School of Architecture, Civil and Environmental Engineering, ENAC
Environmental Engineering Institute, IEE
Laboratory on Human-Environment Relations in Urban Systems, HERUS

Master/Semester project

Title: Analyzing Socio-Technical and Political Tipping Points with Agent-Based Modelling

Description of research: Greenhouse Gas Emissions (GHGs) are the key driver for climate change rising and the rising temperatures across the globe climate change. It is widely argued that ambitious climate policies present a key leverage point to mitigate climate change. Yet, the relationship between climate policy ambition and wider socio-technical systems are treated as exogenous in most models, including Integrated Assessment Models and Agent-Based Models. This project seeks to develop a simple Agent-Based Model, which includes key feedback mechanisms between the policy ambition level and the socio-technical system for Switzerland. The model will be composed of agents who decide to adopt renewable energy technologies, like solar photovoltaics, electric vehicles, or heat pumps or conventional fossil-fuel-reliant ones, emit GHGs, and vote for policies and/or politicians. In this sense, the project will build on past research in the social sciences, which has shown that the decisions to adopt renewable technologies can influence public support for additional climate policies.

Methods: Using one of the programming languages like Scala, Python, or R, this project will develop the key building blocks modelling the feedback mechanisms between the socio-technical system and the policy ambition level. New policy ambition data compiled by the OECD, data on Swiss voting patterns, and survey-based population data collected by the HERUS at EPFL will serve to populate agents in the model and calibrate the model to the data. If the model fits the data, it may potentially be used for scenario analysis.

Potential implications: Simulating many runs with different initial configurations can show what socio-technical and political tipping points are needed for Switzerland to reach net zero GHG emissions by 2050 compatible with the Paris Targets. Deeper insights into this tipping dynamics will be crucial for more realistic assessments what policies should be introduced and what technologies need to be adopted first to leverage big future changes – these have, unfortunately, been largely absent in the existing modelling approaches that inform the reports by the Intergovernmental Panel on Climate Change as well as current climate action by governments and private actors.

Requirements: Programming knowledge with the statistical software Python/R is required.

Starting date: between February 2025 and September 2025

Duration: 1-2 semesters

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