Report 2022

Switzerland

Photo Source: Suisseéole.

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By the end of 2022, Switzerland had 41 large wind turbines with a total rated power of 87 MW in operation. These turbines collectively produced 153 GWh of electricity throughout the year. Additionally, a new wind farm with a capacity of 14 MW is under construction and will be commissioned in 2023.

Since 2009, Switzerland has benefitted from a cost-covering feed-in tariff (FIT) for renewable energy [1]. In 2022, a new scheme with an investment subsidy of 60% also entered into force. These policies offer an attractive economic environment for wind energy. However, the authorisation process is causing a 25-year delay. Currently, around 2 TWh of projects are under development.

In terms of research, Switzerland collaborated Internationally on projects focused on cold climates, complex terrain, aviation cohabitation, and social acceptance throughout 2022.

Highlight(s)

- The lengthy approval process continues to delay wind energy deployment.

Table 1. Key National Statistics 2022: Switzerland

Total (net) installed wind power capacity	87 MW
Total offshore capacity	0 MW
New wind power capacity installed	0 MW
Decommissioned capacity (in 2022)	0 MW
Total electrical energy output from wind	153 GWh
Wind-generated electricity as percent of national electricity demand	0.3%
Average national capacity factor	20.2%
Target	4.3 TWh
National wind energy RD&D budget	5.455 mio CHF (2019 most recent)

- The last federal court has positively judged six projects with 133 MW / 274 GWh.
- In 2022, the Swiss Federal Office of Energy updated the sustainable potential of wind energy from 4 TWh to 30 TWh.

Market Development

Targets and Policy

The Energy+ Strategy projects an additional 39 TWh from renewable energy by 2050. Newly proposed legislation anticipates more ambitious goals of 35 TWh by 2035 and 45 TWh by 2050. Wind energy should contribute 4.3 TWh/year to this target (with intermediate goals of 0.3 TWh in 2025 and 1.2 TWh in 2035), the Swiss Wind Association 9 TWh for 2050.

The current FIT scheme has concluded, and a new scheme based on investment subsidies, covering up to 60%, started supporting wind energy deployment in 2022. However, the new scheme is disadvantaged by its inability to address long-term market price risks and is therefore inappropriate for wind energy projects, which tend to operate over long timelines. Nevertheless, the scheme has potential for community-owned wind turbines, but this depends on the duration of the authorization process for smaller projects, which has not yet been defined.

A levy on electricity consumption finances the cost of the FIT. The maximum levy is 23 CHF/MWh (21.2 EUR/MWh; 23.8 USD/MWh), and a fund to support renewable energies in Switzerland is financed. The FIT for newly installed wind turbines in 2022 was between 130 CHF/MWh and 230 CHF/MWh (135.8 EUR/MWh and 240 EUR/MWh; 144 USD/MWh and 255 USD/MWh). The payment period extends over 15 years. This price is a contract for difference. As the market price was exceptionally high in 2022, wind turbine operators under this scheme had to repay money to the fund. The 41 operational wind turbines provided around 9.6 million CHF (10 million EUR; 10.6 million USD) to the fund in 2022.

Progress and Operational Details

Approximately 57% of Switzerland's electricity production comes from renewable sources, with hydropower providing the biggest contribution of 92%. Currently, wind power provides 0.3% of Swiss electricity consumption. An additional 360 MW of capacity are already in advanced planning stages, while early-stage projects represent roughly 600 MW. These projects should be realized in the next 3-5 years.

Matters Affecting Growth and Work to Remove Barriers

Lengthy planning procedures, comprising 20 to 25 years, greatly hinder the growth of Swiss wind energy. Stakeholders at different authority levels must first give their authorisation, and voters must also seek approval for specific projects in the local population.

Generally, the Swiss population favours wind energy, as confirmed by votes at national and local levels. However, the opposition is very well organised and manages to polarise discussions on specific topics while systematically using every possible channel of appeal, which slows down the planning procedures.

Some Cantons (provinces) created combined procedures for land use

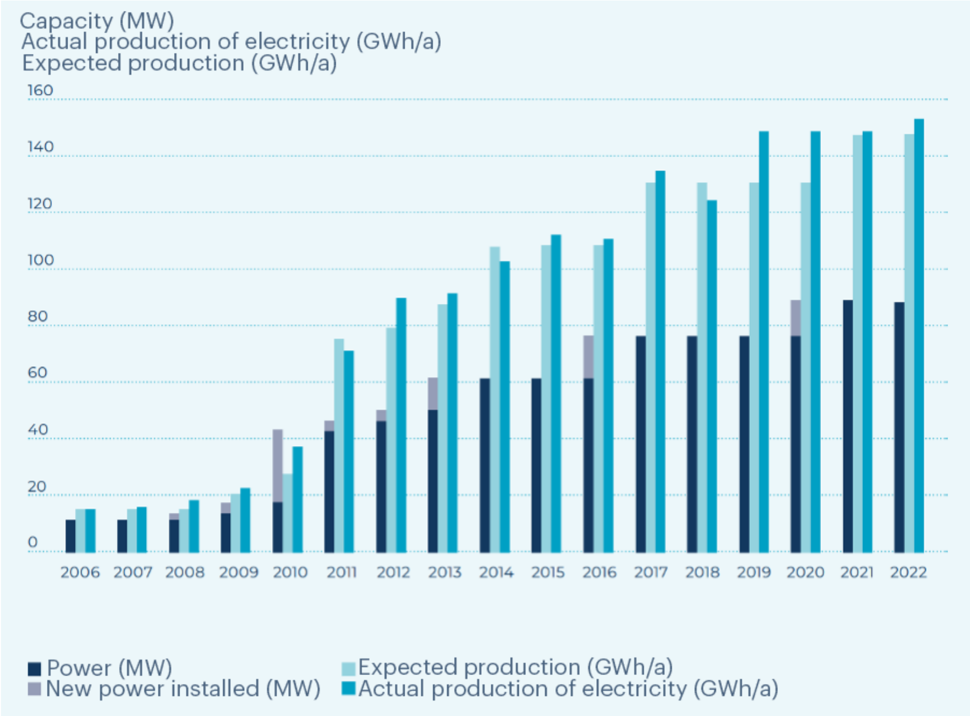

Figure 1.

planning and building permitting. In lieu of the energy crises, several improvements in permitting processes are discussed on the national level. The most advanced is considering reducing the number of courts involved in the last step of wind energy authorisations.

RD&D Activities

National RD&D Priorities and Budget

The Swiss R&D priorities are:

Plants:

- Development of data-related methods for planning, layout, and operation of wind parks;
- Development and validation of control strategies for optimising overall operational performance (e.g., concerning forecasts and shut-down algorithms).

Turbines:

- Component optimisation, especially for the use of wind energy in complex terrain;
- Development and validation of components for cold climates and for accurate forecasting of ice formation;
- Noise abatement strategies.

Additionally, alternative wind energy technologies above 1 MW.

In 2021, the budget for wind energy-related R&D and demonstration projects from the Swiss Federal Office of Energy was approximately 0.5 million CHF (0.44 million EUR; 0.53 million USD). Within the national Swiss Energy program, approximately 0.4 million CHF (0.37 million EUR; 0.45 million USD) were allocated to the wind energy sector for information activities, quality assurance measures, and supporting regional and communal planning authorities [2]. Budget-wise, the 2023 trend is the same as for 2022.

National Research Initiatives and Results

A Meteotest study [3] demonstrates that the wind energy potential in Switzerland is much higher than previously estimated. In Switzerland, 29.5 TWh per year could be generated from wind energy, of which 19 TWh in the winter half of the year alone, according to a new study commissioned by the Swiss Federal Office of Energy (SFOE) from Meteotest AG to determine the wind energy potential in Switzerland. If 30 percent of this sustainably usable potential were to be exploited, corresponding to around 1,000 wind power plants, 8.9 TWh of wind power could be produced in the country per year or 5.7 TWh in winter.

The EPFL MaxWep Project [4] explores the potential of the wind in complex terrain as an energy source during wintertime in Switzerland. A wind assessment method is developed based on short-term wind profile measurements with a wind lidar, and long-duration meteorological station measurements connected via machine learning to a specific site. Driving a high-resolution numerical weather model (WRF) with the COSMO model as an input, a map is created showing the spatial pattern of the local wind speed potential for short episodes of predominating weather patterns. The in-depth analysis of spatial patterns from Wind-Topo and WRF suggests that areas of high wind potential may be missed by the wind atlas, particularly in slopes and valleys. The study suggests further investigation of these effects and an update of the Swiss wind atlas at higher temporal and spatial resolution.

In 2022, OST finished the COME-SI project [5]. In wind energy, the accuracy of estimating wind resources has an enormous effect on the expected rate of return of a project. For a given project, the modeller faces a difficult choice of a wide range of simulation tools with varying accuracies and costs. In this project, a public "simulation challenge" for wind energy sites in complex terrain is being implemented in collaboration with IEA Wind Task 31. Participants submit their simulation data and results in a pre-defined template. The goal is to collect hundreds of comparison metric data regarding the "skill" and "costs" of simulation tools both before and after carrying out the simulations.

The influence of site complexity on the skill versus cost score plots was briefly explored by comparing three different models for four sites with increasing complexity. It was shown that for increasing site complexity, the "before" skill scores decreased, and the gaps between the skill scores of each model increased depending on its sophistication, i.e., LES outperformed RANS and WAsP simulations. In turn, less complex sites such as RANS and WAsP simulations performed similarly to the LES case but had significantly better cost scores. With more data, machine-learning and statistical models can replace this manual process and achieve more generalised and reliable results. The current methods and functions serve as a starting point for further development.

Collaborative Research

Switzerland is involved in the following IEA Wind TCP Tasks:

- Task 11: Base Technology Information Exchange Wind SCOUT (Operating Agent).
- Task 28: Social Acceptance of Wind Energy Projects.
- Task 32: LIDAR: Wind Lidar Systems for Wind Energy Deployment LiDAR.
- Task 34: Working Together to Resolve Environmental Effects of Wind Energy (WREN).
- Task 47: Aerodynamics.
- Task 48: Airborne Wind Energy.
- Task 52: Large-Scale Wind Lidar.
- Task 54: Cold Climate Wind Power.

Impact of Wind Energy

Environmental Impact

The results of the Carbowind study [6] show a significant impact on carbon reduction with newly installed wind power plants offsetting 378 g/kWh, despite the almost entirely carbon-neutral electricity generation mix. This study considers the relevant import of carbon-based electricity during winter in Switzerland. Wind power generation, combined with

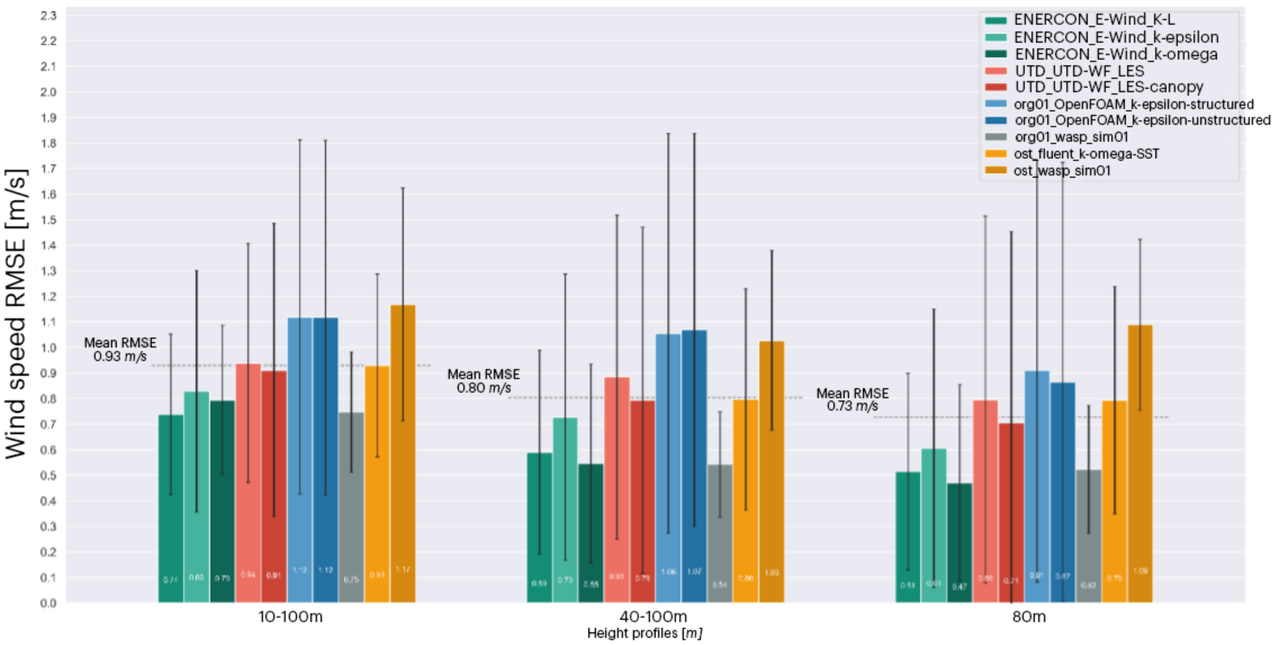

Figure 2: RMSE values between simulated and measured wind profiles for different heights for met mast 20. The dashed lines represent the mean RMSE values for all simulations at the specific height profile.

solar power, is expected to replace power generated by nuclear power plants. Nuclear plants are expected to be shut down at the end of their lifetime, where the Mühleberg power plant was the first to be effectively shut down in December 2019.

Economic Benefits and Industry Development

The Swiss industry is active in several wind energy fields:

- Development and production of chemical products for rotor blades, such as resins or adhesives (Gurit Heberlein, SIKA, Huntsman, Clariant).
- Grid connection (ABB).
- Development and production of power electronics such as inverters (ABB, VonRoll).
- Services in the field of site assessments and project development (Meteotest, Interwind, NEK, New Energy Scout, etc.)

Next Term

New energy laws with the purpose of accelerating the energy transition are in discussion in 2023. In June 2023, a dedicated law for Wind Energy was adopted and will reduce the permitting time from 25 to 22 years for advanced wind projects. Six projects are expected to benefit from this change and be built in 2025-2026 instead of 2028-2029.

References

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