



Sweden's 2019 report under the Directive on the deployment of alternative fuels infrastructure

Pursuant to Article 10(1) of Directive 2014/94/EU of the
European Parliament and of the Council of 22 October 2014

Foreword

This is Sweden's first national report on the deployment of alternative fuels infrastructure under Article 10 of Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure. Under Article 10 of the Directive, each Member State must submit to the Commission a report on the implementation of its national policy framework by 18 November 2019, and every three years thereafter.

The report is based on information from the Swedish Energy Agency.

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1 Summary

Under the Directive on the deployment of alternative fuels infrastructure (2014/94/EU), each Member State is required to submit to the Commission a report on the implementation of its national policy framework by 18 November 2019, and every three years thereafter. The report must contain a description of the measures taken in a Member State in support of alternative fuels infrastructure build-up. The Swedish Energy Agency's basis is a government-commissioned report to be submitted to the Government Offices of Sweden no later than 30 September 2019. The information for the basis report has been collected through written sources, analyses of data and statistics, and contact with the responsible authorities and market actors.

Sweden's ambition is to become one of the first fossil-free developed nations in the world. Sweden will have zero net emissions of greenhouse gases to the atmosphere by 2045, and will attain negative emissions thereafter. Greenhouse gas emissions from domestic transport (excluding domestic aviation included under EU ETS) shall be reduced by at least 70% by no later than 2030 compared with 2010. In 2017, domestic transport accounted for 31% of Sweden's greenhouse gas emissions. A fossil-free vehicle fleet requires a combination of different measures: a transport-efficient society, improved energy efficiency and a shift to renewable fuels. Measures for alternative fuels and associated infrastructure development will be targeted at vehicles, fuels and infrastructure, so that these areas can be developed simultaneously.

Many of the measures for alternative fuels and associated infrastructure development support a combination of vehicles, alternative fuels and/or infrastructure. For example, work to develop a strategic plan for the switch to a fossil-free transport sector, initiatives to reduce the climate impact of freight transport and the Fossil-free Sweden initiative.

HVO100, road fuel gas and FAME100 are the three most common alternative fuels (to diesel MK1 and petrol MK1) in the case of road transport. Road fuel gas consisted of 93% biogas in 2018. Refuelling points for gas fuels are increasing, primarily those for LNG/LBG. Interest is increasing among vehicle manufacturers for liquid methane (LNG/LBG) as a fuel in heavy vehicles and several refuelling points have been awarded aid under Climate Leap. In certain cases, Sweden is applying tax relief for sustainable biofuels. This tax relief means that clean and high-blend biofuels can be priced to improve competitiveness compared with their fossil counterparts. All high-blend sustainable biofuels are exempt from both CO₂ and energy taxes.

There are numerous policy instruments aimed at promoting vehicles in road traffic that can be powered using alternative fuels, including e.g. bonus-malus, reducing the benefit value for environmentally adapted cars and the electric bus premium to promote the placing of electric buses on the market. The bus fleet is well advanced in the switch to renewables compared with the car and lorry fleets. Interest in rechargeable electric cars has risen sharply, and the number of rechargeable electric vehicles has increased rapidly, boosting demand at existing recharging stations. The Swedish Energy Agency has been tasked with coordinating aid for alternative fuels infrastructure deployment, and since 2018 this task has included both the recharging infrastructure and infrastructure for other renewable fuels.

Guidelines for LNG bunkering and guidelines for connection to the shore-side electricity network have been produced to facilitate the switch to alternative fuels in shipping. Differentiated fairway and port charges mean lower charges for vessels with better performance, thereby rewarding alternative fuels. Ports with access to LNG have increased in number in recent years, and the requirements for LNG bunkering have become clearer since the national guidelines for the bunkering of liquid methane were completed in 2018.

A special study has proposed a number of measures to promote the use of biofuels in aviation. The quantities of biojet fuel being supplied are very small and are not included in the official statistics. The number of moorings with electricity supply provision for stationary aircraft has increased.

Aid for the expansion of alternative fuels infrastructure and production aid for alternative fuels often take the form of a larger, more general package where several different aims may be achieved under the same support. Aid is primarily given through the Climate Leap initiative, although there are also specific production aid initiatives for biogas.

There are numerous initiatives relating to research, technical development and demonstration of alternative fuels. There are numerous road transport initiatives relating to energy and environment-efficient vehicles and alternative fuels. In shipping, there are initiatives for increased energy efficiency and to increase the proportion of renewable energy used. Investments have been made in sustainable biofuels for aviation. Many of the initiatives in Sweden do not focus on a specific mode of transport or specific fuel, but include or promote the potential for several different fuels and modes of transport or a combination thereof.

Long-term scenarios for the development of the transport sector provide an estimate of the expected number of vehicles using alternative fuels in the future. A switch is taking place in the car fleet from conventional petrol cars to diesel cars, rechargeable cars, plug-in hybrids and gas-powered cars.

2 Terms and definitions

Term	Definition
Alternative fuels	Fuels which serve, at least partly, as a substitute for fossil fuels in the energy supply to transport and which have the potential to contribute to their decarbonisation and enhance the environmental performance of the transport sector.
B100	See FAME.
BEV	See electric vehicle.
Fuel cell vehicle	An electric vehicle powered by a fuel cell supplying a current to an electric motor. Hydrogen is usually converted into electricity, heat and steam in the fuel cell.
Biofuel	Liquid or gaseous fuels produced from biomass and used for transport purposes.
Biojet fuel	A biofuel blended in aviation kerosene.
CBG	Compressed biogas
CNG	Compressed natural gas. Note that CNG also covers compressed biogas in Directive 2014/94/EU.
Fuel	A fuel or other form of energy intended for engine operation.
E85	A fuel that can replace petrol in adapted engines and that consists of a mixture of ethanol and petroleum, on average 85% by volume of ethanol.
ED95	A fuel that replaces diesel and consists on average of 95% by volume of ethanol and the addition of ignition enhancers, lubricants and corrosion protectors.

Term	Definition
Electric vehicle	A vehicle that is solely powered by electricity and charges its battery from the mains. The British equivalent is called a Battery Electric Vehicle (BEV).
Ethanol	Alcohol that can be included in both high-blend biofuels such as E85 and ED95 as well as in a low-blended form in petrol.
FAME	Fatty Acid Methyl Ester. Normally referred to as biodiesel and includes both clean fuels such as B100, which is included in low-blend volumes in ordinary diesel. RME (rapeseed methyl ester) is a FAME produced through the esterification of rapeseed oil.
FCV	See fuel cell vehicle.
Road fuel gas	Methane gas used as a fuel in vehicles and may consist of natural gas, biogas or a mixture of the two.
HVO	Hydrogenated Vegetable Oil. May be produced from different types of oils and fats, which create a synthetic diesel with identical chemical properties to diesels of fossil origin through a hydrogenation process. Covers both clean fuels such as HVO100 and low-blend volumes in ordinary diesel.
HVO100	See HVO.
Hybrid	Vehicles that have a supplementary electric powertrain whose battery is only charged when driving.
Rechargeable vehicle	Electric vehicles and plug-in hybrid electric vehicles that charge their battery on board via the mains.
Plug-in hybrid electric vehicle	Vehicles that use electricity, but also use an internal combustion engine for propulsion. Also known as plug-in-hybrids (PHEV).

Term	Definition
Recharging point	An interface that is capable of charging one electric vehicle at a time or exchanging a battery of one electric vehicle at a time.
Recharging station	Geographical location with the potential to charge one or more rechargeable electric vehicles. A recharging station may provide multiple recharging points.
Shore-side electricity supply	The provision of shore-side electrical power through a standardised interface to seagoing ships or inland waterway vessels at berth.
LBG	Liquefied biogas
LNG	Liquefied natural gas. Note that LNG also covers liquefied biogas in Directive 2014/94/EU.
Refuelling point for LNG	A refuelling facility for the provision of LNG, consisting of either a fixed or mobile facility, offshore facility, or other system.
Recharging or refuelling point accessible to the public	A recharging or refuelling point to supply an alternative fuel which provides Union-wide non-discriminatory access to users. Non-discriminatory access may include different terms of authentication, use and payment.
Pure and high-blend liquid biofuels	Fuels that are not conventional petrol or diesel and largely consist of biofuels, e.g. E85, ED95, B100 and HVO100.
PHEV	See plug-in hybrid electric vehicle.
RME	See FAME.
Refuelling point	A refuelling facility for the provision of any fuel with the exception of LNG, through a fixed or a mobile installation.
TEN- T	Trans-European Networks for Transport.
TEN-T Core Network	The highest priority sections of the Trans-European Networks for Transport.

3 Background

In 2016, the Swedish Government adopted a national policy framework for alternative fuels infrastructure in accordance with the requirements in Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure. Under Article 10(1) of the Directive, each Member State is required to submit to the Commission a report on the implementation of its national policy framework by 18 November 2019, and every three years thereafter. The report must include a description of the measures taken in a Member State in support of alternative fuels infrastructure build-up.

3.1 Description of Directive 2014/94/EU on the deployment of alternative fuels infrastructure

Directive 2014/94/EU on the deployment of alternative fuels infrastructure is based on Europe 2020: A Strategy for Smart, Sustainable and Inclusive Growth¹, and the white paper on the EU's future transport policy². The Commission's white paper entitled *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system* calls for a reduction in oil dependency in the transport sector. The white paper calls for the increased use of sustainable alternative fuels and the deployment of associated infrastructure to achieve this. The primary aim of Directive 2014/94/EU is to minimise dependence on oil and to mitigate the environmental impact of transport.

The directive defines alternative fuels as fuels or power sources which serve, at least partly, as a substitute for fossil fuels in the energy supply to transport and which have the potential to contribute to their decarbonisation and enhance the environmental performance of the transport sector. They include, inter alia:

- electricity;
- hydrogen;
- biofuels as defined in Article 2 of Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC;
- synthetic and paraffinic fuels;

¹ Communication from the Commission – COM(2010) 2020 final, Europe 2020: A strategy for smart, sustainable and inclusive growth, 3 March 2010.

² WHITE PAPER Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system /* COM/2011/0144 final */.

- natural gas, including biomethane, in gaseous form (compressed natural gas (CNG)) and liquefied form (liquefied natural gas (LNG)); and
- liquefied petroleum gas (LPG).

The Directive sets out minimum requirements for infrastructure development, common technical specifications for recharging and refuelling points and requirements concerning user information. A central issue in the Directive is that each Member State is required to establish a national policy framework for the infrastructure build-up for alternative fuels. The policy framework must contain national targets and objectives for the deployment of recharging and refuelling points for different types of alternative fuels, such as electricity, hydrogen and natural gas, along with various forms of aid measures. The intention is for the strategies of the Member States, in the long term, to provide security for private and public investment in vehicle and fuel technology and infrastructure build-up.

In addition to the requirement to produce a policy framework, the Directive states that Member States must ensure that common technical standards are met for recharging stations for vehicles, for refuelling points and for shore-side electricity facilities. The standards are specified in the Annex to the Directive and are based on standards adopted by standardisation organisations. The Directive also contains specific requirement for user information, e.g. regarding the types of motor vehicles that may regularly be refuelled with fuel on the market or recharged at charging stations. Where appropriate, when fuel prices are displayed at a fuel station, a comparison between the relevant unit prices shall be displayed for information purposes. Clear and readily comparable information on the prices of different fuels could play an important role in enabling vehicle users to better evaluate the relative cost of individual fuels available on the market. Thus, when fuel prices are displayed at a fuel station, in particular for natural gas and hydrogen, it should be possible for unit price comparison to conventional fuels, such as ‘1 petrol litre equivalent’, to be displayed for information purposes. The display of this information shall not mislead or confuse the user.

3.2 Sweden has supplemented its national policy framework

The Swedish Government adopted the national policy framework in November 2016³. The policy framework describes the current state and a future assessment of the market as regards alternative fuels in the transport sector and the national targets and objectives for the deployment of alternative fuels infrastructure. The policy framework also specifies the measures necessary to ensure the national targets and objectives are met. The Swedish policy

³ Sweden’s policy framework for alternative fuels infrastructure under Directive 2014/94/EU. Annex to Minutes II 8 of Government meeting held on 17 November 2016, N2016/07176/MRT, etc.

framework attracted criticism for not fulfilling all of the requirements of the Directive, and the Commission notified Sweden accordingly in a formal notification in July 2017. The Commission also invited Sweden to fully incorporate the EU provisions on the alternative fuels infrastructure deployment in a reasoned opinion in October 2017. Thus, the Swedish Government decided to supplement the policy framework in August 2018⁴.

3.3 First report on measures supporting alternative fuels infrastructure

Under Article 10(1) of Directive 2014/94/EU of the European Parliament and of the Council on the deployment of alternative fuels infrastructure, each Member State shall submit to the Commission a report on the implementation of its national policy framework by 18 November 2019, and every three years thereafter. The report shall contain a description of the measures taken in a Member State in support of alternative fuels infrastructure build-up. The report shall cover the information referred to in Annex I to the Directive and shall, where appropriate, contain a relevant justification regarding the level of achievement of the targets and objectives adopted through the national policy framework. The report must include at least the following elements:

1. Legal measures;
2. Policy measures supporting the implementation of the policy framework;
3. Deployment and manufacturing support;
4. Research, technological development and demonstration (RTD&D);
5. Targets and objectives;
6. Alternative fuels infrastructure developments.

The Commission has produced guidelines and a reporting template for the Member States to use in preparing the reporting under the Directive.

⁴ Supplement to the policy framework for alternative fuels infrastructure under Directive 2014/94/EU. Annex to Minutes II 20 of Government meeting held on 30 August 2018. N2018/04594/MRT, etc.

4 Legal measures

This section describes the legal measures performed in the implementation of Directive 2014/94/EU on the deployment of alternative fuels infrastructure. The legal measures aim to support the deployment of alternative fuels infrastructure and to ensure that common technical standards are met for refuelling points and recharging stations for vehicles. The regulations have also been clarified to make it easier to recharge vehicles on individual occasions without entering into agreements and reducing the administrative burden on companies, which promotes the deployment of alternative fuels infrastructure. The reporting of legal measures to support alternative fuels infrastructure deployment corresponds to the requirement in point 1 of Annex I of Directive 2014/94/EU.

Sweden has ensured that common technical standards will be fulfilled for recharging stations for vehicles, refuelling points and shore-side electricity facilities through a new law⁵ and a new Ordinance⁶. The legislation contains provisions on how installations for alternative fuels should be designed and on information provided to the users of such installations. It is also required that charges for electric vehicles at recharging points accessible to the public must be reasonable, objective and non-discriminatory. The Act and Ordinance entered into force on 18 November 2016.

Under the Ordinance, the Swedish Transport Agency and the Swedish Consumer Agency can issue regulations on information for users regarding the types of fuel vehicles can be refuelled with and information on unit prices for fuels. The aim of unit prices for fuels is to enable vehicle users to compare the price of an alternative fuel with the price of a conventional fuel. The Swedish Transport Agency has initiated regulatory work on the elements of Article 7 of the Directive to ensure relevant, consistent and clear information is made available as regards those motor vehicles which can be regularly fuelled with individual fuels placed on the market, or recharged at recharging points. The Swedish Energy Agency is responsible for the supervision of charges for recharging electric vehicles and the design of recharging points for electric vehicles. The Swedish Transport Agency and the Swedish National Electrical Safety Board is responsible for the supervision of shore-side electricity supplies for vessels.

⁵ Swedish Act (2016:915) on requirements for installations for alternative fuels.

⁶ Ordinance (2016:917) on requirements for installations for alternative fuels.

As part of the implementation of the Directive, the Swedish Electricity Act (1997:857) has been clarified⁷ to make it clear that owners of recharging stations for electric vehicles are not covered by certain obligations under the Act, including in cases where the owner receives payment for the electricity. The requirements not required of these operators are certain requirements for information that must be included in the agreement between consumers and electricity suppliers and the obligation to provide information to the network authority on prices and delivery terms. Therefore, the requirement of the Directive that it must be possible for electric vehicle users to recharge on an ad hoc basis without entering into a contract with the electricity supplier or operator concerned has been fulfilled.

The electricity certificate system is a market-based support system that aims to increase the generation of renewable electricity in a cost-effective way. Persons subject to quota under the Electricity Certificates Act (2011:1200)⁸, must purchase a specific percentage of electricity certificates in relation to their electricity sales or electricity usage. An exemption from the quota obligation has been introduced in the Act for electricity suppliers only supplying electricity to recharging stations for vehicles. This reduces the administrative burden on undertakings and facilitates the deployment of charging infrastructure.

⁷ Swedish Act (2016:914) on the amendment of the Electricity Act (1997:857).

⁸ Swedish Act (2017:813) amending the Electricity Certificates Act (2011:1200).

5 Policy measures supporting the implementation of the policy framework

Reduced emissions from the transport sector are crucial if Sweden is to attain its long-term climate targets and become one of the world's first fossil-free prosperous nations. To achieve this, Sweden has to have a fossil-free vehicle fleet. A fossil-free vehicle fleet requires a combination of several different measures: a transport-efficient society, improved energy efficiency and a shift to renewable fuels. Measures are aimed at vehicles, fuels and infrastructure so that these areas can be developed simultaneously. Policy measures supporting the implementation of the national policy framework⁹ are described below along with legal measures not directly connected to the implementation of the Directive. The reporting in this section corresponds to the requirements in points 1 and 2 of Annex I of Directive 2014/94/EU.

Measures implemented to promote alternative fuels and associated infrastructure are listed in Table 1. All of the measures listed support the achievement of national targets and objectives. Many of the measures are formulated in a general manner to support several different objectives, for example, several measures promote both private and public recharging infrastructure.

Table 1. Policy measures supporting the implementation of the national policy framework.
AF= Alternative fuels, AFV= Vehicles that can run on alternative fuels, AFI= Alternative fuel infrastructure.

Policy measures supporting the implementation of the national policy framework					
No	Designation	Area	Alternative fuel	Mode of operation	Status
5.1.1	Bonus-malus system for light vehicles	AFV	Combination	Road	Current
5.1.2	Super green car premium	AFV	Combination	Road	Not applicable
5.1.3	Reduced taxable benefit rate for certain environmentally sound cars	AFV	Combination	Road	Current
5.1.4	Vehicle tax exemption for green cars	AFV	Combination	Road	Not applicable
5.1.5	Lower vehicle tax for heavy vehicles that can run on alternative fuels	AFV	Combination	Road	Current

⁹ Sweden's policy framework for alternative fuels infrastructure under Directive 2014/94/EU. Annex to Minutes II 8 of Government meeting held on 17 November 2016, N2016/07176/MRT, etc.

Policy measures supporting the implementation of the national policy framework					
No	Designation	Area	Alternative fuel	Mode of operation	Status
5.1.6	CO ₂ -based vehicle tax	AFV	Combination	Road	Current
5.1.7	Electric bus premium	AFV	Combination	Road	Current
5.1.8	Reserved recharging spaces	AFV	Electricity	Road	Current
5.1.9	Environmental zones	AFV	Combination	Road	Current
5.1.10	Port and fairway charges	AFV	Combination	Shipping	Current
5.2.1	Energy and CO ₂ tax exemption for clean or high-blend renewable fuels	AF	Biofuel	Combination	Current
5.2.2	Environmental information on biofuels	AF	Combination	Road	Future
5.2.3	National guidelines for liquid methane bunkering in Sweden	AF	LNG (incl. LBG)	Shipping	Current
5.2.4	Reduced energy tax level for electricity supplied to vessels in ports and guidelines and recommendations for the connection of vessels and boats to a shore-side electricity supply	AF	Electricity	Shipping	Current
5.3.1	Swedish Pumps Act	AFI	Combination	Road	Current
5.3.2	Implementation of requirements in the Directive on the energy performance of buildings (EPBD)	AFI	Electricity	Road	Future
5.3.3	BeBo and Belok networks	AFI	Electricity	Road	Current
5.3.4	Coordination of recharging infrastructure and renewable fuels requiring special infrastructure	AFI	Combination	Combination	Current
5.3.5	Assignment under County Administrative Boards concerning regional plans for electric vehicle and renewable fuels infrastructure	AFI	Combination	Combination	Current
5.4.1	National freight strategy	Combination	Combination	Combination	Current
5.4.2	KNEG – Climate neutral freight transport by road	Combination	Combination	Combination	Current
5.4.3	Climate Leap	Combination	Combination	Combination	Current
5.4.4	Urban environment agreements	Combination	Combination	Combination	Current
5.4.5	Public procurement of transport	Combination	Combination	Combination	Current
5.4.6	Coordination of conversion of transport sector to being fossil	Combination	Combination	Combination	Current

Policy measures supporting the implementation of the national policy framework					
No	Designation	Area	Alternative fuel	Mode of operation	Status
	fuel-free				
5.4.7	Regional energy agencies	Combination	Combination	Combination	Current
5.4.8	Fossil-free Sweden	Combination	Combination	Combination	Current
5.4.9	Strengthening applications under Connecting Europe Facility (CEF)	Combination	Combination	Combination	Current

5.1 Policy measures supporting vehicles and vessels that can run on alternative fuels

5.1.1 **Bonus–malus system**

The system only covers new cars and means that cars, light buses and light commercial vehicles with low CO₂ emissions benefit at the time of purchase through a bonus, while a higher level of vehicle tax (malus) is levied on vehicles with relatively high emissions during the first three years from the time when the vehicle became taxable for the first time¹⁰. A CO₂-based vehicle tax is levied in year four and every year subsequently (see below).

The maximum bonus is awarded to cars with zero emissions, which receive SEK 60 000, and the bonus is then reduced linearly to an emissions level of 60 grams, for which the bonus is SEK 10 000. The limit will increase to 70 grams on 1 January 2020. A malus is incurred from 95 grams of CO₂/kilometre and increases in line with increasing emissions. No malus is incurred for vehicles that can run on ethanol or a gas other than ethanol, and cars that run on gas receive a bonus of SEK 10 000.

The bonus-malus system came into operation on 1 July 2018. SEK 1 240 million has been allocated in the budget for 2019 and SEK 1 630 million has been allocated for 2020.

5.1.2 **Super green car premium**

A premium is paid for green cars which fulfil the requirements for classification as super green cars. The provisions concerning the premium are set out in the Ordinance (2011:1590) on super green car premium. The premium covered cars with very low greenhouse gas emissions of a maximum of 50 grams CO₂ per kilometre, which also meets the EU's most recent exhaust requirements (Euro 5 or Euro 6). The premium amounted to a maximum of SEK 40 000 per car and

¹⁰ Swedish Government, Government Budget Bill 2018. Prop. 2017/18:1

was paid by the Swedish Transport Agency. The premium was paid until 30 June 2018 (inclusive) and has been replaced by the bonus-malus system.

5.1.3 *Reduced taxable benefit rate for certain environmentally sound cars*

Company-registered cars account for around 50% of all new car registrations in Sweden and a large percentage of these are offered to employees for private use. The benefit value of the private use of a company vehicle is subject to personal income tax.

Current rules on the reduction of the benefit rate for environmentally sound cars comprise two parts. The first part is made up of a permanent reduction, which means that the benefit value for a car that is entirely or partially equipped with technology to run on electricity or a more environmentally sound fuel than petrol or diesel will be reduced to a rate corresponding to the benefit value for a comparable petrol or diesel powered car. This applies to electric and plug-in hybrid electric vehicles and cars that run on biofuels.

For electric vehicles and plug-in hybrid electric vehicles that can be charged from the mains and for cars that run on gas (not liquefied petroleum gas), the benefit value may be reduced further to a value corresponding to 60% of the benefit value for the nearest comparable conventional car. Such reductions may amount to a maximum of SEK 16 000 per year.

The temporary reduction has been extended from 2017 up to 31 December 2020 (inclusive), but the maximum amount for the reduced taxable benefit rate has been reduced from SEK 16 000 to a maximum of SEK 10 000 per year.

New provisions entered into force from 1 January 2018 on the calculation of a car's taxable benefit rate in force. The car's vehicle tax shall form an additional item in the calculation of the taxable benefit rate in addition to the price base amount, the interest-related amount and the price-related amount. Moreover, the benefit of paid congestion charges and road/bridge tolls and ferry charges will no longer be included in the car's taxable benefit value. The aim of the new provisions is to adapt the taxable benefit value to the new bonus-malus based vehicle tax introduced on 1 July 2018 (inclusive).

5.1.4 *Vehicle tax exemption for green cars*

The vehicle tax exemption system for green cars was abolished in connection with the implementation of the bonus-malus system on 1 July 2018.

Cars, light commercial vehicles and light buses classed as green vehicles and being used for the first time in Sweden are exempt from vehicle tax for a period of five years from the time when the vehicle was used for the first time from 1 January 2013. The calculation determining whether a vehicle is classed as a green vehicle is the vehicle's service weight minus 1372 multiplied by 0.0457. A

value of 95 is then added for vehicles running on petrol or diesel, or alternatively 150 for vehicles running on biofuels. The vehicle is covered by the tax exemption if the information in the road traffic register is the same or lower than the calculated amount. If the vehicle is electric or a plug-in hybrid electric vehicle, the electricity consumption may not exceed 37 kWh per 100 kilometres based on information from the manufacturer or general agent. Tax exemption will be obtained automatically if a vehicle is covered by this. The purpose of this is to encourage the purchase of fuel-efficient vehicles and vehicles that run on biofuels or electricity.

5.1.5 *Lower vehicle tax for heavy vehicles that can run on alternative fuels*

The vehicle tax for heavy vehicles is differentiated based on vehicle weight. Hybrid buses, as well as buses and trucks that cannot run on diesel fuel, but can run, for example, on electricity, ethanol and gas, pay only the minimum tax level of SEK 984 per year¹¹. This provides an incentive to choose vehicles that run on alternative fuels.

5.1.6 *CO₂-based vehicle tax*

This tax applies to vehicles prior to the introduction of the bonus-malus system in July 2018 and continues to apply to vehicles ‘leaving’ the bonus-malus system three years after purchase. In order to provide an incentive for vehicle purchasers to choose cars, light commercial vehicles, light buses and campervans with low greenhouse gas emissions, Sweden applies a differentiated annual vehicle tax based on the vehicle’s CO₂ emissions per kilometre. This means that vehicles with lower CO₂ emissions are taxed at a lower rate than vehicles with higher emissions.

CO₂ differentiated vehicle tax was introduced in 2006. The tax comprised a basic amount of SEK 360 per year from 2015 (inclusive). The CO₂ amount is SEK 22/gram for CO₂ emissions above 111 grams/kilometre for mixed driving.

For vehicles equipped with technology to run on a fuel mixture consisting predominantly of alcohol, or wholly or partly on some form of gas other than autogas, the CO₂ amount is SEK 11/gram CO₂ the vehicle emits per kilometre in connection with mixed operation above 111 grams (e.g. ethanol, methane gas).

For vehicles running on diesel, the total of the basic amount and the CO₂ amount must be multiplied by a fuel factor of 2.37. An environmental supplement of SEK 500 is added for vehicles that became taxable for the first time before the end of 2007 and SEK 250 for vehicles that became taxable for the first time after the end of 2007:

¹¹ The vehicle tax amount is specified in Annex 2 of the Swedish Road Traffic Tax Act (2006:227).

- Class I vehicles with a registration year of 2006 or later in the road traffic register.
- Class I vehicles with a registration year predating 2006, but fulfilling the requirement for the environmental class 2005 for electric vehicles or plug-in hybrids;
- Class II vehicles (campervans), light buses and light commercial vehicles that became taxable for the first time following the end of 2010;
- Light vehicles older than 2006 are taxed according to weight amongst other things.

5.1.7 *Electric bus premium*

The Swedish Government has allocated SEK 750 million for the period 2016–2023 for an ‘electric bus premium’ through Ordinance (2016:836) on the electric bus premium. The purpose of the premium is to promote the introduction of electric buses to the market and thus contribute to the overall environmental objective of a better climate, reduced air pollution and less noise. The electric bus premium is aimed at regional public transport authorities and transport companies. Thus, the measure supports alternative fuels infrastructure in public transport. The premium can be paid for electric buses, plug-in hybrids, trolley buses and fuel cell buses with a passenger capacity exceeding 15. The magnitude of the electric bus premium corresponds to 20% of the purchase price of the electric bus, but is limited by the difference in price between the electric bus and the nearest comparable conventional bus. Plug-in hybrid buses receive half the premium amount. A total of SEK 52 million was paid during 2017 and 2018.

5.1.8 *Reserved recharging spaces*

Municipalities have been able to reserve recharging and parking spaces for rechargeable electric vehicles since 2011¹². It is not possible to create a recharging space without recharging facilities being made available at the same time. It is also possible to allow an electric vehicle to park in the space during times when recharging is not taking place. A decision relating to local traffic regulations (LTF) is required in order for a space to be designated as a recharging space.

5.1.9 *Environmental zones¹³*

Municipalities may introduce environmental zones to improve the air quality of an area. The provisions on environmental zones can be found in the Road Traffic

¹²

[https://skl.se/samhalsplaneringinfrastruktur/trafikinfrastruktur/trafikreglering/fra_gorochsvartrafikreglering/lokalatrafikforeskrifteromladdplatser.7832.html](https://skl.se/samhallsplaneringinfrastruktur/trafikinfrastruktur/trafikreglering/fra_gorochsvartrafikreglering/lokalatrafikforeskrifteromladdplatser.7832.html).

¹³ <https://transportstyrelsen.se/sv/vagtrafik/Miljo/Miljozoner/>.

Ordinance (1998:1276) and addresses the types of vehicles that may be driven through particularly environmentally sensitive areas. The penalty for breaching the regulations is a fine of SEK 1 000 and liability for this lies entirely with the driver.

The purpose of the environmental zones is to improve air quality, reduce noise and to stimulate the technological development of the vehicle fleet. Therefore, this may have a positive effect on vehicles running on alternative fuels, as in certain cases it is easier for such vehicles to fulfil the requirements to be driven in certain areas. Environmental zones may only be introduced by municipalities in particularly environmentally sensitive areas in densely populated areas. The requirements made of vehicles in order that they may be driven in an environmental zone varies depending on the class of environmental zone introduced. Generally, requirements are made for vehicles of a certain age, or that the vehicle must fulfil specific environmental requirements under the Euro Classification system. From 2020, municipalities will be able to introduce environmental zones for light vehicles and an additional environmental zone for heavy vehicles. The environmental zones will help to improve air quality in urban areas, and may also help to accelerate the transition to a fossil-free vehicle fleet.

5.1.10 *Fairway and port charges*

A new charging model for shipping in Swedish waters was introduced on 1 January 2018¹⁴. Fairway charges apply to vessels intending to load or unload in Sweden or that will set down or pick up passengers, and the charges must take into consideration the size of the vessel, its load, passengers and environmental impact. The charge is divided into four different environmental classes. This division is based on the vessel's verified credits in accordance with the Clean Shipping Index (CSI)¹⁵. CSI assesses a vessel's environmental impact in a number of areas, including emissions of sulphur oxides, nitrogen oxides, carbon dioxide and particles, which provides an incentive to use alternative fuels such as LNG, methanol or electricity.

All ports levy charges for infrastructure and cargo handling in connection with calls made by vessels. Port charges are determined individually by each port and may follow a set price list or may be determined by agreement between the port management or port authority and the ship owner or ship operator. Therefore, the size and form of port taxes differs between ports. Around 20 Swedish ports use environmentally differentiated port charges to comply with local environmental programmes and encourage the shipping industry to do more than is required by

¹⁴ <http://www.sjofartsverket.se/sv/Sjofart/Taxor-och-avgifter/Den-nya-avgiftsmodellen/>.

¹⁵ <https://www.cleanshippingindex.com/>.

law as regards the environment¹⁶. Charges are often differentiated by discounting the fee for vessels with low NO_X emissions, but there are also examples of discounts for vessels running on liquefied natural gas (LNG) or that use a shore-side electricity supply.

5.2 Policy measures supporting alternative fuels

5.2.1 *Energy and CO₂ tax exemption for high-blend or clean renewable fuels*

Sweden applies a tax reduction for sustainable biofuels in certain cases. The reduction in tax improves the competitiveness of clean and high-blend biofuels compared with their fossil counterparts. Energy taxation is a generic term for excise taxes on fuel and electricity and is regulated in the Swedish Energy Taxation Act (1994:1776). Energy tax is paid on most fuels and is based, inter alia, on energy content. CO₂ tax is calculated on the fossil carbon content of the taxable fuels. All high-blend sustainable biofuels are exempt from both CO₂ and energy tax. CO₂ and energy tax are applied to low-blend biofuels covered by the system for a reduction obligation at a level corresponding to their fossil counterparts.

However, the tax exemption does not lead to overcompensation for additional costs in the production of the biofuels in question in relation to the fossil fuels they are replacing. Sweden has State aid approval for the current tax relief for liquid biofuels and for biogas until the end of 2020 (inclusive).¹⁷ Any extension of the approval requires an adaptation in accordance with Communication from the Commission – Guidelines on State aid for environmental protection and energy 2014-2020. To ensure that Sweden fulfils the requirements of the guidelines^{18, 19}, so-called ‘asset notification’ was introduced on 1 January 2016 in the Swedish Sustainability for Biofuels and Liquid Biofuels Act (2010:598) and the Swedish Energy Taxation Act (1994:1776). The asset notification must demonstrate that there is a control system to ensure that the biofuels for which the taxpayer seeks a deduction originates from facilities commissioned prior to 31 December 2013 which have not been fully depreciated.

5.2.2 *Environmental information on biofuels*

An amendment to the Fuels Act entered into force from 1 January 2019, which required operators that supply liquid or gaseous fuels or electricity as a fuel to

¹⁶ IVL Swedish Environmental Research Institute, 2018 State control of port fees for vessels (*Statlig styrning av hamnavgifter för fartyg*).

¹⁷ <http://www.regeringen.se/pressmeddelanden/2015/12/forlangda-statsstodsgodkannanden-for-skattebefrielse-av-biodrivmedel/>.

¹⁸ Memorandum, Production plant permits for biofuels, M2015/3227/R.

¹⁹ <http://www.regeringen.se/artiklar/2015/10/lagandring-om-skattebefrielse-for-biodrivmedel/>.

inform consumers about the fuel's greenhouse gas emissions and other factors of relevance in assessing the environmental impact of the fuel. A corresponding amendment was also made to the Fuels Ordinance. The obligation to provide environmental information applies from 1 January 2020.

The information must be based on the information already reported under the Fuels Act and must be presented by the supplier on the supplier's website and on the devices in the organisation intended for consumer use in refuelling and stating that the information refers to historical data.

5.2.3 *National guidelines for liquid methane bunkering in Sweden²⁰*

The Swedish Transport Agency presented guidelines for the bunkering of liquid methane at Swedish ports in 2018. The guidelines aim to facilitate the switch to alternative fuels in shipping. The guidelines cover both liquefied natural gas and liquefied biogas.

5.2.4 *Reduced energy tax level for electricity supplied to vessels in ports and guidelines and recommendations for the connection of vessels and boats to a shore-side electricity supply²¹*

Sweden has applied reduced energy taxation rates for electricity consumed by large vessels in port since 2011. Sweden has been granted a permit for this tax reduction from the Economic and Financial Affairs Council up until 25 June 2020.

The Swedish Transport Agency presented guidelines for connecting vessels to a shore-side electricity supply in 2015, building on a recommendation made by the European Commission. The guidelines aim to serve as a tool for all boat owners wishing to connect their vessels to a shore-side electricity supply in port. The purpose of connecting vessels to a shore-side electricity supply is to reduce the use of auxiliary diesel engines to power a vessel's generators to provide an electricity supply while the vessel is in port.

5.3 *Policy measures supporting alternative fuels infrastructure*

5.3.1 *The Pumps Act*

Under Act (2005:1248) entailing an obligation to provide renewable fuels, larger refuelling points have been required to provide renewable fuels since 1 April 2006. The aim of the 'Pumps Act' is to reduce CO₂ emissions by

²⁰ Swedish Transport Agency, National guidelines for bunkering liquid methane in Sweden.

²¹ Swedish Transport Agency. Guidelines and recommendations for connecting vessels and boats to a shore-side electricity network. Issued by the Swedish Transport Agency, 20 April 2015.

increasing the availability of renewable fuels. Since 1 August 2014, sales outlets have been covered where these have a sales volume exceeding 1 500 cubic metres of petrol or diesel fuel during the two previous calendar years.²²

5.3.2 ***Energy performance of buildings (EPBD²³)***

The EU Directive on the energy performance of buildings was reworked during the spring of 2018, and work is under way to transpose this into Swedish legislation. An important new element is the reworked Directive is the Article on the preparation for and installation of charging points in connection with buildings. The purpose of this is for EU Member States together to enable the electrification of the vehicle fleet. The Directive states that the deployment of recharging infrastructure for electric vehicles in car parks of buildings must be supported through the introduction of requirements relating to the installation of ducting infrastructure and charging points.

The Swedish National Board of Housing, Building and Planning has together with the Swedish Energy Agency and the Swedish Energy Markets Inspectorate has been tasked with investigating how the new requirement can be introduced into Swedish legislation. The report was presented at the end of May 2019.

5.3.3 ***BeBo and Belok networks***

BeBo is the Swedish Energy Agency's network for energy-efficient apartment buildings. The network comprises over 20 property owners working to ensure compliance with the EU's energy efficiency Directive. Belok is a corresponding network for energy efficiency in commercial premises. Collectively, the networks have a strong focus on recharging infrastructure and promoting the deployment of recharging infrastructure in apartment buildings and commercial premises.

5.3.4 ***Coordination of charging infrastructure and renewable fuels requiring special infrastructure***

During the period 2015–2018, the Swedish Energy Agency was tasked with coordinating aid for the deployment of recharging infrastructure by the Swedish Government. This task was expanded from 2018 to also cover gas and other renewable fuels requiring special infrastructure. The work included supporting the Swedish Environmental Protection Agency in providing aid for recharging infrastructure under Climate Leap, and included the provision of expert knowledge and advice on prioritisation and information on geographical distribution and the evaluation of aid provided. The work is coordinated with the

²² SFS 2014:537.

²³ Directive 2010/31/EU on the energy performance of buildings.

strategy work performed under the Swedish Energy Agency's task of coordinating the switch to a fossil-free transport sector. Under the Coordination assignment, the Swedish Energy Agency has focused on capacity development among community actors. The focus has been placed on engaging relevant actors in the development of an appropriate recharging infrastructure. Unlike conventional fuels, the recharging infrastructure has involved entirely new actors not intuitively forming part of the transport sector, e.g. housing associations and real estate companies, but which have been key players in establishing home recharging for households in multi-family homes.

5.3.5 *Assignment of County Administrative Boards concerning regional plans for electric vehicle and renewable fuels infrastructure*

In the appropriation document for 2018, the County Administrative Boards have been tasked by the Swedish Government to develop regional plans for electric vehicle infrastructure and renewable fuels. The assignment forms part of the County Administrative Boards' long-term work in leading and coordinating the regional work in all relevant business areas regarding energy conversion and a reduced climate impact. The work on the regional plans must be presented by no later than 31 January 2020.

5.4 *Policy measures providing overall support for a combination of vehicles, alternative fuels and/or infrastructure*

5.4.1 *National freight strategy²⁴*

In June 2018, the Swedish Government presented a national freight strategy aimed at creating the conditions for effective, capacity-efficient and sustainable freight transport. The strategy has three elements:

- Competitive and sustainable freight transport;
- The switch to fossil-free transport; and
- Innovation, skills and knowledge.

A total of 14 focus areas and 95 initiatives have been designated for these three elements. The element and associated initiative must contribute towards fulfilling the transport policy targets, a high level of competitiveness in industry and promote the switch of freight transport from road to rail and shipping. A total of

²⁴ <https://www.regeringen.se/informationsmaterial/2018/06/effektiva-kapacitetsstarka-och-hallbara-godstransporter--en-nationell-godstransportstrategi/>.

13 special government assignments have been issued since the strategy was presented, of which 11 are investigation assignments; however, the strategy contains many more initiatives than these special assignments. The Swedish Government has established a national freight council, which will work on the development of the transport sector based on the national freight transport strategy. There is a secretariat²⁵ operating under the Swedish Transport Administration to support the work of the council. Transport Analysis has been tasked by the Swedish Government to follow up the implementation of the strategy and evaluate the result of the work during the period 2018–2022²⁶.

5.4.2 **KNEG – Climate neutral freight transport by road²⁷**

An effective goods transport sector is an essential part of a modern growth-oriented society. Freight transport as operated at present accounts for significant CO₂ emissions affecting the climate. The various actors in society must work together to reduce the impact of freight transport on the environment.

The KNEG cooperation project brings together some of Sweden's leading vehicle manufacturers, fuel and logistics companies, in addition to the Chalmers University of Technology and the Swedish Transport Administration to demonstrate jointly how road freight transport in Sweden can be reduced through various measures. The cooperation was initiated in 2006 and is primarily aimed at more efficient transport, more efficient vehicles and the increased use of renewable fuels. The work is being led by a secretariat at the Gothenburg Centre for Sustainable Development (GMV), Chalmers University of Technology and the University of Gothenburg.

5.4.3 **Climate Leap**

The Climate Leap initiative is part of the Government Budget determined by the Swedish Parliament for 2018 and is regulated through Ordinance (2015:517) on support for local climate investments. The Swedish Environmental Protection Agency granted funding for 3 200 measures between 2015 and 2018 and has allocated SEK 4.7 billion under Climate Leap²⁸. The 2019 spring budget determined by the Swedish Parliament has allocated a further SEK 750 million for investment aid under Climate Leap. This means that the total appropriation for 2019 is SEK 1.5 billion and therefore new applications may be granted aid. Aid paid for the production of alternative fuels and the deployment of alternative

²⁵ <https://www.trafikverket.se/for-dig-i-branschen/Planera-och-utreda/planera-person--och-godstransporter/Planera-godstransporter/nationella-godstransportradet/>.

²⁶ <https://www.trafa.se/etiketter/transportovergripande/uppfoljning-av-regeringens-godstransportstrategi---2019-8238/>

²⁷ <https://kneg.org/>.

²⁸ 2019, Swedish Environmental Protection Agency. Status report for Climate Leap, 11 April 2019 (*Lägesbeskrivning för Klimatkivet. 2019-04-11*).

fuels infrastructure is reported under *Section 6 Aid for deployment and production*.

Aid from Climate Leap goes to climate investments at a local level, such as a city or municipality, a company or a school. The funds invested must have the primary aim of reducing greenhouse gas emissions. Most of the projects that have received support promote the use of renewable energy, e.g. through the increased production of biogas or recharging points for electric vehicles. Over 30 000 new recharging points for electric cars had been allocated aid by the end of 2018. The dissemination and market launch of new technology and impacts on other environmental quality objectives, health and employment are also desired effects. According to the Environmental Protection Agency's summary of the reduction in emissions from the measures granted aid under Climate Leap, the annual reduction in emissions corresponds to around 3% of Sweden's total CO₂ emissions or 9% of emissions from domestic transport²⁹.

5.4.4 ***Urban environment agreements***

Municipalities and county councils may apply for aid to promote sustainable urban environments, or so-called urban environment agreements, which are processed by the Swedish Transport Administration under Ordinance (2015:579) on aid to promote sustainable urban environments. The purpose of an urban environment agreement is to use state cofinancing to create the conditions for a greater percentage of transport to take place via public transport and by bicycle or sustainable transport solutions. The measures must lead to energy efficient solutions with lower greenhouse gas emissions, and the aid must in particular promote innovative, high capacity and resource efficient solutions for public transport, cycle traffic or freight transport. Amongst other things, aid may be awarded in demonstrating or proving new transport solutions for local and regional public transport, cycle traffic or freight transport. Aid may be paid to a maximum of 50% of the costs for the measures implemented. The programme commenced in 2015 and from 2018 forms part of the financial framework for the development of the transport system and comprises SEK 1 billion per year during the period 2018–2029.

The *National plan for the transport system 2018–2029*³⁰, contains SEK 1 billion per year for urban environment agreements. The measures for which aid is applied and offsets must be completed by no later than during 2029.

²⁹ 2019, Swedish Environmental Protection Agency. Status report for Climate Leap, 11 April 2019.

³⁰ <https://www.trafikverket.se/for-dig-i-branschen/Planera-och-utreda/Planer-och-beslutsunderlag/Nationell-planering/nationell-transportplan-2018-2029/>.

5.4.5 *Public procurement of transport*

The Swedish Act (2011:846) on environmental requirements in the procurement of vehicles and certain Public transportation services³¹ contains criteria for the requirements that must be fulfilled for the public procurement of vehicles and public transport services. The aim of the criteria is to reduce environmental impacts by establishing requirements, including for energy consumption and emissions. The Act entered into force on 1 January 2017.

The procurement authority establishes requirements for the public procurement of passenger transport, freight transport, fuels, tyres, public transport and vehicles.³²

5.4.6 *Coordination of the conversion of transport sector to being fossil fuel-free*

In the appropriation for 2016, the Swedish Energy Agency was tasked with coordinating and developing a strategic plan for the conversion of the transport sector to being fossil-free together with five other authorities (Swedish National Board of Housing, Building and Planning, Swedish Environmental Protection Agency, Transport Analysis, Swedish Transport Administration and the Swedish Transport Agency). The Swedish Energy Agency has been allocated SEK 3 million per year between 2016 and 2019 under the Government Budget Bill for 2016. The strategic plan was presented in April 2017 and work is now under way to implement the plan. Funds have currently been allocated for the assignment up to 2019 (inclusive).

5.4.7 *Regional energy agencies*

The Swedish Energy Agency has addressed financial aid for the regional energy agencies since 2002, accounting for part of the financing for the energy agencies. The energy agencies report in particular on the initiatives conducted to coordinate municipal energy and climate consultants. The energy agencies also take the role of regional development leaders in the coordination of energy and climate consultants, which entails greater responsibility for the development of the consultancy, and the link between the energy agencies and consultants has become clearer. The role of national initiative leader has also existed since 2016 for the initiative projects implemented by all consultants in the country.

The energy agencies take the initiative and participate in extensive project activities relating to energy efficiency and renewable energy sources with funding from the EU, County Administrative Boards, regional associations and other organisations. The energy agencies also operate at a regional level where

³¹ https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfatningssamling/lag-2011846-om-miljokrav-vid-upphandling-av_sfs-2011-846.

³² <https://www.upphandlingsmyndigheten.se/hallbarhet/stall-hallbarhetskrav/fordon-och-transport/>.

they work together with business, County Administrative Boards, municipalities and municipal associations, etc. This may for example relate to plans and strategies. The regional energy agencies also have geographical coverage throughout Sweden. There are 15 energy agencies and aid amounts to around SEK 10 million per year and this is split between all energy agencies in the period leading up until 2020. The aid is included in the appropriation 1:2, Initiatives for energy efficiency, under expenditure area 21 (energy), especially under the appropriation item for municipal energy and climate consultancy.

The energy agencies are also active in the area of transport with a focus on vehicles, fuels and behavioural changes in passengers.

5.4.8 **Fossil-free Sweden³³**

The Government initiative ‘Fossil-free Sweden’ was launched in 2016 with the aim of strengthening the Government’s dialogue with business, municipalities, other public actors and civil society. The Swedish Government has appointed a national coordinator for Fossil-free Sweden, serving as a link between the actors and the Swedish Government to remove barriers and create the conditions for a more rapid reduction in emissions.

The initiative has now brought together more than 400 actors and is open to anyone fulfilling the declaration produced. The actors participating in the initiative share the view that the world must become fossil-free and that Sweden must take the lead in this work. The declaration means actors undertake to also demonstrate specific measures for reducing emissions.

Industry wide road maps are developed under the initiative with the aim of promoting business opportunities for companies and industries to become fossil-free. A total of 13 such road maps have been presented by various industries during 2018-2019. The road maps form a good basis for constructive interaction between the State and business in relation to common climate goals. Several road maps concern alternative fuels, particularly the road maps for the aviation industry³⁴, the shipping industry³⁵ and the haulage industry³⁶, all of which highlight the importance of alternative fuels to reduce emissions. Additional road maps are being developed, including for the automotive industry, and the initiative launched 27 proposals for fossil-free competition in October 2019.

³³ <http://fossilfritt-sverige.se/>.

³⁴ <http://fossilfritt-sverige.se/fardplaner-for-fossilfri-konkurrenskraft/fardplaner-for-fossilfri-konkurrenskraft-flygbranschen/>.

³⁵ <http://fossilfritt-sverige.se/fardplaner-for-fossilfri-konkurrenskraft/fardplaner-for-fossilfri-konkurrenskraft-sjofartsnaringen/>.

³⁶ <http://fossilfritt-sverige.se/fardplaner-for-fossilfri-konkurrenskraft/fardplaner-for-fossilfri-konkurrenskraft-akerinaringen/>.

5.4.9 *Strengthening applications under the Connecting Europe Facility (CEF)*³⁷

The Connecting Europe Facility (CEF) aims to address deficiencies, primarily relating to cross-border elements, of the European transport, energy and telecommunications networks. The Fund will contribute towards improved competitiveness in the EU, as well as strengthening economic, social and territorial cohesion. CEF is also an important source of financing for projects with links to the Trans-European Network for Transport (TEN-T). All applications made under CEF require the approval of the Swedish Government.

At the request of the Swedish Government, the Swedish Transport Administration is coordinating applications for assistance from the Connecting Europe Facility (CEF) in the transport sector that are established by a Swedish actor, or where a Swedish actor is included in an application established by a foreign actor. The Swedish Transport Administration has also been tasked with coordinating the follow up of projects granted aid via this fund.

Examples of projects where Swedish actors have been granted aid include biogas and electric buses in public transport, LNG bunkering, LNG lorries and hydrogen gas refuelling points. Another announcement will be arranged in 2019, relating inter alia to alternative fuels³⁸.

³⁷ <https://www.trafikverket.se/tjanster/ansok-om/ansok-om-bidrag/finansiering/>.

³⁸ <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/apply-funding/blending-facility>.

6 Aid for deployment and production

This section describes the aid provided for the deployment of alternative fuels infrastructure and production aid for alternative fuels. This primarily involves aid under the Climate Leap initiative, which will finance the development of alternative fuels infrastructure and alternative fuels production, but also special biogas production aid. A description is given below of the aid for deployment and production allocated during the period 2016-2018. The reporting in this section corresponds to the requirement under point 3 of Annex I of Directive 2014/94/EU.

The actual amount of aid provided during the period 2016-2018 for the deployment of alternative fuels infrastructure or alternative fuels production is displayed in Table 2. The aid measures are often designed as part of a larger more general package in which several different objectives may be achieved with the same aid, e.g. Climate Leap. There are also specific biogas production aid initiatives.

Table 2 Deployment and production aid
AF= Alternative fuels, AFV= Vehicles that can run on alternative fuels,
AFI= Alternative fuels infrastructure.

Deployment and production aid								
Designation	Description	Area	Alternative fuel	Mode of operation	Annual public appropriation (SEK million)			
					2016	2017	2018	
Aid for deployment of alternative fuels infrastructure								
Climate Leap	Aid for recharging infrastructure	AFI	Electricity	Road	69.5	48.2	158.4	
Climate Leap	Aid for transport sector – mostly refuelling points for biofuels, but also two production facilities	AFI	Combination	Road	61.9	69.5	402.6	
Climate Leap	Aid for the procurement of vehicles that can run on alternative fuels	AFI	Combination	Road	9.5	0.09	54.2	
Aid for production of alternative fuels								
Production aid for manure gas	Addressed by Swedish Board of Agriculture	AF	CNG (incl. CBG)	Combination	47	50.2	57	

Deployment and production aid								
<i>Designation</i>	<i>Description</i>	<i>Area</i>	<i>Alternative fuel</i>	<i>Mode of operation</i>	<i>Annual public appropriation (SEK million)</i>			
					<i>2016</i>	<i>2017</i>	<i>2018</i>	
Biogas investment aid under the Rural Development Programme	Addressed by Swedish Board of Agriculture	AF	CNG (incl. CBG)	Combination	0.187	4.6	8.0	
Single aid payment for biogas production	Addressed by Swedish Board of Agriculture – only applicable for 2018	AF	CNG (incl. CBG)	Combination	-	-	270	
Climate Leap	Aid for production of biogas	AF	CNG (incl. CBG)	Combination	160.7	156.9	190	

6.1 Aid for the deployment of alternative fuels infrastructure

6.1.1 **Climate Leap – Aid for infrastructure and vehicles**

The framework of the Climate Leap initiative includes aid for the procurement of vehicles that can run on alternative fuels, aid for alternative fuels infrastructure and aid for recharging infrastructure.

Since Climate Leap began, there has been a clear shift in distribution between the type of recharging stations allocated aid. During 2015 and 2016, the majority of recharging stations receiving support were located along roads and in urban areas. However, during 2017 and 2018 the majority of the recharging stations that received aid from Climate Leap were for non-public recharging. Overall, three quarters of the recharging stations granted aid were non-public recharging stations sited in connection with residential areas or workplaces. During the period 2016-2018, the total amount of aid for recharging infrastructure amounted to SEK 276.1 million³⁹. By the end of 2018, over 30 000 new recharging points for electric vehicles had been granted aid.

Aid has also been given for refuelling points for biofuels under Climate Leap. This primarily relates to public refuelling points, but also involves several refuelling points for buses, refuse vehicles and other municipal vehicles. The applications granted indicate a variety of biofuels and contribute to the potential to choose renewables with a deployment in infrastructure throughout the country. There is increasing interest among vehicle manufacturers in liquefied biogas (LBG) as a fuel for heavy vehicles. Aid provided by Climate Leap has meant that a network of refuelling points for liquified biogas has begun to be developed throughout the country. During the period 2016-2018, the total amount of aid

³⁹ Information from the Swedish Environmental Protection Agency.

granted to the category Transport under Climate Leap amounted to SEK 533.9 million⁴⁰.

During the period 2016-2018, SEK 63.8 million⁴¹ has been granted in aid for the procurement of vehicles that can run on alternative fuels. For example, this may involve heavy lorries that instead of running on fossil fuel can run on liquefied biogas. In total, this involves around 495 vehicles, of which around 400 run on liquefied biogas (LBG).

6.1.2 *Aid for home recharging*

In 2018, the Swedish Environmental Protection Agency was given a new assignment to address a new type of aid for home recharging for private individuals seeking aid for a recharging station at home or some other location where they had access rights. Under Ordinance (2017:1318), the contribution may amount to 50% of the cost for the purchase and installation of a charging box up to a maximum of SEK 10 000 per property. The assignment received a maximum amount of financing of SEK 90 million.

There was a moderate number of applications at the start of the year, but this number increased as the year progressed. One reason for this may be that it took time for the public to become aware of the grants that were available. The grant was not fully utilised, and just under 28% of the funds that could be applied for were distributed among a total of 3 300 people⁴². SEK 750 million was allocated for Climate Leap and Aid for home charging in the Government's Spring Budget Amendment Bill, of which a maximum of SEK 50 million may be paid with the support of Ordinance (2017:1318) on grants to private persons for the installation of charging points for electric vehicles.

6.1.3 *Investment aid for recharging stations used by companies and other organisations*

Special investment aid will be available from 2019 aimed at organisations, companies, municipalities, foundations, societies and associations wishing to invest in recharging stations for their own use. Examples include the installation of recharging stations for the members of a housing association, in a company's staff car park or for company vehicles.

This type of recharging infrastructure aid was previously included under Climate Leap. The Swedish Government has determined special rules for these types of organisations for simplification purposes. The provisions apply under a new Ordinance⁴³. Grants apply to charging points installed no earlier than

⁴⁰ Information from the Swedish Environmental Protection Agency.

⁴¹ Information from the Swedish Environmental Protection Agency.

⁴² 2019, Swedish Environmental Protection Agency. Status report for Climate Leap. 11 April 2019.

⁴³ Ordinance (2019:525) on State aid for the installation of charging points for electric vehicles.

15 July 2019. The grant is paid as a lump sum at a maximum of 50% of the costs eligible for a grant up to a maximum of SEK 15 000 per recharging station.

6.2 Aid for alternative fuels production

6.2.1 Climate Leap – Aid for alternative fuels production

In total, Climate Leap has paid grants to around 40 facilities producing biogas for industry, shipping and road traffic. These are generally large measures where the amounts granted range from around SEK 1 million to over SEK 100 million. The first of these facilities has now been completed and has started producing more biogas for the transport sector and industry. During the period 2016-2018, a total of SEK 508 million⁴⁴ has been paid in aid for these types of measures.

Climate Leap has also granted aid to two large applications to start producing biofuels from waste products from forestry. A company in Söderhamn has developed a renewable biooil based on lignin, which is a waste product from the pulp industry. Lignin can be refined into both renewable diesel (HVO) and renewable petrol and therefore can be used in ordinary combustion engines. The project involves the construction of a production facility for the oil. A production facility will also be built in Gävle. Pyrolysis oil derived from sawdust and wood shavings will be produced here. The biobased oil can then be used to replace fuel oil or be refined into diesel. Over SEK 250 million has been granted to these two projects together and is anticipated to lead to a reduction of CO₂ of over 215 000 tonnes/year (reported under the category *Transport* in Climate Leap, Table 2).

6.2.2 Biogas aid

In 2018, the Swedish Board of Agriculture was tasked with administering a single aid payment for biogas production. The aim of this was to increase competition to accelerate the switch to renewable energy sources.

SEK 270 million was paid in December 2018 as an advance to 39 facilities, and the aid amounted to 26 öre per kWh of biogas produced⁴⁵.

6.2.3 Manure gas aid

Aid has been available for the production of biogas from animal manure since 2015. The aim of the aid is to contribute to an increased production of manure-based biogas and thereby achieve double environmental and climate benefits through reduced methane gas emissions from manure and a replacement of fossil energy sources. The aid is designed as a project running from 2014 to 2023, with a total of SEK 385 million allocated for the period. In 2015, the compensation

⁴⁴ Information from the Swedish Environmental Protection Agency.

⁴⁵ 2018 annual report of the Swedish Board of Agriculture.

level was SEK 0.20 per kWh, which was increased to SEK 0.40 per kWh from 2016. The level of aid is fixed after 2016.

The aid is based on the quantity of manure that is digested by a facility and how much biogas is produced. If the manure is digested together with another substrate, aid will only be paid for the gas that may theoretically be derived from animal manure. The funds allocated for the aid period also constitute the limit for the amount of aid disbursed. SEK 154.2 million in aid has been disbursed during the period 2016-2018⁴⁶.

6.2.4 *Biogas investment aid under the Rural Development Programme*

The Rural Development Programme enables applications for investment aid for the construction of facilities for the production and use of manure-based biogas, upgrading facilities or building a facility for processing digestate. The aim of the aid is to increase access to and increase the use of renewable energy. Biogas can be used to produce heat, electricity, or may be upgraded for use as vehicle fuel. Farmers and other businesspersons in rural areas wishing to invest in facilities for the production and use of manure-based biogas, upgrading facilities or building a facility for processing digestate may receive investment aid for 40% of expenses through the Rural Development Programme. The budget for biogas aid is national and is applied for via the Swedish Board of Agriculture.

A total of SEK 12.8 million was disbursed during the period 2016-2018⁴⁷.

Approximately SEK 34 million has been granted from the total budget of SEK 218 million for the period 2014-2020⁴⁸.

⁴⁶ 2016, 2017 and 2018 annual reports of the Swedish Board of Agriculture.

⁴⁷ Information from the Swedish Board of Agriculture.

⁴⁸ Swedish Board of Agriculture 2019, Programme and funding Result from the Rural Development Programme on energy efficiency, renewable energy and reduced emissions of greenhouse gases and ammonia 2018.

7 Research, technical development and demonstration

The largest and most important initiatives in research, technical development and demonstration in relation to alternative fuels for the period 2016-2018 are described below. Many of the initiatives being implemented in Sweden are not aimed at a specific mode of transport, but include or create the potential for different fuels and types of traffic or a combination of these. The report in this section corresponds to the requirement in point 4 of Annex I of Directive 2014/94/EU.

The annual public appropriations for research, technical development and demonstration are shown in Table 3. Many of the initiatives performed in Sweden are not aimed at a specific mode of transport or a specific type of fuel, but include or create the potential for several different types of fuel and types of traffic or a combination of these. The initiatives below have been categorised on this basis as far as possible. The total budget for the initiative is presented instead where appropriations per year could not be obtained.

Table 3. Annual public appropriations for research, technical development and demonstration. AF= Alternative fuels, AFV= Vehicles that can use alternative fuels, AFI= Alternative fuels infrastructure.

Research, technical development and demonstration											
No	Designation	Area	Alternative fuels	Mode of operation	Annual public appropriations (SEK thousand)				Total estimated budget (SEK thousand)	From year	To year
					2016	2017	2018	2019			
7.1.1	Strategic Vehicle Research and Innovation (FFI) Energy and Environment	AFV	Electricity	Road	410 000	410 000	410 000			2009	2030
7.1.2	Energy efficient vehicles	AFV	Combination	Road	22 000	22 000	22 000	22 000		2015	2019
7.1.3	Electrified roads	Combination	Electricity	Road					635 000	2015	2022
7.1.4	Future alternative transport fuels	AF	Combination	Combination	4 696	5 648	5 716	4 020	22 080	2015	2020
7.1.5	Assignment to establish an innovation cluster for liquefied biogas	AF	Biofuels	Combination			28 000	32 000	200 000	2018	2021
7.1.6	Assignment to establish an innovation cluster for ethanol and transport-efficient electrified urban freight transport	Combination	Combination	Combination			2 000	8 000		2018	2020
7.2.1	Shipping programme	Combination	Combination	Shipping			3 000	15 000	83 000	2018	2023
7.2.2	Swedish Transport Administration's industry programme Sustainable shipping	Combination	Combination	Shipping					100 000	2019	2028
7.3.1	Assignment to promote sustainable biofuels for aviation	AF	Biofuels	Aviation			20 000	30 000	100 000	2018	2020
7.4.1	Electrified mining transport in an Arctic climate	Combination	Electricity	Road			4 515	5 210	9 725	2017	2019
7.5.1	Biofuels programme	Combination	Biofuels	Combination	5 000	45 000	45 000		180 000	2017	2021

7.5.2	Cooperation programme Renewable fuels and systems	Combination	Combination	Combination					33 000	2018	2021
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Research, technical development and demonstration											
No	Designation	Area	Alternative fuels	Mode of operation	Annual public appropriations (SEK thousand)				Total estimated budget (SEK thousand)	From year	To year
					2016	2017	2018	2019			
7.5.3	SamspeEl	AFI	Electricity	Combination					283 000	2016	2023
7.5.4	TripleF	Combination	Combination	Combination					290 000	2018	2030
7.5.5	Assignment to support research and development in electromobility	Combination	Biofuels	Combination			10 000	10 000	200 000	2018	2023
7.5.6	Biogas research centre	Combination	Biofuels	Combination					202 000	2014	2022
7.5.7	Three centres of excellence for internal combustion engine research	Combination	Combination	Combination			60 000	60 000		2018	2021
7.5.8	Competence Centre for Catalysis (KCK)	AFV	Combination	Combination			20 000	20 000		2018	2021
7.5.9	Northvolt	Combination	Electricity	Combination			90 421	36 481	146 025	2018	2023
7.5.10	Swedish Electromobility Centre	Combination	Electricity	Combination					144 000	2019	2023
7.6.1	Demonstration programme for electric vehicles	AFV	Electricity	Combination	7 748	9 481	7 625		285 000	2012	2018
7.6.2	Autonomous Electric Rockets Demonstrator	Combination	Electricity	Road	28 862	29 987	1 962		65 000	2015	2019
7.6.3	CleanFuel – a chain link from black lye to green petrol and diesel	AF	Biofuels	Combination					71 033	2015	2018
7.6.4	Marine Biogas	AF	Biofuels	Combination	3 308	3 351			9 962	2015	2017
7.6.5	ElectriCity	Combination	Electricity	Road					48 237	2013	2018

7.6.6	Swedish Electric and Hybrid Vehicle Center (SHC)	Combination	Combination	Combination	9 600	9 600	9 600	9 600		2015	2019
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7.1 Road

7.1.1 ***Strategic Vehicle Research and Innovation (FFI) Energy and Environment***⁴⁹

Strategic Vehicle Research and Innovation (FFI) is a cooperation between the State and the automotive industry concerning the joint financing of research, innovation and development activities focusing on the areas of Climate and Environment and Safety. The background to the FFI initiative is that the development in road transport and the Swedish automotive industry is of vital importance to growth.

There are currently five cooperation programmes under FFI: traffic safety and automated vehicles, electronics, software and communication, sustainable production, effective and connected transport systems and energy and environment.

The Swedish Energy Agency is responsible for the cooperation programme Energy and Environment. The Energy and Environment programme is aimed at vehicle-related research, innovation and development activities in energy efficiency, renewable fuel propulsion systems, electric power, local and/or regional environmental impacts and other energy technology with the potential to strengthen Sweden and the Swedish automotive industry's competitiveness from a global perspective.

The initiative means research and development activities worth around SEK 1 billion per year, of which public funding represents around SEK 410 million per year.

7.1.2 ***Energy efficient vehicles***⁵⁰

In 2015, the Swedish Energy Agency decided to allocate SEK 66 million to implement the Energy efficient vehicles programme during the period 2015-2019. This was increased to SEK 88 million through additional decisions. The programme has since been further extended by SEK 44 million for the period 2020-2021. The annual financing has been and is expected to remain at SEK 22 million.

The programme's vision is to radically increase energy efficiency and make light vehicles and non-road mobile machinery fossil fuel-free by 2030. The

⁴⁹ <https://www.energimyndigheten.se/forskning-och-innovation/forskning/transporter/fordon/program/fordonsstrategisk-forskning-och-innovation-ffi/>.

⁵⁰ <http://www.energimyndigheten.se/utlysningar/energieffektiva-fordon2/>.

programme also supports research with the objective of lowering exhaust emissions from combustion engines.

7.1.3 *Electrified roads*⁵¹

Together with the Swedish Energy Agency and Vinnova, the Swedish Transport Administration has a pre-commercial procurement programme for electrified roads. Between 2015-2025, the Swedish Transport Administration is demonstrating two different solutions for electrified roads for lorries, one involving an overhead line and one with a rail in the ground. These two demonstration projects have received a State budget of SEK 150 million. In 2018, the Swedish Transport Administration completed a procurement programme to broaden the knowledge base relating to electrified roads. Following evaluation, the Swedish Transport Administration has decided to give two participants the opportunity to proceed with the construction of demonstration stretches of electrified roads. One demonstration stretch involves inductive technology and one demonstration stretch involves a conductive ground rail. The new demonstration stretches will be operational during the period 2019-2022 and will have a budget of SEK 175 million. Through the adoption of the national plan for transport infrastructure for the period 2018-2029 (N2018/03462/TIF), the Swedish Government decided that the Swedish Transport Administration should build and commission a permanent electrified road during the plan period. The Swedish Transport Administration is now developing road plans for a section of the E20 between Hallsberg and Örebro and highway 73 between Nynäshamn and Västerhaninge.

7.1.4 *Future alternative transport fuels*

In 2015, the Swedish Energy Agency granted aid to the Chalmers University of Technology corresponding to 79% of the eligible costs up to a maximum of SEK 22 080 000 to implement the project Future alternative transport fuels during the period 2015-2019. The aim of the project is to identify fuels that combine good combustion properties with long-term sustainability. The chosen solutions must be sustainable over time, and thus raw materials, land use and production methods must be studied so that the best overall solution can be obtained in terms of well-to-wheel as regards CO₂ emissions and energy use⁵².

7.1.5 *Assignment to establish an innovation cluster for liquefied biogas*

In May 2018, the Swedish Government tasked the Swedish Energy Agency with announcing funding for the development and use of liquefied biogas in

⁵¹ <https://www.trafikverket.se/resa-och-trafik/forskning-och-innovation/aktuell-forskning/transport-pavag/elvagar-ett-komplement-i-morgondagens-transportsystem/>.

⁵² Swedish Energy Agency decision, 19 November 2015, ref No 2015-006317.

combination with the creation of an innovation cluster for liquefied biogas⁵³. The objective of this is to promote the switch to fossil-free for heavy freight transport. The initiative will promote the demonstration, application and dissemination of technology for the production of liquefied biogas, the operation of gas-powered vehicles in regional or local transport and combinations of these technologies in Sweden. Under the framework for the project, the Swedish Energy Agency will receive SEK 28 million in 2018, SEK 32 million in 2019, SEK 25 million in 2020 and SEK 115 million in 2021. Of this total amount of SEK 200 million, SEK 5 million has been spent on establishing the innovation cluster itself, which will be performed by the Swedish Gas Association.

The demonstration measures to date include⁵⁴

- Production (five production facilities)
- Distribution (five refuelling points, two bunkering depots for the joint bunkering of liquefied biogas and LNG)
- Usage (159 LBG lorries, 10 LBG coaches, one port tow vehicle)

7.1.6 *Assignment to establish an innovation cluster for ethanol and transport-efficient electrified urban freight transport*

In 2018, the Swedish Energy Agency decided to allocate SEK 25 million to implement the Assignment to establish an innovation cluster for ethanol and transport-efficient electrified urban freight transport during the period 2018-2020.

In May 2018, the Swedish Government tasked the Swedish Energy Agency with announcing funding for the establishment of two innovation clusters for the demonstration of ethanol and transport-efficient electrified urban freight transport⁵⁵. The announcement of funding aims to form innovation clusters to demonstrate fuel and vehicle technology. This may take the form of cooperation between the public sector, business and academia. The demonstration of fossil-free heavy freight transport not only contributes towards being fossil-free nationally, but also to the export of technology and knowledge and reduced emissions in other countries.

The annual financing of the innovation cluster amounts to SEK 2 million in 2018, SEK 8 million in 2019 and SEK 15 million in 2020. An application concerning ethanol powered heavy freight transport was received in connection with the

⁵³https://www.regeringen.se/49aa30/contentassets/c2d4c09342564936adb9d18aecc0da42/n2018_02934-uppdrag-att-inratta-innovationskluster-for-flytande-biogas-20180509.pdf.

⁵⁴ Up until August 2019 (inclusive).

⁵⁵ <https://www.regeringen.se/regeringsuppdrag/2018/05/uppdrag-att-inratta-innovationskluster-for-ethanol-och-transporteffektiva-elektrifierade-urbana-godstransporter/>.

announcement. Aid has been granted to establish an innovation cluster and demonstrate ethanol powered freight transport, the establishment of tank infrastructure and the development of ED95. SEK 450 000⁵⁶ in aid has been granted for the cluster organisation and SEK 7 468 400⁵⁷ in aid has been granted for demonstration and development. No applications have been received relating to the transport-efficient urban freight transport element.

7.2 Shipping

7.2.1 *Shipping programme*⁵⁸

The Swedish Energy Agency decided to allocate SEK 83 million for the implementation of the Shipping programme during the period 2018-2023. The Swedish Energy Agency's annual financing of the programme is SEK 3 million for 2018, SEK 15 million for 2019, SEK 20 million for 2020, SEK 20 million for 2021, SEK 15 million for 2022 and SEK 10 million for 2023.

The objective of the programme is to:

- Develop new knowledge concerning the way in which increased energy efficiency can be achieved and how the percentage of renewable energy used in shipping can be increased;
- Demonstrate innovative and further developed ways of working, services, business models, technology and adapted solutions that significantly improve energy and resource efficiency in the maritime transport sector;
- Strengthen long-term skills development in the form of strong research environments in the maritime transport sector at several educational institutions;
- Facilitate cooperation in academia, business and the public sector, both nationally and internationally to contribute jointly to understanding and change;
- The dissemination of results with a strong focus on usefulness has been performed with respect to relevant target groups in academia, the public sector, business and civil society;
- Establish interdisciplinary cooperation between researchers in the natural sciences/technical and social sciences/humanity disciplines leading to a variety of perspectives and solutions.

⁵⁶ Swedish Environment Agency Decision, 12 December 2018, ref. No 2018-014606.

⁵⁷ Swedish Environment Agency Decision, 20 August 2019, ref. No 2019-004495.

⁵⁸ <http://www.energimyndigheten.se/forskning-och-innovation/forskning/transporter/sjofartsprogrammet/>.

7.2.2 ***Swedish Transport Administration's industry programme Sustainable shipping***

The Swedish Transport Administration's industry programme Sustainable shipping will create an internationally competitive, sustainable and safe shipping sector with a good working environment. This is achieved through a strengthened, broadened and deepened triple helix cooperation where academia, business and the authorities address the challenges faced by shipping together. This ranges from themes such as air pollution, greenhouse gas emissions and impact on the marine environment to making shipping more cost-effective, safer and healthier and attractive as a workplace. The programme will run for a period of 10 years between 2019 and 2028 and comprises SEK 100 million of State funding supplemented with part financing from the industry. The programme is operated by the Lighthouse Swedish Maritime Competence Centre cooperation platform.

7.3 **Aviation**

7.3.1 ***Assignment to promote sustainable biofuels for aviation***

In 2018, the Swedish Government decided to task the Swedish Energy Agency with promoting sustainable biofuels for aviation. Under the assignment, the Swedish Energy Agency must announce funding during the period 2018-2020 to support research and innovation for sustainable biofuels for aviation and establish an innovation cluster bringing together the entire value chain and developing a common needs analysis to address the switch to fossil-free fuels in aviation. The cluster has now been established. Under the framework for the assignment, the Swedish Energy Agency will pay out SEK 20 million in 2018, SEK 30 million in 2019 and SEK 50 million in 2020. Thus, the total amount of aid amounts to SEK 100 million. A maximum of SEK 10 million may be used to support the activities of the innovation cluster⁵⁹.

7.4 **Non-road mobile machinery**

7.4.1 ***Electrified mining transport in an Arctic climate***

In 2018, the Swedish Energy Agency decided to grant aid to Boliden Mineral AB corresponding to 24% of the eligible costs up to a maximum of SEK 9 725 000⁶⁰. The aid was provided to implement the project Electrified mining transport in an Arctic climate during the period 2018-2019. The aim of the project is to conduct a demonstration project for a section of electrified transport in a mine with

⁵⁹https://www.regeringen.se/49972b/contentassets/7f05b0814e6648c191c5d41e50e8c825/n2018_02705.pdf.

⁶⁰ Swedish Energy Agency decision, 7 February 2018, ref. No 2017-010988.

overhead contact wires. This is to provide a decision-making basis for converting mining trucks to electric operation.

7.5 Combination (Initiatives not associated with a specific traffic type)

7.5.1 *Biofuels programme⁶¹*

The Biofuels programme is funded by the Swedish Energy Agency, the focus of which being to announce funding for academia, businesses and institutes to develop knowledge and technologies required for the market launch of biofuels produced from lignocellulosic or residual products. The main areas of the programme are thermochemical transformation processes, biochemical transformation processes, system issues, integration and biorefinery concepts. The programme is scheduled to take place during the period 2017-2021 and has a budget framework of SEK 180 million. The annual funding allocated is SEK 5 million in 2017, SEK 45 million annually during the period 2018-2020 and SEK 40 million in 2021.

The programme supersedes the previous programmes Biofuels programme – Thermochemical processes and Biofuels programme – Biochemical methods, which respectively had allocated funds in the form of SEK 2 million in 2015, SEK 20 million in 2016 and SEK 8 million in 2015 and SEK 25 million in 2016 before these were replaced by the Biofuels programme.

7.5.2 *Cooperation programme Renewable fuels and systems⁶²*

The cooperation programme ‘Renewable fuels and systems’ is funded by the Swedish Energy Agency in cooperation with f3 Swedish Knowledge Centre for Renewable Transportation Fuels.

The aims and objectives of the cooperation programme are formulated in line with the Swedish Energy Agency’s biofuels strategy, where the collaboration programme is aimed at contributing specifically with interdisciplinary and system-oriented studies, thereby complementing the Swedish Energy Agency’s other initiatives regarding more technology-specific development.

The first stage of the programme took place between 2014 and 2017. The total budget framework for previous stage was SEK 44 million, where the Swedish Energy Agency contributed SEK 22 million. The next stage of the programme

⁶¹ <https://www.energimyndigheten.se/forskning-och-innovation/forskning/transporter/biodrivmedel/program/biodrivmedelsprogrammet/>.

⁶² <https://www.energimyndigheten.se/forskning-och-innovation/forskning/transporter/biodrivmedel/program/fornybara-drivmedel-och-system/>.

runs over four years with a total research budget of SEK 33 million. The Swedish Energy Agency will also contribute a maximum of SEK 22 million in aid in the forthcoming programme period. The remainder will be funded by various parties included in the cooperation programme.

7.5.3 ***SamsPEL***⁶³

The SamsPEL research and innovation programme comprises a total of SEK 283 million during the period 2016-2023. The programme brings together Swedish Energy Agency initiatives in the area of electrical systems and covers both social science and technical work. The programme contains three research, development and innovation areas:

- Knowledge and skills for a resource-efficient development of Sweden's power system;
- New technologies, system services and market models that create added value for electricity system operators;
- Leading Swedish research and innovation actors in a global market.

In addition to these three areas, the Swedish Energy Agency has the opportunity to fund supporting activities that are considered to facilitate a broader implementation of the results of the programme. Finance under the programme includes the development of the recharging infrastructure for plug-in vehicles, although the main focus of the programme is not the transport system.

7.5.4 ***TripleF***⁶⁴

Triple F is the Swedish Transport Administration's research and innovation initiative that aims to contribute towards the conversion of the Swedish freight transport system to fossil-free fuels. The anticipated results are overarching cooperation between actors and knowledge building that contributes to reducing the CO₂ emissions of freight transport in accordance with the targets set. This will take place through broad innovation efforts leading up to 2030 involving cooperation between academia, institutes, industry and authorities.

A focus will be placed on three major challenges:

- A more transport-efficient society;
- Energy-efficient and fossil-free vehicles and vessels;
- Increasing the percentage of renewable fuels.

⁶³<http://www.energimyndigheten.se/forskning-och-innovation/forskning/fornybar-el/elnat-och-elmärknad/program/samspel/>.

⁶⁴<https://triplef.lindholmen.se/nyheter/brett-forsknings-och-innovationsprogram-ska-gora-godstransporter-fossilfria>.

The Swedish Transport Administration has initiated and is funding the programme in the amount of SEK 290 million over a period 12 years until 2030. The programme is in line with the national freight transport strategy presented by the Swedish Government in June 2018 (see *Article 5.4.1 National freight strategy*). Business and community stakeholders will co-finance innovation projects under the programme with around SEK 100 million. The programme has the objective of increasing external financing over time and thereby growing significantly within the time-frame.

7.5.5 Assignment to support research and development in electromobility

In 2018, the Swedish Government tasked the Swedish Energy Agency with supporting research and development and the innovation of products and test methods in electromobility⁶⁵. The initiatives will contribute to a more rapid development of new technologies primarily for electrified vehicles, but also for electrified vessels, aircraft and non-road mobile machinery and strengthening skills and Swedish competitiveness in these areas and contribute towards Sweden attaining the energy and climate policy goals determined by the Swedish Parliament. In order to do this, the Swedish Energy Agency will disburse a maximum of SEK 10 million in 2018. The Swedish Government also expects to allocate SEK 10 million in 2019, SEK 10 million in 2020, SEK 60 million in 2021, SEK 60 million in 2022 and SEK 50 million in 2023 for the same purpose. The total amount is SEK 200 million during the period 2018-2023.

7.5.6 Biogas Research Center at Linköping University (LiU) and the Swedish University of Agricultural Sciences (SLU)

The Swedish Energy Agency has granted Linköping University SEK 40 million in aid for the project Biogas Research Center at Linköping University (LiU) and the Swedish University of Agricultural Sciences (SLU). The project will run during the period 2018-2022 and is a continuation of previous activities. The aim of this third stage is to further develop knowledge and expertise in the area of biogas in cooperation between academia and business to enable the implementation of innovative and resource-efficient biogas solutions in both established and new sectors. The Swedish Energy Agency will fund the project in the amount of just under SEK 11 million per year in 2019, followed by a further SEK 10 million in 2020, SEK 10 million in 2021 and around SEK 9 million in 2022. In addition, Linköping University and the Swedish University of Agricultural Sciences will provide co-financing in the amount of SEK 40 million, and various municipalities and regions will provide a further SEK 8.5 million

⁶⁵ Government Decision ref. No 2018-9952.

over the entire project period. The project costs will amount to a total of SEK 120 million⁶⁶.

The Swedish Energy Agency has previously granted aid corresponding to around SEK 27 million to Linköping University for the project Biogas Research Center at Linköping University (BRC), which was a previous stage in the competence centre that ran during the period 2014-2018. Linköping University also provided co-financing in the amount of around SEK 27 million and various municipalities provided SEK 3.4 million. The total project cost amounted to around SEK 82 million.

7.5.7 *Three competence centres for combustion engine research*

The Combustion Engine Research Center (CERC)⁶⁷ at the Chalmers University of Technology in Gothenburg is a resource centre within the field of combustion engine technology. CERC primarily focuses on the fields of spray and combustion in direct injection diesel and petrol engines, as well as hybrids between these two combustion concepts, biofuels and the regulation of engines. The current stage is taking place between 2018 and 2021. The Swedish Energy Agency is providing funding of SEK 10 million annually throughout the stage, and amounting to SEK 40 million in total. The Chalmers University of Technology is also providing an equal amount of co-financing.

The Competency Centre for Combustion Processes (KCFP)⁶⁸ at Lund University focuses on research concerning partial premixed combustion (PPC) with conventional and renewable fuels, laser diagnostics and combustion control. The focus is on combustion concepts which can combine low exhaust emissions and high efficiency and how these can utilise alternative fuels. This stage is taking place between 2018 and 2021. The Swedish Energy Agency is providing financing in the amount of SEK 10 million annually throughout the stage, amounting to SEK 40 million in total. The Faculty of Engineering at Lund University is also providing cofinancing at the same amount.

The Competence Centre for Gas Exchange (CCGEx)⁶⁹ at the KTH Royal Institute of Technology in Stockholm is conducting research in the field of gas

⁶⁶ Swedish Energy Agency Decision ref. No 2018-010740.

⁶⁷<https://www.energimyndigheten.se/forskning-och-innovation/forskning/transporter/fordon/kc/kompetenscentrum-combustion-engine-research-center-cerc/>.

⁶⁸<https://www.energimyndigheten.se/forskning-och-innovation/forskning/transporter/fordon/kc/kompetenscentrum-forbranningsprocesser-kcfp/>.

⁶⁹<http://www.energimyndigheten.se/forskning-och-innovation/forskning/transporter/fordon/kc/kompetenscentrum-gasvaxling-ccgex>.

exchange in combustion engines. The aim of this is to increase understanding and identify new technical solutions in gas exchange, EGR systems, overcharging and aftertreatment systems. The current stage is taking place between 2018 and 2021. The Swedish Energy Agency is providing financing of SEK 10 million annually throughout the stage, and amounting to SEK 40 million in total. KTH Royal Institute of Technology is also providing co-financing at the same amount.

7.5.8 *Competence Centre for Catalysis (KCK)*

The Competence Centre for Catalysis (KCK)⁷⁰ is a research centre at the Chalmers University of Technology working in the areas of catalysis for emissions purification and energy-related catalysis. The aim of the Competence Centre for Catalysis is to develop a research environment conducting high quality research in the area of catalytic emission purification and catalysis for sustainable energy systems. The current stage is taking place between 2018 and 2021. The Swedish Energy Agency is providing funding of SEK 10 million annually throughout the stage, amounting to a total of SEK 40 million. KTH Royal Institute of Technology is also providing co-financing in the same amount.

7.5.9 *Northvolt*

In 2018, the Swedish Energy Agency granted aid to Northvolt Labs AB corresponding to 20% of the eligible costs up to a maximum of SEK 146 million to implement the project Northvolt Pilot Production Line during the period 2018-2023⁷¹. The project involves the construction, commissioning and testing of a pilot facility to produce lithium ion battery cells. The pilot facility aims to serve two purposes. It will partly validate the vertically integrated production model, which is characterised by process innovations and enables more sustainable battery production with a lower carbon footprint, and will partly act as a centre for research and development. Approximately SEK 90 million was disbursed during the first year, and in 2019 it is estimated that around SEK 36 million will be paid out, with the remaining funds being split equally over the remaining four years of the project.

7.5.10 *Swedish Electromobility Centre*

In 2019, the Swedish Energy Agency granted aid to the Chalmers University of Technology corresponding to 33% of the eligible costs up to a maximum of SEK 72 million to implement the project Swedish Electromobility Centre stage IV during the period 2019-2023⁷². The aim of the centre is to develop strategically important knowledge and expertise in the area of electric and hybrid vehicles, and thereby contribute to the development of vehicles with lower

⁷⁰ <http://www.energimyndigheten.se/forsknings-och-innovation/forskning/transporter/fordon/kc/kompetenscentrum-katalys-kck>.

⁷¹ Swedish Energy Agency Decision, 1 February 2018, ref. No 2017-011436.

⁷² Swedish Energy Agency decision, ref. No 2019-007869.

energy consumption and less environmental impact. The Swedish Electromobility Centre (SEC) will also represent a holistic view of the problem in order to meet the requirements of the environment and society and act as a support and partner for the Swedish automotive industry. In order to achieve this, SEC will perform industrial and socially motivated research in electric and hybrid vehicle technology and associated recharging infrastructure.

SEC serves as a hub for Swedish research in this area, partly by organising a doctoral network, providing doctoral courses, publishing a newsletter and arranging seminars. The Swedish Energy Agency's annual financing of the programme amounts to SEK 9 million for 2019, SEK 18 million for 2020, SEK 18 million for 2021, SEK 18 million for 2022 and SEK 9 million for 2023.

This is being co-financed by academia with a corresponding amount of SEK 72 million and by industry with a corresponding amount of SEK 72 million, meaning the total cost of the project amounts to SEK 216 million.

7.6 Completed initiatives

7.6.1 Demonstration programme for Electric vehicles⁷³

The demonstration programme for electric vehicles seeks from a user perspective to identify and if possible, remove barriers to the large-scale introduction of electric vehicles to the Swedish market. The programme commenced in 2011 and has been extended to 30 June 2018 (inclusive).

The budget framework for the programme amounted to a total of SEK 285 million following the extension of the programme, which added SEK 85 million through a decision reached in June 2013. The programme was extended at the end of 2015 by a further six months through to 30 June 2018 (inclusive). The programme was entirely funded by the Swedish Energy Agency.

7.6.2 Autonomous electric Quarry – Demonstrator

The project involved the development of electrified and autonomous vehicles/machinery for a quarry. The Swedish Energy Agency's annual payments for the project amounted to around SEK 4 million in 2015, just under SEK 30 million in 2016, just under SEK 30 million in 2017 and just under SEK 2 million in 2018.

⁷³ <http://www.energimyndigheten.se/forskning-och-innovation/forskning/transporter/fordon/program/demonstrationsprogram-for-elfordon-2011-2017/>.

7.6.3 ***CleanFuel – a chain link from black lye to green petrol and diesel***

The Swedish Energy Agency granted around SEK 71 million in aid in the period 2015-2018 to Renfuel K2B AB to implement the project CleanFuel – a chain link from black lye to green petrol and diesel. The aim of the project is to develop and test a complete industrial process for converting lignin from pulp mills into a lignin oil on a pilot scale. This will then be used as a raw material in a conventional refinery to produce renewable petrol and diesel.

7.6.4 ***Marine Biogas***

In 2015, the Swedish Energy Agency granted aid to Marin Biogas AB corresponding to SEK 10 million to implement the project Marine Biogas during the period 2015-2017. The aim of the project was to develop and verify a concept for the large-scale cultivation of marine biomass on the west coast of Sweden. The biomass is digested to form biogas.

7.6.5 ***ElectriCity***

In 2013, the Swedish Energy Agency granted aid to Volvo Bussar AB corresponding to 25% of the eligible costs up to a maximum amount of SEK 48 237 258. The aid was provided to implement the project ElectriCity during the period 1 December 2013 – 30 June 2018. The aim of the project was to demonstrate a sustainable and attractive transport system for public transport in Gothenburg with rechargeable hybrid buses (plug-in) and fully electrified buses.

7.6.1 ***Swedish Electric and Hybrid Vehicle Centre (SHC)***

In 2015, the Swedish Energy Agency approved stage 3 of the Swedish Electric and Hybrid Vehicle Centre⁷⁴. The task of this centre is to develop strategically important knowledge and expertise relating to electric and hybrid vehicles and thereby support and serve as a cooperation partner for the Swedish automation industry. It is also important that the centre represents a holistic view of the problem in order to meet the requirements of the environment and society. Therefore, the centre must conduct industrial and socially motivated education and research in the field of electric and hybrid vehicle technology.

The main task of SHC is to develop and optimise existing and future technological solutions relating to energy supply, energy storage and propulsion for commercially competitive, energy efficient and environmentally friendly electric and hybrid concepts. The Swedish Energy Agency is providing financing

⁷⁴ Swedish Environment Agency Programme Description for the Swedish Electric and Hybrid Vehicle Centre (SHC) stage 3, 23 April 2015, ref. No 2015-002021.

of SEK 9.6 million every year during this stage of the project. Swedish academia is also providing funding in the same amount.

SHC has been renamed the Swedish Electromobility Centre since the decision was reached and will operate under the same name throughout the next stage during the period 2019-2023.

8 Aims and objectives

It has been clarified under the Swedish action programme⁷⁵ that reducing emissions from the transport sector is crucial for Sweden to reach its long-term climate targets. Sweden has an ambition to become one of the world's first fossil-free prosperous nations. To achieve this, Sweden has to have a fossil-free vehicle fleet. The climate policy framework adopted in 2017 is presented below. Sweden's emissions are falling too slowly to be in line with climate policy targets, even though the proportion of renewable energy in the transport sector is rising. Long-term scenarios for the development of the transport sector provide an estimate of the anticipated number of vehicles powered by electricity or gas in the future. Finally, information is provided concerning the method used to take into account the charging efficiency of high-power recharging points. The report in this section corresponds to point 5 of Annex I of Directive 2014/94/EU.

8.1 Long-term climate targets

In 2017, the Swedish Parliament adopted with a wide majority a climate policy framework with emissions targets, a Climate Act⁷⁶ and the establishment of a climate policy council. Under the Act, every Government has an obligation to pursue a policy based on the climate targets adopted by Parliament. Under the Climate Act, the Swedish Government must present a climate report to the Swedish Parliament every year in the Budget Bill, with the report being presented for the first time in the Budget Bill for 2019⁷⁷. The task of the climate policy council is to evaluate the extent to which the Government's overall policy is consistent with the climate targets determined by the Swedish Parliament.

In the climate policy framework⁷⁸, the Swedish Government established a number of targets regarding how Sweden's climate emissions should be reduced. These may be summarised as follows:

- By 2045, Sweden is to have zero net atmospheric emissions of greenhouse gases and should thereafter achieve negative emissions. Supplementary measures may be necessary in order to achieve net zero emissions. Emissions from activities in Sweden must be at least 85% lower than in 1990.

⁷⁵ Sweden's action programme for alternative fuels infrastructure under Directive 2014/94/EU. Annex to Minutes II 8 of Government meeting held on 17 November 2016, N2016/07176/MRT, etc.

⁷⁶ Swedish Climate Act (SFS 2017:720).

⁷⁷ PROP. 2018/19:1 EXPENDITURE AREA 20 Annex.

⁷⁸ Government Offices of Sweden, A climate policy framework for Sweden. Proposition 2016/17:146., 2017.

- By 2030, emissions in Sweden in the non-trading sectors⁷⁹ that will be covered by the EU Effort Sharing Regulation should be at least 63% lower than in 1990. A maximum of 8% of the emissions reductions may be through supplementary measures.
- By 2040, emissions in Sweden in the sectors that will be covered by the EU Effort Sharing Regulation should be at least 75% lower than in 1990. A maximum of 2% of the emissions reductions may be through supplementary measures.
- By 2030, emissions from domestic transport (excluding domestic aviation, which is included in EU ETS the EU's emissions trading system) will be reduced by at least 70% compared with 2010.

8.2 Towards being fossil fuel-free

Sweden's territorial emissions of greenhouse gases has reduced by 26% between 1990 and 2017⁸⁰. Emissions primarily fell during the period 2003-2014, after which the rate of reduction declined. In 2017, emissions were only 0.5% lower compared with 2016. Emissions from domestic transport decreased over the year, despite an increase in traffic volume.

In 2017, domestic transport accounted for 31% of Sweden's greenhouse gas emissions⁸¹. The climatic impact of transport in Sweden is dominated by road traffic. In 2017, this accounted for 95% of emissions from domestic transport. Following this is aviation at 3%, shipping at 2% and finally rail traffic at 0.3%. During the period 2010-2017, emissions from domestic transport, excluding domestic aviation, has reduced by 18%. The reduction in greenhouse gas emissions can be explained by the increased percentage of biofuels and energy-efficiency measures in the vehicle fleet. The increase in the volume of cars and lorries in particular has to some extent been countered by the effects of energy efficiency and biofuels.

8.2.1 *Renewable energy increasing in the transport sector*

Sweden's transport sector is increasingly using renewable energy (see Figure 1). This was 23% for domestic transport during 2017⁸². The estimated percentage of renewable energy is based on official energy statistics for all domestic transport,

⁷⁹ Sectors not included in the EU Emissions Trading Scheme: accommodation and premises, domestic transport (excluding aviation), agriculture, waste management as well as emissions from industries and energy supply facilities.

⁸⁰ Swedish Environmental Protection Agency. Basis for the Swedish Government's climate policy action plan, Report 6879. 2019.

⁸¹ Swedish Transport Administration environment report 2018. 2019:070.

⁸² Energy indicators 2019.

i.e. road transport, rail transport, domestic shipping and domestic aviation. However, there are no official statistics on electricity use in road vehicles. Thus, the percentage for renewable electricity only relates to the use of electricity for rail transport⁸³.

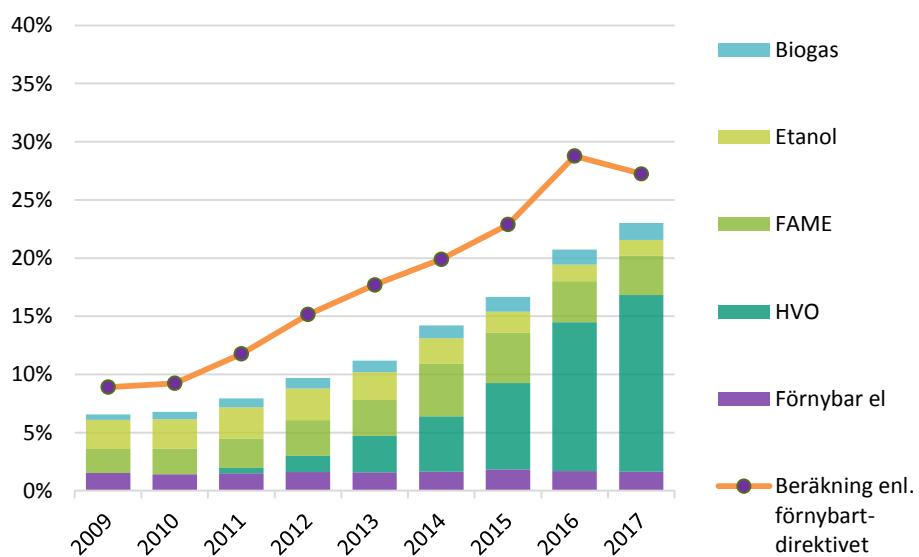


Figure 1. Percentage of renewable energy in relation to the total quantity of energy for domestic transport. Energy indicators 2019.

Förnybar el = renewable electricity

Beräkning enl. förnybartdirektivet = Calculation in accordance with Renewable Energy Directive

The EU's target for the percentage of renewables in the transport sector is formulated in the Renewable Energy Directive⁸⁴ that 10% of the energy used in the transport sector by 2020 must be renewable based on the calculation method specified in the Directive, where double counting of, inter alia, biofuels from certain residues is specified in Annex IX of the Directive. According to the revised Renewable Energy Directive⁸⁵, the goal for the transport sector is imposed on fuel suppliers, which will ensure that 14% of the energy is renewable

⁸³ I.e. railways, trams and subways.

⁸⁴ Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

⁸⁵ Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources.

by 2030. By 2011, Sweden had already passed the EU target for Member States to reach 10% renewable energy in the transport sector by the year 2020⁸⁶.

8.3 Long-term scenarios for development of the transport sector

The Swedish Energy Agency is developing long-term scenarios for Sweden's energy system⁸⁷. This uses the same basis as that used in the reporting of Swedish climate emissions to the European Commission performed by Sweden every two years. These scenarios are formulated according to the requirements of the Swedish Ordinance on climate reporting⁸⁸ and the main aim is to produce scenarios for energy use and future supply based on the present energy system. The European Commission produces common conditions for price trends for coal, oil, natural gas and emissions allowances that are used in a scenario referred to as *Reference EU*. The outcome of this scenario may be considered a possible development if no additional instruments are implemented⁸⁹.

The general trend in the transport sector is for energy consumption to decrease through to 2030, and then increase during the period leading up to 2050; see Figure 2. This is largely due to an improvement in energy efficiency in the car fleet, partly offset by a parallel growing demand for transport. A switch is taking place in the car fleet from conventional petrol cars to diesel cars, rechargeable cars, plug-in hybrids and gas-powered cars. The anticipated rise in demand for transport in the scenarios applies to both passenger transport and freight transport. The results are largely influenced by economic development in future. Economic development amongst other things affects car ownership, willingness to travel in the case of passenger transport and demand for goods and services (in the form of freight transport).

The use of electricity in the transport sector is expected to increase in all scenarios as a consequence of a continued increase in electric vehicles. The proportion of renewable energy in the transport sector is also expected to increase because of the electrification described, and due to low-blend biofuels and the use of pure biofuels. See the report for a more detailed description of the long-term forecasts and conditions for the scenarios⁹⁰.

⁸⁶ Swedish Energy Agency. Energy indicators 2019. ER 2019:11.

⁸⁷ Swedish Energy Agency. Scenarios for the Swedish energy system 2018. ER 2019:7.

⁸⁸ Swedish Ordinance on climate reporting (SFS 2005:626).

⁸⁹ Instruments implemented by 1 July 2018 are included.

⁹⁰ Swedish Energy Agency. Scenarios for the Swedish energy system 2018. ER 2019:7.

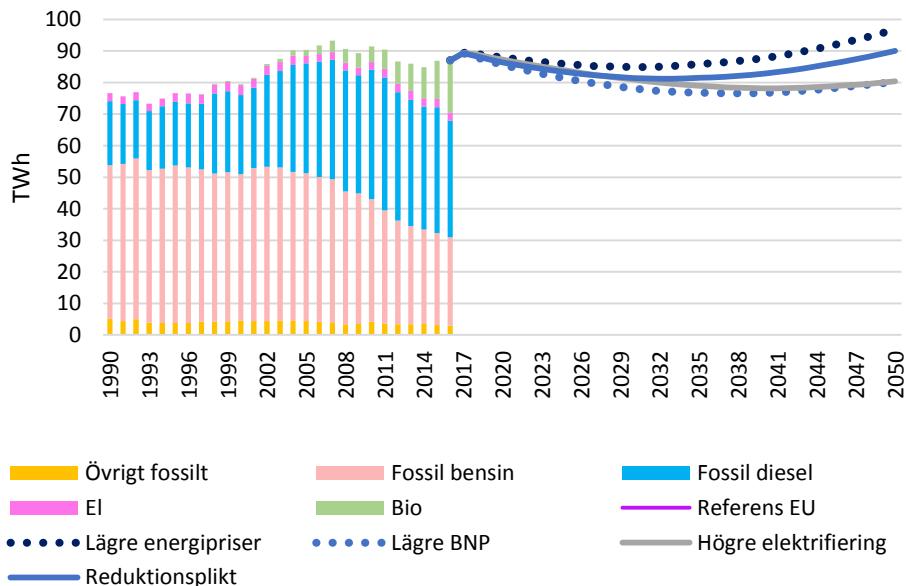


Figure 2. Energy consumption for domestic transport 1990-2016 and in the scenarios for the period leading up to 2050, TWh.

Övrigt fossilt = Other fossil

El = Electricity

Lägre energipriser = Lower energy prices

Reduktionsplikt = Reduction obligation

Fossil bensin = Petrol from fossil fuels

Lägre BNP = Lower BNP

Referens EU = Reference EU

Högre elektrifiering = Increased electrification

8.3.1 ***Anticipated number of vehicles running on electricity or gas***

The estimate for the anticipated number of vehicles which use electricity or gas is presented in Table 4. The estimate of the number of vehicles in 2020, 2025 and 2030 is based on the scenario *Reference EU* in the Swedish Energy Agency's long-term scenarios 2018⁹¹. The scenario includes the emissions requirement of 130 g CO₂ for new cars and a tightening of the requirement to 95 g CO₂ (2021) and 147 g CO₂ for light commercial vehicles (2021). Only instruments introduced by 1 July 2018 were included in the calculations. The figures in this estimate differ from previous figures in the supplement to Sweden's action programme⁹², which were based on the Swedish Transport Administration's short-term forecasts reported in May 2018. The total vehicle fleet is smaller in

⁹¹ Swedish Energy Agency. Scenarios for Sweden's energy system 2018. ER 2019:7.

⁹² Supplement to the policy framework for alternative fuels infrastructure under Directive 2014/94/EU. Annex to Minutes II 20 of Government meeting held on 30 August 2018. N2018/04594/MRT, etc.

the Swedish Energy Agency's scenarios than that used in the forecast produced by the Swedish Transport Administration. Only from December 2019 will it be possible to distinguish vehicles which use LNG/LBG in the road traffic register from those which use CNG.

Table 4. Anticipated number of electric-powered and gas-powered vehicles in Sweden in 2020, 2025 and 2030 under the scenario reference EU.

Anticipated number of vehicles	2020	2025	2030
Cars, electric (BEV)	28 506	64 799	112 538
Cars, plug-in hybrids (PHEV)	113 705	305 818	531 610
Light commercial vehicles, electric (BEV)*	0.6%	1.0%	1.4%
Light commercial vehicles, plug-in hybrids (PHEV)	0%	0%	0%
Buses, electric (BEV)	1.9%	4.4%	6.9%
Buses, plug-in hybrids (PHEV)	2.4%	4.9%	7.4%
Cars, road fuel gas (CNG/CBG)	42 351	54 268	76 898
Buses, road fuel gas (CNG/CBG)	16.6%	16.0%	15.4%
Heavy goods vehicles, road fuel gas (CNG/CBG)	1.2%	1.6%	1.9%
Heavy vehicles, liquefied natural gas (LNG/LBG)	No information	No information	No information
Fuel cell vehicles (FCV)	At least 36	At least 36	At least 36

*The percentage of the vehicle fleet is specified for light commercial vehicles

The updated emissions requirement from the EU⁹³ entails a 37.5% reduction by 2030 for cars and a 31% reduction for light goods vehicles (including the EU's new driving cycle); these are not included in the estimate of the anticipated number of vehicles presented in Table 4. The Swedish Energy Agency has performed sensitivity analyses to estimate the effects of the updated emissions requirements made by the EU. The analysis investigated one case with a 30% emissions reduction with an updated driving cycle from 2021 and one case with a 50% emissions reduction with an updated driving cycle from 2021 and an increased potential for electrification. These analyses indicate a larger than anticipated percentage of rechargeable electric vehicles⁹⁴. The sensitivity analysis estimated the number of electric vehicles in 2030 as being almost 180 000 for the case with a 30% emissions reduction and around 300 000 for the case with a 50% emissions reduction. The result indicates that the assessment of the number of

⁹³ Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO₂ emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011.

⁹⁴ The sensitivity analysis only covered cars.

vehicles that can run on electricity or gas according to the scenario *Reference EU* is restrictive.

8.4 Information on the method applied to take into account the recharging efficiency of high-power recharging points

The Climate Leap climate assessment⁹⁵ calculates the climate benefit of high-power recharging points (50 kW) by assuming that a public recharging point for high-power recharging using direct current (DC) is used twice a day and that each recharging session transfers 10 kWh to the battery of the electric vehicle. Note that a 50 kW charger is generally only equipped with a CCS socket and therefore only constitutes one recharging point. Thus, a public recharging station for high-power DC recharging contributes to an annual reduction of 7 000 kg CO₂-eq per CCS recharging point⁹⁶.

⁹⁵ Swedish Energy Agency, Climate assessment of non-public and public recharging stations under Climate Leap <http://www.naturvardsverket.se/upload/stod-i-miljoarbetet/bidrag-och-ersatning/bidrag/klimatkivet/Klimatvardering-laddstationer-sep-2017.pdf>.

⁹⁶ $3\ 365 \times 2.5 \text{ [times/day]} \times 10 \text{ [kWh/day]} \times 0.96 \text{ [kg CO}_2\text{-ekv/1 kWh]}$.

9 Development of alternative fuels infrastructure

The change in supply and demand for alternative fuels infrastructure is described below. The number of rechargeable electric vehicles has risen rapidly in the case of road transport, which has led to greater demand at available recharging points. There is also increasing interest among vehicle manufacturers in liquid methane (LNG/LBG) as fuel for heavy vehicles. Several ports offer the potential for LNG bunkering and a special investigation has proposed a number of measures to promote the use of biofuels in aviation. The report in this section corresponds to the requirement in point 6 of Annex I of Directive 2014/94/EU.

9.1 Road transport

9.1.1 **Vehicle fleet**

The average lifespan of a car in Sweden is 17 years⁹⁷, which means that renewing the vehicle fleet takes a long time. Sweden's car fleet grew by 0.5% during 2018 and now comprises just under 4.9 million cars⁹⁸. The number of new car registrations during 2018 remained high at 365 535. However, car sales fell compared with 2017, and there were around 27 000 fewer new car registrations in 2018. Compared with the rest of the EU, Sweden has a high level of new car sales relative to the existing car fleet⁹⁹.

Of almost 4.9 million cars on the road, 92% use pure petrol or diesel; see Figure 3. Ethanol-powered cars are most common after petrol and diesel, although the number of ethanol-powered cars has reduced during the past three years. The large size of the current fleet is due to the fact that sales of ethanol-powered cars amounted to 10-15% of new car sales between 2006 and 2010¹⁰⁰. In September 2019, the number of models of ethanol-powered cars stocked by car dealers was five, all from the same manufacturer.¹⁰¹

⁹⁷ Memorandum, Road traffic emissions, Swedish Transport Administration, 21 February 2019.

⁹⁸ Transport Analysis. Vehicles 2018 - Statistics 2019:4.

⁹⁹ Energy indicators 2019.

¹⁰⁰ Energy indicators 2019.

¹⁰¹ Source: Miljöfordon.se.

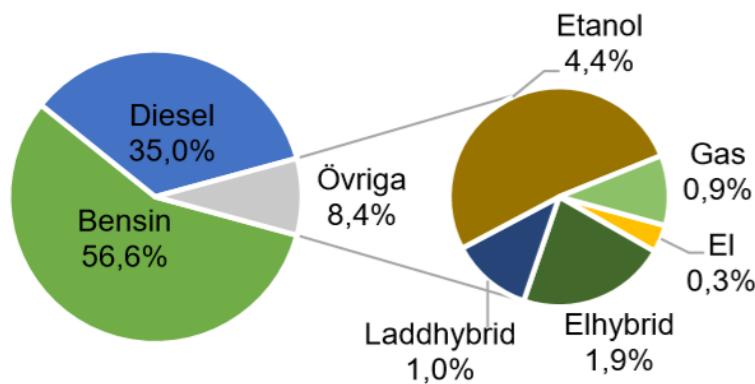


Figure 3. Percentage of cars on the road according to fuel, 2018. Source: Transport Analysis Vehicles 2018.

Bensin = Petrol

Övriga = Other

Laddhybrid = Plug-in hybrid

Elhybrid = Electric hybrid

EI = Electric

Etanol = Ethanol

However, interest in rechargeable cars has increased sharply. There were 66 000 rechargeable cars by the end of December 2018. This represents an increase of around 50% compared with the same month of 2017. This increase was partly due to a drop in battery prices, a rise in the number of recharging stations and an increase in the number of models available¹⁰². Around 9% of all cars sold during 2018 were either electric cars, plug-in hybrids, gas-powered cars or ethanol-powered cars¹⁰³. The conditions for various types of new registrations were influenced by the introduction of the bonus-malus system¹⁰⁴ and the introduction of the new test cycle WLTP¹⁰⁵, which both occurred during 2018. One category of electric vehicle particularly favoured by the introduction of the bonus-malus system is light commercial vehicles, which were not previously supported by the super green car premium. One effect of the introduction of WLTP is extended delivery times for some models as a result of a lack of test capacity in Europe to get new models of cars approved according to the new test method.

¹⁰² Energy indicators 2019.

¹⁰³ Statistics Sweden (SCB), Statistics Database, Vehicle Statistics.

¹⁰⁴ Ordinance (2017:1334) on super green vehicles.

¹⁰⁵ Commission Regulation (EU) 2017/1151.

Alternative fuels such as electricity, ethanol and gas are still relatively uncommon for lorries. Gas is the most common alternative fuel for both heavy and light commercial vehicles, although thus far it is not possible to distinguish vehicles running on LNG from those which use CNG in the road traffic register. This will be possible from December 2019. Out of around 570 000 light commercial vehicles, around 2 600 are rechargeable¹⁰⁶. 1-2% of heavy and light commercial vehicles run on alternative fuels. It must be noted that diesel vehicles that can run on B100 and HVO100 are not included in these figures. The main reason for this is that the distribution of vehicles that can run on HVO is difficult to predict because buses and heavy commercial vehicles that can and do run on HVO do not necessarily need to be registered for this.

9.1.2 Bus fleet driving switch to renewables

Gas, ethanol and biodiesel have been commonly used as a fuel for bus transport for several years, and since 2016 electricity has become increasingly common as a fuel in Sweden. The bus fleet is considerably more advanced in the switch to renewables compared with the car and lorry fleets. According to the Swedish Public Transport Association's environment and vehicle database FRIDA¹⁰⁷ around 85%¹⁰⁸ of public transport was provided by buses powered by renewable fuels in 2018. According to statistics from the Swedish Bus and Coach Federation (*Sveriges Bussföretag*)¹⁰⁹, 63% of buses ran on fuels other than conventional diesel in 2017. For the almost 30% of the buses¹¹⁰ registered as running on a fuel other than diesel, road fuel gas is the most common fuel, accounting for 18% of the buses (note that diesel vehicles that can use HVO are not included in these figures); see Figure 4.

¹⁰⁶ Transport Analysis, Vehicles 2018.

¹⁰⁷ <https://www.svenskkollektivtrafik.se/verktyg-och-system/frida-miljo-och-fordonsdatabas/>.

¹⁰⁸ Refers to the percentage of vehicle-kilometres involving renewable fuels.

¹⁰⁹ Statistics on the bus industry, Swedish Bus and Coach Federation.

¹¹⁰ Of these, 75% have permits for commercial transport, i.e. may be used for scheduled services or request services.

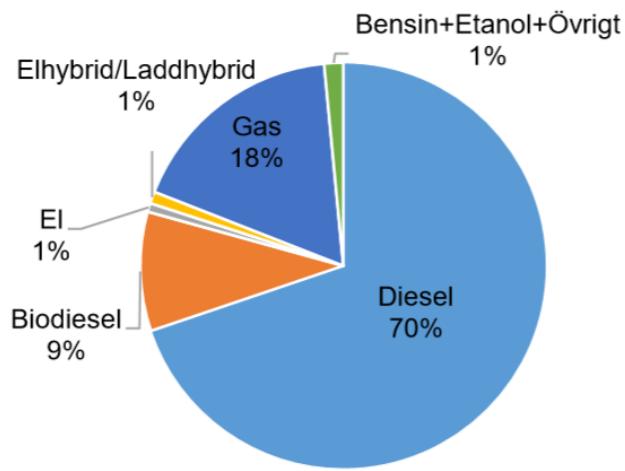


Figure 4 Percentage of buses in traffic according to fuel for 2018. Source: Transport Analysis Vehicles 2018.

Bensin+Etanol+Övrigt = Petrol+Ethanol+Other

Elhybrid/Laddhybrid = Electric hybrid/plug-in hybrid

EI = Electricity

A summary of developments in the vehicle fleet is shown in Table 5. The development in rechargeable cars has been rapid, while vehicles which use gas fuel has been somewhat slower.

Table 5. Number of electric and gas-powered vehicles in Sweden. Source: Transport Analysis Vehicles 2018

Number of electric and gas-powered vehicles			
	2016	2017	2018
Cars, electric (BEV)	7 532	11 034	16 664
Cars, plug-in hybrids (PHEV)	18 844	32 253	49 394
Light commercial vehicles, electric (BEV)	1 552	1 947	2 661
Light commercial vehicles, plug-in hybrids (PHEV)	7	9	9
Cars, road fuel gas (CNG/CBG)	43 693	43 706	42 463
Heavy vehicles, liquefied natural gas (LNG/LBG) ¹¹¹	No information	No information	No information
Fuel cell vehicles (FCV) ¹¹²	23	37*	42

* Updated figures according to Transport Analysis statistics Vehicles 2018. The figures in the national policy framework were obtained from the Transport Analysis short-term forecasts revised in May 2018.

9.1.3 ***Alternative liquid and gas fuels in road transport***

HVO100, road fuel gas and FAME100 are the three most common alternative fuels (to diesel MK1 and petrol MK1) on the Swedish market¹¹³. Supplies of HVO100 increased sharply during 2016 and 2017, but fell somewhat during 2018, where supplied as a pure fuel. HVO100 accounted for 4.6% of the total fuel consumption during 2018. Sales of FAME reduced during 2016 and 2017 before sharply increasing in 2018 because the fuel took a market share from HVO100 following the introduction of the reduction obligation¹¹⁴. Supplies of E85 have declined steadily since 2012 and constituted less than 1% of the supplied fuel in 2017, although the quantity of E85 rose somewhat in 2018.

Pure HVO may be used directly in diesel engines in buses and lorries if it fulfils the standard for diesel fuel or the vehicle has been approved to run on HVO100. However, the use of pure HVO in cars is currently limited, as only a few vehicle manufacturers are approved to use the fuel in certain models. The reduction obligation¹¹⁵ introduced in the summer of 2018 serves to reduce CO₂ emissions from petrol and diesel. This is achieved by increasing the blending of biofuels in

¹¹¹ No information available in the road traffic register.

¹¹² Information from Transport Analysis.

¹¹³ Fuels 2018. ER 2019:14.

¹¹⁴ Fuels 2018. ER 2019:14.

¹¹⁵ Swedish Act (2017:1201) on reduction of greenhouse gas emissions by mixing of biofuels in petrol- and diesel fuels.

fossil petrol and diesel. In 2018, the average percentage of low-blend biofuels in diesel was 23% by volume and 6.3% by volume in petrol.¹¹⁶

Road fuel gas is Sweden's fourth most common fuel and in 2018 represented 1.65 TWh. The blending of renewable components in road fuel gas has increased over the years. In 2013, the biogas content in road fuel gas was 55% and steadily increased to 90% (GWh/GWh) in 2017 and increased to 93% in 2018, see Figure 5.¹¹⁷

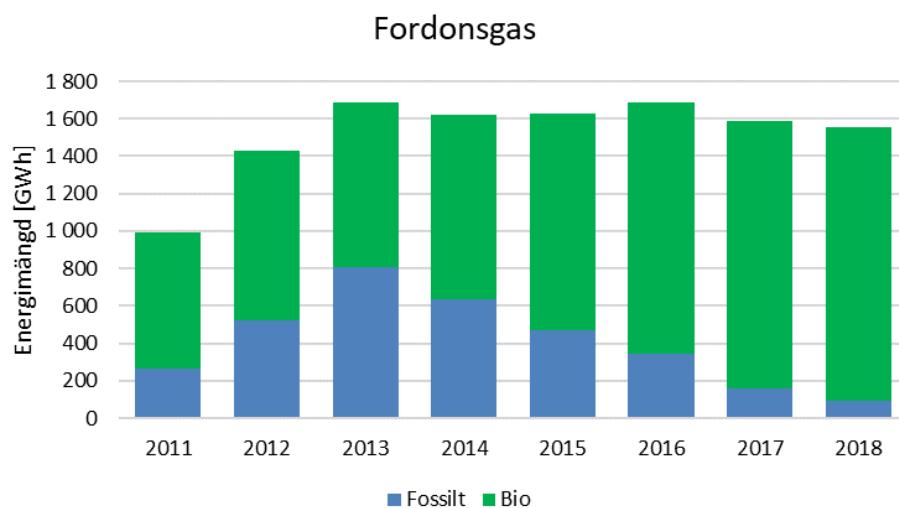


Figure 5. Supplies of road fuel gas.

Fordongas = Road fuel gas

Energimängd [GWh] = Quantity of energy [GWh]

Fossilt = Fossil

9.1.4 Alternative liquid and gas fuels infrastructure

The Pumps Act¹¹⁸ requires larger fuel stations to provide renewable fuels. It is not possible to fulfil the requirement by providing electricity. Many actors currently fulfil the legislative requirement by providing E85, although other renewable fuels are also provided. The trend in refuelling points for liquid biofuels is shown in Table 6.

¹¹⁶ Fuels 2018. ER 2019:14.

¹¹⁷ Fuels 2018. ER 2019:14.

¹¹⁸ [Act \(2005:1248\) entailing an obligation to provide renewable fuels.](#)

Table 6 Sales points with one pump for a renewable fuel at the start of each respective year, source: SPB¹¹⁹

Sales points for liquid renewable fuels			
	E85	HVO100	RME
2016	1 828	0	38
2017	1 749	93	5
2018	1 723	162	9

The fixed distribution network for natural gas in Sweden is concentrated on parts of the west coast and local urban networks in certain locations. Many of the small local networks are primarily used to transport biogas intended for vehicles from a production facility to refuelling points. Refuelling points for pure biogas are also often found in the vicinity of biogas facilities. Refuelling points for road fuel gas are located throughout the country, although there are no such refuelling points across much of the inland areas in the north, which are sparsely populated. In 2018, there were 185 public refuelling points for road fuel gas (CNG/CBG) in Sweden and more than 60 private or municipal ones¹²⁰. Liquid road fuel gas (LNG/LBG) is increasingly being used as a fuel for heavy commercial vehicles and buses, and there were six refuelling points for LNG/LBG in 2018. Three new refuelling points for LNG/LBG have opened in 2019, and financing has been sought for further LNG/LBG refuelling points. Refuelling points for hydrogen gas are currently found at a limited number of locations in Sweden, and in 2018, it was possible to refuel with hydrogen gas at six refuelling points. Further refuelling points are under construction in 2019, and one hydrogen refuelling point has been completed in Umeå and another is planned for Växjö. A summary of the refuelling infrastructure for gas biofuels is shown in Table 7.

Table 7. Refuelling points for gas fuels. Source: SCB (CNG), Swedish Gas Association (LNG), Hydrogen Sweden (Hydrogen).

Refuelling points for gas fuels			
	2016	2017	2018
Public refuelling points for CNG/CBG	170	175	185
Public refuelling points for LNG/LBG	6	6	6
Public refuelling points for hydrogen gas	5	5	6

¹¹⁹ <https://spbi.se/statistik/forsaljningsstallen/forsaljningsstallen-med-fornybara-drivmedel/>.

¹²⁰ Swedish Energy Agency/SCB Supplies of road fuel gas <https://www.scb.se/hitta-statistik/statistik-efter-amne/energi/tillforsel-och-anvandning-av-energi/leveranser-av-fordonsgas/>.

9.1.5 ***Electricity as a fuel and recharging infrastructure***

Most rechargeable electric vehicles are recharged at home by private individuals or by companies for an activity, and these may be categorised as non-public recharging stations. Access to public recharging infrastructure complements this and enables good usability for rechargeable electric vehicles and has the objective of fostering confidence in rechargeable electric vehicles. There are two types of recharging output; normal charging (less than 22 kW) and high-power recharging (more than 22 kW). Normal charging is most appropriate where vehicles are parked up for longer and at public transport nodes and alongside major roads, shopping centres or meeting points. The shorter the period of time that a vehicle is expected to be parked for, the more important it is to have a higher charging output. There were approximately 6 700 public recharging points at the end of 2018, see Table 8. Reference is made to information from Power Circle¹²¹ for more details on recharging points in Sweden.

Table 8. Recharging points in Sweden. Source: Laddinfra.se, Power Circle.

Recharging points in Sweden		2016	2017	2018
Recharging points, accessible to the public		2 600	4 700	6 700
Recharging points, not accessible to the public		No information	No information	No information

9.1.6 ***Development in road traffic***

There has been increasing interest among vehicle manufacturers in liquefied methane (LNG/LBG) as a fuel for heavy vehicles, and this has also been granted aid under Climate Leap. In total, this concerns aid for around 400 heavy vehicles that run on liquefied biogas (LNG/LBG¹²²).

Climate Leap has also granted several applications for aid for refuelling points for biofuels. These primarily concern public refuelling points, but also cover numerous refuelling points for buses, refuse vehicles and other municipal vehicles. The applications approved indicate a diverse range of biofuels and contribute to the scope to choose renewables through infrastructure deployment throughout the country¹²³; see Figure 6.

¹²¹ <https://www.elbilsstatistik.se/laddinfrastatistik>.

¹²² Swedish Environmental Protection Agency. Status report for Climate Leap. Communication, 11 April 2019.

¹²³ Swedish Environmental Protection Agency. Status report for Climate leap. Communication, 11 April 2019.

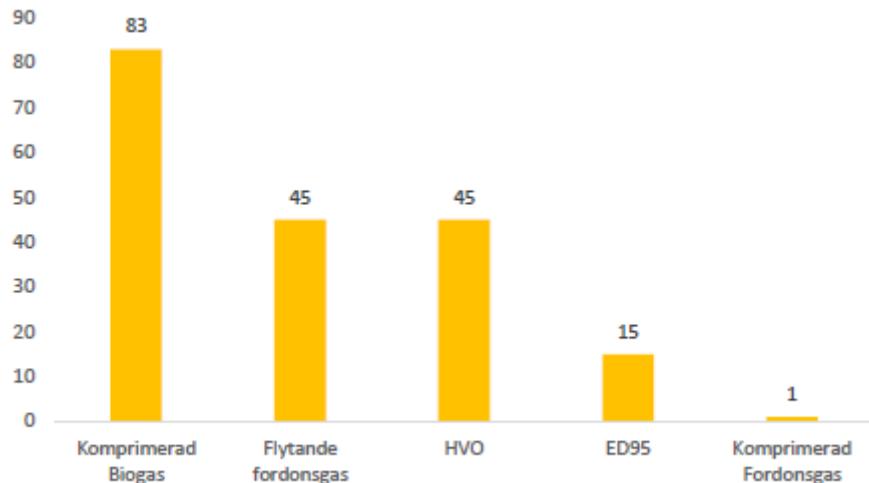


Figure 6. Number of applications approved under Climate Leap for refuelling points for biofuels from 2015 up to 1 March 2019 (inclusive).

Komprimerad biogas = Compressed biogas

Flytande fordongas = Liquid road fuel gas

Komprimerad fordongas = Compressed road fuel gas

A previous assessment of the future development of public refuelling points for CNG indicated 230 such refuelling points by 2020 and 22 refuelling points for LNG in the same year¹²⁴. Further refuelling points are planned for LNG/LBG which will be opened during 2019 or 2020. With aid provided by Climate Leap, a network of refuelling points for liquefied biogas has been initiated throughout the country. A number of refuelling points for hydrogen are under construction in 2019, and there are two models of fuel cell vehicle available to purchase on the Swedish market. Based on information from Hydrogen Sweden, the Swedish Energy Agency continues to estimate that 13 hydrogen refuelling points will be available by 2020.

Recharging infrastructure and rechargeable electric vehicles continue to increase

The number of public recharging points had increased to 7 800 by the first quarter of 2019, with over 1 800 recharging points in Sweden. The number of rechargeable electric vehicles has increased rapidly, which has created increased demand for the number of recharging points available, both public and non-

¹²⁴ Supplement to the policy framework for alternative fuels infrastructure under Directive 2014/94/EU. Annex to Minutes II 20 of Government meeting held on 30 August 2018. N2018/04594/MRT, etc.

public. Sweden believes that, by 2020, there will be 9 000 recharging points accessible by the public and 20 000 non-public recharging points¹²⁵.

Since the start of the Climate Leap initiative, there has been a clear shift in the breakdown of the type of recharging points being granted aid. In 2015 and 2016, the majority of the recharging points were located along roads and in urban environments. However, in 2017 and 2018, the majority of the recharging stations receiving aid under Climate Leap were non-public recharging points. Applications in this category were primarily from housing associations and property owners intending to provide their residents with the opportunity to charge electric vehicles, e.g. internal company vehicles. To date, just under 700 of the country's 20 000-30 000 housing associations have been granted aid, which is why there remains a need for aid for housing associations.

9.2 Shipping

9.2.1 *Alternative fuels and associated infrastructure for shipping*

Ports with access to LNG have increased in number in recent years, and the requirements for LNG bunkering have become clearer since the national guidelines for the bunkering of liquid methane were completed in 2018¹²⁶. In 2018, bunkering was available in 11 ports and a further seven ports were added to this during the first quarter of 2019¹²⁷.

Vessels that can use LNG which routinely call at Swedish ports are Viking Grace (Viking Line, with another LNG ferry ordered for delivery in 2021), Destination Gotland ferry m/s Visborg (with another ferry ordered for delivery in 2020), in addition to a number of cargo vessels running on LNG. LNG vessels can also run on MGO (marine gas oil) as a backup. There are also several electric powered vessels, e.g. two ferries on the route between Helsingborg and Helsingør (ForSea) and the Swedish Transport Administration's electrically powered cable ferries. In March 2019, the Swedish Transport Administration's shipping company commissioned a hybrid ferry that can run on electricity (batteries) or synthetic diesel¹²⁸. Stena Line has a ferry which uses methanol (Stena Germanica) with engines converted for this purpose. Methanol is used as the primary fuel, but the ferry may still be operated on MGO (marine gas oil) as a

¹²⁵ Supplement to the policy framework for alternative fuels infrastructure under Directive 2014/94/EU. Annex to Minutes II 20 of Government meeting held on 30 August 2018. N2018/04594/MRT, etc.

¹²⁶ Swedish Transport Agency, National guidelines for bunkering liquid methane in Sweden.

¹²⁷Information from the Swedish Transport Agency.

¹²⁸ <https://www.trafikverket.se/farjerederiet/om-farjerederiet/klimat-och-miljo/eldrivna-frigaende-farjor/>.

backup. Interest in alternative fuels is increasing among shipping companies, and half of the ferries ordered in 2017 are being constructed to run on LNG.¹²⁹

The figures for ports with access to a shore-side electricity supply were provided in the supplement to the Swedish national policy framework¹³⁰. This information was obtained through a survey of Ports of Sweden (*Sveriges Hamnar*) and counted all opportunities for an electrical connection without taking into consideration whether the electrical connection complied with the standard. There are no official statistics for access to a shore-side electricity supply for vessels in port through a standardised interface. Shore-side electrical connections may be available at ports but are not always used because there are also requirements for special installations on vessels. There is no information available on how much shore-side electrical connections are used. The number of ports with access to LNG or a shore-side electricity supply is shown in Table 9.

Table 9. Ports with access to LNG or a shore-side electricity supply. Source: Swedish Transport Agency¹³¹ and Ports of Sweden (*Sveriges Hamnar*).

Ports with access to LNG or a shore-side electricity supply	2016	2017	2018
Ports in the core network TEN-T with access to LNG	2	2	3
Other ports with access to LNG	0	5	8
Inland ports with access to LNG	0	0	0
Ports with access to a shore-side electricity supply*	9**	20	At least 20

*Refers to all quay-side electrical connections

**Figures for 2015

9.2.2 *Developments in shipping*

Previous assessments of developments in shipping indicated that all five Swedish ports in the core network TEN-T¹³² and 12 other ports will have access to LNG bunkering by 2025 and 2030¹³³. Ports with access to LNG have increased in recent years, and the requirements for LNG bunkering have become clearer since

¹²⁹ <http://www.sjofartstidningen.se/halften-av-alla-bestallningar-lng-fartyg/>.

¹³⁰ Supplement to the policy framework for alternative fuels infrastructure under Directive 2014/94/EU. Annex to Minutes II 20 of Government meeting held on 30 August 2018. N2018/04594/MRT, etc.

¹³¹ Swedish Transport Agency. Guidelines and recommendations for connecting vessels and leisure boats to a shore-side electricity network.

¹³² The designated Swedish ports in the TEN-T Core Network are Luleå, Stockholm, Gothenburg, Malmö and Trelleborg.

¹³³ Supplement to the policy framework for alternative fuels infrastructure under Directive 2014/94/EU. Annex to Minutes II 20 of Government meeting held on 30 August 2018. N2018/04594/MRT, etc.

the national guidelines for the bunkering of liquid methane were completed in 2018, and a further seven ports were added during the first quarter of 2019¹³⁴.

A shore-side electricity connection for vessels requires the port to be equipped with the installations for this and the requisite installations to be present on the vessel concerned. This has been less common in recent years because installations onboard vessels are expensive. Capacity problems may typically be encountered by new major electricity users; this also applies in certain ports where the local electricity system must be designed to supply large cruise ships.

9.3 Aviation

9.3.1 *Alternative fuels and associated infrastructure for aviation*

A total of 1.36 million cubic metres of aviation fuel was refuelled in Sweden in 2017, corresponding to 13 TWh. Of this, 228 000 cubic metres was refuelled for domestic aviation, see Table 10. The quantity of biojet fuel supplied was very small and is not presented in the official statistics.

Table 10. Energy consumption for aviation¹³⁵

		2015	2016	2017
Aviation fuel	Aviation	1 112	1 266	1 358
-	Domestic aviation	212	226	228
-	International aviation	900	1 040	1 130

All aviation fuel must be certified in accordance with a global standard. The standard currently permits blending with up to 50% by volume of biojet fuel. The blending of biojet fuel in fossil aviation fuel may take place in existing tanks and pipe systems. One of the first initiatives in the world to demonstrate the use of biojet fuel in existing infrastructure was at Karlstad Airport in 2014 through a

¹³⁴ Information from the Swedish Transport Agency.

¹³⁵ Swedish Energy Agency statistics database Energy consumption in the transport sector.

partnership between Karlstad Airport, Karlstad Municipality, Air BP and the Dutch company SkyNRG¹³⁶.

There are various initiatives allowing air passengers to pay for biojet fuel. For example, passengers may pay for biojet fuel through a fund and the biojet fuel paid for by passengers is refuelled in (another) aircraft at a central refuelling point (e.g. Arlanda). An airport may join the fund and become a partner, thereby ensuring that biojet fuel is supplied to its own airport. It is also possible to establish a local fund so that passengers willing to pay for biojet fuel can be certain that their payment is spent on biojet fuel aviation at the local airport.

The aviation company BRA Flyg has a programme for the increased use of biojet fuel that primarily takes place via two routes. There are green agreements in place for companies wishing to increase their blending according to which a certain percentage of journeys must take place using biojet fuel. The other route is a biojet fuel ticket costing SEK 300 for domestic flights. In addition, the aviation company itself uses 5% biojet fuel for its own business travel.

9.3.2 *Electricity supply for stationary aircraft*

Seven of Swedavia AB's airports have provision for supplying stationary aircraft through an electrically connected Ground Power Unit (GPU) at all aprons¹³⁷. One of the airports does not have such an apron. The two remaining airports do not have electrical connections for 20% of the moorings¹³⁸. Thus, the number of moorings with an electrical connection for stationary aircraft has increased. Electrical connections are in great demand amongst airlines, and Swedavia is working to reduce its greenhouse gas emissions, partly by replacing diesel units with electrical connections for stationary aircraft.

9.3.3 *Development in aviation*

On 22 February 2018, the Swedish Government initiated a special study of sustainable biofuels in aviation. The aim of the study is to analyse how the use of sustainable biofuels in aviation can be promoted in order to contribute to the switch to a fossil-free energy system and a reduced environmental impact.

The study presented its proposals on 4 March 2019¹³⁹:

- A reduction obligation for jet fuel;
- Scope to purchase biojet fuel should be introduced in the State framework agreement;

¹³⁶ Biojet fuel for aviation. SOU 2019:11.

¹³⁷ An apron comprises several moorings for aircraft.

¹³⁸ Information from Swedavia, September 2019.

¹³⁹ Biojet fuel for aviation. Report on the Investigation into instruments to promote the use of biofuels in aviation. SOU 2019:11.

- The Swedish Armed Forces must procure biojet fuel for State aviation.
- The Swedish Energy Agency should be tasked with analysing the issue of whether an investment or operating aid should be developed for production facilities using new technology that is too expensive to compete in the reduction obligation;
- The Swedish Consumer Agency should be tasked with preparing a climate declaration for long-distance travel;
- An investigation should be added for extended night rail transport as an alternative to air travel.

9.4 Rail transport

9.4.1 *Alternative fuels and associated infrastructure for rail transport*

In 2017, a total of 229 million rail journeys were made using Swedish rail transport, 159 million journeys were made by tram and 353 million journeys were made by underground rail. When the number of kilometres travelled by all passengers is measured – transport work – both regional and long-distance journeys have increased by 3% and 5% respectively in 2017 compared with 2016. The quantity of freight transported measured in tonnes increased by 3% in 2017, and increased by 5% compared with 2012¹⁴⁰.

The railway infrastructure comprised a total of 10 874 kilometres of transport lines in 2017, and the length of railway line used for transport has largely remained unchanged over the past 20 years. The entire double and multi-lane track length is electrified. Out of the total length of railway line, 75% (corresponding to 8 189 kilometres) was electrified in 2017. The number of traction vehicles on the railways increased by 141 in 2017 compared with 2016. This increase primarily consisted of electric rail cars and electric traction vehicles. The number of diesel vehicles decreased by three diesel locomotives. At the end of 2017, there was a total of 2 699 traction vehicles on the railways (641 locomotives and shunters and 2 058 railcars)¹⁴¹.

Electricity is primarily used for rail transport, along with diesel to a lesser extent; see Table 11. As is the case for diesel consumption, electricity consumption has changed relatively little from year to year during the 2000s. In the long-term

¹⁴⁰ Transport Analysis. Rail transport 2017.

¹⁴¹ Transport Analysis. Rail transport 2017.

scenarios¹⁴², electricity consumption for rail transport is expected to increase as a consequence of the increase in demand for passenger transport.

¹⁴² Swedish Energy Agency. Scenarios for Sweden's energy system 2018. ER 2019:7.

Table 11. Energy consumption for rail transport¹⁴³

		2016	2017	2018
Rail, passenger transport	Electricity	1 492	1 503	1 544
	Diesel*	56	49	52
Rail, freight transport	Electricity	819	789	782
	Diesel*	113	110	118
Tram, passenger transport	Electricity	79	86	85
Underground, passenger transport	Electricity	207	203	198

* based on the energy content 9.8 MWh/m³ for diesel.

¹⁴³ Swedish Energy Agency statistics database Energy consumption in the transport sector.