

## Nuclear

## Keywords

- > Anti-Nuclear movement
- > Switzerland
- > Chernobyl and Fukushima
- > Nuclear phase-out

**Table 1.** Important events in the history of the Swiss nuclear industry, and anti-nuclear protest movement.

1967	Construction of first nuclear power plant (NPP) - Beznau 1
1969	Partial core meltdown at prototype test reactor at Lucens (INES level 4 event), area decontaminated and reactor decommissioned
1971	Both Beznau 2 and Mühleberg reach criticality, however a fire in a steam turbine of Mühleberg causes 1 year delay to commercial operations (to 1972)
1975	Two-month occupation of Kaiseraugst NPP construction site by 500 activists, leads to cancellation of plant construction
1979	National "Atomschutz" referendum rejects radically tightened nuclear safety rules (49% yes, 51% no)
1984	Referendum rejects complete phase out of nuclear power rejected (45% yes, 55% no)
1986	Chernobyl disaster adds momentum to anti-nuclear movement, 30 000 demonstrate at Gösgen plant
1990	Fissures discovered in core shroud of Mühleberg

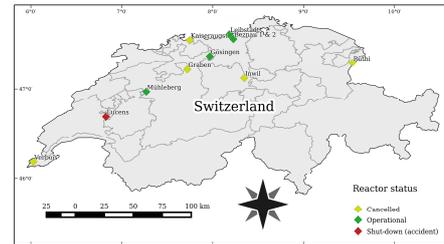
## Summary

Switzerland adopted commercial nuclear power in 1969 and has a total of five operational nuclear reactors. These are located in four plants that supply 36.4% of Switzerland's energy. While reactor construction halted in the 1980s due to pressure from a growing anti-nuclear movement (reinvigorated by the Chernobyl disaster), existing plants have been strongly criticized for their age (the Beznau 1 reactor is the oldest in the world), risk of accident, and lack of long-term waste disposal plans. At the time of the adoption of nuclear-energy, the technology was actually favoured by environmental groups over hydroelectricity and fossil fuels. This initial approval soon turned to opposition through non-violent direct action, supported by a range of political parties, NGOs, activist networks and associations.

The Swiss anti-nuclear movement experienced early success during the occupation of the Kaiseraugst nuclear power plant construction site in 1975. Around 500 activists drew a 15 000-strong crowd of supporters on-site and widespread popular support in the Basel region and nationally, leading to construction plans being cancelled. However, popular support and momentum for the movement has fluctuated since then, with short-term waves of mobilization largely catalysed by outside events, specifically the Chernobyl and Fukushima Daiichi disasters. The current outlook paints a picture of mixed success. Switzerland's post-Fukushima pledge to exit nuclear energy is upheld in principle, but watered down in practice through periodic extensions of the operating licences of existing plants.

## Background

Switzerland adopted nuclear power in 1969 with the construction of the Beznau 1 nuclear power reactor. The country has a total of five operational nuclear power reactors contained in four power plants (construction date and capacity in megawatts): Beznau 1 (1969; 365 MW)



*Figure 1. Map of nuclear reactor locations in Switzerland, showing operational, decommissioned and planned (cancelled) reactors. (Source: Michael Curran)*

and 2 (1972; 365 MW), Mühleberg (1972; 355 MW), Gösgen (1979; 970 MW) and Leibstadt (1984; 1165 MW). A sixth prototype reactor (Lucens, 1968; 6 MW) was decommissioned after a year of operation due to a partial core meltdown (see Figure 1). In total, nuclear energy supplies 24.8 terawatt-hours (TWh) of electricity, accounting for 36.4% of Switzerland's production capacity. Soon after the country adopted nuclear power, an anti-nuclear protest movement also developed opposing the impacts of nuclear energy, particularly local health and economic effects, potential risk of catastrophe, and the enormous pollution legacy shifted to future generations.

## An overview of the reactors

Both Beznau 1 and 2 are owned by "Axpo Holding AG", a company registered in Canton (territory) Aargau, Switzerland, with a turnover of USD 6.6 billion (fully owned by Swiss Cantons in the northeast of the country). Following the decommissioning of the Oldbury nuclear power plant in Britain in 2012, Switzerland's Beznau 1 reactor has occupied the top spot as the oldest operating nuclear power plant in the world. The reactors are planned to be decommissioned in 2029 and 2031, respectively, following 60 years of operation. This is strongly opposed by the anti-nuclear movement, who advocate an earlier (immediate) decommissioning.

The Mühleberg nuclear power plant is located in the Canton of Bern, Switzerland, and is a first generation



1990  
Swiss referendum accepts introduction of 10-year moratorium new NPP construction (54.5% yes, 45.5% no)

1996  
Core shroud fissures in Mühleberg repaired with tension anchors, but Swiss Federal Nuclear Safety Inspectorate (ENSI) rejects repair as safe long-term solution

2003  
Two Swiss referendums proposing a phase-out of nuclear energy (33.7% yes, 66.3% no) and extension of the existing moratorium of 1988 (41.6% yes, 58.4% no) fail

2008  
Plans for a second Mühleberg reactor (Mühleberg 2), a third Beznau reactor (Beznau 3) and a new reactor (Niederamt) submitted for approval by Swiss Federal Office of Energy

2009  
In an EINES level 2 event, a room in Beznau 2 is irradiated. Two workers exposed to high doses of radiation

2010  
Another EINES level 2 event in Leibstadt. A worker's hand is irradiated with more than a one year dose of radiation

2011  
Fukushima Daiichi catastrophe in mobilizes Swiss protest of 20 000. Government pledges halt to new reactor construction and exit nuclear energy by 2034. Limits operational life of existing plants to 50 years.

2013  
Shut down date for first of Switzerland's five reactors (Mühleberg) announced by plant operators for 2019

2014  
Swiss government reneges on pledge of early exit from nuclear energy, allows plants to extend operation to 60 years, provided safety requirements met.

General Electric "boiling water reactor" with Mark I containment and an electricity generation capacity of 373 Megawatts. It is owned by the "Bernische Kraftwerke AG" group, located in the Canton of Bern (who own 52% of shares) and was built with USD 150 million in equity capital in 1971. Due to an accident (a fire in a turbine), it did not become commercially operational until November 1972. Due to its age, outdated technology and proximity to the capital of Switzerland, the reactor has been a frequent target of the Swiss anti-nuclear movement, which has repeatedly called for the plant's immediate closure.

Both Gösgen and Leibstadt are owned by ad hoc groups of "Kernkraftwerk Gösgen-Däniken AG" (shareholders include both private companies and Swiss Cantons) and "Kernkraftwerk Leibstadt AG" (composed of seven other energy companies), respectively. Both reactors have seen protest, in particular Gösgen, whose construction attracted a demonstration of over 30 000 people.

## Impact

In 1969, Switzerland's experienced a significant nuclear accident with wider repercussions. In parallel to the first commercial plants becoming operational, an underground test reactor in Lucens had a partial core meltdown, releasing large doses of radiation that required decontamination and decommissioning of the facility. This qualified as a level 4 "accident with local consequences" on the International Nuclear Event Scale (INES), which increases logarithmically from 0 ("deviation") to 7 ("major accident"). In addition, the country's nuclear industry has had two further level 2 events ("incidents") and nine level 1 events ("anomalies"). The INES scale was developed by the International Atomic Energy Agency (IAEA) in 1990 as a public relations rather than objective analytical tool. Its scoring has been criticized due its qualitative nature, arbitrary upper limit (of 7), and conflation of intensity with magnitude of effect (an alternative proposal for scoring nuclear

events is provided in the references of this factsheet).

Heightened future risks associated with continued operation of three of the oldest nuclear reactors in the world (Beznau 1, Beznau 2 and Mühleberg) has attracted criticism by the anti-nuclear lobby. In particular, a growing fissure in the core shroud of Mühleberg that was discovered in 1990 has attracted widespread concern (see Table 1 for a list of significant events in the history of the industry and the anti-nuclear movement). In addition, long-term waste disposal has remained a core issue in the anti-nuclear movement, as suitable sites have not been identified to guarantee safe storage for an estimated 10 000 years of radioactivity.

## Conflicts and consequences

In the late 1960s, when Switzerland adopted nuclear energy, objections were near-absent and many environmental groups favoured nuclear power as a substitute for hydroelectricity and fossil fuels. However, by the end of the first decade of operations a prominent anti-nuclear movement had established that employed non-violent direct action. To this day, the movement has been supported by a wide range of concerned citizens, farmers, students and political parties, and is credited as having giving birth to the Green Party in Switzerland. To this day, the movement has been supported by a wide range of concerned citizens, farmers, students and political parties, and is credited as having given birth to the Green Party in Switzerland. The most prominent non-violent protest involved the occupation of the Kaiseraugst nuclear power plant construction site in 1975 by approximately 500 activists. This in turn drew wide support from over 170 parties and associations along with a 15 000-strong crowd of supporters on-site, along with huge support regionally and nationally. After 2 months, a successfully negotiated end to the occupation led to the cancellation of construction of the plant. In the latter half of the decade, splits and internal disputes slowed the movement,



Figure 2. Protest following the Fukushima Daiichi catastrophe, which drew a crowd of over 20'000 protesters. (Source: Greenpeace Switzerland)



Figure 3. A protest camp outside the headquarters of the "Bernische Kraftwerke AG" group (owners of the Mühleberg nuclear power plant) in 2011, following the Fukushima Daiichi catastrophe. The camp, which demanded an immediate shut-down of the beleaguered Mühleberg plant, was cleared by police following 11 weeks of protest. (Source [http://akw-ade.ch/?page\\_id=56](http://akw-ade.ch/?page_id=56))

but there were a number of attempted occupations (drawing the support of thousands of activists) and a successful launch of a national referendum (the "Atomschutzinitiative") in 1979. The referendum would have required plant operators to construct long-term waste-storage facilities in parallel to nuclear power plants and accept all financial liabilities associated with accidents and long-term disposal of radioactive material. A tight rejection by the population (49% yes versus 51% no) pushed the movement into a second period of demobilization until the Chernobyl disaster occurred in Ukraine in 1986. This hardened public opinion against nuclear energy and led to two further referendums. One failed to close down existing plants, but a second successfully established a 10 year moratorium on new reactor construction (affecting a further five planned plants). Between Chernobyl and Fukushima, the movement again lost steam, with voters rejecting further local and national referendums for an early phase out nuclear energy. The Fukushima disaster reinvigorated the anti-nuclear movement, with over 20 000 marching in the streets (see Figure 2) and many localized protests emerging around the country (see Figure 3).

In the days following these protests, policy-makers immediately committed to a mid-term phase-out of nuclear energy by limiting reactor operation to 50 years, leading to a phase-out by 2034. However, this resolve has since weakened with the government supporting 10-year extensions for plants that meet safety requirements, essentially side-stepping any commitments to decommission plants early in their life-cycle. Even the world's oldest plant, Beznau 1, is planned to be shut down in 2029 after 60 years of operations. This is strongly criticized by opponents as a safety risk due to the

limited capacity of the ageing equipment. However, in 2014 the anti-nuclear movement in the Canton of Bern successfully organized a referendum on the immediate closure of the Mühleberg reactor. While the referendum was eventually rejected by the Bernese population, mounting pressure in the run-up to voting caused the operators of the Mühleberg plant to announce an early (compromise) decommissioning date of 2019.

All in all, the success of the anti-nuclear movement in Switzerland has been comparable to other European countries. Its achievement of resisting 50% of

#### More on this case

- Greenpeace Switzerland: <http://www.greenpeace.ch/>
- Greenpeace Switzerland: <http://www.greenpeace.ch/>
- Mitwelt Anti-Atomkraftgruppen Schweiz: <http://www.mitwelt.org/anti-akw-schweiz.html>
- Menschenstrom Gegen Atomkraft: <http://www.menschenstrom.ch>
- Nie Wieder Atomkraftwerke (NWA): <http://www.nwa-schweiz.ch/>
- Official BKW Website – <http://www.bkw.ch>
- Swiss Energy Foundation: <http://www.energiestiftung.ch>
- Tri-national Anti-nuclear Association: <http://www.atomschutzverband.ch>
- Wikipedia – [http://de.wikipedia.org/wiki/Kernkraftwerk\\_Leibstadt](http://de.wikipedia.org/wiki/Kernkraftwerk_Leibstadt)
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planned reactors compares well to countries such as Germany (72%), the U.K. (44%) and the Netherlands (11%). At the same time, Switzerland is one of only three countries in western Europe to pledge a nuclear phase-out (alongside Germany and Belgium), indicating a favourable degree of long-term success. Despite this, while external events such as Chernobyl and Fukushima have brought waves of momentum and optimism to the movement, the lasting legacy currently appears to be a 21st Century still significantly powered by nuclear energy.



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