

Switzerland – 2018 update

Bioenergy policies and status of implementation

Country Reports

IEA Bioenergy: 09 2018

This report was prepared from the 2018 OECD/IEA World Energy Balances, combined with data provided by the IEA Bioenergy Executive Committee. Reference is also made to Eurostat data and Swiss national statistics. All individual country reports were reviewed by the national delegates to the IEA Bioenergy Executive Committee, who have approved the content. General background on the approach and definitions can be found in the central introductory report¹ for all country reports.

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NATIONAL POLICY FRAMEWORK IN SWITZERLAND

Historically, Switzerland's longest-serving and most important source of renewable energy has been hydropower. But the "new" renewables, including bioenergy, are also playing an increasingly important role in today's Swiss energy mix. A total revision of the Energy Act is in force since 1 January 2018 as part of the Energy Strategy 2050. The new Energy Act aims to enable Switzerland's progressive withdrawal from nuclear energy production as well as a significant development of the existing potential for energy efficiency and the potential of water power and the new renewable energies (sun, wind, geothermal, biomass). The new Energy Act contains indicative values for the development of electricity from renewable energies for the years 2020 and 2035.

Table 1: Switzerland's 2020 and 2035 renewable energy indicative values for the electricity production.

Sector	2020	2035
New renewable energies (incl. biomass)	4400 GWh	11400 GWh
Hydropower	-	37400 GWh

The 2016 revised Energy Act contains a package of measures aimed at promoting renewable energies and energy efficiency, the mainstay of which is the compensatory feed-in remuneration at cost (KEV, "Kostendeckende Einspeisevergütung") scheme for electricity generated from renewable energies. It covers the difference between the production cost and the market price, and guarantees producers of electricity from renewable sources a price that corresponds to their production costs. Feed-in tariff at cost is available for the following technologies: hydropower (installed capacity up to 10 MW),

¹ Available at <https://www.ieabioenergy.com/iea-publications/country-reports/2018-country-reports/>

photovoltaics (installed capacity from 10 kW), wind energy, geothermal energy, and energy from biomass and biological waste.

A surcharge of up to 2.3 Swiss cents per kilowatt-hour can be levied on high-voltage grid transmission costs in order to fund the compensatory feed-in remuneration. This brings up to CHF 1300 million in a year. The actual objective of the Energy Act is to produce 4400 GWh electricity from renewable energies until 2020 and 11400 GWh until 2035.

Through the CO₂ law, the CO₂ tax on fuels for stationary applications was raised to CHF 96 per ton of CO₂ on 1.1.2018. The tax generates some CHF 1.2 billion revenues, one-third of which are earmarked for the national buildings refurbishment programme.

In the mobility sector, the amendment of the Mineral Oil Tax Act from July 2008 enables the fiscal promotion of environmentally friendly and socially acceptable fuels. Biofuels (e.g. biogas, bioethanol, biodiesel, vegetable and animal oils) are completely or partially relieved from the mineral oil tax if they comply with ecological and social minimum criteria. This amendment is limited in time and is going to disappear after mid-2020. The future strategy for promoting biofuels is currently being discussed with the revision of the CO₂ act for the period after 2020. A parliamentary initiative asks to extend the period for the fiscal promotion of biofuels after mid-2020.

The main measure for the promotion of the renewable energies in the initial package remains the feed-in remuneration for electricity generated from renewables.

A detailed description of all fiscal and non-fiscal supports for bioenergy development is available at: <http://www.iea.org/policiesandmeasures/renewableenergy/?country=Switzerland>

TOTAL PRIMARY ENERGY SUPPLY (TPES) AND THE CONTRIBUTION OF BIOENERGY

Biomass is the second most significant domestic source of renewable energy. Proportionally, however, biomass provides 5.5% of the total energy consumed in Switzerland, while its share in electricity production is around 2.9%. With regard to renewable heat 68% is from biomass of which 52% comes from wood combustion alone. It is estimated that 10% of the final Swiss energy consumption could be covered with domestic biomass sources and this in an ecologically acceptable manner. To what extent this potential can actually be exploited depends in particular on developments in technology and energy efficiency, the cost of raw materials and prices for bioenergy on the domestic and international markets, and not least on political measures to encourage use of biomass and social acceptance of the technology.

The total primary energy supply of Switzerland in 2016 amounted to 1,088 petajoule (PJ)². About half comes from fossil fuels, including 458 PJ oil products and 125 PJ natural gas; the use of coal is very low (5 PJ). Nuclear energy in nuclear power stations represents 20% of total primary energy supply or 221 PJ. Renewable energy sources have a share of 21% or 236 PJ – 7.1% bioenergy and 14.2% other renewable energy sources.

Compared to 5 years earlier (2011) the share of oil products has gone down from 43.8% to 42.1%, and nuclear energy from 24.6% to 20.3%. On the other hand, natural gas has increased from 9.9% to

² Based on Swiss national statistics. The IEA database mentions a TPES of 1001 PJ. The main difference seems to be related to the inclusion of international aviation fuels in Swiss statistics, leading to a higher share of 'oil products'.

11.5%. In the same period the share of renewable energy increased from 17.4% to 21.3%.

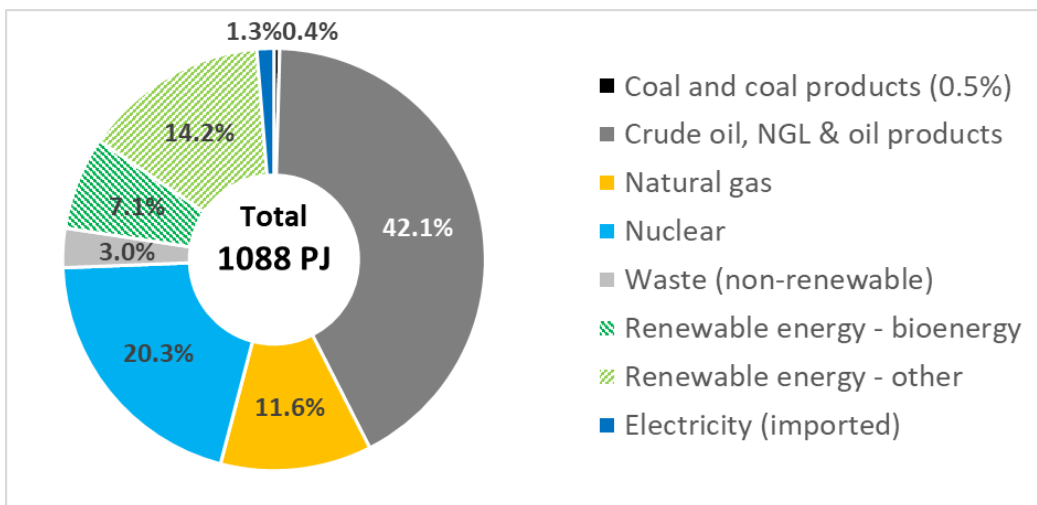


Figure 1: Total primary energy supply³ in Switzerland in 2016 (Source: Swiss Federal Office of Energy, Schweizerische Gesamtenergiestatistik 2017; Schweizerische Statistik der Erneuerbaren Energien 2017)

Most of the total primary energy supply of renewable energy sources is covered by hydropower (131 PJ), followed by bioenergy (77 PJ) and geothermal energy (16 PJ). The role of solar energy is limited to 7 PJ, and wind energy is marginal.

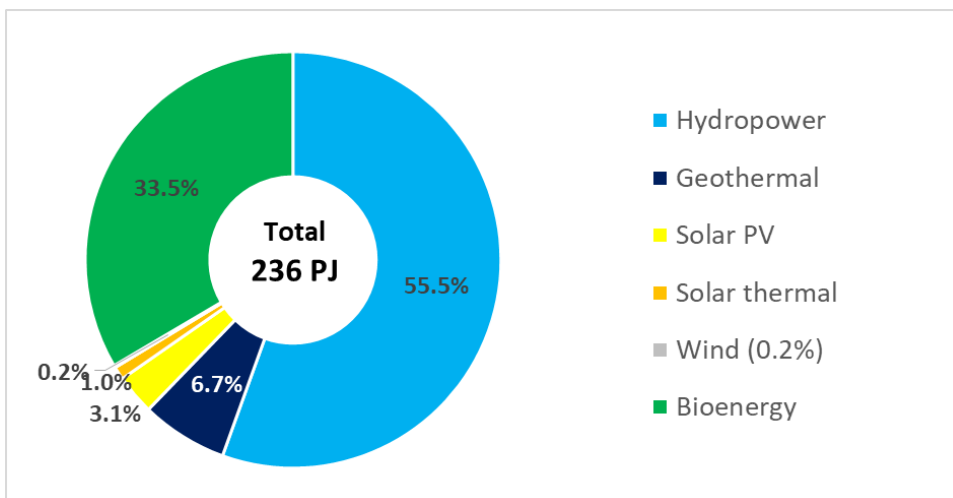


Figure 2: Total primary energy supply of Renewable Energy Sources in Switzerland in 2016 (Source: Swiss Federal Office of Energy, Schweizerische Gesamtenergiestatistik 2017; Schweizerische Statistik der Erneuerbaren Energien 2017)

The majority of bioenergy in Switzerland is from solid biomass (43 PJ), of which almost half (19 PJ) is used in residential applications. There is also a significant role of renewable MSW (26 PJ). Biogas (4.9 PJ), biodiesel (2.3 PJ) and biogasoline (0.8 PJ) reach lower shares.

³ TPES underestimates the actual role of pure electricity sources like PV, wind or hydro energy, and overestimates the role of resources producing electricity with a high share of unused waste heat (like nuclear).

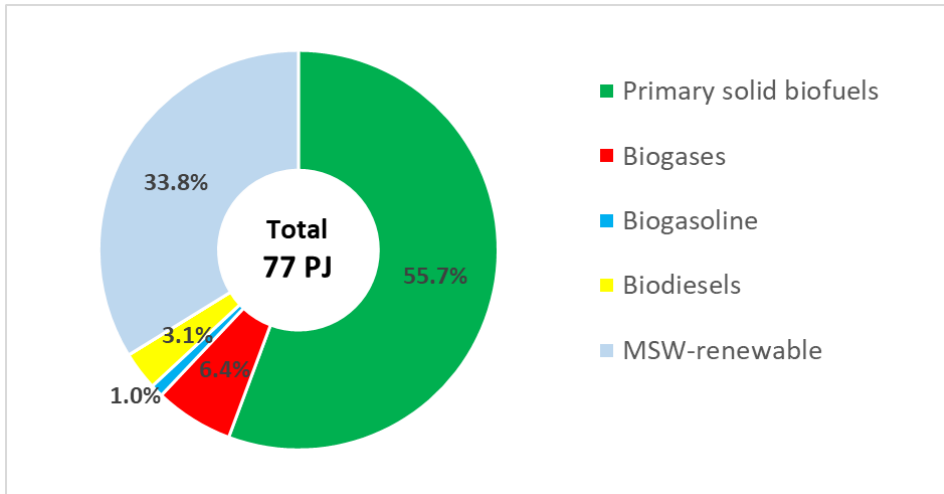


Figure 3: Total primary energy supply from bioenergy in Switzerland in 2016 (Source: Swiss Federal Office of Energy, Schweizerische Gesamtenergiestatistik 2017; Schweizerische Statistik der Erneuerbaren Energien 2017)

The share of bioenergy in TPES in Switzerland increased from 4% in 1990 to 6% in 2010. Afterwards there was a relative stabilization until 2014, and a renewed growth afterwards, reaching 7.1% in 2016. Solid biomass increased from 2000 to 2010 from 29 PJ to 40 PJ, and fluctuates between 36 and 44 PJ since 2010. Renewable MSW had its main growth between 1995 and 2005, and stabilized around 23-26 PJ. Biogas is consistently growing, from 2.4 PJ in 2005 to 4.9 PJ in 2016. Liquid biofuels are picking up since 2013.

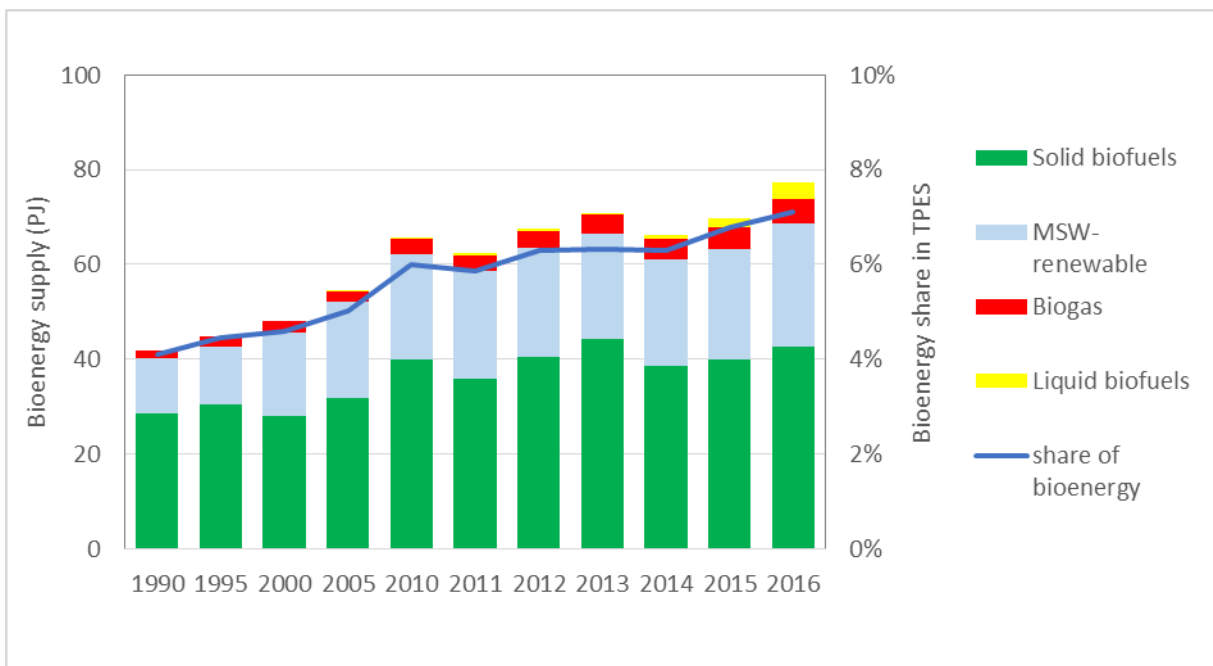


Figure 4: Development of total primary energy supply from bioenergy in Switzerland 1990 – 2016 (Source Swiss Federal Office of Energy, Schweizerische Gesamtenergiestatistik 2017; Schweizerische Statistik der Erneuerbaren Energien 2017)

Table 2 expresses the 2016 TPES figures per capita, considering Switzerland's population of 8.37 million people. Compared to the other 22 member countries of IEA Bioenergy (expressed per capita), Switzerland ranks in the top 3 for renewable MSW, halfway for biogas and solid biofuels, and in the lower end for liquid biofuels.

Table 2: Total primary energy supply per capita in 2016

	GJ/capita
Total energy	119.6
Bioenergy	9.0
Solid biofuels	5.1
Renewable MSW	2.9
Biogas	0.6
Liquid biofuels	0.4

Source: World Energy Balances © OECD/IEA 2018

Role of bioenergy in different sectors

Switzerland has a high share of renewable electricity (92% of it is related to hydropower). Biomass represents around half of non-hydro renewable energy.

The share of biofuels for transport was around 1.3% in 2016. Mind that there is also a considerable share of renewable electricity in the Swiss transport system, predominantly through rail.

Overall, the direct share of biomass for heating in the different sectors is around 12%. Heat output generated and sold by CHP plants and heat plants represents around 6% of fuel/heat provided, of which on average 40% is produced from biomass. In the residential sector biomass represents about 11% of fuel/heat consumption.

Table 3: Role of bioenergy and renewable energy in electricity production, transport energy consumption and fuel/heat consumption in 2016

Sector	Share of bioenergy	Share of renewable energy	Overall production/consumption
Electricity production	2.9%	62% (57% hydro)	61 TWh (220 PJ)
Transport energy (final consumption)	1.3%	3.0%	238 PJ
Overall fuel and heat consumption⁴	Direct biomass: 12.2% Biobased heat: 2.5%	19.8%	342 PJ

Source: World Energy Balances © OECD/IEA 2018

⁴ This includes final consumption of fuels and heat in industry, the residential sector, commercial and public services and agriculture/forestry. Transport fuels are excluded. Energy used for transformation and for own use of energy producing industries is also excluded.

RESEARCH FOCUS RELATED TO BIOENERGY

The Bioenergy research programme of the Swiss Federal Office of Energy focusses on innovative concepts of relevance to Switzerland, in particular in the fields of combustion, gasification and anaerobic digestion. Of special interest are improved substrate digestion of input materials leading to higher gas yields in fermentation processes, system optimisation and integration to increase efficiency, and a complete evaluation of the value-chain. Furthermore, standardisation and principles of quality control and efficient communication to raise awareness and therefore increase acceptance of the technology in general.

The programme coordinates research at the national level, utilizes synergies between academic and industrial partners and promotes networking at an international level.

Since 2014 the Swiss Competence Centre for Energy Research BIOSWEET, a consortia of 9 Academic Institutions and more than 50 partners from the private and public sector focuses on the engineering and implementation of biochemical and thermochemical biomass conversion processes with a high level of technological readiness and sustainability. One major innovation challenge is the development of small, decentralized but still economic technologies to convert biomass to gaseous and liquid fuels, and electricity. Another challenge for the conversion of biomass to gaseous or liquid fuels is related to the scaling up of technologies and to bridging the gap between laboratory and industrial scale. The activities are structured in three work packages: Biochemical fuels and power / Thermochemical fuels and power/ Assessment and availability. In a second phase 2017 – 2020 the activities will focus on anaerobic digestion and hydrothermal gasification of wet biomass, on medium scale production of ligno-cellulosic bioethanol, on biogas upgrading and methanation technologies, and on the increase of the system efficiency of dry biomass conversion for heat and for combined heat and power (CHP). Furthermore, cross cutting issues such as the evaluation of biomass availability, improvements in biomass collection processes and thermo-economic characterization of energy systems will be addressed.

The National Research Programme "Resource Wood" (NRP 66) which started in 2012 established basic scientific knowledge and practical methods for increasing the availability of wood as a resource and expanding its utilisation. It was successfully completed in 2017 with publishing 4 synthesis reports. The synthesis reports cover the broad research spectrum of NRP 66:

- (1) New developments in timber construction
- (2) Novel ways of bio-refining wood
- (3) Innovative wood-based materials
- (4) Provisioning and sustainable use of wood

All reports can be downloaded free of charge: see

http://www.nfp66.ch/en/News/Pages/171031_news_nfp66_programme_summary.aspx

RECENT MAJOR BIOENERGY DEVELOPMENTS

Anaerobic digestion (AD)

Biogas and biomethane production in Switzerland is achieved in 423 biogas plants and three landfills (Table 4). With 275 plants or 64%, domestic sewage sludge digesters outnumber all other categories of AD plants. With 27 plants, the sector of biowaste AD installations is small but characterized by installations with a high average treatment capacity of 18'000 t/year. Compared to this, the 98 agricultural AD installations, mostly co-digesting manure and organic wastes, show an average treatment capacity of about 7,600 t/year. Industrial wastewater digesters are few with only 23 installations mainly situated in the food and beverage industry.

The total gross biogas production in Switzerland was 1350 GWh or 4,860 TJ in 2016. Roughly, 44% thereof is produced in WWTP sludge digesters whereas agricultural co-digestion and industrial biowaste digestion accounts for 25% each.

Table 4: Status of biogas production in Switzerland (2016)

Plant type	Number of plants	Biogas production*		thereof Biomethane
		[GWh/year]	[TJ/year]	[GWh/year]
Sewage sludge	275	604	2,175	146
Biowaste	27	329	1,184	112
Agriculture (co-digestion)	98	339	1,220	8
Industrial waste water	23	74	267	11
Landfills	3	4	13	0
Total	426	1,350	4,859	277

* = produced raw biogas expressed as its energy content from the different plant types

Source: Schweizerische Statistik der erneuerbaren Energien, Ausgabe 2016 (2017)

The biogas is still mainly used to produce electricity and heat in CHP plants, with biomethane production and grid injection growing rapidly (Table 5). A growing number of domestic sludge digesters and industrial biowaste installations are switching from electricity production to biomethane upgrading and grid injection. The same development is expected in agricultural co-digestion with digesters located in close distance to the widespread natural gas grid. Biomethane upgrading for off-grid fuel usage is still rare with only two installations in operation.

Table 5: Utilization of biogas in Switzerland (2016)

Utilisation type	[GWh/year]	[TJ/year]
Electricity (mainly CHP, few gas turbines, no fuel cells)	321	1155
Biomethane (mainly grid feeding, few off-grid fuelling stations)	277	998
Heat (mainly from CHP, some industrial burners)	446	1606
- thereof parasitic heat	114	410

Source: Schweizerische Statistik der erneuerbaren Energien, Ausgabe 2016 (2017)

In 2016, there were 35 upgrading plants in operation, mainly pressure swing absorption (PSA), membrane upgrading and organic physical scrubbers. Seventeen upgrading installations are operated on wastewater treatment plants, nine at industrial biowaste AD sites, four are on agricultural co-digesters and three at industrial wastewater treatments plants. Total biomethane production reaches approximately 280 GWh/a (2016). Today more than 11,000 vehicles run on methane in Switzerland and 140 natural gas filling stations exist (<http://www.ngvaeurope.eu/european-ngv-statistics>).

There is still a considerable sustainable potential for further production of biogas and biomethane in Switzerland. With 27,000 TJ/year the agricultural sector offers by far the largest share whereas biowaste and domestic sewage sludge also have unexploited biogas potentials with 3,000 TJ/year and 1,400 TJ/year respectively.

Wood combustion

In 2016 there were 573,502 wood combustions installations (stoves, boilers, automatic boilers, wood CHP installations, without waste incineration plants). The installed combustion capacity in 2016 was 10,208 MW.

Table 6: Combustion installations in Switzerland in 2016

Type of installation	Units 2014	Installed capacity		Final energy consumption	
		GW	GW	GWh/a	%
Room heater	511,465	5.45		2,463	20.11
Heat supply for buildings	52,950	1.73		2,034	16.6
Automated boiler (> 50 kW)	9,012	2.46		5,876	47.9
Combustion plants for renewable wastes (without municipal solid waste incineration plants)	75	0.56		1,892	15.44
Total	573,502	10.208		12,266	100

Source: Swiss Federal Office of Energy (2017): Schweizerische Holzenergiestatistik – Erhebung für das Jahr 2016

Thermal gasification

In 2016, there were four commercial thermal gasification plants in operation (2x690 kW_{el}; 2 gasifier lines; 1x 140 kW_{el}; 1x 125 kW_{el}; 1x 45 kW_{el}). In addition, several units are under construction, resp. in planning.

LINKS TO SOURCES OF INFORMATION

The following websites provide useful information and data on national Swiss bioenergy policy, production and consumption.

Related documents: <http://www.bfe.admin.ch/energiestrategie2050/index.html?lang=en>

Renewable Energy Statistics Switzerland:

http://www.bfe.admin.ch/themen/00490/00496/index.html?lang=en&dossier_id=00772

Biomass and Wood Energy Research Programmes:

<http://www.bfe.admin.ch/themen/00519/00636/06886/index.html?lang=en>

Swiss Competence Center for Energy Research - Biomass for Swiss Energy Future (SCCER BIOSWEET):

<http://sccer-biosweet.ch/>

National Research Programme "Resource Wood" NFP 66: <http://www.nfp66.ch/en/Pages/Home.aspx>

Swiss Association of the energetic utilisation and sustainable use of Biomass:

<https://www.biomassesuisse.ch/>

Swiss Association on Wood Energy (German, French, Italian): www.holzenergie.ch

"Infothek Biomasse" Literature Database on Biomass Research (German, French, Italian):

<http://www.infothek-biomasse.ch/index.php?lang=de>



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