SOLID SUSTAINABLE ENERGY CARRIERS FROM BIOMASS BY MEANS OF TORREFACTION (SECTOR) BIOMASS-TO-END-USE CHAINS

Keywords: torrefaction, supply chain, cost-efficiency, modelling, scenario development
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Introduction

Torrefaction is a very promising technology that can convert biomass into dense energy carriers to rise transportation efficiencies and ease handling. The FP7 SECTOR-project investigates different possible advantages that could broaden the solid biofuel feedstock for the European Union. For example lower specific distribution prices due to higher energy densities, lower storage costs because of the hydrophobic nature of torrefied material and the avoidance of extra costs for coal fired power plants due to a higher grindability stand against higher production costs for this new technology and the open question if small scale pellet boiler users prefer torrefied pellets to normal high quality wood pellets.

Objective

This poster shows the basic methodology and setup of the model BioChainS. Results from this model will be available until end of 2013. The objective of this research is to derive conclusions and recommendations about cost-efficient and environmentally sound deployment strategies for torrefied material. Through the calculation of the entire biomass-to-end-use chain, conclusions can be derived for specific cases. To investigate the role of torrefied material in general all kinds of combinations rather than selected examplary chains have to be considered.

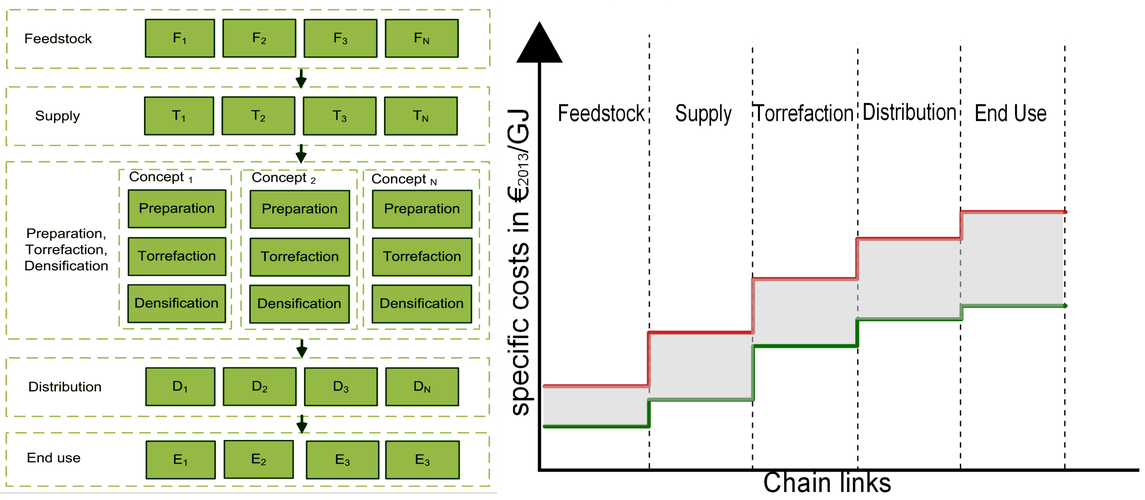

Figure 1: Left: Illustration of the composition of generic biomass-to-end-use chains. Right: Presentation of results, showing a range of cumulated specific cost rates of the chain

About the need for a software tool

The software tool BioChainS is capable of calculating different settings for biomass-to-end-use chains taking into account linkages, dependencies and restrictions between the chain links. Chains are defined through four parameters; Kind of feedstock and its origin, preparation method and end user type (see table 1). Uncertainties like preparation plant sizes and properties, raw material prices, utilisation of chippers, supply distances, end user efficiencies and others are implemented as probability distributions. The results are around 2000 generic biomass-to-end-use chains with specific solid biofuel cost distributions. These distributions are discussed and further used to analyse the possible market diffusion of these chains in various scenarios.

Table 1: Cost and efficiency factors broken up into the different chain links considered within the tool

Chain link	Cost & efficiency factors
Entire chain	Locations, time (year & season), fuel costs, labour costs, energy taxation
Supply – feedstock specific	feedstock properties and costs, sustainable yield
Supply – pre-densification	pre-densification costs and time
Supply – transport	(un)loading velocity and costs, vehicle capacity, transport distance, transportation speed, feedstock properties
Solid biofuel production plant	Type torrefaction and pelletisation, pelletisation, torrefaction , or none), scale, depreciation times of components, interest rates, personnel, energy and mass flow, operation window, solid fuel output properties and costs, temperature and duration time
Storage	Type, time, volume, costs, personnel, moisture content decline
Distribution	Distribution distance, different vehicle capacities, transportation speeds, (un)loading velocities and costs, solid fuel properties
End user	Type (cofiring, cogasification, small scale pellet boiler, biochemicals), efficiency, biomass treatment costs, scale, quality demand, demand pattern, personnel, revenues of by-products,

Biomass-to-end-use chains simulation - BioChainS

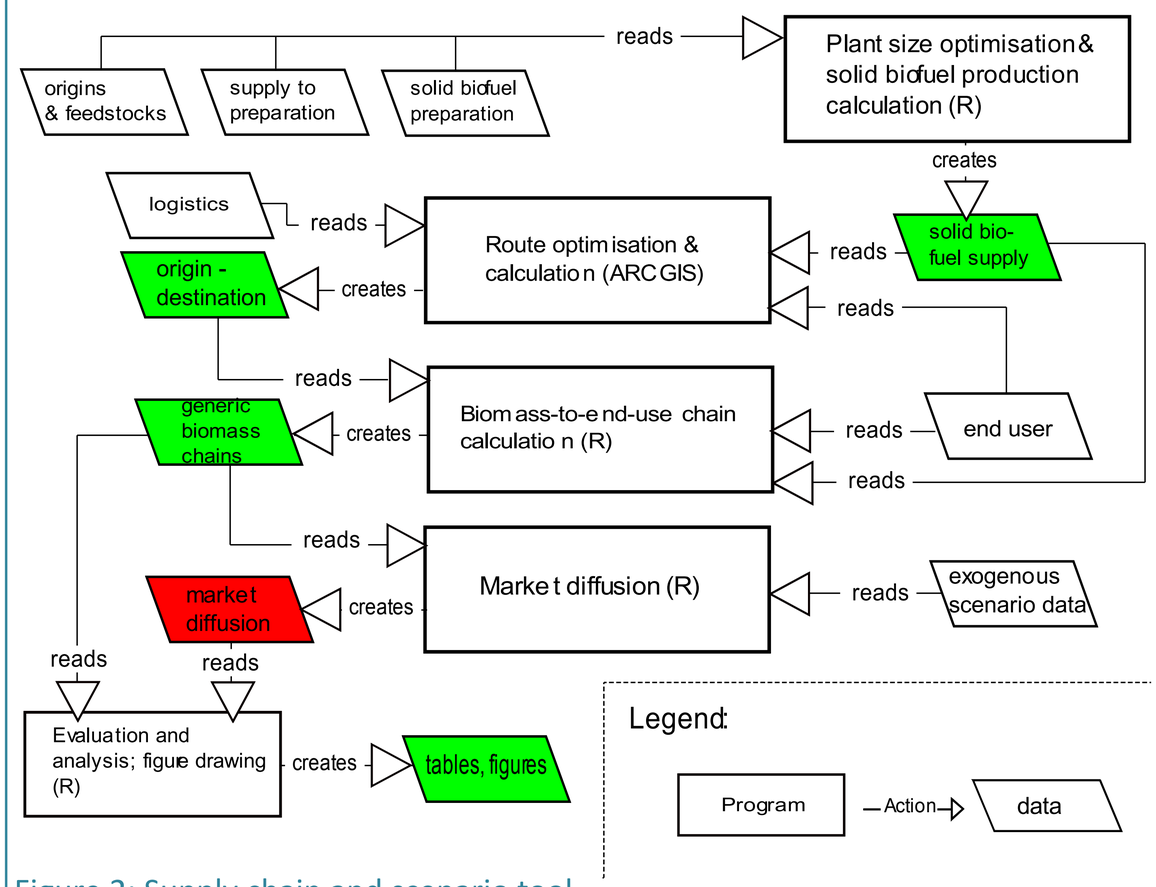

Figure 2: Supply chain and scenario tool

Figure 2 shows the structure of the model BioChainS. The key modules are:

Plant size optimisation & solid biofuel production calculation: The first step is to optimise plant sizes for different feedstocks and their origins. The optimal sizes will be used as mean values and a probability function will serve for further simulations. Input data for different preparation methods and location specific biomass supply information is used to compute prices and efficiencies for the production of solid biofuel.

Route optimisation and calculation: A route optimisation program will be used to find best routes and compositions in regard to transport modes for the distribution from different generic solid biofuel production plants to different end users. End user types rather than locations will be distinguished and probability distributions for distances and transport modes used. An origin-end-user matrix with cost distributions is the output of this process.

Biomass-to-end-use chain calculation: Biofuel production and distribution are extended with end user properties and demand patterns to calculate the total specific costs for the utilisation of solid biofuels. The output data will be prepared to derive conclusions about cost-efficient and environmentally sound deployment strategies. The prepared data will be further used for the LCA and socio-economic assessment.

Market diffusion: Varying fossil fuels, labour costs, taxes, benefits and restrictions will be considered in different storylines. The most promising chains will be recalculated with this exogenous data. The generated scenarios for the utilisation of torrefied material in the European Union up to 2030 will be evaluated and analysed.

Contact and further informations

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