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European Commission

SCIENCE FOR POLICY BRIEF

Biomass in the EU

The European Commission's Knowledge Centre for Bioeconomy

Biomass supply and demand in the EU 2012-2022

HIGHLIGHTS

- The total supply of biomass in the EU summed up to 1.2 billion tons dry matter (tdm) in 2022, with 82% coming from primary biomass, 7% from secondary biomass and 11% from recovered biomass.
- The main demand of biomass in the EU in 2022 was for food, feed and bedding (47% of the total known demand), followed by energy production (29%), and material production (24%).
- The overall EU biomass supply increased by 6% between 2012 and 2022. Demand for material and energy uses increased respectively by 11% and 14% over the same period.
- Agricultural crops, residues and grazed biomass constitute 67% of the primary sources in 2022, wood 33%, while fisheries and aquaculture sources (in dry matter) less than 0.3%.
- In 2022, the EU was a net importer of agricultural plant products (about 2% of agricultural supply) and of wood-based industrial by-products (about 3%).
- The EU was a net-exporter of bio-based materials (mostly wood-based products) in 2022. Overall, the EU net-exported less than 1% of the total production.

Joint Research Centre

BACKGROUND

The Joint Research Centre (JRC) regularly monitors biomass supply, demand and trade within the European Union (EU) and with partner countries, under the umbrella of the European Commission's Knowledge Centre for Bioeconomy (KCB) and as part of activities within the JRC Biomass Mandate[1].

This science for policy brief summarises the most recent JRC assessment of biomass supply and demand in the EU, covering the years 2012-2022 and complementing the report "EU Biomass supply, demand, governance and regenerative actions – 10-year anniversary edition" [1].

The brief combines two workstreams: the analysis of biomass supply data, and the analysis of biomass demand data. The analysis consolidated a variety of data sources (see Box 2) into a comprehensive and coherent overall assessment. All data are converted into tons of dry matter (tdm), enabling the comparison of different biomass sources and uses [2, 3]. Some biomass value chains are covered up to the semi-finished products stage, thus excluding finished products. It is worth noting that a direct comparison with previous JRC assessments is not possible due to major updates in the methodology and definitions of data aggregation categories. A comprehensive technical report will follow this policy brief, providing detailed definitions and a full description of the methodology adopted.

BIOMASS SUPPLY IN THE EU

In this brief, supply represents all domestic sourcing plus net imports. The EU's biomass supply is divided into three main categories: primary, secondary, and tertiary or recovered biomass (Figure 1).

1. Primary biomass, which accounts for 82% of the total supply, includes:
   (a) collected and net-imported crops, collected agricultural residues and grazed biomass,
   (b) domestically harvested and net-imported roundwood e collected residues,
   (c) total caught fish, algae and available biomass from aquaculture as well as net-import of unprocessed seafood.
2. Secondary biomass, which accounts for 7% of the total supply, includes by- or co-products from manufacturing processes, such as industrial wood chips and particles, black liquor, and bagasse.
3. Tertiary or recovered biomass, which accounts for 11% of the total supply, includes recovered biowaste, such as recovered paper, post-consumer wood, agricultural, industrial and household biowaste.

In 2022, the total EU biomass supply amounted to approximately 1.2 billion tdm. It was mostly sourced domestically; around 1 billion tdm as primary biomass, 0.08 billion tdm as secondary biomass and 0.13 billion as recovered biomass. Of the total biomass supply, 0.7 billion tdm (58.5%) came from the agriculture sector, 0.5 billion tdm (41.2%) came from the forest sector, and less than 0.3% came from the fishery and aquaculture sectors.

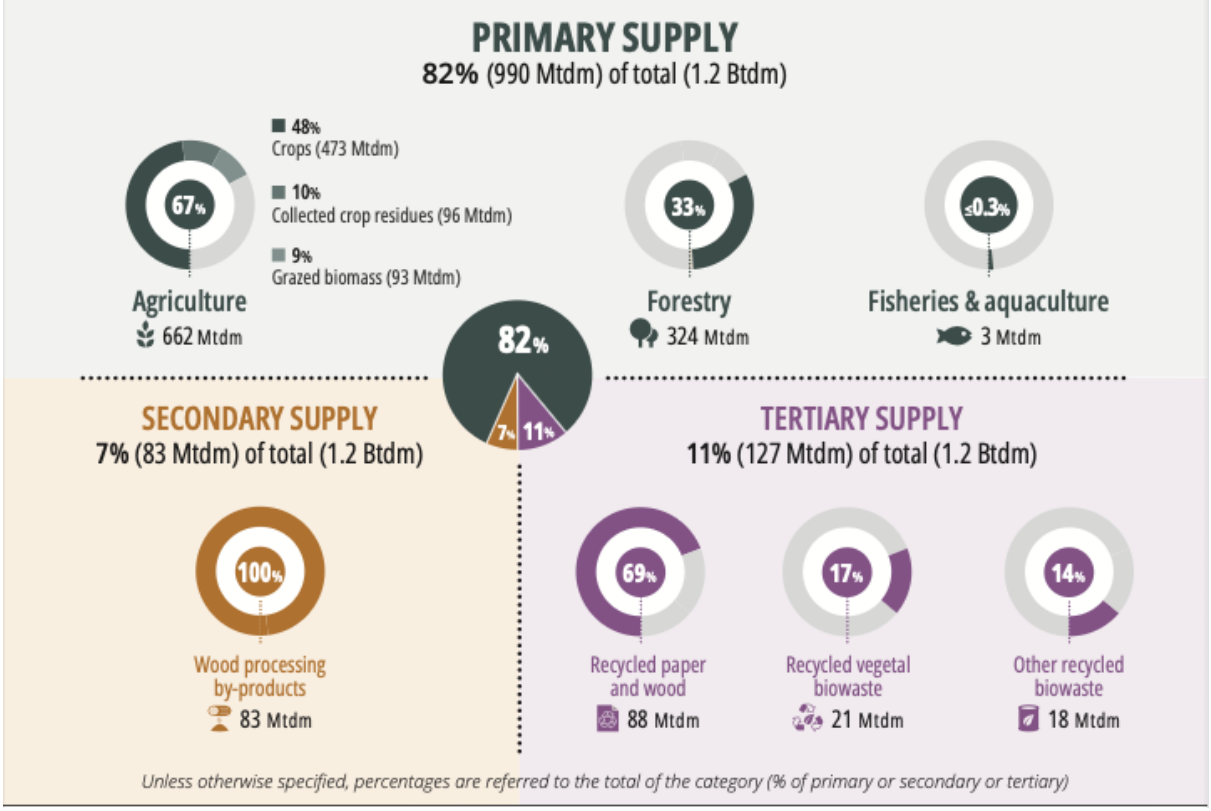
The notions of primary, secondary and tertiary (or recovered) biomass are used in this assessment to provide a comprehensive picture regarding biomass sources. The numbers tell us how much biomass is sourced directly from land or sea, how much derives from side streams and how much is recovered. However, it is worth noting that the arithmetic sum of these amounts, and therefore the overall total, may imply double counting.

The EU was overall a net importer of biomass in 2022: 1.8% of the total EU biomass supply originates from net imports. Since 2014 the total supplied biomass has stayed relatively stable (Figure 2), with some interannual differences in net trade due to market fluctuations.

In the following subsections, we present biomass supply and its development over time in more detail.

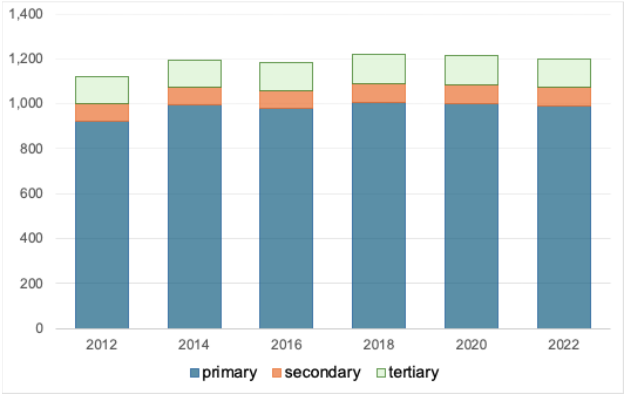
[1] https://knowledge4policy.ec.europa.eu/projects-activities/jrc-biomass-mandate_en

Figure 1 – EU biomass supply in 2022. Total 1.2 billion tons dry matter (Btdm), net imports 0.02 Btdm (1.8%)



Source: JRC, own elaboration.

Figure 2 –EU biomass supply 2012-2022 in million tons dry matter (including net-imports).



Source: JRC, own elaboration.

Primary supply

Agriculture. In 2022, agricultural crops accounted for approximately 48% of primary biomass supply, collected crop residues for 10% and grazed biomass for 9%. Therefore, agriculture biomass accounted for approximately 67% of primary biomass supply in the EU. This share remained relatively stable over time, after a growth in reported crop supply occurred between 2012 and 2014. The slight steady decrease in grazed biomass along the studied decade had no significant impact on the overall biomass supply from agriculture.

About 2% of the primary agricultural biomass supply derived from net-import to the EU in 2022.

Forestry. Since decades, the growing stock in the EU forests has continuously increased, as the annual harvests have stayed below the net annual increment, even if the difference has decreased over time. In 2020, 75% of the annual forest increment was harvested, compared to 65% in 2012 [4]. The relative increase in harvest intensity is driven by a growing demand for both material and energy production, as well as salvage logging of damaged wood following growing natural disturbances such as insects, windfall, droughts, and also forest fires.

In 2022 forests provided 33% of primary biomass supply in the EU. The amount of primary wood supplied increased by 11% over the studied decade, and its share in primary biomass supply rose from 29% to 33%.

Further, the EU has shifted from being a net importer of wood (about 2% of total wood supply in 2012), to be a net exporter, shipping annually about

1% of its domestic wood removals outside the Union since 2020.

Fisheries and aquaculture. The contribution of fisheries and aquaculture to the overall EU biomass supply is relatively small in dry matter, accounting for less than 0.5% in 2022. The EU relies heavily on imports to meet its consumption of fishery and aquaculture products. In 2022 only 37.5% of its consumption was met through domestic supply, while the remaining 62.5% was imported. Globally, the EU is the eighth largest producer of fisheries and aquaculture products, accounting in 2022 for around 2% of global production [5].

Secondary supply

Industrial by-products. In 2022, industrial by-products accounted for 7% of the total biomass supply in the EU. These by-products are primarily supplied by forest industries as wood chips and black liquor.

The EU imported 3% of its total secondary supply in 2022, while the large majority was domestically produced.

Over the studied decade, the domestic production of industrial by-products increased by approximately 13%, while the net imports decreased by around 3%. This trend is closely linked to the overall growth in domestic production of primary woody biomass supply.

Tertiary supply

Recovered waste. Recovered biomass, also referred to as tertiary supply, includes biowaste such as woody or plant biomass, as well as biowaste sourced from, e.g., paper, bio-rubber, bio-based textiles, or animal-based waste. This biomass is recovered to produce new material or energy. In 2022, the EU generated a total of 140 million tdm of biowaste and approximately 90% of these were recovered. Post-consumer wood and recovered paper account for the largest share of total biowaste generated in the EU (68% in 2022).

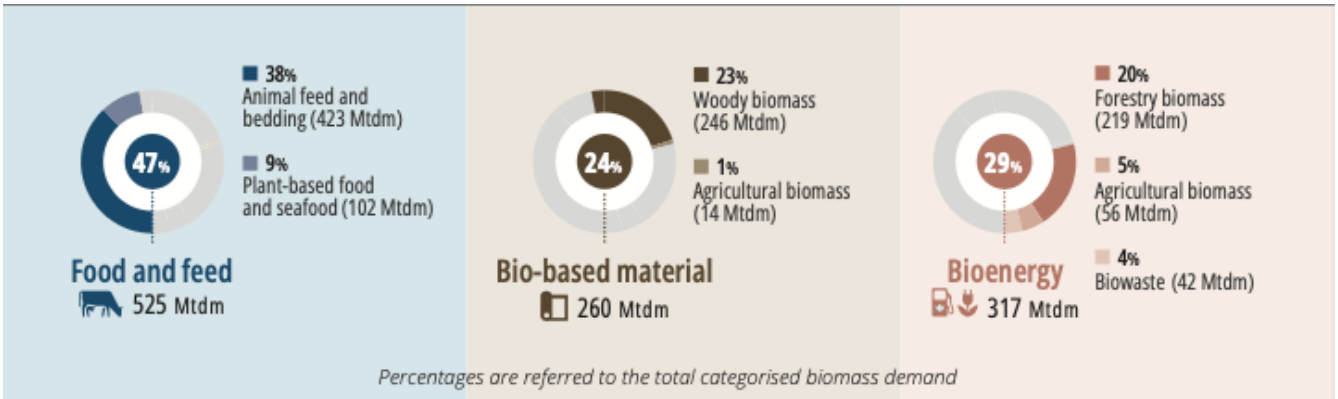
Considering trend changes, biowaste generated in the EU has increased by around 2% from 2012 to 2022, while recovered biowaste increased by 11%. During the studied decade the growth of recovered biowaste was stronger for agricultural and related biowaste categories, with a 25% increase. Wood and paper recovery has increased less in relative terms, but their overall recovery rate was already high in 2012 and remained higher than agricultural and related biowaste.

BIOMASS DEMAND IN THE EU

Biomass demand includes domestic uses and net export. The EU's total biomass demand in 2022 amounted to approximately 1.2 billion tdm, estimated by balancing the amount of total biomass supplied. However, it must be noted that current statistics do not account for around 8% of this demand, equivalent to 0.1 billion tdm, which is neither reported as given uses nor as losses. Hence, it was not possible to attribute this fraction to any specific use. The remaining 1.1 billion tdm of biomass demand could be attributed to specific uses (Figure 3), and subsequent share calculations are based solely on this known fraction. The known biomass demand was distributed as follows in 2022:

- 47% for food, animal feed and bedding,
- 24% for material production.
- 29% for energy production

Figure 3 – EU biomass demand in 2022. Total categorised demand 1.1 billion tons dry matter (Btdm), net exports 0.01 Btdm (1%)



Source: JRC, own elaboration.

Over the studied decade, biomass demand increased for all three main categories: food, animal feed and bedding; energy production; and material production (Figure 4).

However, conclusions about trends in specific sectors over time are more uncertain because a portion of the overall biomass demand is uncategorised.

Box 1: Uncertainties in the assessment of biomass demand

A fraction of the biomass supplied in the EU could not be attributed to any specific use. This corresponds to around 8% of the total biomass demand in the EU in 2022. A short analysis in the time series showed that this data gap is decreasing in time (in 2014 the unassigned uses were larger than 10%). Possible reasons for this gap are unreported biomass losses in the supply chains, uncertainties in the available statistics and missing data from some sectors.

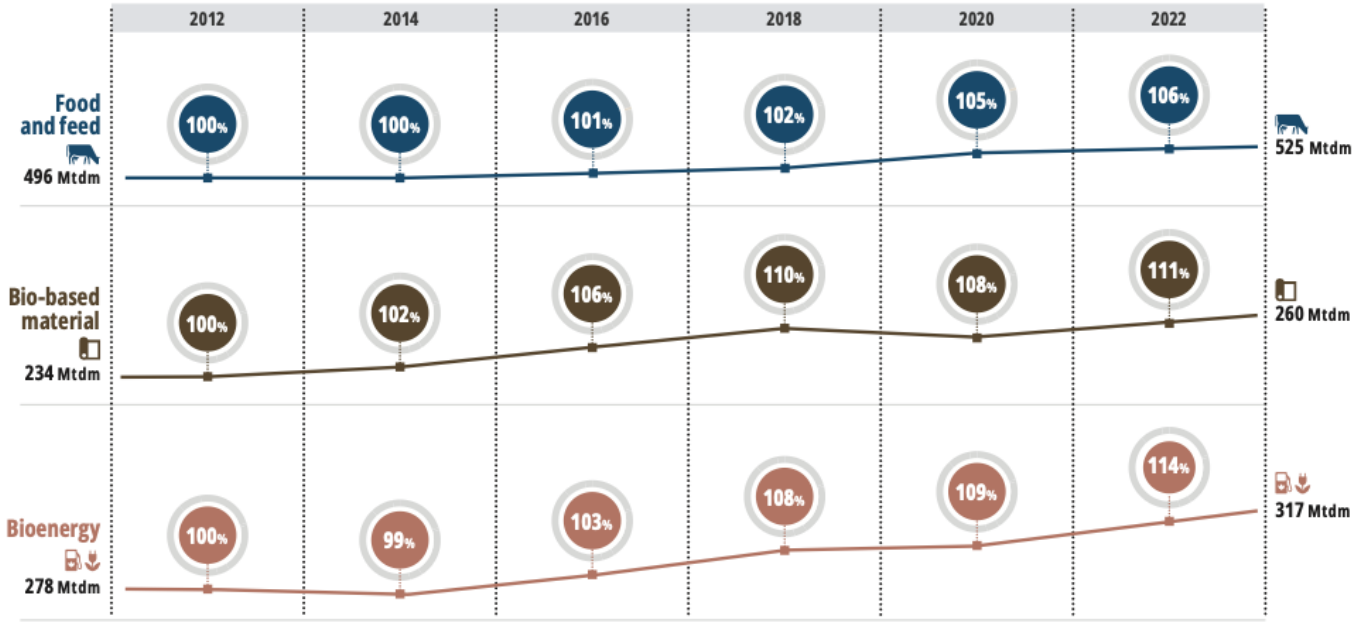
Food, feed and animal bedding

In 2022, about 47% of known biomass demand in the EU was used for food, feed and animal bedding. Of this amount, 81% was used for animal feed and bedding, while only 19% was used for plant-based food for human consumption. In Figure 3 the numbers refer to the total categorised biomass demand, 38% is for animal feed and bedding and 9% is for plant-based food.

Demand for food, animal feed and bedding increased by 6% over the past decade, more specifically a 6.4% increase in animal feed and bedding and a 4.5% increase in plant-based food. The increase in demand was mainly driven by the growth in food and feed exports. During the same period the EU population grew only by 1.2% [6].

Since 2016, the EU has been a net-exporter of food, with an average of 9 million tdm exported each year from 2016 to 2022.

Figure 4 – EU Biomass demand 2012-2022 in million tons dry matter (Mtdm) and % change vs 2012 baseline (100%)



Source: JRC, own elaboration

Material production

The estimated EU demand for bio-based materials includes mainly wood-based solid products, wood pulp and semifinished paper and paperboard, bio-based textiles, biochemicals, and other novel bio-based products. Materials can be derived from primary biomass, secondary biomass or from recovery of biowaste. While data on wood-derived products is readily available, information on products derived from other biomass sources is limited.

In 2022, the use of biomass for bio-based materials covered around 24% of the known biomass demand in the EU. About 95% of the biomass used for material is for wood-based products, including wood pulp and paper. The remaining 5% of the bio-based materials derives from agricultural sources. In Figure 3 the numbers refer to the total categorised biomass demand, 23% of this demand is covered by the use of wood for material products, 1% by the use of agricultural biomass for material products.

The demand for biomass for wood-based products has grown steadily over the past decade, with an 8% increase between 2012 and 2022, mainly driven by the demand of solid wood products, while pulp and paper production stayed relatively stable. The demand for biomass for biochemicals and other materials produced from agriculture sources has more than doubled between 2012 and 2022. However, due to its small relative amount, the impact on the overall growth of biomass demand for material uses was limited, with an overall 11% increase between 2012 and 2022.

The EU in 2022 net-exported 1.3% of its bio-based materials, mostly wood-based semifinished products and paper. However, all net-export figures have been declining over the studied decade.

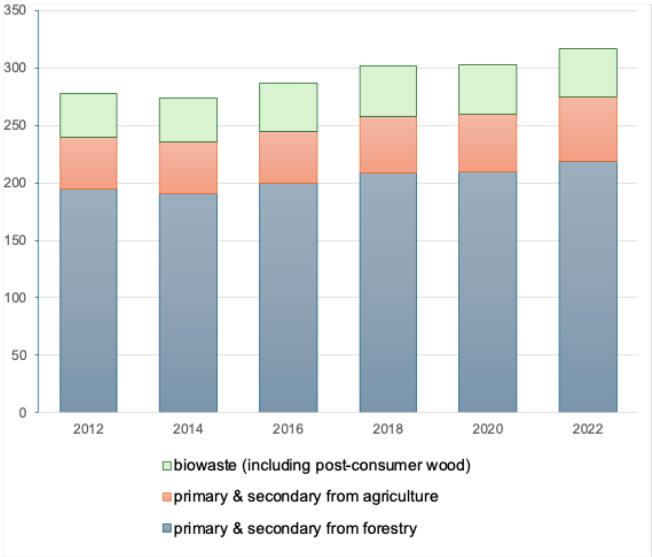
Energy production

The estimated demand for biomass for energy in the EU (Figure 5) encompasses biomass for the production of heat, electricity, and transport fuels and comes from various sources including primary and secondary agricultural biomass (mainly cereals, vegetable oils and sugar beet, residues and bagasse), primary and secondary woody biomass (e.g. fuelwood, black liquor, wood chips), and tertiary biomass (e.g. post-consumer wood, recovered paper, other biowastes).

In 2022, the total amount of biomass used for energy production accounted for 29% of the total known biomass uses in the EU. Woody biomass was the largest component of this total, with primary and secondary woody biomass contributing by 69%, primary and secondary agricultural biomass contributing by 18%, and tertiary biomass contributing by 13% to the total amount of biomass used for bioenergy. In Figure 3 the shares refer to the total categorised biomass demand: 20% of the categorised biomass demand is for woody biomass used for energy, 5% for agricultural biomass used for energy and 4% for biowaste used for energy.

Biomass used for energy increased by 14% between 2012 and 2022. In more detail, use of primary and secondary woody biomass for energy increased by 12%, while the use of primary and secondary agricultural biomass rose by 25%, mainly driven by the increased production of biogas and liquid biofuels. The use of tertiary biomass augmented by 9% over the same period, driven by the 27% increase in the use of biowaste such as waste vegetable oils, organic fraction of municipal solid waste, sewage sludges and manure, used for biogas and liquid biofuels production and the 43% increase in the use of recovered paper contributing to bioheat and bioelectricity production mainly through Combined Heat and Power (CHP) systems. The largest fraction of tertiary biomass used for energy comes from post-consumer wood, which remained relatively stable over the period considered.

Figure 5 – Inland consumption of biomass for energy in the EU 2012-2022 (million tons dry matter)



Source: JRC, own elaboration.

Box 2: Main data sources used

Several data sources have been used for the assessment of biomass supply and demand presented in this brief. While a technical report will follow with details on specific datasets considered, we have consulted and cross-checked the following data sources: Eurostat, FAOSTAT, UN Comtrade, UNECE, UNFCCC GHG inventory submissions, Joint Forest Sector Questionnaire (JFSQ), Joint Wood Energy Enquiry (JWEE), International Energy Agency (IEA), Clean Energy Technology Observatory (CETO), Scientific, Technical and Economic Committee for Fisheries (STECF), European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), peer-reviewed literature.

FUTURE RESEARCH NEEDS

Compiling consistent data over the total EU biomass supply and demand remains challenging due to unbalanced data availability: while agricultural supply is well-documented, forestry supply is more uncertain. By contrast, the wood-based demand is better captured than the demand for agricultural biomass. A full balance is only possible by acknowledging the existence of a gap between supply and demand, with part of the demand remaining unknown and as such not categorised under any specific use.

The uncategorised demand is primarily in the agricultural sector, in 2022 it was about 8% of the total, in 2014 it was 13%. This raises the question of whether the volume is too small to warrant further investigation, or whether these unknown flows may point to overlooked or emerging (high value) demand that deserves closer attention.

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SUGGESTED CITATION

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