



# The European Commission's Knowledge Centre for Bioeconomy



## Brief on forestry biomass production<sup>1</sup>

### Key messages

1. The land area covered by forests in the EU<sup>2</sup> has been expanding at an average rate of 0.26% or 0.4 million hectares (Mha) per year from 2000 to 2015 (slowing down in 2010-2015). It reached 161 Mha (38% of the EU territory) in 2015. Of this area, 84% is potentially available for wood supply (see section 1).
2. The total aboveground biomass stocked in EU forests reached 18 600 Mt in 2013. It has been increasing since 2000 at a rate of approximately 1.3% per year (see section 2), although the forest growth has been slowing down slightly, mostly due to ageing of forests (see section 3).
3. The average annual harvest level – 281 Mt (of which 224 Mt are removed from the forest) – amounts to 63% of the growth rate (measured as net annual increment) of EU forests – 444 Mt per year. Since fellings are underreported, the actual harvest rate is likely to be higher, but still not exceeding the growth rate (see section 4).
4. Detailed and harmonised quantitative data on forest management, and especially wood removals, present severe gaps and uncertainties at EU level, with marked differences between Member States. While significant progress has been made, efforts to improve the current assessments should be pursued (see section 5 and knowledge gaps).
5. Sustainable wood production implies reconciling the full range of ecosystem services which the forests provide (see section 5).

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<sup>1</sup> This brief is based on the JRC Science for Policy report "Biomass production, supply, uses and flows in the European Union. First results from an integrated assessment" (Camia et al., 2018), unless stated otherwise.

<sup>2</sup> European Union, comprising of the following 28 Member States: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

## 1. How much land area in the EU is covered by forests?

In 2015, forests in the EU covered an area of 161 Mha, i.e. 38% of the total land surface (Forest Europe, 2015). Of this area, 134 Mha (84%) are considered as forests available for wood supply. This brief focuses on woody biomass from forest and does not account for additional biomass available in other wooded land and trees outside forests (Figure 1).

From 2000 to 2015, the total land area covered by forests in the EU has been expanding by roughly 413 000 ha per year (6.2 Mha in total), corresponding to an average expansion rate of 0.26% per year. However, from 2010 to 2015 the expansion rate slowed down to 339 000 ha per year, lower than the 15-year average.



**Figure 1:** Land area with woody biomass in the EU (source: Forest Europe 2015). Only wood resources within the red frame are considered in this brief.

## 2. How much aboveground biomass is stocked in EU forests?

The total aboveground living biomass stocked in EU forests is estimated at 18 600 Mt<sup>3</sup> (in 2013), of which 16 000 Mt are stocked in forests considered available for wood supply (see section 1). This includes both growing stock (i.e. mainly wood from the stem which is the principal merchantable component of the tree<sup>4</sup>)

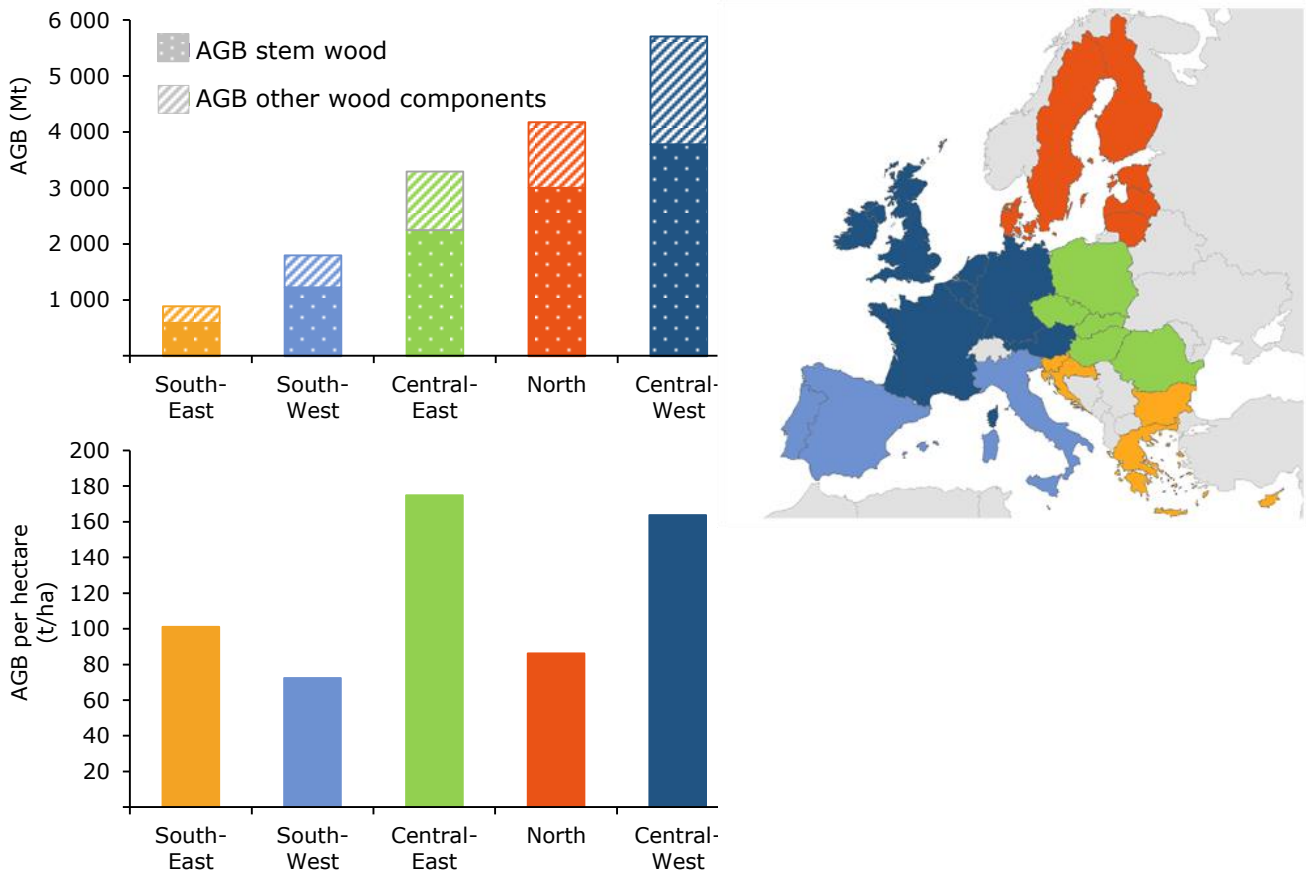
<sup>3</sup> All estimates related to forest biomass are consistently presented in oven-dry metric tonnes (t) throughout this brief.

<sup>4</sup> The exact definition of growing stock may differ depending on the country considered.

as well as estimates of the rest of the woody biomass, including all branches, stumps and tree tops, here referred to as 'other wood components'. The figures are derived from National Forest Inventories (NFIs)<sup>5</sup>.

Since 2000, the stock of aboveground biomass in the EU has been increasing by 223 Mt per year, which corresponds to an average annual growth rate of 1.3%. This stock increase is key for climate change mitigation as it constitutes a significant part of the carbon sink of EU forests.

Countries in Central-Western Europe account for the largest share of this total (36% of the EU), followed by Northern Europe (see Figure 2)<sup>6</sup>. The latter has on average lower biomass stock per hectare, mostly due to ecological factors, but also due to forest management practices.



**Figure 2:** Aboveground biomass (AGB) and average AGB per hectare in EU forests by regions<sup>6</sup> (source: JRC estimates based on NFI data).

<sup>5</sup> The support of NFI organisations was essential for the JRC to derive harmonised biomass estimates of EU Member States. Since NFI results are produced according to national definitions (not always corresponding to the international ones) and for different years, these data were processed using models and correction factors to estimate the biomass in 2013 according to the international definitions. Therefore, these estimates may differ from national statistics.

<sup>6</sup> To simplify the description, EU Member States are grouped in the regions described in Forest Europe (2015), here limited to the EU.

### 3. How much biomass grows annually in EU forests?

The quantity of EU forest biomass grown annually is estimated at 510 Mt/a of which 444 Mt/a are in forests considered available for wood supply. It is measured as the net annual increment, defined as the wood produced in forests annually minus losses due to the natural mortality of trees (i.e. death of forest trees due to the natural turnover rate, thus excluding disturbances such as wildfires or storms).

It is estimated that, since the year 2000, the average net annual increment per hectare of the EU has been slightly decreasing (from 3.33 t/ha/a in 2000 to 3.25 t/ha/a in 2013).

A declining trend in the net annual increment had already been registered, especially in Central-Western Europe by Nabuurs et al. (2013), attributed to a combination of ageing EU forests and high stock volumes per hectare. More detailed explanations about this process have been provided in Pilli et al. (2017). Over-mature forests tend to be more prone to pests and in general are more vulnerable to natural disturbances.

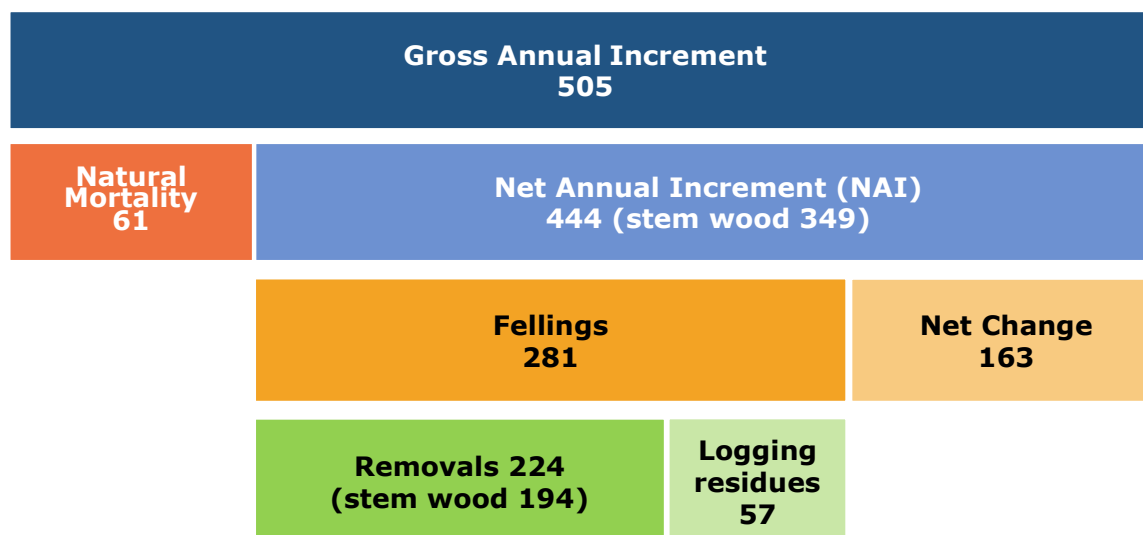
### 4. How much biomass is harvested from EU forests?

The average annual harvest level (fellings) from EU forests is estimated at 281 Mt, 224 Mt of which are removed from the forest.

Figure 3 illustrates the relationship between different terms used for growth, fellings and removals<sup>7</sup>, together with EU estimates (2004-2013 yearly average).

The average harvesting ratio for the EU is 63%. This is estimated as the fellings-to-net-annual-increment ratio based on total biomass (stem wood plus other wood components).

The balance between the harvested living biomass and the quantity of biomass produced determines whether the stock of living biomass will increase or decrease. In order to be conclusive, such a comparison should be made on a multi-annual basis.

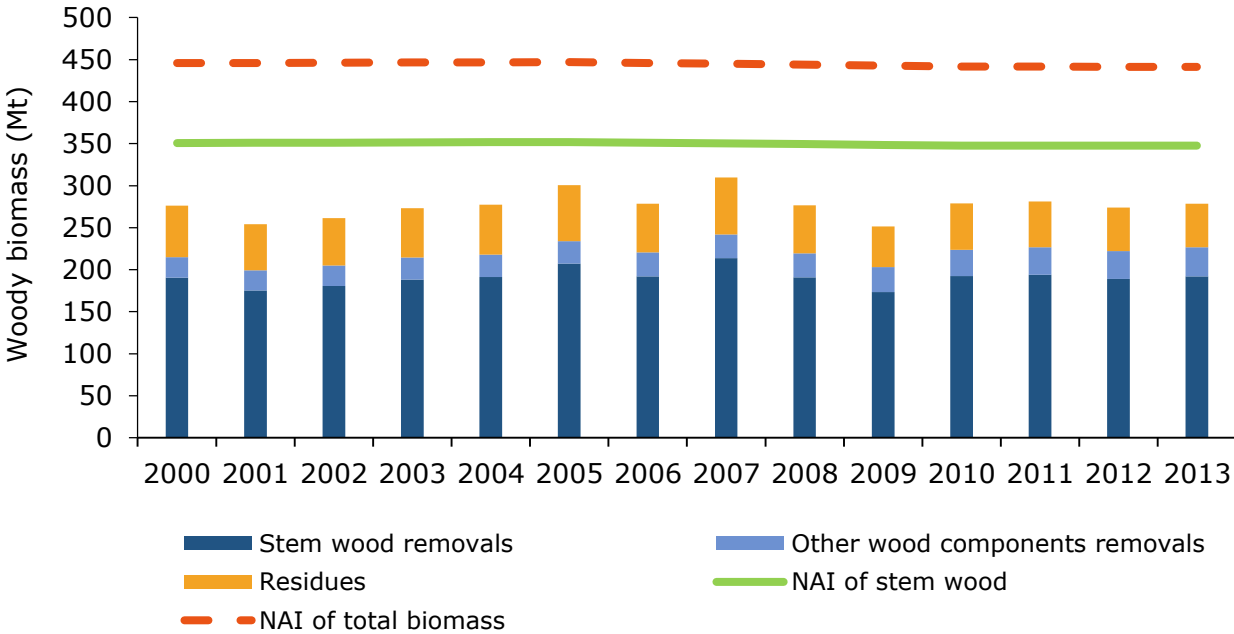


**Figure 3:** Increments, fellings and removals in the EU forest area available for wood supply; average values in Mt/a for the period 2004-2013 (sources: JRC calculations from Eurostat and NFI data).

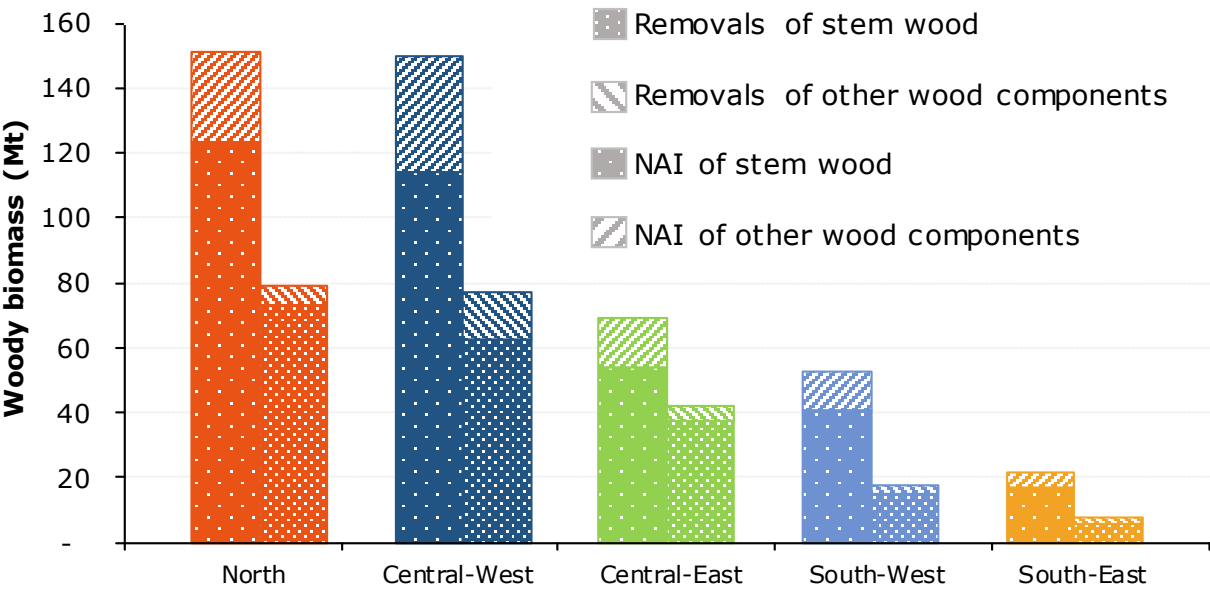
<sup>7</sup> Fellings refer to the cutting down of trees; removals refer to the wood actually removed from the forest.

Figure 4 illustrates the time series of annual removals and increments. At EU level, removals have consistently been lower than increments. This, together with the expansion in forest area, has resulted in increasing woody biomass stocks in forests over time. The chart below shows that removals were at a minimum in 2009, following the 2008 economic crisis. The slight decline in net annual increment over time is barely visible.

Figure 5 shows biomass produced annually (net annual increment) in regions of the EU compared to removals (10-year average, 2004-2013).



**Figure 4:** Removals from and net annual increment (NAI) in the EU forest area available for wood supply; woody biomass in Mt (sources: Removals, JRC calculation form Eurostat; NAI, JRC calculation from NFI data).



**Figure 5:** Removals and net annual increment (NAI) of woody biomass in Mt in regions of the EU<sup>6</sup> (FAWS, 10-year average for 2004-2013) (sources: Removals, JRC calculation form Eurostat; NAI, JRC calculation from NFI data).

It is important to note that felling and removal statistics are subject to high levels of uncertainty. Analyses carried out by the JRC (Camia et al. 2018) indicate that removals at the EU level are significantly underestimated (by up to 20% as an EU-level conservative estimate, although with large differences between the Member States). Consequently, the actual EU harvesting ratio is likely to be approximately 12% higher<sup>8</sup>. Nevertheless, this still implies an EU harvesting ratio of less than 100%, resulting in a steady increase in forest biomass stock, albeit with significant differences between Member States and from year to year. Net annual increment is also estimated with high levels of uncertainty, however its difference from the true value may be both positive or negative. Because of the increase in biomass stock, EU forests act as a net carbon sink.

During wood-harvesting operations, only a part of the biomass from felled trees is removed from the forest, the remainder is left on the ground as primary residues. This is an important management practice. Excess removal of residues from forest sites implies removal of nutrients and organic matter, which affects soil and, indirectly, influences competing vegetation and soil microclimates. This in turn may alter the physical properties of soil, reduce soil carbon and forest productivity, and may also adversely affect biodiversity (Vance et al., 2018).

However, effects are highly variable and site-dependent, thus limiting the possibility of generalised conclusions about potential impacts. For example, in fire-prone areas, a more intense removal of residues is a positive management practice, since it reduces the fuel load, thereby lowering the fire hazard.

## 5. Methodology

The main sources of forest biomass data are National Forest Inventories (NFIs), which are designed and carried out based on country-specific definitions and specifications. Harmonisation efforts - also supported by the European Cooperation in Science and Technology (COST) and Horizon 2020 programmes - have been undertaken by the Member States with NFIs in the context of international reporting obligations<sup>9</sup> since the 1990s. While significant progress has been made, in many instances comparability of national statistics is still an issue.

The JRC has addressed the main sources of uncertainty and differences in the biomass assessment. It has analysed available data in depth, both independently and in cooperation with the organisations in charge of the NFIs. Modelling techniques have also been used, for example, to reconstruct time series and align data in time. The values presented in this brief represent EU-level estimates harmonised to the best extent possible and are subject to uncertainties. Further refinements will be made as knowledge becomes available.

While forests available for wood supply represent the portion of the forest where no legal, economic or specific environmental restrictions have a significant impact on the supply of wood, the assessment of the actual, sustainable supply of wood from forests implies reconciling the provision of a wide range of forest ecosystem services, such as carbon storage and sequestration, non-wood forest products, habitat provision, water regulation (quality, quantity, flow), air quality regulation, erosion control and recreation.

Additional factors may also significantly affect wood mobilisation and therefore the amount of actual woody biomass supply. These include forest ownership (60% of forests are privately owned), fragmentation of forest lands (size and structure of forest holdings) and economic profitability of forest management. Those are key aspects not covered by this brief.

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<sup>8</sup> A major reason behind this underestimation is underreporting. In many instances, small-scale informal loggings (and subsequent use) are not reported in the national statistics (e.g. fuelwood harvesting).

<sup>9</sup> Forest Europe (<http://foresteurope.org/>) and FAO Global Forest Resource Assessments (<http://www.fao.org/forest-resources-assessment>)

## Knowledge gaps

1. Comprehensive and detailed quantitative data on forestry biomass are currently not readily available. Data are often reported only for forests available for wood supply, and are limited to stem wood.
2. Net annual increments and reported wood removals are associated with relatively high uncertainties. The latter are likely to be underestimated (with differences between EU Member States). The reporting of both the quality and quantity of wood removals needs to be improved.
3. Efforts to harmonise forest-inventory estimates have been pursued by EU Member States since the first international reporting exercises in the 1990s, but full comparability of national statistics remains an issue.

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This brief has been prepared by the Joint Research Centre (JRC) for the European Commission's Knowledge Centre for Bioeconomy, which brings together knowledge and scientific evidence from within and outside of the European Commission in a transparent, tailored and concise manner, to inform policymaking on the bioeconomy. The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use that might be made of this publication.



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doi:10.2760/59347  
ISBN 978-92-79-77233-7  
JRC109352