BIOENERGY EUROPE

STATISTICAL REPORT 2022

REPORT
BIOMASS SUPPLY

Bioenergy EUROPE

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ABOUT

THE STATISTICAL REPORT

Every year since its debut release in 2007, Bioenergy Europe's Statistical Report has provided an in-depth overview of the bioenergy sector in the EU-27 Member States.

Bioenergy Europe's Statistical Report has been enriched each year with new figures and information, collecting unique data on the developments of the European bioenergy market from a growing number of international contributors.

Bioenergy Europe develops detailed reports that aid industry leaders, decision makers, investors and all bioenergy professionals to understand the situation of bioenergy in Europe.

With more than 150 graphs and figures, readers of Bioenergy Europe´s Statistical Report can get accurate and up-to-date information on the EU-27 energy system such as the final energy consumption of biomass for heat and electricity, the number of biogas plants in Europe, the consumption and trade of pellets, the production capacity of biofuels and other key information to help break down and clarify the complexity of a sector in constant evolution.

In 2017, the Report was rewarded by the European Association Awards for being the 'best Provision of Industry Information and Intelligence', a recognition after a decade of collective work.

THE EUROPEAN ASSOCIATION AWARDS 2017

ABOUT

BIOENERGY EUROPE

A bit of history

Bioenergy Europe is the voice of European bioenergy.

It aims to develop a sustainable bioenergy market based on fair business conditions. Founded in 1990, Bioenergy Europe is a non-profit, Brussels-based international organisation bringing together more than 40 associations and 90 companies, as well as academia and research institutes from across Europe.

Our vision

Bioenergy Europe will be the leading player in ensuring that sustainable bioenergy is a key pillar in delivering a carbon neutral Europe.

Our mission

Bioenergy Europe facilitates the development of a sustainable, strong, and competitive bioenergy sector through:

- Promotion towards European policymakers and stakeholders for awareness, acceptance, and reputation of bioenergy.
- Promote the development of consistent, realistic, and sustainable bioenergy scenarios in the heat, electricity, and transport sectors.
- Pro-active proposals to develop more favourable European legislation.
- Market intelligence to support decision making.
- Services to members, including support to advocacy at a national level.
- Tools, including certification schemes, to sustain market growth and credibility.
- Industry collaboration throughout the entire supply chain.
- Promotion of efficient and innovative technologies within the bioeconomy.

2007 First Statistical Report published

2009 + analysis on the National Renewable Energy Action Plan + (108 pages)

2010 89 pages

2011 + pellet chapter + (108 pages)

2012 + statistics on ENplus® + 2700 downloads + (124 pages)

2013 + socio-economic indicators + 2600 downloads

2014 + EPC European Wood Pellet + Overview + expert's view + 3000 downloads + 158 pages

2015 + statistics on wood chip consumption + 200 page report on bioenergy support scheme in Europe + key findings report + 3500 downloads

2016 + chapter on environmental impact of bioenergy + projections on bioheat & bioelectricity + awarded as 'the Best Provision of Industry Information & Intelligence'by the European Association Award + 4000 downloads

2017 + updated information on bioelectricity / bioheat market & support schemes in all EU28 Member States + a seperate report on ENplus®

2018 + report available to the public, free of charge + emphasis on providing transparent data & sharing knowledge to support private & public initiatives to promote bioenergy + 300 pages

2019 / 2020 / 2021 + Bioenergy Europe publishes 7 focussed reports published throughout the year

2022

OUR

ACTIVITIES

Bioenergy Europe carries a wide range of activities aimed at supporting its members on the latest EU and national policy developments. Bioenergy Europe works to voice their concerns to EU and other authorities, including, advocacy activities in key policy areas as well as the organisation of dedicated working groups.

Working Groups

Bioenergy Europe's working groups act as a platform for members to discuss common issues and exchange information on the state of play of bioenergy.

There are currently 8 active working groups:

- Agro-biomass;
- Competitiveness;
- Domestic Heating;
- Pellets;
- Sustainability;
- Wood Supply;
- Task Force Carbon Removal;
- Task Force National Advocacy.

Certification Schemes

Thanks to the experience and authority acquired over the last 20 years, Bioenergy Europe has successfully established two international certification schemes to guarantee high quality standard for fuels, namely, ENplus®, as well as the latest edition in the certification for sustainable bioenergy: SURE.

Networks

Bioenergy Europe is the umbrella organisation of both the European Pellet Council (EPC) and the International Biomass Torrefaction Council (IBTC). These networks have been created thanks to the dynamics of Bioenergy

EUROPEAN PELLET COUNCIL
A NETWORK OF BIOENERGY EUROPE

INTERNATIONAL BIOMASS TORREFACTION COUNCIL
A NETWORK OF BIOENERGY EUROPE

Europe members. Today, these networks bring together bioenergy experts and company representatives from all over Europe and beyond.

The European Pellet Council (EPC), founded in 2010, represents the interests of the European wood pellet sector. Its members are national pellet associations or related organisations from over 17 countries.

EPC is a platform for the pellet sector to discuss issues relating to the transition from a niche product to a major energy commodity. Issues include the standardisation and certification of pellet quality, safety, security of supply, education and training, and the quality of pellet-using devices. EPC manages the ENplus® quality certification.

Launched in 2012, the International Biomass Torrefaction Council (IBTC), aims to build the first platform for companies that have common interests in the development of torrefied Biomass markets. Currently, the IBTC initiative is supported by more than 20 companies worldwide.

IBTC's objective is to promote the use of torrefied biomass as an energy carrier and to assist the development of the torrefaction industry. In this respect, IBTC's key activities are to undertake studies or projects, and to commonly voice its members' concerns to third parties to help to overcome barriers of market deployment.

For further information on Bioenergy Europe's Networks & Certification Schemes visit www.bioenergyeurope.org

OUR

MEMBERS*

As the common voice of the bioenergy sector, Bioenergy Europe, aims to develop a sustainable bioenergy market based on fair business conditions and does so by bringing together national associations and companies from all over Europe – thus representing more than 4000 indirect members, including companies and research centres.

Associations

Academia

*Members as of November 2022

Companies

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(Exclusive to Bioenergy Europe Members)

This opportunity entails a free of charge promotion for Bioenergy Europe members only. This offer includes the chance to display your organisation's logo as well as a featured 100-word description, placed in 1 of the 7 annual statistical reports of your choice.

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You can find more information in regard to the sponsorship on our website or get in touch with our Team at info@bioenergyeurope.org

*Bioenergy Europe Members receive a 50% discount on this sponsorship package

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- Halogens
- Major Elements (MAA)
- Minor Elements (Trace)
- Mechanical durability
- Bulk density
- Biomass content
- Length & diameter
- Particle size distribution
- Ash melting behavior (AFT's)
- DNA (Rice husk)

Inspection

- Sampling (ISO 18135:2017)
- Draft survey
- Hold inspection
- Cargo superintendence
- Stockpile survey
- Volumetric assessments
- Bias testing
- Mechanical Sampling System (MSS) design and installation
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PROGETTO FUOCO

Progetto Fuoco is the most important international trade fair in the biomass sector. Next edition will be held in Verona Exhibition Centre from February 28 to March 2nd 2024.

www.progettofuoco.com

SURE
SUSTAINABLE RESOURCES
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SURE enables all economic operators along the supply chain, from biomass producers to conversion plants, to prove sustainable use of biomass in electricity production.

SUSTAINABLE RESOURCES Verification Scheme (SURE) is a voluntary certification scheme that aims at ensuring the sustainable and responsible use of biomass within the energy sector. SURE's set of criteria is in accordance with the principles of the European Energy Directive (RED II) and enables all economic operators within the bioenergy sector to demonstrate compliance with RED II requirements.

Interested to learn more? Visit our website
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EN*plus*

EN*plus*® is the worldleading quality certification scheme for wood pellets that systematically certifies the entire supply chain, from the early stages of production to the delivery process. The EN*plus*® requirements go beyond those of the international standard ISO 17225-2 to guarantee optimum efficiency. In addition, all actors along the supply chain follow detailed guidelines to ensure consistent quality. In more than ten years of existence, the EN*plus*® scheme has certified more than 1200 companies in 47 countries and has become a widely recognized brand trusted by professionals and consumers alike.

https://enplus-pellets.eu/

Bioenergy EUROPE

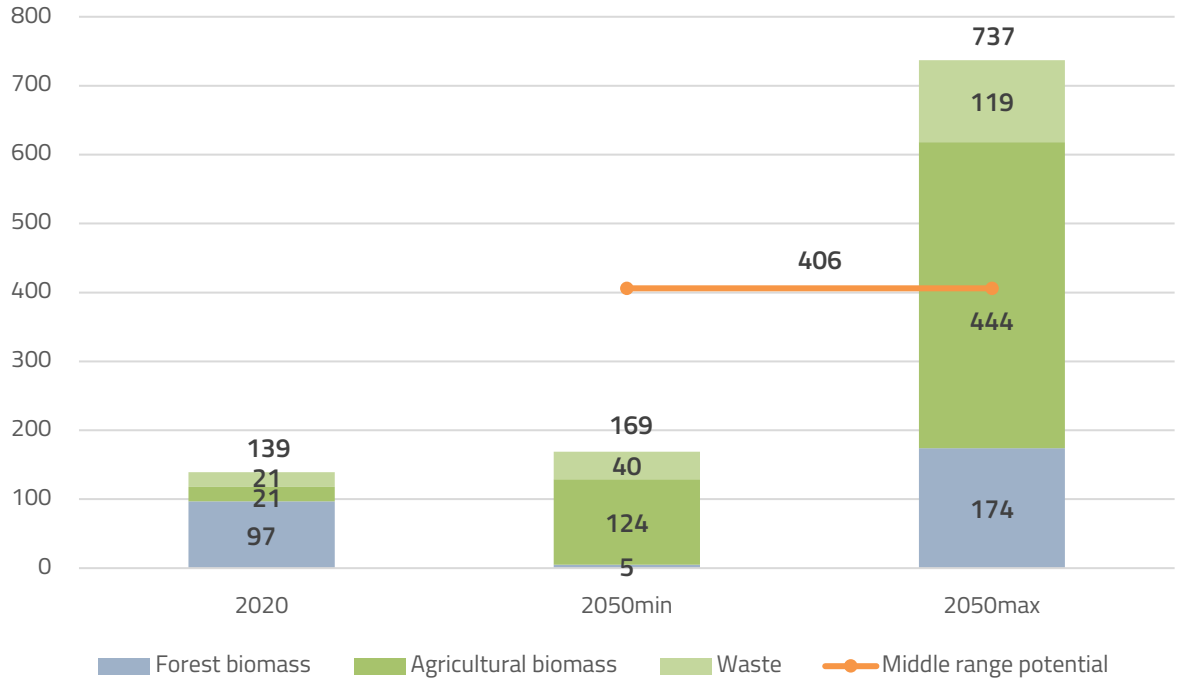
1. Overview

Biomass is any organic matter that stores solar energy and was created through a photosynthesis reaction. Given that biomass develops before use, and can be replanted after harvesting, it is considered to be a source of renewable energy. Biomass which is utilised for energy purposes takes various forms and can be solid, liquid or gaseous, depending on the type of processing techniques being used. Biomass encapsulates a variety of sources, including:

- Forests, including thinnings and logging residues
- By-products of the wood industry (e.g. bark, saw dust, shavings, black liquor)
- Energy crops (e.g. arable crops that are sugar-, starch- or oil-based; perennial lignocellulosic crops, both woody and grassy)
- Agricultural by-products (e.g. straw, manure, orchard and vineyard prunings)
- By-products of the agro-food industry (e.g. nutshells, seed husks and olive pits)
- Waste streams (e.g. municipal waste, post-consumer wood)
- Aquatic biomass (algae)

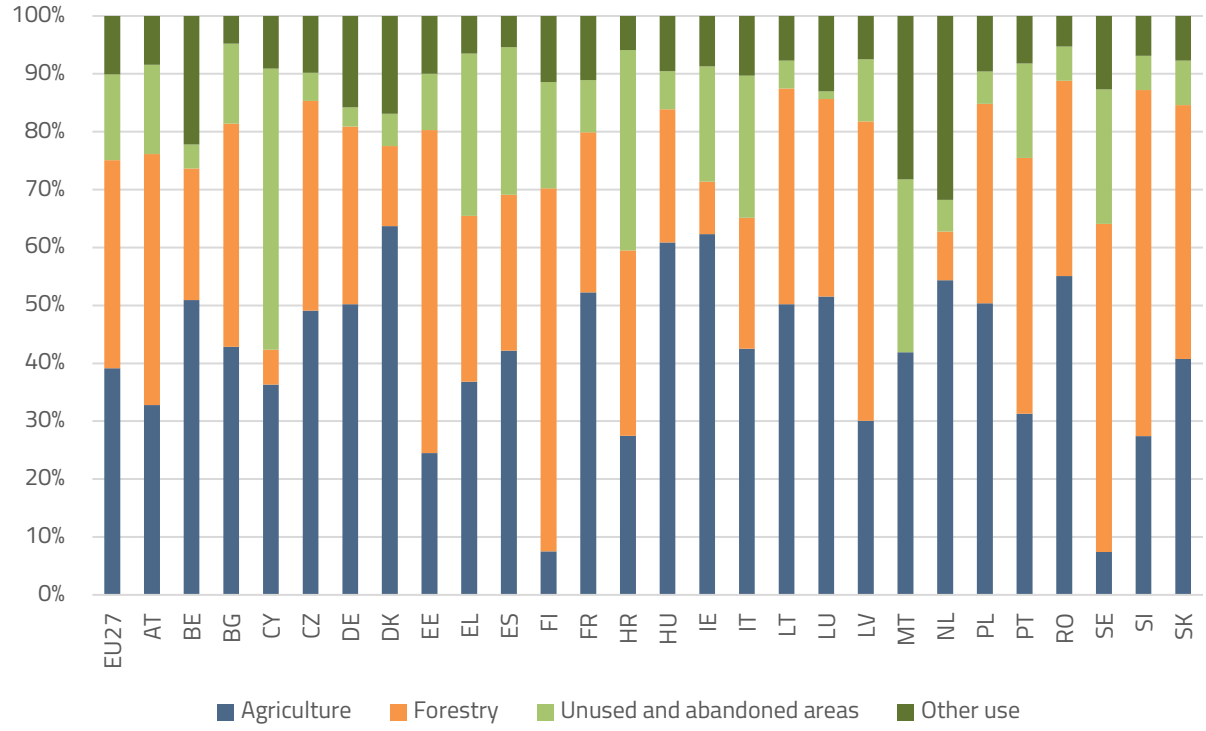
According to existing assessments, Europe's domestically available biomass for energy potential in 2050 ranges at 169-737 Mtoe (Cf. Figure 1). Based on a literature review, the combination of all available biomass resources that may be mobilised over time, taking into account various technical constraints (such as costs), could yield a total of 406 Mtoe by 2050. This means that, as compared to the actual 139 Mtoe used in 2020, the potential gives enough room to almost triple the amount of available bioenergy in the European energy mix.

Figure 1 Gross inland energy consumption of biomass in 2020 and potential in 2050 for the EU27 + UK (in Mtoe)



Source: *Securing sustainable resource availability of biomass for energy applications in Europe; review of recent literature*. Prof. Dr. André P.C. Faaij

Figure 2 Land use by type in EU27 in 2018 (%)

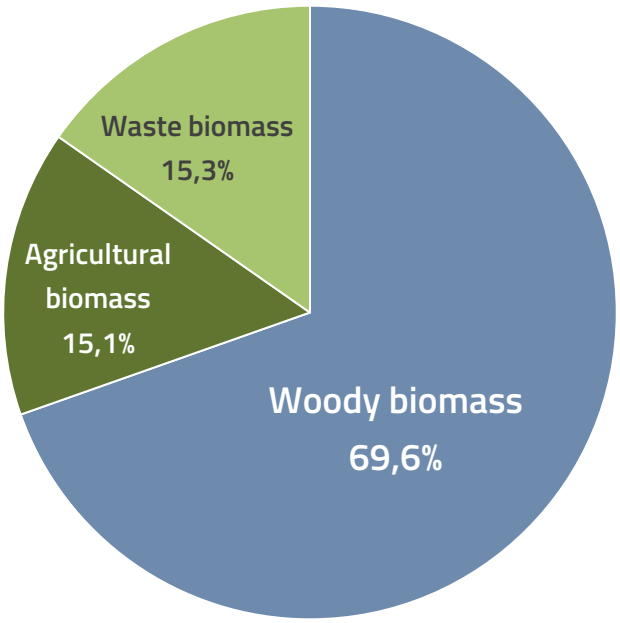


Note: The definition for "unused and abandoned areas" is defined in the Annexes and "other use" includes services & residential areas, the industry-related areas and fishing areas.
Source: Eurostat

While there are constraints on the amount of available land, it is notable that unused and abandoned areas represent 14,8% of total land use in the EU27, which is land that can partly be used to grow energy crops or for afforestation. The countries with the highest rates of land abandonment are Cyprus (48,5%), Croatia (34,6%), Malta (29,9%), Spain (25,4%), Italy (24,5%) and Sweden (23,2%). However, excepting Cyprus and Malta, the areas involved remain relatively small, given the overall size of these countries. In absolute terms, the 3 countries with the highest rates of unused and abandoned areas are Spain, Italy and Sweden.

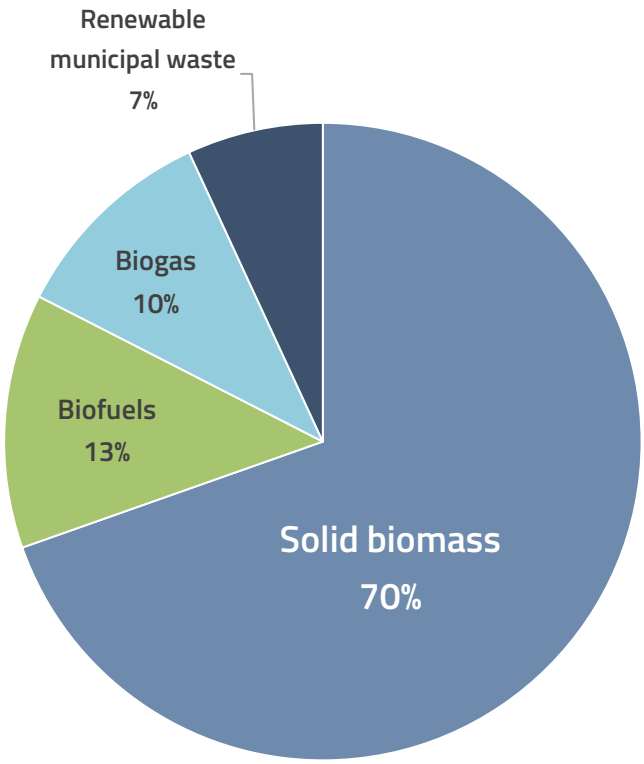
Since the majority of biomass being used for energy production currently originates as forest biomass, the highest potential in bioenergy use can be found in the countries with the largest amount of forested area. In absolute terms, the top three countries are Sweden, Finland and France. When thinking in relative terms, the countries with the highest proportion of forest (as compared to total land area) are Finland (62,7%), Slovenia (59,8%) and Sweden (56,6%).

Figure 3 Distribution of the various biomass feedstock for energy in 2020 (%)



Source: Eurostat and Bioenergy Europe's estimate

Figure 4 Gross inland energy consumption of biomass by type in the EU27 in 2020 (%)



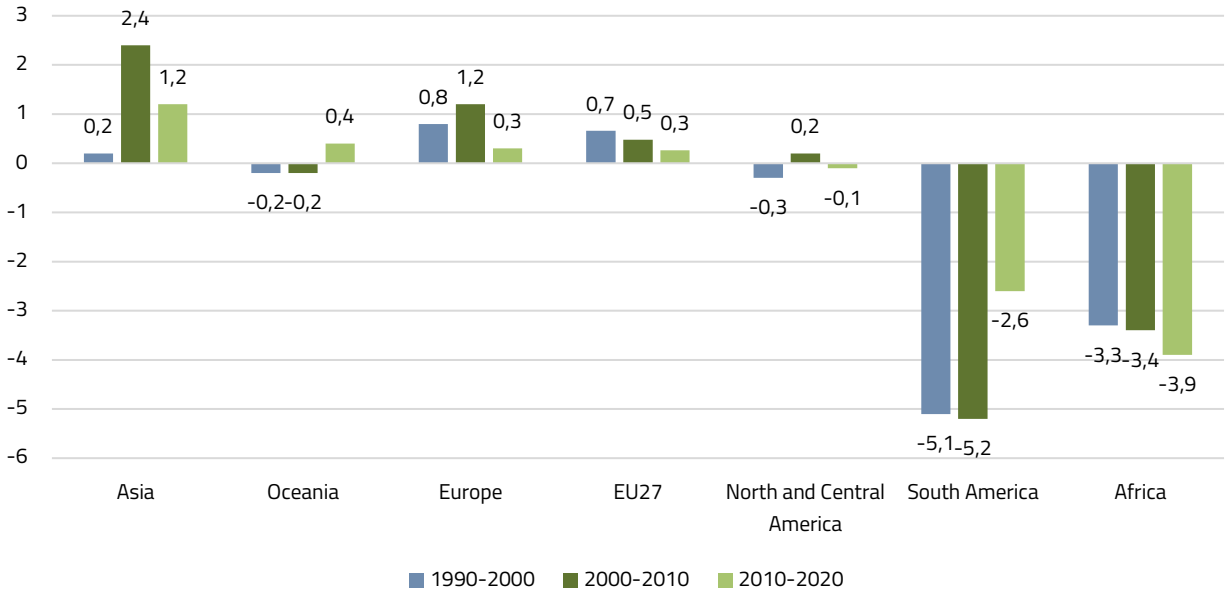
Source: Eurostat

2. Biomass from forestry

2.1. Current state of EU forests

The global forest area in 2020 is estimated at 4,06 billion ha, corresponding to 31% of the entire global land. The rate of net forest loss has been globally decreasing since 1990, with EU27 showing a net forest gain for the past 30 years (and an average annual increase of 262.000 ha between 2010 and 2020).

Figure 5 Annual forest area net change, by decade and region, 1990-2020 (million ha per year)[1]

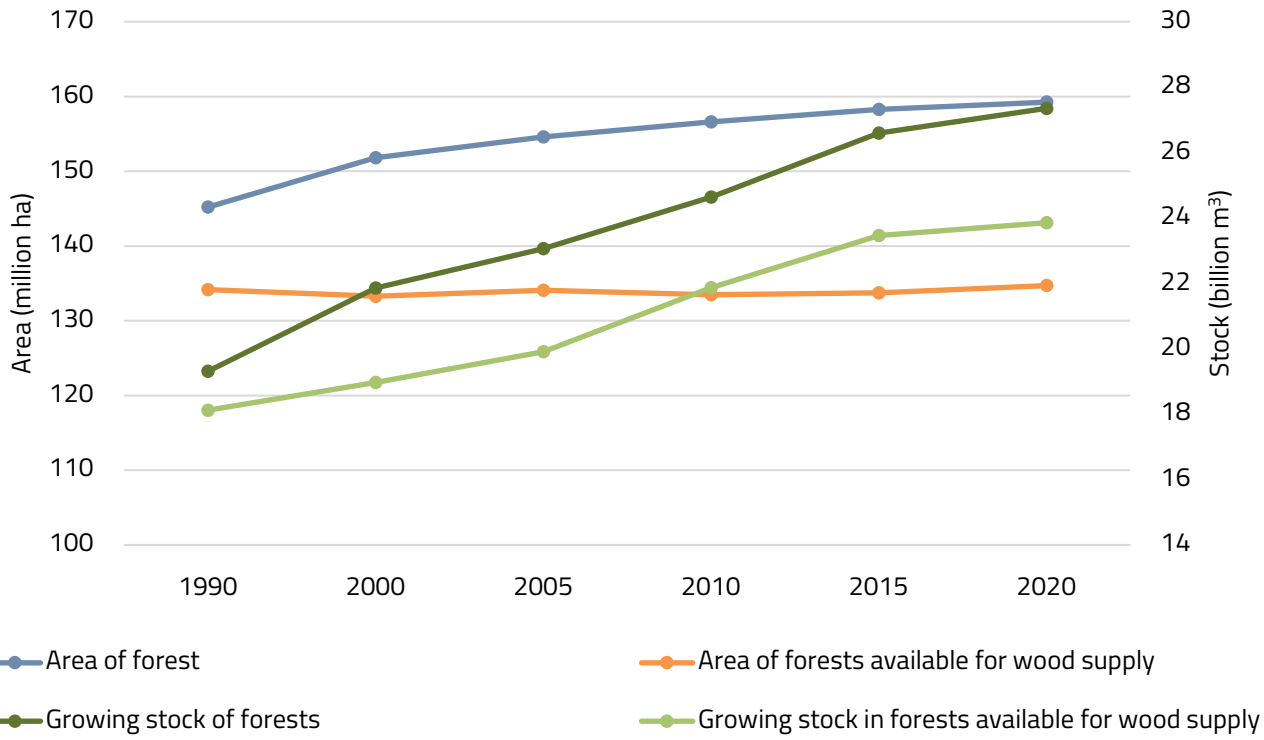


Source: FAO Global Forest Resources Assessment 2020 and State of Europe's Forests 2020 (Forest Europe)

In 2020 the EU27 is estimated to have had approximately 180 million hectares of forests and other wooded land (of which 159 million are forest), corresponding to 45% of its land area.

[1] Europe includes Albania (Desk study), Andorra, Austria, Belgium, Bulgaria, Bosnia and Herzegovina (Desk study), Belarus, Switzerland, Czechia, Germany, Denmark, Spain, Estonia, Finland, France, Faroe Islands, United Kingdom of Great Britain and Northern Ireland, Guernsey (Desk study), Gibraltar (Desk study), Greece, Croatia, Hungary, Isle of Man (Desk study), Ireland, Iceland, Italy, Jersey (Desk study), Liechtenstein, Lithuania, Luxembourg, Latvia, Monaco (Desk study), Republic of Moldova, North Macedonia (Desk study), Malta, Montenegro, Netherlands, Norway, Poland, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Svalbard and Jan Mayen Islands, San Marino (Desk study), Serbia, Slovakia, Slovenia, Sweden, Ukraine, Holy See (Desk study).

Figure 6 Evolution of total area (left axis) and available stock (right axis) of forest and forest available for wood supply in EU27 (million ha and billion m³)



Notes: Data regarding the growing stock available for wood supply was incomplete. Definitions of growing stock and forest area available for wood supply are found in Annexes.
Source: State of Europe's Forests 2020 (Forest Europe)

At the European level, it is possible to observe a general increase in the available stock in forests over the last 30 years. Indeed, the available stock at the beginning of the 1990s was estimated at 18,2 billion m^3 versus 23,8 billion m^3 in 2020, which represents an evolution of 30,7% (or around a percentage point of increase per year). This growth can be attributed to:

(1) **The increase in forest area**: according to FAO, EU27 forest coverage gained on average 468.000 hectares every year from 1990 to 2020, meaning that European forests are increasing in sizeat the rate of size of 1,24 football fields every minute.
(2) **The overall forest density has risen** from 133 m^3/ ha in 1990 to 173 m^3/ha in 2020 (considering the forest area and stock).

In addition to having a greater forested area, maintaining and improving biodiversity in European forests is a particularly important issue in the current climate context. Indeed, it allows forest ecosystems to function as a coherent whole, enabling them to better handle increasingly harsh conditions.

Today, about a quarter of the total European forest area is considered as protected areas for biodiversity, conservation or landscape reasons. Forest diversity (number of species in forests) across the continent has also been growing over the last 30 years. Since 2005, for example, tree species diversity has also increased, reducing disturbance-sensitive monocultures to only 1/3 of the total European forest area.

Table 1 Forest area in the EU27 Member States in 2020 (1000 ha)

	Total Land area	Total area of forests and other wooded land	Forests	Forests available for wood supply	Other wooded land	Share of forests and other wooded land
EU27	**399.637**	**180.263**	**159.232**	**134.608**	**21.031**	**45%**
AT	8.252	4.029	3.899	3.305	130	49%
BE	3.028	722	689	664	33	24%
BG	10.856	3.917	3.893	2.039	24	36%
CY	924	386	173	41	213	42%
CZ	7.721	2.677	2.677	2.304	0	35%
DE	34.886	11.419	11.419	9.942	0	33%
DK	4.199	665	628	614	37	16%
EE	4.347	2.532	2.438	2.106	94	58%
EL	12.890	6.539	3.903	3.595	2.636	51%
ES	49.966	27.954	18.572	17.079	9.382	56%
FI	30.391	23.155	22.409	19.719	746	76%
FR	54.756	18.096	17.253	16.493	843	33%
HR	5.596	2.557	1.939	1.743	618	46%
HU	9.053	2.253	2.053	1.871	200	25%
IE	6.889	848	782	607	66	12%
IT	29.414	11.432	9.566	8.454	1.866	39%
LT	6.265	2.263	2.201	1.936	62	36%
LU	243	92	89	N.A.	3	38%
LV	6.218	3.519	3.411	3.199	108	57%
MT	32	0	0	N.A.	0,1	0%
NL	3.369	370	370	299	0	11%
PL	30.619	9.483	9.483	8.331	N.A.	31%
PT	9.161	4.855	3.312	2.199	1.543	53%
RO	23.008	6.945	6.929	5.586	16	30%
SE	40.731	30.344	27.980	19.556	2.364	74%
SI	2.014	1.265	1.238	1.130	27	63%
SK	4.808	1.946	1.926	1.796	20	40%

Source: FAO Global Forest Resources Assessment 2020, Eurostat

In 2020, 8 of the 27 EU Member States are estimated to have at least half of their land area covered by forests and other wooded land (Finland, Sweden, Slovenia, Estonia, Latvia, Spain, Portugal and Greece). In Finland and Sweden, the forested area accounts for approximately three quarters of the land area.

Between 1990 and 2020, the change in forest area varied significantly among EU27 Member States. Portugal and Sweden were the only two countries with a small decline in forest area among the 27; however, both countries lost less than 3% of their forest area (2.56% for Portugal and 0.3% for Sweden)

In many countries, such as Austria, Belgium, Czechia, Finland, Luxembourg, Germany and Slovakia, there was hardly any change in forest area (0-4% change).
There were also several countries which experienced strong growth in their forest areas, such as Bulgaria, Denmark, Estonia, Greece, France, Hungary, Italy and Lithuania, all of which had an increase ranging from 10% to 26%.

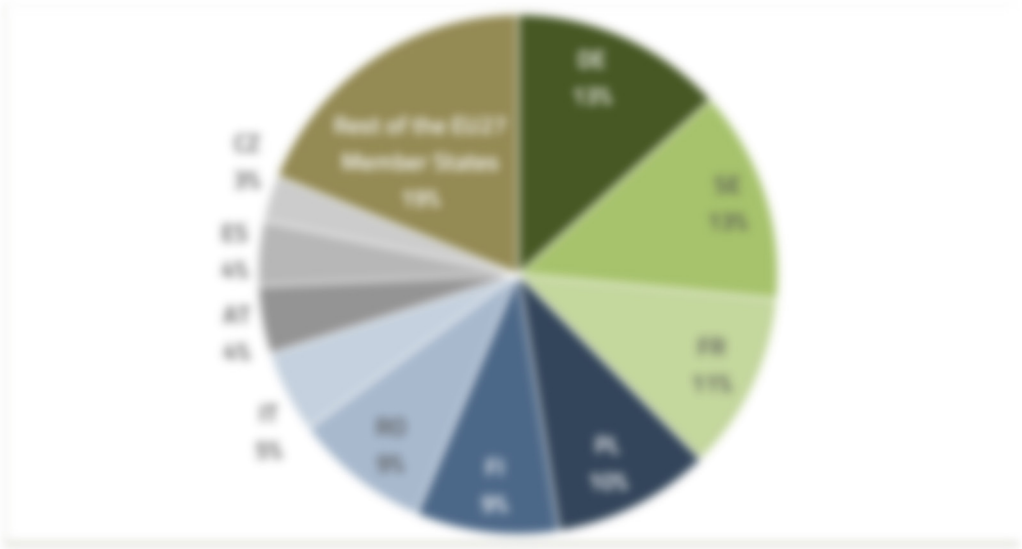
Finally, the countries with the largest increase in forest area were Ireland and Spain (69% and 34% respectively). However, it is important to note that although the figure for Ireland seems big, the 69% increase only corresponds to about 310.000 ha. By comparison, the 34% for Spain represents some 4.667.000 ha of forest area.

Figure 7 Evolution of forest area in EU27 Member States, 1990-2020 (1000 ha)

Source: State of Europe's Forests 2020 (Forest Europe).

The total forest stock in the EU27 amounted to approximately 28 billion m^3 in 2020. Germany had the highest share (13,27%), followed by Sweden (13,24%) and France (11,08%). The largest increase in forest stock over the period 1990-2020 occurred in Denmark (+102%), Spain (+98%) and Ireland (+97%). Only one country saw its forest stock decreasing: Portugal with a reduction of 16%.

Figure 8 Distribution of the available stock of forest among EU27 Member states in 2020 (%)



Note: Last available data for Malta and Portugal is from 2015.
Source: State of Europe's Forests 2020 (Forest Europe), Eurostat

Figure 9 Evolution of available stock of forest in EU27 Member States, 1990-2020 (million m^3)

Note: Last available data for Malta and Portugal is from 2015.
Source: State of Europe's Forests 2020 (Forest Europe), Eurostat

In today's climate context, the matter of the sustainability of forestry operations is more relevant than ever. The following graph shows the percentage of wood harvested in relation to annual growth in the EU27 Member States. On average, 75% of annual growth is harvested in Europe. The rate of harvest ranges from 19% in Cyprus to 98.7% in Belgium. No country therefore exceeds the 100% threshold, which means that each year the resource removal from European forests is more than compensated for by forest growth.

Primary Woody Biomass

During the revision of the Renewable Energy Directive as part of the European Green Deal and the Fit-for-55 package, the European Parliament has suggested a new definition of primary woody biomass. Primary woody biomass is defined very broadly as *"all roundwood felled or otherwise harvested and removed. It comprises all wood obtained from removals, i.e., the quantities removed from forests, including wood recovered due to natural mortality and from felling and logging..."*[2] Following extensive advocacy work, the legislation now includes important exceptions such as *"woody biomass obtained from sustainable wildfire prevention measures in high-risk fire prone areas, woody biomass obtained from road safety measures, and woody biomass extracted from forests affected by natural disasters, active pests or diseases to prevent their spread"*[3]. However, this does not account for all the feedstock with no other commercial use than bioenergy or all the low-quality woody biomass that should be removed to guarantee the health and productivity of forests.

There is a lot of woody biomass that is not suitable for use in other industries for several reasons: the wood is split, bent, rotten, too small for commercial use or has some other defect. Wood that has these kinds of defects will be rejected by sawmills, and sometimes even by the pulp and paper industry, since they cannot produce a cost-effective good, or because of contamination risks.

The report on the use of woody biomass for energy production in the EU (2021) by the Joint Research Centre (JRC) touches upon this timely discussion and opposes a blanket ban on using primary woody biomass for bioenergy. The *"possible regulation of forest bioenergy sources purely on the basis of wood feedstock categories (e.g., only residues or thinnings, no stumps, etc.) was discussed in detail. It was concluded that, given the wide variety of situations across Member States, it was difficult to univocally define and meaningfully implement such restrictions in an EU legislation – the risk would have been to complicate compliance without necessarily fostering further sustainability or biodiversity conservation"*[4].

The report also evaluates various pathways for using biomass for bioenergy and identifies 5 win-win pathways for bioenergy using primary woody biomass. While the report does identify 19 other pathways that result in at least some negative effects, this overview does not consider whether pathways are occurring, likely to occur[5] or are already illegal under REDII.

If adopted, the definition and related restrictions proposed by the European Parliament would cause significant disturbances to the EU's energy market. Given that 70% of the biomass used for bioenergy is woody biomass, the restriction by the Parliament on primary woody biomass would impact up to 35,7% of the feedstock for bioenergy. This means that up to 20,5% of the EU's renewable energy would be impacted and disrupted.

[2] European Parliament, Amendments to the Renewable Energy Directive, Article 1 (47ab)
[3] Ibid
[4] Camia, A., et al., The use of woody biomass for energy production in the EU, Publications Office of the European Union, Luxembourg, 2020, JRC122719, page 92.
[5] Ibid, page 5.

Figure 10 Fellings as % of net annual increment in EU27 member states in 2015

* Data from 2010.
Note: No data available for BG, EL, LU, LV, MT, PL, PT
Source: State of Europe's Forests 2020 (Forest Europe).

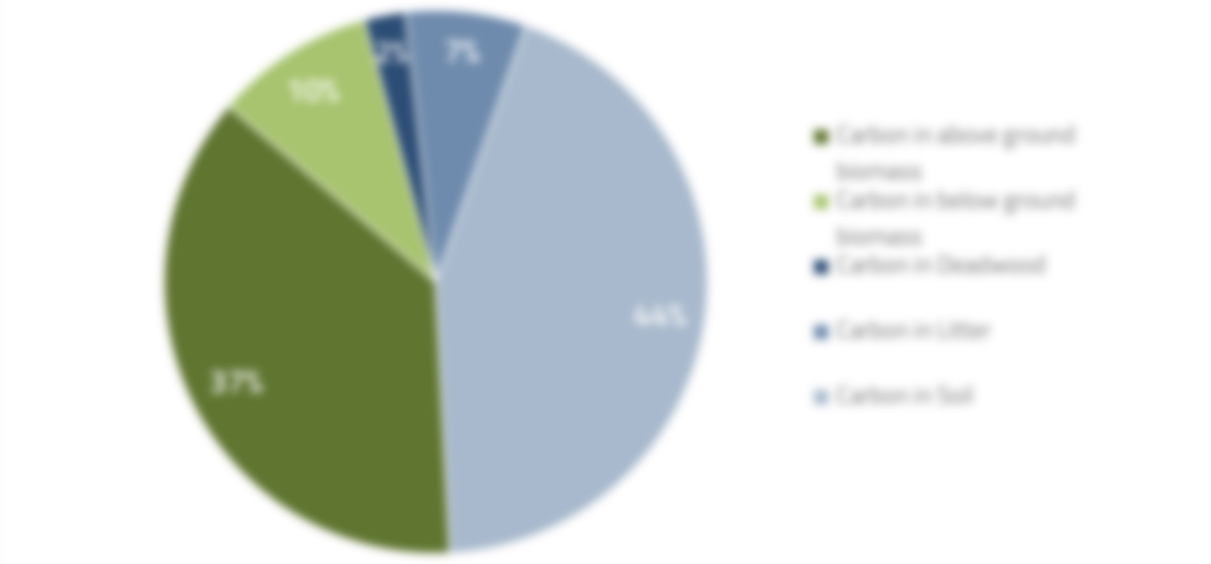
As can be seen in the following graph, the biomass stock across the EU27 Member States is relatively varied. In general, most of the carbon stock is located underground or in above-ground vegetation. However, data on carbon stored in soil was not available for all countries in 2020, which may lead to an underestimation of the stock for some European countries (e.g. France, Croatia, Hungary, Portugal). The country with the highest share of above-ground biomass (above-ground vegetation) is Czechia, with 115,3 tonnes of carbon per hectare. Romania has the highest density of deadwood, with almost 9,2 tonnes of carbon per hectare. Finally, the country with the highest soil carbon stock is Denmark, with about 184 tonnes of carbon per hectare.

Figure 11 Forest biomass stock in EU27 Member States in 2020 (tonnes of carbon/ha)

Note: Last available data for Portugal is from 2015.
Source: State of Europe's Forests 2020 (Forest Europe).

The pie chart below illustrates, at EU27 level, the distribution of forest carbon stock across the different categories. As explained earlier, the majority of the carbon stored in Europe is in the soil (44%). It is therefore essential that soil is maintained and restored, which is important if forests are to continue playing their role as carbon sinks.

Figure 12 Average forest carbon stock in EU27 in 2020 (tonnes of carbon/ha)

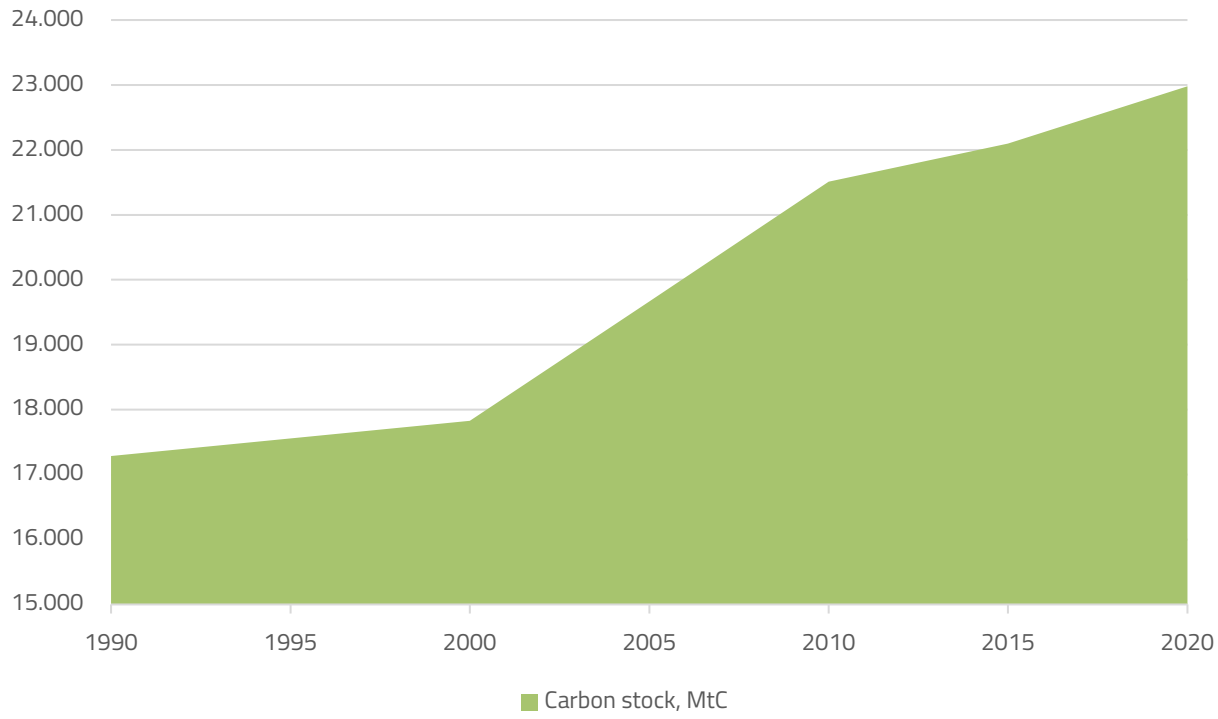


Note: Reference values for carbon stock from data available were used in years where data was missing. Definition of legend items under Annexes.
Source: State of Europe's Forests 2020 (Forest Europe).

Focusing on the quantities of carbon stored, it becomes clear that across the continent the amount of stored carbon has increased overall. In Europe the carbon stock has increased by more than 5000 Mt over the past 30 years, which corresponds to a net annual increase of about 166,7 MtC. This growth can be seen in Figure 12. In addition to observing this growth in carbon stock, the rate at which it is growing has also increased from 54,2 MtC per year for the period 1990-2000 to 88,1 MtC per year for the period 2015-2020.

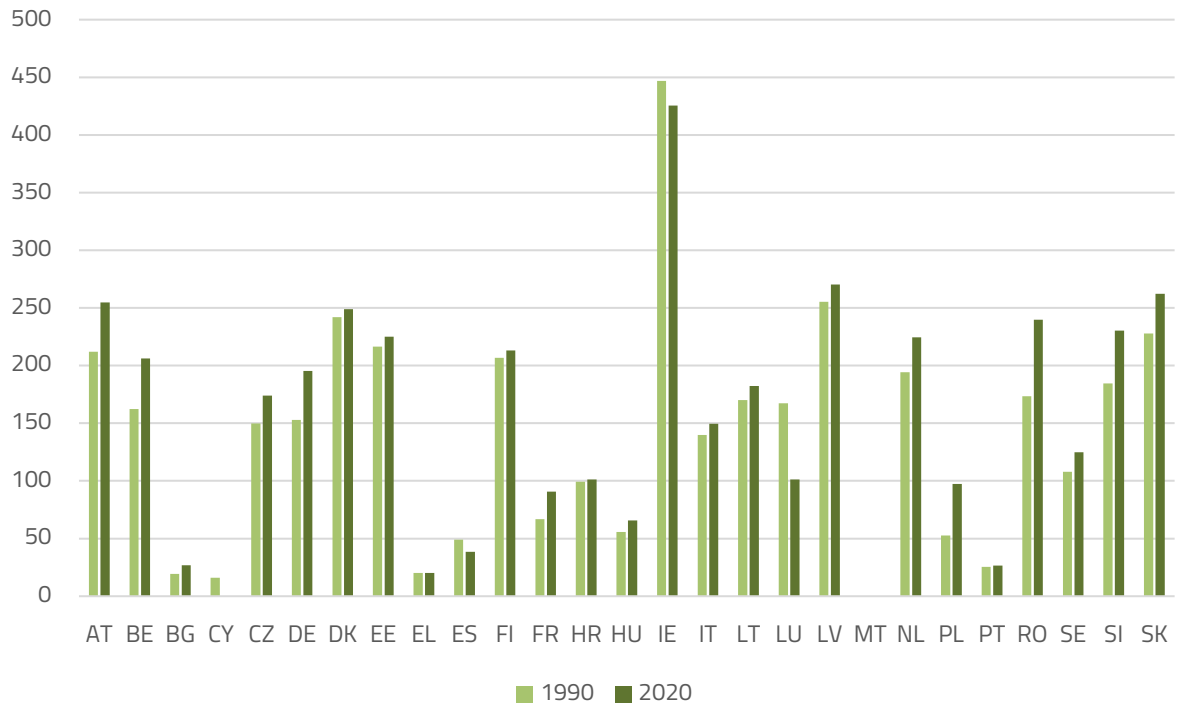
Examining the situation in individual Member States, the increase in carbon stock is uneven. Figure 13 compares the carbon per hectare in 1990 versus 2020 for all Member States. Poland and Bulgaria have seen the largest percentage increase in the EU27. While it may be surprising that Ireland has the largest carbon sequestration per hectare, this can be explained by the fact that many of Ireland's forests are on carbon-rich peatlands and have very high carbon stocks in the soil. Only four Member States have seen their carbon stock decrease over the last 30 years, but it is difficult to know whether this decrease is due to a real reduction in carbon stock or rather to irregularities in data collection.

Figure 13 Evolution of forest carbon stock in EU27, 1990-2020 (Million tonnes of Carbon)



Note: Last available data for Portugal is 2015.
Source: State of Europe's Forests 2020 (Forest Europe).

Figure 14 Evolution of forest carbon stock in EU27 Member States, 1990-2020 (tonnes of carbon/ha)



Source: State of Europe's Forests 2020 (Forest Europe).

The ownership structure of EU27 forests is diverse and divided between small family holdings, state-owned forests and large estates owned by enterprises, the latter being more frequently managed by the forest and wood products industries. In 2015, about half of the forests in the EU27 were privately owned. Portugal has the highest percentage (97.1%), while Bulgaria has the lowest (12.2%).

Table 2 Forest ownership in 2015 across EU27 Member States (1000 ha)

	In public ownership	In private ownership	% of private ownership
EU27	**61.890**	**94.888**	**60.5%**
AT	715	3.167	81.6%
BE	326	363	52.7%
BG	3.365	468	12.2%
CY	119	54	31.1%
CZ	2.019	650	24.3%
DE	5.933	5.486	48.0%
DK	150	462	75.6%
EE	1.177	1.133	49.1%
EL*	2907	845	23.0%
ES	5.255	13.260	71.6%
FI	6.861	15.397	69.2%
FR	4.358	12.478	74.1%
HR	1.366	556	28.9%
HU	1.169	864	42.5%
IE	391	364	48.2%
IT*	3032	5996	66.0%
LT	1.348	839	38.4%
LU	41	48	54.0%
LV	1.741	1.642	48.5%
MT	N.A.	N.A.	N.A.
NL	177	188	51.5%
PL	7.655	1.765	18.7%
PT	97	3.215	97.1%
RO	4.249	2.306	35.2%
SE	6.224	21.756	77.8%
SI	290	947	76.5%
SK	926	638	40.8%

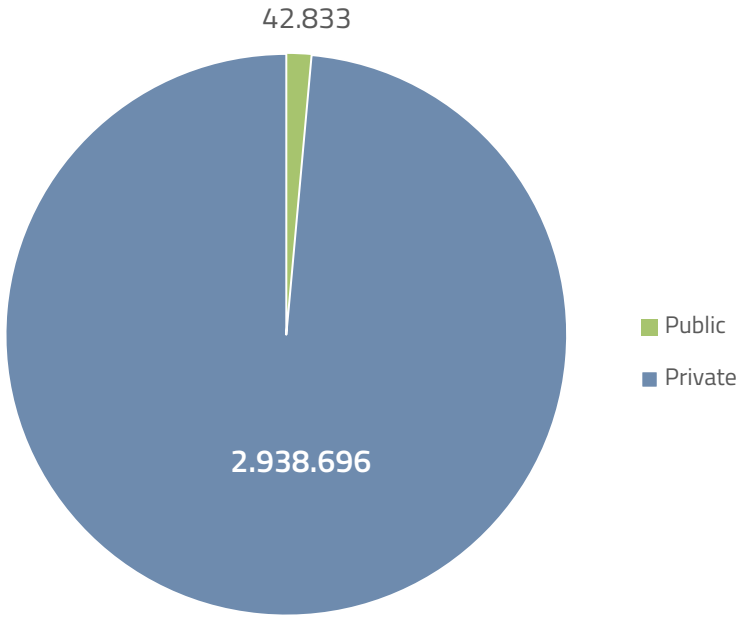
*Data from 2010.

Source: FAO Global Forest Resources Assessment 2020, Eurostat

As shown in the table above, the distribution in terms of forest area in Europe is 60.5% private and 39.5% public. However, in terms of the number of holdings, the trend is dramatically different. The pie chart below illustrates the number of private and public holdings in the EU27 and shows that the overwhelming majority are private holdings, which are close to 3 million in 2020, compared to only 42 833 public holdings in the same

year. On average, public forest holdings are substantially bigger than private ones. The size and quantities of both, however, vary substantially among countries. The majority of public forest holdings in Europe (20.342 as reported by 19 countries) are between 11 and 500 ha, and most private holdings (nearly two million as reported by 18 countries) are no larger than 10 ha, due mainly to inheritance issues.

Figure 15 Distribution of forest holdings in EU27 in 2020 (number of holdings)



Source: State of Europe's Forests 2020 (Forest Europe).

49% of EU27 forest area available for wood supply is certified PEFC and 30% is certified FSC (note that these numbers cannot be added as some forests may be certified both PEFC and FSC). The Member State with the largest share of PEFC certified areas is Austria, with around 100% (101% is shown in the table because the total area data is from 2020 and the PEFC data is from 2022, leading to a small bias) while the country with the largest share of FSC certified areas is Sweden, with 100%.

What are PEFC and FSC?

- FSC, or Forest Stewardship Council, is a global certification scheme that assures customers that the wood they buy comes from properly managed forests. The label is based on the implementation of 10 principles which owners must follow in order to qualify for the label. The FSC principles are adapted to national standards in any given country.
- PEFC, or Programme for the Endorsement of Forest Certification, is a third-party certification scheme owned by an international organisation based in Switzerland that promotes sustainable forest management. Whereas the FSC label requires an initial level of forest quality in order to be awarded, the PEFC label is based on continuous improvement in forest management.

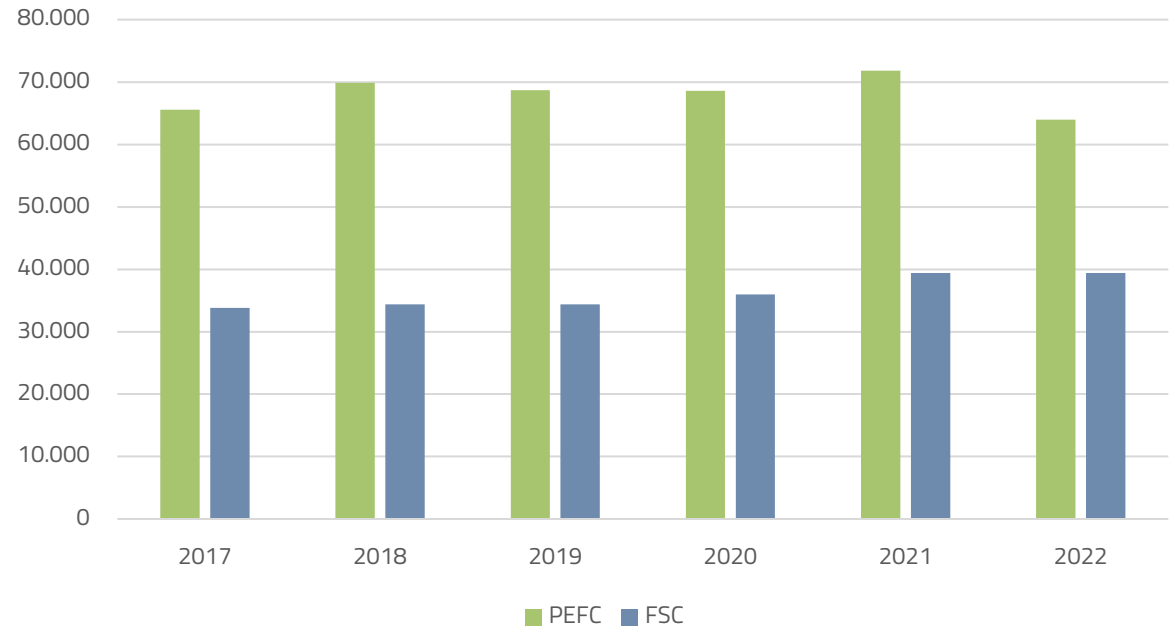
Historically speaking, the FSC (1993) label has been around longer than PEFC (1998) but the former was mainly developed for tropical countries. In an effort to certify European forests, PEFC was born and quickly became the most important forest certification label in Europe.

Table 3 Certified areas PEFC and FSC in the EU27 Member States (1000 ha) (Data from June 2022 for PEFC and October 2022 for FSC)

	PEFC	% of forest available for wood supply	FSC	% of forest available for wood supply
EU27	**63.672**	**48%**	**39.402**	**30%**
AT*	3.343	101%	0,59	0,02%
BE	305	46%	42	6,4%
BG*	N.A.	N.A.	2.338	115%
CZ	1.780	77%	136	5,9%
DE	8.753	88%	1.440	14%
DK	317	52%	228	37%
EE	1.326	63%	1.240	59%
ES	2.568	15%	546	3,2%
FI	10.828	55%	2.248	11%
FR	5.740	35%	98	0,6%
HU	N.A.	N.A.	443	24%
IE	454	75%	444	73%
IT	889	11%	N.A.	N.A.
LT	N.A.	N.A.	1.278	66%
LU	37	44%	24	28%
LV	1.749	55%	1.210	38%
NL	32	1,1%	164	55%
PL	7.221	87%	6.666	80%
PT	318	14%	543	25%
RO	12	0,2%	N.A.	N.A.
SE	16.832	86%	19.626	100%
SI	N.A.	N.A.	261	23%
SK	1.196	67%	426	24%

*Note: Austria has more than 100% of its forest available for wood supply as certified PEFC area, the same can be said for Bulgaria for FSC. This statistical mismatch can be explained by the fact that the last available data for area of forest available for wood supply comes from 2020 while certification data covers 2022, and/or due to a disparity in the classification of forest area and forest available for wood supply area.
Source PEFC & FSC

Figure 16 PEFC and FSC certified forest area between 2017 and 2022 in the EU27 (1000 ha)

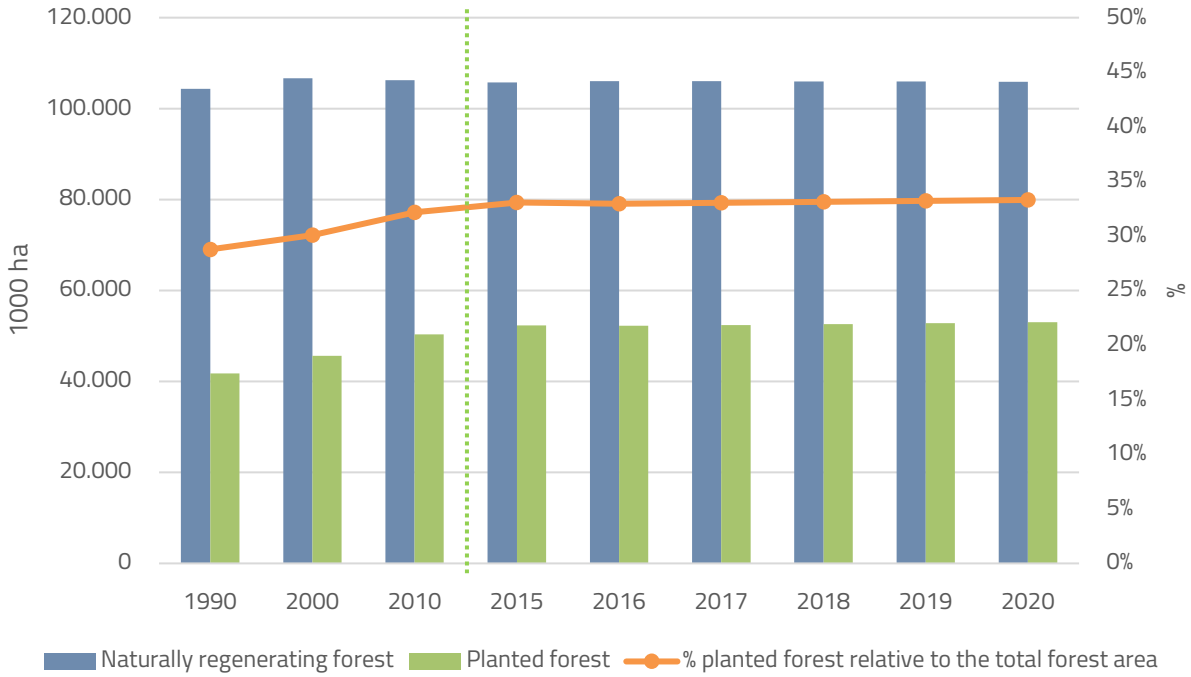


Source: PEFC & FSC

After a substantial 2020-2021 increase in certified areas, both from PEFC and FSC, 2022 witnessed a substantial decrease in PEFC certified areas (-7,2%). This decrease for PEFC reflects changes in Finland, which witnessed a drop of 7.442.000 ha of PEFC certified forest, representing a relative decrease of 41%. This trend can partly be explained by a revision of the PEFC requirements[6], undertaken from 2019 to 2021, but this information could not be independently verified.

[6] https://pefc.fi/press-release-the-finnish-pefc-forest-certification-requirements-revised/

Figure 17 Forest in EU27 by stand origin type (1000 ha) and evolution of planted forest area relative to total forest area, 1990-2020

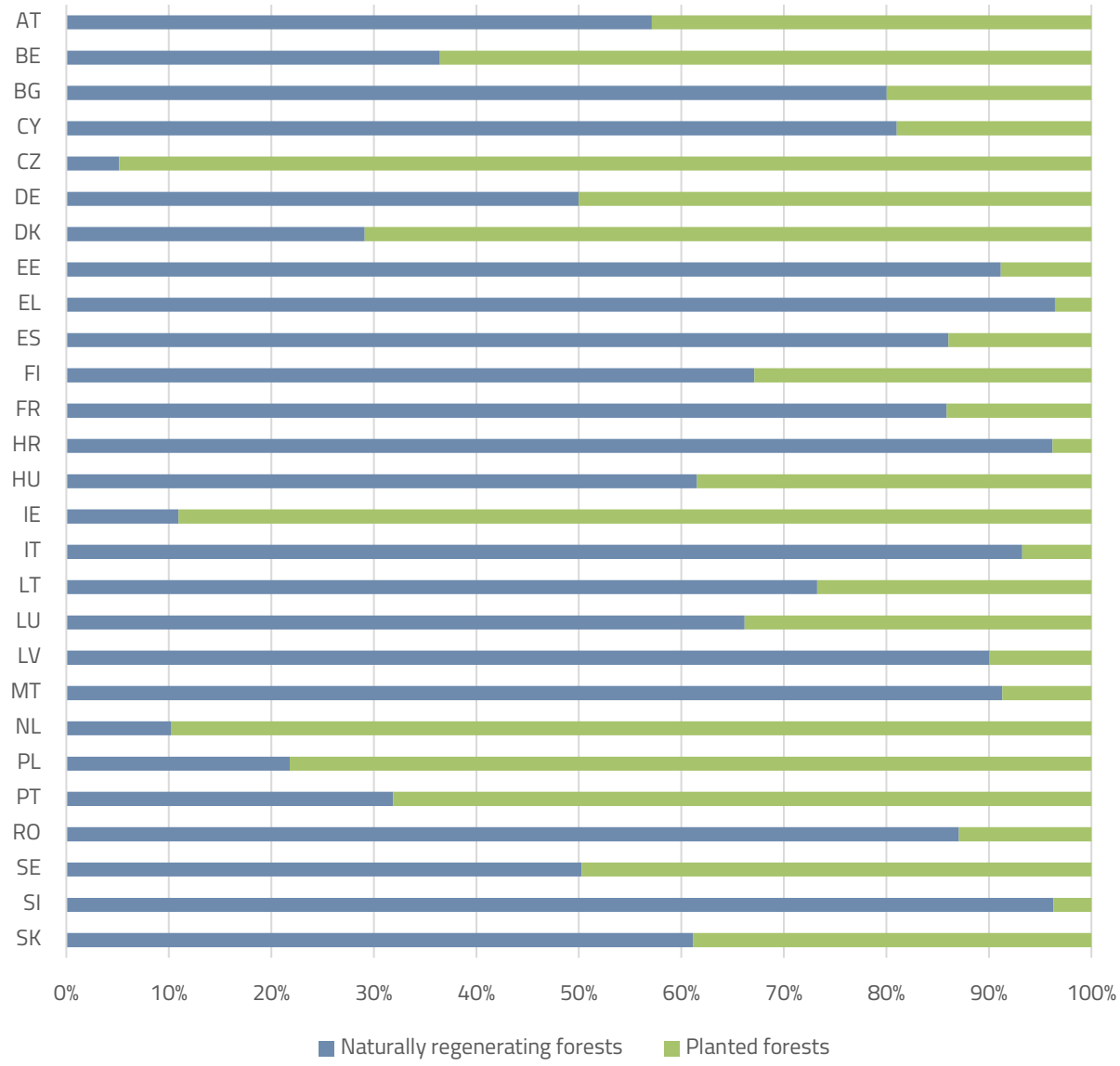


Source: State of Europe's Forests 2020 (Forest Europe).

Forest regeneration is a requirement for long-term forest preservation. The re-establishment of a forest stand through natural seeding or coppice sprouting is referred to as natural regeneration. Planting or artificial seeding are two methods of artificial regeneration.

Looking at data at the national level, great variation can be observed across countries. Czechia has the highest proportion of planted forest, equal to 94,8% of total forested area, whereas in Slovenia, the country with the lowest share of planted forest, only 3,7% of forested area is planted. A likely explanation for the high share of planting in Czech forests is the emergence of bark beetles in 2018, which resulted in increased salvage logging. It is to be expected therefore that a high planting rate followed in 2020.

Figure 18 Forest in EU27 by stand origin type as % of total forest area in 2020



Source: State of Europe's Forests 2020 (Forest Europe).

Table 4 Forest area in EU27 by stand origin type in 2020 (1000 ha)

	Naturally regenerating forest	Planted forest	Plantation forest	Other planted forest	% planted forest relative to total forest area
EU27	**102.990**	**52.721**	**3.979**	**48.743**	**33%**
AT	2.228	1.672	0	1.672	43%
BE	251	438	438	0	64%
BG	3.116	777	0	777	20%
CY	140	33	0	33	19%
CZ	138	2.539	0	2.539	95%
DE	5.710	5.710	0	5.710	50%
DK**	182	444	260	184	71%
EE	2.223	216	7	209	9%
EL*	3.763	139	139	0	4%
ES	15.982	2.590	1.004	1.586	14%
FI	15.041	7.368	34	7.334	33%
FR	14.819	2.434	0	2.434	14%
HR**	1.858	73	73	0	4%
HU*	1.268	793	141	652	39%
IE**	81	662	662	0	85%
IT	8.921	645	128	517	7%
LT**	1.562	604	0	604	27%
LU	59	30	0	30	34%
LV	N.A.	N.A.	N.A.	N.A.	N.A.
MT	0,42	0,04	0,04	0	9%
NL	38	332	3	329	90%
PL*	2.054	7.366	4	7.362	78%
PT	1.056	2.256	695	1.561	68%
RO	6.034	895	0	895	13%
SE	14.068	13.912	382	13.530	50%
SI	1.152	46	0	46	4%
SK	1.177	748	8	740	39%

*Data from 2015

*Data from 2017

Source: State of Europe's Forests 2020 (Forest Europe).

SURE

EXPERT COMMENT

In a world where the pressure on the natural resources is ever increasing and where the global temperatures continue rising, the need to replace fossil fuels for renewable energy sources is imperative.

With the establishment of the EU Renewable Energies Directive 2018/2001 (RED II), coupled with the ongoing revision of EU's climate, energy and transport legislation under the framework of the Fit for 55 Package, Europe has taken a leading position globally towards increasing the share of green energies and reducing greenhouse gas (GHG) emissions.

We believe that achieving EU's 2030 targets of at least sourcing 32% of renewable energies, as well as reducing 55% of the GHG emissions is key for addressing the impacts of the global climate crisis and that bioenergy is an important part of the solution.

85% of the renewable heat used within the EU in 2019 was in the form of bioheat. Bioenergy is the only renewable energy source capable of providing heating, cooling, electricity and transport fuel. It therefore plays a fundamental role in the journey of substituting fossil fuels for renewable energy sources.

Sustainable Resources Verification Scheme (SURE) certification was created in 2019, following the establishment of RED II. Our aim is to promote the use of sustainable biomass for bioenergy production and to provide a robust certification scheme for demonstrating compliance with the sustainability criteria under RED II.

At SURE we understand the challenges faced by the biomass operators, given the continuous changes in EU legislation and the ambitious timelines for implementation. Our scheme offers a pragmatic solution for operators, where our scheme requirements are built on the existing companies' systems and processes, with the objective of streamlining efforts by operators and avoiding redundancies.

We are very glad to see biomass operators' commitment towards EU's renewable energy targets and their willingness to invest the efforts necessary to demonstrate the sustainability of their operations and compliance with RED II. In the past year SURE certification has grown exponentially. With over 2500 valid certificates and almost another 2000 on the way, we are convinced to make a significant contribution based on the interest shown by stakeholders who are ready to face their responsibility.

We believe SURE certification is both beneficial for the environment and the industry. In addition to the market incentives associated to certification, obtaining SURE certification entails positive environmental benefits linked to the RED II sustainability criteria, including: ensuring the legality of biomass sourcing, protecting nature conservation areas, preserving ecological biodiversity and soil quality, promoting forest regeneration and the long term forest production capacity and the reduction of greenhouse gas emissions, among other.

SURE will continue to keep a close eye on upcoming EU legislation changes affecting biomass operators and focus its efforts in communicating these changes and facilitating the certification process, thereby promoting the sustainable use of biomass for energy production, to ultimately ensure that EU's green energy targets are met.

Amparo Arellano
Senior Expert
Sustainability Certification

SURE
SUSTAINABLE RESOURCES
Verification Scheme GmbH

2.2. Forest production and trade

Self-regulation is a common practice across the wood market, which gives it flexibility to use resources in the most efficient way. The market follows the cascading principle, which can be explained as follows: the harvesting of a tree yields various qualities of wood, to be used by many sectors in line with their desired product. Generally, the highest value wood is found at the base of the tree (the first few meters) and is destined for sawmills to produce furniture or construction timber. The residues from sawmills and the less valuable parts of the tree are used in other industries such as paper mills, wood panels manufacturers and to produce energy from biomass.
Thus, the fact that the tree is destined for various industries, coupled with the fact that waste from upstream industries can be reused by other sectors, allows the wood market to be relatively circular and avoid waste of raw materials.

Among the EU27 Member States in 2020, Germany is still the leader in roundwood production, with 84,1 million m^3. As compared to last year's figures, Germany experienced a robust growth of 10,3% in total roundwood production. The second top producer in the EU is Sweden, with total roundwood production at 76 million m^3; however, the country experienced less than 1% growth last year. The top four are rounded out by Finland (60,2 million m^3) and France (47,7 million m^3). As regards the use of this wood, a similar trend to last year can be observed, i.e. 75,5% for industry and 24,5% for fuel wood.
However, at the Union level, there has been a general decrease in roundwood production (-3,73% between 2019 and 2020) which holds true for all subcategories except for the <Other Industrial Roundwood> category, which experienced modest growth but remains small in terms of absolute production and represents less than 2% of all roundwood production.

Table 5 Wood removals from forests in EU27 Member States by assortment in 2020 (1000 m³)

	Roundwood	Total roundwood		Industrial roundwood			Shares	
		Wood fuel	Industrial roundwood	Sawlogs and veneer logs	Pulpwood, round and split, all species (production)	Other industrial roundwood	Share of Wood fuel from total roundwood	Share of industrial roundwood from total roundwood
EU27	**488.067**	**119.413**	**368.654**	**215.241**	**146.773**	**6.639**	**24%**	**76%**
Growth 2019-2020	-3.73%	-3.15%	-3.91%	-2.54%	-6.21%	5.29%	=0%	=0%
AT	16.790	5.327	11.462	8.504	2.958	0	32%	68%
BE	5.212	893	4.319	2.815	1.331	173	17%	83%
BG	5.404	2.332	3.072	1.417	1.612	42	43%	57%
CY	9	6	2	2	0	0	74%	26%
CZ	33.347	6.726	26.621	18.844	7.660	117	20%	80%
DE	84.051	22.261	61.790	48.213	13.503	74	26%	74%
DK	3.842	2.061	1.781	1.070	381	330	54%	46%
EE	10.638	4.136	6.502	4.134	2.316	52	39%	61%
EL	1.359	947	412	345	0	67	70%	30%
ES	18.308	2.951	15.356	5.337	9.710	310	16%	84%
FI	60.233	8.937	51.296	22.279	29.017	0	15%	85%
FR	47.703	23.444	24.259	15.965	7.793	501	49%	51%
HR	5.234	2.207	3.027	2.469	554	4	42%	58%
HU	5.575	2.684	2.892	1.274	924	693	48%	52%
IE	3.912	285	3.627	2.471	1.013	143	7%	93%
IT	15.841	10.839	5.002	3.352	1.018	632	68%	32%
LT	6.366	1.994	4.372	3.032	1.340	0	31%	69%
LU	350	59	291	81	104	106	17%	83%
LV	15.347	2.620	12.727	7.379	4.123	1.225	17%	83%
MT	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
NL	3.063	2.323	740	260	450	30	76%	24%
PL	40.584	4.720	35.864	16.958	18.338	568	12%	88%
PT	13.311	1.618	11.692	1.820	9.540	332	12%	88%
RO	15.530	4.582	10.948	9.020	989	938	30%	70%
SE	76.060	5.460	70.600	38.200	32.100	300	7%	93%
SI	3.881	1.077	2.804	1.958	785	61	28%	72%
SK	7.448	524	6.924	3.913	2.984	26	7%	93%

Note: Volume under bark. Total roundwood is the sum of wood fuel and industrial roundwood. Industrial roundwood is the sum of sawlogs and veneer logs, pulpwood and other industrial roundwood.
The term "removal" differs from "felling" as it excludes trees that were felled but not removed.
Source: FAOSTAT

Figure 19 Wood fuel and industrial wood from forest removals across the EU27 in 2020 (%)

Source: FAOSTAT

Figure 20 Roundwood removals in EU27 Member States according to end use in 2020 (1000 m³)

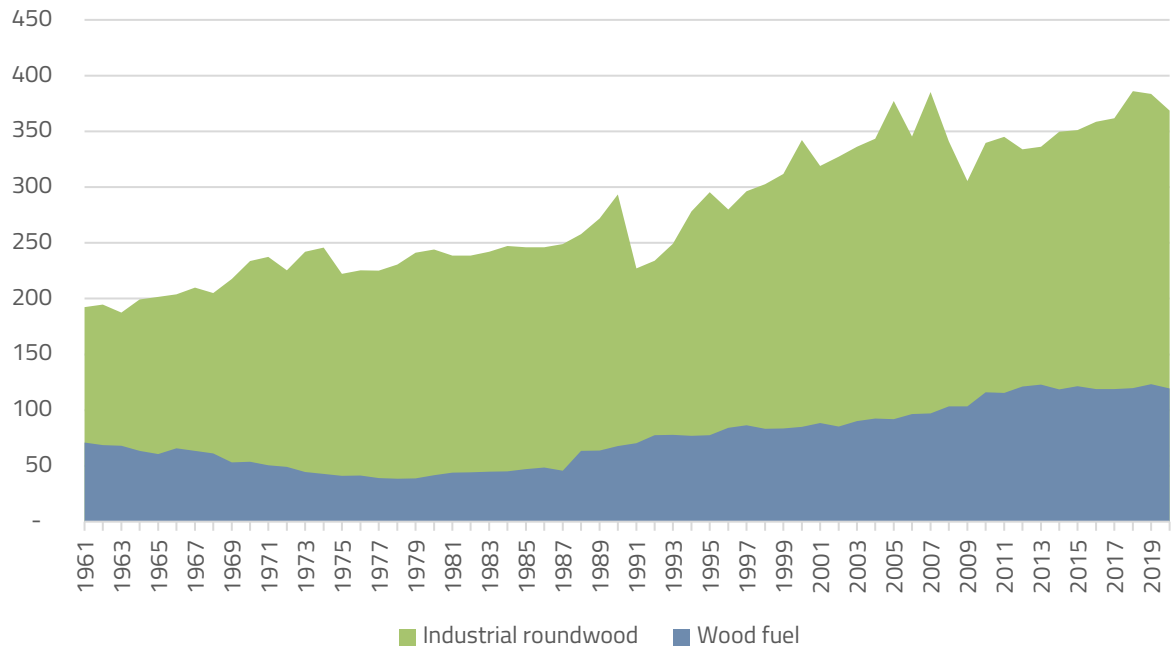
Source: FAOSTAT

Looking at the graphs above, it is clear that the overwhelming majority of the primary wood harvested in Europe is for industrial use. Indeed, when felling, the parts of the trees with the highest value and best features are destined for creating furniture, building materials and other products with high added value. The remaining parts are used where the raw material does not have to meet the same restrictive quality standards as found in the construction sector. For instance, that which falls short of these quality standards can be used

in the production of bioenergy. The conclusion here is that it is incorrect to say that forests are exclusively harvested for the purpose of firewood, when most of the material being taken out of the forest goes to industrial use. In accordance with the cascading principle, as explained above, a lot of wood for bioenergy does not even come directly from forests but rather from side-streams and residues of other industries. Furthermore, it is illogical to suggest that the bioenergy sector competes with the timber processing sector, when the price per cubic meter of quality logs far exceeds the price which the wood-based energy sector can afford to pay.

Furthermore, when looking at the evolution of roundwood production by type of end-use (Figure 20), it is obvious that a strong increase in bioenergy use is not the main driver of harvesting in EU27 forests. The percentage of wood harvested for the purpose of energy slightly increased from 18,7% in 2000 to 24,5% in 2020. This remains around one fourth of the total harvest in the EU27, a proportion that has not changed significantly since the 1990s, even though consumption of bioenergy in Europe has tripled since then. More specifically, while the proportion of wood removal for energy remained relatively stable, the energy consumption of woody biomass had increased by 186% between 1990 and 2017 (from 41 Mtoe to 117 Mtoe).

Figure 21 Stacked area of the evolution of roundwood production by end use type in the EU27 (Mm³)



Source: FAOSTAT

Table 6 shows that the imports of fuelwood from non-EU countries are very low and decreasing (-23% as compared to 2019). The volume imported from outside the EU only represents less than 1% of the wood fuel that is locally produced in Europe (0,87%). When looking at industrial roundwood trading on the other hand, the EU27 experienced quite a substantial growth in exports to non-EU countries (+45%), reaching 17 million m³ in 2020 (mostly driven by Belgium, Germany and Poland).

Table 6 Roundwood trade in EU27 Member States in 2020 (1000 m³)

	Fuelwood (including wood for charcoal)				Industrial roundwood			
	Imports from non-EU countries	Imports	Exports to non-EU countries	Exports	Imports from non-EU countries	Imports	Exports to non-EU countries	Exports
EU27	**1.041**	**2.716**	**280**	**4.434**	**10.963**	**57.759**	**17.308**	**56.500**
Growth rate 2019-2020	-23%	-21%	53%	11%	-6%	4%	45%	8%
AT	50	194	0	11	95	12.298	6	628
BE	33	93	0	62	44	5.387	2.521	3.320
BG	0	0	17	106	0	14	32	142
CY	2	2	0	0	0	5	0	0
CZ*	22	51	13	239	26	1.353	2.504	14.146
DE	108	246	3	257	502	5.623	6.625	12.830
DK**	12	102	0	167	494	385	632	667
EE	1	40	78	154	97	517	64	1.583
EL***	33	189	0	6	9	436	9	41
ES	0	22	4	426	14	784	13	1.930
FI	28	189	3	101	4.752	6.274	122	1.163
FR	2	182	7	449	177	943	623	3.578
HR	46	73	0	538	3	121	42	256
HU	26	27	0	71	23	260	98	728
IE*	0	15	N.A.	4	0	308	0	106
IT	407	627	1	4	348	2.694	133	439
LT	37	43	37	318	108	261	71	1.774
LU***	10	18	0	44	0	766	4	375
LV	49	82	71	523	241	1.699	300	2.930
MT*	1	2	0	0	0	0	0	0
NL	28	61	1	341	7	311	99	448
PL	21	62	28	185	288	2.953	2.027	4.373
PT	0	0	0	35	218	2.558	12	262
RO	22	70	1	44	255	1.644	92	118
SE	21	106	15	62	3.252	7.240	438	1.071
SI	81	147	0	215	10	720	192	1.372
SK	3	76	0	71	0	1.924	348	2.219

* Data from 2019
** Data from 2016
*** Data from 2015
**** Data from 2012
Source: Eurostat

Figure 22 Trade balance of fuel wood in EU27 Member States (1000 m³)

Note: Positive values represent net imports, negative values represent net exports

* Data from 2019

** Data from 2016

*** Data from 2015

**** Data from 2012

Source: Eurostat

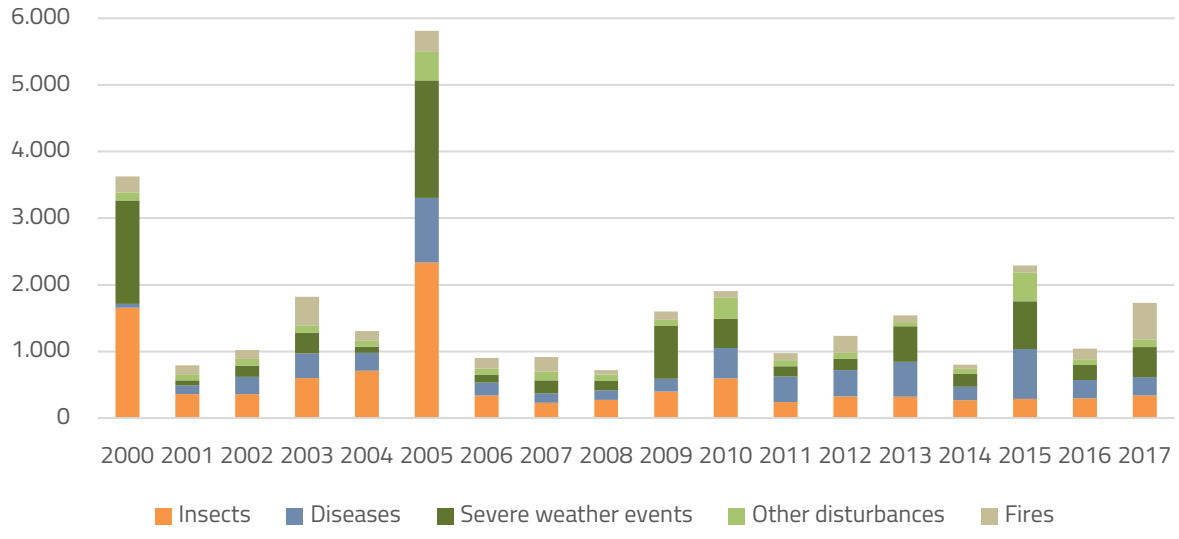
2.3. Impact of climate change on EU forests

For several years now, forests around the world have been experiencing increasingly difficult conditions that threaten their survival. Whether as a result of bad weather, fires, insect outbreaks or other attacks by living organisms (viruses, fungi, bacteria, etc.), these threats are responsible for the destruction of an increasing share of forested area. Due to global warming, the frequency of these various events is increasing, and forests are simply not able to recover quickly enough in order to keep up.

Indeed, even if the increase in temperature does not seem to be directly affecting plants in a negative way, it is still one of the main causes of problems that forests face. Take for example the spruce bark beetle, a forest pest that has become increasingly known in recent years. Rising temperatures allow this insect to reduce the time needed for completing its growth cycle, to emerge earlier in the year and to generate a higher number of offspring per year. Rising temperatures are also responsible for a changing water cycle, leading to more droughts and indirectly allowing a greater number of forest fires to emerge. The combination of all these elements creates an extremely dangerous cocktail, threatening the survival of our forest ecosystems.

Looking at the following graph, it is obvious that the areas affected by disturbances vary greatly at the European level. Moreover, the affected areas seem to be relatively small in terms of quantity – for example, when looking at 2017, just over one percent of the European forested area was affected by disturbances. However, given the events of the past few years, it seems that this is somewhat underestimated. Indeed, collecting data on forest disturbances is rather difficult, which might mean an underestimation is likely. Unfortunately, the latest available 2017 FAO data on disturbances has a five-year lag and it is therefore difficult to understand what has been happening recently.

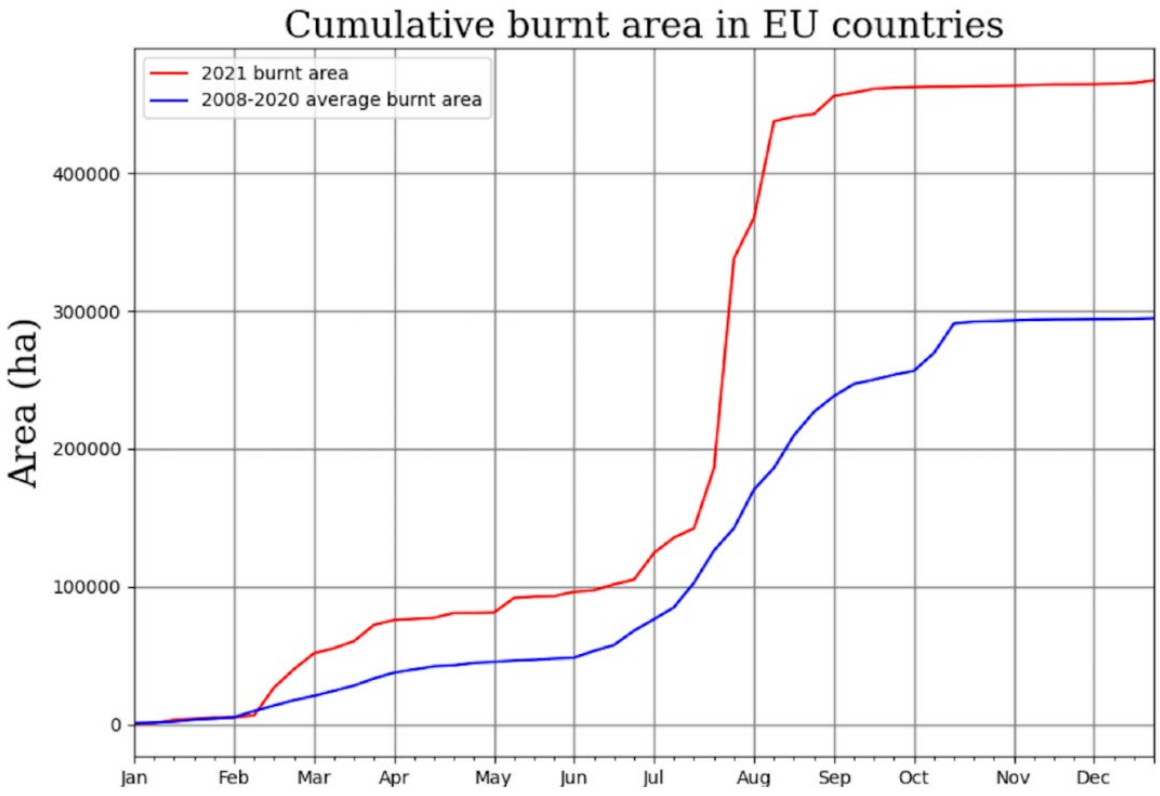
Figure 23 Forest area affected by disturbances in EU27, 2000-2017 (1000 ha)



Note: Considered diseases are caused by bacteria, fungi, phytoplasma or viruses; severe weather events include snow, storms or drought. 2000 and 2005 values are due to inconsistencies of data: countries with large forest-damaged areas were introduced in those years (Romania in 2000; Italy, Romania and Slovenia in 2005).
Source: FAO Global Forest Resources Assessment 2020

At the level of the Member States, some countries seem to be more affected than others, or perhaps they measure disturbances differently. The type of disturbance also varies according to where the county is located within Europe. For example, forests in northern European countries are more likely to be strongly affected by sticky snow than by fire, even though this trend might be different in the future due to climate change.
For more detailed information on forest fires, the European Union developed a database called EFFIS[7], or European Forest Fire Information System. This database was created following collaboration between the European Commission and the various administrations in charge of forest management at the Member State level. It records several different types of data, including the evolution of burnt areas over time, and makes it possible to obtain graphs such as the one below:

Figure 24 2021 cumulative burnt area in EU countries versus 2008-2020 average burnt area



Data source: European Forest Fire Information System (EFFIS). Credit: EFFIS/Copernicus EMS

This graph shows a rather alarming trend: every single month of 2021 shows more forest fire activity than the average of the previous 12 years. Moreover, 2022 is likely to be even more dramatic, with many areas of southern Europe ravaged by fires (France, Greece, Italy, Portugal, Spain, etc.) In Table 7, 2021 shows an 86% increase in burnt area in the EU as compared to 2019. Some Member States were hit harder than others, especially in the Mediterranean area. Several countries saw their share of burnt area more than double; Italy (+322%), Cyprus (+802%), Greece (+1085%) and Croatia (+2955%) all experienced catastrophic fires that contributed to the 86% increase in burnt area witnessed by the EU.

[7] https://www.copernicus.eu/en/european-forest-fire-information-system

The question now arises as to the consequences of these disturbances for bioenergy. Indeed, according to the cascading principle, disruptions in the availability of woody material for industry have a direct impact on the availability of raw material for energy. According to the JRC report, *The use of woody biomass for energy production in the EU* from 2021, the period 1950-2000 is characterised by an average volume of damaged wood of 35 million m³ annually. In 2018, some 100 million m³ were damaged by extreme events, which is three times the annual amount for the second half of the twentieth century. The disturbances of the first 10 years of the 21st century were also compared with the period 1971-1980 and revealed a drastic increase: +602% insect outbreaks, +231% wildfires and +140% windstorms.

The advantage of bioenergy in this context is that the sector is less constrained in terms of the quality of the raw material than the construction or furniture manufacturing sectors. In addition, it is important for the health of the forest that the waste resulting from the partial destruction of woodland be removed. Otherwise, the waste would favour the emergence of insects, serve as fuel for forest fires, etc. One solution to this problem is the practice of salvage harvesting.

However, this practice results in a large amount of wood being available on the market very quickly. This can lead to disruptions in the timber market, leading to large fluctuations in price. For example, when Czechia experienced a strong emergence of bark beetles in 2018, this resulted in the market being flooded with large quantities of wood, thereby causing a 75% drop in the price of wood as compared to the period 2011-2017.

In order to be prepared for such situations, the available data on these salvage harvests should be studied. However, no database on this subject exists yet at the European level, so it is necessary to look at Member State data directly. The JRC report collected this data from 17 Member States which together represent more than 75% of Europe's forested area: Austria, Bulgaria, Croatia, Cyprus, Czechia, Estonia, France, Finland, Germany, Hungary, Latvia, Lithuania, Romania, Poland, Slovakia, Slovenia and Sweden.

For most countries, fluctuations in the removals match fluctuations in the salvage harvests. In general, salvage loggings have increased drastically in these countries over the period 2014-2018, from 44.5 million m³ to 106 million m³, which corresponds to an increase of 138%. This sharp increase in salvage logging practices could partly explain the current increase in wood removals in Europe, and could also help to clarify the situation regarding bioenergy. Indeed, given the state of the harvested wood, it is destined toward use in bioenergy or the manufacturing of lower quality products.

Table 7 Forest area affected by disturbances in EU27 member states in 2017 and 2021 for fires (ha)

	Total disturbances	Insects	Diseases	Severe weather events	Other disturbances	Fires (2021)	Growth in burnt area from 2019 to 2021
EU27	**3.041.600**	**484.700**	**776.670**	**891.390**	**466.110**	**416.730**	**86%**
AT	222.877	29.770	113.230	74.600	5.160	117	N.A.
BE*	44.100	2.400	11.500	1.300	28.900	N.A.	N.A.
BG	97.643	40.540	24.970	27.000	1.990	3.143	-44%
CY	6.612	N.A.	N.A.	N.A.	N.A.	6.612	802%
CZ	53.391	24.520	9.830	18.110	520	411	-21%
DE	141.818	29.350	88.580	9.260	14.480	148	-95%
DK	15.430	2.860	4.000	5.470	3.100	N.A.	N.A.
EE	5.123	320	590	1.740	2.440	33	N.A.
EL	108.418	N.A.	N.A.	N.A.	N.A.	108.418	1085%
ES	87.880	N.A.	N.A.	N.A.	N.A.	87.880	5%
FI*	30.085	0	2.200	6.100	21.000	785	39%
FR	21.074	1.970	590	2.840	560	15.114	-36%
HR	287.360	152.200	15.400	50.900	62.200	6.660	2955%
HU	85.913	6.980	1.820	56.590	18.110	2.413	-63%
IE	1.070	N.A.	570	500	N.A.	N.A.	N.A.
IT	151.964	N.A.	N.A.	N.A.	N.A.	151.964	322%
LT	7.011	1.000	3.000	1.000	2.000	11	-95%
LU**	200	N.A.	N.A.	200	N.A.	N.A.	N.A.
LV	1.564	60	60	610	330	504	-37%
MT	0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
NL	10.858	N.A.	10.840	N.A.	N.A.	18	-93%
PL*	364.894	19.000	23.000	17.000	305.000	894	-75%
PT*	464.360	75.000	361.000	N.A.	N.A.	28.360	-33%
RO	239.391	37.680	N.A.	199.610	N.A.	2.101	-16%
SE*	573.661	47.100	104.700	421.000	N.A.	861	-30%
SI	15.304	11.570	550	2.940	120	124	-19%
SK	3.599	2.380	240	620	200	159	-66%

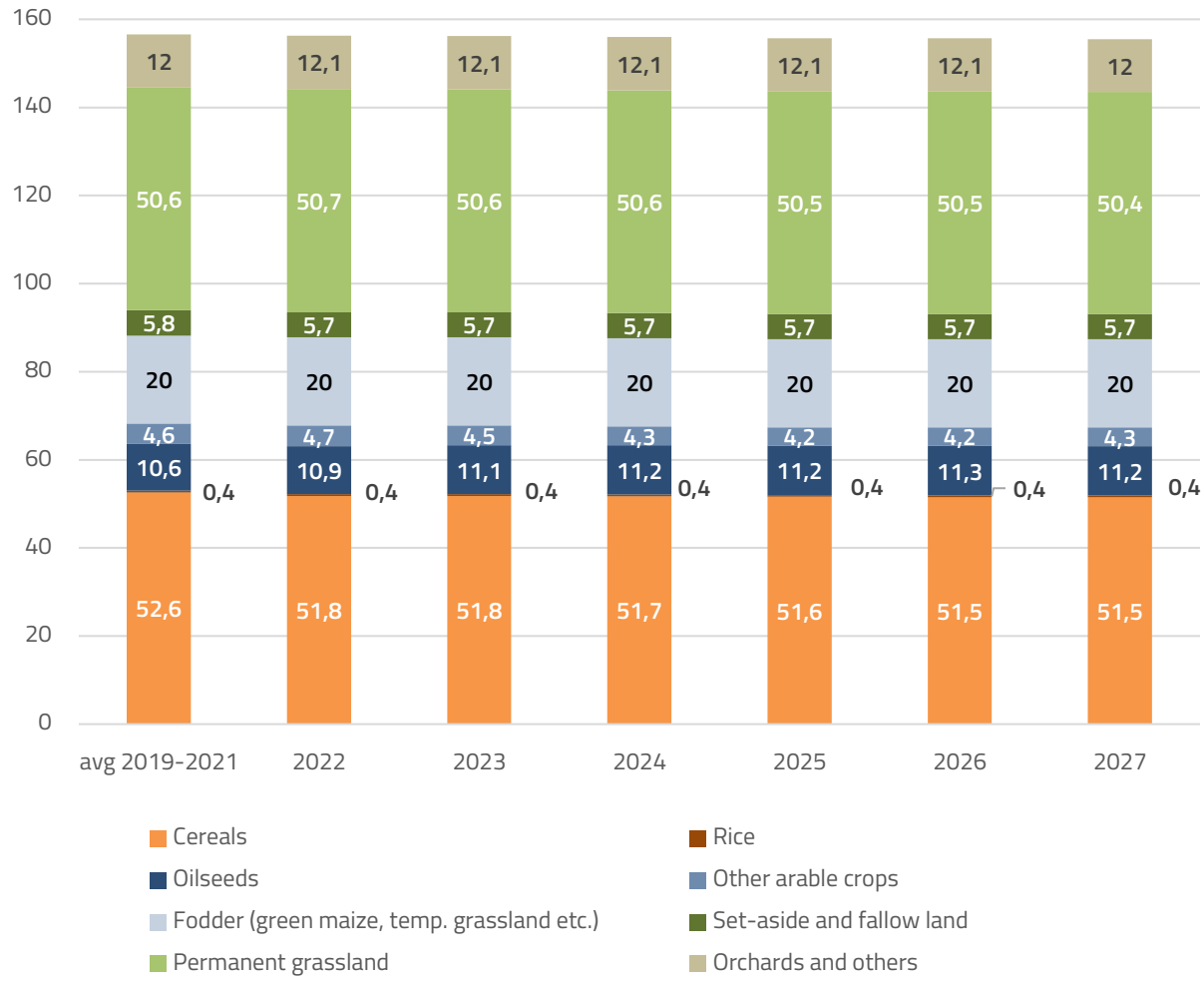
*Data from 2015 for all the disturbances except fires

**Data from 2014 for all the disturbances except fires

Source: FAO Global Forest Resources Assessment 2020/JRC Forest fires in Europe, Middle East and North Africa technical report 2021

3. Biomass from agricultural land and by-products

Figure 25 Evolution and projection of the composition of EU27 agricultural land use (Millions of ha)



Note: Data for the years 2021-2023 are predictions based on 2016-2020 data.
Source: European Commission "EU Agricultural Outlook for markets, income and environment 2021-2031"

Since 2016, the total European agricultural area has fluctuated only slightly, but the overall trend is an increase. Indeed, between 2016 and 2020, the cultivated area grew by 300.000 ha, which corresponds to a variation of 0,19%. For the upcoming years, the European Commission has forecasted a small fluctuation in agricultural areas (with trends varying according to the type of land use) which should bring the total agricultural area to 155.5 million ha by 2027 (-0,7% as compared to the 2019-2021 average).

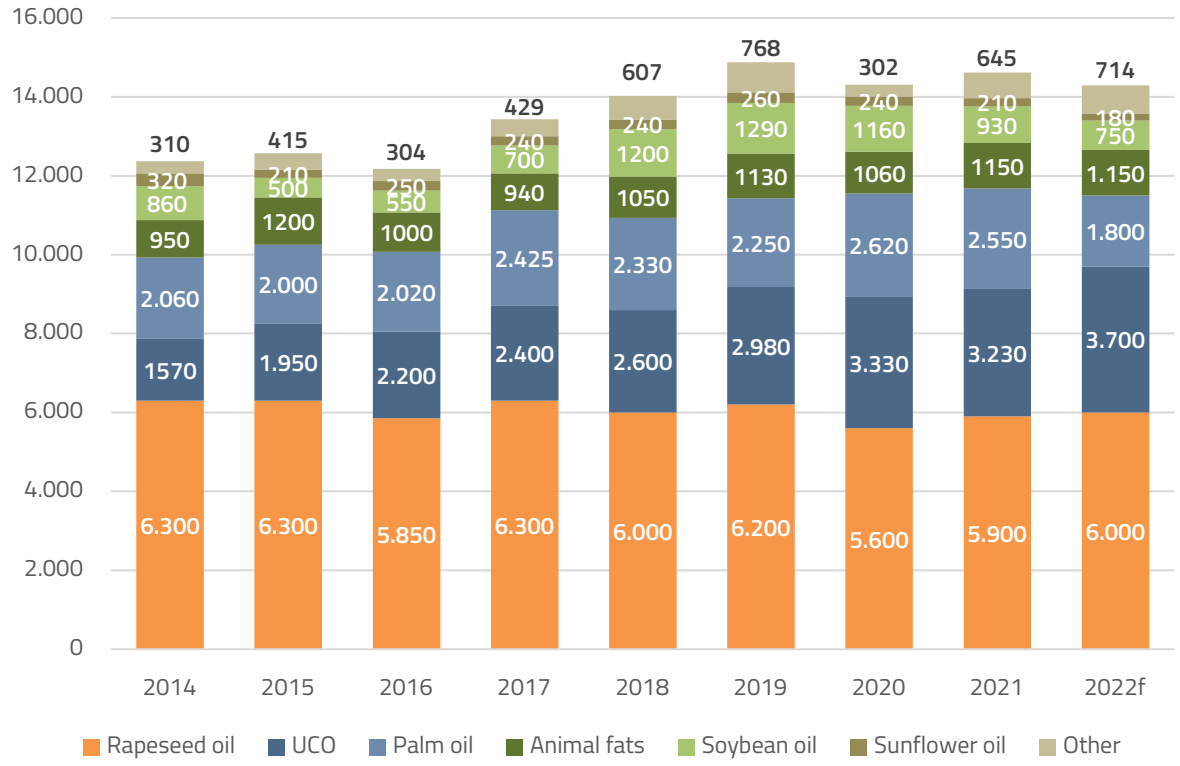
Figure 26 Evolution of bioethanol feedstock in EU27+UK (1000 tonnes or in tonnes of sugar equivalent for sugar beet)

*In tonnes of sugar equivalent, calculated with the converting factor of 16% (average sugar content).
Note: e=estimate/f=forecast
Source: USDA

Overall, the 2014-2020 period has remained stable in terms of the total quantity of feedstock involved in bioethanol production (0.5% fluctuation).

The graph shows very various trends depending on the feedstock being considered. Indeed, on the one hand a reduction in the quantities of sugar beet (-52%) and rye (-47%) being used to produce bioethanol can be observed. On the other hand, the quantities of corn (+26,4%) and barley (+8%) have increased.

Figure 27 Evolution of biodiesel feedstock in EU27+UK (1000 tonnes)



Note: "UCO" stands for used cooking oil. "Other" include pine oil, tall oil and free fatty acids.
Note: f=forecast
Source: USDA

Between 2014 and 2020, the amount of feedstock involved in biodiesel production increased by almost 16%, driven mainly by growth in UCOs (used cooking oils, +112%), palm oil (+27%) and soybean oil (+35%). Some categories, such as sunflower oil and rapeseed oil, decreased, with -25% and -11%, respectively.

4. Biomass from waste

Waste constitutes the third main source of biomass for energy. Waste can have several origins and categories (sewage, animal residues, vegetal residues, etc.) but the focus here is on municipal waste and its renewable fraction.

Table 8 Municipal waste (renewable and non-renewable) by waste operation in EU27 Member States in 2020 (1000 tonnes)

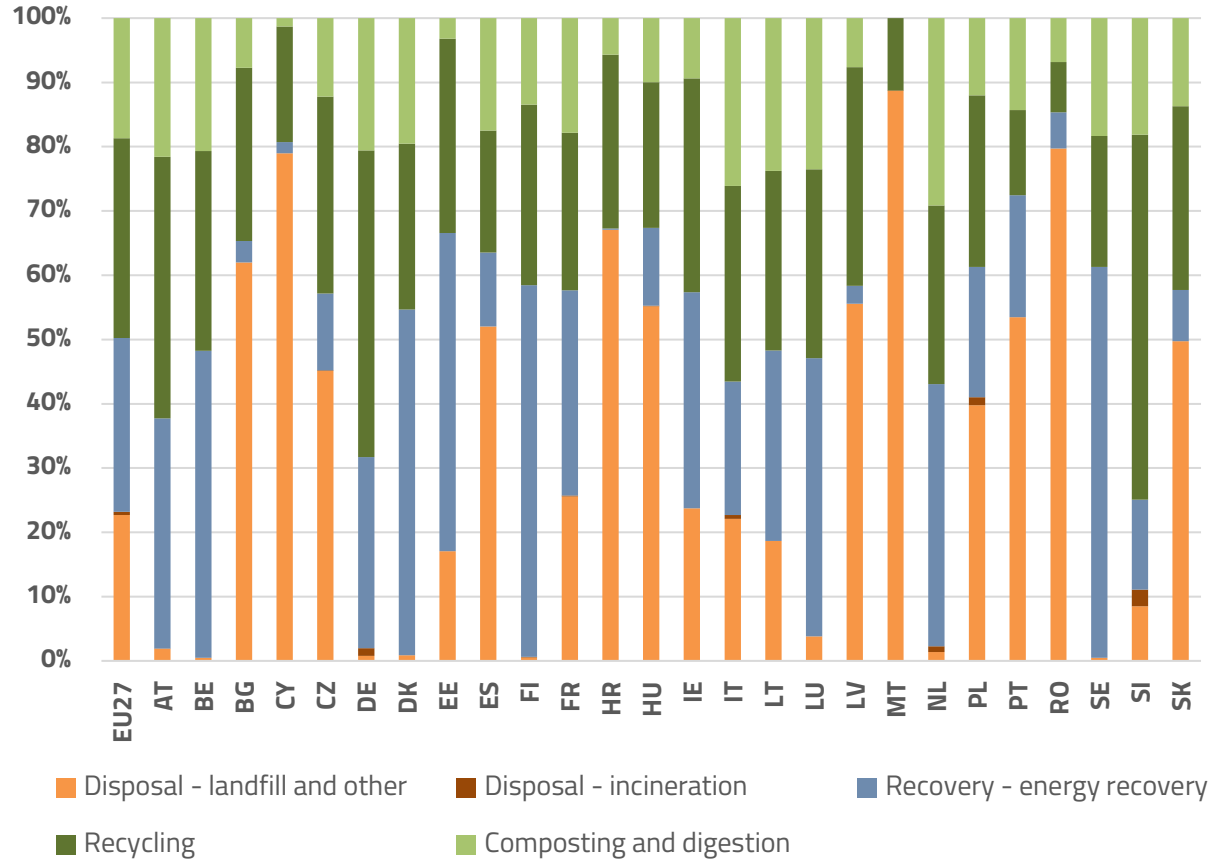
	Waste generated	Waste treatment	Disposal - landfill and other	Disposal - incineration	Recovery - energy recovery	Recycling	Composting and digestion
EU27	**225.636**	**222.085**	**50.299**	**1.116**	**59.963**	**68.826**	**41.441**
Growth rate 2019-2020	3,2%	3,5%	-1,8%	-0,4%	4,9%	3,7%	7,2%
AT	7.438	7.438	137	7	2.645	3.006	1.592
BE	8.604	8.604	42	0	4.129	2.688	1.790
BG	3.080	3.071	1.903	0	103	827	238
CY	543	462	364	0	8	83	6
CZ	5.814	6.174	2.778	5	735	1.886	753
DE	52.199	52.199	417	616	15.517	24.910	10.739
DK	4.744	4.744	41	0	2.536	1.214	921
EE	509	440	75	0	218	133	14
EL	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
ES	21.529	21.529	11.197	0	2.487	4.079	3.767
FI	3.296	3.296	18	3	1.905	926	444
FR	36.370	36.511	9.311	52	11.601	8.916	6.481
HR	1.693	1.525	1.023	0	3	412	87
HU	3.931	3.931	2.124	4	466	873	384
IE	2.768	2.724	623	0	881	872	246
IT	28.945	26.304	5.817	158	5.457	8.004	6.868
LT	1.350	1.197	220	0	348	329	280
LU	498	498	19	0	215	146	117
LV	909	865	480	0	24	294	66
MT	332	309	274	0	0	35	0
NL	9.304	9.304	128	84	3.794	2.584	2.713
PL	13.117	13.117	5.218	166	2.656	3.499	1.578
PT	5.279	5.071	2.711	0	962	673	725
RO	5.534	5.179	4.114	0	291	404	353
SE	4.460	4.422	21	0	2.680	898	808
SI	1.024	809	69	21	113	460	147
SK	2.366	2.362	1.175	0	188	675	324

Source: Eurostat

In terms of the amount of waste produced, the EU27 witnessed a 3,2% increase in total production between 2019 and 2020. Furthermore, it can be observed that the proportion of treated waste (waste treatment) is increasing slightly faster than the total amount of generated waste (+3,5% from 2019 to 2020), which is a positive trend reflecting efforts made by the Member States.

The five largest waste producing countries in absolute terms are Germany, France, Italy, Spain and Poland. This ranking matches the population ranking, which makes sense because more people equals more waste. With regard to the European trend within the types of waste treatment, only landfilling and incineration display negative figures (-1,8% for landfilling and -0,4% for incineration). The fact that landfilling is decreasing in Europe is actually a positive change because it means that this waste fraction is now being treated for energy recovery, recycling or composting.

Figure 28 Municipal waste treatment in EU27 Member States by treatment type in 2020 (%)



Source: Eurostat

The countries with the highest share of waste in landfills are Malta, Romania and Cyprus, with 89%, 79% and 79% respectively. Countries converting the most waste into energy are Sweden (61%), Finland (58%) and Denmark (53%). As regards recycling, Slovenia (57%), Germany (48%) and Austria (40%) have the highest rates. Finally, in terms of composting, the Netherlands leads the way with 29% of its waste production being recycled, followed by Italy (26%) and Luxembourg (23%).

Figure 29 Map of incineration plants in Europe and mass of waste thermally treated in 2019

* Includes plant in Andorra

Source: CEWEP (Data supplied by CEWEP members unless national sources)

For waste-to-energy plants, minimal variation can be observed between 2018 and 2019. The year 2019 experienced 5 plant closures, Denmark closed 3, Sweden 1 and Italy 1. In terms of openings, 6 new plants were registered in the UK, 4 new plants in Germany and 3 in France. The data found on these maps may differ from the data available on Eurostat, due to the waste streams involved. Indeed, this map was created by taking into account not only domestic but also commercial and industrial flows. As the latter can represent almost 50% of the total waste, it is normal that the data on the map is higher than the Eurostat data (where only domestic flows are considered)

Table 9 Wood waste by waste operation in the EU27 Member States in 2020 (ktonnes)

	Wood waste treatment	Disposal - landfill	Disposal - incineration	Energy recovery	Recycling and backfilling
EU27	**42.127**	**138**	**114**	**21.849**	**19.712**
Growth rate 2019-2020	-3,7%	-30,2%	-33,96%	-5,31%	-1,5%
AT	1.288	0	N.A.	N.A.	973
BE	879	0	28	367	484
BG	386	1	0	214	171
CY	2	0	0	0	2
CZ	520	18	0	16	486
DE	11.342	0	0	7.984	3.358
DK	397	2	0	74	321
EE	111	0	0	70	41
EL	0	0	0	0	0
ES	838	12	0	31	796
FI	2.447	1	3	2.319	124
FR	9.335	56	22	4.467	4.789
HR	121	4	0	42	75
HU	237	2	0	2	234
IE	N.A.	N.A.	N.A.	N.A.	N.A.
IT	4.321	1	0	731	3.588
LT	165	1	0	31	133
LU	284	0	0	69	215
LV	182	1	0	11	171
MT	10	10	0	0	0
NL	2.318	20	60	1.394	845
PL	1.389	0	0	324	1.065
PT	289	1	0	3	285
RO	2.635	1	0	1.273	1.361
SE	2.150	0	0	2.112	37
SI	74	0	0	19	55
SK	406	7	0	298	102

Source: Eurostat

Examining the amount of wood waste processed in the EU27, a slight downward trend emerges. Indeed, 3,7% less wood waste was processed in the EU in 2020 as compared to 2019. Even though less wood waste is being treated, it is important to note that the fraction of wood waste being landfilled has decreased more sharply over the last year (-30,2%), which indicates that a larger fraction of this waste is being recovered via other treatments. The presence of wood waste in landfills is particularly concerning because when woody

debris decomposes, it releases carbon into the atmosphere without being used for useful purposes (such as for energy). When this occurs in a forest environment, the presence of wood waste or deadwood (in a reasonable amount) is an asset for biodiversity, but of course the same cannot be said about landfills.

Figure 30 Wood waste trading in Europe, 2021

Source: Suez Trading Europe

As far as wood waste trading is concerned, the situation remains relatively similar to that of last year. Some countries, such as the UK, Netherlands, Croatia and Denmark, have changed their status from 2020 to 2021 and are now net exporters of wood waste. Other countries, such as Poland and Portugal, have lost their net exporter status and are now in balanced trade.

Most of the trade flows have been very stable over the past years, and 2021 is following the same trend. According to Suez Trading, a drop in trade volume is to be expected for 2022 due to overall market shortages. This slowdown in wood waste trading could potentially continue in 2023 as the market balance remains tight.

Table 10 Animal and vegetal waste* by waste operation in the EU27 Member States in 2020 (ktonnes)

	Animal and vegetal waste treatment	Disposal - landfill	Disposal - incineration	Energy recovery	Recycling and backfilling
EU27	**79.246**	**2.018**	**866**	**7.238**	**69.124**
AT	2.117	0	0	0	2.116
BE	6.276	0	25	12	6.239
BG	647	87	1	85	474
CY	158	5	0	2	151
CZ	1.099	7	1	132	958
DE	14.617	0	5	1.407	13.205
DK	1.803	0	0	173	1.629
EE	47	2	0	0	45
EL	754	28	3	92	631
ES	2.634	107	1	93	2.432
FI	1.707	4	10	618	1.075
FR	13.924	1.343	319	3.702	8.560
HR	717	14	0	10	694
HU	911	16	1	215	680
IE	0	0	0	0	0
IT	7.562	4	1	121	7.435
LT	218	1	0	4	213
LU	140	0	0	6	134
LV	105	51	0	0	54
MT	15	10	5	0	0
NL	15.865	55	456	377	14.977
PL	2.691	1	2	72	2.616
PT	257	13	0	9	235
RO	1.277	270	29	83	896
SE	2.689	0	1	9	2.677
SI	233	0	0	0	232
SK	786	1	4	16	765

* Including mixed food waste

Source: Eurostat

Table 11 Gross inland energy consumption of waste by type in the EU27 Member States in 2020 (ktoe)

	Renewable municipal waste	Industrial waste (non-renewable)	Non-renewable municipal waste	Total GIC
EU27	**9.584**	**4.823**	**9.460**	**23.868**
Growth rate 2019-2020	1,7%	5,1%	1,6%	2%
AT	191	344	324	860
BE	387	294	353	1.034
BG	42	66	0	108
CY	33	7	28	68
CZ	96	305	64	464
DE	3.129	1.060	3.129	7.318
DK	547	0	447	994
EE	31	3	31	65
EL	0	10	0	10
ES	236	304	236	776
FI	330	48	245	624
FR	1.244	389	1.244	2.877
HR	0	39	0	39
HU	72	148	63	283
IE	145	0	147	292
IT	843	347	843	2.033
LT	28	24	35	86
LU	13	23	21	58
LV	36	10	43	88
MT	0	0	0	0
NL	928	0	790	1.718
PL	144	661	409	1.213
PT	112	99	88	299
RO	2	279	2	284
SE	965	99	891	1.955
SI	0	57	0	57
SK	32	206	28	267

Note: Renewable municipal waste is defined in Annexes.
Source: Eurostat

5. Annexes

Definitions:

Artificial land cover is defined by Eurostat as:
- roofed built-up areas including buildings and greenhouses;
- artificial non-built-up areas including sealed area features, such as yards, farmyards, cemeteries, car parking areas etc. and linear features, such as streets, roads, railways, runways, bridges;
- other artificial areas including bridges and viaducts, mobile homes, solar panels, power plants, electrical substations, pipelines, water sewage plants, and open dump sites.

Above-ground biomass stock includes all biomass of living vegetation, both woody and herbaceous, above the soil including stems, stumps, branches, bark, seeds, and foliage.

Below-ground biomass stock considers all biomass of live roots. Fine roots of less than 2 mm diameter are excluded because these often cannot be distinguished empirically from soil organic matter or litter.

Carbon in below-ground biomass is carbon in all biomass of live roots. Fine roots of less than 2 mm diameter are excluded, because these often cannot be distinguished empirically from soil organic matter or litter.

Carbon in deadwood is carbon in all non-living woody biomass not contained in the litter, either standing, lying on the ground or in the soil. Deadwood includes wood lying on the surface, dead roots down to 2 mm, and stumps larger than or equal to 10 cm in diameter.

Carbon in litter is carbon in all non-living biomass with a diameter less than the minimum diameter for deadwood (e.g. 10 cm), lying dead in various states of decomposition above the mineral or organic soil.

Carbon stock in above-ground biomass is carbon in all living biomass above the soil, including stems, stumps, branches, bark, seeds and foliage.

Coppice is an area of woodland in which the trees are periodically cut back to ground level to stimulate growth and provide firewood or timber (in rare cases)

Deadwood stock includes all non-living woody biomass not contained in the litter, either standing, lying on the ground or in the soil. Deadwood includes wood lying on the surface, dead roots and stumps larger than or equal to 10 cm in diameter or any other diameter used by any given country.

Energy crops n.e.c. are crops exclusively used for renewable energy production, not elsewhere classified and grown on arable land: miscanthus (Miscanthus giganteus), reed canary grass (Phalaris arundinacea), etc. These crops can vary depending on the country. With changes in agricultural policy, it is expected that new plants used exclusively for energy production will be produced. Areas of crops which are not exclusively used for renewable energy production (e.g. rape, green maize) are recorded under the respective headings (e.g. 'rape and turnip rape' in the case of rape used as an energy crop). Because short rotation coppices do not belong to UAA, they are excluded.

Forest available for wood supply are forests with no environmental, social or economic restrictions that could have a significant impact on the current or potential supply of wood. These restrictions could be based on legal acts, managerial owners' decisions or other reasons.

Forest growing stock is defined by FAO as: volume over bark of all living trees with a minimum diameter of 10 cm at breast height (or above buttress if these are higher). Includes the stem from ground level up to a top diameter of 0 cm, excluding branches.

Municipal waste refers to renewable and non-renewable household waste and waste similar in nature and composition to household waste.

Naturally regenerating forest is forest predominantly composed of trees established through natural regeneration. Includes forests for which it is not possible to distinguish between planted or naturally regenerated. Includes forests with a mixture of naturally regenerated native tree species and planted/seeded trees, and where the naturally regenerated trees are expected to constitute the majority of the growing stock at stand maturity. Includes coppice from trees originally established through natural regeneration. Includes naturally regenerated trees of introduced species.

Other planted forest is planted forest which is not classified as plantation forest.

Planted forest is a forest predominantly composed of trees established through planting and/or deliberate seeding. In this context, it means that the planted/seeded trees are expected to constitute more than 50 percent of the growing stock at maturity. Includes coppice from trees that were originally planted or seeded.

Plantation forest is planted forest that is intensively managed and meets all of the following criteria at planting and stand maturity: one or two species, even age class and regular spacing. Specifically includes: short rotation plantation for wood, fibre and energy; forest planted for protection or ecosystem restoration; forest established through planting or seeding which at stand maturity resembles or will resemble naturally regenerating forest.

Renewable municipal waste is waste produced by households, industry, hospitals and the tertiary sector which is biological material collected by local authorities and incinerated at specific installations.

Soil carbon is organic carbon in mineral and organic soil (including peat) to a specified depth chosen by any given country and applied consistently through the time series.

Unused and abandoned areas

Abandoned areas

This class consists of abandoned areas with signs or structures showing previous use of any kind. Areas belonging in this class are not in use and cannot be used anymore for the original purpose without major reparation/renovation work.

Unused areas

This class includes areas which are in a natural/semi-natural state and show no signs of any use.

Table 12 Country codes

EU27	European Union (27 members)
AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czechia
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain
FI	Finland
FR	France
HR	Croatia
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovak Republic

Table 13 Symbols and abbreviations

Symbol	Meaning
,	Decimal separator
.	Thousand
N.A.	Data not available

Table 14 Decimal prefixes

10^{1}	**Deca (da)**	10^{-1}	**Deci (d)**
10^{2}	**Hecto (h)**	10^{-2}	**Centi (c)**
10^{3}	**Kilo (k)**	10^{-3}	**Milli (m)**
10^{6}	**Mega (M)**	10^{-6}	**Micro (μ)**
10^{9}	**Giga (G)**	10^{-9}	**Nano (n)**
10^{12}	**Tera (T)**	10^{-12}	**Pico (p)**
10^{15}	**Peta (P)**	10^{-15}	**Femto (f)**
10^{18}	**Exa (E)**	10^{-18}	**Atto (a)**

Table 15 General conversion factor for energy

to **from**	**1 MJ**	**1kWh**	**1 kg oe**	**Mcal**
1 MJ	1	0,278	0,024	0,239
1 kWh	3,6	1	0,086	0,86
1 kg oe	41,868	11,63	1	10
1 Mcal	4,187	1,163	0,1	1

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