



ABBY-NET E³-Systems Research Project Update 2019:

#3a: Regional assessment of opportunities and challenges of alternative energy technologies and their environmental impacts

Amarachi Kalu, PhD student

Ludwig-Maximilians-University of Munich, Department of Geography

email address: a.kalu@iggf.geo.uni-muenchen.de

Research Team:

Supervisor: Prof. Ralf Ludwig, LMU, Department of Geography

Cosupervisor: Prof. J. Karl, FAU Nuremberg, Depart. of Process Engineering

Cosupervisor: Prof. J. Bergerson, University of Calgary, Depart. of Chemical Engineering



Project summary

Regional energy transitions require a growing share of alternative technologies powered by biomass sources, for which not all environmental impacts are yet fully understood. This study aims at applying a set of modeling methods and Life-Cycle-Assessment (LCA) to integrate environmental, socio-economic and engineering perspectives of energy transitions, using Alberta and Bavaria as case studies. It provides, on a regional scale, robust quantitative estimates of GHG emissions, comprehensive cost indicators, and land-use impacts of natural gas production. Additional objectives of this project are to (a) explore how different regions tackle energy related climate change problems while finding the tradeoffs across various impacts in both jurisdictions, (b) discover current natural gas production technology pathways in different regions (Bavaria, Alberta) with respect to their GHG emissions mitigation goals and (c) using LCA to compare the biogas potentiality of energy substrates (e.g. maize, manure) with other imported raw materials regarding GHG emissions.

Progress to date

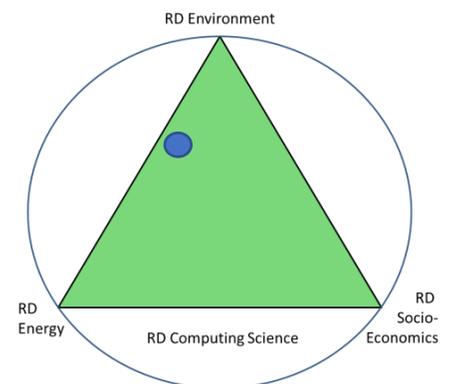
The project is currently ongoing; graduation is expected in the fall of 2021. So far, much effort has been placed in the assessment of environmental impacts stemming from the energy transition towards renewable energy sources in Germany, particularly within the SustainableGAS project. Here, the InVEST model is applied to analyze the impacts of biogas technologies on ecosystem services, such as water yield, sediment and nutrient delivery. The next step will be to spend time with the co-supervisor Prof. Bergerson in Calgary, to collect regional data, extend the ecosystem services analyses and strengthen the competences in innovative approaches of life cycle assessment.

Contribution to E3-system and Implications

The project is placed at the interface of energy and environment, leaning slightly to the latter; socio-economics is also considered. The outcome should help in providing the necessary information to find a balance between alternative energy technologies and environmental protection/prosperity.

Geographic location

The project conducts a comparison study, taking place in Bavaria and Alberta.



Final Outcomes

The final outcome of this project is my PhD thesis, which I plan to submit in the fall of 2021. As I am planning to deliver a cumulative dissertation, I will have to submit three first-authored journal articles in order to comply with the regulations of the Faculty of Geosciences at LMU. Still, the publications shall be of an interdisciplinary nature and co-authored, as much as possible, with other ABBY-Net members. A first paper on "Bioenergy technologies and their environmental impacts in relation to the German energy transition" is currently in preparation.