Biomass and Bioenergy 81 (2015) 602–611

Contents lists available at ScienceDirect

Biomass and Bioenergy

journal homepage: http://www.elsevier.com/locate/biombioe

Research paper

Simulating possible impacts of roundwood procurement problems in Austria on wood-based energy production and forest-based industries

Peter Schwarzbauer [a, b, *], Stefan Weinfurter [c], Tobias Stern [b], Sebastian Koch [d]

[a] University of Natural Resources and Life Sciences Vienna, Institute of Marketing & Innovation, Feistmantelstraße 4, A-1180 Vienna, Austria
[b] Kompetenzzentrum Holz GmbH (Wood K plus), Market Analysis and Innovation Research Team, Altenberger Straße 69, A-4040 Linz, Austria
[c] University of Applied Sciences Wiener Neustadt, Business Engineering, Johannes Gutenberg-Strasse 3, A-2700 Wiener Neustadt, Austria
[d] Institute for Advanced Studies, Stumpergasse 56, A-1060 Vienna, Austria

ARTICLE INFO

Article history:
Received 17 October 2013
Received in revised form
22 June 2015
Accepted 3 August 2015
Available online 29 August 2015

Keywords:
Forest-based sector
Raw material shortage
Forest products markets
Biomass energy production
Simulation model

ABSTRACT

Wooden biomass is the main source for energy based on biomass in Austria. Only a part of the wooden biomass for energy directly originates in forests. Other major sources include post-consumer wood and by-products of the Austrian forest-based industries. Consumption of wooden biomass has been growing much more than domestic production, forest-based industries are building up capacities in neighbouring countries, leaving less raw materials for exports to Austria than in the decades before. The authors have assessed the possible effects of a wood raw material shortage with a System-Dynamics simulation model of the Austrian forest-based sector (FOHOW). The model covers the interactions between the general economy and the forest-based sector, including wood-based energy. The simulation period ranged from 2006 to 2025. Beside a business as usual scenario, scenarios with a sawlog import reduction, a sawmill capacity reduction as well as a paper and panel capacity reduction were simulated. Probably the most notable result of the analysis is the strong impact of the sawmill industry on the fuelwood prices and availability. Despite increased fuelwood supply from forests, reduction of sawmill capacity will lead to the inability of fully meeting renewable energy policy objectives due to a shortage of sawmill residues. With exemption of the panel & paper capacity reduction scenario all other scenarios project a slight reduction of growing stock until 2025. But after decades of harvest below the increment such a development is not per se unsustainable. It can be expected that a shift in the Austrian forests towards younger stands will slightly increase the average increment.

1. Introduction and background

Wood is the main source for energy based on solid biomass in Austria [1]. Favourable conditions have been created by the so-called “Ökostromgesetz” (law regarding ecologically produced power)[1] which promoted the construction of many biomass power plants. Because of numerous new plants in construction and an increasing number of private households changing to wood pellet boilers [2] as well as growing pellet exports [1] a further increase in demand is projected [3].

On the other side the production of forest products is of considerable importance to Austria's economy. The forest-based sector accounts for about 3.3% of GDP [4], the country is a major net-exporting country of processed wood products [5]. However, the Austrian forest-based industries are increasingly facing procurement problems regarding wood raw materials for the following reasons:

- On the supply side domestic harvests are restricted due to the ownership structure: 57% of the Austrian forests available for wood supply (FAWS) belong to small non-industrial private forest owners (NIPFs; <200 ha[2]) [7]. For many reasons (see e.g. Refs. [8,9]) the harvests in this ownership category is far below the sustainable potential. This phenomenon is not limited to

* Corresponding author. University of Natural Resources and Life Sciences Vienna, Institute of Marketing & Innovation, Feistmantelstraße 4, A-1180 Vienna, Austria.
E-mail address: peter.schwarzbauer@boku.ac.at (P. Schwarzbauer).

[1] Came into force for the first time in 2006, several amendments since then.

[2] All international publications and statistics use the unit of “hectares” when referring to forest area. Therefore we use here this unit, although it is considered by the Systeme International [6] as a “Unit outside the SI”, but its use is accepted (1ha = 1 hm^2 = 10^4 m^2 = 10.000 m^2).

http://dx.doi.org/10.1016/j.biombioe.2015.08.001
0961-9534/

Austria, but typical for countries with a high percentage of NIPFs (cp. [10]).

- The consumption of wooden biomass has been growing much more than domestic production. This is mainly caused by the politically driven continuous increase of wooden biomass used for energy (cp. [3]), which in turn is also expected to further increase in the future [11]. In addition, also the production of sawnwood, wood-based panels and wood pulp has grown much more than the domestic supply of roundwood [12].
- As a result Austria has become a large net-importer of industrial roundwood over the last decades; in terms of quantities imported Austria globally ranked second after China in 2013 [12]. About one third of the industrial roundwood consumption in the sawmill and paper industry as well as one fourth in the wood-based panel industry is currently imported, mostly from neighbouring countries [13,14]. However, Austrian sawlog imports have been starting to decrease (Fig. 1),[3] in particular because forest-based industries are building up capacities in these neighbouring countries, leaving less volumes of raw material for exports. This could further restrict the roundwood supply for the Austrian industries in the future (see e.g. Ref. [15]).

The procurement problem and the production of forest products are strongly interconnected to the use of wooden biomass for energy. On the one hand, sawmills produce sawmill residues which can be and have been increasingly used for energy, on the other hand, the paper and panel industries during the last decade have been increasingly competing with the energy sector for wooden biomass.

The competitiveness of wood for energy use is secured by the political will to reduce the emission of carbon dioxide. In 2010 the Austrian Federal Ministry of Economy, Family and Youth launched the "National Renewable Energy Action Plan 2010 for Austria" under Directive 2009/28/EC of the European Parliament and of the Council [20]. It can be generalised that the wooden biomass demand for material uses is largely depending on economic developments whereas the demand for energy use is mainly driven by policies rather than by the economy [21].

Energy-related wooden biomass markets are affected by a variety of economic and policy frame conditions. Among many others these include aspects like forest area conservation vs. wood harvests [22], subsidizing wood-based energy [23], subsidizing wood products for material use as well as structural changes in forest ownership, including diminishing interest in wood harvest [24]. This is one explanation for the increase of international wood-based biomass trade to Europe [25].

The major increase in international wood-based biomass trade (e.g. pellets) is from North America to Europe. This increase is largest and concentrated on those countries which have a small forest area base and – as a result – also a marginal forest-based industry sector (e.g. UK, Italy, Denmark, Netherlands) [25]. These countries also have sea-ports! In European countries with a strong forest-based sector (e.g. Austria, Finland, Sweden, Baltic countries, also Germany) the wood-based biomass markets are more of a domestic nature, sometimes with higher exports than imports (e.g. pellets in Austria; [26]). In these countries, like in Austria (but also other landlocked countries, e.g. Switzerland), the energy-related wood-based biomass markets are not dominated by international trade but by the performance of the domestic forest-based sector

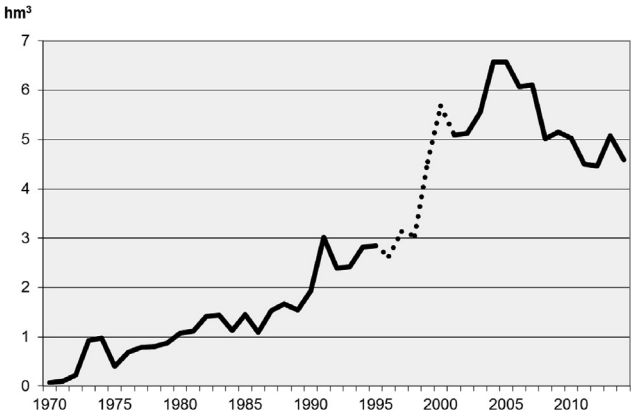

Fig. 1. Coniferous sawlog imports to Austria. The estimates for the years 1996–2001 are based on the (close) correlation between coniferous industrial roundwood and coniferous sawlog imports in the other years (the data for coniferous industrial roundwood imports are available throughout the whole estimation period). Sources: [16–19], own estimations 1996–2001

(forestry – production of fuelwood from forests directly; forest-industry – production of by-products (sawmills) and/or competing for the raw material (paper & panel industry)).

Because no scientific paper can seriously incorporate all possible aspects affecting wood-based energy markets, we here focus only on the raw material procurement-based effects on the forest-based industry (including roundwood imports) and their impacts on wood-based biomass for energy.

Only a few publications exist analysing the connection between procurement problems (e.g. due to decreasing roundwood imports) and their impact on domestic roundwood and wood product markets. Turner et al. [27] as well as Eastin and Turner [28] used the Global Forest Product Model (GFPM) [29], Solberg et al. [30] used the EFI version of the Global Trade Model (EFI-GTM) to simulate the impact of a Russian roundwood export tax on forest products markets in Russia, but also on major importing countries, like China and Finland. Sjølie et al. [31] tested the impact of an import ban for coniferous roundwood to Norway by implementing the Norwegian forest-sector model NoFor. Schwarzbauer [32] used the ATM, an Austrian variation of the IIASA Global Trade Model (GTM) [33], and an earlier version of FOHOW to assess the effect of a total roundwood import stop on the Austrian forest sector. An older FOHOW-version was also used to simulate the impacts of an investment stop and a complete shut-down of the Austrian pulp industry on the whole forest-based sector, but at that time without a focus on the use of wood for energy [34]. Lately Schwarzbauer and Stern investigated the impact of the increasing use of wood for energy production [23] as well as the impact of economic crises [21] on the forest-based sector. Kallio et al. [35] also used the EFI-GTM to simulate the impact of nature conservation in Europe on the forest-based sector, which includes changing roundwood trade patterns. However, none of these studies specifically addressed the impact of decreasing capacity and production[4] in forest-based industries as a consequence of procurement problems on the use of wooden biomass for energy.

Hence, the objective of this paper is

- to investigate and assess the potential economic effects of plausible future developments regarding changes in the wood

[3] There is also a difference between the European wood enterprise use of M m^3 in their published statistics and the international standards [6] to describe 1,000,000 cubic metres. In this paper in accordance with the Systeme International, we will use 1 $hm^3 = 10^2 * 10^3 = 1{,}000{,}000\ m^3$.

[4] Capacity here refers to the potential of production (maximum upper limit), while production is the actually produced amount (lower as or equal to capacity).