DECARBONISATION STRATEGIES IMPLEMENTING BIOCHAR AS A CARBON CAPTURE TECHNOLOGY

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Overview

As part of the Paris Agreement, many countries have adopted measures to de-carbonise the energy sectors and to prevent the rise of global earth temperature above levels that could have serious consequences for our climate. Technologies which can capture CO_2 will become crucial to smooth the energy transition to a system based on renewable energies[1]. In this paper, biochar will be modelled and different scenarios will be discussed. Biochar is one of the output products from the pyrolysis process and it has the property of absorving CO_2. The aim of this paper is to show the effect of allowing pyrolysis plants on the energy system of Germany. Different scenarios based on the German energy transition path will be described and discussed, whereas a business as usual BAU scenario does not allow pyrolysis. These scenarios will show the difference in the energy system when implementing this new technology. Costs, emissions and energy produced from different power powerplants will be analysed.

Methods

In order to evaluate the effect of biochar into the energy system it has been implemented in the open-source model PyPSA-Eur [2]. Pyrolysis plants have three outputs: oil, biochar and heat. In this model oil is neglected and heat is directly transformed into electricity by the use of another additional technology which is represented by an efficiency factor. In short, the output of the pyrolysis plant will be electricity and biochar. Electricity will be used to cover the load and as flexibility because it can also be used when renewables cannot produce electricity. Regarding the biochar, it will be considered for the model as a carrier which has negative emissions, which means that it can absorve CO_2 from other technologies being used. This should let other technologies which produce CO_2 continue further and smooth the energy transition.

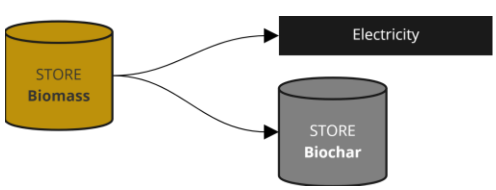

Figure 1: Simplified sketch of the pyrolysis process model.

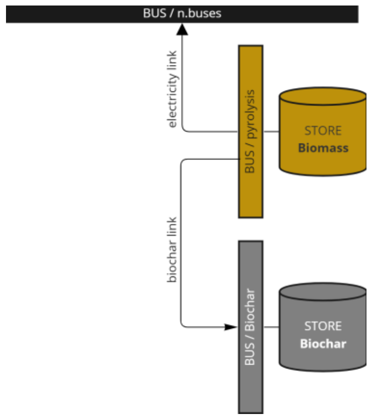

Figure 2: Detailed sketch of the pyrolysis process model.

The model is composed of a store of biomass which is the input and has a certain capacity, a link with an efficiency to the biochar store and another link with an efficiency to the electricity buses.

By making use of this new model it is the plan to examine four scenarios. The main idea is to asses the new german energy transition path while providing the effect of biochar into the energy system. The scenarios will imply a carbon neutrality for the German energy system by 2045, in a pyrolysis scenario adding pyrolysis and in the BAU scenario not. Furthermore the situation with a partly decarbonized energy system, year 2030 with CO_2 emission reductions of 65% compared to the year 1990 will be assessed.

Results and Conclusions

The model is finished. First model runs on the scenarios will be done by the end of April and the final results are available by the end of May. Therefore we cannot display the results here yet.

References

[1] Q. Zhao, A Review of Pathways to Carbon Neutrality from Renewable Energy and Carbon Capture, E3S Web Conf. 245 (2021) 1018.

[2] J. Hörsch, F. Hofmann, D. Schlachtberger, T. Brown, PyPSA-Eur: An open optimisation model of the European transmission system, Energy Strategy Reviews 22 (2018) 207–215.