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HYDROPOWER AND PUMPED-STORAGE HYDROPOWER: BENEFITS AND CONSEQUENCES

Elcin Kentel
Middle East Technical University, Turkey

Hydropower serves as the key domestic energy source for a number of developing countries, such as Turkey, that are dependent on foreign energy sources in supplying their increasing energy demands. Being a renewable energy source, hydropower has lower lifecycle CO_2 emissions compared to conventional energy sources such as coal and natural gas, and a comparable levelized cost of electricity. Moreover, pumped-storage hydropower (PSH) is currently the main large-scale energy storage technology and is essential in managing intermittency in renewable energy sources, especially wind and solar. PSH works in a dual manner, both as turbine and pump. In the turbine mode, water stored in the upstream reservoir is released to the downstream reservoir to produce electricity and in the pump mode; electricity is used to pump water from the downstream reservoir to the upstream one. Either two existing reservoirs that are close enough to each other with sufficient head difference or one existing reservoir that has a nearby suitable site for the second reservoir are candidate topologies for PSH. Against these advantages, inadequate water resources and hydropower management strategies may result in river disruption, and other environmental impacts such as alteration in natural distribution and timing of streamflow, and disturbance of ecosystem components, especially aquatic life. Modifying two existing reservoirs (i.e. conventional hydropower plants) as PSH can alleviate some of these environmental impacts. Although some energy is lost in this process, with proper operation, such PSH systems may bring additional monetary benefits due to hourly electricity price variations in the electricity market as well. A conventional cascade multi-reservoir system composed of three hydropower plants, namely Arkun, Yusufeli and Artvin located in the Coruh Basin of Turkey, is simulated in the pumped-storage mode to evaluate additional monetary benefits. Additional monetary benefits strongly depend on hourly price variations and for a year with high oscillations in hourly electricity prices, around 10% increase in net revenue is obtained. Thus, it can be concluded that especially for energy importing countries like Turkey development of PSH systems may be a feasible alternative and deserves further investigation.

ekentel@metu.edu.tr