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Project

Investments in hydropower

An Uncertain Future for Hydropower

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Hydropower is an important pillar of the Energy Strategy 2050, but this formerly profitable business has become difficult due to a decline in wholesale electricity prices. In future, climate change and new power storage technologies may exacerbate this phenomenon. How can hydropower remain economically viable despite growing uncertainties?

The Contra dam in the Val Verzasca, canton of Ticino. *Source:* Wikimedia Commons

At a glance

- New renewable energies and electricity storage options make it more difficult to economically produce electricity from hydropower, as the latter requires significant and long-term investments.
- Wind farms and solar power stations can be expanded progressively and their service lives are comparatively short. As such, investment decisions can be made more flexibly than is the case for hydropower.
- Nevertheless, hydropower remains important, as it can compensate for the volatility of renewable energy production and allows electricity to be stored in pumped storage power stations.
- To ensure that power producers can continue to provide these services in an economically viable way, the planning of hydropower projects must become more flexible and include elements such as modular expansion steps.

Hydropower is central to the implementation of the Energy Strategy 2050 because electricity production is emission-free and flexible. It also allows the storage of excess energy from other power sources, such as photovoltaics or nuclear power plants, in pumped storage power stations and its release at times of high demand. A lucrative business model for many years, times have now changed and uncertainty characterises the use of hydropower: overproduction on the European market and low prices for fossil fuels have caused wholesale prices to collapse. In addition, dams, pressure tunnels and turbine houses are expensive, have long service lives and amortization periods, and the concessions required for hydropower plants are not very flexible, which makes it impossible to quickly adapt the dimensions of a power plant. Changes in water volumes due to climate change cause additional uncertainty.

So how can hydropower plants continue to be operated at a profit? This question was addressed by the scientists working on this research project.

Start small, think big

To this end, the researchers created mathematical models for the proceeds from storage stations and renewable energy sources. The calculations show that given the current uncertain conditions on the power market, it is more profitable to invest in novel renewables than in pumped storage power stations. The former have a payback period of 20 to 27 years, the latter of up to 80 years. Pumped storage power stations must therefore provide decision-makers with more flexible options. According to the investigators, one way to achieve this is by adopting the "start small, think big" approach: potential future expansion projects should be taken into account within the planning phase of retrofits or new constructions. Turbine houses and pressure tunnels should be dimensioned so that further turbines can be added at a later date, the foundation of a dam wall in such a way that it can support a later increase in height.

The simulations show that such optional expansion steps can turn an initially unprofitable project into a financially attractive one.

Climate change and water rights

Hydropower plants are also affected by climate change. The flow pattern of rivers changes in the course of a year: in autumn, precipitation usually occurs in the form of rain rather than snow and thus runs off directly. And where glaciers have melted, water is scarce in summer. The researchers calculated the effects of these changes on the basis of three dams. They found that it is possible to compensate for lower runoff volumes by accumulating water in a sufficiently large reservoir and thus storing it for times of low precipitation. Thus, clever planning can help manage the uncertainty caused by climate change.

Water rights concessions are an additional factor that promotes inflexibility with regard to hydroelectric power plant planning. Many of these concessions, required for the operation of hydropower plants, have 80-year terms. But researchers also see this as an opportunity, as many of these concessions will expire in the next few years and will have to be renewed. These renewals are an opportunity to find more flexible solutions taking into account market liberalisation, and politicians should completely rethink the allocation of concessions.

New conditions

However, this is not the only area in which politicians should take action: the legal framework for hydropower must be adapted to the objectives of the federal government's energy strategy.

The investigators believe that a gradual expansion would increase public acceptance. Hydroelectric power and its storage facilities are essential to the implementation of the Energy Strategy 2050, as they can compensate for the irregular energy production associated with solar and wind power plants and thus provide the required capacity during peak hours. According to the researchers, new storage systems are becoming increasingly competitive, and novel technologies for electricity production and storage should complement hydroelectric power.

Produkte aus diesem Projekt

- Conceptual framework to classify and manage risk, uncertainty and ambiguity: An application to energy policy
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Contact & Team

Franco Romerio
Institut des Sciences de l'Environnement
Université de Genève
24 rue du Général-Dufour
1211 Genève 4

+41 (0)22 379 71 11
franco.romerio@unige.ch

Franco Romerio
Project direction

Ludovic Gaudard

Werner Hediger

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