Can torrefied products enhance the European bioenergy portfolio?

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Overview

In order to investigate possible (dis-)advantages of deploying torrefaction technologies, the experimental work done within the FP7 SECTOR (Solid Sustainable Energy Carriers from Biomass by Means of Torrefaction) project is complimented by extensive desk studies and modelling work. The combination of torrefaction and pelletisation or briquetting can lead to higher energy densities for biomass commodities than single pelletisation and therefore holds the potential to enhance the renewables product portfolio of not only the European energy market but also a biobased industry in general. We simulate a large range of production and utilisation pathways based on torrefaction that could become relevant in the near future under different framework conditions. We evaluate corresponding biomass-to-end-use chains in terms of socio-economics and GHG-emissions. This results in a comparative biomass-to-end-use chain assessment for several scenarios highlighting chains plausible to be implemented in the following decade as well as the possible impact of torrefaction and torrefied products on biomass trade.

Methods

A biomass-to-end-use chain simulation tool (BioChainS) was developed to assess the large number of production and utilisation pathways based on torrefaction which are discussed within the project community and could become relevant in the near future. Different feedstocks are simulated to be processed to torrefied and, as a reference, to white pellets and briquettes in several countries and world regions. Direct consumption of these commodities for industrial or domestic deployment of energy or further processing to biochemicals and biomaterials respectively are considered. Related costs and GHG-emissions are calculated. Direct consumption costs are extended with transport cost functions which are further used to generate cost ranges and break even distances for competing commodities. This approach tackles the crucial and complex part of transport in biomass trade. On one side feed-in tariffs, other supporting schemes and fossil fuel prices outline the capability to pay a certain biomass price for most of the examined end users. On the other side the distances biomass can be transported until this financial threshold is reached give an insight into the quantity of biomass available to meet the end user demands. In four storylines the exogenous data for possible future political and technical framework conditions for the period of 2020 to 2030 are drawn. Deployment scenarios for torrefied biomass are simulated by using this exogenous data including quantitative effects of policies regarding biomass supply, demand and research and development. Deployment strategies for torrefied biomass under different framework conditions are formulated based on a thorough sensitivity assessment of the driving parameters.

Results

Scenarios regarding on how and to which extent the torrefaction technology can broaden the biomass portfolio in the European energy market and its biobased industry are calculated highlighting the competitiveness of torrefied pellets against reference energy carriers under different framework conditions. A thorough assessment of possible relevant biomass-to-end-use chains based on torrefaction results in cost-efficient and environmentally sound deployment strategies for this commodity and further outlines risks and bottlenecks for the diffusion of the torrefaction technology and torrefied products.

Conclusions

The method developed within this research is capable not only to simulate if biomass can be an economically viable option for substituting fossil fuels and fossil fuel byproducts but also to compare different supply chains which qualify for this purpose. Further work within the SECTOR project will extend selected examples of the comparative biomass-to-end-use chain assessment with a full environmental assessment and overall conclusions and recommendations for stakeholders, policy makers and international sustainability forums will be derived.

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