IEA GEOTHERMAL

Switzerland Country Report
2012

IEA Geothermal
Implementing Agreement

National Activities

Chapter 20 of Draft 2012 GIA Annual Report

Switzerland

Figure 20.2 Aerial view of the well pad at the St Gallen combined heat and power project site. (Photograph courtesy of City Utility of St Gallen)

20.0 Introduction & Overview

Switzerland's uptake of shallow geothermal continues unabated and is not constrained by its natural potential. This sector has enjoyed annual compound growth rates of about 12% per annum for the last 12 years (Figure 1), with a total number of some 80'000 ground source heat pumps systems deployed in Switzerland by the end of 2012 (reference 1). Similarly, the theoretical potential for direct use geothermal and geothermal for power generation is considered to be very large. Yet more realistic estimates of the technical and (with support mechanisms) economic potential is limited to between 1-20 TWhs and associated with it co-produced heat.

2012 saw the maturation and execution of two deep geothermal projects, in Schlattingen (Canton Thurgau) in the north of the country and preparations for a combined

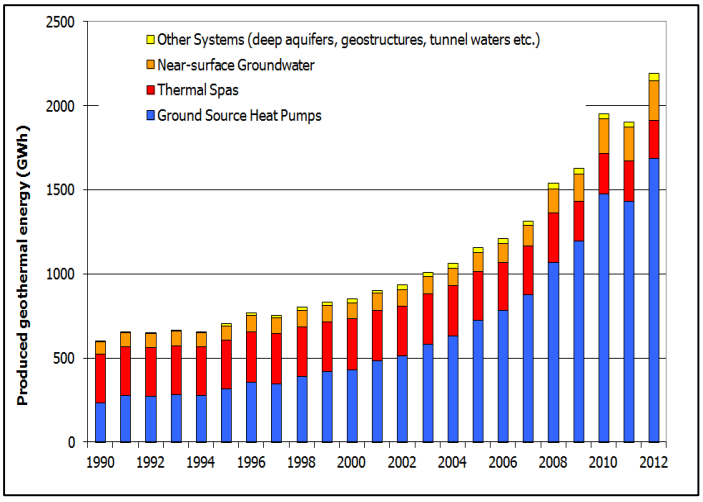

Figure 20.1 Geothermal energy utilization in Switzerland.

heat and power project in the city of St. Gallen (Canton St Gallen) located in the east of the country. The combined heat and power project of the City Utility of St Gallen obtained a CHF 24.1 million geothermal guarantee in case the subsurface development fails to deliver the projected reserves.

Policy incentives for power generation from deep geothermal energy resources continue to be developed yet this results in little industrial activity. R&D funds remain for 2012 at a level of US$ 4 million (including funds for deployment activities). A significant part of R&D funds in the deep geothermal energy sector are geared at managing induced seismicity in geothermal operations.

In the wake of the major incident at the Fukushima Daiichi Nuclear Power Plant due to the 11 March 2011 earthquake and tsunami, the cost reduction in renewables and political instabilities in North Africa and the Middle East, Switzerland is in the process of developing and implementing the 2050 energy strategy. The key feature is a phased exit over the next approximately 20-30 years from nuclear energy, which today supplies around 40% (25 TWh) of the country's electricity demand. One of the consequences is an ambitious drive to increase the share of power from new renewables from today's 1.9 TWh to some 4.4 TWh and 14.5 TWh by 2020 and 2035. Geothermal energy is envisaged to provide about 1 TWh by

Table 20.1 Status of geothermal energy use in Switzerland for 2012.

Electricity	
Total Installed Capacity (MW_e)	0
New Installed Capacity (MW_e)	0
Contribution to National Capacity (%)	0
Total Generation (GWh)	0
Contribution to National Generation (%)	0
Target (MW_e, % national generation, etc.)	0
Estimated Country Potential (MW_e or GWh)	0
Direct Use	
Total Installed Capacity (MW_{th})	4.3
New Installed Capacity (MW_{th})	1.3
Total Heat Used (PJ/yr or GWh/yr)	0.015 [4.0]
Total Installed Capacity Heat Pumps (MW_{th})	1581
Total Net Heat Pump Use [GWh/yr]	1962
Target (PJ/yr,)	na
Estimated Country Potential (MW_{th} /PJ/yr/GWh/yr)	na

2035 from today's zero. Further aggressive targets for end-users in terms of energy efficiency and reduced greenhouse gas emissions are expected to fuel growth for indirect and direct heat supply from geothermal energy. While targets are discussed in terms of consumption, no targets are given for individual sources on the supply side.

20.1 National Program

In 2012, the Swiss Federal Office of Energy has developed a comprehensive policy support program for deep geothermal energy (see reference 2) which will be part of the implementation of Switzerland's energy strategy 2050. While not all policy measures will be implemented from the very start, parliament and the federal and cantonal administrations are expected to support a progressive implementation.

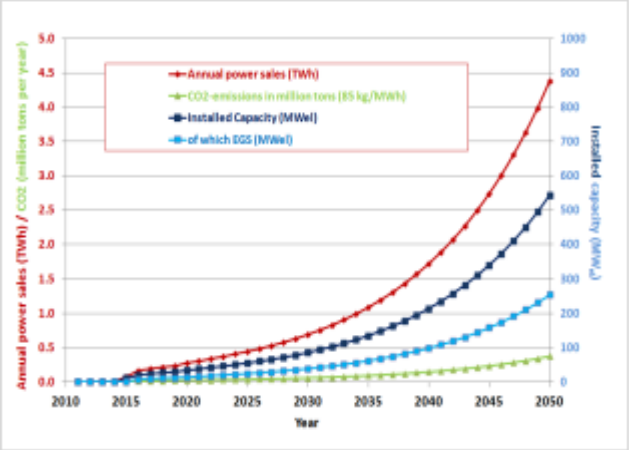

Figure 20.2 Scenarios for growth of power from geothermal energy resources in Switzerland. The scenario is the basis for the development of policy measures to promote power from geothermal energy (Source: Swiss Federal Office of Energy).

In 2012 no major new laws or significant regulations have been issued.

Since federal and cantonal governments and their administration cannot drive geothermal development, it is left to the private sector to develop geothermal energy. Government incentives for deep geothermal energy include feed-in tariffs for geothermal energy, a geothermal guarantee scheme to offset some of the financial consequences of not finding suitable resources which ultimately owes to the poor knowledge of Switzerland's deep subsurface, and funds for research, development and deployment (for technologies at the pilot and demonstration stage).

For shallow geothermal energy utilization, cantons offer support mechanisms for utilizing ground source heat pumps (the principal drivers are energy efficiency and greenhouse gas targets).

20.2 Industry Status and Market Development

Market conditions for industry players in the ground source heat pump sector are increasingly challenging (reference 3). Due to the success of ground source heat pump deployment, many players have entered a market which based on anecdotal evidence suggests early signs of consolidation. Most shallow geothermal drilling companies compete on price, yet quality assurance has been maintained at a high level owing to quality labeling schemes for heat pumps and drilling companies on the hand and norms (SIA 384/6) and guidelines provided by the Swiss Federal Office of the Environment for ground source heat pumps. A number of gaps have been identified for ground source heat pump schemes; checks and controls are not implemented widely, completion of ground source heat pumps pose the biggest risks (installation, backfills and testing). It is possible that materials pose limits. In addition, the lack of spatial planning regulations in Switzerland suggests a poorly regulated legal framework for the deployment of deep ground source heat pumps. In general, ground source heat pumps are problem-free to depths of 150 m. At depths larger than 250 m, risks are higher and problems are observed. In general, it appears, however, that the Swiss Molasse Basin which straddles about 50% of the country by area and serves as the deep underground of the more than 75% of its population is well suited for wide-spread uptake of ground source heat pumps (see reference 3).

The Swiss federal government does not have any direct incentive schemes for utilizing geothermal energy. A number of Switzerland's 26 cantons have support schemes that are in effect investment subsidies for ground source heat pumps.

Switzerland's industry is less well developed in respect to the development of its deep geothermal resources. This covers the entire value chain from exploration, drilling, facilities and operation of geothermal heat and power plants. Players in the, to date, practically nonexistent market are not very numerous. The development is constrained by lack of financial resources, lack of skilled human resources and deficits in the legal and regulatory framework. It should be noted, however, that most of the core competencies for overcoming those barriers exist, and notably cantonal administrations and legislators are willing to work with developers in designing and implementing business friendly legal and regulatory frameworks.

Complimentary to these efforts, the Swiss federal government continues to implement feed-in tariffs and a geothermal guarantee scheme for geothermal power plants. The requisite funds for financing the feed-in tariffs and other related measures such as the geothermal guarantee derives from a surcharge that end customers pay for power transmitted via the high voltage grid. In 2012, the surcharge amounted to 0.45 Rp. per kWh, a part of the average end price to the customer of 17 Rp. per kWh. Since the surcharge is designed to make whole the distributor who is obliged to take off (uncompetitive) power from new renewables, the surcharge revenues may only be used for measures to assist new renewable power commercial viability. In effect the measures amount to technology development.

Since the revenues resulting from the surcharge are defined by the power transmitted via the high voltage grid, there is – unlike for example Germany – a cap on the annual subsidies available for all measures (approximately CHF 250 million per year). In effect, this implies a wait-list for projects. The wait-list has a substantial turn-over because many announced projects (mostly photovoltaic or wind energy) do not materialize. Next, feed-in tariffs are paid out only for 20 years.

Since feed-in tariffs are governed by the Energy Ordinance there is one unusual side effect on the feed-in tariff for geothermal power: the power required for artificial lift is not subtracted from the power supplied to the grid subject to the feed-in tariff. This feature stems from an analogy to power from biomass. The energy required to mobilize bio-feedstock to the factory gate is not subtracted from the power supplied to the grid. Hence artificial lift, the energy necessary to deliver hot water/steam to the power plant is also discounted.

Table 20.2 Feed-in tariffs for electricity from geothermal energy resources (Reference 4).

Installed capacity	Feed-in Tariff (Rp./kWh)
≤05 MW	40.0
≤10 MW	36.0
≤20 MW	28.0
>20 MW	22.7

US$ 1 = CHF 0.95 or 95 Rappen (Rp.)

Owing to the severe gaps in the knowledge of the deep subsurface of Switzerland (only 10 wells have been drilled in the country to depths greater than 3000 m), the federal government has instituted a geothermal guarantee scheme for geothermal power projects (reference 5). The scheme is underwritten by a CHF 150 million fund that has been financed by the grid surcharge. Geothermal power projects may apply for a geothermal guarantee and once qualified may be reimbursed for up to 50% of the total subsurface development cost of the project in case of failure.

20.3 Research, Development and Demonstration/Deployment

Funding for RD&D comes from a variety of sources in Switzerland. Fundamental research is funded

predominantly be the Swiss National Science Foundation. Funds usually flow to university researchers. Dedicated to geothermal energy utilization is the COTHERM (COmbined hydrological, geochemical and geophysical modelling of geotTHERMal systems) – project (https://www.rdb.ethz.ch/projects/project.php?proj_id=30445&z_detailed=1&z_popular=1&z_keywords=1). 2012 funding amounted to approximately CHF 0.2 million.

The main actors in funding oriented and directed fundamental research are the ETH Domain (the 5 research institutes of the Swiss confederation) and the Swiss Federal Office of Energy. The funding in 2012 amounted to a combined CHF 2 million. Notable projects include GEOTHERM (2008-2012) which has analysed in depth the data of the Basel EGS Project, and derived some important learnings with respect to the stress and strength heterogeneity in seemingly homogeneous crystalline rock masses, assessed the relationship of distance to the borehole, stress drop, earthquake statistics (frequency-magnitude relationships) and various other features during a massive hydraulic stimulation (http://www.cces.ethz.ch/projects/nature/geotherm)

The Swiss Federal Office of Energy also funds pilot and demonstration projects. Geothermal energy projects receive between CHF 0.5 – 1 million per year. The main project funded throughout 2012 was a direct use project in the canton of Thurgau; here a agribusiness drilled to a depth of about 1200 m encountering temperatures of 60 ^{o}C to supply direct heat to the greenhouse instead of burning fossil fuels (http://www.grob-gemuese.ch/cms/index.php?id=23). The Swiss Federal Office of Energy publishes annually a summary of the activities of its geothermal RD&D program (reference 6).

The Universities of Applied Sciences which are jointly funded by the Swiss confederation and groups of cantons also perform applied research and development – mostly in the field of shallow geothermal energy utilization, heat pumps and quality control. Funding levels are difficult to ascertain but range from CHF 0.1 – 0.5 million per year.

Lastly, the Commission for Technology and Innovation CTI of the Swiss confederation funds joint academia-industry projects. Industry funds its own contribution, but CTI funds the academic portion up to 50% of the total project cost. Geothermal energy has not been highly successful in obtaining funds in part owing to lack of funding requests by industry in the shallow geothermal sector and in part owing to the immaturity of the deep geothermal industry. Total CTI funding amounts to about CHF 0.1-0.2 million per year for geothermal energy projects.

Switzerland's utility companies run a joint R&D organisation (swisselectric Research) which has funded on occasion projects related to geothermal energy at funding levels of no more than CHF 0.3 million per year. Individual utilities also award grants to the research sectors for directed research. Funding levels are not known but are likely less than CHF 1 million per year. Finally some field activities may be declared as R&D expenses by individual companies. Again amounts are unknown.

20.4 Geothermal Education

The University of Neuchâtel has launched a highly successful, oversubscribed Certificate for Advance Studies or CAS DEEGEOSYS - Exploration & Development of Deep Geothermal Systems (reference 7).

20.5 Future Outlook

Beyond 2012 a number of policy changes will be progressed; mostly notably the totally revised Energy Act will be submitted for discussion to parliament in September 2013. A major new Energy R&D capacity expansion is being prepared for launch in 2013. Energy R&D is considered one of the 5 pillars on which Switzerland's energy strategy 2050 rests. Project-wise it is expected that the St Gallen Geothermal Project (the first major combined heat and power project in Switzerland since 2006) will spud their first well. Similarly, a second highly deviated well is being planned for the direct use agri-business project in Schlattingen TG.

20.6 Publications and Websites

1 - Statistik der geothermischen Nutzung in der Schweiz Ausgabe 2012 (2013). Published by the Swiss Geothermal Association geothermie.ch
http://www.geothermie.ch/data/dokumente/miscellanusPDF/Publikationen/Geothermiestatistik%20Schweiz%202012.pdf
[Document only available in German]

2 - Energiestrategie 2050 – Erstes Massnahmenpaket Zusammenstellung der Massnahmenbeschriebe (2012)
http://www.bfe.admin.ch/php/modules/publikationen/stream.php?extlang=de&name=de_691836301.pdf
[Document only available in German; deep geothermal enery support program pp. 116-140]

3 – Qualitätssicherung Erdwärmesonden by Dr. Walter Eugster, dipl. Natw. ETH
http://www.fws.ch/tl_files/download_d/Downloads/Eugster-QS-EWS_Eugster.pdf
[Document only available in German; presentation on Quality Assurance in Ground Source Heat Pumps]

4 – Energy Ordinance (730.01) - Appendix 1.4
http://www.admin.ch/opc/de/classified-compilation/19983391/201210010000/730.01.pdf
[Document available in German and French]

5 – Energy Ordinance (730.01) - Appendix 1.6
http://www.admin.ch/opc/de/classified-compilation/19983391/201210010000/730.01.pdf
[Document available in German and French]

6 – 2013 Report of the RD&D Program Geothermal Energy of the Swiss Federal Office of Energy http://www.bfe.admin.ch/php/modules/enet/streamfile.php?file=000000011027.pdf&name=000000290789

7 – Certificate of Advances Studies at the University of Neuchâtel: CAS DEEGEOSYS - Exploration & Development of Deep Geothermal Systems Certificate http://www2.unine.ch/foco/CAS-DEEGEOSYS

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