Modeling Energy and Climate Policy in the Finnish Forest Sector

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Background

- Research team:

  Lauri Hetemäki, Hanna-Liisa Kangas, Jani Laturi, Jussi Lintunen & Jussi Uusivuori (PL) (all at Metla)

- Objective: To build a simulation model for analysing the impacts of climate, energy and forest polices to Finnish forest and energy sectors
- 3 Ph.D. theses
- Work started at Metla 2007-2008
- The project runs until the end of 2010

Outline

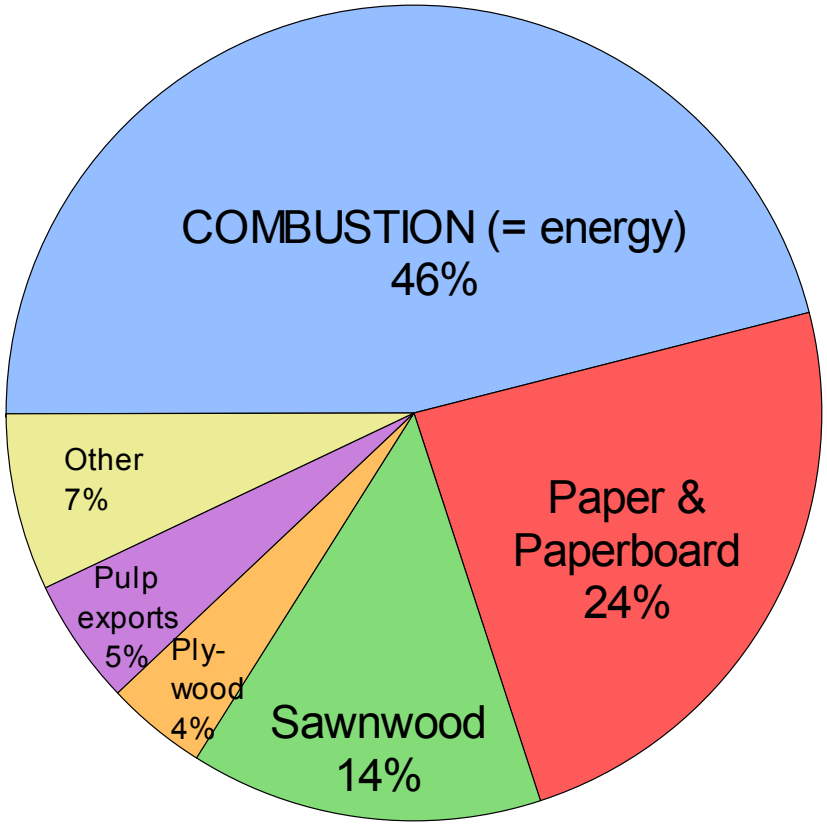
1. Introduction – motivating the model
2. Model features
3. Model structure
4. Discussion and open issues

Motivation for the Model

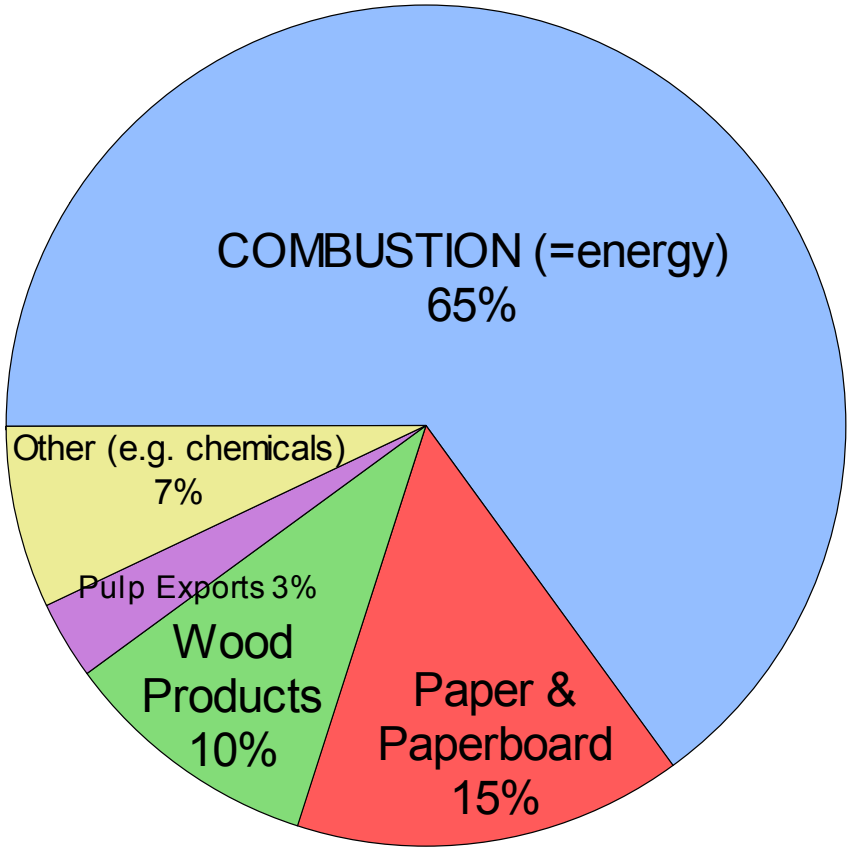
- Metla assists government forest policy planning processes
- Forest and energy sector is changing because of demands for climate services and bioenergy from forests (not only gradual, but structural change)
- Decision makers will need to know how to design efficient climate, energy & forest policies (mutual dependence between policies)
- Forest sector needs to be analyzed simultaneoulsy with the energy sector and climate policies, and at the rather detailed sectoral (and regional) level
- Linking the NIPFs utility maximization behavior to wood fiber demand

Ongoing Structural Change in Finnish Wood Consumption

2004



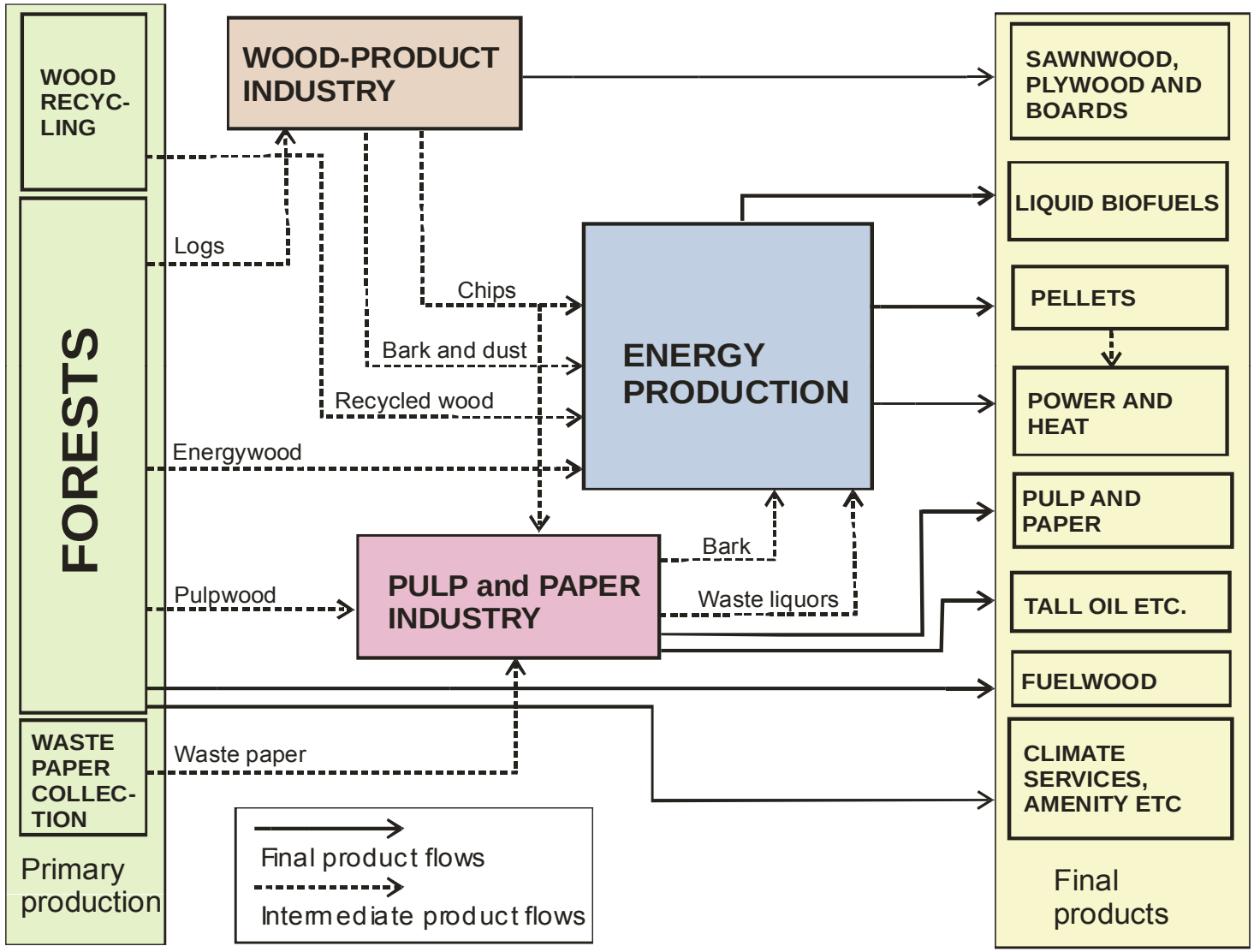
”Conceivable” outlook 2020



Model Features (targets)

- Partial Equilibrium Simulation Model
  (macroeconomic background and final product demands are exogenous)
- ”Hybrid model” (behavioral optimization, but realistic technology choice)
- Finland (and at regional level)
- Incorporates a wide range of domestic and EU policies
- Around 10-15 final products (≈ sawnwood, plywood, paper & board, chemical pulp, mechanical pulp, power & heat (total), pellets, fuelwood, liquid biofuels & climate services)
- Inputs and intermediate goods (logs, pulpwood, forest chips, industrial chips, bark, sawdust, black liqour), labour, capital & fossil fuels
- Dynamic model

Flows of Forest Goods



Supply Side

- Derived from behavioral optimization → Forest owners maximize utility
- NIPFs' supply = *f* (wood prices, interest rate, replanting & thinning costs; wealth of owner, amenity preferences; forest structure; policy parameters)
- Clearcutting and thinning harvests, logging residue collection from age-structured forests
- Logwood, pulpwood, small-sized trees, stumps and roots and logging residues
- + Wood imports
- + State and industry forests

Demand Side

- Derived from behavioral optimization → profit maximization

1. **Demand for pulpwood**: prices of end-products, pulpwood, chips, labor, electricity and heat, other costs
2. **Demand for logwood**: prices of end-products, logwood, labor, other costs
3. **Demand for energywood**: prices of electricity and heat, energywood, transportation costs, substitutes, CO_2 emission price

Policy Instruments

- **Climate policy**: emission trading, carbon taxes and carbon rentals
- **Energy policy**: feed-in tariff, green certificates, investment subsidies, transportation subsidies and other subsidies
- **Forest policy**: harvesting and forest management subsidies, NIPF taxation
- Import/Export levies on timber

Model Characteristics

- Linking energy & forest sector
- Rich description of energywood markets and intermediate goods
- National and regional analyses
- Utility maximizing NIPF modeling
- ”Sufficiently realistic” description of technologies and economic behavior (e.g. co-firing*)
- Policy relevancy for decision makers — includes major policies influencing the sectors (simultaneous analysis of multiple policies; e.g. how emission trading and feed-in tariff interact*)

**Kangas, Lintunen & Uusivuori ”The Cofiring Problem of a Power Plant under Policy Regulations”, submitted*

Discussion and Open Issues

- Dynamics:

— technological change (e.g. ”learning-by-doing”)*
— investments
— time horizon (five-year periods, long-run)
— intertemporal wood supply decisions

- Production function specification (functional form)
- Data and aggregation level (at what level the different industries are included?)
- International trade?

**Gillingham, Newell & Pizer (2008) ”Modeling endogeneous technological change for climate policy”, Energy Economics*

Thank you!

Project home-page:
http://www.metla.fi/hanke/50168/index-en.htm

Supply Side:
Age-classes and timber category shares

- timberContent(1,1,:)=[0.6, 0.4, 0.0];
  Timber content in the age-class 1 [energy, pulp, log]

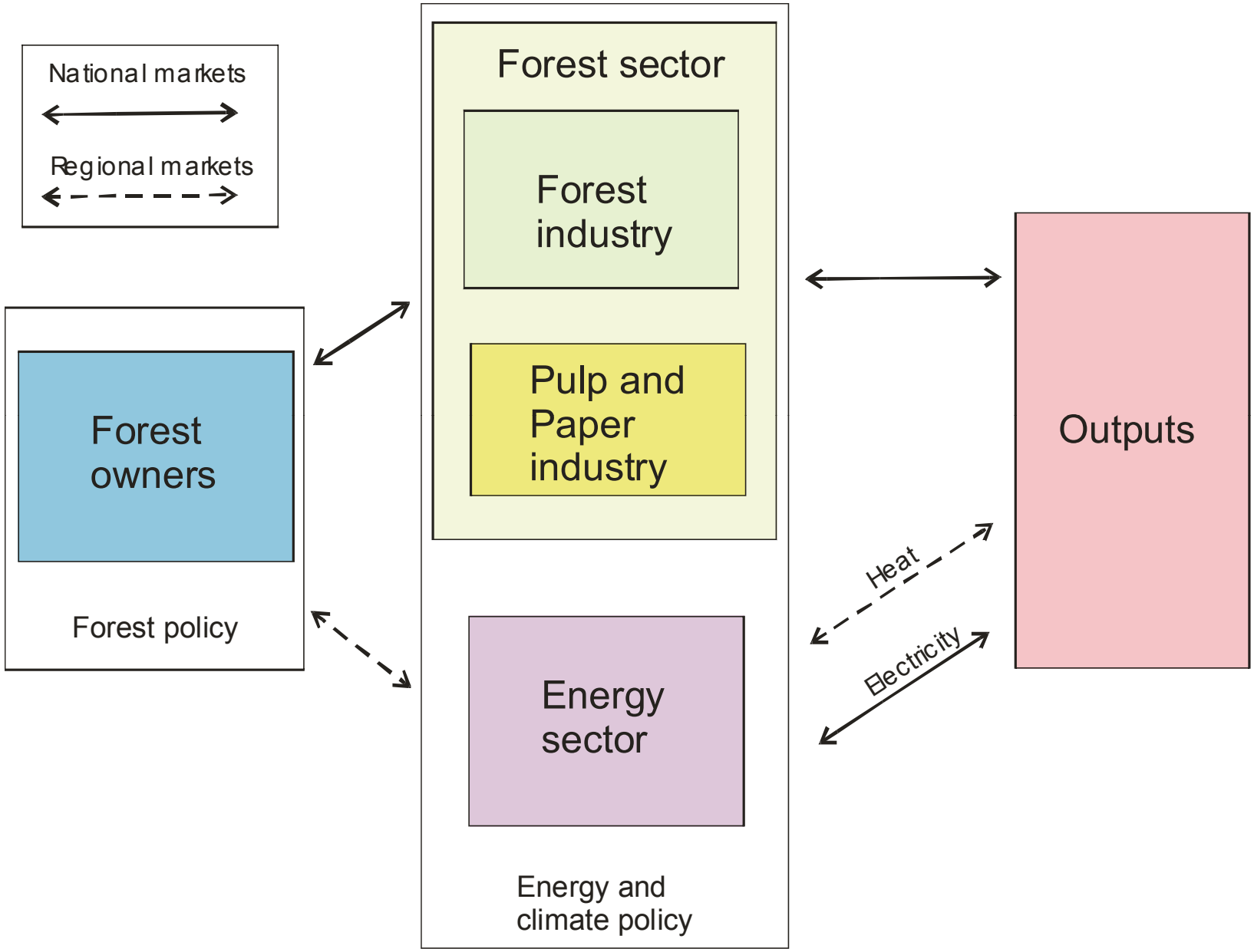
- timberContent(1,2,:)=[0.0, 0.7, 0.3];
  Timber content in the age-class 2 [energy, pulp, log]

- timberContent(1,3,:)=[0.2, 0.3, 0.5];
  Timber content in the age-class 3 [energy, pulp, log]

NIPF objective function

$$U = \underset{\{a_{i+t}, b_{i+t}, C_t\}}{Max} \sum_{t=0}^{\infty} \beta^t \left[(1-\alpha) u(C_t) + \alpha A(x_t) \right]$$

$$s.t. \quad w_0 + \sum_{i=0}^{n} LV(x_i) \geq \sum_{t=0}^{\infty} \left(\frac{1}{1+r} \right)^t C_t$$


National markets
Regional markets
Forest sector
Forest industry
Pulp and Paper industry
Forest owners
Forest policy
Energy sector
Energy and climate policy
Outputs
Heat
Electricity