Project

EBP

The feasibility of phasing out nuclear power in Switzerland

The aim of the Swiss citizens' initiative to decommission Switzerland's nuclear power plants was to take a phased approach to their removal from the power grid 45 years after they were initially commissioned. EBP reviewed the initiative's feasibility from the perspective of energy security.

Three reference years and three scenarios

The initiators of the Swiss Citizens' Initiative to Phase Out Nuclear Power in Switzerland proposed the following years for the decommissioning of Swiss nuclear power plants: Beznau 1, Beznau 2 and Mühleberg: 2017; Gösgen: 2024; and Leibstadt: 2029. The feasibility of adhering to this schedule without jeopardizing energy security can essentially be determined by assessing energy supply in the winter months following the plant shutdowns. In its review, EBP therefore assessed the following three winters: 2017/18, 2024/25 and 2029/30. In addition to this, EBP took account of three different scenarios, since the technical feasibility of the initiative is dependent on the assumptions about future developments. Among other factors, these scenarios reflect various developments relating to domestic supply and demand for electricity.

Modeling the Swiss electricity system

Switzerland's power supply (Electricity Statistics 2015) is characterized by its domestic production significant imports and exports that are transacted predominantly at voltage level of 380-kV. It follows that a secure supply of power is critically dependent on production capacity and the availability of

Client

Greenpeace Schweiz / Swiss Energy Foundation (SES)

Facts

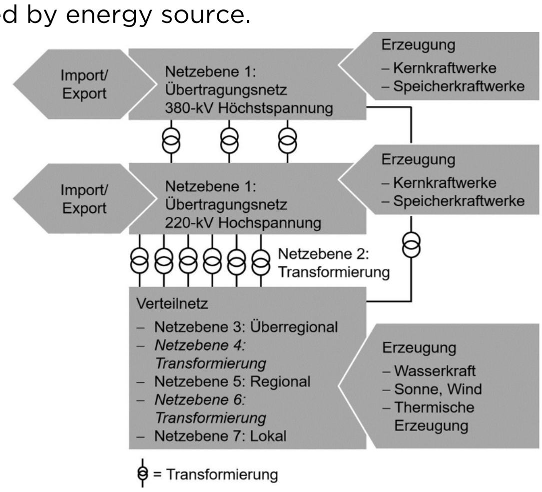
Period	2016
Project Country	Switzerland

Contact persons

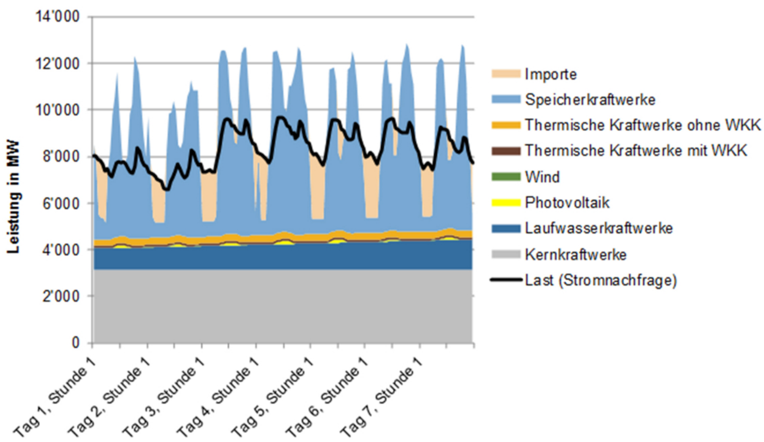
Dr. Michel Müller
michel.mueller@ebp.ch

Silvan Rosser
silvan.rosser@ebp.ch

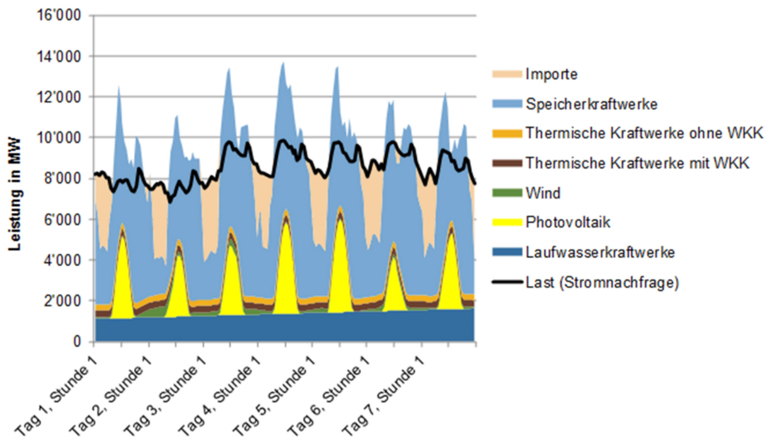
sufficient transmission and transformer capacity. This is illustrated by the ElCom Monitoring Concept: Production and network capacity are the crucial variables for energy security. Moreover, these variables are interdependent and need to be considered together when assessing questions of energy security. In our review, we therefore take restrictions on import and transformer capacity into account. The assumptions about grid expansion are based on the grid development plan Strategic Grid 2025. We simulate the Swiss power system with an hourly resolution. Nuclear power plants and storage power plants are modeled on the level of a single power plant. The remaining renewable and thermal power plants are modeled aggregated by energy source.



Overview of the Swiss electricity system



Reference: a week in the second half of February 2011/12, modeled with an hourly resolution



Considered scenario: a given week in the second half of February 2029/30, modeled with an hourly resolution

Energy security indicators

We used two indicators to assess energy security quantitatively. We developed these indicators expressly for our review based on existing methods.

— The first indicator is the remaining capacity at grid level 220 kV and lower. The indicator shows the difference between secured power-plant capacity and the maximum annual load as a security margin, i.e. calculated with a power balance sheet to the annual maximum load. All grid levels of 220 kV and lower, as well as all transformer and import restrictions are taken into consideration.
— The second indicator is the power reserve. The indicator is expressed as the minimum reservoir fill level behind Switzerland's hydroelectric dams during a water year. This second indicator is also analyzed at the 200-kV transmission grid level and lower and takes account of any applicable restrictions on transformer and import capacity.

Sensitivity analysis of important assumptions

We used sensitivity analyses to check the three key assumptions for the power reserve indicator:

— We examined the maximum net import capacity across a range of possible values.
— Import capacities can only be entered into the calculation if power reserves are available in Europe. Therefore, in one of our sensitivities we assume that imports are not possible in the 200 hours with highest domestic demand. Additionally, imports are also not possible in a hypothetical two-week cold spell in February.
— In another sensitivity, we assumed that reservoir-based hydroelectric capacity is used either on a purely revenue-oriented basis or oriented toward making the largest possible contribution to energy security.

Review findings

Our review shows that phasing out nuclear power in the manner proposed by the initiative would be technically feasible as long as the necessary measures are implemented. Strategies conceived to ensure energy security may give different weight to the following variables:

- Securing or increasing import capacities, for instance, by expanding Switzerland's participation in the European Union's internal energy market
- Allocating at least a part of the capacity of Switzerland's storage power plants to energy security
- Implementing measures to expand the generation of domestic power, making greater use of renewable sources of energy and reducing consumption

We are convinced that our results are particularly reliable given the fact that they are based on three scenarios and sensitivity analyses covering a broad range of possible developments. Moreover, we make use of conservative assumptions regarding technological development. Finally, our results are also consistent with those of other studies: Switzerland's Energy Future (ETH Zurich); results published by the Swiss Academy of Technical Sciences (SATW); and Strategic Grid 2025 (Swissgrid).