

IEA-Advanced Motor Fuels ANNUAL REPORT 2023

FINLAND



Finland

Drivers and Policies

Finland's 2016 energy and climate strategy calls for a 50% reduction in carbon dioxide (CO₂) emissions from transport by 2030 (from reference year 2005).¹ The [2019 Government Programme](#) sets a new upper level: Finland will achieve carbon neutrality by 2035 and aims to be the world's first fossil-free welfare society.

In May 2021, the Ministry of Transport and Communications of Finland published a roadmap for fossil-free transport with the goal of halving greenhouse gas (GHG) emissions from transport by 2030, (using 2005 as the base year) and achieving zero emissions by 2045. Roadmap measures include actions to support the procurement of electric and gas-powered vehicles, the distribution infrastructure, pedestrian and bicycle traffic, and public transport. In addition, roadmap cover the impacts of a stricter obligation to distribute renewable fuels, as well as the impacts of remote work, new transport services, and combined transports in freight traffic.²

In spring 2019, the biofuels obligation was revised and Finland's pathway toward 2030 was set. The biofuel target for 2029 and beyond was set at 30%, and this time, the target reflects actual energy contributions without double counting, which explains the lower obligation for 2021 compared with 2020 (20%). A separate sub target for advanced biofuels also exists, following the European Union (EU) Renewable Energy Directive (RED II): 2% between 2021 and 2023. In 2021, Finland passed a law amending gaseous and liquefied biogas in the transport biofuels obligation beginning January 1, 2022, and passed a law amending electro-fuels in the biofuels obligation beginning January 1, 2023.^{3,4} In September 2022, the government proposed that Parliament increase the renewable fuels blending obligation to 34% in 2030 and onward.⁵ The original biofuels obligation (liquid biofuels) calls for 19.5% biofuels for on-road transportation in 2022. However, due to a sudden increase in fuel prices during the spring of 2022, the government decided to reduce the blending obligation by 7.5%, to 12% for 2022. In October 2023, the government of Finland proposed that Parliament reduce the biofuels obligation from 28% to 13.5% for 2024,⁶ which was the approved. The reason for reduction was an estimated 17-cent increase in diesel and 15-cent increase in gasoline prices that would result from a 28% biofuels obligation.

In addition, a separate renewable fuels obligation was established for non-road machinery diesel fuels. With the current level at 6%, the original law called for an annual increase of up to 10% in 2030. In November 2022, the government proposed that Parliament increase the renewable fuels blending obligation in non-road machinery use to 30% in 2030 and onward.⁷

As of 2011, the fuel tax system consists of an energy component, a CO₂ component, and a bonus for reduced local emissions. The system favours the best biofuels, but it is still transparent and technology-neutral and can be used in combination with the obligation for liquid biofuels. Passenger car taxation (purchase tax and annual tax) has been CO₂-based (tailpipe) since 2008, providing substantial incentives for battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).⁸ In addition, since 2020, Finland has offered a reduced-tax benefit for citizens who drive a company-

¹ Ministry of Economic Affairs and Employment of Finland, "Energy and Climate Strategy," <https://tem.fi/en/energy-and-climate-strategy-2016>

² Ministry of Transport and Communications, "Transport emissions can be halved by 2030 through national and EU measures," <https://www.lvm.fi/en/-/transport-emissions-can-be-halved-by-2030-through-national-and-eu-measures-1641099>.

³ Edilex, "Obligation to distribute biofuels," https://www.edilex.fi/verohallinnon_ohjeet/2020_1116.html

⁴ Ministry of Economic Affairs and Employment of Finland, "Working Life Barometer 2023: More support for continuous learning needed at workplaces," <https://tem.fi/-/biopolttoaineet-jakeluvellvoitteeseen>.

⁵ Parliament of Finland, "Government proposal HE 174 /2022 vp," https://www.eduskunta.fi/FI/vaski/HallituksenEsitys/Sivut/HE_174+2022.aspx.

⁶ Ministry of Economic Affairs and Employment of Finland, "Bill: Transportation fuel distribution obligation 13.5% also next year," <https://tem.fi/-/lakiesitys-liikennepolttoaineiden-jakeluvellvoite-13-5-myos-ensi-vuonna>.

⁷ Parliament of Finland, "Government proposal HE 297 /2022 vp," https://www.eduskunta.fi/FI/vaski/HallituksenEsitys/Sivut/HE_297+2022.aspx

⁸ Parkkonen, L., 2013, "Taxation of petroleum products and vehicles in Finland," CEN/TC 19 Conference. Helsinki, May 27, 2013.

owned car. The value has been 170€/a for BEVs and 85€/a for cars with CO₂ emissions in the range of 1–100g/km. The benefit will end at the end of 2025.

The current government programme promotes the use of renewable fuels via fuel conversion kits. The government has also proposed national legislation modifications for promoting flexi-fuel (E85) and biomethane passenger car conversion kit installations.⁹ However, the proposal leaves open the details regarding how motorists with converted cars can demonstrate compliance with safety and emissions requirements.

Advanced Motor Fuels Statistics

In 2022, the energy consumption in domestic transport (all modes together) was 164 petajoules (PJ), and energy consumption in road transport was 151 PJ, or 3600 kilo tonnes of oil equivalent (toe) (Table 1). Relative to Finland's total energy consumption of 1,275 PJ in 2022, the transport consumption figures were 12.9% (total) and 11.8% (road), respectively.¹⁰

Table 1. Energy in Road Transport, 2022

	PJ	ktoe	Share of fuels (%)	Share of biofuels (%)
Petrol (fossil)	44.1	1052	27.98	
Biocompatible petrol	4.8	114	3.0	9.8 of petrol
Diesel (fossil)	81.7	1951	54.7	
Biocompatible diesel	17.7	423	17.8	22.2 of diesel
Natural gas	0.25	0.6	0.02	
Biomethane	1.16	27.7	0.78	99.8 of gas
Σ fuels	149.4	3569		15.8 of fuels
	PJ	ktoe	Share of total (%)	
Electricity	1.44	34.5	0.97	
Total	150.9	3,604		

Source: pxnet2.stat.fi/PXWeb/pxweb/fi/StatFin/StatFin__ene__ehk/statfin_ehk_pxt_12sz.px/

In terms of energy, the contribution of biofuels relative to the total fuel consumption in road transport is 15.8%, varying from 9.8% in petrol (mostly ethanol and some ethyl tertiary-butyl ether [ETBE], but also bio-naphtha; the statistics do not give details on this) to 99.8% in methane. The actual amount was 565 ktoe, or 15.8% of the fuels.

The four major Finnish players in biofuels are Neste (the world's biggest producer of hydrotreated vegetable oil [HVO]), UPM, St1, and Gasum.

Table 2 presents the vehicle fleet in use at the end of 2022 (without two- and three-wheelers and light four-wheelers). Table 3 presents the sales figures for new passenger cars in 2015–2022 (revised).

⁹ Finlex, "The government's proposal to parliament as a law on amending the Vehicle Act and related laws," <https://www.finlex.fi/fi/esitykset/he/2022/20220291>

¹⁰ StatFin, "12sz — Energy consumption in transport, 1990–2022," https://pxdata.stat.fi/PxWeb/pxweb/fi/StatFin/StatFin__ehk/statfin_ehk_pxt_12sz.px/

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Table 2. Vehicle Fleet in Use at the End of 2023 (without two- and three-wheelers and light four-wheelers)¹¹

Fuel	Cars	Vans	Trucks	Buses	Special vehicles
Petrol	1,820,926	8,920	2,354	20	260
FFV/ethanol	4,496	16	131	0	0
Diesel	695,233	330,367	86,896	10,250	1,227
Methane	7,766	849	331	67	0
Methane bi-fuel	8,620	323	96	0	0
BEV	83,762	3,181	65	653	0
PHEV petrol	128,564	212	0	0	0
PHEV diesel	6,541	82	5	2	0
Other	59	17	194	5	0
Total	2,756,015	343,976	90,086	11,000	1,487
Fuel	Cars (%)	Vans (%)	Trucks (%)	Buses (%)	Special vehicles (%)
Petrol	66.1	2.6	2.6	0.2	17.5
FFV/ethanol	0.2	0.0	0.1	0.0	0.0
Diesel	26.1	96.4	99.6	95.2	88.0
Methane	0.3	0.2	0.4	0.6	0.0
Methane bi-fuel	0.3	0.1	0.1	0.0	0.0
BEV	3.0	0.9	0.1	5.9	0.0
PHEV petrol	4.7	0.1	0.0	0.0	0.0
PHEV diesel	0.2	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.2	0.0	0.0

Table 3. Sales of New Passenger Cars, 2015–2023¹²

Year	Petrol (P)	FFV	CNG	Diesel (D)	HEV P	HEV D	PHEV P	PHEV D	BEV
2015	66,248	105	158	38,797	2,817	29	400	15	243
2016	7,3251	14	165	39,451	4,668	11	1115	93	223
2017	70,520	1	433	36,060	8,512	2	2,401	152	502
2018	73,065	0	1,161	28,710	11,631	224	4,797	135	776
2019	67,751	0	2,142	20,871	14,582	990	5,807	159	1,897
2020	45,589	0	1,841	14,133	17,371	1,354	12,797	435	4,245
2021	30,757	12	909	8,397	25,871	2,235	19,519	620	10,152
2022	19,244	27	595	5,418	24,084	1,626	15,770	401	14,530
2023	12,910	17	453	4,124	21,444	932	17,897	220	29,535

In 2023, 87,502 new cars were sold – approximately 7% more than in 2022. Diesel shares of new sales continue to decline and in 2023 represented only 4.7%, compared to 35.7% in 2015. Sales of PHEVs increased slightly to around 20.7% of total new sales. BEVs are becoming more popular, and sales have increased year over year. In 2023, BEVs represented about 34% of total new sales.

¹¹ Tieto.Traficom, “Vehicle fleet statistics,” <https://tieto.traficom.fi/fi/tilastot/ajoneuvokannan-tilastot?toggle=K%C3%A4ytt%C3%B6voimat>

¹² Finnish Information Centre of Automobile Sector, “Motive power statistics of first registered passenger cars,” https://www.aut.fi/tilastot/ensirekisteroinnit/ensirekisteroinnit_kayttovoimittain/henkiloautojen_kayttovoimatilastot.

Finland has an estimated 558 alternative-fueled trucks, including FFVs and bi-fuel vehicles. Methane-fueled trucks represent the greatest share. The numbers for these two categories are explained by the fact that some heavy pickup trucks and vans are registered as trucks. With the development of liquefied natural gas (LNG) refueling infrastructure and increased offerings of heavy gas trucks, trucks fueled by LNG now operate on Finnish roads. The number of trucks fueled by compressed natural gas (CNG) and LNG has grown to 331 in 2023. In the case of buses, the number of battery electric buses has surpassed the number of CNG buses. The increase of electric (city) buses has been rapid. In 2020, Finland has a total of 87 electric buses and in 2023, already 656.

Research and Demonstration Focus

The following paragraphs describe some major national R&D projects in which the VTT Technical Research Centre of Finland (VTT) is taking part, as well as a number of additional projects.

In 2020, Business Finland funded a new project on liquid electrofuels. The E-Fuel project (2021–2024) aims to integrate hydrogen production through high-temperature electrolysis with CO₂ sequestration and Fischer-Tropsch fuel synthesis; the project also includes research on end use. Electrofuel developed from green hydrogen and CO₂ was demonstrated in an agricultural tractor in November 2023.¹³

The BIOFLEX project (2020–2024) explores how suitable fuel oils made from biomass and waste plastics are for power plants and ship diesel engines. The project studied the development of production processes and measurements of the emissions when using new biofuels in marine engines.

The Clean Propulsion Project (2021–2024), funded by Business Finland, focuses on developing maritime and non-road engine technologies for better efficiency and renewable fuels. The project has four focus areas:

1. Developing a roadmap for sustainable shipping.
2. Investigating and developing multiple power source propulsion systems, including hybrid technology demonstration.
3. Formulating novel combustion concepts and exhaust gas after-treatment technologies that achieve close to zero emissions. Different fuel options are investigated, including hydrogen in non-road applications.
4. Developing a virtual sensor and control algorithm for increased powertrain efficiency and full deployment of renewable fuels.

The NoDamageTruck project (2022–2024), funded by Business Finland, focuses on developing an electrically assisted trailer axle for heavy-duty vehicles to improve the energy efficiency of internal combustion engine (ICE)-powered vehicles and improve work productivity. The focus is on typical Nordic countries' vehicle applications (i.e., vehicles with a gross weight up to 76 tonnes). The project includes formulating a flexible and rapid design methodology for combining model-based development with experimental testing activities to accelerate the overall development process. The project also includes a simulation-based evaluation of the potential of e-axles in different heavy-duty vehicle (HDV) applications, such as timber, long-haul, and rock transport. The e-axle concept will be demonstrated on an experimental basis.

The DeCARBO project (2022–2024), funded by Business Finland, investigates the most suitable technologies for decarbonization of non-road mobile machinery (NRMM) in mining, harbour, and forestry use cases. The project consists of four focus areas.

1. Foresight and scenario investigation that allows researchers to offer guidance on possible future development paths.

¹³ VTT, "Electrofuel developed from green hydrogen and carbon dioxide to be tested in practice for the first time," <https://www.vttresearch.com/en/news-and-ideas/electrofuel-developed-green-hydrogen-and-carbon-dioxide-be-tested-practice-first>.

2. Research on the most promising potential technological solutions for decarbonization of NRMM in different use cases and operational environments. In particular, the study looks at different options for off-grid-environment NRMM applications.
3. Hydrogen fuel-cell and renewable fuel ICE power generation options for off-grid power generation needs.
4. Techno-economic analyses to evaluate not only technical attributes but also economic feasibility.

Outlook

Finland must reduce its CO₂ in the non-ETS (not part of the EU emissions trading scheme) sector by 39% by 2030, putting pressure on emission reductions in transport. Biofuels — or, in more general terms, renewable fuels— are seen as a very important element of emission reductions in transport. With its new liquid biofuels mandate written into law in spring 2019, Finland is one of the few countries with a fixed biofuels policy articulated through 2030. In parallel with increasing the amount of biofuels, Finland is promoting energy efficiency and electrification in transport as well.

In the newest government program, much attention is given to the circular economy and biogas, so the country has the political will to promote the use of biomethane in transport. Opening the gas market (gas transmission and sales separated) as of 2020, a new pipeline connector to Estonia, and terminals for LNG offer important new possibilities for methane in stationary, as well as mobile, applications on land and at sea.¹⁴ Currently, the Finnish LNG vessel fleet encompasses 10 LNG-fueled ships, including passenger and cargo ships, one icebreaker, and one border patrol vessel. At the end of 2020, a biogas obligation for transport and heating gas was proposed. The new law requires that biogas be mixed in the national gas grid.

Finnish energy companies have a record of being active in the field of biofuels. New capacity is to be expected within the borders of Finland and abroad.

During 2022, green hydrogen and e-fuels production advanced as many new investment plans were published. In total, currently planned capacity will be more than 1 GW for green hydrogen and more than 500 MW for green methane production. In addition, there are investment plans for green ammonia production. Green methane is targeted to support green fuels use in HDVs.

To support e-fuels production, more than 3,680 MW of new wind power capacity was installed during 2022 and 2023. At the end of 2023, the total peak power capacity of wind was around 6,949 MW in comparison to around 12,000 MW capacity of traditional sources (combined heat and power [CHP], condensing power, hydro, and nuclear). Wind power capacity is expected to increase to around 9,000 MW by 2025.¹⁵

Major changes

Finland's energy and climate strategy calls for a 50% reduction in CO₂ emissions from transport by 2030, and a new upper-level target for the country to be CO₂-neutral by 2035. A renewable fuel (including liquids and biomethane) law for road transport calls for an actual energy share of 34% renewable fuels by 2030. A separate sub-target of 10% is set for advanced biofuels. In addition, the law for non-road machinery fuels calls for a 30% share of renewable fuels beginning in 2030. This legislation signals that Finland is implementing one of the world's most progressive biofuels policies. In addition, the government emphasizes a circular economy and the development of biogas.

¹⁴ GASGRID, 2020, "This Is How The Gas Market Opened in Finland," <https://gasgrid.fi/en/2020/06/30/this-is-how-the-gas-market-opened-in-finland/>.

¹⁵ Investment decision made before 01 April 2023.