Optimal localisation of second generation biofuel production in Sweden

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Introduction

Ambitious targets for renewable energy in transport boost interest in second generation biofuels, in particular in forest rich regions such as Sweden. Large plant capacities and feedstock competition makes geographic localisation important. Integration with other industries provides an opportunity for efficient resource utilisation, but also puts additional requirements on the choice of locations.

BeWhere

- Techno-economic geographically explicit optimisation model
- Analysis of optimal locations and properties of bioenergy conversion facilities
- Previous studies have been made on regional, national and European levels, with different levels of detail in the modelling

Objective

Development of BeWhere Sweden, with focus on second generation biofuels.

BeWhere Sweden:

- Decision support for biofuel stakeholders, government and policy makers
- System studies of biofuel production under different policies
- Identification and analysis of plant locations and characteristics

BeWhere model development:

- Detailed modelling of integration of biofuel production with industry
- Detailed descriptions of flows of biomass feedstock
- Possible integration with BeWhere Europe model

Model description

BeWhere is a mixed integer linear programming model (MILP). The model minimises the total cost of the studied system. In the total cost the supply chain cost as well as costs associated with emitting fossil CO_2 are included.

The number, type and location of biofuel plants are determined by the model. All potential biofuel plants are dimensioned to fit the site specific heat demand of the industries and district heating systems. The energy balance of each plant sites is considered explicitly.

The model is executed for different scenarios regarding biofuel demand, energy market conditions, policies and feedstock availability, in order to identify robust solutions.

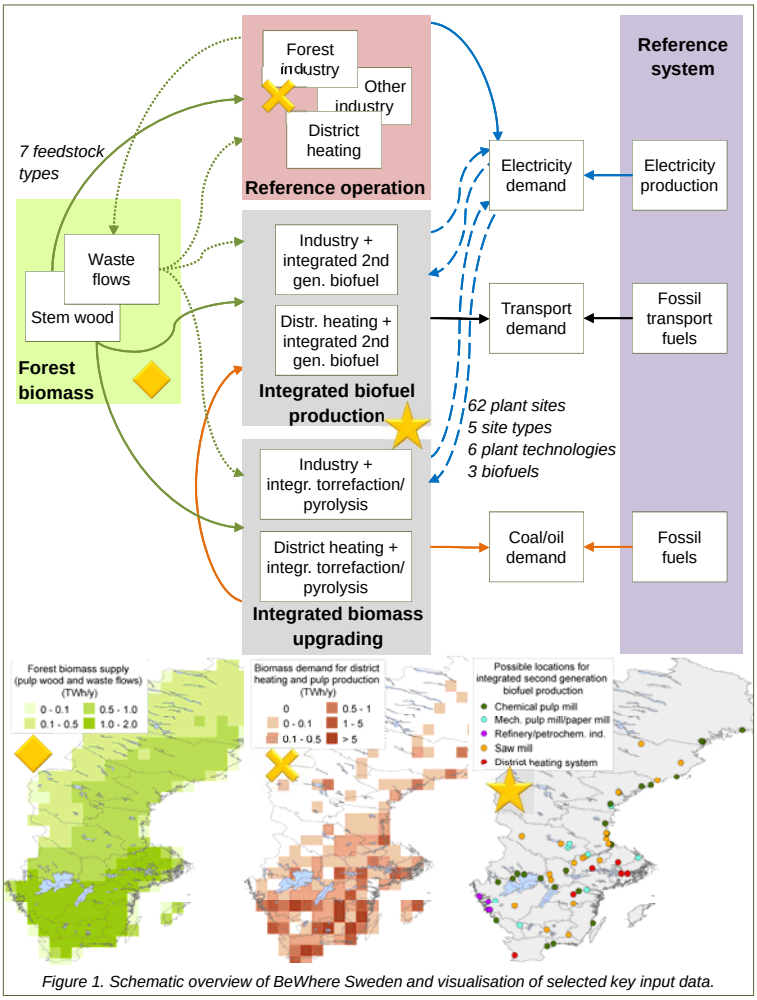

Figure 1. Schematic overview of BeWhere Sweden and visualisation of selected key input data.

Example of results

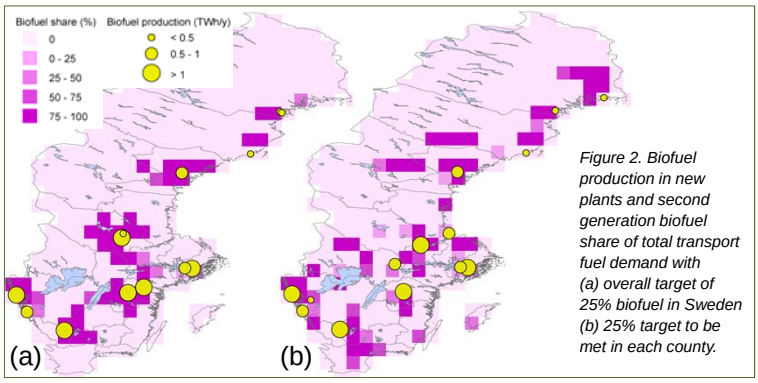

Figure 2. Biofuel production in new plants and second generation biofuel share of total transport fuel demand with (a) overall target of 25% biofuel in Sweden (b) 25% target to be met in each county.

Model runs are made using two second generation biofuel target scenarios:

(a) 25% biofuel share of total transport fuel demand in Sweden overall

(b) 25% biofuel in each county

The preliminary results show that plant positions with high heat demand are favoured, due to high investment costs and strong economies-of-scale effects.

When biofuel needs to be distributed to all parts of Sweden, the plants are more evenly distributed (right side of figure).

Due to longer total transport distances for biomass and biofuel, as well as reduced integration benefits, the total system cost is around 5% higher when all counties need to have their biofuel demand met.

Summary

Aggregated modelling studies of broadly introduced second generation biofuels typically make generalised assumptions about production integration and excess heat utilisation.

Here detailed bottom-up studies of integrated biofuel production are introduced into a top-down model and taken to a higher system level.

BeWhere Sweden will be a useful decision support tool for energy and transport system studies. Since Swedish production of second generation biofuels is of considerable interest from a European perspective, results from BeWhere Sweden can also be of value for EU policies and strategies.

More information

Project website

www.f3centre.se/projects/RD-Optimal-Localization

BeWhere model website

www.iiasa.ac.at/bewhere

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