Market diffusion of biomass-to-end-use chains for solid sustainable energy carriers from biomass by means of torrefaction

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(1) Overview

This paper develops a methodology for evaluating generic biomass-to-end-use chains on a global scale and for generating scenarios up to 2030 with regard to economic, social and environmental criteria. Economic feasibility and environmental sustainability are key issues of modern biomass utilisation in particular regarding the transition to a future low carbon economy. For the EU Member States, this means to critically examine existing and future biomass-to-end-use chains including the production, preparation and distribution of raw material as well as its end-use. Less explored social impacts such as effects on the labor market or the rural development should be taken into account. The focus will be on torrefaction as an upcoming biomass preparation technology. At temperatures of 200 to 320°C and in the absence of oxygen, torrefaction can optimise the properties of biomass for the preparation and handling as a high-energy-dense solid biofuel. Three major case studies of feedstock supply will be used to calculate exemplary biomass-to-end-use chains. Those represent different socio-environmental conditions – especially regarding regulatory framework and climate – under which relevant feedstock already is or may be produced in the near future. The results presented in this paper have been developed within the European research project SECTOR (Solid Sustainable Energy Carriers from Biomass by Means of Torrefaction), funded under the 7th framework programme.

(2) Methods

The key objective of this paper is twofold: (1) to develop a methodology that is capable of generating and comparing biomass-to-end-use chains as well as of developing scenarios up to 2030 with regard to economic, social and environmental criteria. (2) to apply this methodology for exemplary biomass-to-end-use chains based on torrefaction with representative feedstock supply from different regions of the world and selected end-use options within Europe.

In order to achieve this objective, we proceed as following: The first step focuses on the development of an optimisation tool. This tool will generate a selection of comparable but highly differing biomass-to-end-use chains. Knowledge of biomass potentials and their present use in certain regions will help to identify possible supply patterns. Costs and fuel consumption for the purchase and transport of the feedstock as well as for the preparation step including chipping, drying, torrefaction and densification will be calculated. The further distribution and utilisation of the produced high-energy-dense solid biofuel for different types of end-consumers will be evaluated. A methodology for comparing these biomass-to-end-use chains in terms of socio-economics, GHG- and net energy balances will be developed. In the further work, data collected from literature as well as from pilot-plants, extensive logistics and end-use testing, accomplished in frame of the FP7 project SECTOR will be used. The second major step is to set up a model for simulating the future diffusion of these biomass-to-end-use chains in various scenarios. The basic approach is the assessment of future end-use potential, economic attractiveness compared to alternative reference technologies and diffusion restrictions. The final step of this paper is the development of first exemplary scenario results for the future diffusion of torrefaction under certain environmental conditions – especially regarding regulatory framework and climate as well as selected end-use options within Europe.

(3) Results

The first results will be the methodological framework for comparing biomass-to-end-use chains and the scenarios developed for the diffusion of these chains. The second result will be a comprehensive set of relevant torrefied biomass-to-end-use chains and a comparison of selected chains with reference cases in terms of socio-economics, GHG- and net energy balances. Time variant economic and environmental input parameters will be used for the scenario modelling tool. This tool will be used to compute and demonstrate exemplary results for the future diffusion of torrefaction.

(4) Conclusions

The methodological framework developed in this paper is suitable for investigating key questions of emerging bioenergy technologies concerning their diffusion potentials, research and funding requirements. Further work will derive conclusions and recommendations about cost-efficient, socially and environmentally sound deployment strategies that can support investment projects and policymakers. These conclusions and recommendations will be limited to the comparison of torrefaction- with selected reference solid biofuel production technologies. A general overview on the energetic use of biomass will be out of scope of the presented work.

References

International Energy Agency (IEA) Bioenergy Task 32 (2013) "Final Report: Status overview of torrefaction technologies", http://www.ieabcc.nl/, last access in March 2013.

International Energy Agency (IEA) Bioenergy Task 40 (2012) "Possible effect of torrefaction on biomass trade", http://www.bioenergytrade.org, last access in March 2013.

Uslu, Ayla, André P.C. Faaij, and P.C.A. Bergman (2008) "Pre-treatment Technologies, and Their Effect on International Bioenergy Supply Chain Logistics. Techno-economic Evaluation of Torrefaction, Fast Pyrolysis and Pelletisation." Energy 33 (8) (August): 1206–1223. doi:10.1016/j.energy.2008.03.007.