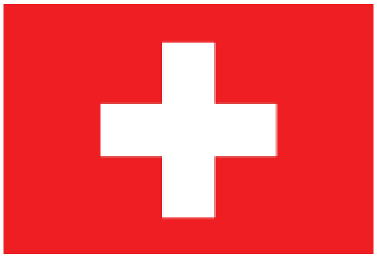
COUNTRY HIGHLIGHT

The Role of Solar in Switzerland's Energy Transition



Swiss Energy Policy

Switzerland ratified the Paris Agreement on 6 October 2017, setting a commitment to reduce emissions 50% by 2030 from 1990 levels, with partial emissions reductions from abroad. As an indicative target for 2050, the Swiss government decided in August 2019 that Switzerland should aim for net zero greenhouse gas emissions by 2050. The net zero target is also the subject of a popular 2019 initiative, the "Glacier Initiative." In response, the government has made a direct counter-proposal, and both the initiative and the counter-proposal are currently under discussion in Parliament.

The national legal basis for implementing climate goals in Switzerland is the CO_2 Act. In June 2021, the Swiss electorate rejected a revised version of the CO_2 Act. After analyzing the reasons for rejection of the new law, the government concluded that it was not a general 'no' to climate policy, but that it was mainly concerns about rising costs, in particular the possible increase in the price of transport fuels, that led to the rejection. The Swiss government, therefore, wants to send a draft of a new CO_2 Act into public consultation before the end of 2021 and submit it to Parliament next year. This draft should stick to the reduction target of 50% by 2030.

Future climate policy will be based on a mix of instruments. For example, Switzerland already has a CO_2 levy on thermal fossil fuels, such as heating oil and natural gas. This levy should be supplemented with effective incentives and targeted financial support measures to enable the population to reduce CO_2 emissions in everyday life and support the ongoing efforts of the various industries.

It is expected that the actual energy and climate policy will significantly increase the electricity demand for electromobility and heating (heat pumps). And, this will challenge the 2017 energy law that stipulates a gradual phase-out of nuclear energy, which today covers about 35% of the country's electricity demand. The targets, therefore, can only be achieved by reducing electricity demand in other areas and expanding the use of hydropower and renewable energy sources such as PV, wind, and geothermal energy use.

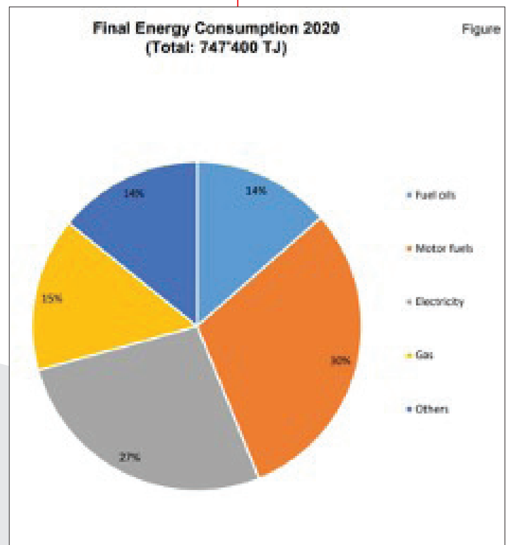
Total Energy Use

The Swiss Overall Energy Statistics is an annually updated document reporting on the final energy consumption of all energy carriers used in Switzerland. In 2020, Switzerland's final energy consumption fell by 10.6% compared to 2019. The main reasons for this are the COVID-19 pandemic and the warmer weather conditions compared to the previous year.

During the two COVID-19 lockdowns, distance traveled and vehicle movements in passenger transport decreased, as well as industrial production and gross domestic product (real GDP -2.9%). Warmer weather conditions compared to the previous year also brought down energy consumption: the number of heating degree days, an important indicator of energy consumption for heating, decreased by 4.4%. In contrast, other factors that determine the long-term growth trend in energy consumption increased slightly in 2020: the permanent resident population (+0.7%), the

LOOKING TO 2050, SOLAR THERMAL HAS A PLACE IN THE ENERGY MIX THAT INCLUDES APPLICATIONS NOT ONLY FOR DOMESTIC HOT WATER PREPARATION BUT ALSO FOR GEOTHERMAL, ICE STORAGE REGENERATION, AND SOLAR DISTRICT HEATING.

continued on page 19



number of motor vehicles (+1.3%), and the housing stock (increase; detailed figures are not yet available). Efficiency gains and substitution effects, meanwhile, tended to stem the growth in energy consumption.

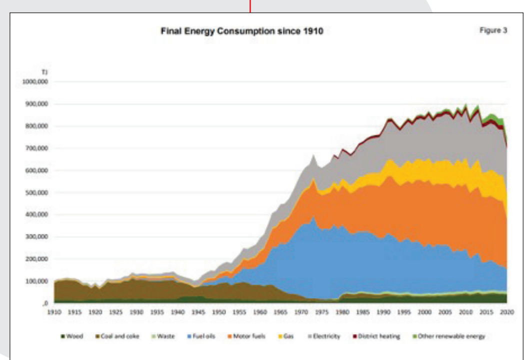
The warm weather conditions did not affect all renewable energy sources for heating purposes equally. The consumption of energy wood decreased by 3.5%, as did district heating consumption (-2.2%). However, the use of solar heat and ambient heat with heat pumps increased (solar: +0.8%; ambient heat: +3.6%). These energy sources represent 11.0% of total final energy consumption (energy wood: 5.3%, ambient temperature: 2.5%, district heating: 2.8%, solar thermal: 0.4%).

You can find more detailed market figures here.

Solar Heating Today

In the context of the Swiss energy scenarios, solar thermal energy use is seen as a means to reduce the energy demand of buildings. The challenge is that solar thermal systems are still seen to be relatively expensive in terms of system costs. Evacuated collectors continue to hold a small market share, while unglazed collector installations have increased, primarily due to a few big projects, mainly in combination with charging an ice storage. Heat pumps are beginning to overtake solar thermal's market shares.

Unfortunately, the Swiss solar thermal market has seen a decline in installations over the last 10 years after a peak of 160,000 m^2 installations in 2009. In 2020 about 29,000 m^2 were sold in Switzerland. In contrast, the PV market is at its highest level ever with a market grow of 48% in 2020 compared to 2019. It is obvious that homeowners are tending to invest more and more in PV and less in solar thermal applications.



In terms of systems installed, single-family homes dominate the market, with a slight trend to small collector areas – 70% on single-family houses and 27% on multi-family houses, totaling 97% of the market share. The majority (56%) of these systems are combi systems, 35% are domestic hot water systems, and only a small percentage are systems for other applications, such as process heat.

But looking to 2050, solar thermal has a place in the energy mix that includes applications not only for domestic hot water preparation but also for geothermal, ice storage regeneration, and solar district heating, as spotlighted in the research work below.

◀ **An 800 m^2 plant with evacuated flat-plate collectors for the return flow boost of the Geneva district heating network. At operating temperatures of 80 - 85 °C, the system achieves an excellent solar yield of 625 kWh/m^{2}a.** (Source: Magali Girardin / SIG)

continued on page 20

Swiss Research Highlights

▲ **Experimental ice storage heat exchanger using flat plat collectors in stainless steel.**

Solar thermal energy in the context of the Swiss overall energy supply in 2050

The brand-new study "SolTherm2050" analyzes the energy policy significance of solar thermal energy in Switzerland for the next 30 years. Based on the energy system model, "Swiss Energyscope" of ETH, domestic hot water preheating, geothermal probe/ice storage regeneration, and solar district heating achieve a techno-economic potential of 5 - 10 TWh/a or 2 - 4 % of the overall energy consumption. By conserving scarce resources such as wood, biogas, waste, and geothermal energy, solar thermal energy results in annual savings of 200 - 400 million CHF (2 - 4 %). Furthermore, the report shows which incentives are needed to develop these potentials. (Researchers: HSLU, SPF, ETH, EBP, Swissolar)

Solar thermal potentials for district heating networks

According to the "SolCAD" study, 40% of Switzerland's 1,100 district heating networks would be suitable for solar thermal integration. In order to assess the suitability, many international projects, especially Danish ones, were studied. In the case of wood-fired systems, solar thermal energy helps to avoid harmful emissions thanks to fewer burner starts. On the basis of two existing heating networks with up to 1,200 m2 collector area and 250 m3 storage volume, dimensioning rules for such networks were simulated, validated, and optimized. (Researchers: CREM, EPFL, HES-SO, Martigny)

With "BigStoreDH," the dimensioning and operation of different size storages and the replacement of fossil backups are investigated. Based on the district heating supply of Basel and Zurich, which aim to reach "net zero" by 2040, technologies, transformation strategies, and opportunities for sector coupling are investigated. (Involved: SPF, VFS, IWB, energie360, Verenum, WV Buttisholz).

Ice storage for heating and cooling

In the projects "Big-Ice" and "SlurryStore," concepts and technologies are developed to use the latent heat of the water/ice phase change. Ice storage in combination with PVT and heat pumps is an interesting alternative to geothermal probes. Buildings with cooling demands use the store for low-cost cold storage in the spring. SPF has developed simple rules of thumb for sizing. Processes for the production of slurry ice help to increase storage capacities and minimize the equipment and costs. In the "Ice-Grid" project, the planning and intelligent control of area and energy grids is being investigated, with a focus on sector coupling and relieving the load on the power grids in winter. (Involved: SPF, EW Rapperswil-Jona)

Function control and yield monitoring of solar thermal systems

The system data transmitted via LoRaWAN is compared in real-time to current weather data. The device developed in the "LoCoSol" ("Low-Cost Monitoring") project can be retrofitted at low cost. Self-learning algorithms analyze the behavior of the plant, warning in case of malfunctions to avoid a gradual drop in yield. Losses due to gravity circulation can also be detected with high reliability. Hardware and software are planned to be commercially available in about one year. (Researchers: FHNW, EZS)

Hybrid seasonal storage for 100% solar homes

Thanks to custom-tailored PCMs, inexpensive commercial rainwater storage tanks can be used as modular seasonal storage units for single-family and multi-family homes and retrofitted at low cost.

continued on page 21

In the "HyTES" project, encapsulated PCMs based on salt hydrates are adapted to the supply temperature of the building and managed via conventional heat exchangers. The charging via PV and heat pump allows high flexibility and self-sufficiency in summer and winter and relieves the power grid. (Involved: HSLU, COWA, energy4me)

Inexpensive components and systems

With "TriSolHP," the yields from irradiation and ambient heat are optimized over the year for unglazed PVT modules with the aid of cooling fins on the back. The functional matching of the heat pump to the PVT energy roof makes it possible to dispense with a backup storage system in moderate climates, or to efficiently regenerate geothermal probes or ice storage systems in colder regions and achieve high levels of self-sufficiency, also in winter. (Involved: HEIG-VD, UNIGE, Energie-Solaire/Soltop)

▲ **SPF's dual-axis trackers for solar collector testing in Rapperswil/Switzerland. The people in the picture are visitors at a 2020 open house day. (This will be the venue for the IEA SHC Executive Committee meeting in June 2022.)**

In the "PVT-COPRAS" project, glazed PVT modules are optimized for simultaneous high heat and electricity yields by combining several overheating protection mechanisms. On the one hand, the electricity production reduces the stagnation temperature; on the other hand, the electricity can be used for household and energy technology. A combination with the above-mentioned hybrid storage system, which is optimally charged only up to a certain temperature level, is conceivable. (Researchers: SPF)

The SPF Institute for Solar Technology

The dedicated solar institute, SPF Institute for Solar Technology, supports industrial partners to turn their ideas into innovative market products and to test their newly developed products. In (international) cooperative research projects, SPF contributes its highly recognized expertise and research infrastructure in the field of sustainable, renewable, and efficient energy systems.

SPF is the Swiss testing laboratory for solar energy and heating appliances and for durability, optical and thermal properties of building materials - accredited according to ISO 17025 to guarantee the highest level of professional expertise and confidentiality.

Currently, 50 employees engage in Research and Development and Component and System Testing of innovative energy technologies with a general focus on energy efficiency and renewable energy technologies and a particular focus on solar thermal and solar electrical energy (Solar Thermal, PV, Heat Pumps and Solar Energy, Energy Storage, Systems and Grids, Industrial Process Heat and Cold, and Efficient Buildings and Systems).

This article was contributed by Swiss Executive Committee members Andreas Eckmanns and Stephan A. Mathez, and Andreas Häberle (SPF).