

# *Hydropower Design under Uncertainties*

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## **Introduction**

Real Option Analysis, Robust Design and Adaptive Operation are promising approaches to manage uncertainties of hydropower projects. In this research project, we intend to incorporate these methods into the engineering design process and to test them on real projects. The approaches will be adjusted for hydropower projects, analysed and compared to identify the best approach for specific uncertainties, conditions and design phases. Criteria shall be defined to select either approach or a combined application. The findings will be used to elaborate a planning framework which allows a preparation of a project specific strategy to manage uncertainties.

## **Issues**

The design of hydropower plants is determined by long-term forecasts. These forecasts are highly uncertain and are one of the sources of major risk for hydropower projects.

The traditional engineering task is to optimize the hydropower plant so that it meets the forecasted scenario. The engineering and economic approaches that underlie virtually all water planning assume that the hydrological processes and market processes are stationary, even if it is well known that these processes can

change. None of these are static and a forecast is highly complex and contains many uncertainties. Additional uncertainties may also stem from interpretation of incomplete data. An aberration of the effective values from the forecasts can highly affect the success of a project.

Numerous hydropower projects exist where the forecasts were not matching the effective values and finally the plants did not reach the expected performance. Consequently, hydropower is strongly affected by risks and makes many developers sceptical against hydropower. It is a major reason why some hydropower projects are not constructed and cannot contribute to sustainable energy supply.

Furthermore, the increasing proportion of private investors for hydropower projects reinforces the trend towards control or limitation of risks when making investment choices.

Despite the high risks taking over on large hydropower projects, surprisingly little systematic knowledge exists about the incorporation of risk management into the design of hydropower plants.

## **Objectives**

The aim of the research project is to develop a Planning Framework for Project Specific Strategy (PFPS) which incorporates Adaptive Operation, Robust Design and Real Option Analysis into the design process for hydropower projects. With this project we make important steps towards a better understanding of the application of innovative design approaches for management of uncertainty in the hydropower sector.