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# Methodology for systematic data collection of wood flows in Flanders

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collection of wood flows in  
Flanders**

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# Executive Summary

**The report presents a framework for a comprehensive wood flow analysis, which is essential to fulfil reporting obligations, make well-informed decisions on future planning and investment and ensure circular and sustainable forest management and wood use. The approach followed was from the theory of information systems. After analysing the information needs of diverse stakeholders associated with the Flemish wood-based sector, a framework was defined to collect and process data and present relevant information to stakeholders to meet their objectives.**

The scope of this assignment was **monitoring primary wood production** (from forests and non-forest regions) and import into Flanders and tracking its destination industries and regions (whether within Flanders or outside). Despite the availability of several data sources, the information they provide remains fragmented, lacking a comprehensive overview of wood flows in Flanders. A key proposal in this study is to conduct **surveys of roundwood traders** who are involved in both wood purchasing (from locally harvested and imported sources) and sales (to wood-processing companies within Flanders, other regions of Belgium, or abroad) and have better insights into the sourcing and consumption pattern of the primary wood. Currently, there is no established channel for roundwood traders to share this data, and there may be some reluctance to do so. To address this, strengthening collaboration within the wood-based stakeholder community, particularly with the support of the *Belgische Houtconfederatie*, and ensuring transparency in data sharing will be essential to encourage them to provide valuable information.

The proposed framework marks a critical first step towards understanding wood flows in Flanders. However, to have a complete picture, it is imperative to extend and enhance this framework through continuous improvement. The first logical progression should be incorporating the monitoring of **secondary wood flows**. Secondly, to make well-informed decisions on future investments and planning and develop adaptive strategies, it will be essential to **integrate forecasting data** alongside existing supply and demand information. The framework also emphasises the significance of **enhancing data quality** with each iteration. This can be achieved by incorporating secondary data sources and ensuring regular data collection.

This information system will provide policymakers with information relevant to reporting purposes and supporting the sustainable forest management and circular use of wood resources and to wood processing industries for future planning and investment and build a resilient and thriving wood-based sector in Flanders.

# Samenvatting

Het rapport presenteert een raamwerk voor een uitgebreide analyse van houtstromen, die essentieel is om aan de rapportageverplichtingen te voldoen, goed geïnformeerde beslissingen te nemen over toekomstige planning en investeringen en om circulair en duurzaam bosbeheer en houtgebruik te garanderen. De gevolgde benadering kwam voort uit de theorie van informatiesystemen. Na analyse van de informatiebehoeften van diverse belanghebbenden geassocieerd met de Vlaamse houtsector, werd een raamwerk gedefinieerd om gegevens te verzamelen en te verwerken en relevante informatie aan belanghebbenden te presenteren om hun doelstellingen te bereiken.

De reikwijdte van deze opdracht bestond uit het **monitoren van de primaire houtproductie** (uit bossen en niet-bosregio's) en de import in Vlaanderen en het opvolgen van de industrieën en regio's van bestemming (zowel binnen Vlaanderen als erbuiten). Ondanks de beschikbaarheid van verschillende databronnen blijft de informatie die zij verschaffen gefragmenteerd, waardoor een alomvattend overzicht van de houtstromen in Vlaanderen ontbreekt. De studie stelt voor om **enquêtes uit te voeren bij handelaren in rondhout** betrokken bij zowel aankoop van hout (van lokaal geogste en geïmporteerde bronnen) als verkoop (aan houtverwerkingsbedrijven in Vlaanderen, andere regio's van België of in het buitenland) en die betere zicht hebben op het herkomst- en consumptiepatroon van primair hout. Momenteel bestaat er geen vastgelegd kanaal voor hen om deze gegevens te delen, en er bestaat mogelijk enige terughoudendheid om dit te doen. Hiertoe zal het versterken van de samenwerking, vooral met de steun van de Belgische Houtconfederatie, en het garanderen van transparantie bij het delen van gegevens essentieel zijn om hen aan te moedigen informatie te verstrekken.

Het raamwerk markeert een cruciale eerste stap in het begrijpen van de houtstromen in Vlaanderen. Om een compleet beeld te krijgen is het echter absoluut noodzakelijk dit raamwerk uit te breiden en te verbeteren door middel van voortdurende verbetering. De eerste logische stap zou het monitoren van **secundaire houtstromen** moeten zijn. Ten tweede zal het, om goed geïnformeerde beslissingen te nemen over toekomstige investeringen en planning, en om adaptieve strategieën te ontwikkelen, essentieel zijn om **voorspellingsgegevens te integreren** naast bestaande vraag- en aanbodinformatie. Het raamwerk benadrukt ook het belang van het **verbeteren van de gegevenskwaliteit** bij elke iteratie. Dit kan worden bereikt door secundaire gegevensbronnen op te nemen en te zorgen voor regelmatige gegevensverzameling.

Dit informatiesysteem zal beleidsmakers voorzien van informatie relevant voor rapportagedoeleinden, ter ondersteuning van duurzaam bosbeheer en circulair gebruik van houtbronnen, voor houtverwerkende industrieën voor toekomstige planning en investeringen, en voor het opbouwen van een veerkrachtige en bloeiende houtsector in Vlaanderen.

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# List of Abbreviations

<b>ANB</b>	Agentschap Natuur & Bos – Agency for Nature and Forests
<b>DIPLA</b>	Digital Platform Landscape Management
<b>DNF</b>	Département de la Nature et des Forêts - Department of Nature and Forest
<b>FAO</b>	Food and Agriculture Organisation
<b>GHG</b>	Greenhouse gas
<b>IMJV</b>	Integraal Milieujaarverslag – Integral Environmental Annual Report
<b>IPRFW</b>	L'Inventaire permanent des Ressources forestières de Wallonie - the Permanent Inventory of Forest Resources
<b>LULUCF</b>	Land Use, Land Use Change and Forests
<b>NBB</b>	National Bank of Belgium
<b>OEWB</b>	Walloon Timber Economic Office - L'Office économique wallon du Bois
<b>OSB</b>	Oriented strand boards
<b>OVAM</b>	Openbare Vlaamse Afvalstoffenmaatschappij - Public Waste Agency of Flanders
<b>RFI</b>	Regional forest inventory
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>VEKA</b>	Vlaams Energie- en Klimaatagentschap - Flemish Energy and Climate Agency

# Definitions

**Primary wood** refers to wood sourced directly from forests or other natural sources. It is the raw material that is initially harvested, including roundwood (logs and timber) and firewood and serves as the starting point for various wood-based processing, such as sawmilling. Primary wood also includes industrial residues, such as wood chips and sawdust, which are by-products of primary processing and can still be utilised for initial applications or further processing.

**Roundwood:** Felled logs with or without bark, stripped of side branches and top wood, which has not yet undergone industrial processing.

**Firewood:** Roundwood that is used in wood stoves by private individuals.

**Sawn wood:** Sawn wood refers to wood that has been cut or sawn into standardised dimensions in a sawmill and serves as a primary resource for construction, woodworking, and furniture production.

**Secondary wood** refers to wood that has already undergone some level of processing or manufacturing. Secondary wood includes interim products, such as lumber and plywood, or final products, such as furniture.

**Post-consumer wood:** Wood products that reached the end of their useful life and are no longer needed by the original use.

**Industrial wood:** Industrial wood refers to wood products formed by the initial processing of roundwood (excluding firewood). These are typically intermediate products, such as lumber and plywood, and form a raw material for wood-processing industries, such as furniture manufacturing, packaging and construction.

**Material quality:** This has been derived from the definition proposed by Sirkin and Houten (1994). It is the measure of potential resource utility – the capacity to perform tasks of varying degrees of difficulty. It is a function of embodied energy, chemical composition or structural organisation of a given resource, substance or material. It is also a function of the effort required to produce or reproduce the quality

# 1. Problem statement

**Reliable, steady and sustainable wood supply** from forests and other sources, such as wood edges and agroforestry, is essential to ensure a **well-functioning and thriving wood processing sector**. This bolsters this sector's **economic significance** and fosters value creation and employment opportunities. However, securing that necessitates interaction and collaboration between **wood production** and **wood processing companies**, which is currently limited in Flanders. Along with enabling this collaboration, it is crucial to have a comprehensive understanding of these sectors and accurate estimates of the wood resources available (from the wood-producing sectors) and wood consumed by the different **wood-processing sectors**.

The need for this data is also driven by increasing **regulatory requirements**, notably the obligation as a Party to the United Nations Framework Convention on Climate Change (UNFCCC), under which Belgium must report greenhouse gas (GHG) emissions and sequestrations by Land Use, Land Use Change and Forests (LULUCF). For that, Flanders is obliged to draw up an inventory of **carbon stocks and flows** that take place by LULUCF, which includes information on carbon stock in forests (the carbon in the living biomass, dead organic matter and mineral soil in forests) and wood products and the annual change in that carbon stock. To fulfil this inventory requirement, an overview of the **wood harvests from forests and non-forest areas and the application of that wood** is required. Another reporting obligation is EU regulation on environmental economic accounts (Regulation (EU) No 691/2011), which now includes forest accounts. Under this regulation, Member States must produce forest and wood supply data, including stock, annual growth (or net annual increment NAI) and removal. However, this reporting requirement goes beyond presenting volumes, as stipulated by the LULUCF obligation. It also entails the reporting of the monetary value of timber. Currently, the data required to meet these reporting obligations is lacking, which necessitates the development of a systematic data collection methodology for wood flows in Flanders.

A comprehensive wood flow analysis is also needed to achieve **sustainable and circular wood use**, which is crucial to (1) reduce primary wood consumption to ensure that wood harvest does not exceed long-term sustainable forest yields and (2) minimise (and delay) waste and emissions throughout the wood life cycle, thereby reducing their environmental impact. Circularity is achieved in the case of wood through **optimal cascading use**, which is a strategy of using the wood resource consecutively, as long and as efficiently as possible (WWF - World Wide Fund For Nature, 2016) by preserving the material quality over time through multiple sequential applications. This involves avoiding quality loss during use and processing and ensuring high-quality wood is not wasted on low-quality applications (Sirkin and Houten, 1994). That requires a holistic perspective of all wood supply flows and their current destinations to

guarantee that wood resources are used for the highest quality applications possible and identify opportunities to minimise quality loss throughout the value chain (Navare et al., 2021).

This emphasises the crucial requirement for a **comprehensive information system** – a robust framework designed to address the diverse information needs of stakeholders within the wood-value chain. The system must clearly define the processes for data collection, processing, and distribution to facilitate effective decision-making and collaboration. In essence, it should answer key questions such as what data is needed, which methods should be employed for data collection (including both readily available and actively collected data), and how the data should be processed, structured, and made accessible to the relevant stakeholders to achieve the desired objectives.

## 2. Objective

The assignment's objective is **to develop a framework for systematic data collection, processing and presentation of wood Flows in Flanders. The scope of the assignment includes monitoring primary wood production and consumption, in terms of its quantity (mass/volume) and quality (species, dimensions, types).**

**Primary wood production** includes wood flows from (private and public) forests, nature, landscape and green management, fruit growing and agroforestry and industrial residue streams from primary wood-processing companies. **Primary wood consumption** includes wood consumed in the primary wood-processing industries (primarily sawmills, wood panel producers, paper and pulp companies, and energy producers) and primary wood consumed by households.

The scope of the assessment includes also the **primary wood import and export**. A considerable amount of wood used in Flanders is sourced from outside the region, either through imports or from other Belgian regions, mainly Wallonia. Moreover, a significant quantity of locally produced wood is either exported or consumed in Wallonia or Brussels. Additionally, a substantial portion of wood imported into Flanders is subsequently transferred to other Belgian regions. The extent to which Flanders serves as a transit region, meaning the proportion of imported wood that is actually consumed locally remains unclear. Therefore, accounting for imports, exports, and wood transferred across regional borders is necessary to obtain a precise wood resource balance.

An essential prerequisite for developing this framework is ensuring that the methodology, particularly data collection and access, can be carried out cost-efficiently and regularly (e.g., biennially). To address this, the assignment clearly outlines the responsible parties, the

frequency of data collection, and the proposed approach. The aim is to establish a systematic and time-efficient process that ensures effective execution and periodic follow-up of the exercise.

This assignment serves as the first step – the current scope is monitoring the primary wood flows, but it must be extended to secondary and tertiary wood resources to build a comprehensive understanding of the wood flows. Moreover, the current focus is on the volume of wood. However, certain regulations also require reporting the monetary value of wood. Therefore, this aspect must be integrated in subsequent phases.

## 3. Approach

The assignment was approached with a focus on developing an effective information system to meet the specific data needs for a comprehensive wood flow analysis in Flanders. It began by identifying the **specific data needs** (section 4.1) for achieving the objective. The next step was identifying the **available sources** (section 4.2) that could potentially provide the necessary information. Using this information, a **comprehensive gap analysis** (section 4.3) was conducted to evaluate the data provided by these sources and identify any missing data for constructing a comprehensive overview of primary wood production and consumption in Flanders. This analysis served as a basis for **designing a systematic data collection framework** (section 4.4), which outlines the specific steps to follow for data collection, integrating existing data sources with additional data-gathering methods. It also describes the entities that could execute these steps and suggests the frequency at which they should be performed. Additionally, the framework describes the format of presenting the outcomes of the exercise, which is a complete Flemish wood resource balance. Finally, the current limitations of the framework were acknowledged and opportunities were highlighted for further enhancements to support the development of a more thorough understanding of Flemish wood streams.

# 4. Results

## 4.1 Data needs

### *Primary wood production*

The majority of wood produced in Flanders comes from the forest regions, which cover an area of 140,279 ha. Out of that, approximately 60% is privately owned, covering an area of around 84,840 hectares, while the remaining 40% is publicly owned, accounting for 55,439 hectares (Govaere and Leyman, 2020). The forest growth rate is approximately 9 m<sup>3</sup> per hectare annually, and the annual harvest is around 851,000 m<sup>3</sup> – with industrial roundwood approximately 526,000 m<sup>3</sup> (Cuypers and Belderbos, 2022) and firewood approximately 325,000 m<sup>3</sup> (Oldenburger et al., 2017). The harvest accounts for 67% of the annual growth, which is only slightly below the recommended upper limit of 70% for sustainable forest management as advised by the European Environment Agency (EEA, 2021).

The data required to monitor primary wood production is the **annual harvest** from these private and public forests – i.e. the **amount** (mass/volume) of the wood removed from the forests **per species and diameter class**.

However, wood resources are not limited to forest areas alone. Non-forest areas also contribute to the available wood supply. This includes the plantation of fruit trees (orchards), non-fruit trees (coniferous plantations intended exclusively for sale as Christmas trees), landscape (public gardens, parks and hedges) and agroforestry. These areas do not fall under the FAO definition of forest<sup>1</sup>. While wood production is not the primary goal of these sectors, wood is a by-product of their activities. Wood from landscape management is obtained through pruning woody upright vegetation in the landscape (such as trimming hedges and shrubs) and felling solitary trees, rows of trees, hedgerows and orchards. This source of wood primarily consists of trunks and branches, with little to no industrial roundwood being produced. Previous studies have estimated the **volume of wood from landscape management** to be approximately 77,316 m<sup>3</sup>, which is significant compared to the 851,000 m<sup>3</sup> of locally produced wood (Cuypers and Belderbos, 2022). However, the 77,316 m<sup>3</sup> figure also include also the non-roundwood fractions, mainly branches.

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<sup>1</sup> FAO definition state that “forests are areas of more than 0,5 hectares with trees higher than five metres, a canopy cover of more than 10 %, or trees that can reach these thresholds on-site (FAO, 2020).

In addition to the wood sourced from forests and non-forest areas, primary wood resources in Flanders also come from the primary wood processing industries, primarily sawmills and the paper and pulp sector. Various residues such as wood chips and sawdust are generated during the primary processing of wood. These residues, known as pre-consumer waste wood or **industrial residues**, can still be utilised for initial applications or further processing.

Apart from locally produced wood, primary wood available in the Flemish market includes **imports**, with a significant portion originating from Germany and France and wood purchased from Wallonia. This assignment's scope is solely on primary wood imported into Flanders and does not delve into imports of secondary products (such as boards or plywood) or tertiary products (such as furniture). A significant amount of firewood or pellets are also imported, but are currently not considered as it falls outside the current purview of this assignment. Expanding the system boundary to include secondary and tertiary wood product flows is recommended as a follow-up step (Refer to section 5).

In summary, the data required to monitor primary wood production is

1. The annual volume or mass of roundwood and firewood extracted from both forested and non-forested areas, categorized by species and diameter class.
2. The annual production of industrial residues by primary wood processing companies.
3. The annual import of roundwood and firewood in Flanders or purchase from Wallonia.

### **Primary wood consumption**

Most locally produced and imported wood is traded (purchased and sold) by **roundwood traders**, who play a vital link between wood producers and consumers. These traders are involved in wood harvesting (including the purchase of standing wood and felling operations), transportation to wood-processing companies and the sale to the primary wood-processing industries. Other than that, a substantial portion of the roundwood (especially imports) is purchased directly by wood-processing companies without the intermediary of the roundwood traders.

The main primary wood processing industries are the **wood panel industry** (primarily oriented strand board (OSB) production, accounting for a substantial 51% of the market share. Following closely is the **sawmill industry**, which consumes 37% of the wood available. Other industries consume wood to a lesser extent – **paper and pulp** (8%) and **veneer** (4%; Oldenburger et al., 2017). Although these numbers might be outdated as the situation could have changed, they indicate the scale and importance of different industries in the Flemish wood value chain. It also highlights the significance of accurately determining wood quality, especially regarding dimensions like diameter and height, as it influences the potential utility of wood, i.e. the application or the sector where wood is consumed.

Additionally, approximately 50% of Flemish industrial roundwood is **processed outside Flanders**. Out of the total harvested volume of industrial roundwood in Flanders, estimated to be 526,000 m<sup>3</sup>, only around 266,000 m<sup>3</sup> is processed within the region. The remaining portion is processed outside. While a small share is processed in Wallonia, a significant fraction is exported to various destinations, including China, which stands out as one of the largest importing countries (Oldenburger et al., 2017).

In Flanders, a notable portion of **firewood** is consumed by households, often obtained through informal channels that are unaccounted for in official records. An earlier survey that attempted to estimate this consumption indicated that Flemish households consume approximately 1 million m<sup>3</sup> of firewood from woody biomass annually (Vandekerkhove et al., 2014). However, it's important to note that this estimate carries a high level of uncertainty, and the study does not specify the proportion derived from the forests. In the Netherlands, 32.5% of this firewood (consumed by households) comes from forests (Oldenburger et al., 2017). Assuming a similar percentage for Flanders suggests a harvest of 325,000 m<sup>3</sup> of firewood from the Flemish forests. With the remaining diverted from landscape management, gardens and imports to domestic heating. The share from forests is significant compared to 266,000 m<sup>3</sup> of roundwood processed in Flanders and thus cannot be overlooked. Although, the estimates of firewood consumption includes not only roundwood but also thick branches and top wood sold or given away as firewood.

Another sector consuming primary wood is **niche consumers**. These companies or individual manufacturers specialise in producing unique applications from wood. While many of these companies do not rely on primary wood consumption, there are exceptions, such as specialised sawmills that focus on processing specific wood species. Including these actors in our analysis allows for a stronger connection between locally harvested wood and local processing and utilisation, ensuring a comprehensive representation of all consumer types as much as possible.

In summary, the data required to monitor primary wood consumption is

1. The annual wood consumption of primary wood processing companies by species, diameter class, and wood type.
2. The annual consumption of primary wood, predominantly firewood, by households.
3. The annual export quantity of roundwood and firewood produced in Flanders.

## 4.2 Data Landscape

This section **describes all the available data sources** that could potentially provide the information necessary to build the Flemish wood resource balance.

## *Production data:*

### *Regional Forest Inventory (RFI)*

The primary data source of relevance is the regional forest inventory (RFI). Since 1997, the Agency for Nature and Forest (ANB) has been monitoring the condition of the forest in Flanders through the Flemish forest inventory. This inventory consists of a network of 27,163 sampling points strategically placed across Flanders by laying a fictitious grid of 1\*0.5 km. At each grid intersection where the forest is visible in aerial photographs, information is captured on woody and herbaceous vegetation. The collected data includes the circumference and height of living and dead (both standing and lying) trees and the tree species. For a detailed explanation of the RFI measurement procedure and data collection and processing, please refer to the “Forest Inventory | Agency for Nature and Forest”. The initial survey of the entire monitoring network took place between 1997 and 1999. The second round of inventory began in 2009, following a ten-year cycle where 10% of the points were surveyed annually, completing the inventory over a decade. The third round commenced in 2019.

Since the completion of the second round of inventory (in 2019), data is available for multiple measurement cycles, which makes it possible to estimate changes and trends in the forests over time. This allows for estimating annual forest growth, natural losses, and wood harvest. It provides information on the **quantity (volume) of wood per species and the diameter class of living and dead trees (both standing and lying)**. The volume estimates are specified with a confidence interval on all types of forests, soils, and ownerships (private vs. public). Starting in 2024, the annual wood harvest estimates will become available, which is calculated based on the moving average of the last five years (and up to ten years in 2029).

### *Harvest and sale data*

In addition to the inventory data, ANB also keeps records of the **annual volume of wood sold**, albeit exclusively for wood originating from the public forests under ANB's jurisdiction. Some public forests are also managed by other public bodies, such as provinces and municipalities. While ANB oversees some of these forests and possesses corresponding sales data, the remainder lack such records. As for private forests, there is no centralised management entity, which makes it challenging to obtain annual harvest and sale data for these forests. Nonetheless, some private foresters are associated with Bosgroepen and sell their harvest through them. Bosgroepen maintain sale data for these foresters. Significant private forest properties, especially from the bigger forest owners, are either not affiliated with Bosgroepen or do not sell via Bosgroepen. So, Bosgroepen do not have recorded information on their harvest or wood sales. It is hard to estimate the share of forest (forest area or forest owners) that sell their harvest through means other than via Bosgroepen, making it challenging to use the available sale data to estimate this fraction.

### *Non-forest wood production data*

The systematic monitoring of wood harvest from non-forest areas in Flanders is currently limited. The most recent estimates date back to 2011 and are based on extrapolations from the theoretical harvest volume calculated within the Limburgs Groen project (Gybels et al., 2012). The Digital Platform Landscape Management (DIPLA) (<https://www.dipla.be/>) offers a potential source of comprehensive information on these wood flows. This software platform is dedicated to green maintenance and management, and it assists municipalities responsible for local landscape management in inventorying wood stocks and tracking wood production from landscape management activities.

### *Industrial residues*

OVAM gathers data on industrial waste production while producing the Integral Environmental Annual Report (IMJV) using a statistically representative sample of companies that report their annual waste and secondary raw materials. Companies are categorised into different size classes based on employment levels and a sample from each group is requested to report their annual waste and secondary raw material production. This data is used to **estimate the total amount of wood waste residues generated by wood-processing companies in Flanders**, the portion utilised as secondary raw material and the purposes it serves.

OVAM has also recently introduced a system for reporting industrial waste Materials information system (MATIS) - a system obliging the waste collectors and processors (treatment facilities) to report their waste streams every three months. Waste collectors have to report the in and out-going waste amounts and from where. The reporting obligation has been gradually enforced since 2022. In the context of the primary wood value chain, this includes (1) Wood panel producers (who use industrial residues as raw materials), (2) Incinerators (companies that purchase industrial residues for incineration, as well as those that incinerate industrial residues generated within their own facility) and (3) wood waste processing or treatment facilities.

The IMJV will continue to exist but will only contain information collected from waste producers. So, IMJV and MATIS are complementary. However, the MATIS system is mandatory, and the waste amounts are estimated by aggregating the amounts reported by different companies in the sector with no need for extrapolation. Therefore, MATIS will provide a more accurate picture of industrial residue production moving forward.

### *Import and Export data*

The international trade data (wood import and export) information is already available at the National Bank of Belgium (NBB) online statistical (<https://stat.nbb.be/>). It reports data on the **volume of different types of wood** (softwood/hardwood and species) and the destination or source of that wood. Although the data is available at the regional level for Belgium, it is difficult to estimate the amounts that are consumed in each region. As seen in Figure 1, most of the

importers are present in Flanders, however, the wood purchased by these importers is sold to traders or wood-processing companies in Wallonia or Brussels. These interregional trade flows are not accounted for in the NBB trade statistics and need to be considered to accurately estimate the amount of wood imports consumed in Flanders which is essential to build regional resource balance.

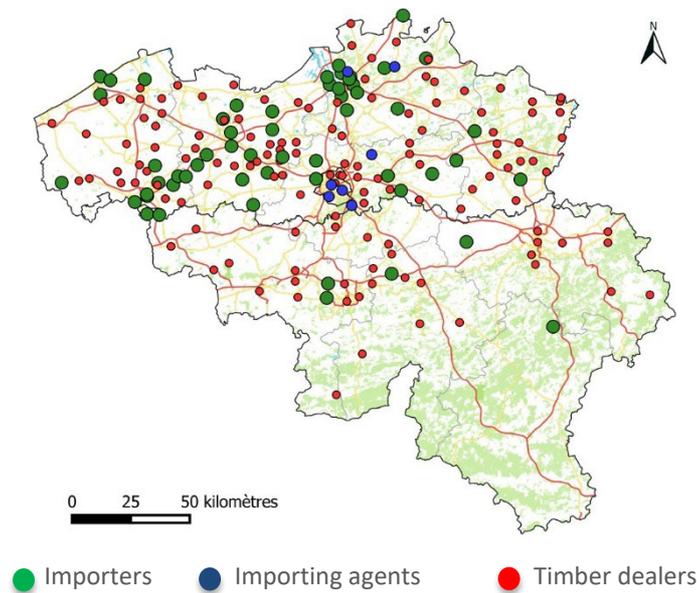


Figure 1: Location of roundwood traders in Belgium. Sources: Office Économique Wallon Du Bois (OEWB, 2021).

### Consumption data:

#### Surveying sawmills - Situation sketch of the Belgian sawmill sector in 2020

De Belgische Houtconfederatie, along with Hout Info Bois, surveyed sawmill industries in 2020 to draw a detailed picture of the state of this sector – the number of sawmills, their roundwood consumption, supply, and associated economic and societal challenges. To carry out the survey, sawmills were classified based on the annual amount and the type (hardwood, coniferous or mixed) of roundwood they consume. Then a layered sample was surveyed, with a random sampling rate of 50%. The data collected from these sawmills were extrapolated to estimate the total volume of roundwood processed by the sawmill industry annually and the origin of that wood (Flanders, Wallonia or abroad). This information provides insights into the **quantity and type of locally produced wood consumed by sawmills**, which is crucial for developing a comprehensive wood resource balance for Flanders. While this survey was conducted as a one-time initiative, if performed regularly it will enable the stakeholders involved in timber production, including forest managers and owners, to stay informed of the trends in this sector and align their actions in accordance with the anticipated change. For a detailed explanation of the methodology followed to assess the consumption by the sawmill sector, please refer to:

[https://www.houtinfo Bois.be/wp-content/uploads/2021/12/FNS-Sciage2021\\_NL\\_P04-BR.pdf](https://www.houtinfo Bois.be/wp-content/uploads/2021/12/FNS-Sciage2021_NL_P04-BR.pdf).

### *Surveying wood panel producers*

The highest share of Flemish industrial roundwood processed by volume in Flanders is mainly by the wood panel industry (51%), mainly for OSB production. An attempt was made in a previous project (Oldenburger et al., 2017) to survey the wood panel producers [refer to the supplementary text for the survey form used] to estimate the **volume of roundwood consumed in the production of wood panels**.

The OSB producer already provides data [wood panel production (volume in m<sup>3</sup>) and their consumption (volume in m<sup>3</sup> and origin of the wood used)] regularly for building the wood resource balance for Wallonia ([https://www.oewb.be/sites/default/files/media-documents/OEWB-PanoraBois\\_2021\\_0.pdf](https://www.oewb.be/sites/default/files/media-documents/OEWB-PanoraBois_2021_0.pdf)). They have also expressed their willingness to provide their data for this assignment, which could be a useful source of information. This information repository is accessible through Fedustria, the Federation of the Wood and Furniture Industry, which could also be approached to facilitate data access and consultation.

### *Energy*

The Flemish Energy and Climate Agency (VEKA) compiles an annual energy balance, which provides an estimate of the energy source of the different industries in Flanders. As part of this process, all wood-burning installations (with a total nominal thermal capacity of more than 25 kW) must provide the installation's consumption, operation and production data. However, it provides information on the quantity of biomass used for energy production in Flanders. The biomass fraction includes the wood and non-woody fraction, and within the wood fraction – roundwood, fuelwood, processed wood (such as pellets and charcoal) and waste wood (industrial residues or post-consumer wood). So, for this information to be useful for monitoring wood flows, we need data specifically on the quantity of firewood for energy production in Flanders. This level of granularity is currently not available.

### *Informal sector*

The portion of woody biomass, primarily firewood, consumed by households through informal channels is significant. Vandekerkhove et al. (2014) surveyed households and estimated that this fraction could amount to as much as 1 million m<sup>3</sup> of firewood from woody biomass consumed annually by Flemish households. However, there is currently no systematic and regular method to accurately determine this quantity. It is essential to establish a reliable method as various socio-economic factors, such as energy prices and inflation, can significantly influence this consumption pattern.

## 4.3 Data Gaps

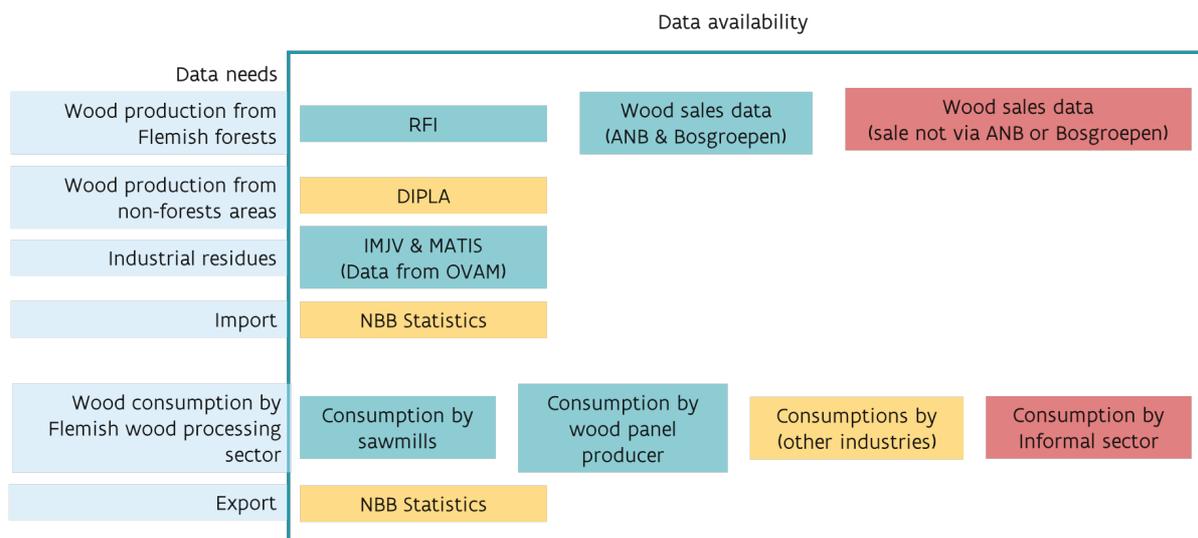


Figure 2: Data landscape. The figure shows the data required to achieve the objective, and the data sources that can support that. The **blue blocks** indicate data that is available with a sufficiently high level of confidence. The **yellow blocks** indicate partially available data and the **red blocks** indicate unavailable data.

### Primary wood production

Table 1: Summary of the data gap analysis – the table summarises (1) the data needs for monitoring wood availability (produced or imported) on the Flemish market, (2) the available data sources that can provide the requisite information, (3) the data gaps – aspects for which data is currently unavailable and (4) recommendations on closing those gaps.

Data needs	Data sources available	Data gaps	Suggestions for closing the gaps
Primary wood production in and import to Flanders			
Wood harvest from public forests (volume of wood per species and diameter class)	<b>Regional forest inventory</b> (RFI): volume harvested annually per species and diameter class.	The confidence interval on estimation for less prominent species may be wider.	<ol style="list-style-type: none"> <li>1. Use <b>secondary data sources</b> to improve data quality (suggested as future work – described in section 5)</li> <li>2. Survey directly the <b>roundwood traders</b>.</li> <li>3. Survey the <b>primary wood processors</b> that procure wood directly from the producer.</li> </ol>
Wood harvest from private forests (volume of wood per species and diameter class)			
Wood harvest from landscapes, plantations and agroforestry	<b>Digital Platform Landscape Management</b> (DIPLA): volume harvested from landscapes	<b>Coverage is limited</b> as not all landscapes are included. Additionally, <b>plantations, agroforestry</b>	<ol style="list-style-type: none"> <li>1. <b>Extend the DIPLA platform</b> to plantation and agroforestry owners.</li> </ol>

(volume of wood per species and diameter class)		<b>and orchards are not included</b>	2. Survey directly the <b>roundwood traders</b> , who are involved in the wood purchase. 3. Survey the <b>primary wood processors</b> that procure this wood directly without intermediary traders.
Industrial residues (volume of wood residues per type)	<b>IMJV</b> report and <b>MATIS</b> : volume produced annually	MATIS would provide more accurate estimates, but this system is still being implemented.	
Import (volume of primary wood – roundwood and firewood – per species and diameter class)	<b>NBB</b> statistics: volume imported per species and type.	The statistics also include wood purchased by Flemish traders and sold to wood processing companies in Wallonia (and not consumed in Flanders). No data on interregional trade – wood from other regions consumed in Flanders.	1. Survey directly the <b>roundwood traders</b> involved in the wood purchase from abroad. 2. Survey the <b>primary wood processors</b> involved in the wood purchase from outside Flanders.

To accurately create a wood resource balance, we require information on the **quantity** (mass/volume) and **quality** (species, dimensions, types) of **wood supplied to the Flemish market**, which originates from various sources, including Flemish forests, non-forest regions, industrial establishments, and imports.

The primary data sources for this purpose include:

1. **RFI** for the annual harvest (supply) from Flemish forests
2. **DIPLA** for the annual harvest (supply) from non-Forest regions
3. **IMJV** and **MATIS** provided by OVAM for the annual production of industrial residues
4. **NBB** statistics for the annual primary wood import

While these data sources offer a comprehensive overview of primary wood supply, they are incomplete and potentially inaccurate for the specific data we require. For instance, DIPLA allows municipalities to inventory green space and landscapes, providing estimates on the wood harvest from these areas. However, not all municipalities are mandated to participate in DIPLA, leading to potential gaps in coverage. Additionally, the platform only covers landscapes and does not include plantations, agroforestry, and orchards.

The NBB statistics provide data on the annual import of primary wood into Flanders. However, these statistics also include wood purchased by Flemish traders and subsequently sold to

primary wood processing companies in Wallonia. Additionally, there is no data available on the primary wood purchased from Wallonia or Brussels.

From the remaining data sources, RFI provides comprehensive coverage of wood flows but relies on estimations. While these estimations employ statistically robust methods, they have associated uncertainties. To enhance the accuracy and reduce uncertainties, it is beneficial to complement the top-down approach of data estimation of wood harvest with bottom-up data sources. One such source is wood sale data, which offers precise information on the annual volume of wood sold in the Flemish market. However, this data is only accessible for public forests and private forests that engage in wood sales via ANB or Bosgroepen.

It is important to note that assuming the annual wood harvest from Flemish forests is equivalent to the annual sale of wood may not hold for two reasons. First, the wood is often sold while still standing, and traders have up to a year to harvest it. Therefore, the actual harvest might occur in a different year than the sale. However, this time lag is not expected to significantly impact the overall estimates. Secondly, it is important to consider the substantial amount of harvested wood that enters the market through informal channels. Relying solely on local trade data may not accurately reflect the quantity of locally harvested wood.

A complementary approach to address this data gap is gathering information directly from **roundwood traders** who are intermediaries between producers and consumers. As they are directly involved in purchasing and selling primary wood, they have a comprehensive understanding of the wood flows. Surveying these traders about the volume and origin of their wood purchases would be instrumental in bridging this information gap. Unfortunately, it is currently challenging to access data from roundwood traders, underscoring the need for concerted efforts in data collection within this sector. It is important to note that even with the inclusion of roundwood trader data, exchanges via informal channels may remain unaccounted for.

A substantial portion of the roundwood is purchased directly by wood-processing companies, especially imported wood. So, this survey of wood purchases (volume and origin) must be extended to these companies that procure wood directly from the producer or outside Flanders (abroad or Wallonia).

**Primary wood consumption**

*Table 2: Summary of the data gap analysis – the table summarises (1) the data needs for monitoring wood consumption and export from Flanders, (2) the available data sources that can provide the requisite information, (3) the data gaps – aspects for which data is currently unavailable and (4) recommendations on closing those gaps.*

Data needs	Data sources available	Data gaps	Closing the gaps
Primary wood consumption in and export from Flanders			

Primary wood consumption in wood panel producers	<b>Survey of wood panel producers:</b> volume, type and source of wood consumed		Regular data gathering to improve data quality
Primary wood consumption in wood sawmills	<b>Survey of the sawmill industries:</b> volume, type and source of wood consumed		
Round wood consumption industries where it is consumed to a lesser extent (paper and pulp, veneer, niche markets etc.)			<b>Extending the survey to other wood-consuming industries</b>
Firewood consumption industries and households			Estimated by <b>subtracting the total wood consumed by all sectors from the total volume of primary wood</b> put on the Flemish market.
Export	<b>NBB statistics:</b> volume of roundwood imported per species.	No data on interregional trade – Flemish wood consumed in Wallonia	<b>Survey roundwood traders</b> involved in the sale of primary wood

To assess the consumption aspect in the wood resource balance, we need to gather information on the wood consumed by primary wood-consuming industries, particularly **wood panel producers and roundwood sawmills**. These industries collectively consume a significant portion (~88%) of the wood available on the Flemish market. Additionally, it is crucial to obtain data on primary wood consumption in **other industries** that utilise the remaining wood even though these quantities may be relatively minor, as they contribute to the overall resource balance. Another crucial data need is for **wood consumption outside of Flanders**, including Wallonia, Brussels, and other countries, as this accounts for approximately 50% of the Flemish harvest (Oldenburger et al., 2017).

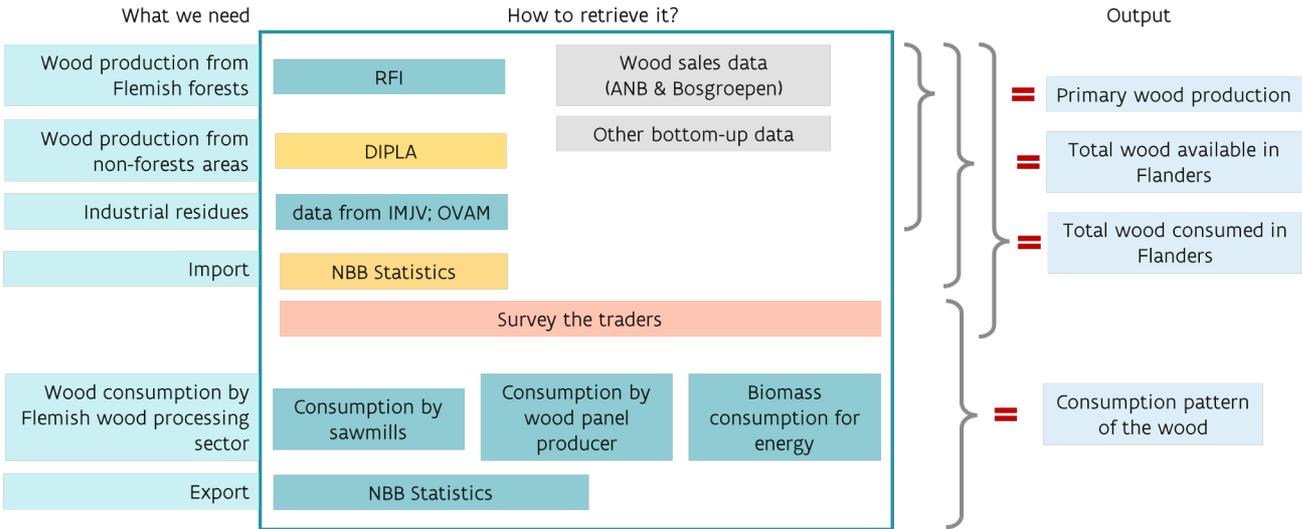
**Regular surveys of primary roundwood processors**, such as sawmills and wood-panel producers, can provide valuable insights into the consumption of locally harvested wood within Flanders. The **NBB statistics** offer information on wood exports from Flanders; however, it does not have information on interregional trade – the amount of locally harvested wood sold to wood-processing companies in Wallonia and Brussels. It is necessary to estimate that to determine the quantity of wood consumed within the regional borders of Flanders. Additionally, as described in the previous section, accurately estimating the primary wood consumption in the energy sector, by niche consumers and via informal channels poses challenges.

One potential solution to address this data gap is to **survey roundwood traders** on the amount of wood sold to companies outside Flanders (exported or in Wallonia). As previously highlighted, roundwood traders are directly involved in the sale of wood and thus have a better overview of the consumers - their respective sectors, and their geographical locations—whether in Flanders, other regions of Belgium, or abroad. Unfortunately, at present, information from roundwood traders specific to Flanders is currently unavailable, emphasizing the need for further data collection efforts to gain insights into primary wood consumption.

## 4.4 Framework for compilation of wood flows data

### Procedure

It is evident that several data sources are available, but they offer fragmented information, lacking a comprehensive overview of wood flows in Flanders. To address this limitation, there is a need to establish a systematic framework for data compilation and take concrete steps to bridge the existing data gaps. In the following subsections, we propose a framework based on the best available data sources, aiming to provide the most comprehensive overview of wood flows possible. However, it is important to acknowledge that this overview may still be incomplete. Section 5 outlines specific measures to enhance and refine this understanding. We advocate for the establishment of a monitoring framework despite the existing gaps, and efforts to be taken for continuous improvement with each iteration.



*Figure 3: Pictorial representation of the framework. The figure shows the data required to achieve the objective, and the data sources that can support that. The blue blocks indicate data that is available with a sufficiently high level of confidence. The yellow blocks indicate partially available data*

and the red blocks indicate unavailable data. The grey blocks indicate secondary data sources that could assist in completing the picture.

Table 3: Summary of the framework to collect and process data on primary wood flows in Flanders

Steps	Task
Step 1	Use the RFI to determine <b>the total primary wood harvest</b> , i.e. volume, species, and quality (dimensions) of the wood, from forest areas
Step 2	Combine it with the data from these sources (DIPLA and IMJV), and estimate the <b>total primary wood production in Flanders</b> , i.e. volume (in cubic meters), types (species), and quality (roundwood, chips, sawdust, etc.) of the primary wood, from non-forest regions and primary wood producing industries.
Step 3	Access NBB statistics to estimate the <b>total import of primary wood in Flanders</b> .
Step 4	Surveying roundwood traders to estimate the share of wood import sold across regional borders and purchased from Wallonia (so produced in forests in Wallonia). Surveying wood-processing companies (that directly procure wood from Wallonia) on the amounts purchased.
Step 5	By subtracting the amount of Step 4 from the total import (Step 3), estimate the total primary wood import that is consumed in Flanders.
Step 6	Combining the data for wood produced from forests (Step 1), non-forest areas (Step 2) and the industrial entities (Step 2) with the imports consumed in Flanders (Step 5) and purchased from Wallonia (Step 4) provides the best available estimate of the <b>total primary wood consumed in Flanders</b> .
Step 7	<b>Survey</b> the largest primary wood processors – <b>sawmills and wood-panel producers</b> – on the quantities of locally sourced and imported wood consumed within these facilities.
Step 8	<b>Survey</b> the other primary wood processors – the <b>paper and pulp sector and the energy sector</b>
Step 9	Access the NBB statistics to estimate the <b>total export of primary wood from Flanders</b>
Step 10	<b>Surveying roundwood traders</b> to estimate the share of their wood purchases sold across regional borders or abroad.
Step 11	By adding the amount of Step 10 to the total export (Step 3), estimate the total primary wood consumed outside Flanders.
Step 12	Estimated the share of primary wood consumed informally by <b>subtracting the total wood consumed by all sectors and exported from the total volume of primary wood</b> put on the Flemish market

In developing this framework, we draw inspiration from the successful approaches followed in the Netherlands and Wallonia, where established frameworks for data collection have enabled the regular publication of wood statistics reports. The approaches utilised in these regions are described in detail in Box 4.1 and 4.2, providing valuable insights for the development of our own data collection framework.

Box 4.1: Description of the approach followed in Wallonia for building an inventory of the timber sector for the region.

Wallonia has been compiling data on the timber sector's inventory since 2013, a task undertaken by the Filière Bois Wallonie (formerly Walloon Timber Economic Office – L'Office économique wallon du Bois, OEWB). This office was established under the initiative of the

Walloon Government to foster the economic development of the timber industry in the region, with its activities commencing in January 2012.

The OEWB produces a comprehensive report every two years, offering valuable insights into the state of the sector. To generate this report, the OEWB utilises data from various sources. It relies on the **Permanent Inventory of Forest Resources** (L'Inventaire permanent des Ressources forestières de Wallonie – IPRFW) and **sales data** to estimate the volume of roundwood harvested. The sale data provides actual harvest amounts exclusively for public forests (managed by the Department of Nature and Forest – Département de la Nature et des Forêts DNF). While for private forests, the information is based on the IPRFW. The methodology employed for forest inventory is similar to that used in Flanders. The first inventory took place between 1994 and 2008, followed by a second cycle that began in 2008.

The volume of firewood in Wallonia is estimated through various data sources and calculations. To determine the estimates for firewood, the **harvest roundwood volume is subtracted from the total biomass harvest**. The harvest roundwood volume is estimated using sale data and is extrapolated to include private forests. The total biomass harvest is obtained from the Permanent Inventory of Forest Resources in Wallonia (IPRFW). In addition to these data sources, other bottom-up approaches are used to gather information on firewood consumption. Regular surveys conducted by Wallonian public services collect data on household firewood consumption, providing valuable insights into the residential use of firewood. The **Walloon energy balance** is another data source that provides information on industrial fuelwood consumption.

OEWB uses data from **surveying primary wood processing industries** and **industry federations** for collecting data on wood consumption. To gather information on roundwood consumption in sawmills, they utilise the Hout info bois survey conducted in 2020. For the wood panel sector, OEWB contacts FEDUSTRIA, the federation of woodworking and furniture industries, as well as specific manufacturers – the two manufacturers in Belgium, Unilin and Norbord. These entities provide valuable data on roundwood consumption and panel production volumes. In the paper and pulp sector, OEWB collaborates with **InduFed**, the paper and pulp processing company's federation, to obtain information on roundwood consumption. OEWB refers to the **Wallonia Energy Balance report** for 2019 to assess fuelwood consumption in industries. When it comes to import and export data for wood and wood products, OEWB relies on data available from the **NBB statistics**.

OEWB compiles comprehensive information on wood production and consumption in Wallonia by leveraging these data sources and collaborations with industry stakeholders.

For further information, refer: [https://www.oewb.be/sites/default/files/media-documents/OEWB-PanoraBois\\_2021\\_0.pdf](https://www.oewb.be/sites/default/files/media-documents/OEWB-PanoraBois_2021_0.pdf)

For information on the sawmill survey conducted by *Hout info Bois* and *De Belgische Houtconfederatie*: [https://www.houtinfo Bois.be/wp-content/uploads/2019/05/FNS\\_NL\\_MR1.pdf](https://www.houtinfo Bois.be/wp-content/uploads/2019/05/FNS_NL_MR1.pdf)

*Box 4.2: Description of the approach followed in the Netherlands for building wood statistics for the country.*

The Netherlands has been compiling wood statistics for decades, which now offer valuable insights into the long-term trends of wood production and consumption. These statistics are developed under the commission of the Ministry of Agriculture, Nature Management, and Food Quality and are conducted by **Probos Foundation**, an independent knowledge institute specialising in forestry. Probos utilises **targeted roundwood surveys** to gather the necessary data for building comprehensive wood statistics.

Probos conducts annual **surveys of all companies** involved in the producing, processing, or trading of woody biomass in the Netherlands. This diligent approach ensures that all wood flow streams are carefully monitored and accounted for. Probos collaborates closely with the Branchevereniging Organische Residues (BVOR), an industry association that plays a key role in the supply of woody biomass to the Dutch market.

The first set of surveys is sent to all **primary wood processors**, including sawmills and manufacturers of sheet materials, as well as industries, such as paper and pulp producers, that consume minor amounts of primary wood. The second set of companies surveyed comprises **roundwood exporters**. These surveys are complemented by data from the **CBS statistics on International Trade**, which provide valuable information on the annual import and export of wood products. To obtain a comprehensive overview of wood utilisation for energy production in the Netherlands, the CBE **Renewable Energy statistics** are consulted. The Probos survey does not capture the production and consumption of firewood. Instead, Probos relies on data from Statistics Netherlands, which estimates this amount based on results from the Housing Market Module (**Woningmarktmodule**) and the Energy Module within the Housing Survey (**WoonOnderzoek Nederland**)<sup>2</sup>.

Using the collected data on wood production, import, export, and consumption through different surveys, a comprehensive Dutch wood balance is compiled. It provides a detailed overview of the volume of roundwood processed within the Netherlands, including its origin, as well as the quantity exported. The collected data is made accessible at a national level through the website <https://www.bosenhoutcijfers.nl/>. Additionally, targeted articles on specific topics and an annual publication have been available since 2020, offering a detailed analysis of Dutch wood consumption in the preceding year.

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<sup>2</sup> <https://www.cbs.nl/nl-nl/achtergrond/2019/41/houtverbruik-huishoudens-woon-onderzoek-2018>

For further information, refer: <https://www.probos.nl/publicaties/rapporten/rapporten-2023/1880-houtproductie-en-gebruik-in-nederland-in-2021>

The following sub-sections describe a framework for data compilation to be established in Flanders.

### 1. **Annual primary wood availability**

To estimate the annual harvest from Flemish forests, we recommend relying on the robust statistical estimations that will be provided by RFI. This data source will provide an average annual harvest, including information on the volume, per species and diameter class. For information on the wood from non-forest regions, we recommend using DIPLA and for industrial residues, the IMJV report and MATIS from OVAM, and the NBB statistics for the import of primary wood. By combining the data from these sources, we can **estimate the total primary wood supply to the Flemish market** in terms of volume (in cubic meters), types (species), and quality (roundwood, chips, sawdust, etc.). Refer to Table 3 for a step-wise description.

As mentioned in the previous sections, the NBB statistics also include wood purchased by Flemish traders but processed by primary wood processing companies in Wallonia. To overcome this challenge, we propose **surveying roundwood traders** on the two key aspects: (1) the share of imported wood sold across regional borders and (2) the volume of primary wood purchased from other regions of Belgium. Since some of the wood-processing companies procure wood directly from producers without interim roundwood traders, they should also be surveyed too to determine the amount of primary wood they purchased from other regions of Belgium. By subtracting the share of imported wood sold across regional borders from the total imports to Flanders and adding the volume of wood purchased from other regions of Belgium, we can estimate the primary supply of primary wood from outside Flanders to the Flemish market (and consumed within Flanders). Combining this data for primary wood production in Flanders provides the best available estimate on the total primary wood consumed in Flanders.

A dedicated forum for surveying roundwood traders does not currently exist and needs to be initiated. The following section provides details on how that could be done.

### 2. **Annual primary wood consumption**

For a comprehensive estimation of annual wood consumption from Flemish forests, it is recommended to survey the **primary wood processors**. Initially, the survey should focus on the major primary wood-processing companies – sawmills and wood-panel producers. *De Belgische Houtconfederatie* has already surveyed sawmills and has gathered information on the volumes of primary wood consumed and the types, species, and sources of the wood (Flanders, Wallonia, or abroad). We recommend utilising a similar methodology for future surveys but

ensuring that they are conducted regularly (at least every two years) to establish a consistent data collection routine within the companies. Implementing regular surveys will significantly improve the data quality, as sawmills will become more familiar and accustomed to capturing and reporting this information as part of their standard practices.

Similarly, surveying the **wood-panel producers** has already been carried out within the Interreg project 'eco2eco', offering a suitable methodology to follow. The survey formats and a link to the report detailing the methodology are available in the annexe. The data collected from these surveys will provide valuable insights into the quantities of locally sourced and imported primary wood used in these sectors. The 'eco2eco' report also includes contact details for roundwood processing companies, making it a valuable resource for reaching out to these companies.

In addition to these surveys, including the data from NBB statistics on the wood exported from Flanders, we can capture a significant portion of wood consumption. The results obtained from these surveys will offer the most reliable information regarding the consumption patterns of primary wood in Flanders, enabling a more accurate understanding of the sectors in which primary wood is utilised. However, achieving a complete picture of wood consumption is challenging due to informal wood consumption, the involvement of numerous small sectors and companies, and the sale of primary wood to wood-processing companies in other regions of Belgium.

One approach to tackle this challenge is obtaining this information through **a targeted survey of roundwood traders** to know the quantity of primary wood (in terms of volume and type) purchased and its destination industry. Unfortunately, currently, there is no established channel or forum through which roundwood traders share their sourcing and trade/sell data, and there may be some reluctance to do so. However, efforts should be made to explore potential avenues for gathering this valuable information. Given many roundwood traders are associated with *de Belgische Houtconfederatie*, approaching them could be a starting step. Once sufficient traders are willing to participate in this survey, the scope may be enlarged to include traders not affiliated with *de Belgische Houtconfederatie*.

In this regard, the Dutch practice serves as a valuable example. In the Netherlands, traders are more willing to share data. That is partly due to the persistent efforts of the *Probos Foundation*, which has convinced companies over time that sharing data is mutually beneficial.

This information collated during the wood flow analysis is useful to emphasise the sector's significance in the economy. This information will also ensure that all the policy decisions are well-informed – accounting for the current and future situation of the wood-based sector to enhance resilience and ensure its long-term sustainability. Establishing a regular wood flow analysis for Flanders also enables the identification of the trends in demand and supply, which will allow the companies to recognise market opportunities and guides investment decisions.

Beyond stressing the advantages of sharing data, it is crucial to assure companies that the process will maintain company anonymity and protect their privacy and that the process will be carried out transparently. This understanding will further instil confidence, foster better collaboration between the producers and consumers and increase support and willingness to participate in surveys.

It is worth noting that the success in the Netherlands did not happen overnight; it resulted from long-standing habit-building. For many years, these surveys have been conducted regularly with a gradual increase in sectoral coverage, becoming ingrained in the established routines of companies. By learning from the Dutch example and fostering collaboration with roundwood traders, it is possible to encourage their participation in data collection efforts.

To initiate the data collection process, the first step is to compile a list of roundwood traders affiliated with *de Belgische Houtconfederatie* in Flanders and classify them based on their annual traded volume of roundwood and the type of wood they utilise (hardwood, coniferous, or mixed). Subsequently, a layered sample should be conducted using a random sampling rate of 50%. The existing survey method used for sawmills can be extended to include roundwood traders as well. To gather the necessary data from the sawmill sector, a questionnaire based on the previous work of *Hout Info Bois* in Wallonia in 2017 (Houters and Frère, 2017) can be utilised. The questionnaire is presented to the managers during an interview, which can be conducted on-site or online to increase the response rate and reduce the risk of misunderstandings. Additionally, these conversations often unveil additional information.

Since the framework of interviewing roundwood traders is still in its early stages and there are no obligations or incentives for roundwood traders to share their data, the interview response rate might be low, resulting in limited accuracy in determining the amount traded by these traders. Despite the potential inaccuracy of the collected data at this stage, it should be viewed as an initial step towards establishing a more robust framework for data collection on wood flows. With increasing confidence in how the data is utilized and its potential benefits for stakeholders, the response rate is expected to gradually increase. The next step should be to approach also the roundwood traders not part of *de Belgische Houtconfederatie*. The aim over time must be to achieve a statistically significant sample of the total roundwood traders involved in the survey, which is essential for the estimates to be accurate.

When an effective surveying methodology is developed for roundwood traders, it will provide a complete picture of the consumption pattern of primary wood in Flanders. At that point, surveying the wood-processing companies (that purchase wood from the traders) may no longer be necessary. However, until the survey for roundwood traders is well established and yields reliable data, we recommend continuing to gather primary data from wood-processing companies. In the interim, the data collected from roundwood traders can be used as a secondary source to supplement and validate the primary data.

## Reporting

This section focuses on the logistics of the data collection exercise: who should carry it out, how should the report be presented, and how frequently should it be carried out.

We recommend that the data collection exercise, particularly surveying wood processing companies and wood traders, be assigned to **independent third-party organisations** specialised in this field. The major challenge at this point is to persuade private companies to share data as they have concerns about sharing data and do not see an immediate incentive to do so. Independent organisations are better positioned to convince companies that data would benefit the sector, which could increase willingness among companies to collaborate. Additionally, their involvement will ensure process remains transparent and unbiased. Inspiration comes from the Netherlands, where the *Stichting Probos* has been managing data collection and has been doing it for over 40 years.

The second factor to consider when choosing an organisation is **its expertise, experience, and extensive network**. Prior experience in data collection and analysis and established connections with companies from the wood-value chain will facilitate engagement and collaboration with stakeholders across the value chain and expedite the process.

We recommend conducting this data collection **exercise every two years**. Currently, the data collection in the Netherlands occurs annually, while in Wallonia, the Panorabois report is published every 2 years. Although the data from the RFI on the Flemish wood harvest is available annually, conducting the exercise only every two years will help manage the administrative workload while ensuring regular data collection. Regularity is crucial for habit-building and continuous improvement of the data collection process over time.

Lastly, we recommend presenting the results of this exercise in a publicly available report that could be made available via a website or online data platform. This approach promotes transparency and fosters trust among the various entities in the wood-value chain. While getting data from roundwood traders is a challenge, making the data accessible to roundwood traders would provide them with insights into how their information is being utilised, which in turn can enhance their confidence in sharing data. Additionally, all stakeholders can observe the different wood production and consumption flows, enabling them to monitor trends and make well-informed decisions for the future.

The reports from the Netherlands and Wallonia provide excellent examples of how the output of the wood flow exercise should be presented:

The latest report of Probos on wood flows in the Netherlands

[https://www.probos.nl/images/pdf/overig/2022\\_Infographic\\_Houtproductie\\_en\\_houtgebruik.pdf](https://www.probos.nl/images/pdf/overig/2022_Infographic_Houtproductie_en_houtgebruik.pdf)

The latest report of OEWB on wood flows in Wallonia

[https://www.oewb.be/sites/default/files/media-documents/OEWB-PanoraBois\\_2021\\_0.pdf](https://www.oewb.be/sites/default/files/media-documents/OEWB-PanoraBois_2021_0.pdf)

We recommend presenting the results of the wood resource balance in the **form of a Sankey diagram**, as commonly used in the representation of wood flows (Marques et al., 2020). A Sankey diagram provides a clear visual representation of the volume of primary wood produced from different sources and its distinct uses or destinations. The Flemish wood resource balance has already been represented in the form of a Sankey diagram in the report of Departement Economie Wetenschap en Innovatie (Departement Economie Wetenschap & Innovatie, 2016). Additionally, a Sankey diagram has been used to present the European wood resource balance in the report "Wood flow analysis: Quantification of resource potentials, cascades, and carbon effects" by Mantau (2015). We could strive to build such a Sankey diagram based on the information gathered through the data collection framework. However, this Sankey diagram only provides quantities. An upgraded version of this Sankey diagram should be used to show the division of the wood flows based on species and dimension groups.

## 5. Recommendations

The current assignment marks a vital initial step in the development of a comprehensive Flemish wood resource balance, but there is still much work to be done to ensure its completeness and usefulness in promoting a sustainable and circular wood sector. This section outlines **key areas for improvement**. To enhance the framework, we recommend incorporating one new suggestion during each iteration, corresponding to every biannual publication. Furthermore, as the process advances with each iteration, valuable insights will be gained from the challenges encountered during data collection and feedback received from stakeholders. These valuable lessons must be integrated into future iterations, ensuring continuous enhancement and refinement of the framework.

### *Extending the system boundaries*

The scope of this assignment was on monitoring primary wood. This entailed inventorying the locally produced roundwood and firewood from the forest and non-forest areas, industrial residues and the import of roundwood. At the destination, the focus was on identifying the primary wood processors and the export. The assignment did not encompass the secondary sources of wood, such as waste wood, nor did it track the secondary and tertiary processing of wood into intermediate or final products.

Once the framework for **systematic data collection to monitor primary woody biomass** is established, further assignments will be necessary to expand and refine the framework to

include **secondary sources and destinations**. This entails including post-consumer wood, which consists of end-of-life wood products primarily from the construction, packaging and furniture industries, and import of secondary or tertiary wood (intermediate or final products). Equally important is monitoring the downstream flow of this wood until it reaches its final products. This involves tracking the wood as it goes through various stages of processing, from the **intermediate to the final products**. Furthermore, it is necessary to consider the **export of secondary or tertiary wood**, accounting for its destination outside of Flanders.

This comprehensive overview of wood flows will provide insights for **optimising wood use**. By understanding the sources of all the wood (its quantity and quality) and its destination, we can analyse whether the wood is being utilised to its highest potential. The goal must be to ensure that wood (both primary and secondary wood) is utilised for the highest-value application possible, avoiding the use of high-quality wood for lower-quality purposes. For instance, wood that has a potential material application must not be used for energy production. This is in line with the principle of cascading, which is a strategy to use wood resources in sequential steps as long, often and efficiently as possible (Essel et al., 2014; WWF - World Wide Fund For Nature, 2016) to maximise the overall value derived from wood and reduce the need for primary wood to provide societal needs, thus alleviating pressure on forests.

Implementing cascading strategies requires a systemic perspective on wood utilisation. It involves considering the entire wood value chain, from sourcing and processing to the final products and their end-of-life stage, evaluating each step of the value chain and identifying opportunities for optimising wood use, so we can create a more sustainable and circular wood use.

### *Including the forecasting information*

The second aspect currently out of the scope of the current assignment is **'forecasting information'**. The current framework focuses solely on monitoring primary wood production and processing, lacking the inclusion of forecasting information that anticipates changes in wood production (in terms of quantity and quality) due to factors like climate variations and forest management strategies, as well as changes in wood demand. This forecasting data is crucial for future planning, guiding investment decisions, and ensuring stakeholders can adapt their operations to meet evolving supply and demand dynamics. While the RFI provides information on the annual wood harvest based on collected forest inventory data, estimating future supply requires a sophisticated model that considers various factors that will influence future forest growth and harvest, such as climate conditions and forest management strategies.

One such model for forest harvest forecasting is SIMREG, employed by OEWB in Wallonia. SIMREG models virtual stands based on the RFI data and utilises four simulation models: tree growth, thinning, clearcut, and regeneration (Figure 5). These models are probabilistic, using historical data to predict the likelihood of tree growth, removal (by thinning or clearcut) and

recruitment. By incorporating this information, the model can predict future forest growth and anticipate harvest levels per species and dimensional groups (Perin et al., 2021).

SIMREG uses RFI data, which is already available, and provides species-specific forecasts for wood harvests, providing the precise information required. The model has been calibrated using forest inventory data of Wallonia. However, for it to apply to Flanders, the model will need to be recalibrated using the Flemish RFI data. An earlier calibration of the model has already been done for Flemish forests. It was conducted in 2018 – 19 to estimate the Belgian Forest Reference Level for developing Belgium’s national forest accounting plan (Jérôme et al., 2018). However, it is advisable to incorporate the most recent RFI data and leverage ANB's expertise to ensure its suitability for Flanders.

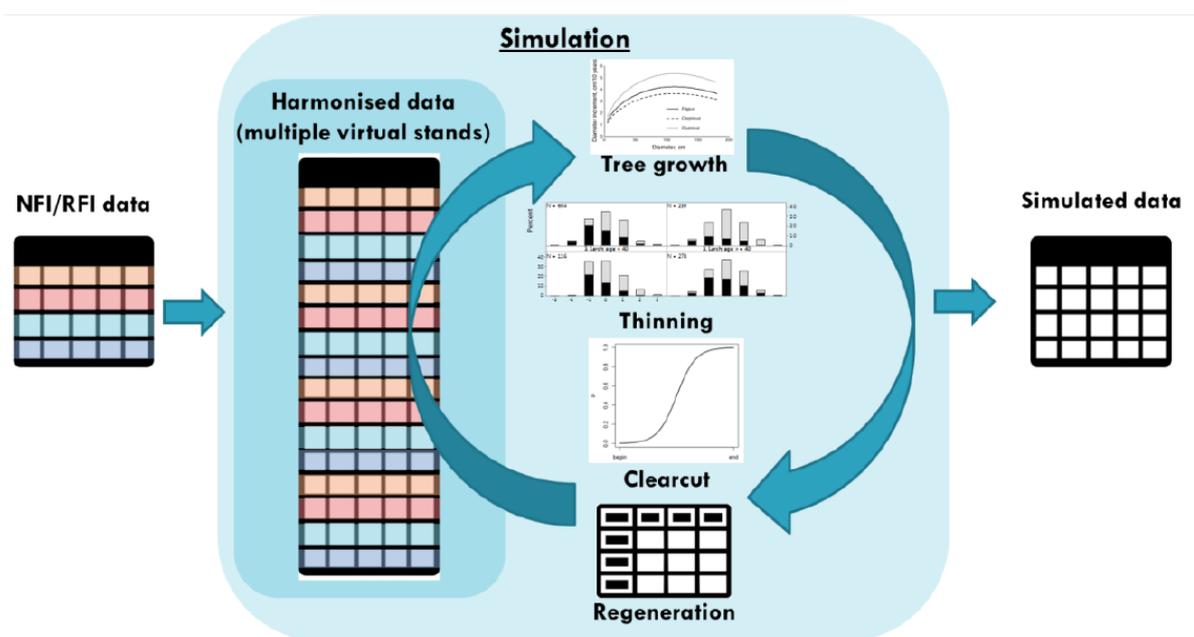


Figure 4: Overview of the forest harvest simulation model SIMREG (Jérôme et al., 2018)

Implementing the SIMREG model would provide valuable insights into future wood availabilities, specifically in terms of the quantity of wood for each species, dimensional group and wood type. This potential future harvest data could also serve as a mechanism to nudge wood-processing companies to share data. Such information is crucial for companies to adapt their business strategies and operations in response to changing circumstances. This highlights the mutual benefits of the wood flow monitoring framework for all stakeholders in the wood value chain and must be utilised to foster collaboration and strengthen relationships and trust. Additionally, it is equally important to gather **information on future wood demand**. To achieve this, we recommend incorporating additional questions into the current survey of wood-processing industries.

### *Improving data quality*

A current limitation of this framework is that RFI, which offers data on wood harvest in terms of quantity, species, and dimensions, relies on statistical estimation rather than direct measurement of the harvest. While the estimation method is statistically robust and includes confidence intervals, the confidence interval size can vary depending on the amount of data available. There are ample measures for predominant species, resulting in narrower confidence intervals. However, for less prominent species, the confidence interval may be wider, indicating a higher level of uncertainty in the estimation.

One approach to consider is enhancing the wood removal RFI model by **incorporating additional bottom-up data**. The primary source for such data is sale information obtained from ANB and Bosgroepen. However, as mentioned earlier, this dataset is incomplete and includes only wood sales by ANB and Bosgroepen. The model can be further enhanced by leveraging forest harvest information from the largest forest owners, such as Natuurpunt, the Provincial domains or municipalities. Additionally, it could be valuable to conduct surveys among prominent private forest owners to gather insights into harvest amounts from these forest properties. This surveying process could be facilitated through collaboration with the association of private forest owners, Landelijk Vlaanderen. Furthermore, another potential data source that warrants exploration is Landmax, which provides support to private forest owners in formulating forest exploitation plans and managing timber sales. While this assignment did not delve into these sources, they could provide additional information that can enhance the model's accuracy.

Similarly, efforts could be taken to further enhance the coverage and completeness of the data on wood consumption, it is necessary to retrieve data from other entities that consume primary wood, specifically the paper and pulp sector and the energy sector. This data is available through InduFed, the federation of paper and pulp processing companies. InduFed already extends this information to OEWB for a similar exercise in the context of Wallonia and would likely be willing to support this assignment as well.

### *Potential Data Sources for Future*

In addition, more information may become available in future through the European Union (EU) Regulation on deforestation-free products (EUDR). This regulation, aimed to curb EU-driven deforestation and forest degradation, obliges operators, who place timber and timber products on the market, to obtain and declare geo-localisation coordinates from where the wood was harvested. This will indirectly oblige the forest owner to share the volume of their harvest, potentially providing additional insights for monitoring and analysis. These developments at the EU level may drive future availabilities of information and make the data collection framework more straightforward.

### *Additional data needs for LULUCF reporting*

The final point not addressed in this framework pertains to the UNFCCC's LULUCF **carbon accounting which is not most often not discussed in forest management inventory** (Korosuo et al., 2023). This framework focused only on the merchantable wood (usually trunk, tree tops and branches), while the LULUCF accounting includes carbon accumulation also in other living parts of trees (such as roots and foliage). Hence, the current wood flow accounting must be translated to carbon accounting and then **extended also to include carbon in parts that are currently not included in the wood inventory**.

Additionally, the LULUCF accounting requirement mandates the assessment of changes in carbon stocks also below the ground. This study did not include the measurement **of soil carbon stocks**. Nonetheless, previous research consistently indicates that soil carbon in Flemish soils has been relatively stable over time (Jérôme et al., 2018). So, we considered it acceptable to defer this aspect for the time being.

## 6. Conclusion

The purpose of this report is to present a **framework for systematic data collection of wood flows in Flanders**. This assessment focuses on monitoring primary wood, including primary wood production and consumption. **Primary wood production** includes wood flows from (private and public) forests, nature, landscape and green management, fruit growing and agroforestry and industrial residue streams from primary wood-processing companies. **Primary wood consumption** includes wood consumed in the primary wood processing industries, primarily sawmills, wood panel producers, paper and pulp companies, and energy producers, and primary wood consumed by households.

The need for this data arises primarily from increased **reporting requirements**. Of utmost importance is the obligation of Land Use, Land Use Change and Forests (LULUCF) accounting, which requires an overview of the wood harvests from forests and non-forest areas and the application of that wood. Another key reason is to ensure the **well-functioning** of the wood-based sector, which relies on healthy collaboration and data exchanges between wood producers and consumers. Regular monitoring of woody biomass from both sides - production and consumption – will ensure both entities are well-informed of anticipated changes in the supply or demand and can adapt their operations accordingly. A comprehensive wood flow analysis is also crucial to achieving **sustainable and circular wood** use by enabling the design of an optimal effective cascading use pathway for wood.

There are several data sources available that provide the information to build the wood resource balance. However, these data sources offer fragmented and incomplete information, making it challenging to obtain a comprehensive overview. We propose a **systematic data collection** approach that integrates existing data sources with additional data-gathering methods to overcome this challenge.

For the assessment of primary wood production, we recommend relying on data sources such as RFI, DIPLA, IMJV and NBB statistics to estimate the annual harvest (from forest and non-forest regions), imports, and production of industrial residues. However, it is important to note that while these data sources offer a comprehensive overview of primary wood supply, they may have limitations in terms of completeness and accuracy. To address this, we propose conducting **surveys of roundwood traders** to gather information on the origin and volume of their wood purchases, as they are directly involved in primary wood purchasing.

Similarly, to estimate the consumption of primary wood, it is essential to conduct surveys of roundwood processing companies, including sawmills and wood-panel producers. The NBB statistics provide insights into primary wood exports. However, obtaining a complete understanding of wood consumption poses challenges due to factors such as informal wood

consumption, the involvement of numerous small sectors and companies, and the sale of primary wood to wood-processing companies in other regions of Belgium. To overcome this challenge, one approach is to gather this information through **targeted surveys of roundwood traders**. Roundwood traders, being directly involved in the sale of wood, have a better overview of the consumers and can provide valuable insights into wood consumption patterns.

The report concludes by highlighting the importance of further development in key areas. This includes expanding the framework to **include secondary wood sources** and monitoring the downstream flow of wood through different stages of processing and cascading use. Additionally, **incorporating forecasting data**, alongside current supply and demand data, will empower stakeholders to make informed decisions and develop adaptive strategies. The report emphasizes the need for regular data collection to establish habits and continuously improve the framework over time. It also highlights the importance of transparency and trust-building within the wood-value chain as crucial factors in fostering collaboration and encouraging a willingness to share data.

In conclusion, the proposed framework represents a crucial first step towards gaining a comprehensive understanding of wood flows in Flanders. This framework efficiently meets the information needs of different stakeholders by using both available data sources and additional methods of data gathering. It serves as a model for an **effective information system**. It facilitates the organisation and flow of information, empowering stakeholders to make informed decisions and act accordingly. This information system will support sustainable forest management, optimise the utilisation of wood resources, and promote circular and sustainable wood use. Additionally, it will also assist in climate change reporting and monitoring, meeting the requirements for LULUCF accounting. As this framework continues to evolve and expand, it will play a vital role in ensuring a resilient and thriving wood-based sector in Flanders.

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## 8. Supplementary Text

Survey form used in the eco2eco project to collect data from wood-panel producers

How much round wood did you process in 2016 (where applicable please tick the unit and whether this is with or without bark)? Can you also indicate what the average price of the round wood was?									
	Quantity		Unit		With or without bark?		The average unit price of round logs		
	From Flanders	Purchasing outside Flanders	m <sup>3</sup>	tone	with	without	€ per unit	without transport	with transport
Softwood									
Poplar									
Other hardwood									
Total									
How much residual wood did you use in 2016 for the production of sheet material?									

	Quantity		Unit	
	From Flanders	Origin outside Flanders	m <sup>3</sup>	tone
Residual wood				
How much post-consumer (waste) wood did you use in 2016 to produce sheet material?				
	Quantity		Unit	
	From Flanders	Origin outside Flanders	tone	
Post-consumer wood				

Source: [https://www.eco2eco.info/wp-content/uploads/2017/11/eco2eco\\_WP3\\_Act1\\_eindrapport.pdf](https://www.eco2eco.info/wp-content/uploads/2017/11/eco2eco_WP3_Act1_eindrapport.pdf)

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