BIOENERGY EUROPE

STATISTICAL REPORT 2023

REPORT

BIOMASS SUPPLY

Bioenergy EUROPE

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
+ Bioenergy Europe publishes 7 focussed reports published throughout the year

2023

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 7 active working groups and 2 task forces:

- Agro-biomass;
- Competitiveness;
- Domestic Heating;
- Pellets;
- Sustainability;
- Wood Supply;
- Carbon Dioxide Removals;
- Task Force Communications;
- 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, EN*plus*®, as well as the latest edition in the certification for sustainable bioenergy: SURE.

Network

Bioenergy Europe is the umbrella organisation of the European Pellet Council (EPC). This network has been created thanks to the dynamics of Bioenergy Europe members. Today, this network brings 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 EN*plus*® quality certification.

EN plus®

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EUROPEAN PELLET COUNCIL
A NETWORK OF BIOENERGY EUROPE

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 5000 indirect members, including companies and research centres.

Associations

Academia

*Members as of November 2023.

Companies

ENHANCED VISIBILITY & SPONSORSHIP OPPORTUNITIES

Enhanced Visibility

(Exclusive to Bioenergy Europe Members)

This offer includes the chance to display your organisation's logo as well as a featured 100-word description, placed in one of our annual statistical reports of your choice.

This enhanced visibility opportunity is limited and interested members are required to contact the team via info@bioenergyeurope.org

You can find further information about this opportunity on the Bioenergy Europe website.

Sponsorship

Bioenergy Europe offers a sponsorship opportunity for the Statistical Report where you will have the opportunity to have the highest level of visibility. In addition to having full page adverts in all of our statistical reports, you will also have your logos placed on publications, policy briefs, and enjoy content-driven tweets, as well as Linkedin posts, amongst a variety of additional advantages.

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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enSURE compliance with RED II sustainability requirements.

SUSTAINABLE RESOURCES Verification Scheme is a worldwide certification scheme to ensure sustainable use of biomass and biogas for the production of electricity or heating and cooling in compliance with the REDII criteria.

SURE provides a solution to all economic operators within the bioenergy sector: agricultural and forest biomass producers, producers of biomass fuel from waste and residues, pellet producers, logistic operators, biomass fuel traders, biomass and biogas plants.

SURE offers certification solutions applicable to economic operators in all stages of the supply chain wishing to demonstrate their compliance with RED II criteria, so there's no need for other 'sustainability' certifications.

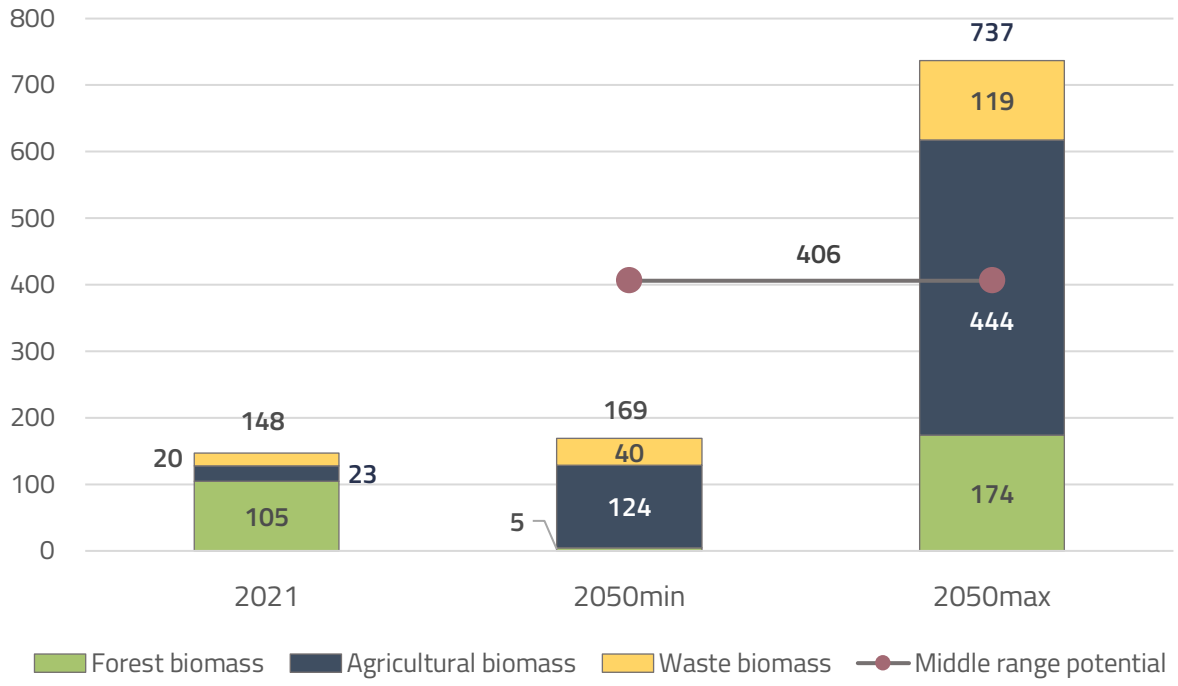
1. Overview

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 utilized 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 thinning 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)

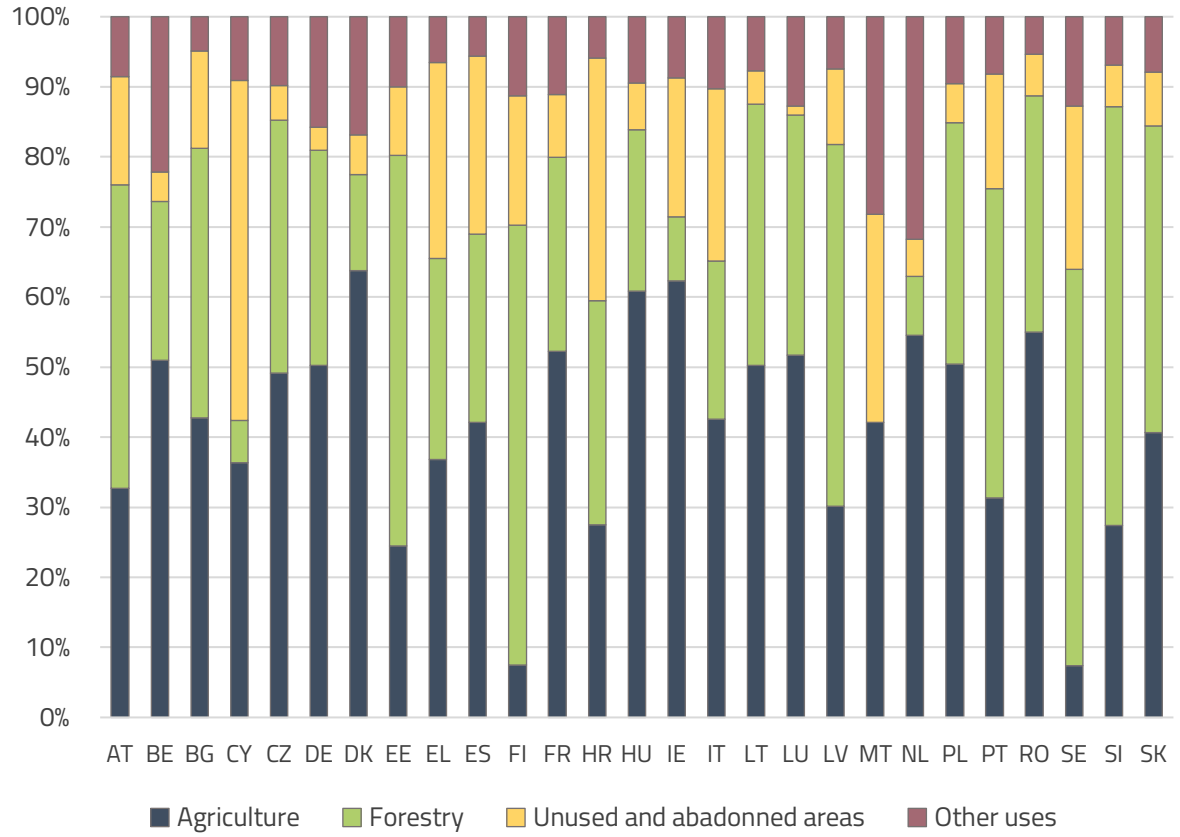
According to existing assessments, Europe's domestically available biomass for energy potential in 2050 ranges at 169-737 Mtoe (Cf. Figure 1). Based on a literature review, the combination of all available biomass resources that may be mobilised over time, taking into account various technical constraints (such as costs), could yield a total of 406 Mtoe by 2050. This means that, as compared to the actual 148 Mtoe used in 2021, 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 2021 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 Member States in 2018 (%)

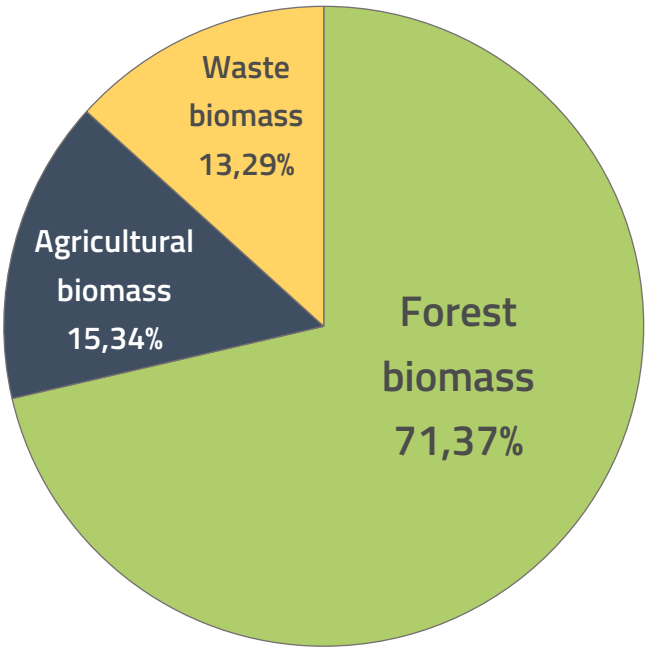


Note: The definition for "unused and abandoned areas" is defined in the Annexes and "other use" includes services & residential areas, the industry-related areas and fishing areas.
Source: Eurostat

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.

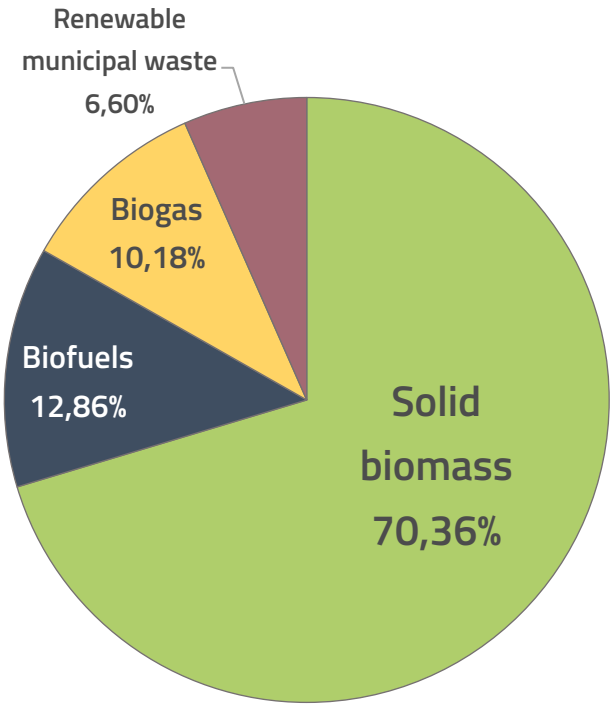
Since the majority of biomass being used for energy production currently originates as forest biomass, the highest potential in bioenergy use can be found in the countries with the largest amount of forested areas. In absolute terms, the top three countries are Sweden, Finland and France. When thinking 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 2021 (%)



Source: Eurostat and Bioenergy Europe's estimate

Figure 4 Gross inland energy consumption of biomass by type in the EU27 in 2021 (%)



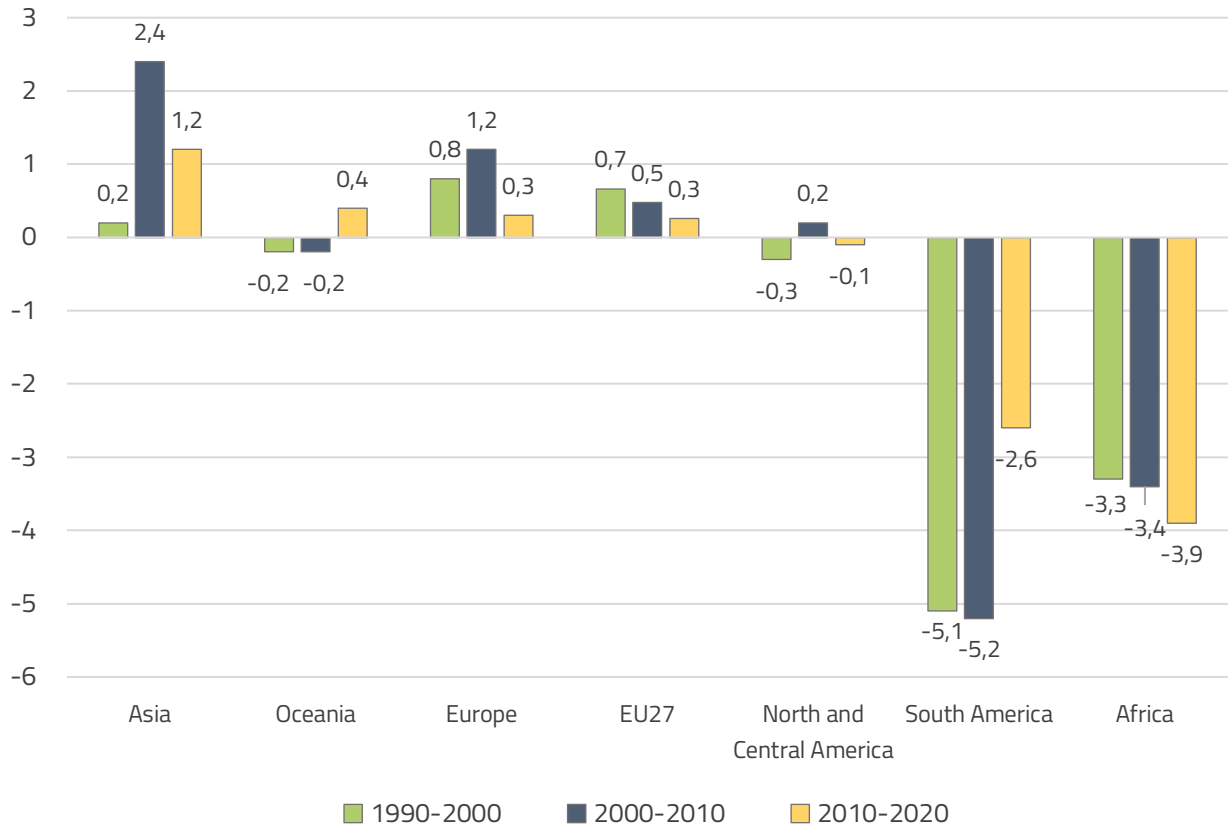
Source: Eurostat

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]

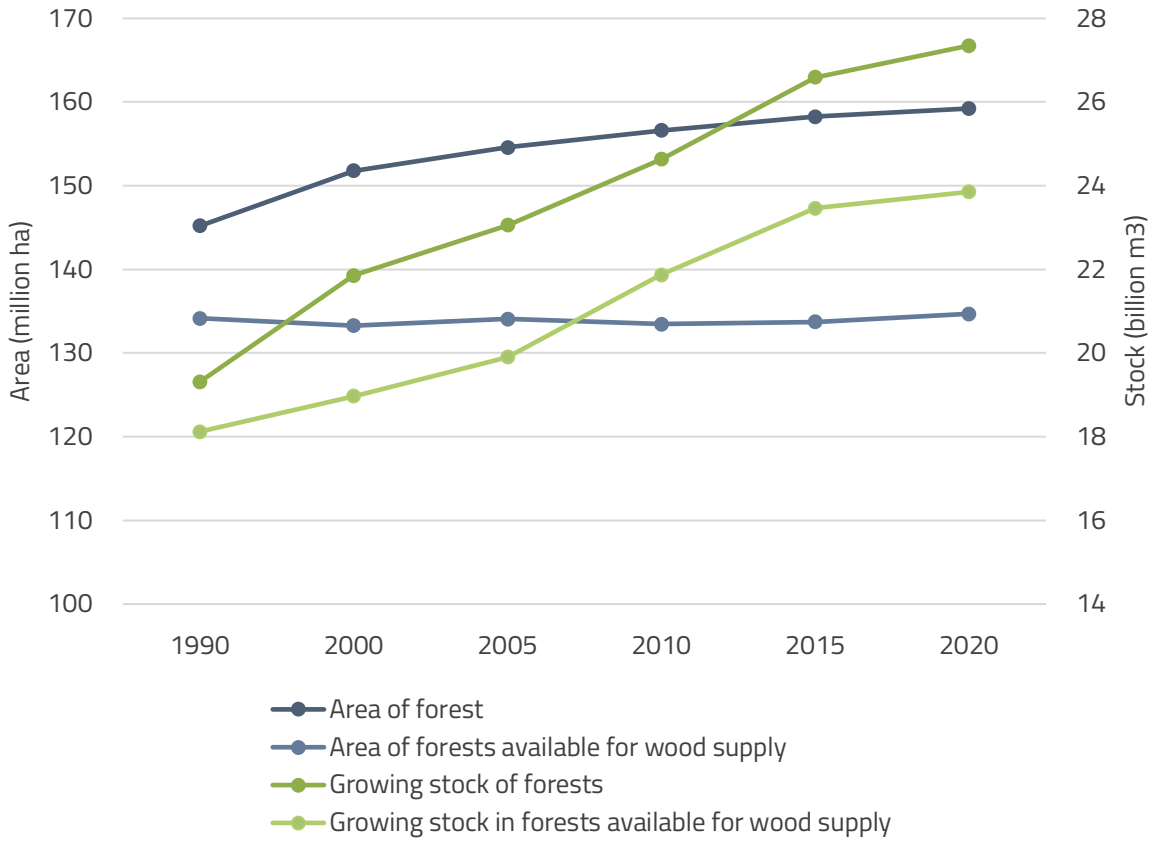


Source: FAO Global Forest Resources Assessment 2020 and State of Europe's Forests 2020 (Forest Europe)

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 m³ versus 23,8 billion m³ 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 size at the rate of 1,24 football fields every minute.
(2) **The overall forest density has risen** from 133 m³/ ha in 1990 to 173 m³/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 2021 (1000 ha)

	Total Land Area	Forest area			Share of forest area out of total land area	Growth in forest area 2020-2021
		Total forest area	Naturally regenerating forest	Planted Forest[1]		
EU27	399 618	156 339	125 673	33 364	40%	0.27%
AT	8 252	3 803	2 232	1 671	47%	0.1%
BE	3 038	689	251	438	23%	0.04%
BG	10 856	3 906	3 139	767	36%	-1.0%
CY	924	173	140	33	19%	-0.28%
CZ	7 716	2 679	742	2 537	35%	0.1%
DE	34 939	11 419	5 710	5 710	33%	0.00%
DK	4 350	629	238	422	16%	0.2%
EE	4 275	2 438	2 223	216	57%	0.02%
EL	12 890	3 802	3 763	139	30%	0.0%
ES	49 973	18 576	15 995	2 581	37%	0.02%
FI	30 395	23 409	15 041	7 368	74%	0.0%
FR	54 756	17 336	14 867	2 469	32%	0.14%
HR	5 556	1 941	1 875	67	35%	0.1%
HU	9 126	2 052	1 264	788	23%	-0.07%
IE	6 889	786	108	678	11%	0.3%
IT	29 572	9 629	8 974	946	33%	0.06%
LT	6 261	2 253	1 589	674	35%	0.1%
LU	257	89	59	30	34%	-0.34%
LV	6 223	3 419	2 943	477	55%	0.1%
MT	32	0	0	0	1%	0.00%
NL	3 367	370	88	333	11%	0.1%
PL	30 619	9 429	2 054	7 368	31%	-0.06%
PT	9 161	3 312	1 056	2 256	36%	0.0%
RO	23 038	6 929	6 034	895	30%	0.00%
SE	40 718	27 980	13 854	14 066	69%	0.0%
SI	2 014	1 236	1 190	45	61%	-0.18%
SK	4 808	1 929	1 177	749	40%	0.0%

Source: FAOstat

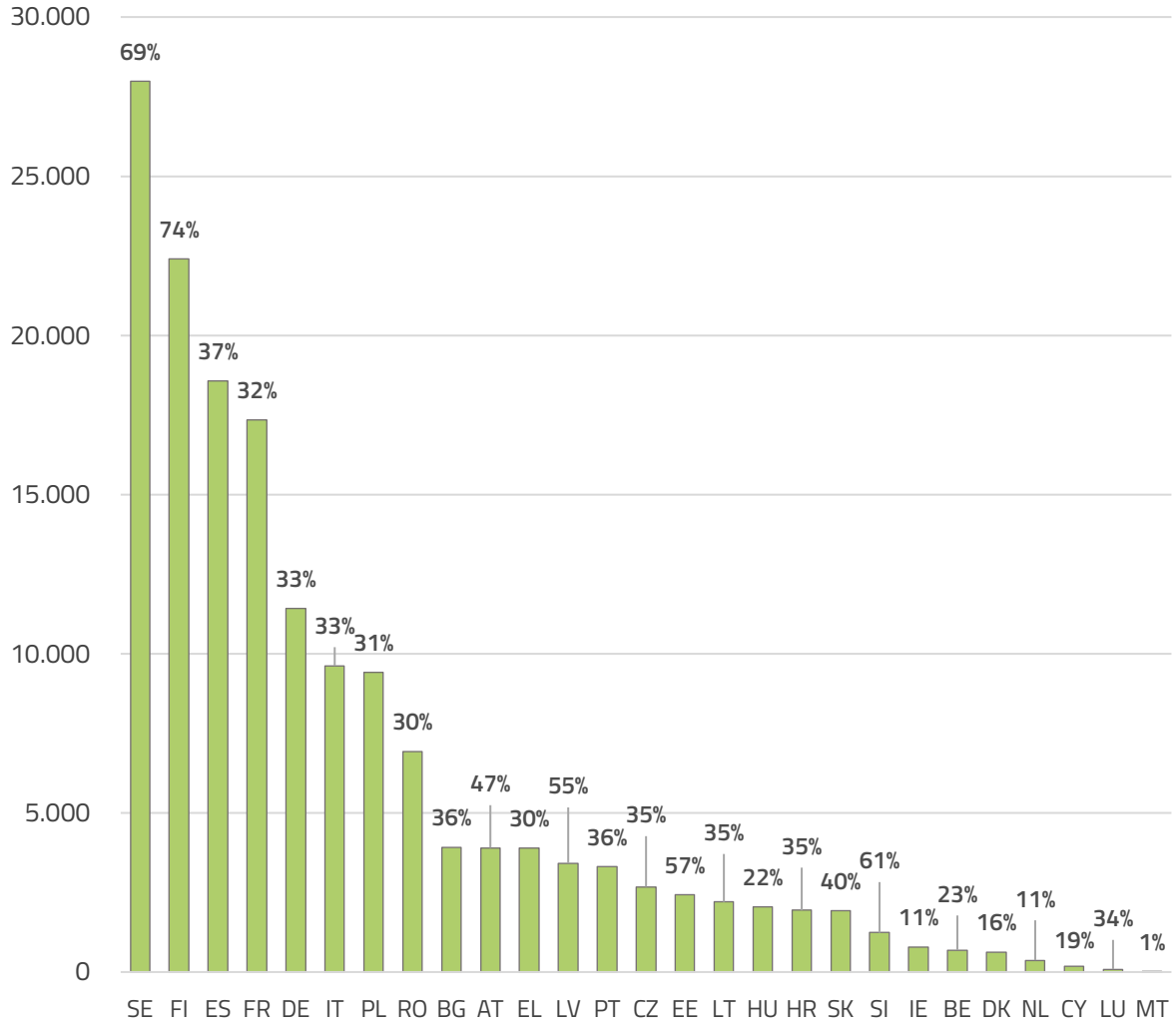
At the EU level, approximately 40% of the total land area consists of forests, and this proportion has been steadily increasing for nearly 30 years. However, the annual changes can be described as relatively small, with an increase of only 0.27% between 2020 and 2021 within the EU. Several member states have more than 50% of their total land area covered by forested areas, such as Estonia (57%), Finland (74%), Latvia (55%), Sweden

[1] FAO uses the current Global Forest Resources Assessment's (FRA) definitions for forests. A planted forest is defined as a forest that at maturity is predominantly composed of trees established through planting and/or deliberate seeding. Planted forest includes but is not limited to plantation forest. Plantation forest is defined as an intensively managed planted forest that at maturity is composed of one or two species, has one age class, and has regular tree spacing. Forest that is planted for ecosystem restoration or protection and forest that resembles natural forest at stand maturity is not defined as plantation forest, as per the Forest Resources Assessment (FRA) 2020.

(69%), and Slovenia (61%). In terms of absolute values, the countries with the largest forested areas are predominantly Scandinavian. Sweden, as the leading member state, boasts 27.980.000 hectares of forests, followed closely by Finland with 22.409.000 hectares. Spain rounds out the top three in this category with 18.576.000 hectares of forested areas.

Regarding the distribution between naturally regenerated forests and planted forests, it's also notable that the ratio is very close to two-thirds for naturally regenerated forests and one-third for planted forests. This balance between natural regeneration and intentional planting reflects a sustainable approach to forest management within the EU. It signifies a commitment to maintaining and nurturing existing forested areas while also engaging in strategic reforestation efforts to support biomass supply and energy production initiatives. This equilibrium helps ensure the long-term viability and resilience of the region's forests.

Figure 7 Total forest area in EU27 Member States, 2021 (1000 ha and % of land area)



Source: FAOstat

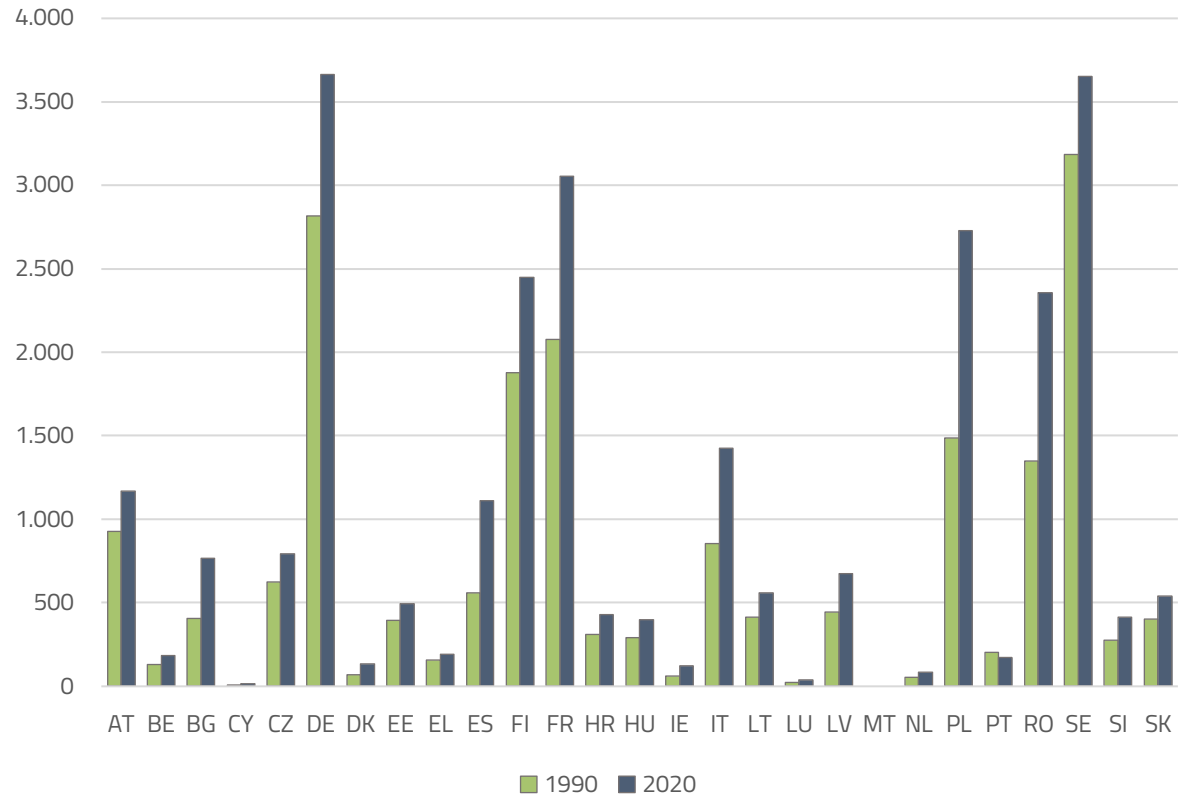
When we shift the focus to the growing stock, which refers to the volume of wood over bark in EU forests, some intriguing insights emerge. Figures 8 and 9 reveal an interesting pattern: the ranking of wood stock in forests doesn't mirror the ranking of forested land area, as could be expected. Notably, Germany stands out as the leader in terms of growing stock over bark, with a volume roughly equivalent to that of Sweden, despite having a significantly smaller forested land area (Sweden boasting nearly 28 million hectares compared to Germany's less than 11.3 million hectares).

These figures underscore the substantial disparities within European forests. They highlight that Western European countries like France and Germany have forests that are more densely stocked with wood compared to regions such as Scandinavia and the Mediterranean countries like Spain. Indeed, despite Spain ranking third in terms of forested land area, it ranks ninth in terms of wood stock. This variation in forest characteristics emphasizes the diverse nature of European forests and their potential for biomass production.

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 m³)



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 table and chart show the percentage of wood harvested in relation to annual growth in the EU27 Member States. On average, 63% of annual growth is harvested in Europe. The rate of harvest ranges from 5% in Cyprus to 104% in Czechia. The figure exceeding the symbolic threshold of 100% might raise concerns about the sustainability of forest exploitation in the Czech Republic, as it suggests that the forest regenerates less than what is harvested. However, to gain a comprehensive understanding of the situation, it's crucial to delve into the details of the recent years, as they have had a drastic impact on forests in several EU member states. The bark beetle infestation in the EU has emerged as a pressing ecological challenge with far-reaching implications. In recent years, this voracious insect has wreaked havoc on vast areas of forested land, particularly in regions where coniferous trees prevail. The sanitary measures implemented to combat the proliferation of this destructive insect include the extraction of contaminated wood to reduce the available habitat for the pest to feed, reproduce, and continue its destructive actions on the forest. Consequently, these sanitary cuttings are included in the harvested volumes, explaining why they surpass 100% for the year 2021 in Czechia, as well as being relatively high in other countries (like Germany with 96% or the Netherlands with 94%) as opposed to previous years. This context highlights the complex dynamics at play in forest management, where external factors like pest infestations can temporarily affect the balance between forest harvesting and regeneration, even in cases where sustainable practices are employed.

Table 2 Removals and net annual increment in EU27 Member States*, in 1000m³ and percentage in 2020

	Net Annual Increment	Removals	Removals as % of net annual increment
EU27	894.895	560.031	63%
AT	26.391	19.659	74%
BE	8.011	8.011	75%
BG	12.560	6.113	49%
CY	203	11	5%
CZ	36.301	27.852	104%
DE	99.758	95.280	96%
DK	6.844	3.590	54%
EE	14.371	12.179	85%
EL	4.735	1.696	36%
ES	44.847	18.152	41%
FI	116.518	68.976	59%
FR	117.483	53.156	45%
HR	9.412	5.601	60%
HU	8.131	8.087	75%
IE	8.477	3.891	46%
IT	80.019	10.352	34%
LT	20.000	7.194	36%
LU	961	477	49%
LV	23.242	17.947	75%
NL	3.843	3.418	94%
PL	77.861	49.589	64%
PT	24.221	17.217	71%
RO	52.364	18.531	35%
SE	126.036	84.900	68%
SI	7.605	4.239	56%
SK	13.411	8.034	94%

*Malta not included in this aggregate because of lack of data
Source: Eurostat

Figure 10 Removals as % of net annual increment in EU27 Member States* in 2020

* Malta not included in this aggregate because of lack of data

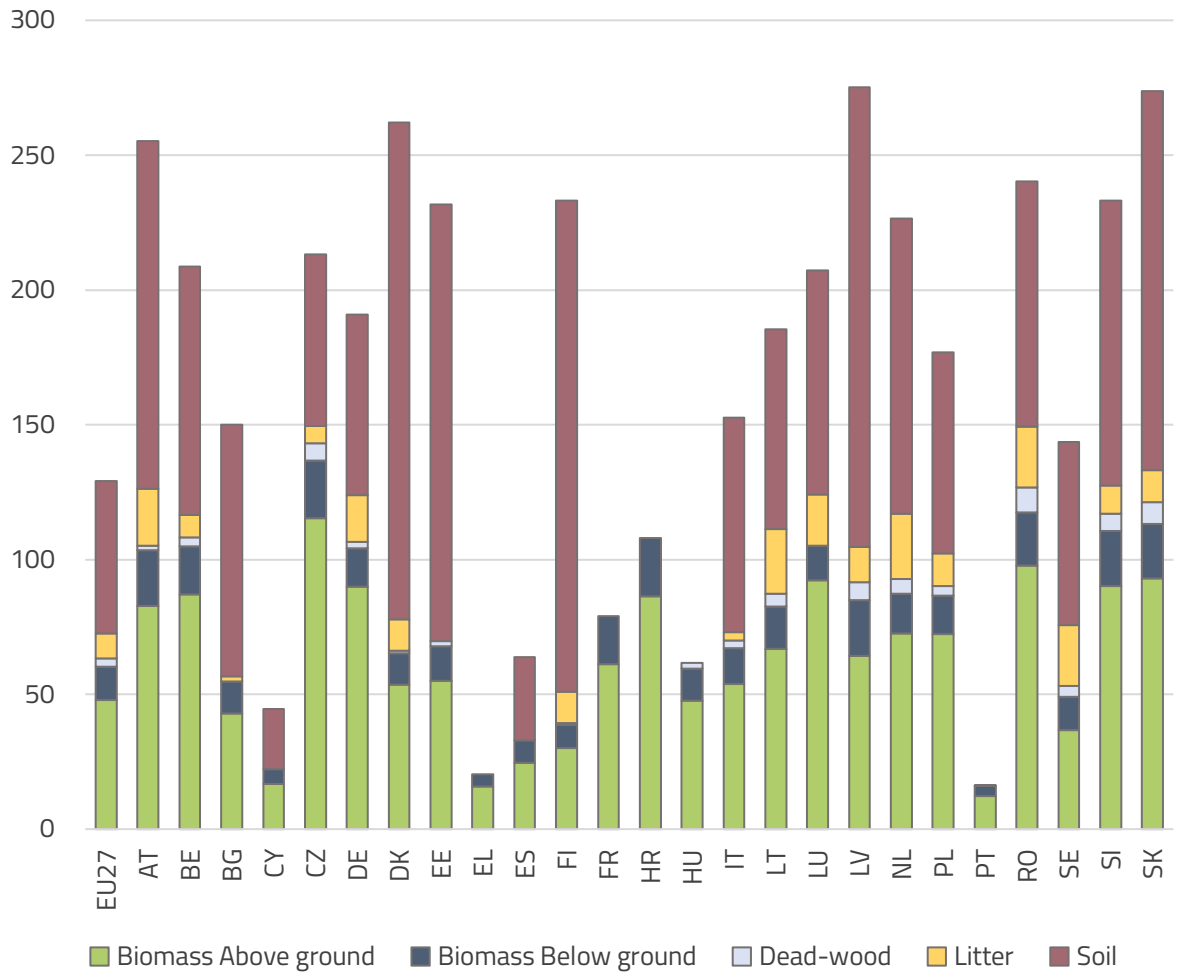
Source: Eurostat

Figure 11 Removals and net annual increment, in m^3 and %, 2021

Source: Eurostat

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 12 Forest biomass stock in EU27 Member States* in 2020 (tonnes of carbon/ha)



Note: Last available data for Portugal is from 2015.

* No data available for MT.

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.

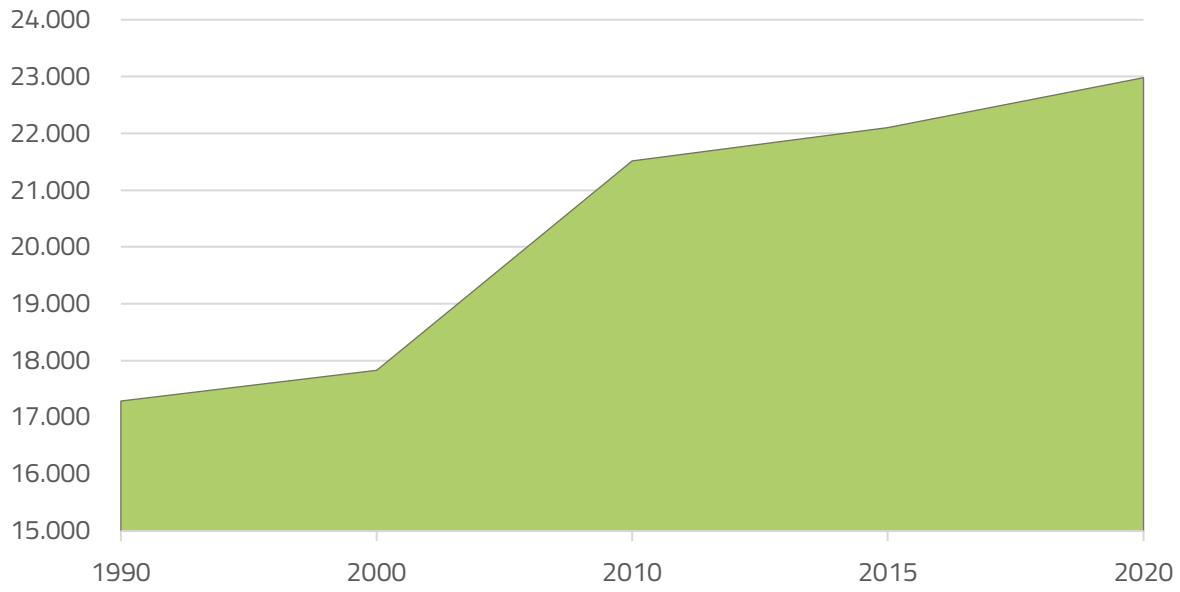
Figure 13 Average forest carbon stock in EU27 in 2020 (t)

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 84,2 MtC per year for the period 1990-2000 to 86,1 MtC per year for the period 2015-2020.

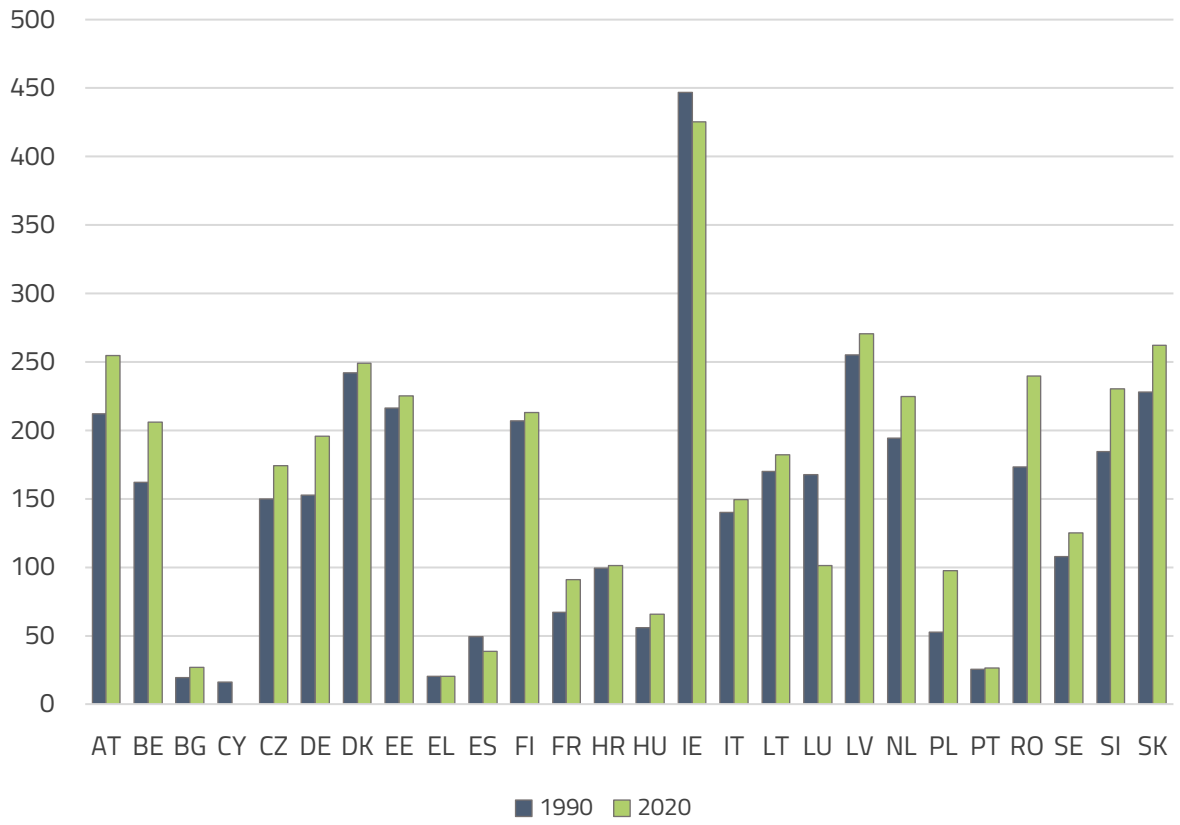
Examining the situation in individual Member States, the increase in carbon stock is uneven. Figure 13 compares the carbon per hectare in 1990 versus 2020 for all Member States. Poland and Bulgaria have seen the largest percentage increase in the EU27. While it may be surprising that Ireland has the 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 14 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 15 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 (91.1%), while Bulgaria has the lowest (12.2%).

Table 3 Forest ownership in 2015 across EU27 Member States (1000 ha)

	In public ownership	In private ownership	% of private ownership
EU27	**87,890**	**94,888**	**60.3%**
AT	715	3,167	82%
BE	326	363	53%
BG	3,365	468	12%
CY	116	54	31%
CZ	2,019	650	24%
DE	5,933	5,486	48%
DK	150	462	76%
EE	5,177	1,133	18%
EL*	2,907	845	23%
ES	5,255	13,260	72%
FI	6,867	15,397	69%
FR	6,358	12,478	74%
HR	1,366	556	29%
HU	1,769	864	33%
IE	351	364	48%
IT*	3,032	5,956	66%
LT	1,948	839	38%
LU	47	48	54%
LV	1,741	1,842	49%
MT	N.A.	N.A.	N.A.
NL	177	188	51%
PL	7,655	1,765	19%
PT	97	3,215	97%
RO	6,249	2,306	35%
SE	6,224	21,756	78%
SI	290	947	77%
SK	935	638	41%

*Data from 2010.

Source: FAO Global Forest Resources Assessment 2020, Eurostat

As depicted in the table above, the distribution of forest area in Europe reveals that 60.5% is privately owned, while the remaining 39.5% is publicly owned. However, when we shift our focus to the number of forest holdings, a strikingly different trend emerges. The pie chart below provides a visual representation of private and public forest holdings in the EU27, highlighting that the vast majority are privately held. In the year 2020, there were nearly 3 million private forest holdings, compared to just +/-2,800 public forest holdings.

On average, public forest holdings tend to be considerably larger than their private counterparts. Nonetheless, it's important to note that both the size and quantity of these holdings exhibit significant variation among countries. Across Europe, the majority of public forest holdings (as reported by 19 countries) fall within the range of 11 to 500 hectares, while most private holdings (reported by 18 countries) are smaller than 10 hectares. This size discrepancy in private holdings is largely attributed to inheritance issues.

Figure 16 Distribution of forest holdings in EU27 in 2020 (number of holdings)

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

+/-% of the EU forests is certified PEFC and 26% 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 87% while the country with the largest share of FSC certified areas is Sweden, with 70%.

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 (1999) 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 4 Certified areas PEFC and FSC in the EU27 Member States (1000 ha) (Data from March 2023 for PEFC and July 2023 for FSC)

	PEFC certified area	Share of PEFC certification out of total forest area	FSC certified area	Share of FSC certification out of total forest area
EU27	72 500	47%	40 480	26%
AT	3 436	87%	1	0%
BE	307	44%	47	6%
BG	0	0%	2 275	6%
CZ	1 819	68%	134	5%
DE	8 769	77%	1 483	13%
DK	334	53%	238	36%
EE	1 693	69%	1 257	52%
ES	2 688	14%	855	4%
FI	16 585	85%	2 334	12%
FR	5 675	33%	704	7%
HU	0	0%	443	23%
IE	446	19%	431	17%
IT	901	10%	82	1%
LT	0	0%	1 267	58%
LU	39	63%	26	29%
LV	1 760	52%	1 224	36%
NL	3	1%	165	44%
PL	7 225	77%	4 836	49%
PT	315	10%	567	18%
RO	48	1%	2 705	39%
SE	16 522	59%	19 304	70%
SI	295	24%	261	21%
SK	1 200	62%	481	24%

Source: PEFC & FSC

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: FAOstat

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.

Figure 18 Forest in EU27 by stand origin type in 2021

Source: FAOstat

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 2021, Germany is still the leader in roundwood production, with 82,41 million m^3. As compared to last year's figures, Germany experienced a decrease of 1,9% in total roundwood production. The second top producer in the EU is Sweden, with total roundwood production at 74,4 million m^3; also experiencing a decrease of around 2%. The top four are rounded out by Finland (66,7 million m^3, a growth of 10,8%) and France (52,9 million m^3, a growth of 10,9%). 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.

At the Union level, there has been a general increase in roundwood production (+5% between 2020 and 2021) which holds true for all subcategories of products.

Table 5 Wood removals from forests in EU27 Member States by assortment in 2021 (1000 m^3)

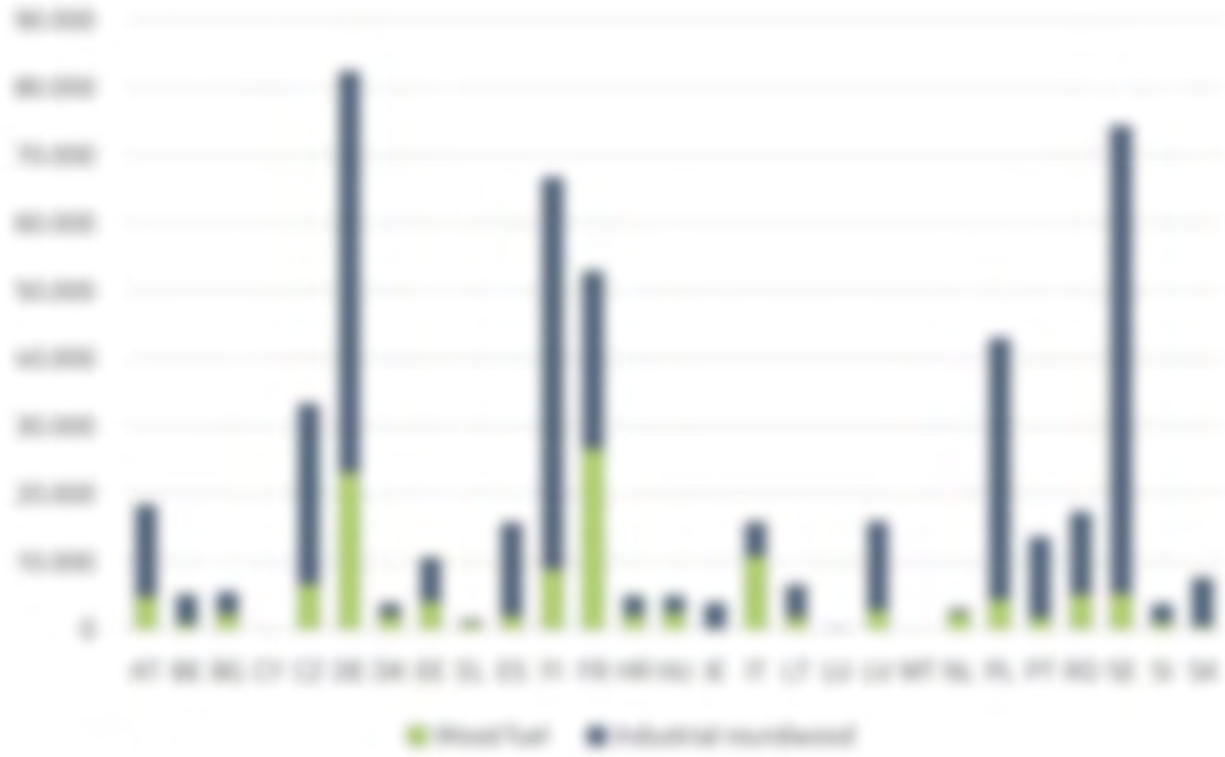
	Roundwood	Total roundwood		Industrial roundwood			Shares	
		Wood fuel	Industrial roundwood	Sawlogs and veneer logs	Pulpwood, round and split, all species	Other industrial roundwood	% wood fuel from total roundwood	% industrial roundwood from total roundwood
EU27	**511,356**	**124,288**	**387,306**	**235,818**	**142,780**	**8,888**	**24.3%**	**75.7%**
Growth Rate 2020-2021	5%	4%	5%	7%	3%	7%	-0.2%	0.2%
AT	18,420	4,893	13,527	10,426	3,101	0	27%	73%
BE	5,272	893	4,379	2,875	1,331	173	17%	83%
BG	5,529	2,357	3,172	1,524	1,606	42	43%	57%
CY	10	7	3	2	0	0	72%	28%
CZ	33,347	6,726	26,621	18,084	7,660	117	20%	80%
DE	82,477	23,326	59,187	47,605	11,024	561	28%	72%
DK	3,842	2,061	1,781	1,070	381	330	54%	46%
EE	10,867	4,148	6,520	4,143	2,323	52	38%	61%
EL	1,359	947	412	345	0	67	70%	30%
ES	15,786	2,000	13,786	4,326	9,176	336	13%	87%
FI	66,774	8,971	57,803	26,093	31,710	0	13%	87%
FR	52,974	26,728	26,188	17,867	7,727	594	51%	49%
HR	4,986	2,130	2,856	2,394	438	4	43%	57%
HU	4,873	2,376	2,437	1,735	902	400	51%	49%
IE	3,912	285	3,627	2,471	1,013	143	7%	93%
IT	15,861	10,809	5,052	3,352	1,078	622	68%	32%
LT	6,074	1,889	4,725	3,425	1,304	0	29%	71%
LU	292	44	277	39	84	54	17%	83%
LV	15,943	2,940	13,003	7,827	3,986	1,190	18%	82%
MT	0	0	0	0	0	0	N.A.	N.A.
NL	3,070	2,352	648	270	394	42	78%	22%
PL	43,070	4,372	38,698	18,422	19,435	841	10%	90%
PT	13,643	1,762	11,883	2,747	8,435	331	13%	87%
RO	17,417	5,186	12,247	10,082	1,111	1,054	30%	70%
SE	74,420	5,420	69,000	37,200	31,500	300	7%	93%
SI	3,710	1,054	2,656	1,900	643	43	28%	72%
SK	7,883	435	7,170	4,254	2,883	33	6%	94%

Note: Volumes 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 2021 (%)

Source: FAOSTAT

Figure 20 Roundwood removals in EU27 Member States according to end-use in 2021 (1000 m³)

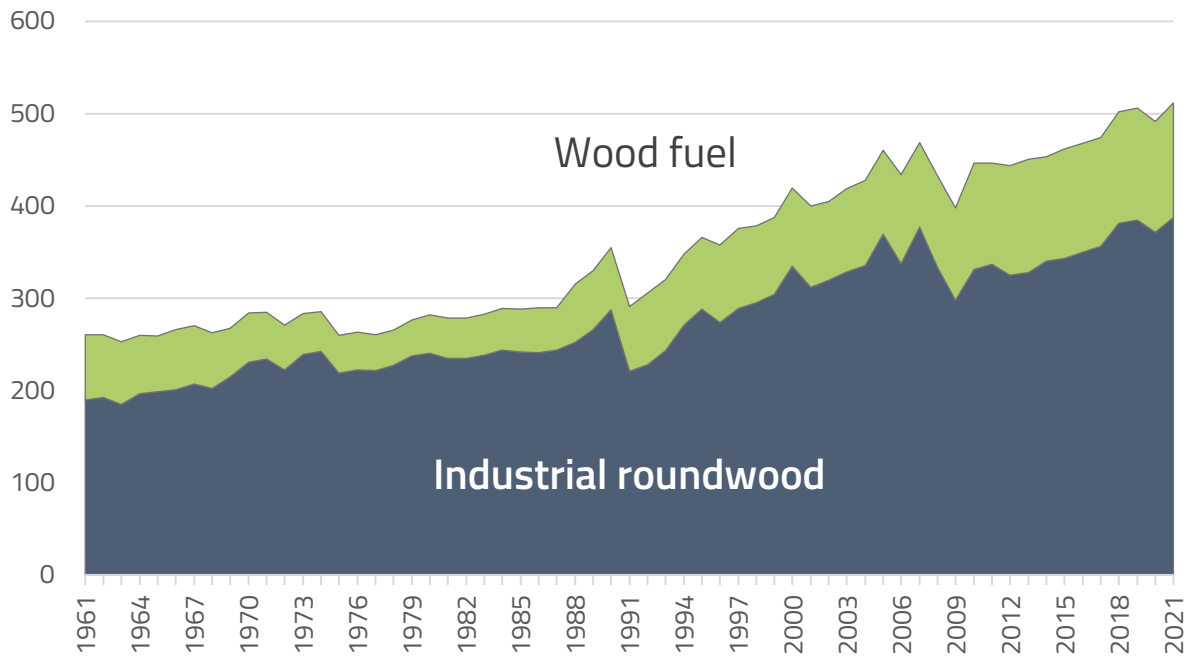


Source: FAOSTAT

Examining the charts provided above, it becomes evident that the predominant share of primary wood harvested in Europe is earmarked for industrial purposes. When trees are harvested, the sections containing the highest value and superior characteristics are allocated for the production of furniture, construction materials, and other high-value products. The remaining portions are utilized in sectors where the raw material doesn't necessitate meeting the same stringent quality standards required in the construction industry. For instance, wood that falls short of these quality standards finds application in bioenergy production. In essence, it's inaccurate to claim that forests are primarily harvested for firewood, as the majority of harvested wood is directed towards industrial utilization. Additionally, in line with the cascading principle previously explained, a significant portion of wood used for bioenergy doesn't even originate directly from forests but instead is sourced from byproducts and residues of other industries. Furthermore, it's not logical to argue that the bioenergy sector competes with the timber processing sector, given that the price per cubic meter of high-quality logs far surpasses what the wood-based energy sector can afford to pay.

Furthermore, when looking at the evolution of roundwood production by type of end-use (Figure 21), 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 24,3% in 2021. 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.

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



Source: FAOSTAT

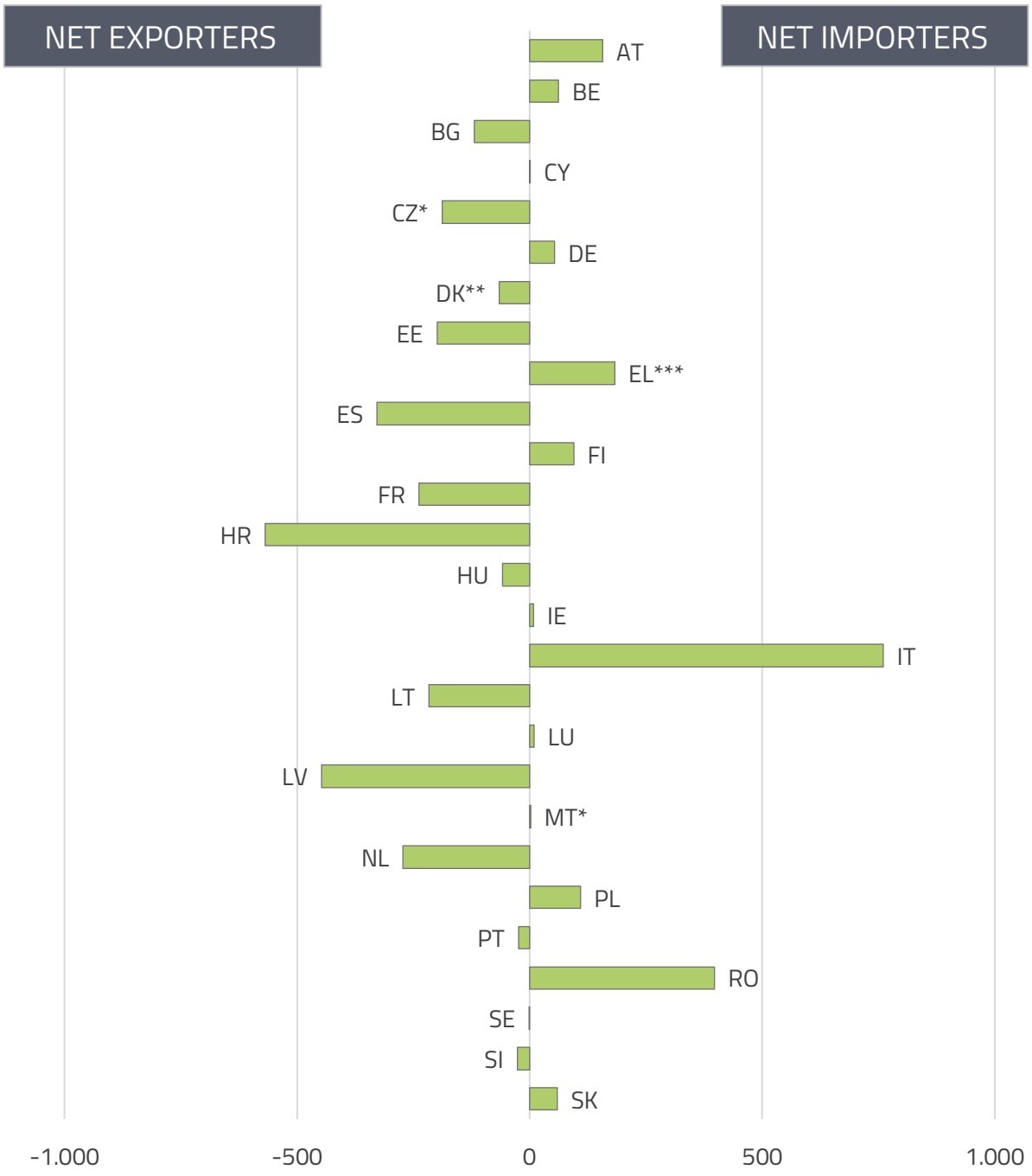
Table 6 shows that the imports of fuelwood from non-EU countries are relatively low, but increasing (+52% as compared to 2020). When looking at industrial roundwood trading on the other hand, the quantities are far greater, but stable (0,001% decrease compared to 2020).The EU27 also experienced quite a substantial growth in exports to non-EU countries (+48%), reaching 25,5 million m³ in 2021 (mostly driven by Belgium, Germany and Poland).

Table 4 Roundwood trade in EU27 Member States in 2021 (1000 m³)

	Fuelwood (including wood for charcoal)				Industrial roundwood			
	Imports	Imports from non-EU countries	Exports	Exports to non-EU countries	Imports	Imports from non-EU countries	Exports	Exports to non-EU countries
EU27	3 017	1 577	4 270	698	57 701	12 238	62 736	25 595
Growth Rate 2020-2021	29%	52%	-1%	140%	-	12%	11%	48%
AT	170	45	13	0	10 903	112	1 293	9
BE	120	33	58	0	5 616	84	10 707	3 018
BG	0	0	119	14	51	0	100	23
CY	1	1	0	0	0	0	0	0
CZ*	51	22	239	13	1 253	26	14 148	2 924
DE	252	130	748	4	9 084	718	11 233	4 858
DK**	102	12	167	0	385	459	867	632
EE	21	2	220	74	868	88	5 734	91
EL***	186	33	6	0	436	9	41	9
ES	42	0	370	3	892	5	1 861	53
FI	143	27	48	2	6 298	4 605	1 071	120
FR	198	198	435	435	985	985	4 712	4 712
HR	108	70	876	1	704	4	339	37
HU	35	22	93	0	258	1	838	48
IE	20	5	12	12	800	275	432	431
IT	766	480	6	1	3 090	484	797	15
LT	70	36	287	16 4	276	5	1 317	54
LU	9	0	0	0	819	0	265	0
LV	54	48	501	82	1 754	352	3 063	385
MT*	2	1	0	0	0	0	0	0
NL	82	44	354	11	289	7	417	137
PL	270	19	167	26	2 764	54	3 999	1 162
PT	0	0	24	0	2 615	808	276	50
RO	447	274	50	0	2 107	16	34	0
SE	66	23	67	20	6 343	3 074	1 218	439
SI	190	105	216	0	715	10	1 160	129
SK	107	7	48	0	2 347	0	2 015	338

* Data from 2019 ** Data from 2019 *** Data from 2015/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

Source: Eurostat

EOS

EXPERT COMMENT

EOS, the European Organization of the Sawmill Industry, represents the interests of the whole sawmill industry. Softwood production represents over 90% of total European sawnwood production, the remaining 8-10% being accounted for by hardwood production. Below we will provide an analysis of the sawn softwood markets in Europe.

Sawn softwood markets in Europe: a strong slowdown after the pandemic boom

The last few years were a rollercoaster for many industrial sectors and the European sawmill industry is no exception. The pandemic triggered an unprecedented boom: many people were stuck at home without the opportunity to spend their income on holidays, restaurants etc so they renovated their homes and refreshed their gardens. As a result, the Do It Yourself (DIY) sector reached unprecedented heights and pushed up sawnwood prices to remarkable levels. Many sawmills across Europe had a very profitable 2021

2022 was another unusual year with the war in Ukraine, the general inflation and the energy prices being significant events that abruptly changed the market trends. For softwood lumber availability in the EU, the impact of the war in terms of imports was significant. The EU in 2021 consumed about 83 million m3 of sawn softwood. Of this, 4,5 million m^3 was imported from Russia, 1,1 from Ukraine, 2,6 million m^3 from Belarus. Altogether the sawn softwood market share of the three countries at war Russia, Ukraine and Belarus was slightly below 10%. However, given the significant slowdown in demand observed from H2 2022 at the moment there is no observable shortage of sawn softwood in the market. This is also because it was possible to import lumber from Russia and Belarus until July 2022 when the sanctions kicked in. Russia might compete with European mills in third markets such as China and MENA, but the lack of spare parts for the sawmills machinery (which cannot be imported from Europe) as well as difficulties in redirecting exports from Northwest Russia away from Europe to distant markets are – at the moment – keeping the flow of Russian goods in international markets lower than one could have expected one year ago.

The increasing energy prices have obviously taken a heavy toll on the European sawmill industry. In a normal situation energy would make up 4% of the costs: in Q4 2022, depending on the countries, energy costs could make up as much as 12-15% of the total operating costs of sawmills.

But overall 2022 was still a positive year altogether with a strong H1 ensuring that many sawmills were profitable.

While the winter was milder and energy prices overall in Q1 2023 were lower than many observers expected, the situation remains quite challenging for many mills across Europe. Raw material prices have sharply increased and reached record-levels during the winter. Some plants, especially large ones were running only one shift in the Winter, especially in Central Europe. On the other hand, in Q1 2023 stock levels are still higher than expected despite a six-month slump. The industry experienced a comparatively strong January followed by a rather quiet February. There was some inventory replenishment buying, but no hoarding like in 2021 and 2022.

When it comes to demand, the high energy prices and inflations pushed central banks to sharply increase interest rates on both sides of the Atlantic which in turn caused mortgage rate to rise. This had a depressing effect on demand in the construction markets, which is strongly connected to the European sawmill industry. At the same time the slowdown was anticipated by many practitioners in the sector, and it was probably not as strong as initially feared, at least in the winter. Having said that, there are many challenges connected to the energy price increases and as a result of the slump in demand sale prices for lumber have fallen back to the pre-pandemic levels. While the sawmill business was profitable for a couple of years, now many sawmills do not achieve break even. In other words, in Europe and in many areas of the world both 2021 and 2022 have seen some market panic which triggered sawnwood prices sudden spikes. In 2023 prices seem to have stabilized on a lower level. Finally, to complete the winter overview, it is worth mentioning that as a result of the high energy prices by-products of sawmill processing have seen their prices sharply increase over the winter, but from the late winter-spring they have significantly declined.

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EOS

While the winter was probably less bad than expected, Q2 and Q3 2023 look instead very challenging. At the time of this writing (August 2023), sawn softwood production and consumption are expected to decline in 2023. It is almost certain that production and consumption will drop significantly. Demand in Europe is shaped by the construction market, which "makes or breaks" the sawmill industry, and this market is expected to be subdued in the next few months. Export markets offer more hope with sales to China doing well (see below figures) so far but the possibility of a construction market collapse in China is not negligible, which is concerning. Also, the US is expected to remain an important market for many European sawmills, both in Central Europe and in Scandinavia – the European mills have attained a 15% market share in the US market. In H1 2023, sales of European sawn softwood to the US increased by 14% compared with H1 2022. As late as 2016 there was virtually no sawnwood being exported from Europe to the US. The Japanese market is more challenging instead – while housing starts were OK, imports of sawn softwood declined as more and more Japanese sawn softwood is appearing on the market.

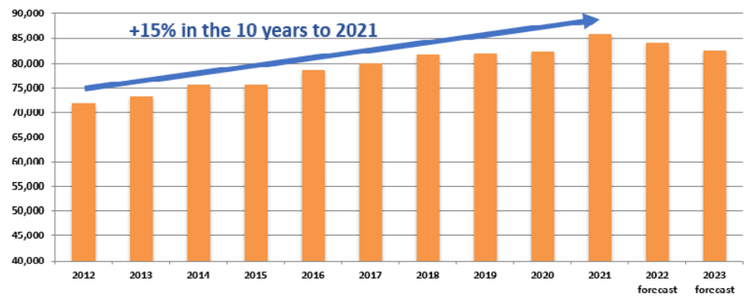
In spite of some bright spots, the situation does not look good overall. The sawmill industry reports a lack of sales opportunities in almost all product ranges. The holiday and maintenance shutdowns that are common in the summer months are therefore often extended. Such weak demand for sawnwood has also caused a fall in sawlog prices.

Chinese imports of sawn softwood
Source: Timber-Online/ Chinese Customs

Softwood lumber imports China | January – July 2023			
Country	**2023**	**2022**	**Change in %**
Russian Federation	**6,986,872**	6,550,147	6.67
Canada	**829,782**	776,488	6.86
Finland	**566,197**	463,056	22.27
Sweden	**557,510**	303,741	83.55
Belarus	**553,287**	284,752	94.3
Germany	**504,048**	272,413	85.03
Chile	**243,013**	173,942	39.71
Brazil	**149,683**	127,094	17.77
New Zealand	**118,750**	56,529	110.07
Uruguay	**105,675**	56,266	87.81
Other	**384,210**	463,135	-17.04
Total	**10,999,027**	**9,527,563**	**15.44**

Sawn softwood production volumes in the EOS member countries 2012-2022 (1,000 m^3)

Source: EOS Annual Report



EOS member countries:
Austria
Belgium
Denmark
Finland
France
Germany
Latvia
Norway
Romania
Switzerland
Sweden

2.3. Impact of climate change on EU forests

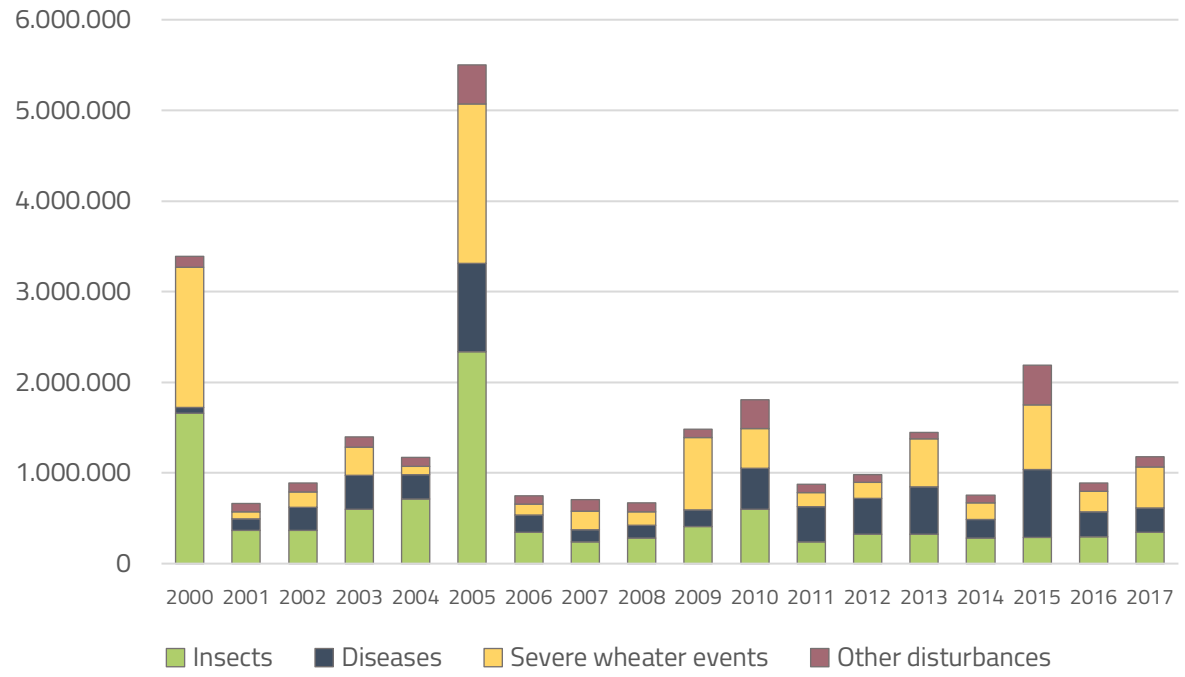
For several years now, forests across the globe have been grappling with increasingly challenging conditions that jeopardize their very existence. Whether it's due to adverse weather events, wildfires, infestations by insects, or attacks by various living organisms such as viruses, fungi, and bacteria, these threats are causing significant damage to a growing portion of our forested areas. What's particularly concerning is that the frequency of these events is on the rise due to global warming, and forests are struggling to recover at a pace that matches the escalating challenges.

Global warming, even though it might not appear to directly harm plants, remains one of the primary drivers behind the issues afflicting forests. Consider, for instance, the spruce bark beetle, a forest pest that has gained notoriety in recent years. The higher temperatures associated with climate change enable this insect to shorten its growth cycle, emerge earlier in the year, and produce a greater number of offspring annually. Additionally, rising temperatures alter the water cycle, resulting in more frequent droughts and indirectly increasing the incidence of forest fires. When all of these factors combine, they create an exceedingly perilous situation that poses a significant threat to the survival of our precious forest ecosystems.

Looking at the graph below, it becomes evident that the extent of disturbances varies significantly at the European level. Additionally, these disturbances, in terms of sheer quantity, appear relatively small. For instance, in 2017, slightly over one percent of the European forested area experienced disturbances. However, it is increasingly apparent that this figure may be somewhat underestimated, especially in light of recent events. The challenge lies in the difficulty of collecting accurate data on forest disturbances, which could lead to an underestimation of their actual impact.

Regrettably, the most recent available data on disturbances from 2017, sourced from the FAO, comes with a six-year lag. Consequently, it poses a considerable challenge in comprehending the more recent developments in this regard. This lag in data availability hinders our ability to stay abreast of the evolving situation in European forests.

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

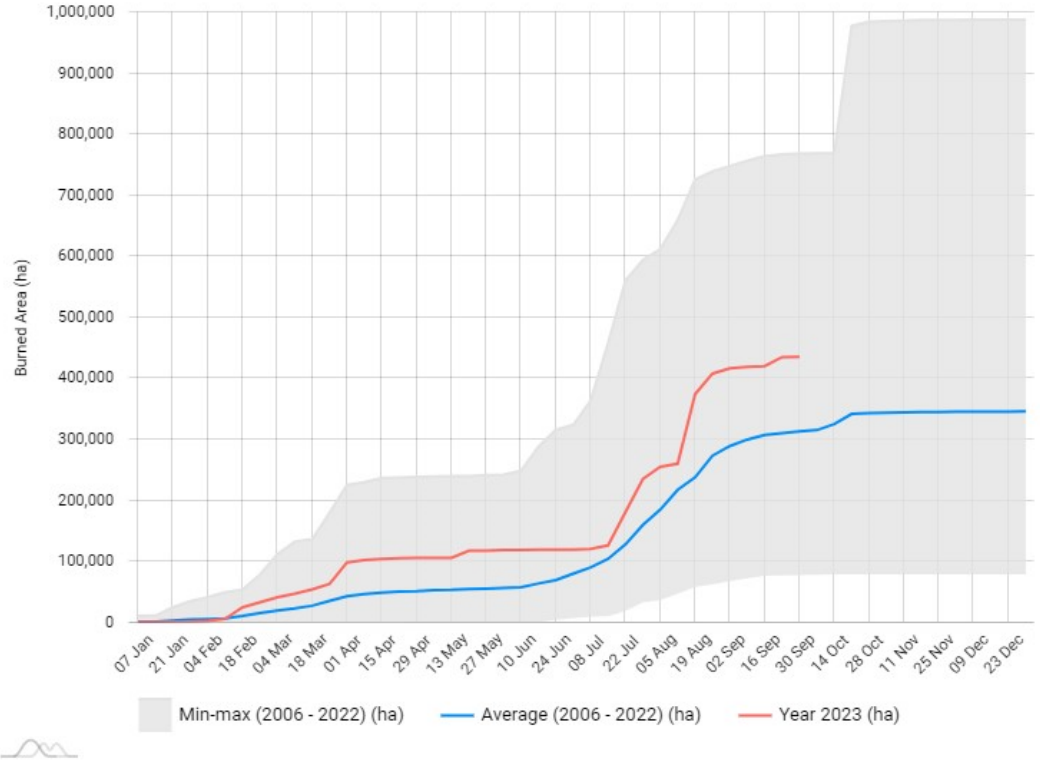


Note: Considered diseases are caused by bacteria, fungi, phytoplasma or viruses; severe weather events include snow, storms or drought. 2000 and 2005 values are due to inconsistencies of data: countries with large forest-damaged areas were introduced in those years (Romania in 2000; Italy, Romania and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

At the level of individual Member States, some countries appear to be more impacted by disturbances than others; however, it is possible that this is purely the result of methodological differences and that they measure disturbances differently because there is no uniform reporting standard across the EU. Moreover, the frequency and intensity of these disturbances can be heavily influenced by climactic factors like levels of precipitation and mean temperatures which vary based on geographical location. For instance, forests in northern European countries are more susceptible to damage from heavy snowfall than from wildfires, although climate change could cause future shifts in these patterns.

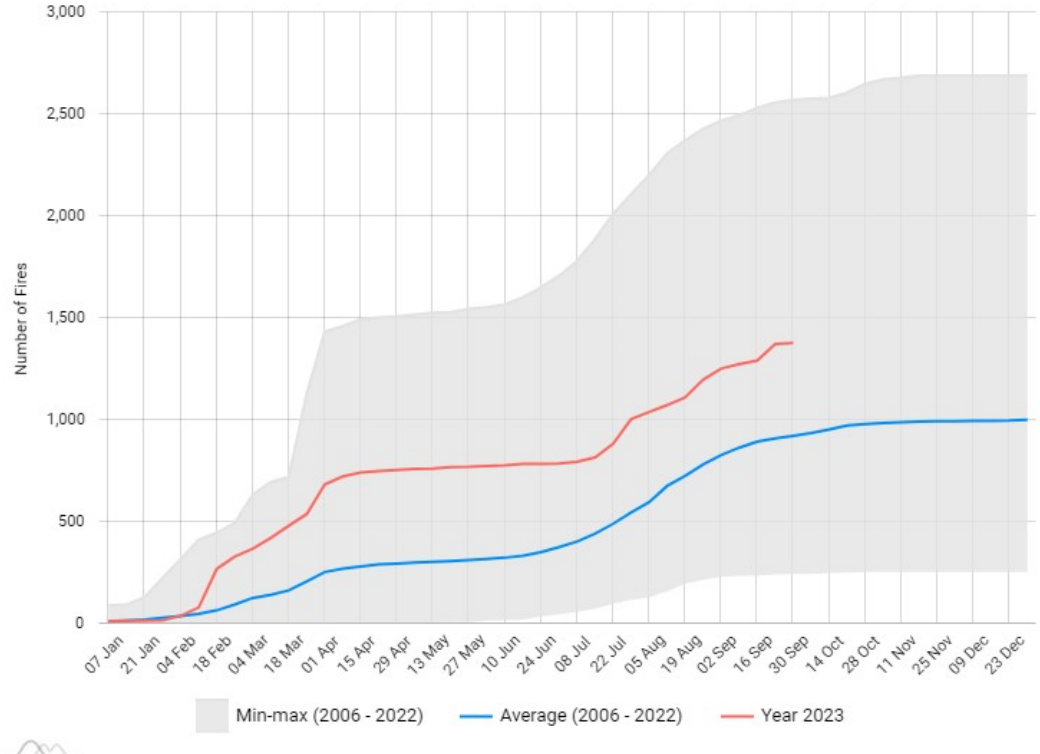
An important and growing forest disturbance is the impact of uncontrolled wildfires. To allow for more detailed insights into forest fires, the European Union has developed a comprehensive database known as EFFIS, or the European Forest Fire Information System. This database emerged from collaborative efforts between the European Commission and the various administrative bodies responsible for forest management at the Member State level. EFFIS encompasses a wide range of data, including the tracking of burnt areas over time as well as the number of wildfires, enabling the creation of informative graphs like the ones illustrated below:

Figure 24 Cumulative burned area in 2023 in EU countries versus 2006-2022 average burned area.



Source: European Forest Fire Information System

Figure 25 Cumulative number of fires in 2023 in EU countries versus 2006-2022 average



Source: European Forest Fire Information System

The two graphs presented above (Figure 24 & 25) are indeed cause for alarm. Following several consecutive record-breaking summers in terms of wildfires over the past few years, it's evident that 2023 is another above average year. Whether we consider the number of fires or the burned area, both indicators surpass the averages observed between 2006 and 2022. This was starkly illustrated by the deadly wildfires that occurred in Greece this year, which devastated nearly 2 million square kilometers of forests and killed 28 people.

It is an open question what impact these disturbances will have on 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 m^3 annually. In 2018, some 100 million m^3 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, or otherwise aggravate the situation and promote further disturbances. One solution to this problem is the practice of salvage harvesting; however, this practice also 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 bark beetle outbreak 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 m^3 to 106 million m^3, 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.

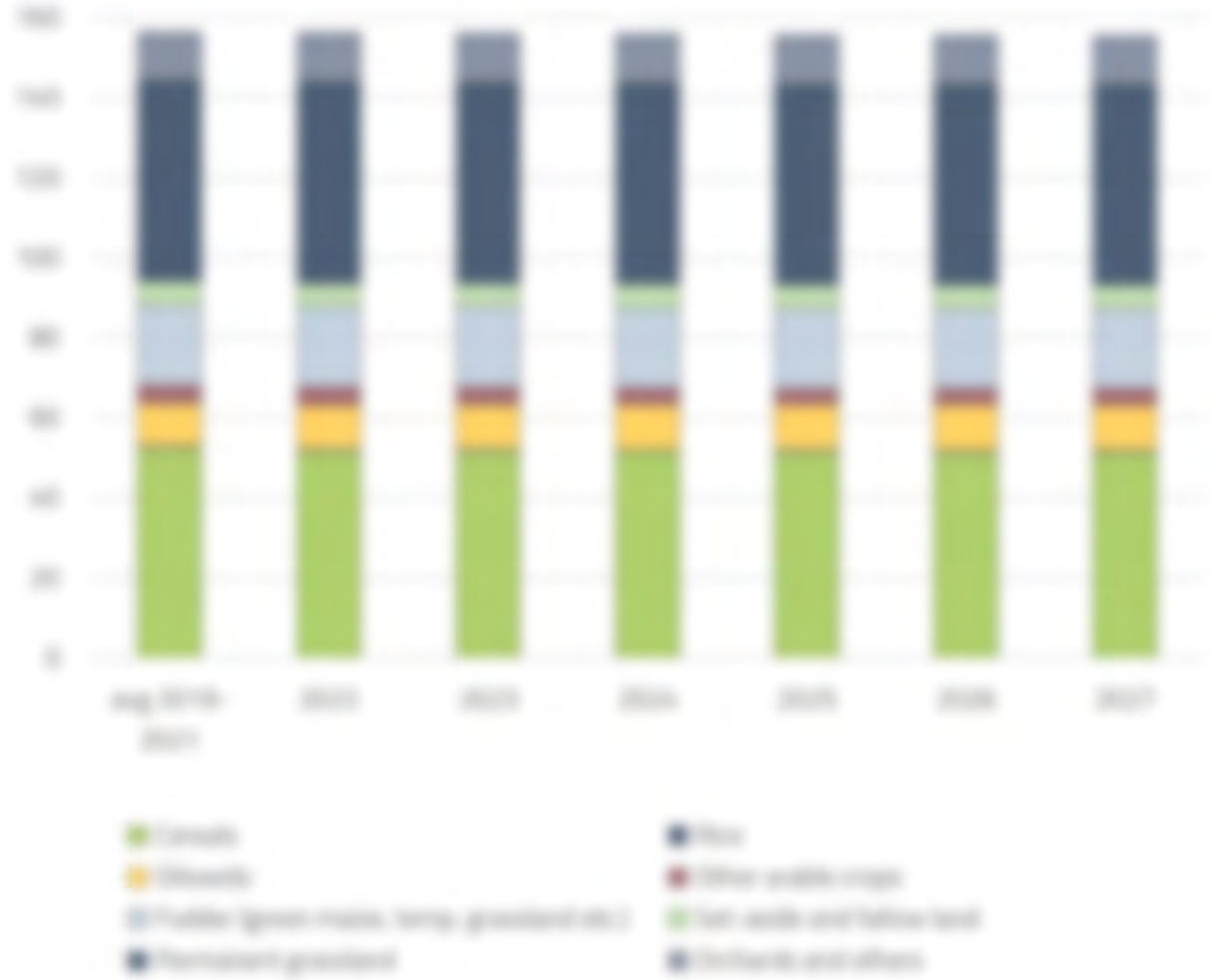
Table 7 Forest area affected by disturbances in EU27 member states in 2017 and 2022 for fires (ha)

	Total disturbances	Insects	Diseases	Severe weather events	Other disturbances	Fires (2022)	2006-2022 Average burned areas
EU27	3.410.475	484.700	776.670	897.390	466.110	785.605	300.322
AT	223.776	29.770	113.230	74.600	5.160	1.016	16
BE	44.482	2.400	11.500	1.300	28.900	382	202
BG	109.079	40.540	24.970	27.000	1.990	14.579	9.337
CY	2.540	N.A.	N.A.	N.A.	N.A.	2.540	1.567
CZ	54.416	24.520	9.830	18.110	520	1.436	9
DE	145.963	29.350	88.580	9.260	14.480	4.293	392
DK	15.771	2.860	4.000	5.470	3.100	341	53
EE	5.090	320	590	1.740	2.440	0	23
EL	22.480	N.A.	N.A.	N.A.	N.A.	22.480	42.167
ES	306.555	N.A.	N.A.	N.A.	N.A.	306.555	63.026
FI	29.460	0	2.200	6.100	21.000	160	181
FR	72.353	1.970	590	2.840	560	66.393	9.248
HR	313.643	152.200	15.400	50.900	62.200	32.943	12.350
HU	90.787	6.980	1.820	56.590	18.110	7.287	319
IE	4.052	N.A.	570	500	N.A.	2.982	3.072
IT	58.751	N.A.	N.A.	N.A.	N.A.	58.751	50.787
LT	7.000	1.000	3.000	1.000	2.000	0	16
LU	200	N.A.	N.A.	200	N.A.	N.A.	N.A.
LV	1.231	60	60	610	330	171	170
MT	0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
NL	11.114	N.A.	10.840	N.A.	N.A.	274	91
PL	364.465	19.000	23.000	17.000	305.000	465	379
PT	540.379	75.000	361.000	N.A.	N.A.	104.379	90.942
RO	390.497	37.680	N.A.	199.610	N.A.	153.207	13.471
SE	573.066	47.100	104.700	421.000	N.A.	266	2.395
SI	19.568	11.570	550	2.940	120	4.388	97
SK	3.757	2.380	240	620	200	317	12

*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 for disturbances other than wildfires/European Forest Fires Information System for wildfires

3. Biomass from agricultural land and by-products

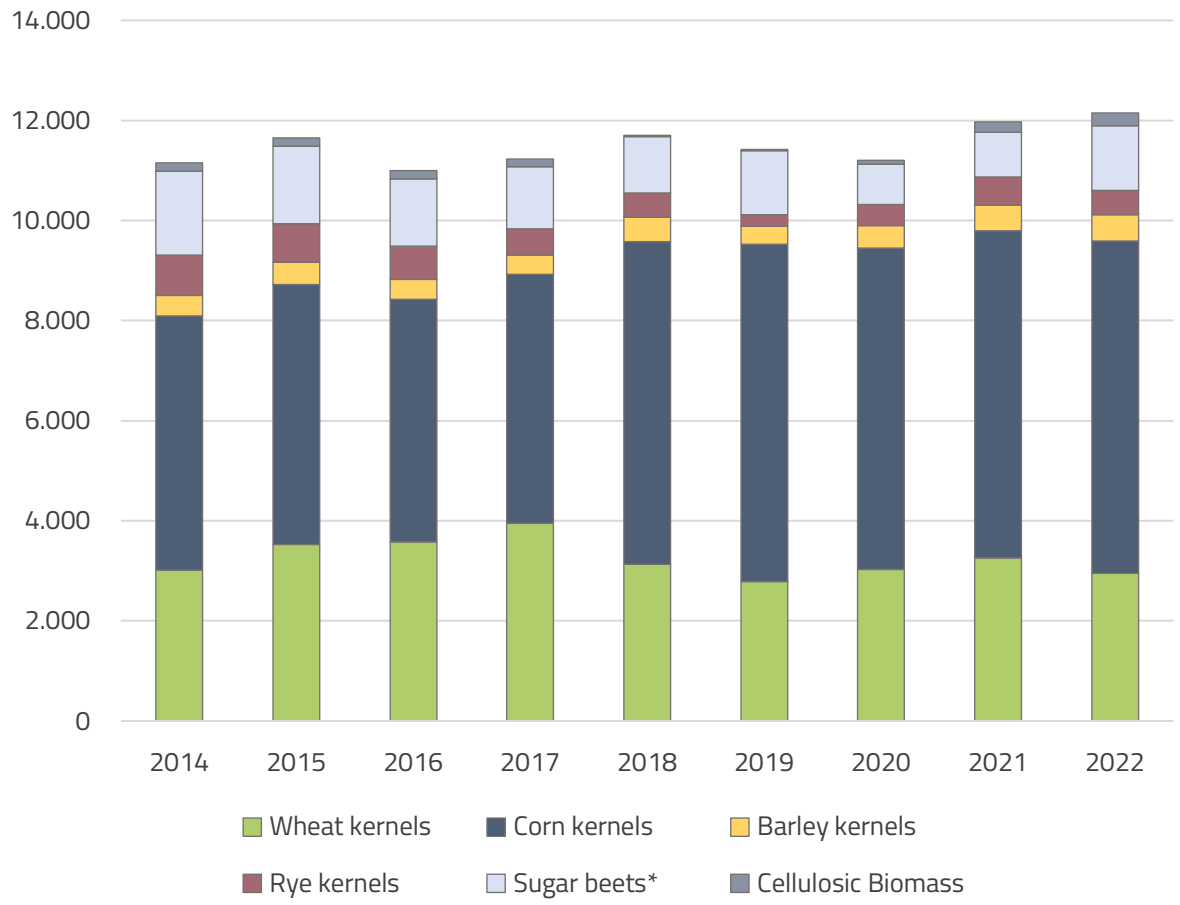
Figure 28 Evolution and projection of the composition of EU27 agricultural land use (Millions of ha)



Note: Data for the years 2021-2031 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 has been 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 27 Evolution of bioethanol feedstock in EU27+UK (1000 tonnes or in tonnes of sugar equivalent for sugar beet)

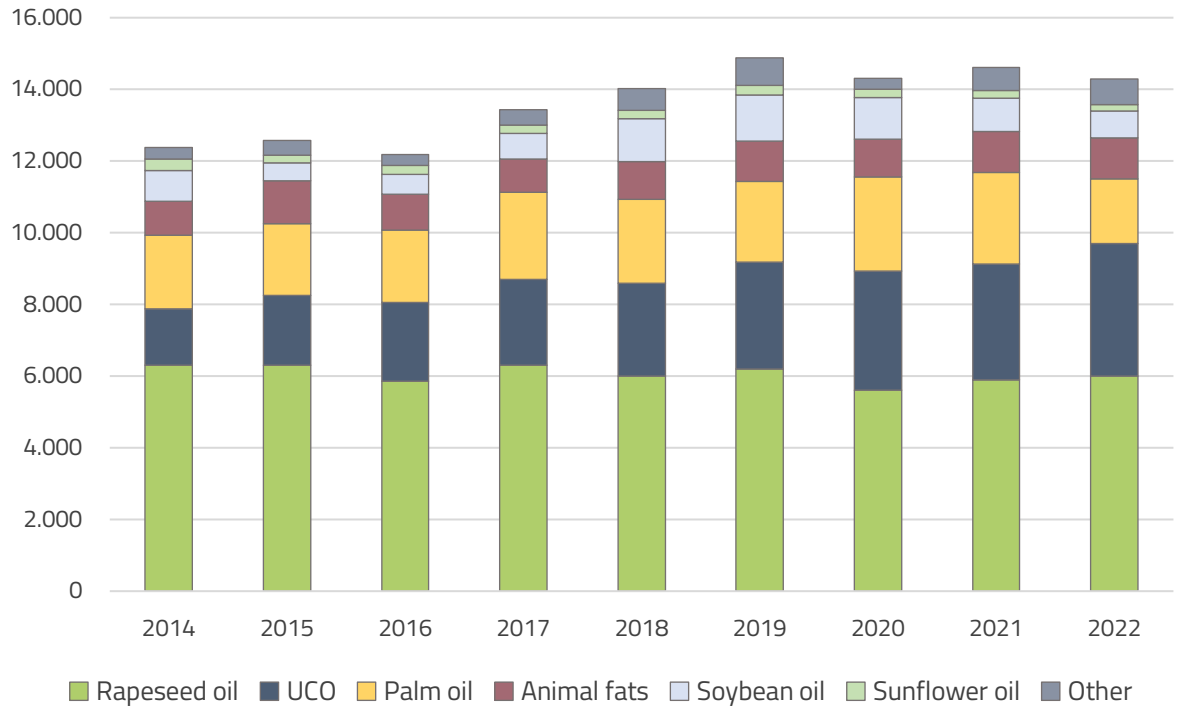


*In tonnes of sugar equivalent, calculated with the converting factor of 16% (average sugar content).
Note: e=estimate/f=forecast
Source: USDA

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 28 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 originates from several different sources and is categorized in different types (sewage, animal residues, vegetal residues, etc.) but this report is focused on municipal waste, specifically the renewable fraction, as municipal waste has more detailed reporting than other waste streams.

Table 8 Municipal waste (renewable and non-renewable) by waste operation in EU27 Member States in 2021 (1000 tonnes)

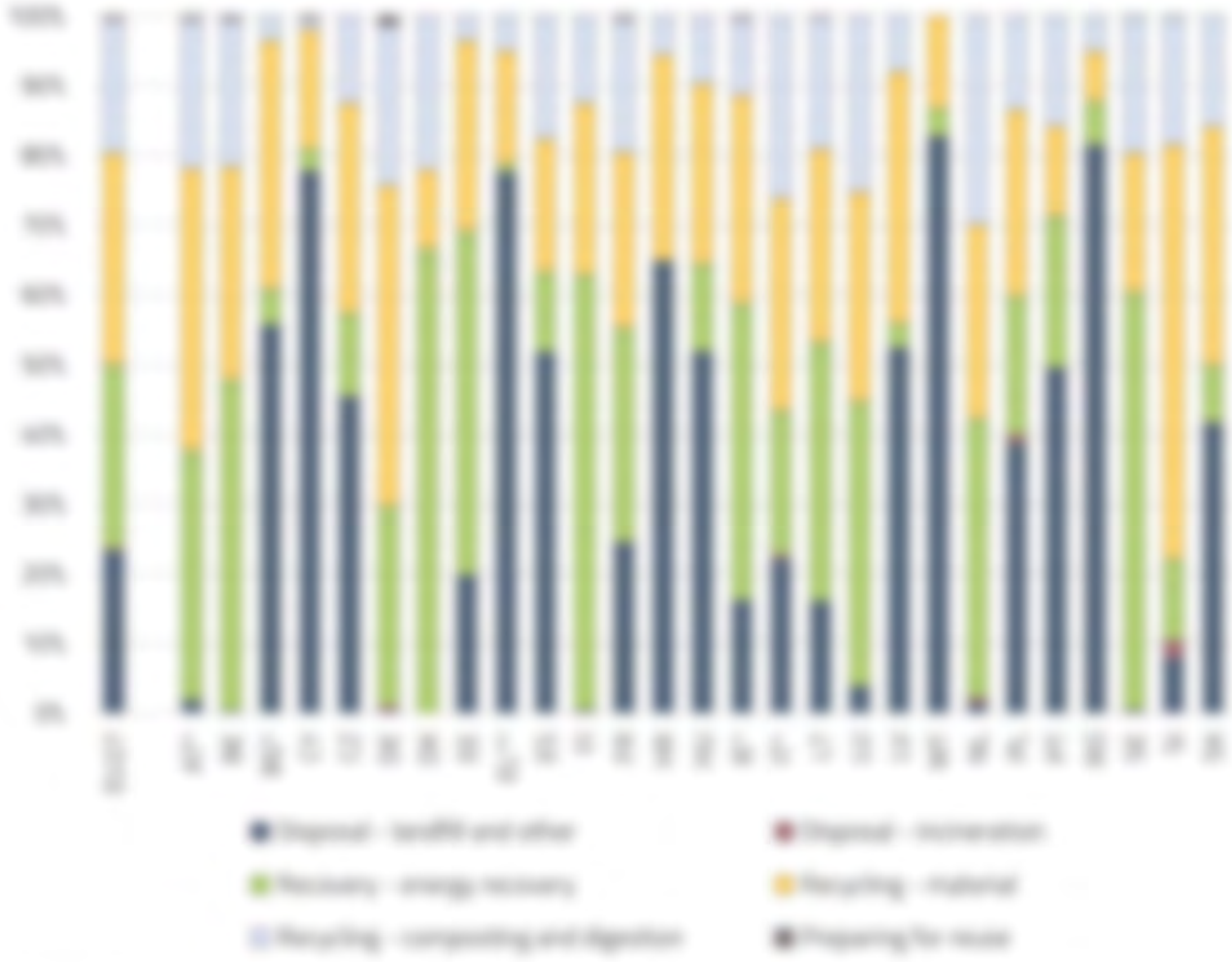
	Waste generated	Waste treatment	Disposal - landfill & other	Disposal - incineration	Recovery - energy recovery	Recycling - material	Recycling - composting & digestion	Preparing for reuse
EU27	236.74m	234.049	54.544	895	62.212	70.856	45.105	578
Growth Rate 2020-2021	4.9%	5.4%	8.4%	-10.8%	3.7%	2.9%	8.8%	4.8%
AT*	7.438	7.438	137	7	2.662	3.656	1.552	33
BE	8.765	8.560	31	2	4.259	2.748	1.884	43
BG*	2.829	2.673	1.423	0	129	908	89	0
CY	570	455	354	0	74	78	7	2
CZ	5.991	6.103	2.768	4	722	1.815	762	0
DE	53.748	53.748	585	885	15.847	25.047	12.481	701
DK	4.801	4.740	3	0	3.157	536	1.044	N.A.
EE	525	518	103	0	255	142	18	N.A.
EL**	5.613	5.613	4.359	0	74	898	283	N.A.
ES	22.37m	22.37m	11.805	0	2.566	4.262	3.943	N.A.
FI	3.376	3.376	74	6	2.103	831	423	N.A.
FR	36.013	36.369	9.412	54	11.793	9.629	7.326	179
HR	1.767	1.590	1.030	0	5	447	89	N.A.
HU	4.042	4.042	2.961	3	593	1.029	362	N.A.
IE*	3.210	3.181	517	0	1.353	948	351	12
IT*	28.943	28.36m	5.811	158	5.457	8.95m	6.868	N.A.
LT	1.843	1.290	257	0	473	35m	240	2
LU	508	508	20	0	207	152	128	N.A.
LV	869	868	456	0	30	31m	69	N.A.
MT	317	325	269	0	10	43	0	0
NL	9.03m	9.03m	122	8m	3.608	2.51t	2.701	N.A.
PL	13.67m	13.67m	5.29t	171	2.702	3.087	1.82m	N.A.
PT	5.211	5.671	2.81t	0	1.237	726	893	0
RO	5.76t	5.34t	4.35t	0	335	38m	27t	0
SE	4.35t	4.35t	2m	0	2.59t	867	851	3
SI	1.077	86m	86	21	97	455	152	1
SK	2.702	2.65t	1.09t	0	21t	801	47t	N.A.

Source Eurostat

Between 2020 and 2021 the EU27 witnessed a 4.4% increase in total production of the amount of waste produced. Notably, the proportion of treated waste (waste treatment) is increasing slightly faster than the total amount of generated waste (+5.0% from 2020 to 2021), 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 intuitive sense because more people will likely result in more waste. With regard to the European trend within the types of waste treatment, only incineration display negative growth figures(-.05%)potentially due to a shift to greater energy recovery but as the smallest category is the most sensitive to high relative fluctuations.

Figure 29 Municipal waste treatment in EU27 Member States by treatment type in 2021 (%)



Source: Eurostat

The countries with the highest share of waste in landfills are Malta, Romania and Cyprus with 83%, 81% and 78% respectively. Countries converting the most waste into energy, are Denmark (57%), Finland (52%) and Sweden (50%). As regards recycling for materials, Slovenia (58%), Germany (47%) and Austria (46%) have the highest rates. Finally, in terms of composting, the Netherlands leads the way with 36% of its waste production being recycled, followed by Italy (26%) and Luxembourg (25%).

Figure 30 Map of incineration plants in Europe and mass of waste thermally treated in 2020

For waste-to-energy plants, minimal variation can be observed between 2019 and 2020. There's an increase in the number of new waste to energy plants in the United Kingdom, with six additional facilities. Spain opened up one plant, Denmark two, and Sweden one as well. On the other hand, France has seen a decrease in its number of waste to energy plants, with seven fewer compared to the previous year.

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 2015-2020	-3.7%	-90.2%	-84%	-5.3%	-1.9%
AT	1 269	0	N.A.	N.A.	973
BE	879	0	28	367	484
BG	306	1	0	214	171
CY	2	0	0	0	2
CZ	535	18	0	16	486
DE	11 342	0	0	7 986	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	2 219	126
FR	9 035	56	22	5 407	3 700
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	2 218	23	60	1 394	841
PL	1 869	0	0	324	1 545
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	426	7	0	298	122

Source: Eurostat

Analysing the quantity of wood waste processed within the EU27, we observe a slight downward trend. In fact, there was a 3.7% reduction in the processing of wood waste in the EU in 2020 compared to 2015.

The presence of wood waste in landfills raises particular concerns because when woody debris decomposes in this environment, it releases carbon into the atmosphere (usually in the form of methane rather than carbon dioxide due to the limited availability of oxygen) without serving any useful purposes, such as energy generation. In contrast, when wood waste or deadwood is present in reasonable amounts within a forest environment, it can contribute positively to biodiversity. However, the same cannot be said for landfills, where its disposal is not environmentally beneficial.

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	79.344	2.018	866	7.236	69.124
AT	2.117	0	0	0	2.116
BE	6.276	0	25	12	6.239
BG	6x7	87	1	85	x7x
CY	108	5	0	2	101
CZ	1.096	1	1	132	958
DE	1x.617	0	5	1.407	13.205
DK	1.803	0	0	173	1.629
EE	47	2	0	0	45
EL	75x	28	3	92	631
ES	2.83x	107	1	93	2.432
FI	1.707	x	10	418	1.275
FR	13.92x	1.2x2	219	3.702	8.562
HR	217	1x	0	10	65x
HU	811	16	1	215	580
IE	0	0	0	0	0
IT	7.962	x	1	121	7.x35
LT	218	1	0	x	213
LU	140	0	0	6	134
LV	105	51	0	0	5x
MT	15	10	5	0	0
NL	15.865	55	x36	277	1x.577
PL	2.691	1	2	72	2.616
PT	257	13	0	9	235
RO	1.277	270	29	83	896
SE	2.688	0	1	9	2.677
SI	233	0	0	0	232
SK	786	1	x	16	763

* Including mixed food waste

Source: Eurostat

Table 11 Gross inland energy consumption of waste by type in the EU27 Member States in 2021 (ktoe)

	Renewable municipal waste	Non-renewable municipal waste	Industrial waste (non-renewable)	Total GIC
EU27	9 780	9 037	4 858	24 275
Growth Rate 2020-2021	2%	1%	3%	2%
AT	205	210	370	685
BE	399	379	282	1 060
BG	42	0	74	117
CY	35	34	8	76
CZ	96	84	302	482
DE	3 148	3 148	1 073	7 370
DK	533	436	0	970
EE	23	36	0	59
EL	0	0	8	8
ES	283	237	280	801
FI	366	270	53	689
FR	1 257	1 257	448	2 963
HR	0	0	45	45
HU	81	73	172	326
IE	144	143	0	287
IT	830	830	212	1 872
LT	55	59	31	145
LU	13	21	21	54
LV	39	38	9	87
MT	0	0	0	0
NL	977	832	84	1 874
PL	140	360	624	1 125
PT	116	93	93	305
RO	2	3	317	321
SE	954	880	93	1 927
SI	0	0	55	55
SK	38	33	204	275

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 processed 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

BIOENERGY EUROPE STATISTICAL REPORT 2023

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