HELSINGIN YLIOPISTO
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# Bioenergy production in Finland

## - effects on growth, employment, and environment at regional level

### Background

Bioenergy production offers great promises for economies that need to reduce their dependency on fossil fuels and their greenhouse gas emissions. European Union also has decided to place emphasis on bioenergy production in its future policies. Its easy-to-remember 20-20-20 policy proposal would imply 20 % reduction of greenhouse gases, 20 % increase in renewable energy production, and 20 % improvement in energy efficiency until year 2020. The second action is of direct interest for this study. Finland has significant land resources which can be used to produce various biomasses used in energy production. At the same time, country's rural areas are lagging behind the more well-off regions. Thus, harnessing the resources of rural areas more efficiently to energy production, might not only bring overall economic and environmental gains, but also contribute to country's regional policy objectives.

### Objectives

The objective of this study is to assess the impacts of increasing bioenergy production on regional economies in Finland. The impacts on economic growth and employment in areas that are facing economic difficulties from other sources, e.g. down-scaling of more traditional industries, are of the main concern. On the whole country level, the effects on overall greenhouse gas emissions will be investigated. This will shed light on the positive externalities produced along with the energy itself. The study is restricted to those energy resources that are produced as side products of forestry and agriculture. This means that the actions under study do not crowd out any traditional production on either of the sectors.

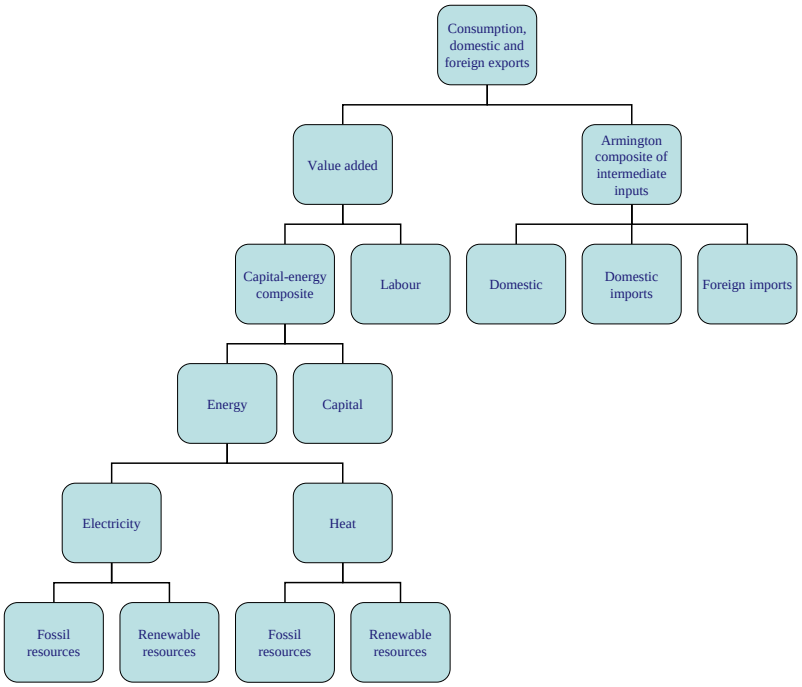
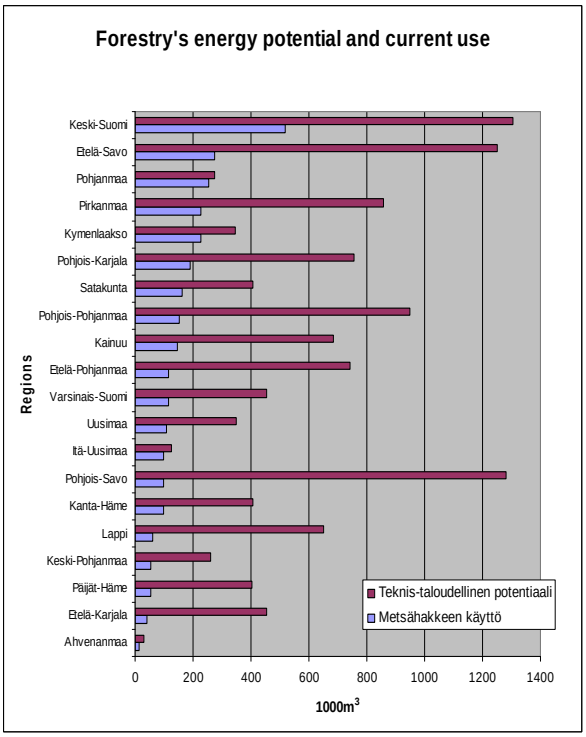



Figure 1. Production nesting structure in the model

Table 1. Example of bioenergy potential data (Maidell et al. 2008)




### Method and Data

The research problem is demanding because of energy sector's tight interlinkages to other industries. Thus, the most suitable method for our analysis would be a quantitative model that would include the linkages from the relevant sectors to the rest of the conomy. Such model would be CGE-model, and further, that would need to be divided to the regions that are of interest. Luckily, such model already existed.

Recursively dynamic CGE model is used for model simulations. RegFinDynBio-model is a result of long development work that started already in late 90s. The model was initially built by Törmä and Rutherford for Finnish regions (NUTS3 level) and later turned dynamic by Kinnunen. Current version contains 37 industries and 20 regions. Agriculture and forestry are divided to traditional industries and industries producing biomass for energy. Fossil energy sectors in the model are oil refining and peat production. Energy resources, renewables and non-renewables, are used by separate electricity and heat production industries and combined heat and power industries. They all produce heat and electricity as end products.

The core data of the model is the input-output-tables (I/O-tables) of Finnish regions from year 2002 that are publicly available. Various other data sources were used to supplement the I/O-tables and to finally construct the social accounting matrices (SAM) used to initiate the model. Crucial elements for the analysis are the actual potentials of bioenergy resources in the regions. These potentials were collected by PTT for forest energy (Maidell et al. 2008) and by MTT Economic Research for energy derived from agricultural resources. In each case, the potentials were divided to theoretical, technical-economic, and willingness-to-supply based potentials (potentials listed in descending order of magnitude).

### Scenarios and Results

Basic scenario is a forecast of regional economies from year 2005 to 2020. First two alternative scenarios will predict the new transition paths when agricultural and forestry's willingness-to-supply potentials are gradually reached by the year 2020. Third scenario will do the same for peat, which is fossil energy resource with similar regional potentials. Fourth scenario considers possibility for biogas production with possible microsimulation approach. Fifth scenario will implicitly include emission permit trading system for fossile energy resources. Finally, the last scenario will combine all of the above scenarios. Some preliminary results from first two scenarios will be available in near future.

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