

The future of Hydropower between energy policy and electricity market liberalization – A case study of Western Europe

Ludovic Gaudard and Franco Romerio, Institute for Environmental Sciences, University of Geneva, Switzerland

Overview

Our article aims to depict different scenarios concerning the future of hydropower in European OECD countries. Hydropower provides different types of services (base-load, peak, super-peak, regulatory energy) depending on the type of installation (run of the river, with reservoir, storage & pumping, pure pumping). In European OECD countries, it represents about 15% of total electricity generation and about 70% of renewable electricity. In the past, it played a very important role in ensuring power supply security at a relatively low cost. In the future, it will be affected by new energy policies which aim to decarbonize the economy and, in some countries, to phase out nuclear power. Even more so given that the process of opening electricity markets to competition is still in progress. The advantage of hydropower plants with reservoirs will remain that they possess flexibility. Pumped-storage power stations may even negatively compensate the unpredictable energy surpluses. However, the management of hydroelectric power plants should be redesigned. Further investments and the renewal of the old installations are at stake.

To highlight the different scenarios concerning hydropower's future, the following issues are analysed: Firstly, we consider possible developments in market design, in particular capacity and ancillary markets, as well as green markets. Secondly, the changes in the daily and seasonal load diagrams (demand and supply side) are simulated, taking into consideration the promotion of demand side management as well as the development of new renewable energy, mainly intermittent (photovoltaic and wind farms). Thirdly, a scenario will be devoted to the creation of smart grids and the conception of new cost effective storage systems. Finally, we suppose the construction of pan-European very high voltage lines, which (according to www.entsoe.eu) should connect the photovoltaic and wind parks in the Mediterranean region with the on/offshore wind parks in the North Sea. Other aspects of the problem will be evoked briefly, notably the impact of climate change on hydropower, the implementation of new rules concerning residual water flows, as well as the use of the reservoirs for flood control.

Method

A synthesis is carried out which takes into consideration the different components of the electricity system (stocks and flows), their interactions and their dynamics. On the one hand, the complexity of the electricity system is analysed and its critical components with respect to hydropower are highlighted. On the other hand, several energy scenarios are discussed in order to anticipate the evolution of the main variables. Uncertainties are quantified wherever possible.

Expected results

We plan to highlight convergences and divergences between new energy policies and electricity market reforms in the field of hydropower. We will emphasize the main risks and opportunities that public bodies and electrical companies may face in the future, in particular in view of the renewal of water concessions and the modernization of hydropower installations that are already envisaged in several countries. The purpose of our article is to highlight future challenges and to discuss possible remedies. Although our case study concerns European OECD countries, our research will provide valuable insight to extra-European regions that must define policies and strategies concerning hydropower.

References

- Gaudard L., M. Gilli, F. Romerio (2013) Economical and hydrological impacts of climate change on hydropower (submitted for publication in Climatic Change)
- Romerio F. (2008). Regional policy and hydroelectric resources: The case of a Swiss Mountain Canton. Journal of Alpine Research, 1.
- Romerio F. (2008). Hydroelectric resources between State and Market in the Alpine countries. In Wiegandt E. (ed.). Mountains: Sources of water, Sources of knowledge. New York, Springer.

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