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Modeling demand and competing use of forestry commodities for material and energy use

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Model-based scenarios of the global energy sector predict with high agreement that both demand and international trade of biomass will increase strongly over the coming years.
Competition for forestry products (and by-products), particularly for low-grade goods, will increase in the coming years due to the growing demand for bioenergy. Modeling and describing the competition between material and energy use of biomass fractions is thus of crucial importance in energy-economic assessments and scenario-building but is, so far, in the fewest models mapped in detail.

In scientific literature various approaches exist to formulate demand equations and interdependence due to competing uses. The complexity of the factors and interactions, which influence the demand for commodities from the forestry sector and biogenic fuels (as well as in principle all products and services), can, in general, only be captured to a certain degree by model equations. Usually far-reaching assumptions about function form of the demand need to be made.
An innovative modeling approach, that is able to model demand patterns with uncertain function form, uses neural networks with multiple output variables in combination with system dynamic modeling. Neural networks allow integration of flexible function forms, whereas the iterative set up of system dynamic models allows a feedback with system variables and exogenous variables, such as economic growth, population or policy driven blend-in targets.
An extensive database has been established, based on the FAO ForeStat database, the World Bank's world development indicators as well as other economic indicators. This global data set has been aggregated in a total of 30 world regions and several forest products (charcoal, firewood, fiberboard, paper fractions, etc.).
It is shown, that a methodology can be developed, that principally enables to reflect the competing use of biogenic fuels, can be calibrated along historical data, and can be used to generate projections of biomass demand. The presented work is primarily oriented along the example of competing use for Austrian forest commodities. Overall, no comparable modeling approach for this sector is known in the scientific literature by the author.