



“Long term evolution of the Swiss electricity system in a decarbonized Europe – Development and application of the EUSTEM model”

Master Thesis

Student: Raluca Anisie

Supervisor: Rajesh Pattupara

Professor: Rachid Cherkaoui

Lausanne, 28/08/2015

ABSTRACT

European electricity sector is currently at a crossroad. The nuclear controversy triggered by the Fukushima accident in 2011 have led to major European countries making nuclear phase out plans. At the same time, ambitious CO_2 targets are set for the decarbonization of the electricity sector. Decreasing the nuclear generation while reaching the stringent CO_2 targets calls for large deployment of renewables. Possible supply options for 22 countries of Europe were analysed using the EUSTEM model – a cost optimization framework with long time horizon and hourly time slice resolution. In the absence of a CO_2 target the most cost effective supply option is coal based generation. Under a climate target the electricity sector heads towards massive renewable deployment, complemented by natural gas and Carbon Capture Storage (CCS). Increased trade volumes as well as storage facilities are required to balance the system. This will lead to a 90% increase in total electricity system costs. EUSTEM is compared to CROSSTEM, a reduced version modeling only Switzerland and its direct neighbours, to determine the impact of distant regions on a country's electricity sector development. The comparative results for Switzerland reveal slight deviations in trade volumes while the major trend stays the same. For the rest of the countries the differences between the models are more substantial.

KEYWORDS

Decarbonization, electricity sector, nuclear phase-out, TIMES modelling framework