanced biofuels. The Act entered into force in April 2019.

There is an entry in Antti Rinne's government programme that states that sustainably produced biogas will also be covered by the biofuel obligation. The Finnish Ministry of Economic Affairs and Employment has begun to work towards this target.

3.1.2 Act on Transport Services

To implement legislative reform in respect of transport markets (Transport Code) (Act on Transport Services)

The Act on Transport Services of (320/2017) entered into force on 1 July 2018. One purpose of the Act is to reduce the need for private car ownership and change the way people use cars: instead of owning cars, people could hire or share vehicles and use company cars. Increasing the number of company cars would speed up the rate

at which cars are replaced overall and the introduction of new technologies in vehicles.

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

To increase cleantech procurement for transport in the public sector. To encourage joint municipal authorities and other public sector actors to introduce financial incentives to increase the share of alternative technologies in procurement.

In June 2019 the EU adopted Directive (EU) 2019/1161 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport, the purpose of which is to boost the share of clean and energy-efficient vehicles in the public sector procurement of vehicles and transport services. The updated Directive defines the notion of a clean vehicle and sets minimum procurement targets as percentages for these vehicles. Finland's target for 2025 is 38.5% of all new vehicle and service procurement for cars and vans, 41% for buses and 9.5% for trucks.

Finland took an active role in drafting the Directive. The Finnish Ministry of Transport and Communications has started drafting the national legislation.

In many municipalities transport operators have been encouraged to acquire clean vehicles. For example, the city of Jyväskylä, as part of the sustainable mobility policy, has stated that when vehicles or transport services are being selected, the first option should be to examine the possibilities of biogas. Four biogas buses procured through public tenders in November 2019 will be operating in the city, which will also have around 30 leased cars that use biogas. The municipal waste management company Mustankorkea Oy produces biogas from local biowaste and also promotes the use of biogas for the transportation of waste, which is subject to invitations for tender. Currently, eight biogas-fuelled refuse collection vehicles operate in the area the company covers. Not only do these buses and refuse collection vehicles use renewable and emission-free biogas, they also make less noise than diesel vehicles.

Twelve biogas buses were operating in Vaasa at the start of 2019. The city of Vaasa leased the buses and a local waste reception centre, Ab Stormossen Oy, invested in a gas refinery. Biogas is produced from biowaste and sewage sludge. The leasing solution lowered the threshold for operators. Biogas buses have meant that the city of Vaasa is cutting its carbon dioxide emissions (the aim is to be a carbon-neutral city by

2035) and the operating costs of the fuel it uses. The procurement of biogas buses has contributed to the development of a regional biogas ecosystem.

In August 2019, 30 new pure electric buses were introduced in the capital region at the same time, because, in its invitation for tender for the routes, the agency responsible for public transport in the area, Helsinki Regional Transport Authority, required that electric buses be used. This is the first time so many electric buses were deployed simultaneously in Finland.

To ensure the availability and effectiveness of advisory and information services relating to energy-efficient public transport service and vehicle procurement as from 2017.

KEINO (competence centre for sustainable and innovative public procurement) was launched in Finland in 2018. It is a consortium based on a cooperation network whose aim is to bolster innovation and effectiveness in public procurement to increase procurement that promotes sustainable development objectives and targets from both the social and environmental angle. KEINO provides support for procurement units in the form of strategic management and the development and measurement of management tools. It also establishes strong and effective buyer teams in the field of procurement, helps improve general procurement competence where it concerns sustainability and innovativeness, and provides procurement units with examples of international procurement experiences. Advice on transport procurement is a major component of the work done there.

3.1.4 Legislative changes

To draft a national Act on the distribution of alternative propulsion systems in transport. To incorporate in the Act the technical requirements established in the Distribution Infrastructure Directive for the distribution in Finland of new propulsion systems for transport, such as electricity, gas and hydrogen, the requirements for notifying consumers of the location of refuelling and recharging points, and information on the prices and other details of the various systems. To amend the current legislation to make it compatible with the new Act.

The Act on the Distribution of Alternative Fuels for Transport entered into force on 1 August 2017. The purpose of the Act is to ensure that public recharging and refuelling points for alternative fuels comply with the common technical specifications

and that users are given sufficient information on alternative fuels and their distribution.

Finland has already implemented the provisions of Article 4 of the Distribution Infrastructure Directive as regards electricity supply for transport. This was done by implementing the provisions of Article 32 of Directive 2009/72/EC of the European Parliament and of the Council concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC regarding third-party access, and the provisions of Article 33(1) of the same Directive regarding eligible customers. The European Commission was informed of these implementation measures in 2012.

In the period between 2016 and 2019 no special measures were implemented in Finland regarding construction permits for alternative fuel infrastructure (such as planning permission, parking permits or refuelling station licences). In autumn 2019 the Ministry of Economic Affairs and Employment set up a working group relating to the production of renewable energy. Its task is to look into the national implementation of the requirements for the organisation of authorisation procedures under the Renewable Energy Directive and their duration. The working group will complete its assignment by June 2020.

3.2 Financial steering mechanisms

3.2.1 Fuel tax

To continue developing the current taxation of fuel from an environmental perspective, so that taxation would treat all fuels used for transport in an objective and impartial manner.

Fuel tax is levied on all liquid fuels used in transport in accordance with the so-called adapted environmental model. The tax is based on the energy content of each fuel type and its CO2 emission (compared to those for fossil petrol).

The fuel tax was raised by EUR 90 million in 2017. The value for a tonne of carbon dioxide, which is the basis for calculating the carbon tax portion for transport fuels, rose from EUR 58 to EUR 62, and the energy content tax portion increased by nearly as much. The tax on petrol rose by 2.12 cents a litre and on diesel by 2.41 cents a litre on account of the altered calculation criteria.

A Government proposal for increasing the fuel tax by EUR 254 million was submitted to the Finnish Parliament in autumn 2019. The basis for calculating the carbon tax portion would rise from EUR 62 to EUR 77 per tonne of CO2 starting in August 2020. The basis for calculating the energy content tax portion would go up as well. Consequently the tax on fossil fuel petrol would increase by 5.71 cents a litre and the tax on fossil diesel oil by 6.46 cents a litre. The tax hike per litre of biofuels produced from renewable raw materials would be lower than that for fossil fuels.

Increases in the fuel tax improve the relative cost-effectiveness of alternative propulsion systems for transport when they are targeted specifically at fossil fuels (i.e. carbon tax).

3.2.2 Car and vehicle tax

To lower vehicle tax as agreed in the government programme for 2016-2019. To continue to improve the guidelines for emissions-based taxes

Tax has to be paid on any vehicle taken into use or newly registered in Finland. Car tax is staggered on the basis of the CO2 emissions associated with the consumption of the fuel used. Currently the tax rate varies between 2.7% and 50%.

Furthermore, annual vehicle tax in Finland is based on the vehicle's CO2 emissions. At present the amount of tax paid varies between EUR 106 and EUR 654 per annum. In addition, a variable propulsion system tax of between 0.5 and 5.5 cents is levied on vehicles not running on petrol for each hundred kilograms of total mass or part thereof per day.

Car tax was reduced in stages in 2016-2019, with greater reductions for low-emission vehicles. Nowadays car tax staggered according to specific carbon dioxide emissions strongly favours the use of pure electric vehicles and rechargeable hybrids. The tax rate for a pure electric vehicle or other zero-emissions vehicle is now 2.7%. The rate for rechargeable hybrids currently averages 4.3%, whereas it is about 16% for new petrol-fuelled vehicles and around 21.7% for diesel vehicles. The tax on new gas vehicles now averages 10.8%.

Vehicle tax on passenger cars and vans will decrease by EUR 50 million as from 2020. The biggest reductions in tax will apply to pure electric and other emission-free vehicles. Annual tax on these will decrease from around EUR 106 to EUR 53. Tax

reductions will gradually become smaller as specific emissions increase. The annual tax on a passenger car with average emissions will be around EUR 216.

Furthermore, in 2018 car and vehicle taxation started being based on the new WLTP (Worldwide Harmonised Light Vehicle Test Procedure) for measuring CO2 emissions. Vehicles with combustion engines previously received considerable tax benefits from the old NEDC (New European Driving Cycle) measurement method, because the measured emissions notified by vehicle manufacturers decreased, especially from 2007, much faster than the actual emissions produced while driving. The new measuring method gives a more realistic picture of the actual fuel consumption of a vehicle and is therefore a more reliable basis for the taxation of emissions from combustion engine vehicles.

3.2.3 Subsidies for acquiring new technologies

Where possible, to carry out an experiment in connection with vehicle purchases to open up the market for new technologies. Decisions regarding subsidies to be made separately at a later date.

A subsidy for purchasing a pure electric vehicle and a conversion subsidy for converting an old vehicle to one capable of using ethanol or gas were introduced in 2018 ([Finnish] Act 971/2017 on the scrapping premium for passenger cars, the subsidy for the purchase of electric cars and the subsidy for the conversion of cars to allow them to be used with gas or ethanol). The subsidy for the purchase of pure electric vehicles or their long-term lease is EUR 2 000, and it is only granted to a private person. The conversion subsidy for gas vehicles is EUR 1 000 and for ethanol vehicles EUR 200. The subsidies will be available from 2018 to 2021, and public funding of EUR 6 million a year has been set aside for that purpose. It is stated in Antti Rinne's government programme that EUR 6 million will be earmarked for the conversion subsidy also in in 2022.

In 2018, a total of 247 subsidised electric vehicles were either purchased or leased long-term. A total of 1 268 subsidies were granted for ethanol conversions and 102 for gas conversions, i.e. 1 370 subsidies in all. Altogether 14.16% of the appropriation was taken up.

In January-October 2019, 1 295 conversion subsidies were granted for ethanol conversions and 112 for gas conversions. A total of 304 subsidised electric cars were

either purchased or leased long-term. Only 15.16% of the entire appropriation for 2018-2019 (EUR 12 million) was taken up.

Act 971/2017 also provided for a ‘scrapping premium’. The scrapping premium paid out of public funds for the purchase of a new petrol or diesel car of under 110 g/km was EUR 1 000. The scrapping premium was EUR 2 000 when purchasing cars that ran on high blend ethanol, electricity or methane fuel, either entirely or as another propulsion system. The automotive industry also contributed a voluntary subsidy of EUR 500. Therefore, the subsidy received by the recipient of the scrapping premium for the purchase of a new vehicle totalled EUR 1 500 or EUR 2 500, depending on the vehicle bought. In all, EUR 8 million was set aside in the state budget for scrapping premiums, and it was available from 1 January to 31 August 2018.

During that period the scrapping premium was used for the purchase of 6 677 new vehicles. Approximately 90% of the EUR 8 million appropriation in the state budget was spent. Most of the new vehicles acquired with the scrapping premium were petrol-fuelled. Of the vehicles with alternative propulsion systems, there were 105 plug-in petrol hybrids, five pure electric vehicles and 290 gas-driven vehicles. These accounted for approximately 6% of all the vehicles purchased under the scrapping premium scheme, which is the same rate as for vehicles purchased without the premium in the same period. However, the number of gas vehicles as a proportion of campaign vehicles (4.4%) was much higher than their share of vehicles purchased without the scrapping premium (approximately 1.0%).

3.2.4 Changes to the taxation of company cars

To explore the possibility of reforming current taxation on company cars to encourage the more frequent choice of vehicles using new technology and/or alternative propulsion systems when purchasing a company car.

No measures were put in place in 2016-2019, but under the new government programme a sustainable transport tax and payment reform will be launched to lower emissions. Under this programme, the taxation of company car benefits will be reformed to favour low-emissions vehicles and the charging of electric cars, provided as an employment benefit, would be exempt from income tax. The Finnish Ministry of Finance has set up a working group to examine these changes.

3.2.5 Energy subsidies

To promote the production and availability of alternative propulsion systems for transport using a technology neutral approach by means of national energy subsidies.

In 2011-2017 the Ministry of Economic Affairs and Employment granted financial support of about EUR 10 million for a demonstration project concerning electric vehicles and their recharging equipment. The financial assistance was granted to the companies involved in the project. The support for vehicles was 30% of the capital portion of the leasing charge and for recharging points it was 35% of the investment costs.

In 2017-2019 the Ministry provided financial support for a number of investment projects relating to renewable energy and new energy technology in transport (the 'spearhead projects' of Juha Sipilä's government).

- Use of biogas in transport: BioSairila Oy (EUR 3.39 million), Gasum Oy (Turku 7.97, Lohja 7.83), Mäntsälän Biovoima Oy (3.65), VSS Biovoima Oy (2.95), Pirkanmaan Jätehuolto Oy (4.55)

- Projects relating to the recharging infrastructure for electric vehicles: Eera Oy (EUR 4.8 million). Financial support was available for the procurement of company vehicles and recharging systems. The support for vehicles was a maximum of 30% and for recharging points 25%. Some 75% (EUR 3.6 million) of the subsidy was taken up.

In 2018 two new support mechanisms were introduced for the distribution network for alternative propulsion systems.

- Infrastructure support programme for electric transport and the use of biogas in transport (EUR 3 million per annum in 2018-2021; Energy Authority). In construction projects for high-capacity recharging systems the subsidy may be a maximum of 35% of the approved costs or a maximum of 45% if the project uses new technology. For other projects the subsidy may be a maximum of 30% of the approved costs or a maximum of 40% if the project uses new technology.

  In 2018 there were rather few applications for sites other than gas refuelling stations. In all, around EUR 1.5 million was granted in subsidies. The number of applications grew overall in 2019. No decisions on the use of the subsidies have yet been made for 2019.

- Grant for the building of electric vehicle recharging infrastructure (in housing cooperatives) (EUR 1.5 million per annum in 2018-2021, Housing Finance and Development Centre of Finland [ARA]). The grant is for 35% of realised costs up to a maximum of EUR 90 000. A requirement is that the organisation provides capacity for at least five recharging points. The grant is also available for the acquisition of recharging equipment.

  Around EUR 0.7 million was paid out in grants in 2018 (for 1 200 recharging points in 75 housing cooperatives). By October 2019 the figure had reached EUR 1.42, and there were 50 pending applications for a total of around EUR 0.6 million.

In 2018 a new energy support programme prepared by the Ministry of Economic Affairs and Employment was launched. Its basic annual budget is EUR 40 million. EUR 55 million was available in 2018 and EUR 40+40 million in 2019, half of which is for large-scale demonstration projects. The funding may also be used for transport projects. The number of applications, especially for biogas projects, has risen. Altogether EUR 40 million has been granted out of this new programme for biogas projects. The largest single subsidy was for the construction of a biogas plant at Nurmo by Nurmon Bioenergia Oy (EUR 9.36 million).

Under Antti Rinne's government programme, the energy support system will be developed during his term so that the focus will switch from production subsidies to support for investment and demonstration projects related to new energy technology.

Under the government programme, financial support for the building of infrastructure for recharging electric vehicles will continue in 2020-2022 with the allocation of an additional EUR 15 million. In connection with this, it has been proposed that the grant for building electric vehicle recharging infrastructure (housing cooperatives) should be increased by EUR 4 million per annum as from 2020.

3.2.6 Rural business and energy subsidies

To provide financial support for the production and distribution of biogas for transport and non-road mobile machinery and renewable propulsion systems outside the scope of the distribution obligation by means of investment aid for rural companies and farms.

So far rural business funding has only been applied for in relation to one investment project for biogas in transport. Several other projects have been started on farms and by other rural businesses, but these have received funding via other channels.

It is also possible to provide finance for biogas plants through investment aid for farms if the biogas is to be used by the farm itself. A few such projects have received funding in recent years.

Support for renewable energy enterprises and farm production is likely to continue within the framework of future EU legislation, the EU's common agricultural policy (CAP), and any available funds.

Under Antti Rinne's government programme, investment aid will start to be granted for biogas and new manure treatment techniques, as well as production aid for biogas production based on the nutrient cycle.

3.2.7 Use of EU financial instruments in building the distribution infrastructure

Finland is to use, where possible, various EU financing instruments for the building of the distribution network.

Listed below are projects that have been implemented in Finland and have received TEN-T support in 2016-2019:

- Development of LNG/L-CNG network in Finland, EUR 2.6 million in financial support (Gasum Oy 2015-2017)

- DOOR2LNG - Upgrade of the maritime link integrated in the multimodal container transport routes, EUR 16.96 million in financial support (Containerships, 2016-2019)

- Bothnia Bulk - Environmental upgrade of year-round supply in the northern Baltic Sea, EUR 6.8 million in financial support (ESL Shipping Ltd, 2016-2019)

- MEGA-E: Metropolitan Greater Areas – Electric, EUR 0.6 million in financial support (Fortum 2017-2021) (support for the whole project EUR 29.3 million / Allego BV)

- Nordic LNG/CNG - Decarbonisation of the Core Network by deployment of alternative fuel refuelling infrastructure, EUR 2.89 million in financial support (Gasum, 2018-2021)

3.2.8 Electrification of rail and other rail projects

A number of rail development projects were in progress or had just been completed in Finland in 2016-2019, including electrification projects:

- The Seinäjoki-Oulu upgrade project (entire project EUR 674 million)

- The western rail track at Pasila (EUR 49 million)

- The Riihimäki triangular junction (EUR 12 million)

- Increased capacity between Helsinki and Riihimäki (EUR 150 million)

- Improvements to the Helsinki rail yard (EUR 55 million)

- The Luumäki-Imatra project (EUR 189 million)

- The Pori-Mäntyluoto electrification project (EUR 7 million)

- The electrification of the line at Uusikaupunki (EUR 21 million)

- The Pännäinen-Pietarsaari electrification project (EUR 4 million)

The state also provided financial assistance for the following urban rail projects:

- western extension of the Helsinki metro, phase 1 (entire project EUR 1 186 million, state contribution EUR 200 million)

- western extension of the Helsinki metro, phase 2 (entire project EUR 801 million, state contribution EUR 240 million)

- Jokeri light rail (entire project EUR 275 million, state contribution EUR 84 million)

- Tampere tramway (entire project EUR 245 million, state contribution 30%)

Under Antti Rinne's government programme, there will be an increase in rail investments during his term. The programme also states that the Kemi (Laurila)-Happaranta railway track is to be electrified (EUR 10 million). 1685

3.3 Policies

3.3.1 Promotion of the use of biofuels in air transport

To explore and promptly adopt various financing models and / or other approaches to guarantee the availability of biofuels at Helsinki-Vantaa Airport.

The various actors have discussed possible models in 2016-2019, but no actual measures have been put in place yet.

Under Antti Rinne's government programme, there should be some progress during his term: the target is for a 30% share for sustainable biofuels in air transport by 2030, to be achieve by means of the obligation to mix fuels.

3.3.2 Promotion of natural gas and biogas in water transport

To continue resolutely with the implementation of the Finnish LNG action programme. The key components of the LNG action programme: 1) to promote gas refuelling facilities for ships in Finland; 2) to examine the use of financial incentives in the establishment of LNG infrastructure and the procurement of LNG-fuelled ships, and 3) to be globally active.

1) There has been support for, and investment in, gas refuelling facilities for ships in Finland (see point 2 below). The LNG terminal at Pori was completed in 2016. The terminal at Tornio was completed in June 2019, and that at

Hamina will be ready in 2020. The new LNG bunker vessel ordered by Eesti Gaas will also be ready in 2020 and will start operating in the Gulf of Finland.

2) Energy subsidies from the Ministry of Economic Affairs and Employment have been used to finance the construction of LNG terminals in Finland. In 2014 the Ministry granted energy subsidies of EUR 93.2 million for four projects for liquefied natural gas terminals (Tornio, Pori, Rauma and Hamina). Two of these (Pori and Tornio) have been completed and the one at Hamina is under construction. The Rauma project was subsequently withdrawn.

The Ministry of Transport and Communications's budget included an appropriation of EUR 60 million for environmental aid for vessels covering the period 2010-2016. In all, EUR 37.5 million was granted for investments in new vessels. Financing for environmental investments in vessels in use was granted, but the amount was EUR 3 million instead of the planned EUR 30 million. The aid was no longer available in 2017-2019.

3) For Finland's global actions see section 3.3.5.

To explore the possibility of using biogas too as a fuel in water transport and to implement the necessary measures.

The use of biogas in transport and its liquefaction to meet the needs, for example, of water transport have been examined in at least two different projects.

- BioSairila Oy's biogas in transport project

- Gasum Oy's biogas in transport project

To explore the needs of inland waterway transport with respect to the use of liquefied gas in Finland and the possibility of increasing its supply to serve vessels that operate on the deep water routes of Lake Saimaa.

No measures in the period 2016-2019.

3.3.3 Promotion of alternative propulsion systems at ports and airports

To explore the possibility of promoting the use of alternative propulsion systems at Finnish ports and airports. To adopt the most promising options by the start of the 2020s at the latest.

In autumn 2019, all of Finavia's diesel vehicles and most of the vehicles of other operators are using renewable diesel at Helsinki-Vantaa Airport. By the end of 2019, renewable diesel will also be used at all of Finavia's regional airports.

Electric non-road mobile machinery at Helsinki-Vantaa Airport now accounts for around 30% of all the vehicles and equipment used by ground handling companies. The figure is about 32% at regional airports. Non-road mobile machinery with combustion engines are replaced with rechargeable equipment in ground handling at the rate of 5-15% per annum.

3.3.4 Impact on EU targets, objectives and measures

Where possible to have an impact on the drafting of EU policy on renewable energy. The aim is for the basic legal instrument in this area to continue to be EU-wide beyond 2020.

Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable sources set a binding overall target for the EU of a 32% share of renewable energy. The renewable energy target for the transport sector was 14% of energy consumption, which includes the energy content of all forms of energy from renewable sources supplied to all transport sectors, also the energy content of electricity produced from renewable sources supplied to the road and rail transport sector. The sub-target for advanced biofuels is 0.2% in 2022, 1% in 2025 and at least 3.5% by 2030. The share of fuels from food and feed crops would be frozen at a maximum of 7%. Finland took an active role in drafting the Directive.

To take an active part in efforts to establish binding CO2 limit values for cars, vans and heavy duty vehicles. To highlight the lifecycle emissions of propulsion system alternatives when determining the limit values.

The new binding CO2 limit values for cars and vans for 2030 were adopted by the EU in January 2019, and those for heavy duty vehicles later that year. The Ministry of Transport and Communications took an active role in the preparatory work related to the setting of limit values for cars, vans and heavy duty vehicles.

Finnish decrees on limit values for cars, vans and heavy duty vehicles refer to the need to take stock of lifecycle emissions in the determination of limit values. They state that the Commission will assess the potential for establishing common methods within the EU for estimating and reporting on the lifecycle emissions of vehicles, and that, where necessary, it will establish monitoring measures and draw up legislative proposals. Without a change to the legislation on limit values there is a risk that, for example, gas-driven vehicles will disappear entirely from the model range offered by European vehicle manufacturers in the longer term.

To take an active role in the drafting of standards to promote the use of alternative propulsion systems for transport. To explore the potential for adopting a national E20 standard.

Finland has had an active role in the drafting of standards to promote the use of alternative propulsion systems for transport.

The European Committee for Standardization (CEN) began work on an E20 or E25 standard about five years ago, but at present the work is on hold, chiefly because of the FQD Directive (Directive 2009/30/EC of the European Parliament and of the Council amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions). According to Annex 1 of the Directive, E10 is the absolute maximum: the standards may not be changed unless the Directive is amended.

If the FQD were re-examined in 2020, it would take years before a change could take effect. E20 or E25 could be authorised under the FQD perhaps by 2025.

As E10 is the absolute maximum in the FQD, a national standard of >E10 is not possible so far.

3.3.5 Impact on international targets, objectives and measures

To be actively involved in the work of the ICAO and the IMO to promote the use of alternative propulsion systems in Finland, the EU and globally.

The International Civil Aviation Organization has recognised the importance of renewable aircraft fuels for reducing emissions from air transport in the short and medium term. Finland has participated actively in the setting of the ICAO targets for the introduction of renewable aircraft fuels and the drafting of sustainability criteria. When CORSIA, the Carbon Offsetting and Reduction Scheme for International Aviation, gets under way at the start of 2021, operators will be able to reduce the number of their offset obligations by starting to use renewable aircraft fuels that meet sustainability criteria. The role of alternative propulsion systems and their increased share are to be examined when drawing up long-term emission reduction targets at the end of 2019.

Finland has also done much to promote the use of renewable aircraft fuels in the context of the work of the ECAC (European Civil Aviation Conference), where, on a proposal from Finland and certain other Member States, a special cooperation forum on renewable aircraft fuels is being set up. The European Commission is also involved in the work of the forum, and there will be an assessment, for example, of the role of the distribution obligations in promoting the use of renewable aircraft fuels in the European Union.

Ways to cut greenhouse gas emissions from international shipping are the subject of discussions of the IMO's Marine Environment Protection Committee (MEPC) and the Intersessional Working Group on Reduction of GHG Emissions from Ships, ISWG-GHG. Finland pushed for the introduction of ambitious emission reduction targets for the IMO's provisional greenhouse gas strategy adopted in spring 2018, in which alternative propulsion systems have a key role. After the strategy was adopted, Finland has stressed at the IMO the importance of alternative propulsion systems and the development of the distribution infrastructure in the achievement of emission reduction targets for shipping.

The development and deployment of alternative propulsion systems now feature on the IMO's list of ways to accomplish this in the short term (before 2023), the medium term (2023-2030), and the long term (beyond 2030). Finland has supported proposals to prioritise these efforts. At IMO, Finland has also promoted the global introduction of a 0.5% limit on the sulphur content of fuel used by vessels. This will come into effect

from the start of 2020 and will encourage shipping companies to switch to alternative fuels and propulsion systems.

At the IMO, Finland and other countries have proposed a ban on the use and transportation of heavy fuel oil in Arctic waters. The ban would encourage the use of alternative fuels, such as LNG and biofuels, in these sensitive areas. Current discussions suggest that the ban could be approved by the IMO in 2021 and enter into force in 2023.

3.4 Research and Development

3.4.1 Information management

To continue and improve information management as it relates to consumers' choice of vehicles.

Much has been done in Finland to influence consumers' choice of vehicle. The Finnish Transport and Communications Agency, Traficom, offers a service[57]for consumers to compare vehicle makes and models with the registered vehicle they currently own. The service is free and available to everyone. The service has also made available an energy label developed in Finland for all new and used vehicles for which there is type approval information on emissions in the register (cars registered after 2001/2002). Traficom has also launched campaigns related to alternative propulsion systems, including the Ole edelläkävijä ('Be a trendsetter') and Aja vaihtoehtoa ('Alternative motoring') campaigns.

In addition to Traficom, many other Finnish actors and operators have been very active in producing information on alternative propulsion systems for transport. Good examples are the Valitse auto viisaasti (Choose a car wisely) website, which is a collaboration project between various actors,[58] and Finnish gas company Gasum's website on motoring with gas vehicles[59].

[57] https://autovertaamo.traficom.fi/
[58] www.valitseautoviisaasti.fi
[59] https://www.gasum.com/Yrityksille/puhdas-liikenne/aja-kaasulla/

In November 2018, the Finnish state and the automotive industry concluded a climate agreement known as the 'green deal')[60]. The Agreement aims at:

1) cutting average carbon dioxide emissions from newly registered cars and vans by at least 4% a year

2) increasing the number of vehicles that are suitable to be used with high amounts of biofuel, especially heavy duty vehicles

3) promoting the wider use of vehicles that rely on alternative propulsion systems, with their share of newly registered vehicles growing to at least 25% by the end of 2025

4) lowering the average age of vehicles and the average age of scrapped cars by 1.5% a year

One of the main measures under the agreement is to provide consumers with more information on alternative propulsion systems when purchasing a vehicle. The agreement will be in effect until the end of 2025.

To continue producing the guidelines and recommendations considered necessary for builders of recharging and refuelling stations.

These were some of the guidelines and recommendations in the period 2016-2019.

- Recommendation for the charging of electric vehicles (2019)[61]

- Electric vehicles and charging systems (electrical technology manual 41) (2019)[62]

- Charging points on properties guide (2016)[63]

[60] https://sitoumus2050.fi/autoala
[61] https://www.sesko.fi/standardit/standardoinnin_aihealueita/sahkoautot_ja_latausjarjestelmat/lataussuositus
[62] https://kauppa.sahkoinfo.fi/product/1613
[63] https://www.motiva.fi/koti_ja_asuminen/taloyhtiot/sahkoautojen_latauspisteet

3.4.2 Research, development and innovation

To allocate both national funds and any money for research Finland receives from the EU to projects that support the wider user of alternative propulsion systems for transport. To initiate demonstration and pilot projects related to alternative propulsion systems in cooperation with various agencies and actors, including local authorities in Finland.

In 2016-2019 several research and pilot projects relating to alternative propulsion systems for transport were carried out in Finland. They included:

- Research into biomethane engines and clean technology BioMet2020: EUR 0.529 million, 2018-2020
- Biofuel demonstration project Biosata: EUR 0.870 million, 2016-2019
- Emissions measurements in urban buses Rakebus; EUR 0.125 million,2019
- The impact of uncertainty in electric bus driving cycles on energy consumption: EUR 0.120 million, 2016-2019
- The factors that account for fluctuations in the energy consumption of electric buses RoBUSt; EUR 0.120 million, 2016-2019
- The impact of financial steering mechanisms on emissions from passenger cars and their energy consumption; EUR 0.120 million, 2017-2020
- Action Plan for the Future of Mobility in Europe Mobility4EU; EUR 1.800 million, 2016-2018
- Cost-effective measures to encourage purchases of electric and gas vehicles Gaselli; EUR 0.1 million, 2018-2019
- Cost-effective paths towards the establishment of biofuels in transport by 2030; EUR 0.1 million, 2018

Finland is also involved in a project initiated by the European Commission to explore best practices for providing consumers with price comparison information on different propulsion systems.

3.4.3 Monitoring

To set up an unofficial monitoring group that meets a few times a year to oversee implementation of the distribution infrastructure and vehicle objectives set in the national distribution network plan.

No monitoring group has been established, but talks on the subject have continued and several other working groups have been following the situation. These include the transport climate policy working group ILMO45 and the RED II working group. The situation has also been discussed at bilateral meetings.