Hochschule Offenburg
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Master thesis:

The impact of the production of bio-char as a negative emission measure on the achievement of climate targets in the agricultural sector.

Overview

With the new climate protection law, it was determined across all sectors that GHG emissions in Germany should be reduced by 65% by 2030 compared to 1990, by 100% in 2045, and that additional CO_2 should be removed from the atmosphere from 2050 on. Since the agricultural sector produces so-called unavoidable emissions from land use and livestock farming, the intrasectoral target for agriculture was softened to only a 30% reduction by 2030, which means that the energy sector will have to additionally compensate for these emissions.

The goal of the “Landgewinn” project is to design and implement a holistic intersectoral energy system model that provides regionally high-resolution results for increasing decarbonization of the agriculture sector in interaction with the other sectors. For this purpose, the PyPSA-Eur energy system model will be used and further developed. The challenge is to adequately represent the diverse and varied nature of the agriculture sector and to integrate 3 selected agriculture-based decarbonization technologies. The potential of these technologies will be investigated and evaluated in different scenarios up to the year 2050. At this point, the focus is on the first decarbonization technology, the production of biochar. The production of bio-char from biomass by pyrolysis is a prom-ising negative emission technology whose potential in interaction with the entire energy system has not yet been explored.

In a Master thesis, the German agricultural sector is to be modelled at the county level in high resolution in the energy system model PyPSA-Eur. For this purpose, the demand for electricity, heat and fuels and the agricultural emission of GHG need to be integrated. Subsequently, with the help of defined scenarios, it will be investigated whether the climate targets can be achieved with the use of the decarbonization technology pyrolysis, which sequestrates carbon as bio-char.

Structure of the Master thesis

- Literature review of the existing energy system modelling software: PyPSA, PyPSA-Eur and PyPSA-Eur-Sec
- Literature review of the technological specifications and economic and ecological characteristics of pyrolysis plants
- Modelling task:
    - Mapping of high resolved spatial regions (NUTS3) in the energy system model PyPSA-Eur
    - Generation of regionally resolved load data for the demand sectors electricity, heat and fuels in agriculture
    - Modeling of simple sector couplings between energy supply and the different demand sectors.
    - Adding of regionally resolved CO2-equivalents emitted by the agricultural sector
    - Further development of the pyrolysis model within PyPSA-Eur and integration into the existing energy system
- Scenario analysis:

- Analysis of the impact of the negative emission technology pyrolysis onto the agricultural and the whole German energy system by making two to four scenarios. Scenarios should be based on the lastly government instructions for the energy transition.
- Analysis of the operational and expansion planning of generators and transmission grids until 2050

Requirements

- Programming language: Python
- German and English
- Energy system knowledge
- Energy economics knowledge

Contact details for an application

If you have interest in the master thesis position please e-mail anna.sandhaas@hs-offenburg.de and attach the CV and transcript of grades.
We will get in touch with you to set another meeting and talk with more detail about the task.