

**Ludovic Gaudard:        Managing uncertainty in energy systems**

Energy systems present, besides complexity, inherent uncertainty. In this challenging context, policy makers and energy utilities need sound and robust decision-making tools to implement their strategies. They must integrate key technical, economic, and institutional aspects of energy systems in order to fulfil ambitious environmental, climate and social goals. Scientists should therefore develop new pragmatic methods in order to support decision-makers.

This presentation will highlight my contributions to these fields based on my physics background and further interdisciplinary aspects. The experience acquired during my PhD thesis at the University of Geneva, has been further enriched during my stay at the London School of Economics and in my current position at the University of Geneva and Imperial College London.

The presentation will show how my present expertise in the field of energy systems and uncertainty management is rooted in my initial investigations on hydropower. This renewable technology has to cope with the time variability of the water resource, while taking advantage of its operational flexibility, i.e., the ability to adapt electricity generation to demand. Therefore, hydropower represents an ideal starting point to deal with a large panel of energy technologies, including intermittent ones (i.e., solar and wind power) and energy storage. Hydropower installations also face severe uncertainty because of their long lifetime, which represents a lack of managerial flexibility, i.e., the ability to adapt the scale of a project and its schedule to changes in the energy market. This can be a major drawback in an uncertain world where large technological innovations are emerging, e.g. smart grid. In fact, the future of this resource, which plays a critical role in Switzerland and in many countries around the World, could be jeopardized if decision-makers do not adjust their strategies.

The presentation will end with a look to the future. The first goal is to further adapt my approach to other energy domains in order to support decision-makers during the energy transition that a number of countries, including Switzerland, are beginning to implement. For instance, energy transition is creating new insights into the deployment of geothermal energy in Geneva, as shown by a promising collaboration that I am currently developing with local stakeholders. Like hydropower, this resource requires strong technical skills in order to manage the severe uncertainty it faces. The second aim is to compare straightforward and pragmatic socio-economic models with sophisticated ones. In collaboration with a number of colleagues in Switzerland and abroad, I am highlighting the benefits, limits and complementarities of these two approaches. This research may have some spillovers beyond the energy field, and create bridges with researchers in other areas, in particular those related to climate change, water resources, natural hazards, etc.