Designing Trans-European Logistics Networks for Biogenic Residues-based Energy Carrier Production

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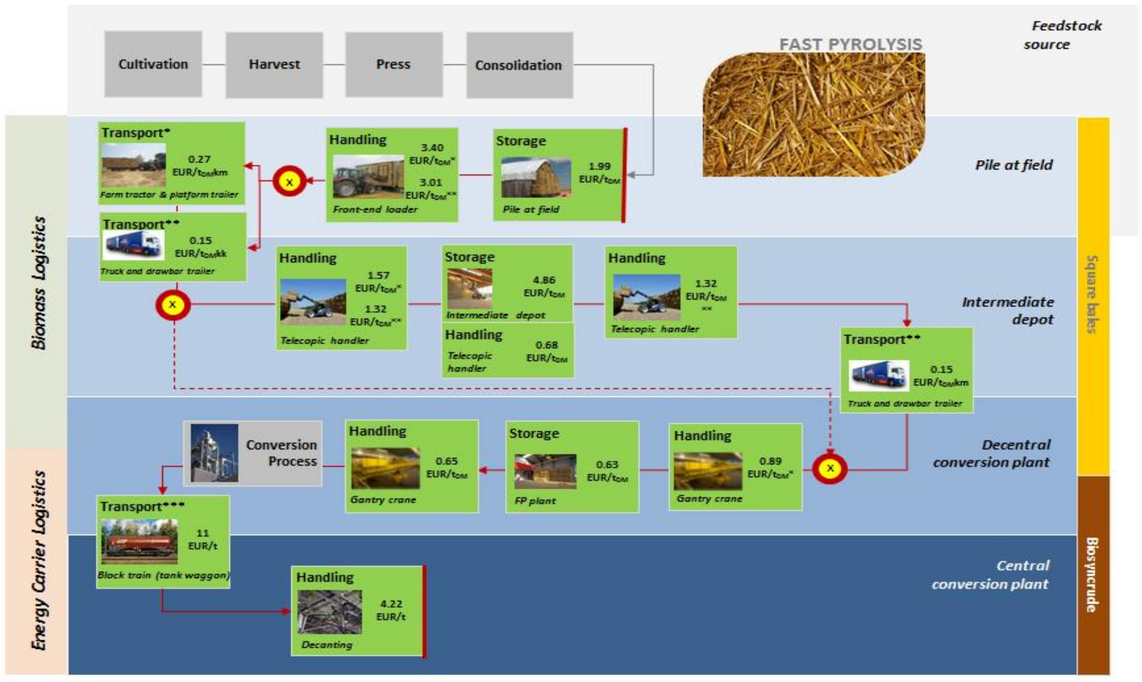
[Motivation] Biogenic residues bear the opportunity to gain energy from them. This is the context of the EU FP7 funded project BioBoost (www.bioboost.eu), whose goal lies in the industrialization of different conversion technologies between biogenic residues and useable energy carriers (e.g. fuel). A major factor to success of this project is the logistics concept that finally determines the total cost of such an endeavor. This poster is about the creation and definition of the logistics network and the related challenges.

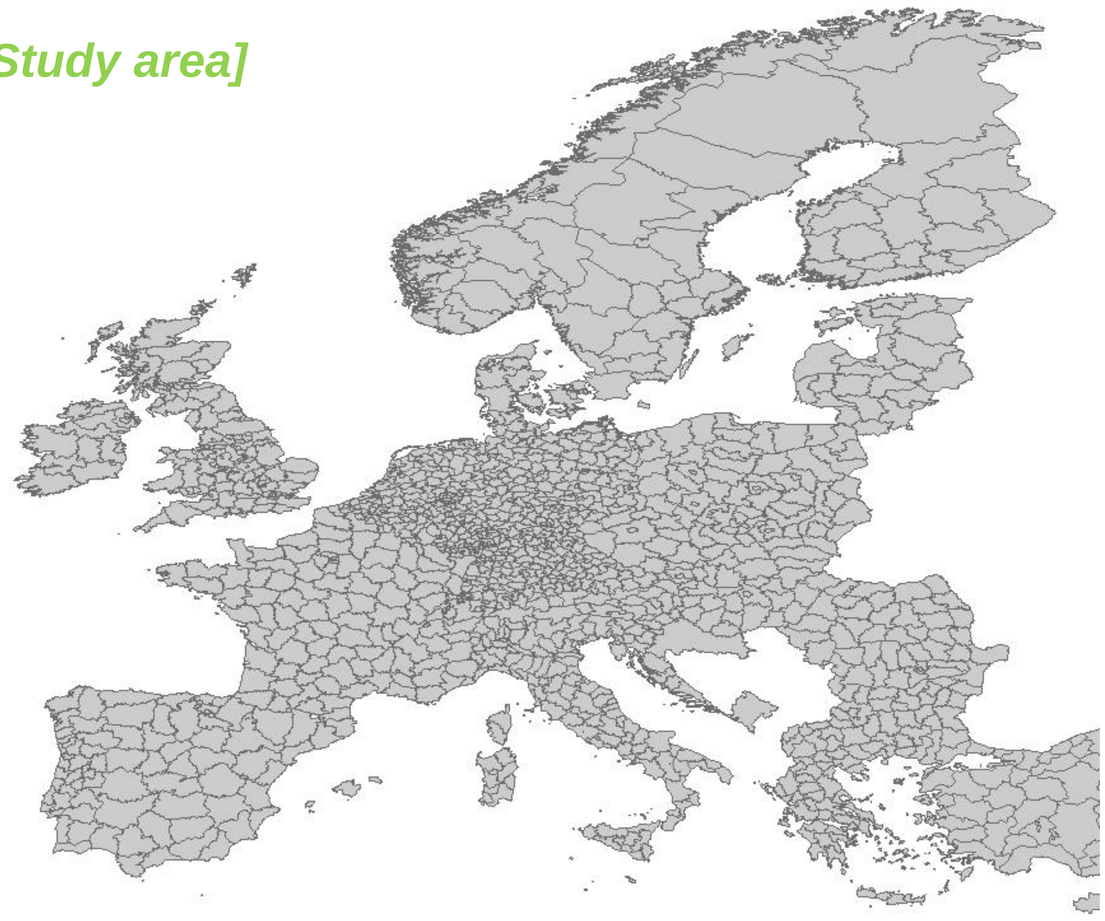
[Objective] Determination of cost and/or emission efficient supply network topology for second-generation bioenergy production in Europe. A major input for the logistics model are the operational logistics processes, i.e. transport, handling and storage for biogenic residues as well as energy carriers.

[Definition of reference pathways] Reference pathways help concentrate on defined conversion technologies (catalytic pyrolysis, fast pyrolysis, hydro-thermal conversion) and typical biogenic residues and hence limit the number of different scenarios.



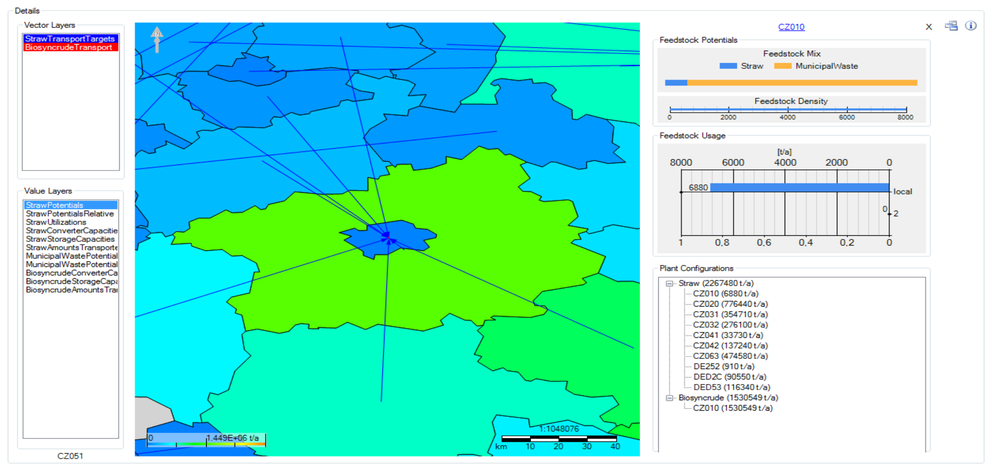
[Logistics Cost Data] Cost data are required for each step within the logistic chain. Therefore, proper equipment and infrastructure need to be chosen for efficient and secure logistics operations. The most appropriate technologies and related cost were found by consulting practitioners and reviewing existing literature. Based on this dataset, logistics costs for logistics equipment, i.e. means of transport, handling device and type of storage are calculated. By means of all evaluated cost rates (EUR/t & EUR/t*km), the reference logistics process chain has been refined for each individual product type.
As a result, some residues require intermediate stores while others should be better transferred by truck directly to conversion stations.

[Study area]



[Risk Analysis] Moreover, a risk analysis is conducted for the before-mentioned reference logistics process chains. Within this task, a qualitative as well as quantitative assessment of different risk types (e.g. biomass loss, HazMat, quality, environmental, etc.) along the supply chain is conducted by consulting literature and practitioners. As a result, actions for risk mitigation are identified and evaluated in order to be integrated in the holistic logistics model.

[Simulation-based Optimization Model] Among others, cost data serve as a major input for the holistic logistics model, which aims at strategically locating facilities and allocating product sources in Europe in an optimal way (Mixed-integer nonlinear programming MINLP model). Since this endeavor is highly complex, a simulation-based optimization approach using meta-heuristics is applied in order to derive an optimal logistics network design. In addition to the optimization model, also a (geo) graphical user interface is created in order to visualize the optimization process.



[System boundary | supply chain]

[Implications & Outlook] This research work provides concrete insights into the field of biomass as well as energy carrier logistics by combining both operational and strategic designing and planning elements. Most importantly, the outlined logistics network for biogenic residues-based energy carrier production in Europe serves as a fundament for another main task within the BioBoost project, namely a life cycle assessment (LCA), which aims at integrating the economic and environmental impacts of the reference supply chains in order to benchmark the biofuels against its fossil equivalents.

The BioBoost FP7 Project: http://www.bioboost.eu/

University of Applied Sciences Upper Austria : http://www.fh-ooe.at/