Energy Situation and Policy in Switzerland

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Energy consumption in Switzerland

The Swiss energy consumption has increased during the last decades by a factor 6. The reasons are:

- Availability of cheap energy
- Increase of comfort
- Increase in standard of living (consume and property)

Liquid fuels cover about 2/3 of the national energy demand. The importance of gas is growing, but the gas consumption is with about 11 % still relatively small.

The second important energy is electricity (about 20 %). Fresh water and hydropower are the two only important natural resources of Switzerland. About 60 % of the electricity are produced by hydropower, which covers mainly peak demand. The other 40 % are produced by nuclear power.

Combined heat and power production, waste burning wood burning, active solar systems and photovoltaics produce a small, but increasing part. The passive gains in housing are not considered in the statistics but they would amount to approx. 6 – 8 % (20 % of building heating energy).

Figure 1: Swiss energy consumption in TJ from 1910 to 1998

Figure 2: Type of energy consumed in Switzerland

Trends in the Swiss Energy Sector

During the oil crisis 1975 the strong dependency of Switzerland from foreign fossil fuels became obvious. About 80 % of the total energy had to be imported. The economy started to substitute oil products either by natural gas or by electricity from nuclear power plants and the first energy conservation programmes were initiated. But the reasons for energy measures were not so much the limitations of non-renewable fossil energy resources; it was much more the dependency of the economy on cheap energy.

Tschernobyl demonstrated 1986 how dangerous the extensive use of nuclear power could be, especially in a heavily populated country. The discussion about the need for further nuclear power plants had started already earlier, but Tschernobyl made it politically impossible to build new ones. All five power plants, which existed already 1986, are still in operation.

Beginning of the 90's, after the Rio and the Kyoto conferences it became obvious that the climatic problems due to the extensive use of fossil fuels was much more critical than the dependency on limited fossil fuels.

That was when Switzerland started its first energy saving programme "Energy 2000". The government had agreed after Kyoto together with many other IEA countries to reduce the CO₂ emissions by 10 % by the year 2010. To understand the governmental energy programmes it is important to know something about the Swiss political system.

Swiss Energy Policy

The Swiss energy policy is influenced by four major factors:

- A direct democracy which allows initiatives and referenda what results in a slow decision process
- A multi party system. No single party or coalition dominates the parliament or government
- A federal system with 26 cantons, each of them with a large independence

The energy policy is based on three different strategies:

- Legislation
- Voluntary measures
- Dialog and information

Legislation

The legislation in the energy sector basically made by the cantons. The federal government collects taxes on fuels (for traffic purposes only) and the value-added tax.

Building regulations are made by the cantons and may differ from one to the other. The federal government just gives recommendations. Some of them are:

- Max. energy consumption for heating and hot water in new buildings (e.g. 530 MJ/m²a for multi family houses)
- Target values for small buildings for walls (0.3 W/m²K), roofs (0.25), windows (2.0) and so on
- Individual metering for more than 4 parties
- No heating of uninsulated rooms or outdoor pools
- Max. cooling load of 10 kW/building without permission
- Max. 2 to 4 m/s air velocity in ventilation systems
- Heat recovery systems for medium and large ventilation systems

Some cantons have more strict regulations others are less strict. The canton of Zurich just allows:

- 20 % lower energy values (additional energy conservation or use of renewable energies) or 30 % lower target values (walls 0.21 W/m²K, roofs (2.1), windows (1.4))
- Low NOX technology for oil based heating systems

These values are to be considered as minimum standard for new houses.

Voluntary Measures

Voluntary measures and private initiatives often go much further than building codes and legislation. The "Energy 2000" programme has supported energy efficiency and renewable energy sources by subsidies. Among other measures were included:

- Energy conservation in buildings
- Heat recovery systems
- Solar collectors for multi family installations
- Electricity from waste
- Electricity from small scale hydro power
- New traffic concepts

The most popular energy standard in the building sector is "Minergie" (minimal energy use). It is based on the energy reduction proposed by the Swiss Association of Engineers and Architects for new domestic buildings. The energy consumption of new domestic buildings for heating and hot water should decrease from 540 MJ/m²a (1990) to about 160 MJ/m²a in 2020. The "Minergie", a standard for sustainable buildings with low costs but high comfort, already achieves this goal. More than 600 buildings have been built in Switzerland according to this standard.

Minergie-houses are based on a well insulated and airtight building envelope and a mechanical ventilation system with heat recovery.

The target values for domestic buildings are:

- 160 MJ/m²a for heating and hot water, 60 MJ/m²a for electricity
- 110 MJ/m²a if electrical heat pumps are used for heating and hot water
- 320 MJ/m²a heating and hot water of retrofitted buildings

The targets for office buildings are:

- 145 MJ/m²a for new buildings
- 250 MJ/m²a for retrofitted buildings

Figure 3: Energy consumption of domestic buildings in the canton of Zurich

Figure 4: Expected trend for energy reduction in new housing (Swiss Association of Engineers and Architects)

The Swiss Federal Institute of Technology (ETH) has set a new goal. It is called "Strategy for Sustainability" and has limited the energy consumption to 2000 Watts primary energy per capita. The strategy is based on an extensive use of renewable energy. The consumption of fossil fuels is only so far permitted, as it doesn't influence the global warming. The total primary energy consumption should not exceed 17,500 kWh per year and capita of which only 1/4 may be covered by fossil fuels. Fortunately Switzerland has a relative large portion of hydropower, which is also a renewable energy source.

Figure 5: Energy sources for a future Swiss society, based on the ETH Strategy for Sustainability

Dialog and Information

The Energy 2000 programme has also published a lot of information on energy efficiency, energy conservation and renewable energies. The programme was specially focussed on professionals but also on the energy consumers.

Results achieved with Energy 2000 programme

The defined goals and achieved results of the *Energy 2000* programme are summarised in table 5:

Goal	Target <i>E2000</i>	Achieved <i>E2000</i>	Target Swiss Energy**
Energy consumption/CO ₂	stable	-0.2 %*	-10 %
Renewable heat	+3 %	+2.35 %	3 - 10 %
Renewable electricity	+0.5 %	+0.45 %	0.5 - 1.5
Hydro power	+5 %	+4.25 %	0 - 3 %
Nuclear power	+10 %	6 %	0 %

Goal of the Energy Conservation Programmes *E2000* and Swiss Energy, and the achieved results between 1990 and 2000

* The energy consumption was reduced by 4.3 % but economical growth created a new energy demand of 4.1 %.

** The goal of the Swiss Energy programme is depending on available energy taxes

The overall result of the *Energy 2000* programme is positive. A lot of encouraging improvements have been achieved. But the targets have not been fully met. The reduction of fossil fuels has mostly been compensated by the growth of the economy. Hardly any CO₂ reduction was possible. In 1999, the government decided to continue the programme for another ten years. Two scenarios have been developed. They depend on a public voting on additional taxes on non-renewable energies to be used for subsidies for energy efficiency measures and renewable energies. The success of this programme is very important for government because it has signed an international contract and is obligated to reduce CO₂ by 10 % compared to the emission in 1990. If voluntary measures do not bring an adequate result, the government has to decide 2004 on more severe measures to fulfil this obligation.

Swiss Energy Research

For Switzerland, as an industrialised nation with only very limited domestic energy sources, new technologies are the key to assuring competitiveness in the world marketplace. This is true in all areas in which research is carried out, but especially so in the field of energy. Over the last thirty years, the priorities of energy research have shifted dramatically. In the 1970s, the quest to secure sufficient energy supplies gave research an almost exclusively quantitative focus, whereas since the 1980s, quality of life issues, such as environmental protection and conservation of resources, are considered of equal importance. This change in public values was quite soon reflected in Switzerland's energy policy and in the basic principles of government energy research.

About 10 % of all expenditure on research and development in Switzerland (around 1 billion Swiss francs a year) is devoted to energy research. As a proportion of gross national product, this makes Switzerland a world leader, second only to Japan. Private industry carries about 4/5 of this sum. However, more than 80 % of this is channelled into product development and less than 20 % into actual energy research or basic development. This means that government and private industry contribute almost the same amount of financial resources to basic energy research.

Every year in Switzerland, over 200 million Swiss francs (CHF) in public funds are used for energy research, a substantial portion of which is devoted to promoting research by private industry.

The strong interest among the general public to encourage the breakthrough of new and especially environmentally compatible energy technologies obliges the government to closely co-operate with private industry in its energy research efforts.

Swiss energy research is conducted on the basis of guidelines formulated in the Federal Government Energy Research Concept. Every four years, these guidelines are reviewed and revised by the Federal Commission on Energy Research and officially approved by the Federal Council. The Federal Office of Energy is responsible for co-ordinating and monitoring energy research.

Co-ordination, support and international integration of government-sponsored energy research are the responsibilities of the Federal Office of Energy, which receives advice on these matters from the Federal Commission on Energy Research.

The majority of projects are run by public research facilities such as the Federal Institute of Technology in Zurich or the Paul Scherrer Institute. However, financial support is also given to industry, engineering companies and projects launched by individuals.

A Federal Commission on Energy Research - established in 1986 - is responsible for advising the Federal Council and the Federal Department of Transport and Energy concerning federal energy research and the implementation of research results and thus plays a key role in defining guidelines for Switzerland's energy research. The Commission updates the Federal Energy Research Concept every four years and organises the Conference on Swiss Energy Research every second year.

The Federal Office of Energy has divided energy research in Switzerland into three sections:

- Efficient energy use,
- Renewable energies, ~
- Special areas.

These three sections comprise a total of 16 »divisions:

- Energy Efficient Buildings,
- Electricity,
- Environmental heat and cogeneration,
- Active solar systems
- Photovoltaics,
- Biomass,
- Geothermal energy
- Small scale hydro power
- Wind,
- Solar chemistry and hydrogen,
- Combustion,
- Energy Storage,
- Nuclear energy,
- Fuel cells,
- Transport,
- Principles of energy economy

Energy efficient buildings programme

The building programme is one of the important ones. It comprises

- Energy conservation in buildings
- Efficient building technical installations
- Energy efficient hot water systems,
- Solar architecture and daylighting

Figure 6: More than 60 % of the Swiss energy consumption is related to buildings and their operation

In Switzerland, as in all industrialised countries with moderate climates, the buildings segment is the largest energy consumer. About half of all end energy goes into keeping residential and office buildings heated, ventilated and air-conditioned and supplied with electricity and water. During the economic boom years between 1960 and 1975, a great deal of shoddy Building was carried out, even in a country as quality-conscious as Switzerland, and energy consumption factors were more or less ignored, since heating fuel was extremely cheap at that time. As a result, the infamous constructions of the 1960s consume more electricity and heating fuel today than older buildings do. The oil crisis of 1973 gave rise to a radical change of approach in this sector, however. Since then, research has paved the way to major advances in all areas of construction. The electricity and heating requirements of buildings incorporating the latest developments are only a fraction of what they were before. However, the positive effects of this progress on overall energy consumption are being felt only gradually, because new constructions are replacing older ones at a rate of only a few percent per year. Several decades normally pass before buildings are renovated, and their replacement takes considerably more time. The problem of excessive energy consumption is therefore not one that can be solved through construction and building technology innovations alone. It is equally important that these innovations are put into practice quickly and on as broad a scale as possible. This goal is hampered by the fact that there is an abundance of research efforts which are rarely co-ordinated with each other, often duplicated and mostly difficult to keep track of. To minimise these obstacles and subsequently improve implementation, the Federal Office of Energy launched a research programme called »Efficient energy use in buildings« In the mid-1980s. This programme has produced the following results:

- Planning aids, e.g. a computer programme simulating air currents in building interiors -- a basic tool for the energy-efficient planning of air-conditioning and ventilation installations. Concepts for efficient construction and operation of schools and hospitals.
- Energy-saving, passive cooling systems for office buildings during the warm season have been developed and successfully tested.
- A standard software package has been developed for calculating ecology indexes for the most important construction and insulating materials.

The Federal Office of Energy's »Solar architecture- research programme has complemented these efforts. This programme has focused on measurement of all types of buildings - from single-family dwellings to factory complexes - and on new solar architecture components. It has identified certain mistakes that were made early on, collected and compiled information in data bases and computer programmes for planners. These data pertain mainly to the properties of new windowpanes with high thermal insulation properties, daylight-based systems, solar air-heating systems, transparent insulation, atria, conservatories and glass-enclosed balconies, comprehensive energy planning and building renovation. All these efforts have brought research an important step closer to its goals, and these have since been defined more precisely on the basis of an energy consumption »reduction curve- for buildings calculated by the Swiss Association of Engineers and Architects. By the year 2000, the average heating consumption of new residential buildings should be reduced to 180 MJ/m²a and by the year 2020 even further to only 100 MJ/m²a (the target for buildings renovated using energy-saving technology is set 50 % higher). In comparison, in 1970 this figure was 570 MJ/m²a for new buildings! The research programme for the 1996-99 period is designed to provide the technical pre-requisites for meeting these targets. In order to take better account - from the point of view of efficient energy use - of the complex relationships between the various energy sub-systems of which a building is composed, the Federal Office of Energy merged the three divisions, "Building systems and shells", "Building technology" and "Solar architecture and daylight utilisation" to form a "Master programme for buildings". Its action plans are formulated on the basis of eight main objectives. By the year 2000, end energy consumption for hot water, room heating and cooling and electricity is to be reduced from 1990 levels by 10 to 25 %, depending on the type (residential or industrial/commercial) and

the age (new construction or renovation) of the building. By 2010 a further reduction by a similar amount is to be achieved. The emphasis is on upgrading the energy efficiency of existing buildings, which means moving away from the "repair strategy" that is still common today. Building ecology and utilisation of renewable forms of energy will be particularly taken into consideration. In order to reach these objectives, research and development work within the "Master programme for buildings" will focus on the following:

- Developments in building systems and shells: simple planning aids for optimising comprehensive approaches in terms of energy efficiency and building ecology; new insulating materials with U-values of between 0.20 and 0.25 W/m²K at 5 to 8 cm thickness and which are easier to work with and fit; windows offering better energy indexes and window renovation systems; simple procedures for assessing quality in energy terms.

Developments in building technology: Guidelines for comprehensive, ecological assessments that also take account of degradability factors; standard solutions (that include new technologies such as heat pumps) for the renewal of outdated heating installations; oil fired boilers with less than 70 kW capacity and at least 95 % annual utilisation; oil and gas burners that consume 50 % less electricity; high-efficiency insulation (e.g. vacuum-based) for heating installations; new, controlled ventilation systems for apartment buildings that adjust according to air quality.

- Developments in solar architecture and daylight utilisation: catalogue of tested solutions, with an emphasis on low-energy-consumption houses, for intensive use of solar energy for lighting and heating (using direct collection or solar air systems); economical transparent insulation modules with integrated protection against over-heating; computer programmes and handbooks for planners of daylight-based systems.

Too little funding had been budgeted for P&D projects in the 1988 programme for the implementation of research results to be called an actual success. Nonetheless, the "Air currents in buildings" project produced important results for the ventilation industry. The 1996-99 programme promoted implementation by the exemplary renovation of apartment houses and office buildings that present common problems particularly difficult to solve, and accompany this with information campaigns.

More information on the Swiss energy policy and research programmes can be found under:

- General information of Federal Office of Energy: <http://www.admin.ch/bfe/>
- Energy research and technology: <http://www.admin.ch/bfe/e/index.htm>
- Energy efficient building research: <http://www.empa.ch/ren>