

Sweden

Drivers and Policies

The overall goal of Sweden's environmental policy is to be able to pass on to the next generation a society in which major environmental problems have been solved, without increasing environmental and health problems beyond the country's borders. Sweden aims to become one of the world's first fossil-free welfare countries. In order to achieve this, the fossil-fuel dependency of the transport sector needs to be broken. Several measures are needed, such as reducing the total energy demand of the transport sector and ensuring that the remaining energy is both renewable and sustainable.

In 2017 a new climate policy framework was approved. The long-term climate goal means that by 2045, at the latest, Sweden will have no net emissions of greenhouse gases (GHG). In more precise terms, the long-term climate goal means that emissions from activities on Swedish territory will be cut by at least 85% compared with emissions in 1990. To achieve net zero emissions, flexibility measures are included. For the transport sector, a reduction in emissions (not including domestic air travel) of at least 70% by 2030, compared with 2010, has also been adopted.

In mid-2018 the Government introduced what is known as a bonus-malus system, whereby environmentally adapted vehicles with relatively low carbon dioxide (CO₂) emissions (up to 60 g/km) are awarded a bonus at the time of purchase, and vehicles with relatively high CO₂ emissions (above 95 g/km) are subject to a higher tax (malus) during the first three years. The system includes cars, light buses, and light trucks. The bonus is limited to a maximum of SEK 60,000 (€5,732; \$6,448 US).

Another important measure introduced in mid-2018 is the reduction obligation, which entails an obligation for fuel suppliers to reduce GHG emissions from sold volumes of petrol and diesel fuels by incorporating biofuels. In 2019 the reduction obligation is 2,6% for petrol and 20% for diesel. The reduction obligation will be increased over time with an indicative target of 40% reduction in 2030. The biofuels included in the reduction obligation system are subject to the same energy and CO₂ taxation as fossil fuels. Biofuels outside the reduction obligation scheme have reduced taxes.

Advanced Motor Fuels Statistics

Since 1990, the number of passenger cars has increased from approximately 3.5 million vehicles to more than 4.8 million vehicles. At the same time, GHG emissions from passenger cars have been rather stable at around 13 million tonnes from 1990 to 2007. However, since 2007, emissions have been reduced significantly and were about 10 million tonnes in 2017. The main reason for the reduction is the increased energy efficiency of new vehicles and renewable motor fuels.

During the same time period, the increase in the number of vehicles other than petrol- and diesel-fueled has been moderate. The fleet of alternative-fueled vehicles was just under 310,000 at the end of 2017 (Figure 1).

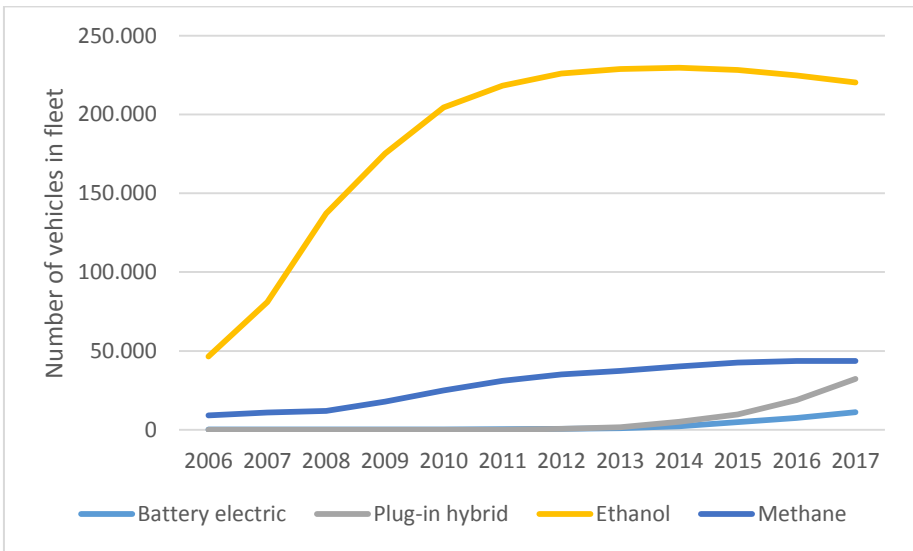


Fig. 1 Number of Advanced Motor Fuel Passenger Cars in the Fleet, 2006–2017

The alternative-fueled vehicles correspond to 6% of the total fleet of passenger cars. For light commercial vehicles and heavy-duty vehicles, the corresponding numbers are 2% and 1%, respectively. However, for buses, the share of vehicles registered as other than petrol- or diesel-fueled is just under 30% of the fleet.

Although flex fuel ethanol vehicles are the most common type of alternative fuel vehicle in Sweden, the ethanol fuel (E85) sold during 2017 only corresponded to less than 1% of the energy content of transportation fuels sold. To a very high extent, flex fuel vehicles are fueled with petrol. On the

other hand, the number of methane-fueled vehicles has increased steadily over the last 10 years and has now passed 40,000 vehicles, which corresponds to approximately 1% of the fleet. The number of chargeable vehicles has increased substantially during the past few years, but from a low absolute number.

The use of renewable biofuels for transport in Sweden amounted to almost 18 terawatt hours (TWh), or 22% of the transportation fuels sold during 2017 (Figure 2). Almost 60% of the renewable fuel used in Sweden during 2017 was low blending of hydrotreated vegetable oil (HVO) and fatty acid methyl ester (FAME) in diesel. On average, the renewable share in diesel corresponded to 21%. Some individual diesel products sold on the Swedish market have a renewable share of 50%.

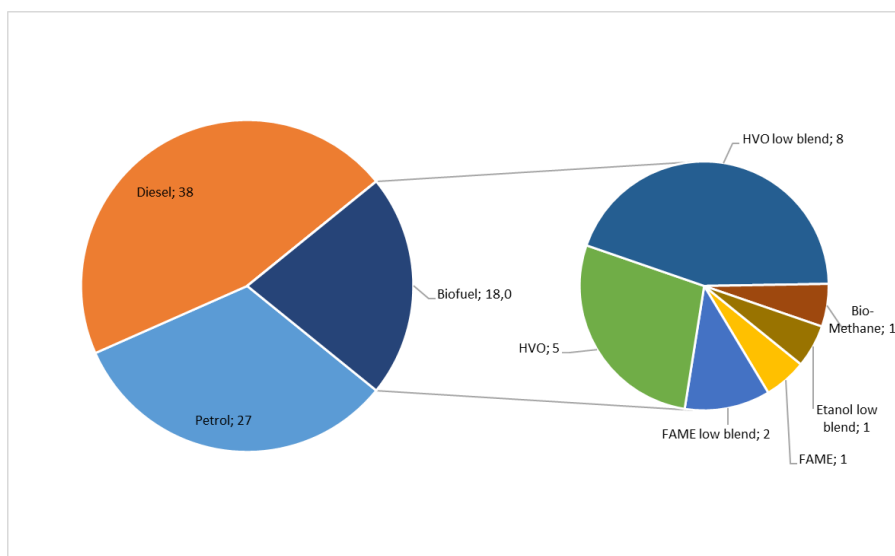


Fig. 2 Fuel Consumption in TWh within the Road Transport Sector during 2017

When HVO was introduced on the Swedish market, it was produced from crude tall oil from Sweden, Finland, and the United States. As the demand for HVO increased, the number of feedstocks and countries of origin increased. Today, the raw materials are slaughterhouse wastes, palm fatty acid distillate (PFAD), crude tall oil, palm oil, corn and rapeseed, in descending order. The majority of feedstock for HVO is imported, as shown in Figure 3. The average GHG emissions from HVO use in Sweden during 2017 correspond to 11.1 g carbon dioxide equivalent (CO₂ eq) per

megajoule (MJ). For FAME, the corresponding figure was 31.1 g CO₂ eq/MJ.

FAME is primarily produced from rapeseed oil. Rapeseed oil is a preferred feedstock because its cold climate properties (i.e., cloud point) are more suitable for the Nordic climate compared with many other vegetable oils.

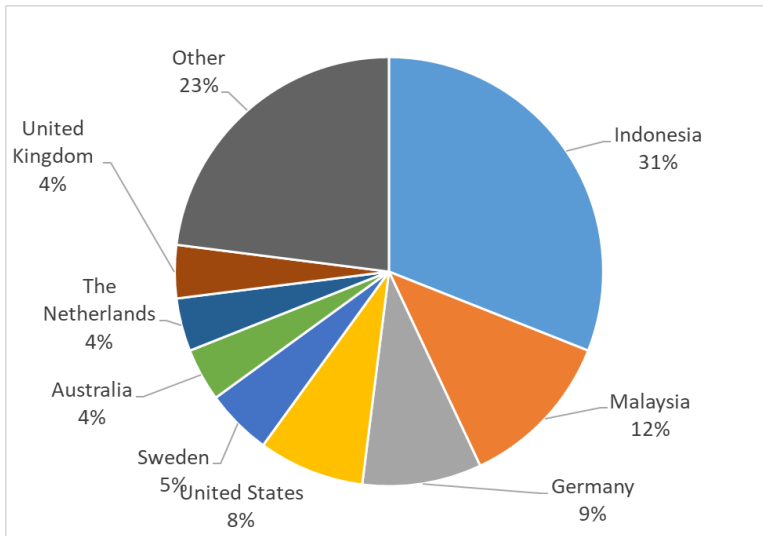


Fig. 3 Country of Feedstock Origin for HVO Consumed in Sweden in 2017

Research and Demonstration Focus

The Swedish Energy Agency has several energy-related research, development, and demonstration programs:

- Energy and environment. This program is focused on automotive-related research, innovation, and development activities in the areas of increased energy efficiency, transition to renewable fuels, reduction of local/regional environmental impacts, and areas with potential to strengthen the Swedish and the English automotive industry's competitiveness in a global perspective.
- Research program for transport-efficient society for 2018–2023 on a system level. The call does not accept projects that focus on technology development of vehicle or engine technologies.
- Energy-efficient vehicles in 2015–2019. Both road vehicles and non-road mobile machinery are covered, as well as advanced motor fuels.

- Biofuels programs, thermochemical processes, and biochemical methods.
- Renewable fuels and systems, 2018–2021. The renewable fuels research program is a collaborative program between the Swedish Energy Agency and the Swedish Knowledge Centre for Renewable Transportation Fuels, f3.
- Three Competence Centers in internal combustion engine research and one Competence Centre for catalysis research. The Competence Centre is a collaboration among the automotive industry, the university, and the Swedish Energy Agency. Each party finances one-third of the cost.
- The Swedish Gasification Center. This center is focused on large-scale biomass gasification for biofuels production, but it also covers other applications of biomass gasification.

Outlook

The goal is set high in Sweden, with a reduction in GHG emissions of 70% compared with 2010, and no net CO₂ emissions by 2045. Considering the rate of turnover of the vehicle fleet, advanced motor fuels play an important role for reaching these targets.

Additional Information Sources

- Swedish Energy Agency, <http://www.energimyndigheten.se/en/>
- The Swedish Knowledge Centre for Renewable Transportation Fuels <http://www.f3centre.se/>

Major Changes

In 2017, the Swedish Parliament adopted a new climate law with the following targets:

- No later than 2045, Sweden shall have no net emissions of GHGs to the atmosphere.
- Emissions from domestic transport (excluding aviation) shall be reduced by at least 70% by 2030 compared with 2010.

Benefits of Participation in the AMF TCP

Sustainable and clean energy for transport is necessary to achieve national and international targets. The AMF TCP gives us an arena where we can cooperate with countries worldwide to develop unbiased reports on the effects of various advanced motor fuels.