

IEA-Advanced Motor Fuels ANNUAL REPORT 2016

An aerial photograph of a city, likely Zurich, Switzerland, showing a dense urban area with many buildings, a river, and a large green forest in the foreground. A highway with several cars is visible in the lower left. The image is framed by a blue, curved border that suggests a lens or a window.

Switzerland

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Drivers and Policies

In 2016, the Swiss Parliament passed a fundamentally revised new Energy Act. It is the first part of a long-term energy policy called “Energy Strategy 2050 [1].” The core measure is to withdraw step by step from the use of nuclear energy without increasing carbon dioxide (CO₂) emissions. This should be achieved by increased energy savings (energy efficiency); the expansion of hydropower and new renewable energy sources; and, if necessary, fossil-fuel-based electricity production (cogeneration facilities, gas-fired combined-cycle power plants) and imports. Important measures related to motor fuels include (1) reducing CO₂ emissions; (2) increasing energy efficiency; (3) increasing the use of renewable energy sources, including biomass; and (4) strengthening energy research.

CO₂ Emission Regulations for Cars

Swiss importers are required to reduce the level of CO₂ emissions from new passenger cars to an average of 130 grams (g) of CO₂ per kilometer (km). Importers who do not meet that target have to pay a penalty. The average CO₂ emissions of new passenger cars in 2015 was 135 g CO₂/km. The penalty amounted to 12.6 million U.S. dollars [2]. In alignment with the European Union (EU) Commission, the Federal Council aims to reduce average CO₂ emissions from passenger cars by 2020 to 95 g CO₂/km and from light commercial vehicles (vans up to 3.5 metric tons [t]) to 147 g CO₂/km [1].

CO₂ Emissions Compensation: Motor Fuels

All importers of fossil motor fuels are required to use domestic measures to compensate for 10% of CO₂ emissions generated by the entire transportation sector by 2020 [3]. The compensation rate started in 2014 at 2% and will be raised to the level of 10% in 2020. Importers of fossil motor fuels may carry out their own projects or acquire certificates. The Swiss Petroleum Association established the Foundation for Climate Protection and Carbon Offset (KliK). It launches and subsidizes projects to reduce CO₂ emissions in fields such as transportation, industry, buildings, and agriculture. Another measure to reduce CO₂ emissions is to blend fossil fuels with biofuels.

Mineral Oil Tax Reduction for Natural Gas and Biofuels

To support the target for CO₂ emissions, a reduction or even an exemption for environmentally friendly motor fuels was enacted in 2008. The tax for natural gas used as a motor fuel was reduced to 0.22 U.S. dollars/kg [4]. Biofuels that satisfy minimum environmental and social standards are completely or partially exempt from the mineral oil tax. As a result, the tax reduction for biofuels is up to 0.72 USD per liter (L), in comparison with fossil fuels.

Advanced Motor Fuels Statistics

Final total energy consumption in Switzerland in 2015¹ amounted to 838,360 terajoules (TJ), of which 35% was transport fuels (Figure 1) [5]. Compared to 2014, fuel consumption for vehicles decreased by 4.4%. In the same period, the total amount of vehicles increased by 1.8%, in the sum of 6,299,234. Fuel consumption by vehicle dropped by 6.0%. Some changes in specific applications were made in 2015: diesel -1.4%, gasoline -7.3%, and aviation fuels +3.3%. All fossil fuels were imported.

¹ At the time this report was prepared, only data from 2015 were available.

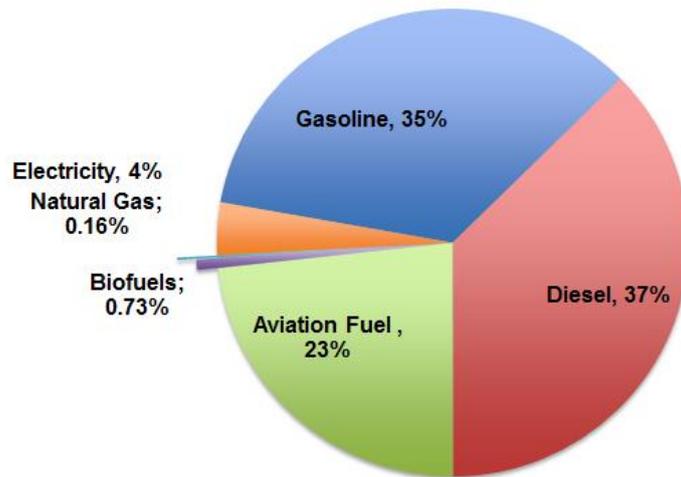


Fig. 1 Shares of Energy Sources in Energy Consumption for the Transportation Sector in Switzerland in 2015 [1]

Electricity is used for railroad transportation, and a negligible amount is used for electric cars. Despite an impressive annual increase of electric vehicles (2013 + 52.6%; 2014 + 65.4%, and 2015 + 69.7%), the total amount is still very small (7,531 passenger cars) [6]. In 2000, the share of diesel of the total amount of fuels (without aviation) amounted to 26%. With a share of 53% in 2015, the consumption of diesel was higher than the use of gasoline.

In Switzerland, firms marketing motor fuels are not under any obligation for blending. This could explain the rather low share of biofuels in the total amount of motor fuels in the past. Since 2014, fuel importers are required to compensate CO₂ emissions by domestic measures. The measure to blend fuel with biofuels is one solution, and a substantial increase of biodiesel (45.055 million L) and bioethanol (28.064 million L) can be observed in 2015 (Figure 2). Pure vegetable oil (PVO) fuel dropped almost to zero (0.111 million L), and upgraded biogas remained at a low level of 3.380 million kg in 2015. Even if the total amount of biofuel consumption doubled compared to the year before, it is still a very small share (0.94%) of the total amount of motor fuels used in Switzerland [7].

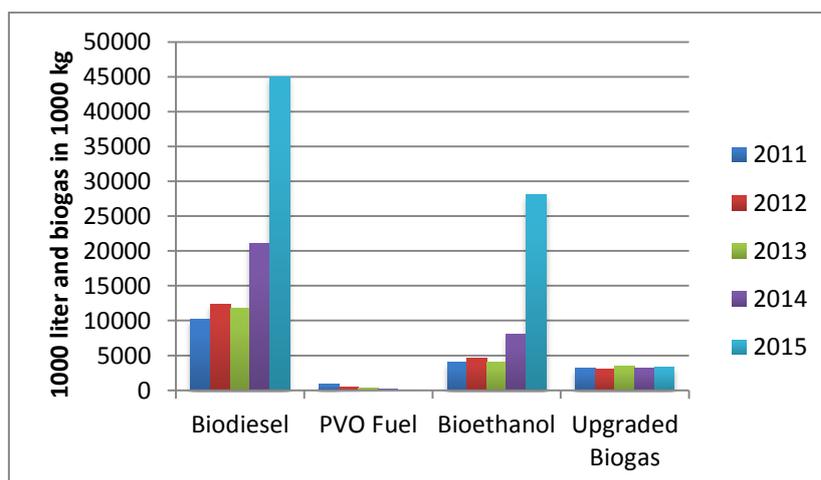


Fig. 2 Development of the Use of Biofuels as Motor Fuels in Switzerland, 2011–2015

Only 7.054 million L of biodiesel was produced in Switzerland. The other 38.000 million L was imported (Germany 52%, France 38%, the rest from six other countries). All bioethanol is imported (Holland 84%, Norway 14%, the rest from two other countries).

The total amount of biogas produced and used in Switzerland in 2015 amounted to 99,031 t. Only 18,570 t have been upgraded and fed into the natural gas grid. From this, only a small amount — 3,380

t — has been sold as biogas for cars [8]. The rest has been used for cogeneration and heating. This means that Switzerland has a potentially large amount of upgraded biogas (15,190 t) for automotive applications. All biogas used as motor fuel in cars is upgraded biogas fed into the natural gas grid. Therefore, cars need no special requirements for biogas as a fuel. Figure 3 shows the development of the use of biogas and natural gas as motor fuels in cars. The demand for biogas is stable, but the demand for natural gas is slightly decreasing. As shown in Figure 3, the total amount of upgraded biogas fed into the natural gas grid has increased threefold in the last 5 years. This is caused by increased demand for biogas for residential heating.

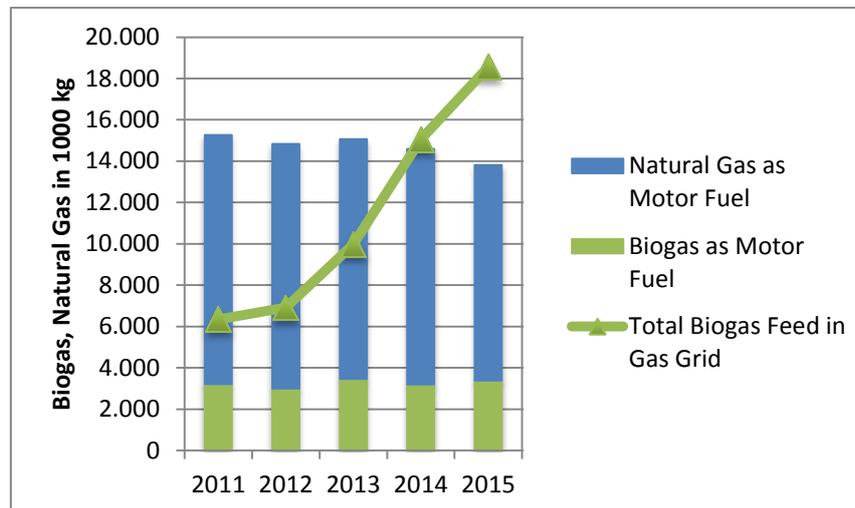


Fig. 3 Development of the Use of Natural Gas and Biogas as Motor Fuel for Cars and Total Upgraded Biogas Fed into the Natural Gas Grid (green line)

Research and Demonstration Focus

In the research, development, and demonstration (RD&D) funding framework of the Swiss Federal Office of Energy, three programs — bioenergy, combustion, and mobility — are supporting AMF research activities. To coordinate research, to improve collaboration, and increase capacity building, in 2013, eight Swiss Competence Centers for Energy Research (SCCERs) were established. One of them is dedicated to mobility [9] and another to bioenergy [10], including liquid and gaseous biofuels.

Hydrogen-enriched natural gas in passenger cars: Natural gas enriched with higher amounts (15% and 25%) of hydrogen was investigated on a chassis dynamometer with passenger cars. Demonstration showed that by adapting the engine control system, an efficiency increase of 2% can be achieved, as well as a reduction of hydrocarbons (between 30 and 60%) and nitrogen oxide emissions (NO_x) after the catalyst (IEA AMF Annex 51).

Effects of gasoline-butanol blend fuels on emissions and combustion in spark ignition (SI) engines: With different butanol blends (BuXX), basic combustion research was performed on a SI-engine dynamometer with accesses for engine parameterization and pressure indication. In the second part of the project, two vehicles were investigated on a chassis dynamometer, with special consideration of non-legislated emission components.

Higher methane yield from biogas: Biogas produced from waste and sewage sludge in fermentation plants contains methane and up to 40% CO_2 . To feed only the methane into the natural gas grid, the CO_2 has to be removed. With a newly developed technology, it is possible to convert the residual CO_2 by adding renewable hydrogen to methane and water. A demonstration plant has been set up at a fermentation and wastewater treatment plant in Zurich.

Outlook

The main drivers in Switzerland to increase the use of biofuels are and will remain tax exemptions and the Government's requirement that the petrol industry compensate 10% of CO_2 emissions via domestic measures. Switzerland has an extensive natural gas grid and a huge potential of biogas. For many years, natural gas sales have been stable, even slightly decreasing. Combined with political demands to stop using fossil fuels, public utilities are discussing how to dismantle their gas grids. Promising

developments are showcase projects with power to gas technologies and methanization of hydrogen with CO₂-rich biogas from wastewater treatment plants or anaerobic digestions plants. These supports arguments to keep natural gas grids and to use them for renewable gases.

Additional Information Sources

- [1] Swiss Federal Office of Energy (SFOE), “Energy Strategy 2050.”
- [2] Federal Office of Environment (FOEN), 2016.
- [3] FOEN, 2012, “CO₂ emission compensation: motor fuels.”
- [4] Mineralölsteuergesetz (MinöStG), Stand: Jan. 1, 2012.
- [5] SFOE, 2015, “Gesamtenergiestatistik.”
- [6] Swiss Federal Statistical Office (BFS), 2016, “Mobility and Traffic,”
- [7] Swiss Custom Administration, 2016, “Mineralölstatistik.”
- [8] SFOE, 2016, “Schweizerische Statistik erneuerbarer Energien 2015.”
- [9] www.sccer-mobility.ch.
- [10] www.sccer-biosweet.ch.