Optimizing the Location of Forest Biomass-based CHP Production Plants in Finland

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Background

As a forest resource rich country (73% of total land area) and a pioneer in forest technology, Finland has a long standing tradition of utilizing forest biomass for bioenergy production. The National Renewable Action Plan 2010 strives to increase the present consumption of forest chips from 6 million m^3 to 13.5 million m^3 (97 PJ) by 2020, mainly for combined heat and power (CHP) production and separate heat production. In 2013, the forest chip consumption was 8.7 million m^3.

To achieve the 2020 target of forest chip consumption, Finland would still need either 8 new CHP production plants (200 MW_{bio}) or increase the share of wood chip consumption at the existing plants (e.g., co-firing, coal boiler substitution).

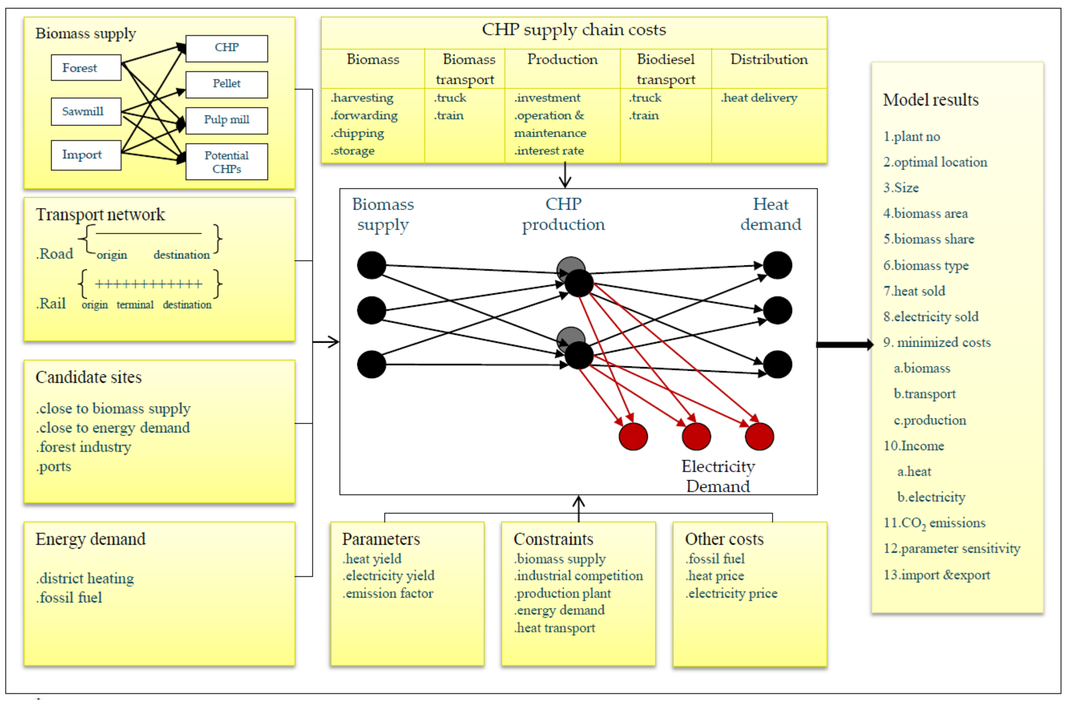
Objective

The aim of this study is to apply a Mixed Integer Linear Programming model (BeWhere) to optimize the potential CHP plant locations and production configurations by minimizing the entire costs and emissions of supply chains with respect to biomass resource availability, energy demand and existing industrial competition. This study envisages the building of new Biomass Integrated Gasification Combined Cycle (BIGCC) - CHP production plants with the aim to achieve the 2020 target of wood chip consumption for bioenergy production by efficiently utilizing the limited available forest resources.

The specific objectives are:

- Locate the new CHP production plants of what size and where to be installed in order to meet the 2020 target.
- Allocate the feedstock resources (by assortment type and at what fuel share) effectively for CHP production.
- Analyse the influence of policy instruments (e.g., subsidy) on the future CHP production plants.

BeWhere Finland



More Information

www.iiasa.ac.at/bewhere

Figure 1: Example of model input

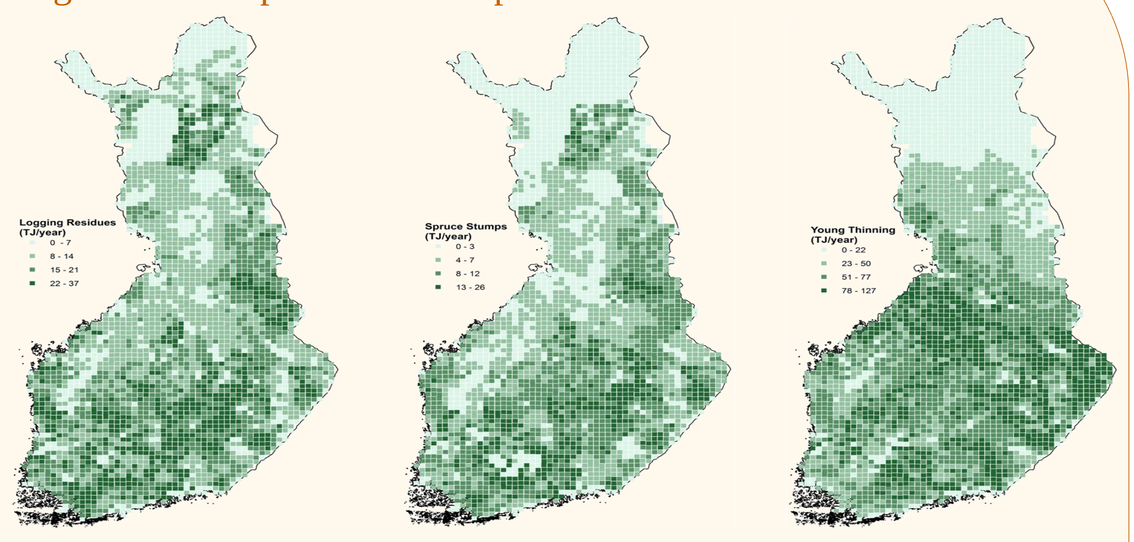
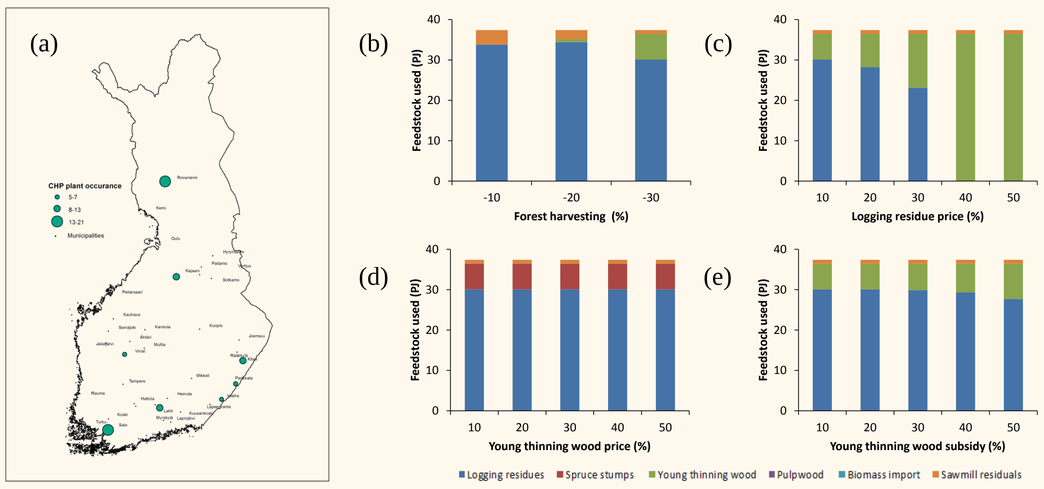


Figure 2: Example of model outputs

Location of the optimal CHP plants over 25 scenarios

Feedstock resource allocation with respect to parameter sensitivity for the most cited 8 CHP plants



Model findings

- Eight optimal CHP plant locations (200 MW_{bio} each) to meet the 2020 target of forest chips consumption (Figure 2a).
- Logging residues (92% biomass share) and sawmill residuals (8% biomass share) would be the feedstock of choice under current market situation.
- Parameter sensitivity (feedstock price) may greatly influence the resource allocation or biomass procurement strategy of the future CHP plants (Figure 2b-d).
- Subsidy for young thinning wood is essential for energy wood supply in future as well (Figure 2e).

To come

As a follow up, the present version of the model will be updated with:

- industrial heat demand
- biomass flow model
- energy flow mapping
- co-firing and coal boiler replacement possibilities at the existing CHP plants

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