

Switzerland

By: R. Bühler, Umwelt + Energie

Date: August 2008

1. Policy

In Switzerland, renewable energies contribute approx. 17% to the total energy consumption and biomass contributes with 5.15 % to the total end energy consumption. From these 5.15%, 92% are consumed for heat, 7% for electricity and 1% for transportation fuel. The biomass potential allows an increase by 100 % (up to 12% of the total energy consumption consist of renewable energies), which is the aim of the Swiss energy policy.

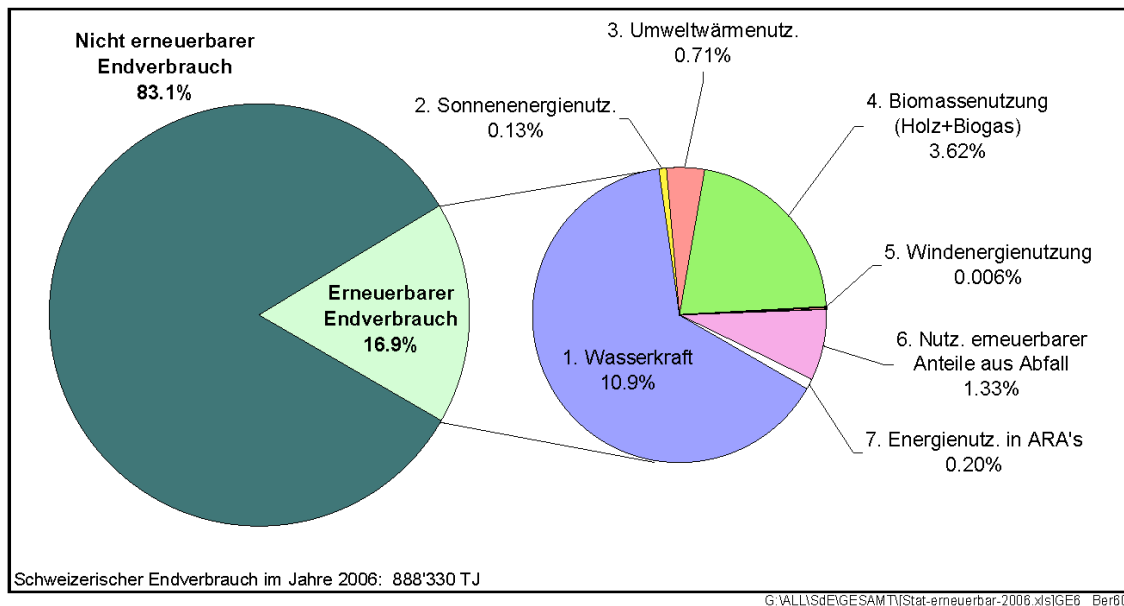


Figure 1: Contribution of biomass to the total energy consumption

The main source of bioenergy in Switzerland is wood. It contributes approx. 3-4 % to the total energy (Schweizerische Gesamtenergiestatistik, 2006). All other biomass beside wood includes biomass contained in municipal solid waste, sewage sludge, paper sludge, agricultural residues, and organic residues for the production of biogas, which is used for electricity production and as a fuel for cars.

In Switzerland, energy production from biomass is supported in different programmes by the government (Energie Schweiz / Swiss Energy), regional governments, power companies and oil and gas trade associations.

2. Programs

R&D program of the Federal Office of Energy

(http://www.bfe.admin.ch/themen/00519/index.html?lang=en&dossier_id=00798). The regional governments also financially support demonstration projects. Furthermore, there are a variety of national as well as international acting agencies, which provide funding in the domain of renewable energies. Within Switzerland there are different funding bodies like EKZ-Innovationsfonds, KTI, ESC, CCEM, E-Center, energie-cluster, swisselectric research, Repic, SNF. Internationally, the EC 7th framework, EUREKA and the Kohäsionsfonds can be mentioned.

In Switzerland, there are different instruments and incentives for promoting environmental friendly technologies:

To avoid CO₂ taxation, the oil trade association has made an agreement with the Federal Government to charge each litre of diesel and of gasoline with 0.01 €. With this money the foundation «Klimarappen» financially supports projects which reduce CO₂ emissions, e.g. biomass utilisation projects.

In 2007, the Swiss parliament revised the Swiss Federal Energy Act. The revised Energy Act stipulates that the production of electricity from renewable energy sources must be increased by at least 5'400 GWh by 2030. It also contains a package of measures for promoting renewable energy and efficient electricity use. Here the most significant measure concerns cost-covering remuneration for the input into the network of electricity produced from renewable energy sources. This form of remuneration is to apply to the following technologies: hydropower (up to 10 megawatts), photovoltaics, wind energy, geothermal energy, biomass and waste material from biomass. The tariffs for remuneration for electricity from renewable energy sources (green power) have been specified on the basis of reference facilities for each technology and output category. Remuneration will be applicable for a period of between 20 and 25 years, depending on the technology. A gradual downward curve is foreseen for these tariffs in view of the anticipated technological progress and the fact that it will be possible to bring more and more of these technologies onto the market.

From 1st of July 2008 Switzerland will change the law concerning fuel taxation. Fuels like biogas, bioethanol and bio diesel will be exempt from petroleum taxation. For natural gas and liquefied petroleum gas the petroleum tax will be reduced. These fiscal measures aim to encourage the replacement of fossil fuels with renewable ones and natural gas. Less CO₂ and particle emissions will be produced by using natural gas and fuels from renewable resources.

3. R&D Institutes

Fachgruppe Bioenergie, HTA Luzern, CH-6048 Horw

Paul Scherrer Institute, CH-5232 Villigen

Umwelt + Energie, CH-8933 Maschwanden

Verenum Research, CH-8006 Zurich

4. Industries

- *Pyroforce*, CH-6020 Emmenbrücke.
Pyroforce is the Manufacturer of the PYROFORCE gasifier.
- *DASAG Renewable Energy AG* (dasagren), CH-8472 Seuzach.
dasagren is selling the IISc-DASAG open top gasifier in Europe. Commercially not active since 2008 (silent liquidation)
- *ProCone GmbH*, CH- 4617 Gunzgen.
ProCone is the manufacturer of the Prometheus (former HTV/Juch) gasifier.
- *CTU Conzepte*, CH- 8400 Winterthur.
CTU is an engineering company active in incineration, gas cleaning and residue treatment. In biomass gasification, CTU is the engineering company for the gas cleaning of several gasification plants.
- *Pyroforce Conzepte AG*
Pyroforce Conzepte AG is a daughter company of Pyroforce and CTU. Pyroforce Conzepte is commercialising the Pyroforce gasifier system, which is equipped with a CTU gas cleaning system.

5. Projects

R&D projects

- Synthetic Natural Gas (SNG) production from woody biomass via conventional gasification *Paul Scherrer Institute*
- Direct methane production from wet biomass by catalytic gasification in supercritical water. *Paul Scherrer Institute*
- CHP via high temperature fuel cell (B-IGFC) *Paul Scherrer Institute*
- Co-firing of gasified biomass in large scale natural gas combined cycles (B-IGCC) *Paul Scherrer Institute*

SNG project of the Paul Scherrer Institute

Paul Scherrer Institute is working on biomass utilization for synthesis gas and synthetic natural gas (SNG). In phase 1, synthesis gas and SNG research is conducted on a slip-stream of the product gas from the Güssing BMG CHP plant in Austria. The raw gas stream is scrubbed to remove Cl and passed through a ZnO bed to remove sulphur. These tests are conducted at up to 10 bar pressure. A single-step, combined water-gas shift and methanation catalyst has been tested for over 1000 hours. The raw product gas contains 45% CH₄, 6% H₂, 1% CO, and the rest is mostly CO₂ (and 2% N₂). Phase 2 entails the construction of a pilot plant with an output of approx. 1 MW in Güssing. The Swiss company CTU and the Austrian company REPOTEC are the industrial partner in that project. Phase 3 will build on experience gained in Phases 1 and 2.

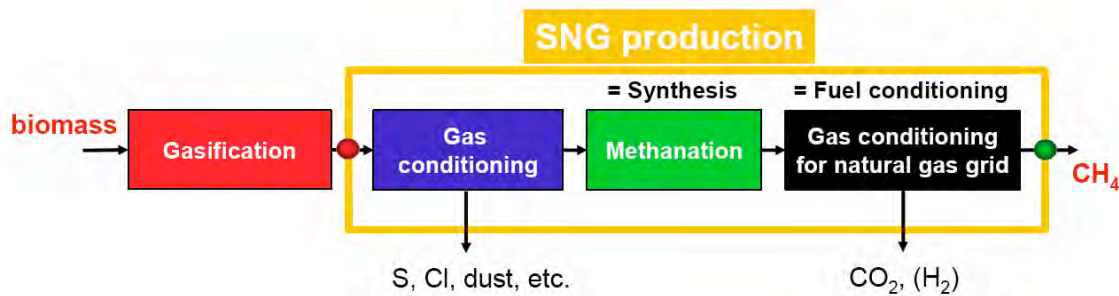


Figure 2: Flow sheet of the SNG production from biomass

B-IGFC and IGCC projects of the Paul Scherrer Institute

Paul Scherrer Institute is working on biomass utilization for synthesis gas for high temperature fuel cells (SOFC, MCFC) in CHP systems. Several tests with different gas processing systems have been performed with SOFC and tar laden gases. The longest test lasted for 1200 h. There are indications that tar can be considered as a fuel and not a problem as in many other syngas applications. One of the challenges is the removal of sulphurous species. The next step is the erection of a pilot plant for the gasification/gas processing part.

A further PSI project towards power generation is focussing on medium to large scale gasification for gas turbine application (50 to 150 MWth). On task is on assessing promising gasification technology for grassy biomass, the other task is on assessing bulk syngas quality towards its combustion properties in gas turbine combustors.

6. Implementation

Pyroforce gasifiers

Technology

The gasifier (see figure 3) is a 2-zone downdraft gasifier. The gas cleaning (see figure 4) has been designed to cope with both fresh wood as well as demolition/waste wood. The engine applied is a standard GE-Jenbacher gas engine adapted to the use of the very low calorific gas (1.5 kWh/Nm³). The turbo charger has been adapted as well as the operating pressure due to the different flame speeds between natural gas and wood gas.

The **wood** used is commercially shredded wood (G50) with a limit of fine particles (less than 5% by weight). Wood is dried if the humidity is higher than 15% in order to increase efficiency and to minimize production of undesired heavy hydrocarbons.

Drying also allows running the plant **waste water free**, which represents a huge advantage considering the very high cost of waste water treatment for such waste. The Pyroforce gasification system is commercialised by Pyroforce Conzepte AG.

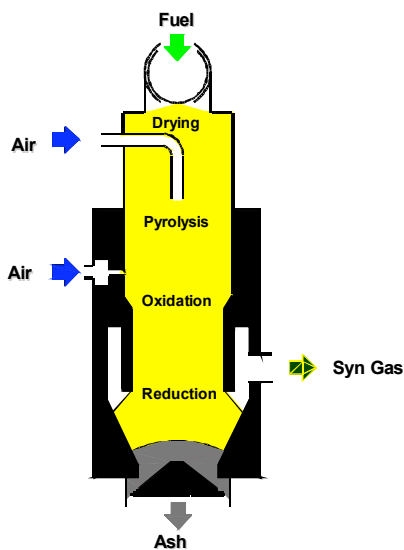
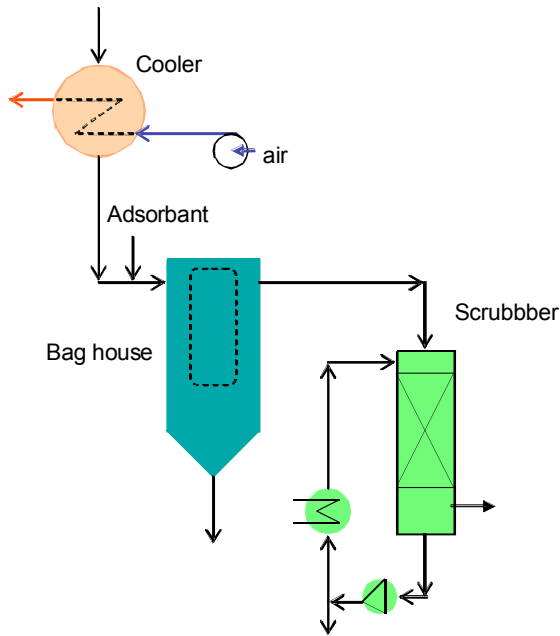


Figure 3: Pyroforce gasifier

Figure 4: Pyroforce gas cleaning system



Commercial Projects

The project **Nidwalden** (Switzerland) (see figure 5, see also www.holzverstromung-nidwalden.ch) is designed for the production of 1200 kW of electrical power and 1700kW of heat. The fuel is waste/demolition wood. Electricity is supplied to the grid and heat to a newly established district heating system.

The system consists of 2 systems with 600kW(el) using each 4 gasifiers, one gas cleaning system and one Jenbacher engine. The selection was based on the fact that in summer heat demand is low and therefore the 2 systems will be in their yearly extended maintenance period during this time however one after the other; thus maximizing the heat sales to the district heating system.

Operation started beginning 2008 with one system. In July 2008 the two engines together had reached 3'000 operating hours.



Figure 5: View of Nidwalden plant with gasifiers in the left (wooden) building, bunker and peak heaters in the concrete building

The project in **Güssing** (Austria) is designed for the production of 300kW of electrical power and approx. 440 kW of heat for the district heating system (pictures 2,3). It consists of 2 gasifiers in parallel using one gas cleaning system and one Jenbacher gas engine. The fuel is wood waste from the adjacent industry. Operation started beginning 2008. In July 2008 the engine has about 2'000 operating hours.

Woodpower, Wila

The Swiss company, DASAG Renewable Energy AG (dasagren), has sold a gasifier plant to Woodpower, Wila (www.woodpower.ch). It is a development of Indian Institute of Science, open top, down draft re-burn gasifier, produced by Netpro, Bangalore, India. The main features of the Wila CHP plant are (see figure 6 and 7):

- Capacity: 350 kWe + waste heat utilisation.
- Feed rate: 450 kg/h of 15% moisture content biomass
- Producer gas cleaning system with cyclone separation, quenching, scrubbing and filtering.
- 1 Jenbacher engine

Operation started beginning 2007. In 2007 several adaptations and new developments were designed and installed by the owner himself. In June 2008, the engine has about 2'500 operating hours with 375 kWe, mainly through operation in 2008. The objective of 2008 is to reach 5'000 hours.

- Time frame for commissioning is approximately 10 to 12 months, including approval of permits from local authorities.

Contact: Woodpower AG, Wila, Oliver Bosshard <o.bosshard@woodpower.ch>.

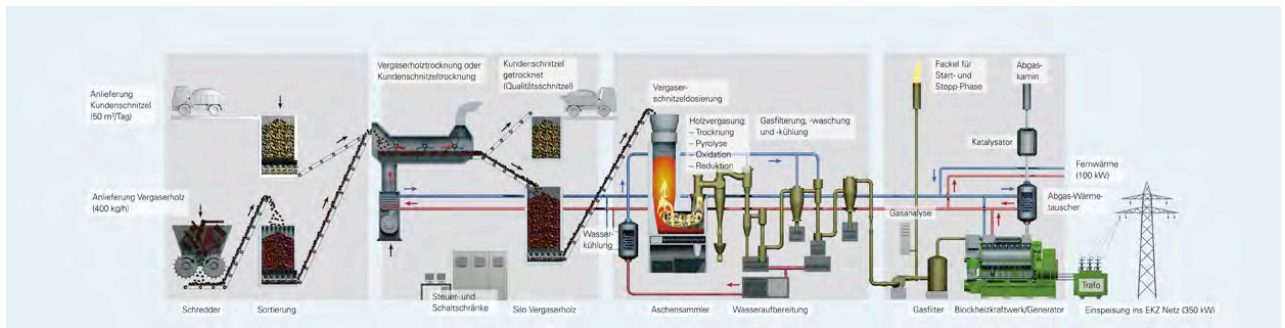


Figure 6: Flowsheet of the Woodpower plant



Figure 7: View of the top of the gasifier of the Woodpower plant