Chapter 19
Switzerland

19.1 INTRODUCTION

The harnessing of wind energy in Switzerland had a more shadowy existence in political energy activities until the middle of the 90th. Thanks to the dynamic development of wind energy in surrounding countries, the wind energy program of the federal office of energy now occupies a clear place and is an important part of the national program, SwissEnergy. Switzerland participates in the International Energy Agency (IEA) Implementing Agreement on Wind Energy Research and Development (R&D), Annex XIX Wind Energy in Cold Climates.

19.2 NATIONAL POLICY

The objectives that have been set for the new SwissEnergy ten-year program are derived from the Federal Constitution and the *Energy and Carbon Dioxide Laws* and reflect Switzerland's commitments under the international convention on climate warming. Specifically, the objectives are as follows.

- The consumption of fossil fuels in Switzerland and the concomitant carbon dioxide emissions must be reduced by 10% from 2000 to 2010.
- The growth of electricity demand must not exceed 5%.
- The contribution of hydro-power to net demand must not be reduced despite deregulation of the Swiss electricity market.
- The contribution made by other forms of renewable energy to total electricity production must increase to 0.5 TWh, or 1%, and to heating energy by 3 TWh, or 3%.

Other important SwissEnergy objectives that are less easy to quantify include the following.

- The development of a greater awareness of the energy dimension among the general public as a prerequisite for the optimum implementation of voluntary measures.
- A closer co-operation among all partners.
- A spirit of innovation in all fields.
- An overall strengthening of the Swiss economy.

All activities and projects within the wind program focus on installing wind power generators at the evaluated sites in the short and medium term. The operational experience gained will contribute significantly to fulfill the goals set by SwissEnergy in the field of renewable energy.

Strategy

According to a 1996 study conducted on behalf of the Swiss Federal Office of Energy (SFOE), the sites suitable for wind power plants offer a potential that might cover 3% to 5% of the electricity demand.

At very windy locations outside landscape zones, approximately 500 wind power plants could produce electricity of approximately 270 GWh. This study has now been actualized when considering the newest wind turbines.

The Federal Department of the Environment, Transport, Energy, and Communications (DETEC) – including the offices of the Swiss Agency for the Environment (SAEFL), SFOE, and the Federal Office for Spatial Development (OSD) – has published a media report with a clearly positive statement concerning wind power generation in Switzerland. In accordance with the strate-

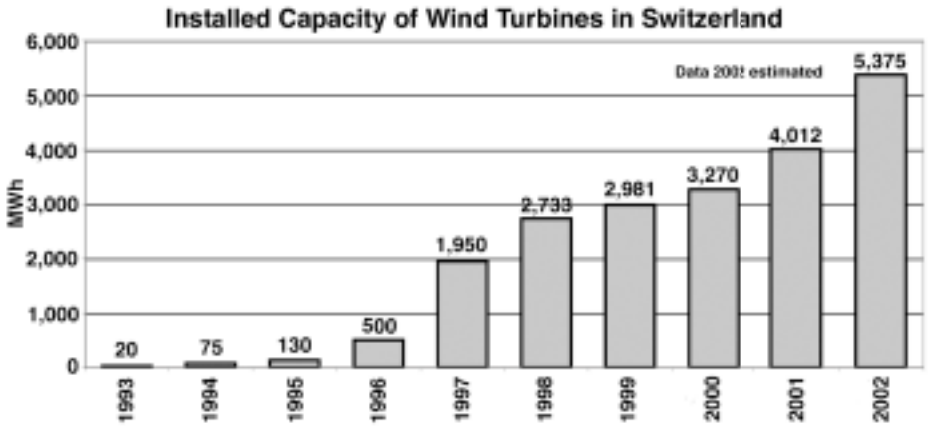

Figure 19.1 Development of Swiss wind energy production

gies developed by SwissEnergy, the report states a goal of 50 GWh to 100 GWh of wind power annual production until 2010. This equals 10% of the goal for all renewable energies set by the federal program, SwissEnergy.

Specific focal points in research for wind power generation in hilly and mountainous terrain will provide more information to enhance Swiss companies' opportunities in the globally booming wind energy market. In 2002, the budget for wind energy related R&D projects was 360,000.00 Euros. Approximately the same amount is spent on promoting activities.

Progress Towards National Targets

In 2002, 5.375 GWh were produced by wind power plants. This meets approximately 10% of the goals until 2010, and growth since 2001 was 33%. More than 95% of the electricity produced was generated at the biggest wind park in Switzerland, on Mt. Crosin by Juvent SA.

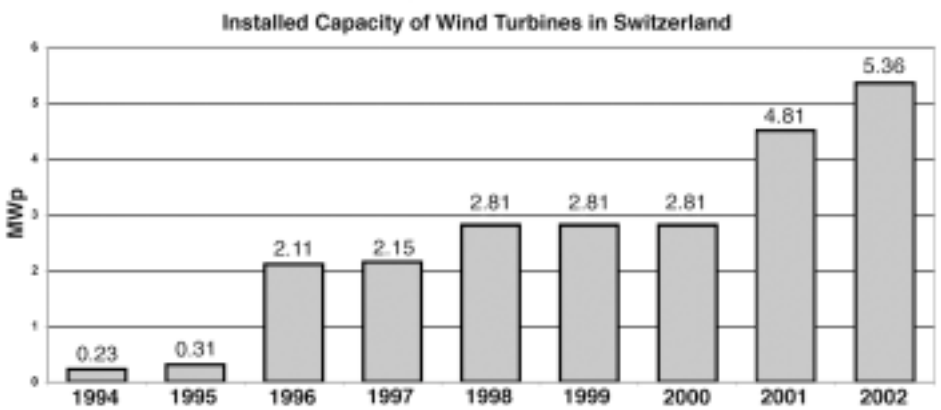

Figure 19.2 Development of installed wind power in Switzerland

19.3 COMMERCIAL IMPLEMENTATION

Installed Capacity

The 19 plants installed so far, with a total capacity of 5.317 MW, produced 5.375 GWh in 2002. The capacity of wind power plants in Switzerland has increased by 20% in the last year.

Rates and Trends in Deployment

Current planned projects have a total production of more than 30 MW. Due to growing opposition on the part of wind energy opponents in our country, the realization of these projects may go on rather hesitatively.

Contribution to National Energy Demand

Electricity produced by wind energy meets 0.01% of the total use of electricity in Switzerland.

19.4 MARKET DEVELOPMENT AND STIMULATION

Main Support Initiatives and Market Stimulation Incentives

Good locations in Switzerland are situated at altitudes above 800 m in hilly or mountainous areas, with correspondingly difficult general conditions such as climate (ice, cold, and turbulent wind regimes) and access and landscape conservation conflicts. Experience shows that wind energy plants can be operated even under these extreme conditions, although the economic viability of the projects is rather poor.

For this reason, the federal government's wind energy program supports planners and operators of wind energy projects in various ways including providing wind energy manuals, location maps, regional planning aids, and promotion subsidies.

Suisse Eole is the organization for supporting wind energy in Switzerland. It supports the wind energy branch in fulfilling the goals of the federal office of energy. Suisse Eole is a recognized partner of the program SwissEnergy and works jointly with environmental organizations.

Unit Cost Reduction

Does not apply.

19.5 DEPLOYMENT AND CONSTRAINTS

Wind Turbines Deployed

Since the 2000, wind energy plants installed in Switzerland have had capacities of 6 kW (nine plants), 800 kW (one plant), and 850 kW (two plants). Bigger plants are not yet installed due primarily to the difficult exploitation in hilly and mountainous terrains.

Operational Experience

Several operations have made available consolidated data on the performance of wind power plants in hilly and mountainous areas under rough climatic conditions. These operations are the 30-kW wind power plant on the Simplon pass (in existence since 1990 at 2,000 m above sea level), the 150-kW wind power plant on the Grenchenberg (in existence since 1994 at 1,300 m above sea level), the 80-kW plant on the Gäbris (in existence since 1995 at 1,100 m above sea level), the 2,960-kW wind park on Mount Crosin (in existence since 1996 at 1,200 m above sea level), and the 30-kW plant on the Titlis (in existence since 1997 at 3,000 m above sea level).

With the commissioning of an 850-kW plant on the Gütsch near Andermatt (at 2,300 m above sea level) in spring 2002, important

Figure 19.3 An 800-kW wind turbine on Mount Gütsch in Andermatt, Switzerland

additional experience on the use of wind energy under climatically extreme conditions have been gained.

Wind generates the most electricity (approximately 60% to 70%) in the winter months when demand is critical. Thanks to wind energy production, additional electricity is available from storage power stations at peak consumption. Wind energy is therefore a perfect complement to electricity generated by storage lakes.

Main Constraints on Market Development

Landscape protectors fight more and more wind energy projects. The Swiss Foundation for Landscape Protection has published a position paper that would make efficient development of wind energy absolutely impossible and would clearly fall behind the position of the foundation taken in 1996. This will slow down the planning of wind energy projects even more.

For this reason, a national concept now exists that allows the realization of the goals set by the DETEC. This would also reduce the uncertainties in the planning procedure by the cantons.

There is a danger that refusal of the law for opening of the electricity market, called *Elektrizitätsmarktgesetz* (EMG), could do a favor to the real coup de grâce for the decentralized electricity production. All possibilities for a market entrance with equal rights would become invalid for independent producers. The question still remains how interested energy suppliers are in ecological energy strategies in a closed market for small-sized and average-sized customers.

19.6 ECONOMICS

Trends in Investment

Wind energy plants are not generally subsidized in Switzerland. However, the SFOE can support up to 60% of costs that cannot be recouped for pilot and demonstration projects. This is also valid for studies and concepts for site assessments. The government's wind energy program substantially supports site assessment (including wind measurements, expert opinions on climate and environmental matters, and feasibility studies) with financial aid.

Trends in Unit Costs of Energy and Buy-Back Prices

The specific costs of large wind-power plants amounts to approximately 2,000.00 CHF/kW or 1,380.00 Euros. Thus, the prime costs at windy locations are lower than 0.20 CHF/kWh or 13.50 Euro cents. Wind energy offers good opportunities for local energy production in remote areas and its importance will increase in a liberalized electricity market.

The production costs of the newest 850-kW wind energy plants installed in 2001 amount to approximately 12.00 Rp/kWh or 8.50 Euro cents.

The Swiss energy law obligates energy suppliers to re-buy the energy produced by independent producers to 15.00 Rp/kWh or 10.50 Euro cents. Because these supplementary costs (current electricity producing price in Switzerland is 8.00 Rp/kWh or 5.50 Euro cents) cannot be passed on, the claiming of these costs turns out be difficult. A progressive solution – payment of these costs by the high voltage net – has unfortunately been prevented by the successful referendum for the EMG law.

19.7 INDUSTRY

Manufacturing

Both offshore installations and power plants in mountainous areas must achieve high reliability, considering the limited access and rough climatic conditions. This opens market opportunities for the expensive, but highly qualified, electrical and measuring industry in Switzerland.

The Swiss electrical industry's understanding of medium voltage gains in significance with increasing plant power (greater than 1 MW). Firms like Bartholdi AG (a generator manufacturer), ids AG, and Technocon (an inverter manufacturer) have already faced this challenge. Aventa AG produces small power plants up to 6 kW, nine of which are installed in low wind areas.

Industry Development and Structure

The power generation by wind holds enormous potential of great economic importance beyond the small Swiss market. Its development is linked to crucial fields of competence of the Swiss electrical and mechanical industry. A substantial home market is an invaluable asset for Swiss companies on the international market.

19.8 GOVERNMENT-SPONSORED R,D&D

Priorities

The following research strategies for promoting acceptance of wind power generation lead to the goals mentioned above.

- Well-founded data analyses concerning the influence of wind power plants on fauna, flora, and tourism.
- Compilation of founded guidelines for projects with small impact on the environment, in co-operation with environmental

organizations and the wind energy industry.

- Evaluation of wind power's contribution to sustainable energy supply and integration into global strategies.
- Elaboration of a nationally coordinated concept for wind power generation, including a definition of spatial development.
- Local electricity production in remote areas.
- Wind energy as a supplement to electrical power generation in grids, strategies for ecological power supply as an additional income of energy suppliers in remote areas, and marketing strategies.
- Appropriate participation models for the local population and in regard to matters of acceptance.
- Wind energy as a supplement to electricity production in insular situations (i.e., for alp co-operatives and southern countries).
- Development of a center of competence for wind power generation in mountainous areas.
- Enhancing knowledge on project development in complex terrain, support for site assessments with specific requirements, and elaboration of planning aids.
- Development of adapted modeling software for site assessments, validation, and optimization.
- Operation of test plants in mountainous areas; interpretation of operational experience; and integration into new plant concepts for networks, small insular grids, and stand-alone plants.
- Development of specific plant components and concepts for rough climatic conditions (e.g., ice, cold, and turbulence) with high reliability (e.g., difficult access and offshore sites) for erection in areas with limited access.

New R,D&D Developments

The development of wind energy projects in Switzerland is still burdened by many uncertainties and planning risks. The program P+D Wind has established various documents, studies, and planning aids that contribute to a successful realization of wind energy projects. A list of specific planning aids follows.

- The manual Planung von Windenergieanlagen (planning of wind power plants), located in the publications area of the website www.energieforschung.ch, provides complete information about the various aspects of a wind energy project, considering the specific Swiss setting. More instruments based on these publications were developed in 2001.
- A comprehensive checklist, called Wind Energy and Spatial Development, has been created in order to standardize the planning procedure in all cantons with relevant wind energy potential. The SAEFL, the OSD, and the Swiss foundation for landscape conservation, or Schweizerische Stiftung für Landschaftsschutz und Landschaftspflege (SL), were members of the group that accompanied the project. The canton's viewpoint was integrated to include a detailed consulting procedure.
- Computer models that have proven their value in lowland applications are often not adaptable to complex and mountainous terrain because physical simplifications approved in low regions are not applicable to complex terrain. Therefore, alternative methods are necessary to provide reliable wind assessments for power plants. The V3-toolbox explains the general procedure for establishing a wind assessment. A flow chart shows the decisions to be taken in the assessing process and the steps to be followed. Comments are made regarding decision basis and tools. In particular, the large choice of available computer models for wind assessment is shown.
- The software program within the V3-toolbox was validated by the pilot project Gütsch. The development method and the calculations were done in tight co-operation with the Swiss Center for Scientific Computing (SCSC) and the Federal Polytechnical Institute of Zurich. The proce-

dure can be run for any terrain but is mainly used for topographically and meteorologically complex locations.

The following detailed information is available from the Suisse-Eole website (www.suisse-eole.ch) under the title, Windmaps of Switzerland.

- Wind measurement points run by MeteoSwiss.
- Average wind speeds at the mentioned measurement points for the years 1983 to 1997.
- Monthly averages of wind speed, beginning in 1998.
- Results of temporary measurements at supported wind energy projects.
- Location descriptions of wind power plants and wind forecasts.
- Publication of potential maps (wind speed and landscape protection aspects).
- V3-toolbox with a calculation of the WEIBULL-parameter A, k from a measured frequency distribution (program in Microsoft Excel 97).
- Detailed description of relevant geographical aspects, including zones of protected landscape.

Offshore Siting

Does not apply.

Site Assessment

The government's wind energy program substantially supports site assessment (e.g., wind measurements, expert opinions on climate and environmental matters, and fea-

Figure 19.4 The wind energy data base, located at stratus.meteotest.ch/mme shows areas of protected natural habitat and landscape

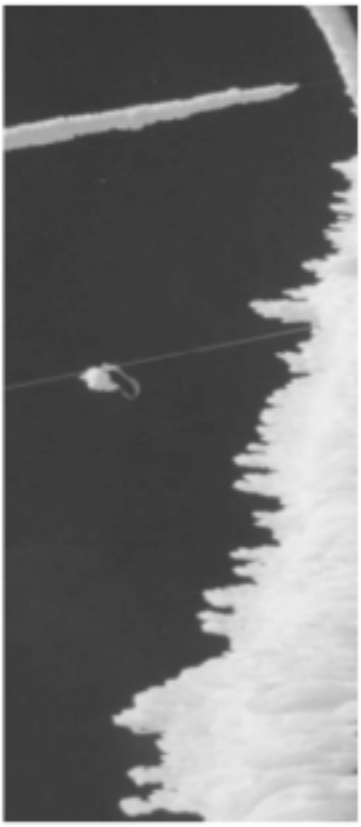

Figure 19.5 and Figure 19.6 At low temperatures, ice and snow accumulates on the mast and guy wires leading to greater loads and a larger area of attack for gusts (photos taken from a Meteotest measurement campaign on the Gotthard Pass at 2,100 m above sea level, Switzerland, courtesy NEK Umwelttechnik AG)

sibility studies) with financial aid. To some extent, plants can also be part-financed. Since 1994, the SFOE's P+D Wind program has co-financed the investigation of climatically demanding sites such as Flumserberge, Arosa Weisshorn, Grimsel and Gotthard passes, and Neuchatel Jura. In this way, a lot of information was obtained in the P+D Wind program on how climatic aspects can be considered when evaluating sites. The results of these investigations have been published in reports via ENET (located on the www.energieforschung.ch website).

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