European Commission

Sankey diagrams of woody biomass flows in the EU-28

ABSTRACT

Sankey diagrams of woody biomass flows in the European Union as a whole are now available for the years 2009 to 2015 on the European Commission's Knowledge Centre for Bioeconomy web portal at: https://ec.europa.eu/knowledge4policy/publication/forestry-sankey**.**

This technical brief provides definitions, data sources and methods applied to derive the estimates.

Introduction

Analysis of woody biomass flows within the forest-based sector illustrates material and energy practices along a quite complex value chain. In fact, starting from primary sources of wood, removals or imports, wood can either feed wood processing industries for the manufacturing of wood-based products, or be used for energy production. Industrial transformation of wood generate by- or co-products, that are in turn used as inputs for the production of other wood-based products or for energy generation. The woody material transferred across the different transformation steps and among the different subsectors determines complex biomass flows, that are best illustrated using Sankey diagrams, where the width of the arrows is proportional to the magnitude of the flow in question.

We have developed Sankey diagrams of annual woody biomass flows in the EU-28 for the years from 2009 to 2015. The basic underlying data are those of the Wood Resource Balances (WRB) [1], illustrating here individual flows and additional details, regarding production and trade of paper and paperboard, including recovered paper, were processed.

Unfortunately, available statistics are often fragmented and the quality of input data is not always satisfactory. As a result, as in the case of the WRB [1], the Sankey diagrams exhibit a non-negligible difference between reported amounts of sources and declared uses. Part of these amounts are flagged in the diagrams as "unaccounted sources".

An illustrative example of a Sankey diagram, referring to the EU-28 for the year 2015, is provided in Figure 1. All numbers are in million cubic meters Solid Wood Equivalent[1] over bark (Mm^3 SWE o.b.). The arrows show direction and size of the flow, and their colours are intended to provide guidance as regards the main flow categories.

Methods

Amounts of woody biomass sources and uses, both domestic and traded, were derived from the same data sources described in [1], briefly recalled below.

Flows among different industrial subsectors were estimated from the Joint Forest Sector Questionnaire (JFSQ) data on production [2] and Eurostat data [3], applying country- and sector-specific input/output coefficients from INFRO [4]. Bark was calculated applying

[1] Solid Wood Equivalent (SWE) refers to the amount of solid wood fibre contained in the product. It is the roundwood equivalent volume (green volume prior to any shrinkage) needed to produce the product when there are no losses or wood residues [5]

coefficients from UNECE/FAO [5]. Wood flows to energy were estimated from the direct use of wood for energy as reported in the JFSQ [2], but also considering the Joint Wood Energy Enquiries (JWEE) [6], complemented with the Progress reports of the National Renewable Energy Action Plans (NREAP) [7]. Yield ratios for papermaking are taken from [8]. In all the countries, there is a certain amount of woody biomass for energy, whose processing chain is not clearly identifiable. To convert from original reporting units to m^3 SWE o.b., we used conversion factors from JWEE [6], UNECE/FAO [5], and, occasionally, from NREAP Progress reports [7].

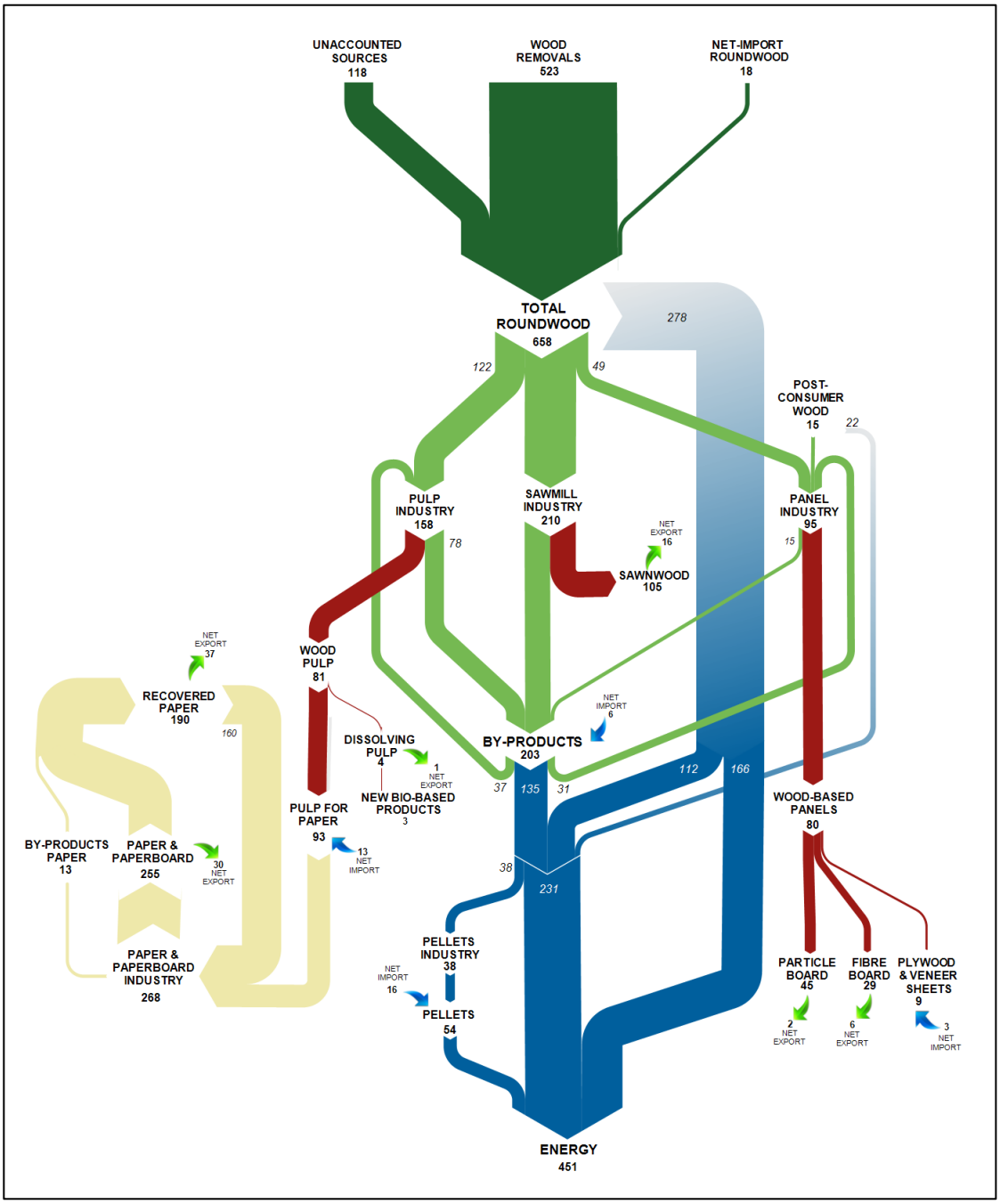

Figure 1: Example of Sankey diagram (year 2015) [Unit: Mm^3 SWE o.b.].

Definitions

The terms used in the Sankey diagrams correspond to the WRB definitions available in [1] and were taken from the glossaries of the data sources used.

Definitions of some additional terms used in the Sankey diagrams and not in the WRB are given below.

By-product: secondary product made in the manufacture or synthesis of something else. In the diagrams, by-products include black liquor, sawmill residues, wood chips and particles (see [1]).

Paper and paperboard: sum of newsprint; printing and writing paper; and other paper and paperboard. Products in this category are generally manufactured in strips or rolls of a width exceeding 15 cm or in rectangular sheets with one side exceeding 36 cm and the other exceeding 15 cm in the unfolded state. It excludes manufactured paper products such as boxes, cartons, books and magazines, etc.

Pulp for paper: It includes chemical pulp, semi-chemical pulp and mechanical pulp (see [1]).

Recovered paper: Waste and scraps of paper or paperboard that have been collected for re-use or trade. It includes: paper and paperboard that has been used for its original purpose and residues from paper and paperboard production.

References and suggested further reading

[1] Cazzaniga N.E., Jonsson R., Pilli R., Camia A. (2019). *Wood Resource Balances of EU-28 and Member States*. EC Joint Research Centre, Publications Office of the European Union, Luxembourg, doi:10.2760/020267, JRC114889.

[2] Results from Joint Forest Sector Questionnaire: https://www.unece.org/forests/fpm/onlinedata.html

[3] Eurostat database: https://ec.europa.eu/eurostat/data/database

[4] INFRO. *Input/output coefficients*. Private communication by Professor Udo Mantau.

[5] UNECE/FAO (2010), *Forest products conversion factors for the UNECE region*.

[6] Results from Joint Wood Energy Enquiries: https://www.unece.org/forests/jwee.html

[7] European Union Member States progress reports for the National Renewable Energy Action Plans: https://ec.europa.eu/energy/en/topics/renewable-energy/progress-reports

[8] Van Ewijk S., Stegemann J. A., Ekins P. (2018). *Global life cycle paper flows, recycling metrics, and material efficiency*. Journal of Industrial Ecology, 22(4), 686-693.

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