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Project

Combined electricity market models

How renewable energies will shape the Swiss electricity market up to 2050

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While nuclear energy is being phased out, wind energy, hydropower and solar electricity are gathering momentum. Can the Swiss electricity market manage the resulting changes?

The expansion of solar energy poses the system with challenges. *Source:* Shutterstock

At a glance

- The electricity market is facing changes: in particular, the volatile feed-in of wind and solar electricity will have a considerable impact on both the supply situation and prices.
- Researchers from the University of Basel and ETH Zurich investigated whether the Swiss electricity system will be able to cope with these changes.
- To this end, they combined technical and economic models, simulating various developments in the process.
- Their conclusion: even without legislative support, the current market architecture is suitable for achieving the objectives of Energy Strategy 2050 – primarily thanks to the flexible energy source of hydropower.

In future, renewable energies should assume a more prominent role in the area of Swiss electricity supply. At present, nuclear power plants and fossil energies provide relatively continuous streams of electricity. In contrast, wind and solar electricity are dependent on external conditions – leading to the volatile feed-in of this power. This will have an impact on imports, exports and electricity prices.

This raises the following questions: can the Swiss electricity market handle these challenges on its own and achieve the objectives stated under Energy Strategy 2050 without further legislative support? And: will the higher share of renewable energies put the reliability of the Swiss electricity grid at risk?

Researchers from the University of Basel and ETH Zurich investigated these questions as part of a joint project. In doing so, they based their work on both technical and economic models for the Swiss and European market. In the sub-project presented here, these models are combined to create a meaningful framework.

With this linked model structure, the impact of various future scenarios can be simulated. It also provides hourly market data which allows for it to be examined how the renewable energies affect electricity imports and exports under different market conditions. This also allows for the identification of seasonal or day-dependent patterns.

The market will succeed

The most important finding of the project is that the current market architecture is suitable for coping with the expected changes as envisaged under Energy Strategy 2050. Hydropower is flexible enough to ensure that the market can deal with the dynamics of renewable energies. There is thus no need for fundamental structural changes.

Switzerland is already well prepared. The high capacities for imports and exports and the planned further expansion of the electricity grid will suffice for the expected changes within the system. However, the continued good integration of Switzerland in the European electricity system will remain key.

This was the conclusion drawn by the researchers after having played through several scenarios up to 2050. These could be assigned to two main scenarios: “no policy”, with developments being left to the market, and “renewable target”, with politicians intervening and renewable energies receiving legislative support.

Electricity imports throughout the year

Either way, the expansion of renewable energies and the phasing out of nuclear power will change the seasonal electricity supply in Switzerland. While electricity is currently exported in summer and imported in winter, it is expected that in future electricity will have to be imported throughout the year.

In the scenario in which renewable energies are provided with legislative support, the old pattern of summer exports and winter imports will likely return in the long term. Viewed over the year as a whole, however, more electricity will still be imported than exported.

Price developments in Switzerland will continue to be greatly dependent on the European market. The model predicts price increases under all scenarios, primarily driven by rising CO_2 prices.

Gas and coal production costs are moving closer together and according to the simulation will reach a similar level from 2045. As a result, the price difference between the hours in which coal or gas determines the price will also melt away. This will be important for pumped-storage power plants whose business model is based on market dynamics.

Cheap in spring, expensive in autumn

The larger share of renewable energies will later also lead to a decline in prices during spring and summer: after all, there is an abundance of sunlight available during the long days at this time of year. In return, prices during autumn and winter will rocket if demand for electricity increases.

This effect will be especially palpable during the transitional phase if the renewable energies are unable to cover increasing requirements alone and fossil power plants set the prices during these periods. When looking at average price developments, it therefore needs to be considered that there will be times with high and low outliers.

Depending on the power plant type, these price developments have a different impact on hydropower. The revenues of run-of-the-river plants remain close to the average market price. Pumped-storage power plants could, however, benefit in the long term: according to the simulation, in 2050 with a large level of feed-in from wind and solar power they will be able to pump water cheaply – and sell it again for a good market price at a later time.

Produkte aus diesem Projekt

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