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EXPERIENCE CURVE ANALYSIS FOR SWISS HYDROPOWER SCHEMES – HOW IMPORTANT IS THE SCARCITY OF FAVOURABLE SITES?

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Overview

This paper conducts an experience curve analysis for the Swiss hydropower schemes. Experience curves describe how costs per unit decline while cumulative production increases over time, where the latter is usually used as an approximation for the accumulated experience in employing a technology. These curves represent the combined effect of a large number of parameters.

The concept of experience curves is widely used to analyse the long-term potential of new renewable energy technologies and to develop policy strategies and instruments to foster their diffusion, see IEA (2000) and Neij et al. (2003). There are only a few experience curve analyses that considered hydropower, e.g. McDonald and Schrattenholzer (2001), Jamasb T. (2006), especially because hydropower is considered as a mature energy technology with a low learning rate.

The cost structure of hydropower is characterised by high fixed costs and very low operating costs. Therefore, it is important to analyse the experience curve to estimate future possibilities of the hydropower sector in Switzerland, particularly because most of the hydropower plants need refurbishment in the near future. The experience curve analysis will help to estimate the remaining hydropower potential, especially for pumped storage schemes, and to evaluate the refurbishment of the existing hydropower schemes (Balmer et al., 2006). The estimated learning rates can also be used in long term bottom-up energy models in order to incorporate endogenous learning.

Methods

First, a construction cost model is estimated based on an extensive database that combines technical, economic and spatial data of hydropower schemes in Switzerland in a geographic information system (GIS). In contrast to other energy technologies hydroelectric power plants are characterised by high site-specific heterogeneity. Therefore it is important to include spatial data in the construction cost model in order to account for a comparison of sites with similar characteristics. Furthermore, this construction cost model will be based on typical hydropower groups to ensure that homogenous hydropower schemes will be compared. Second, the estimated construction cost model is integrated in the experience curve analysis in order to account for the site specificity of hydropower schemes as well as other technological factors. In this paper, the learning rate will be considered as time-variant. The database consists of construction cost data for 161 hydropower schemes including a total of 241 large plants operating in Switzerland.

Results and Conclusion

Because the best sites are chosen first, the site conditions become worse as time passes. Hence, there is an opposing trend to decreasing unit construction cost arising from the site characteristics. In the historical context, however, the best sites are not necessarily chosen

first because the technology needed was not developed yet. Therefore, the easiest accessible sites along rivers were chosen in the first place. Along with technological progress, sites with a higher hydro potential, such as those in the Alps, have been exploited. As a result these sites become scarce, which in turn leads to an increasing usage of more difficult locations with higher construction costs. Therefore, the experience curve for the Swiss hydropower schemes is expected to be u-shaped. Final results are forthcoming in the next month.

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