PRI Principles for Responsible Investment

POLICY REPORT

ADDRESSING EU BIOENERGY POLICY AND INVESTMENT RISKS FOR CLIMATE AND NATURE

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ABOUT THE PRI

The Principles for Responsible Investment (PRI) works with its international network of signatories to put the six Principles for Responsible Investment into practice. Its goals are to understand the investment implications of environmental, social and governance (ESG) issues and to support signatories in integrating these issues into investment and ownership decisions. The PRI acts in the long-term interests of its signatories, of the financial markets and economies in which they operate and ultimately of the environment and society as a whole.

The six Principles for Responsible Investment are a voluntary and aspirational set of investment principles that offer a menu of possible actions for incorporating ESG issues into investment practice. The Principles were developed by investors, for investors. In implementing them, signatories contribute to developing a more sustainable global financial system. More information: www.unpri.org

ABOUT THIS REPORT

Bioenergy provides almost 60% of the EU's renewable energy share, more than solar and wind energy combined. Biomass will continue to play an important role for EU climate and renewable energy targets for 2030 and climate neutrality by 2050. But this reliance on biomass for energy also contributes to substantial policy risks – and related net zero transition investment risks – for climate mitigation, as well as adaptation, nature restoration, biodiversity, and the circular bioeconomy objectives.

This policy report assesses the role of bioenergy for the EU's renewable energy targets, and how to use biomass most effectively to achieve competing energy, climate, and nature objectives, and contribute to the EU net-zero economy transition.

This report is aimed at policy makers and investors that want to engage on the topic of bioenergy in the EU. It builds on a consultation, feedback from and discussions with signatories, research and interviews with climate and energy policy experts, think tanks, and civil society organisations. The recommendations aim to inform a holistic whole-of-government approach to biomass use for the EU transition to a net-zero economy, and to point out implications for financial market actors, as bioenergy use is a growing environmental issue, at the nexus of PRI's climate and nature policy work.

The report:

- presents the status quo regarding bioenergy demand in the EU, including different types, use cases, and why there is growing demand-supply gap for biomass;
- explains climate, environmental, economic and social impacts of biomass use for energy, for GHG emissions, carbon sequestration, biodiversity, and bioeconomy objectives;
- explores financially material risks for bioenergy investments and measures to mitigate these;
- examines relevant policies and instruments that affect bioenergy use in the EU and how they are inter-connected, i.e., RED III, CRCF, EU ETS, EUDR, FMF, LULUCF, NRL, and the EU Taxonomy;
- provides policy recommendations for bioenergy and biomass use aligned with EU 2030 climate targets as well as land use, nature, and bioeconomy objectives for the net zero transition under the Fit for 55 package, in order to reduce existing policy silos.

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Contents

EXECUTIVE SUMMARY

Bioenergy contributes 59% of the EU's renewable energy share, but relying on biomass incurs economic, climate and nature risks (Section 1). Forestry or 'woody biomass' is the single largest feedstock for bioenergy. Bioenergy is mainly used for heating and cooling (75%), followed by bioelectricity (13%) and transport biofuels (12%).[1] Many member states have been harvesting domestic forests or importing wood substantially reach their renewable energy targets. However, rising wood demand is putting pressure on existing supplies, and increasingly putting at risk EU climate, nature and bioeconomy goals' achievement.

Bioenergy use in the EU has doubled since 2005 and is projected to more than double again by 2050.[2] Much of this growth has occurred since 2002, incentivised by the EU's first renewable energy targets and policies promoting biomass[3]. The expanding bioeconomy and increased material substitutions to decarbonise the economy are further fuelling demand for bio-feedstocks. Current use of bioenergy may already be bypassing the limit for sustainable forest biomass supply.[4]

Burning wood will increase emissions for decades, even when replacing coal, oil, or gas (Section 2).[5] Although biomass for energy use is treated as carbon-neutral, burning wood for energy is inefficient and creates significantly more emissions per unit of energy than using fossil fuels.[6] In addition, increasing forest harvest creates a 'carbon payback period' for new trees to regrow of up to 60-100 years.[7] This depletes already shrinking EU carbon sinks which need to increase to achieve 2030 climate targets. Bioenergy use also increases risks of biodiversity loss, deforestation, illegal logging, health impacts, and pollution.

More than half of the EU's wood harvest is burned for energy, increasing pressure on supply for the bioeconomy.[8] Burning wood removes biomass supply from higher-value uses in the emerging bioeconomy and from providing forest ecosystem services. Applying the cascading principle – using and re-using biomaterials before energy recovery as a last step – is core to the transition to a circular net-zero economy. An assessment of the highest value of biomass should include in-situ benefits of keeping trees in forests before harvesting for material uses.

Bioenergy investments face increasing market risks (Section 3). Land scarcity, increasing competition for biomass (for food, feed, pharmaceuticals, textiles, construction, packaging, etc.), and decreasing costs for zero-carbon energy alternatives like wind and solar power continue to lower competitiveness. Bioenergy will remain relevant in niche markets with few feasible electrification alternatives, and secondary biowastes and residues will become more valuable, but overall growth potential is limited.[9]

With mandatory EU climate targets, policy risks for investors are increasing, as are legal, reputational, and disclosure risks. The EU Climate Law mandates all policies to align with emission reductions by 55% by 2030 and climate neutrality by 2050. These mandatory net-zero targets affect changing financial incentives, return on investments, and sustainability criteria for bioenergy.

1 European Commission – Joint Research Centre (2019), Brief on biomass for energy in the European Union
2 European Scientific Advisory Board for Climate Change (ESABCC) (2024), Towards EU climate neutrality: progress, policy gaps and opportunities
3 European Commission, Timeline for renewable energy in the EU
4 Institute for European Environmental Policy (IEEP) (2021), Biomass in the EU Green Deal: Towards consensus on sustainable use of biomass for EU bioenergy?
5 Woodwell Climate Research Center (2021), Letter Regarding Use of Forests for Bioenergy
6 Ibid.
7 EC, Joint Research Group Report (2020), The use of woody biomass for energy production in the EU
8 Energy Monitor (2023), Should the EU count wood as a renewable fuel? Opinions are divided
9 Inevitable Policy Response (2023), Navigating the Future of Bioenergy in the Climate Transition

Transition planning and portfolio decarbonisation strategies based on bioenergy are facing legal challenges regarding claims of carbon neutrality and contributions to the net-zero transition. Investors also risk growing reputational risks related to deforestation, pollution, and health impacts in the EU and in other countries. Despite shortcomings of voluntary certification systems for compliance with sustainability criteria, investors can still mitigate risks by engaging with utilities and the forestry sector to quantify full lifecycle GHG emissions and audit the value chain for sustainable forest management.

Within the Fit for 55 package, conflicting policy signals both incentivise more bioenergy use while also applying higher sustainability criteria and limiting land use for harvest (Section 4). Policies like the Renewable Energy Directive (RED III), the EU Emissions Trading System (ETS), and the EU Taxonomy continue to incentivise using primary woody biomass for energy. The Land Use, Land Use Change and Forestry (LULUCF) Regulation looks to enhance carbon sinks, the Nature Restoration Law (NRL) seeks to restore biodiversity and climate resilience, and the Deforestation Regulation (EUDR) aims to prevent imports that cause deforestation, but these regulations do little to address the financial incentives to use bioresources for energy.

EU policy needs to break up existing policy silos to assess and prioritise the different functions and services biomass has to offer (Section 5). Harvested biomass can be used for its energy retrieval as bioenergy, or as materials for the circular bioeconomy, while non-harvested biomass kept in ecosystems enhances carbon sinks, biodiversity, adaptation capacity, and climate resilience. To ensure biomass supply remains in sustainable limits, climate targets need to be aligned with sustainability criteria, carbon accounting methodology, and price signals for emissions across different uses, including energy, materials, and ecosystems.

A holistic governance framework should prioritise the use of biomass across interrelated Fit for 55 objectives. This requires a whole-of-government approach shifting the focus from ‘biomass for energy’ to nature-based climate solutions, for EU climate targets, the 2030 Biodiversity and Forestry Strategy, and the transition to a circular net-zero economy. Bioenergy should be used to decarbonise the EU energy system where it provides significant, near-term reductions in emissions compared to fossil fuels, and where zero-carbon alternatives are not yet feasible. Woody biomass needs to be used for its highest value in the circular bioeconomy, while the cascading principle should integrate in-situ benefits for living biomass in ecosystems, including carbon sequestration. Better data, monitoring and assessment of biomass use for energy and its impact on carbon sinks is required in National Energy and Climate Plans (NECPs).

The PRI recommends policy makers to:

- provide a cap on biomass for energy in RED III;
- prioritise biomass for carbon sinks and LULUCF objectives;
- remove financial support and incentives for primary biomass for energy;
- harmonise data collection, monitoring, and GHG accounting for biomass for energy;
- apply the cascading principle to ensure high-value biomass use, including in-situ benefits;
- use NECPs to integrate planning and implementation of LULUCF objectives.

In short: 1) Wood is scarce and valuable. Avoid incentivising use of primary forestry biomass for energy production. 2) Maximise forest value to store carbon, enhance biodiversity, and provide materials for the bioeconomy. 3) Shift policies from ‘biomass for energy’ to ‘forests for climate and nature solutions’.

1. STATUS OF BIOENERGY IN THE EU

Bioenergy – biomass used for energy – continues to be the largest source of renewable energy in the EU. In 2021, it made up 59% of renewable energy consumption, more than solar and wind energy combined.[10]

TYPES, SOURCES AND USES OF BIOMASS

Bioenergy is created by converting biomass feedstocks into energy. This energy is in the form of heat (75%), electricity (13%), and liquid biofuels or biogas (12%).[11] Forestry or 'woody biomass' is the largest feedstock for bioenergy, followed by agriculture and organic waste.

- **Primary woody biomass** includes roundwood and stemwood used for timber, and primary forestry residues or 'slash' resulting from the harvesting process in the forest. These residues include bark, pitch, stumps, tops and small branches, and make up around 40-60% of total tree volume.
- **Residual or secondary biomass** comes from processing materials not directly derived from the land (i.e., secondary forestry residues like sawdust, pitch, etc.), or from waste biomass like municipal solid waste, food waste, sewage, paper and cardboard.
- **Other types of bioresources** include agricultural biomass – i.e. primary agricultural and energy crops; primary residues like straw, cobs, manure; and secondary residues from processing harvest products – and waste biomass or tertiary residues, e.g., municipal solid waste, vegetable waste, paper and cardboard, sewage sludge, animal-based waste (manure) and mixed food waste.

Primary solid biofuels (or primary biomass) represent the largest share of bioenergy at around 70%. For solid biomass, 66% comes from woody (forest) biomass, organic waste contributes 26% – three-quarters of which is processed in Germany – and agricultural biomass 8%, notably used in Sweden and Finland.

Next to solid biofuels, liquid biofuels account for 13%, biogas and bio-methane for 10%, and municipal waste contributes almost 7% of the overall bioenergy share.

Bioenergy is mainly used for heating and cooling (75%), followed by bioelectricity (13%) and transport biofuels (12%).[12] Heating and cooling is particularly relevant as about half of all energy consumed in the EU is used for these purposes. In the residential sector, about 80% of final energy consumption is used for space and water heating. More than 70% of heating and cooling is still based on fossil fuels, mostly natural gas.

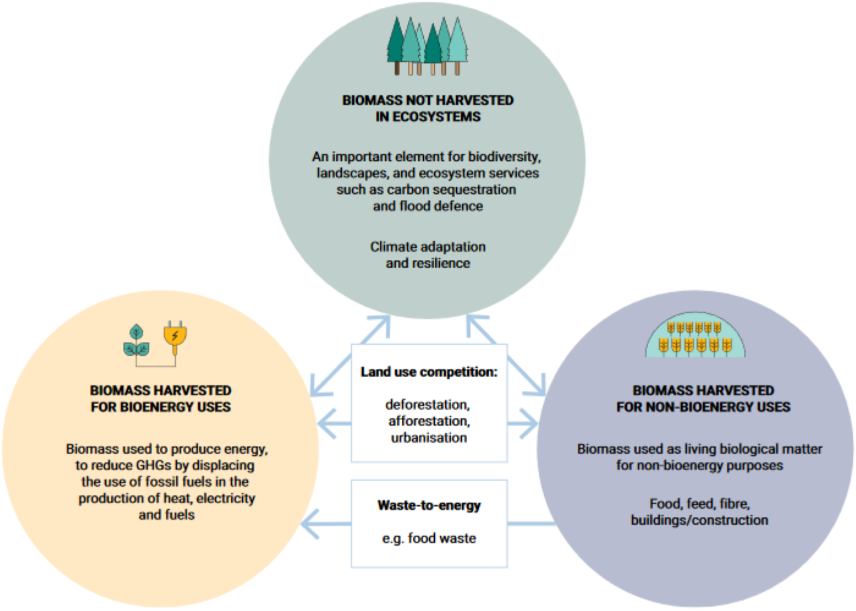
For several heavily forested EU member states, bioenergy offers a substantial contribution to their respective renewable energy targets. The Scandinavian and Baltic countries as well as Austria are the largest consumers of bioenergy on a per-capita basis. The largest overall bioenergy consumption takes place in Germany, France, Italy, Sweden, and Finland.[13]

10 In 2022, according to Eurostat, the overall renewable energy share in the EU reached 23% of total gross final energy consumption, up 1.1% from the previous year, and just over half of the 2030 target of 42.5%. For electricity generation, the renewable energy share in 2022 was 41.2 % (up 3.7% from last year); for heating and cooling, 24.8% (from 11.7% in 2004); and for transport, 9.6% (from 1.6% in 2004).
11 EC – Joint Research Centre (2021)
12 European Commission – Joint Research Centre (2019), Brief on biomass for energy in the European Union
13 Ibid.

DEMAND FOR BIOMASS IS INCREASING

Bioenergy use in the EU has doubled since 2005 and is projected to more than double again by 2050 under the European Commission's decarbonisation scenarios.[14] The increase in bioenergy has contributed to an increase in forest biomass demand. The European Advisory Board for Climate Change (ESABCC) finds that at least 45% of this increase in demand (and likely more) was met by increased harvesting.[15]

Figure 1. The three main uses of biomass: ecosystems, energy, and biomaterials



Source: EEA (2023)

Much of this growth has occurred since 2002, following the EU's first renewable energy policy promoting biomass. Woody biomass has enjoyed political support as a convenient source of energy.

- Biomass can replace fossil fuels using existing infrastructure such as coal power plants while offering electricity generation, heating or cooling, or transportation fuel. It can easily be dispatched and adjusted to match shifting energy demand for power or heat generation.
- As biomass is rated as carbon-neutral in the EU ETS, member states can use bioenergy to simultaneously achieve renewable energy and emission reduction targets.
- Its treatment as carbon-neutral reduces the relative cost of bioenergy use and makes it possible to take advantage of financial incentives for renewable energies.

Biomass demand is growing further by expanding the bioeconomy and increased material substitution – i.e., biomass for pulp and paper, fibre-based products, construction, chemical production, and for conventional food and feed. Next to energy and material (non-energy) uses, biomass in ecosystems refers to non-harvested plants and soils, which are the two largest land sources of carbon storage. Soils store significantly more carbon than vegetation, and wetlands store the largest amount of carbon per unit area, followed by forests.[16] However, living trees and other plants for carbon sequestration, biodiversity and other ecosystem services are rarely included in biomass demand projections.

14 ESABCC (2024)
15 Ibid.
16 EEA (2023), The European biomass puzzle: Challenges, opportunities and trade-offs around biomass production and use in the EU

As a result, imports make up 19% of solid biomass used for energy in the EU. Wood pellets are the main imported biomass feedstock (46%), followed by roundwood (29%), chips, sawdust and other particles (11%), and post-consumer wood (10%).[17] Wood pellets' energy density and stable characteristics make them easy to transport over large distances. Typically made from sawdust from debarked stems, they are used for heating in the residential sector or for electricity production. Since 2019, wood pellet imports have increased by 27% in the EU.

For both categories (wood pellets and chips), Russia was the largest exporter to the EU, followed by the US and Belarus in the case of wood pellets, and Belarus, Norway, and Brazil for wood chips. After Russia's military aggression against Ukraine, stakeholders have expressed concerns about the potential implications for the prices of wood pellet and chip imports.

BIOMASS DEMANDS FACE LIMITS OF SUSTAINABLE SUPPLY

Current use of bioenergy may already be bypassing available sustainable supply[18] and is expected to rise further.[19] According to Material Economics, about 60% of the EU's current biomass supply is used for energy, which translates to just above 6 Exajoules.[20] This demand is expected to at least double to 11-14 EJ by 2050 or may even triple to 20 EJ in more dynamic scenarios. The remaining 40% of total biomass (often neglected in analyses with a sole energy focus) of 4 EJ is used for wood products, pulp, paper, textiles, fibres, etc. Total biomass demand for energy and materials is anticipated to increase to 17-19 EJ, or even up to 25 EJ in some scenarios, an increase by 250% by 2030.

The EU already uses more wood than it can regrow each year. Today, the average forest supply used in the EU is 7.8 EJ per year, but average sustainable supply for biomass from the forestry sector is estimated at only 7.1 EJ per year in 2030, and 6.8 EJ per year in 2050. This indicates that the EU is already surpassing the average limit for sustainable forest biomass supply.[21]

17 European Commission, Directorate-General for Energy (2023), Annex to the Report on Bioenergy sustainability under Regulation EU/2018/1999
18 IEEP (2021)
19 Material Economics (2021), EU Biomass Use in a Net-Zero Economy
20 For reference, 1 EJ corresponds to about 55 million tonnes of wood, or the harvest on 5-7m hectares of land used for energy crops, or 24m tons of oil equivalent, or Mtoe.
21 IIEP (2001)

2. BIOENERGY IMPACTS ON EU CLIMATE TARGETS: 10 INSIGHTS

Biomass for energy has been used extensively by many member states to reach the new renewable energy share target of 42.5% by 2030 in the revised Renewable Energy Directive (RED III). However, increasing harvests of wood for energy[22] create significant trade-offs for the environmental, economic, and social objectives of the European Green Deal. The following section provides 10 insights on bioenergy implications for policy makers and investors.

1. BIOMASS IS NOT CARBON-NEUTRAL

Biomass is not carbon-neutral in the short or medium term for three reasons: 1) Biomass has a carbon payback period that is determined by the time required for forest regrowth. 2) Real-life emissions depend on how woody biomass is used after harvesting. 3) Harvest prevents future carbon sequestration within the living tree and can reduce a forest's overall storage

Biomass is generally assumed to be a carbon-neutral energy source, and this assumption is mirrored in existing legislation. As long as it is harvested according to RED III sustainability criteria, biomass for energy is considered a renewable energy source, and thus excluded from emission allowances under the EU ETS.

The main reason for this classification is the generally accepted yet incomplete understanding of the forest carbon cycle. Forests provide effective storage capacity, as about half of dry wood's weight is carbon. A tree captures a certain amount of carbon over its lifetime. At the time of harvest, all captured carbon within the wood is assumed to be lost immediately irrespective of its use, according to the Intergovernmental Panel on Climate Change (IPCC) and related EU carbon accounting standards.[23] Over time, forest regrowth will balance the carbon emitted from those trees that have been removed.

However, this limited understanding of the forest cycle suggests using woody biomass for energy is carbon-neutral, while in fact, it adds to a significant increase in carbon emissions over the coming decades. There are three main reasons why biomass is not carbon-neutral.

- **This approach ignores the carbon payback period,** the time it takes to store carbon within the tree over its lifetime, which can take up to 60 or even 100 years to regrow. This can lead to large carbon debts that will take decades or even centuries to pay off.[24] These carbon payback periods mean that instead of 'buying time' to address climate change by reducing emissions before 2050, it results in 'selling time' by increasing emissions.
- **Any harvest will prevent future carbon sequestration** in growing trees. If forest residues or slash (like stumps, branches and roots) important for soil carbon and forest growth are removed, it will further decrease the forest's overall carbon storage capacity.
- **The climate impact from alternative uses of biomass is ignored** as all carbon is immediately considered lost at the point of harvest, while real-life emissions depend on what happens to woody biomass after harvesting. Combustion of woody biomass for energy will result in higher emissions than alternative uses.

22 European Commission, Joint Research Centre (2023), Biomass production, supply, uses and flows in the European Union
23 However, these IPCC Guidelines do not automatically consider or assume biomass used for energy as 'carbon neutral', even in cases where the biomass is thought to be produced sustainably. See IPCC Taskforce on National Greenhouse Gas Inventories FAQ
24 EC, Joint Research Group Report (2021)

2: BURNING BIOMASS CAN PRODUCE HIGHER EMISSIONS THAN FOSSIL FUELS

Burning wood emits two to three times as much carbon as fossil fuels for each kilowatt-hour of heat or electricity produced.[25] Woody biomass is less energy dense than fossil fuels. This results in lower energy efficiency when combusting compared to burning coal or gas.

In the EU, coal-burning power plants have higher average net thermal efficiencies (40-45%) than biomass plants dedicated to electricity (20-30%).[26] Comparing technologies and power plants of similar age, woody biomass consistently produces higher emission levels. The lower rates of conversion from biomass into usable energy make it a less favourable alternative to fossil fuels than zero-carbon energy sources. These are energy sources that do not produce carbon emissions while operating, i.e., solar or wind power, or battery storage and release of electricity.

Sustainable sourcing and harvesting practices can conserve carbon stocks in older trees and habitats, and may help to protect biodiversity, but they do not reduce smokestack emissions from combusting woody biomass for energy. Supply chain emissions from harvesting, processing, and transporting woody biomass have a lower impact, but also need to be factored into overall emissions.

Different types of biomass, their use cases, and respective carbon impacts

Types of woody biomass differ in their economic value, their potential use cases, and their thermal efficiencies in terms of energy generation. Their carbon impact compared to fossil fuel emissions depends on how they are used.

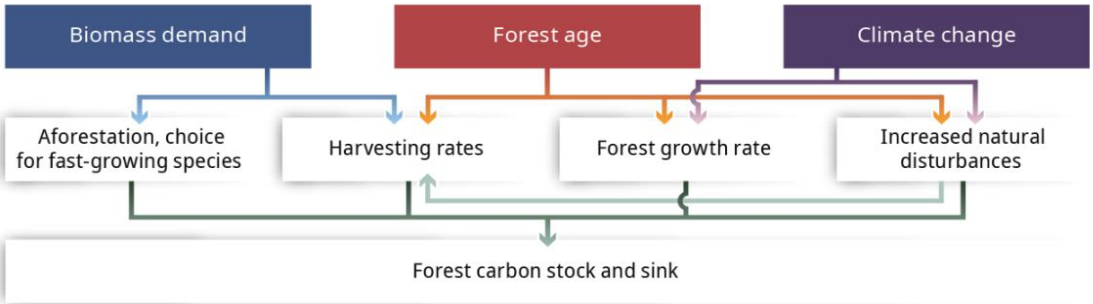
- **Roundwood** is primary woody biomass, i.e., wood in its natural state once felled, used as timber. The harvest of roundwood removes growing carbon stock from the forest. This leads to higher net carbon emissions than those of forest residues or sawmill, as these need to account for avoided future emission that would have been sequestered by the growing tree.
- **Forest residues or 'slash'** are the parts of harvested trees left in the forest after logs for timber have been removed, i.e. stumps, tops and small branches, and pieces too short or defective to be used. These are also primary biomass and can make up 40-60% of total tree volume. Their decay will produce carbon and methane emissions over time, but these are lower and spread over a longer time than emissions from combustion. Removing forest residues also negatively affects soil carbon and forest regrowth, further reducing the future carbon intake of the forest.
- **Mill residues** like sides, bark, shavings, sawdust, trim ends, or offcuts are produced as waste at sawmills and make up 45-55% of the volume of timber. They are generally in demand for fibre products like particleboards, a higher value use than energy retrieval. While their production into pellets has a better climate impact than using primary woody biomass or forest residues, their combustion for energy use is still less efficient than burning fossil fuels and leads to higher carbon emissions per unit of energy produced.
- **Black liquor** is a waste by-product from the process of digesting pulpwood into paper pulp and is highly polluting. It was discharged into the environment in the past but is now generally used on-site for power generation and makes modern pulp and paper mills energy self-sufficient. Burning black liquor for energy is favourable to using other biomass types, as it has no further impact on forest carbon stock, no alternative use next to power generation on-site, needs no transportation, and can be burnt more efficiently.

25 Woodwell Climate Research Center (2021)
26 Chatham House (2018), Woody Biomass for Power and Heat, Demand and Supply in Selected EU Member States

3. HARVESTING BIOMASS FOR ENERGY DEPLETES CARBON STOCKS AND SINKS FOR CLIMATE MITIGATION

Forests are the EU's largest carbon sink, and this sink has been decreasing. Approximately 10% of the EU-27's annual greenhouse gas emissions are absorbed and stored in forest soils and biomass. Despite the forest area increasing by 10% (or 16m hectares) since 1990, the forest carbon sequestration potential has decreased. The main reasons are (i) biomass harvesting rates, (ii) the choice of fast-growing species for afforestation, (iii) reduced forest age and growth rates, and (iv) negative impacts from global warming like extreme weather events, fires, and pests (see figure 2).

Figure 2. Overview of the drivers affecting the forest carbon sink and carbon stock



Source: ESABCC (2024)

To achieve LULUCF targets for 2030 – sequestering 310m tons of CO2 equivalent (MtCO2e) each year – policies need to increase the carbon sink capacity and protect and expand the existing carbon stock.[27] However, the European Environmental Agency (EEA) finds that from 2005 to 2021, net carbon removals have decreased from 342 MtCO2e to only 229 MtCO2e.[28]

At the current rate of decline, most EU countries will fail to reach their 2030 and 2040 land sink targets. The European Commission's own assessment finds that ''*the majority of the draft updated NECPs do not show sufficient ambition and action on land*''. Also, ''*very few Member States show a concrete pathway to reach their national net removal targets, or sufficient actions to assist farmers, foresters and other stakeholders in building sustainable business models in line with these targets*."[29]

By 2040, the Commission estimates that 600m tons of carbon storage in nature will be required to reach proposed climate targets of -90% net reductions. This would require almost tripling current capacity and is not compatible with current biomass demand and harvesting rates. In addition, the EU Biodiversity Strategy includes planting 3 billion trees by 2030, but their carbon payback period and biodiversity benefits will be lower than existing forests in this timeframe. To achieve their objective, the EU would need to plant on average 333m additional trees per year between 2022 and 2030. However, until October 2024, only 23m additional trees have been reported as planted.

27 ESABCC (2024)
28 EEA (2023), Trends and projections in Europe 2023
29 EC, National energy and climate plans: EU countries' 10-year national energy and climate plans for 2021-2030

4. INCREASED BIOMASS USE RISKS ACCELERATING BIODIVERSITY LOSS

Forests contribute to biodiversity and provide ecosystem services like air and water purification, prevent soil erosion, enhance water storage capacity, and moderate air and soil temperatures. In turn, soils enhance forest biodiversity and support tree growth with essential water and nutrient cycling. Forests also increase adaptation capacity and resilience to climate change and extreme weather events.

Primary and old-growth forests cover less than 4% of forest area. Over 90% of forests in the EU are predominantly semi-natural. These old forests are essential for Europe's biodiversity as they are more stable, resistant, and adaptive to disturbances than modified forests. As biomass demands increase, these forests are projected to be under further ecological strain, leading to biodiversity loss, degraded natural habitats, and a decline in ecoservices.

The in-situ benefits of remaining primary forests and other habitats for achieving emission reductions as well as biodiversity objectives are rarely integrated into assessing the value of harvested biomass. The EU's Joint Research Centre has concluded that of 24 forest biomass pathways analysed, 23 pose a risk to biodiversity or fail to achieve emission savings compared to fossil fuels within the next two decades.[30]

5. HIGHER DEMAND FOR BIOMASS INCREASES GLOBAL DEFORESTATION AND ILLEGAL LOGGING

Between 1990 and 2020, an area larger than the European Union was lost to deforestation globally. EU consumption is a big driver of this and causes around 10% of global deforestation, mostly for palm oil and soya. This trend is exacerbated by increasing imports of woody and other biomass for electricity and heating, as domestic supply cannot meet demand. The EU Deforestation Law (EUDR) aims to address this issue by requiring due diligence for supply chains and verification that commodities imported into the EU do not contribute to deforestation or forest degradation.

Annual harvest of wood in the EU would need to increase more than 100% to supply one third of the expanded renewable energy targets in RED III, increasing the demand for imports. At the global scale, supplying 3% of additional energy through woody biomass would require doubling harvesting rates from the world's forests.[31]

Increasing biomass imports include harvests from illegal logging. Belgium, Denmark, Italy and the Netherlands, for example, have imported wood pellets from countries where illegal forest harvesting has been occurring, specifically from Russia, the Baltic states, and eastern European countries. Canada and the US have been increasing their exports of wood pellets to the EU, which are sourced from primary forests and are not subject to sustainability criteria for harvesting.

A European Commission report also found that around 14% of bioenergy used in Europe cannot be traced back to its origin. This highlights the need for improving tracing methodologies for wood sourced for energy and material use, both within the EU and for imports from abroad.

30 EC, Joint Research Group Report (2021)
31 EURACTIV (2018), Letter from Scientists to the EU Parliament regarding Forest Biomass

6. BURNING BIOMASS CAUSES POLLUTION AND HEALTH RISKS

As the use of woody biomass has been increasing, so has its environmental impact. For example, wood burning is now the largest source of hazardous fine particles in the EU, ahead of those from road transport. Increased use of household biomass combustion, which can be cheaper than using coal, gas or electricity for heating, is an increasing source of air pollutants in the EU.

- Health risks include cancers, cardiac, respiratory and pulmonary complaints, asthma and heart attacks, and working days lost to ill health. Scientific estimates of the current contribution of biomass smoke to premature mortality in Europe amounts to at least 40,000 deaths per year.[32]
- Former coal-fired power stations converted to run on biomass or co-fire a combination of biomass and coal cause more severe health impacts than purpose-built biomass plants. Coal-fired power plants are typically larger in size and produce higher levels of sulphur emissions.[33]
- Compared to most other sources of air pollution, emissions from biomass are increasing. The estimated health costs associated with domestic biomass use in the EU are in the range of €33bn to €114bn a year (at 2015 price levels).[34]

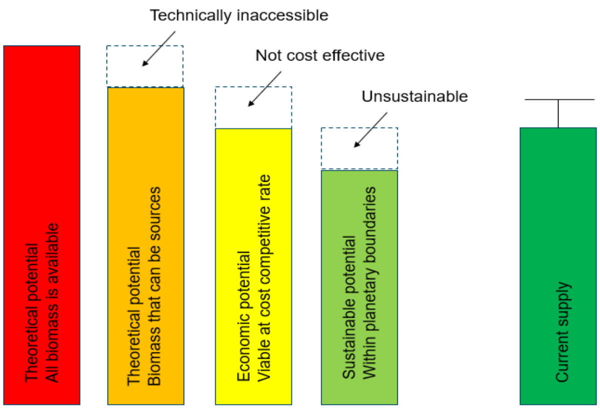
The Commission's impact assessment on the 2040 climate target states that reducing emissions by 90% could reduce premature deaths due to air pollution from 466,000 per year in 2015 to 196,000 per year in 2040, with a related reduction in costs from about €1.7 trillion in 2015 to €670bn in 2040.

7. BIOMASS IS RENEWABLE, BUT SUSTAINABLE SUPPLY IS FINITE

Biomass is a renewable resource that can replenish itself given adequate time. Its regrowth is constrained by various factors, i.e., availability and competing uses; time required for regrowth; and availability of other environmental resources, such as water and fertile soil.

Quantifying the amount of biomass that can be produced and harvested within its regenerative capacity is challenging. One core principle of the sustainability of biomass supply is that harvesting biomass should not deplete stocks of available sources over time but remain at a level of regeneration capacity. This means the sustainable supply of biomass is smaller than the available supply.

Figure 3. 'Available' and 'sustainable' bioenergy supply differs according to its definition



Source: IEEP (2021)

32 Sigsgard et al. (2015), Health impacts of anthropogenic biomass burning in the developed world. European Respiratory Journal. 46(6): 1577-88
33 Fern (2018), Burning biomass: the impact on European health
34 Ibid.

8. ASSESSING THE SUSTAINABLE SUPPLY OF BIOMASS IS HAMPERED BY A LACK OF RELIABLE DATA AND DEFINITIONS

Assessing 'sustainable' supply of biomass is a topic of ongoing debate. This debate is further complicated by a lack of reliable data, consistent monitoring, and agreed definitions. Different stakeholders disagree, for example, if forest 'residues' should only include leftovers from harvesting or also entire trees from thinning forests, or if stumps should be considered as residues or primary biomass.[35] According to the Commission's definition, primary woody biomass is *"all roundwood felled or otherwise harvested and removed [irrespective of its quality], including wood recovered due to natural mortality and from felling and logging [and] branches, roots, stumps".*[36]

There seems to be a growing consensus on the negative impacts on forest regeneration from extracting certain types of biomass, in particular from primary forests, and the value of waste biomass, including agricultural residues and residential organic wastes. However, it is difficult to forecast and ensure consistent supply of waste biomass as there is limited data available. Research commissioned by the EU states that *"the current significant gap in data represents a major obstacle to the effective governance of wood-based bioenergy policies at national scale… Without reliably knowing how much and what type of forest biomass is used for bioenergy, no effective policy can be implemented."*[37]

Bioenergy accounting may overstate its contribution to the transition

Even the role bioenergy plays in the EU's overall renewable energy share may be overstated because of the (internationally agreed) approach of measurement. Bioenergy is measured in terms of 'potential' primary energy, not actual energy output. This means energy lost in the process of conversion from biomass to heating, cooling, or electricity is still included in the measurement of the renewable energy share it provides.

Measuring biomass as primary energy is an international convention, and adopted by most countries, the United Nations, and the International Energy Agency (IEA). The same methodology is applied to other combustible fuels, i.e., natural gas or heating oil. However, for electricity-powered heat pumps, only the real energy output is measured and accounted for, not its overall energy potential. In effect, only around 30% of energy contained in the wood burned in a fireplace is transformed into usable heat, while the remaining 70% is lost in the process. This makes the share of electricity-powered heating from heat pumps seem less significant than heating or power provided by burning biomass.

As a result, the renewable energy share provided by bioenergy looks larger in EU statistics than its actual contribution to heat and electricity. This has shifted incentives for EU member states to use bioenergy to meet their own RES targets, despite the low efficiency of burning biomass.

35 If residues include growing trees or their parts, this will significantly increase the quantity of usable biomass, but it would also increase carbon emissions from additional harvesting and from reduced carbon sequestration capacity. Other examples of disagreement include assessing specific forest carbon stocks or forest areas (without considering their composition, condition, and carbon sequestration potential); applying models that either only consider carbon impacts or include additional biodiversity impacts and benefits; and underlying assumptions on technological change and the shifting policy landscape of future scenarios
36 European Commission – Knowledge for Policy (2024), Glossary: Primary woody biomass
37 EC, Joint Research Group Report (2020)

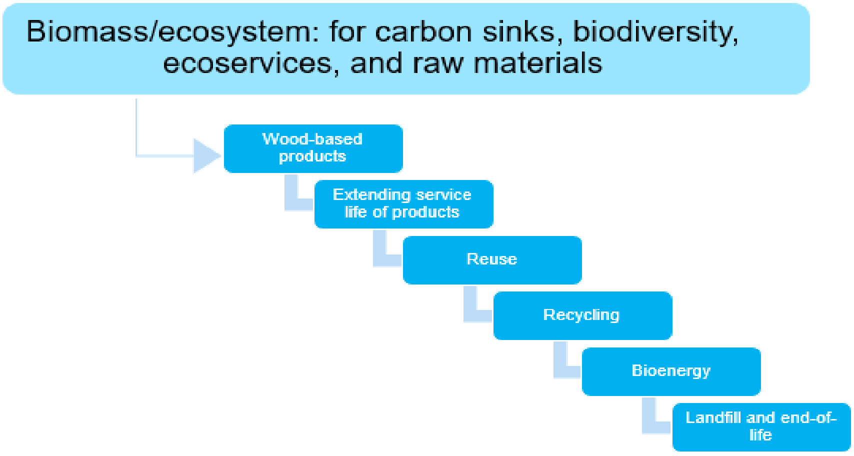
9. BIOMASS SHOULD BE USED FOR ITS HIGHEST ECONOMIC VALUE, INCLUDING IN LIVING FORM

Wood and other bioresources face increasing competing demand from various sectors of the bioeconomy, beyond energy providers. This competition requires a prioritisation of this scarce resource that maximises economic, environmental and social benefits.

The cascading principle establishes a hierarchy of sequential use of biomass that aims to maximise its value by keeping it at its highest level for as long as possible. Priority is given to high-value uses of wood to create a circular bioeconomy that reuses and recycles products and raw materials as much as possible. Energy use is reserved as a last resort after other options have been exhausted, and the remaining waste or residues have no further value.

The ecosystem perspective, i.e. the value of biomass beyond its use in the bioeconomy, is generally excluded from the cascading principle, as it precedes the material use of wood or other bioresources. Biomass not harvested in ecosystems provides an important element biodiversity, landscapes, and ecosystem services such as carbon sequestration and flood defence.[38]

Figure 4. The cascading principle for biomass including its ecosystem functions



Sources: Based on EEA (2023), IEEP (2021), SAF (2021)

The cascading principle is crucial to support a growing bioeconomy. While different sectors are competing for limited supply, the highest-value material uses of biomass should be established at a level above individual economic sectors, which have an inherent incentive to evaluate climate impact according to biomass inputs for their own value chain. The cascading principle helps prioritise the material use of bioresources – and where possible, reuse and recycle – across various use stages according to its utility. Any effective assessment of woody and other biomass use aligned with EU climate and nature objectives needs to assess its economic impact on different bioeconomy value chains (beyond its energy potential), while including in-situ benefits of leaving ecosystems such as forests intact.

The limit to the sustainable supply of biomass increases the importance of organic waste streams. End-of-life biomass has already passed through various use-phases and no longer provides any climate or biodiversity benefits, and thus has no remaining use cases other than energy recovery.

38 EEA (2023)

10. 'OPTIMAL' USE OF BIOMASS REQUIRES A CROSS-SECTORAL ASSESSMENT

Biomass is a scarce and valuable resource that must be strategically managed to prioritise the uses with the highest economic, environmental, and societal value. Such a prioritisation requires assessing climate benefits from harvesting biomass use (and avoided emissions from fossil fuels) and comparing these with in-situ benefits from living biomass (and their carbon capture and storage over time). Prioritisation should also account for the rapidly evolving technology landscape, where electrification, batteries, green hydrogen, and new chemistry provide more viable alternatives.[39] A holistic assessment of different use cases for biomass – as an energy source, material input for the bioeconomy, or nature-based climate solution with co-benefits for biodiversity – helps decide on its most efficient potential for sectoral decarbonisation, while enhancing carbon sinks and potentially removing GHGs from living forests.

National energy and climate plans (NECPs) may help member states to integrate different targets and make inherent conflicts of objectives transparent, for example, between increasing the share of renewable energy, providing a sustainable supply of biomaterials to decarbonise the economy, and increasing carbon sink capacity from domestic natural habitats. An improved monitoring framework would measure biomass supply and expected demand for the energy sector, bioeconomy inputs, and LULUCF objectives.

39 PFPI (2022)

3. BIOENERGY RISKS AND RECOMMENDATIONS FOR INVESTORS

The use of biomass for energy competes with an increasing variety of alternative land use cases. Forests and other natural habitats may be used to grow food or feedstock, produce raw materials, store carbon for climate mitigation, or enhance biodiversity and increase adaptation capacity to extreme weather events. This growing competition for scarce land resources and uncertainty about available bio-feedstocks increases risk for investments in biomass supply chains, bioenergy operators, and infrastructure and utilities.

Many well diversified asset owners and managers are exposed to bioenergy power and cogeneration. Funds dedicated to 'renewable' investment may also include bioenergy projects. Given the challenges biomass presents for net-zero emission strategies – at EU level, for member states, and for individual companies – such holdings translate into significant portfolio risks, as laid out below, and warrant a cautious approach from investors.

MARKET RISK

The Inevitable Policy Response (IPR), a climate transition forecasting consortium commissioned by the PRI, forecasts policy responses to climate change to prepare institutional investors for portfolio risks and opportunities. According to IPR, rising demand for bioenergy is facing increasingly limited supply and regeneration capacity. Factors driving this increasing demand-supply gap include (i) growing land scarcity, (ii) growing demand for biomass for other uses like the bioeconomy, and (iii) the upscaling of zero-carbon renewable energy options with consistently falling costs, all affecting (iv) the growth potential for bioenergy.

- Land scarcity implies sustainable sourcing policy is expected to constrain bioenergy. Solar panels, for example, can produce 100 times as much power per acre as biomass. Conversely, just 2% more global energy from biomass is estimated to double total global wood harvests – leaving even less arable land and essential ecosystem services necessary for producing new biomass.
- Bioenergy investment risks become more pronounced as competition for biomass increases. The demand for biomaterials within a circular net-zero economy will increase, not just for pulp and paper, but also for the chemical industry, construction, manufacturing, and packaging, displacing high-emission materials like cement, steel, and plastics. More biomass will be needed for higher-value applications instead of combustion for energy generation.
- Decreasing costs for alternative renewable energy options will further reduce the economic viability of bioenergy. As upscaling and economies of scale continue to make zero-carbon energy sources cheaper, many traditional bioenergy applications will become less competitive. Wind and solar power, electric heating with heat pumps, and falling battery storage costs already provide cost-efficient alternatives. In contrast, bioenergy uses large quantities of increasingly scarce and valuable biomass for low value combustion.
- The overall growth potential for bioenergy will be negatively affected by increasing competition for scarce land, alternative use cases for biomass, and cheaper renewable energy alternatives. Bioenergy will remain relevant in some niche markets, like maritime transport, aviation. The use of organic wastes is expected to grow in importance.

Sectoral uses for biomass: transport, storage, waste

As biomass resources are becoming scarcer and more expensive, future market applications for biomass will become more niche:

- **Shipping and aviation** are sectors where it is notoriously difficult to lower emissions, and they will require increased green hydrogen production. As long as no feasible alternative is available at scale, biofuels will continue to play a role. The use of renewable fuels from non-biological origin (RFNBOs), i.e., fuels produced by carbon-neutral renewable energies like solar and wind, will need to increase significantly.
- However, other modes of transportation can be more easily electrified, for example replacing gasoline-powered cars with **electric vehicles.** For these sectors, biofuels are too costly and not available at scale to be an effective solution for the mass market. Instead, they need be prioritised for those sectors that do not yet have feasible alternatives.
- **Bioenergy carbon capture and storage** (**BECCS)** is an emerging market, specifically for power and cement industries. However, BECCS projects face scientific concerns that affect (and potentially negate) its climate impacts, based on misguided assumptions of (i) additionality, (ii) carbon neutrality of biomass, (iii) the climate impacts of eligible biomass feedstocks on forest biomass extraction, and (iv) emissions from on-site energy for the carbon capture and storage process. Its growth is further constrained by high land opportunity costs combined with increased competition from direct air carbon capture and storage (DACCS), which is expected to be more cost-competitive than BECCS by 2050.
- Making use of **biowaste and residues** from agriculture or households for energy will become more economical and can be expected to make up a growing share of feedstock as a more sustainable alternative to the common first-generation crops (which compete with food production). Retrieving energy from residues and waste streams with no alternative use cases is in accordance with the cascading principle.

POLICY AND LEGAL RISK

Investor appetite for bioenergy is dependent on four factors: (i) the definition as a sustainable investment (and if it causes environmental harm); (ii) its growth potential; (iii) return on investment; and (iv) risk profile. All of these factors are shaped by policy decisions.

- Policies including RED III strengthen **sustainability criteria** by limiting sourcing of biomass, phasing out direct financial support, and prohibiting its use for electricity-only generation, but also leave loopholes that encourage the use of bioenergy today. Aligning criteria for biomass use with science-based emission reduction pathways and climate targets, and renaturation efforts as mandated by the Nature Restoration Law, will progressively narrow the types and sourcing of biomass defined as sustainable.
- The Deforestation Law applies greater **due diligence requirements** to biomass supply chains to avoid imports that contribute to deforestation, which will affect imports of unsustainably sourced pellets, wood chips, and other harvests. These new requirements increase compliance risks for bioenergy or other biomass-related investments that have previously relied on voluntary certification schemes for sustainability criteria set in RED III. For example, the EU has imported illegally logged woody biomass from old forests from Canada, the US, Russia, and from intra-EU trade.[40]
- The **return of investment** for bioenergy is largely dependent on tax, subsidies and other financial incentives. It will become more difficult for EU member states to rely on biomass to achieve renewable energy targets as they have to implement Fit for 55 policies to achieve mandatory

40 PPFI (2022)

climate targets for 2030. The Commission's climate target of -90% emission reductions by 2040 requires almost doubling carbon sinks from 2030 targets. As member states need to remove incentives and financial support for biomass to bolster their carbon sink capacities, the attractiveness of biomass investments will continue to decline.

- Biomass policies are also susceptible to **legal risks** regarding negative impacts on climate mitigation. Environmental groups are taking the UK government to court over plans to support BECCS to deliver 'negative' emissions as part of its biomass strategy. This case could also impact the EU, where the provisionally agreed Carbon Removals and Carbon Farming (CRCF) Regulation – creating the first EU-wide voluntary framework for certifying carbon removals, carbon farming and carbon storage in products across Europe – includes BECCS as a negative emissions strategy. EU funding for converting existing heat and biomass powerplants into BECCS facilities may also be subject to legal challenges.
- **Clean air standards and regulation** causes further legal risks, given bioenergy accounts for about half of emissions of fine particulate matter (PM2.5) across the EU. For example, Germany and the UK are both being sued over unlawful pollution levels. Energy companies face court cases for 'misleading' claims on the carbon neutrality of biomass, or have had to settle legal claims of air pollution from bioenergy plants fuelled by wood pellets.

CLIMATE DISCLOSURE AND TRANSITION PLAN RISK

Many institutional investors and asset owners have committed to align their portfolios with the Paris Agreement, and investing into renewable energies is a common strategy to shift capital allocation towards green assets. However, increased scrutiny of bioenergy in decarbonisation may increasingly throw investors' net-zero transition pathways off track.

The **Science-Based Targets Initiative's (SBTi)** Corporate Near-Term Criteria and its new Corporate Net Zero Standard specify that *"CO2 emissions from the combustion, processing and distribution phase of bioenergy – as well as the land-based emissions and removals associated with bioenergy feedstocks – shall be reported alongside a company's GHG inventory"* and *"be included in the target boundary when setting a science-based target."*

The SBTi strongly recommends companies to integrate the carbon payback period of the companies' biomass use into their accounting methodologies until a standardised method for bioenergy GHG accounting is developed under the GHG Protocol. This requirement for companies to increase transparency by more accurately accounting for CO2 emissions from biomass use may reduce the attractiveness of bioenergy investments for climate-conscious investors. It also affects investors who may need to disclose substantially higher financed emissions related to bioenergy, putting their own emissions reduction targets and timelines at risk.

REPUTATIONAL RISK

Reputational risks of bioenergy investments feature on the local and the global level. At the local level, residents may protest the negative impacts of nearby bioenergy power plants, as recent examples from India, Ireland, and the UK show. These impacts may include deforestation, water pollution, reduced air quality, and related health issues. Asset owners and investors face the risk of being associated with local conflicts and face increased political and media attention for their ownership decisions.

At a global level, exposure to bioenergy projects and related harvesting of biomass may diminish credibility of companies' climate and sustainability reporting efforts. The reputational risk increases if investors have publicly committed to the Paris Agreement. Investors' science-based climate transition plans and targets, based on disputed assumptions about the climate impacts of different bioenergy types, may come under attack from increased public scrutiny. Global supply chains are increasingly complex and carry the risks of receiving biomass obtained from illegal logging practices, which may lead to further international scrutiny, media attention, and public backlash.

Challenges for EU voluntary certification schemes in RED III

The European Commission has approved certain voluntary schemes to ensure compliance with RED III's sustainability and emission savings criteria, and to lay down specific rules describing the certification process. However, the reliability and effectiveness of these voluntary schemes is constrained by limited independent oversight and quality assurance by the Commission or other independent bodies.

An assessment from the European Court of Auditors concludes that *"because of weaknesses in the Commission's recognition procedure and in the subsequent supervision of voluntary schemes, the EU certification system for the sustainability of biofuels is not fully reliable".*[1] Reasons include a lack of regulatory clarity on assessment requirements; a lack of supervision on technical assessment and compliance with these regulations; inadequate supervision of certification bodies; a lack of transparency over quality assurance of auditors and audit conduct; and inadequate monitoring of certification bodies by member states, according to RED III requirements.[1]

In contrast, voluntary certification is not sufficient for compliance with the EUDR, where operators must instead report their due diligence requirements to public competent authorities set up by member states for regulatory oversight. This higher compliance threshold for EUDR may increase risks for investors previously relying on inadequate certification schemes.

RECOMMENDATIONS FOR INVESTOR ENGAGEMENT TO REDUCE RISKS

To mitigate these risks – i.e., market, policy, legal, disclosure and reputational risks – investors should be aware of the type of biomass harvested and / or used in their investee companies, for energy and other purposes. This includes its sourcing, the location of harvest, the practice of harvesting, regrowth periods for embedded and future carbon removals, and alternative use scenarios. More transparency and better data on these issues is required to identify portfolio risks and alignment of bioenergy investments with decarbonisation and transition planning.

Investors can reduce bioenergy risks through stronger engagement with utilities, the forestry sector, and relevant stakeholders. They should require transparent and credible data from investee companies on applying the following measures:[41]

- Quantify and minimise full lifecycle GHG emissions for utilities
- Measure and disclose the GHG intensity (gCO2/MJ or kgCO2/MWh) of their operations, including long-term loss of carbon from forests, cultivation, processing, transportation and, most significantly, combustion emissions.
- Maximise energy efficiency measurements along their supply chains, production capacities, and operations.

41 See ShareAction (2019), The Biomass Blind Spot

- Audit supply chains by excluding suppliers of biomass with unsustainable harvesting practices, i.e.:
  - harvesting from natural forests and other vulnerable ecosystems, with high carbon stocks, like wetlands and peatlands;
  - converting natural ecosystems (forests, grasslands or wetlands) into managed or plantation forests;
  - clear-cutting in any type of forest (natural, managed, or plantation); and
  - harvesting solely for bioenergy.
- Maximise the proportion of harvest used in long-lived material wood products such as those used in construction and minimise the volume of forest residues used for bioenergy.

For more details on recommended investor engagement questions for forestry and utilities sectors, see **Annex I.**

4. EU POLICIES THAT AFFECT BIOENERGY

Climate, energy, nature and bioeconomy policies can only be understood together as part of the EU's overall Fit for 55 package.

Bioenergy policies affect not just energy, but also climate mitigation, climate adaptation, and biodiversity objectives, which are all part of the Fit for 55 package to reduce emissions by 55% by 2030. The package covers at least 13 legislative files with policy instruments including pricing, targets, rules, and support measures, across energy, industry, transport, buildings, and land use sectors.

The table below provides an overview of EU climate policies most relevant for biomass use for energy, climate, and nature objectives, followed by a snapshot of key policies and their impact on biomass use, sustainability criteria, and climate mitigation potential.

EU policy	Biomass relevance	Climate relevance
1. Renewable Energy Directive III	■ Recognises biomass resources are limited and not all uses are sustainable by default. ■ Introduces sustainability criteria, caps harvest of certain types of biomass, and limits financial support for large-scale energy use. ■ Identifies biodiversity risks.	■ Limits biomass for energy use, thus providing more potential forestry for carbon sinks. ■ Does not explicitly address trade-off of wood-for-energy vs forest-for-carbon.
2. Land, Land Use Change and Forestry (LULUCF) Regulation	■ Accounts for emissions from harvested biomass for any use, including biomass for energy that is treated as carbon-neutral in ETS (and does not require carbon allowances) or RED III. ■ Enables assessment of in-situ benefits of biomass.	■ Incorporates GHG emissions and removals from LULUCF into EU 2030 climate and energy targets. ■ Introduces binding commitment to GHG emissions in forestry and land use for all member states for 2021-2030.
3. EU Forestry Strategy for 2030, and EU Deforestation Regulation (EUDR)	■ Recognises the relevance of sustainable forest management for biodiversity goals while developing a circular bioeconomy. ■ Requires using woody biomass efficiently and only within sustainability boundaries, according to the cascading principle. ■ Law prohibits imports of products and biomass related to deforestation outside the EU.	■ Includes protection of primary forest and restoration of degraded forest, and actions for increased carbon sequestration through enhanced stocks and sinks. ■ Announces legal proposal to improve monitoring, reporting and data collection on forest in the EU, including data harmonisation.
4. EU Biodiversity Strategy 2030, and Nature Restoration Law (NRL)	■ Describes mission to "put biodiversity on a path to recovery by 2030". ■ Long-term plan to expand protected areas, propose mandatory targets for nature restoration (aligned to Global Biodiversity Framework), integrate biodiversity into overall EU policy, and step up EU global action on biodiversity.	■ Stresses how biodiversity and climate challenges from unsustainable use of biomass supply (in EU and globally) need to be assessed together. ■ Headline target of 30% of EU area under protection likely to decrease available land use for biomass harvesting but increases carbon sink and stock potential. ■ Part of the EU Nature Restoration Plan.

5. EU Bioeconomy Strategy (2012, updated in 2018)	■ Launched in 2012 to support sustainable and inclusive growth and competitiveness in the EU. ■ Updated in 2018 with Circular Economy Action Plan to emphasise the necessity of a circular bioeconomy for achieving SGDs and Paris Agreement objectives.	■ Increases demand for biomass for bioeconomy sectors, while acknowledging ecological boundaries for its use. ■ Promotes higher-value and resource-aware circular biomass use that improves climate impacts compared to high-emission energy use.
6. The EU Taxonomy on Sustainable Finance	■ Core element of EU Sustainable Finance framework to improve financial flows towards sustainable economic activities, including those related to biomass production and use, i.e., forestry (afforestation, reforestation, forest management, conservation forestry) and energy use from biomass. ■ References national and RED III sustainability criteria. ■ Applies sustainability criteria for green portfolio decisions and financial flows to bioenergy uses.	■ Introduces technical screening criteria, thresholds, and metrics to define whether an economic activity (like forest management) contributes to climate mitigation or adaptation, and eventually to biodiversity and circular economy impacts. ■ Delegated Act criteria for Forestry and Bioenergy is foreseen for review in accordance with biodiversity and climate neutrality ambitions.
7. National Energy and Climate Plans (NECPs)	■ Member states required to submit integrated 2030 NECPs on national contributions to EU energy-climate targets and achieving proposed national targets by 2030, as part of the Governance Regulation on Energy and Climate Action. ■ Include data on bioenergy, estimated demand, end uses, and feedstocks and origin.	■ NECPs need to include the current and projected use of biomass for energy across different sectors, and its expected impact on carbon sinks, i.e., the impact that wood harvest and other land use will have on carbon sequestration capacity from the LULUCF sector.

Source: Based on IIEP (2021)

The different regulations relate to and interact with each other, for example by providing sustainability thresholds and compliance criteria for biomass harvest. They also provide competing policy objectives for different uses of biomass.

- While sustainability criteria in RED III for harvest-eligible biomass and its use have been strengthened, loopholes remain regarding sustainable sourcing and financial incentives. Monitoring compliance with these criteria remains a challenge, which may be addressed by applying mandatory traceability criteria as required by the EUDR.
- RED III sustainability criteria affect the treatment of bioenergy both in the ETS (by requiring allowances for biomass that does not fulfil these criteria) and for the classification as a sustainable economic activity in the EU Taxonomy.
- Evaluating the impacts of biomass harvest for energy use on national carbon sinks and LULUCF targets requires better data and reporting by member states in their NECPs.
- The Regulation on a Forest Monitoring Framework (FMF) should be adopted and implemented to provide baseline data for EU forest health, tree growth, harvesting practices, monitoring and estimates of future carbon sinks and stocks, and biodiversity impacts.

For a summary of individual key policies relevant for biomass use, see **Annex II.**

5. POLICY PRIORITIES AND RECOMMENDATIONS FOR POLICY MAKERS

In short: 1) Wood is scarce and valuable. Avoid incentivising use of primary forestry biomass for energy production. 2) Maximise forest value to store carbon, enhance biodiversity, and provide materials for the bioeconomy. 3) Shift policies from 'biomass for energy' to 'forests for climate and nature solutions'.

Scarce and valuable biomass has a core function in supporting the EU net-zero climate transition. Within the Fit for 55 package, bioenergy can help to decarbonise the EU energy system, but **only where it provides significant, near-term cuts in emissions compared to fossil fuels.** A coherent EU whole-of-government strategy is necessary to take advantage of the in-situ benefits of living biomass for policy objectives to achieve climate targets, as well as to enhance biodiversity, restore nature, and bolster the circular bioeconomy.

Governing the production and use of biomass needs to consider ecological boundaries, deforestation, land use competition, data gaps, policy incentives, diverging stakeholder interests, and other related 'wicked' policy issues.[42] In the absence of such a systematic and coherent governance framework, there is a lack of clear market signals to biomass suppliers and users, or a common terminology for sustainability criteria.

Given increasing demand and competing use cases for biomass, bioenergy use at current levels and for current use cases is not consistent with the EU's climate or nature objectives. To address these challenges and trade-offs while taking advantage of co-benefits, bioenergy and related policies need to better align with (A) **nature-based climate solutions,** (B) **financial incentives for biomass use,** and (C) a **coherent cross-sectoral governance framework.** Measures are recommended for policy makers at different levels, both at the EU and in member states (see figure 5).

Figure 5. Policy recommendations for policy makers at different levels

	A. Shift from 'biomass for energy' to nature-based climate solutions	B. Consistent price signals for emissions from bioenergy	C. A coherent governance framework for biomass
EU co-legislative bodies	Provide a cap on biomass for energy in RED III	Remove all financial support and incentives for primary biomass for energy	Apply the cascading principle to ensure high-value biomass use, including in-situ benefits
EU co-legislative bodies and member states	Prioritise biomass for carbon sinks and LULUCF objectives	Harmonise data collection, monitoring, and GHG accounting for biomass use for energy	Use NECPs to harmonise bioenergy use with LULUCF objectives

42 Wicked problems are characterised by complex interactions, gaps in reliable knowledge, and enduring differences in values, interests and perspectives. See Brian Head (2022), After half a century of 'wicked' policy problems, are we any better at managing them?

A. SHIFTING FROM ‘BIOMASS FOR ENERGY’ TO NATURE-BASED CLIMATE SOLUTIONS

In short: Burning primary woody biomass increases CO2 emissions compared to fossil fuels while diminishing forests that are critical for carbon removals and ecosystem services. Instead of harvesting biomass for energy, forest carbon stocks and sinks need to be restored and enhanced to achieve 2030 climate targets, as well as nature and biodiversity objectives.

A continuous expansion of carbon sinks is necessary to achieve 2030 climate targets, and nature-based carbon removals will need to increase for climate neutrality. Carbon sink capacity in the EU has been decreasing, due to harvesting of biomass, as well as impacts from climate change and natural disturbances. This trend needs to be reversed, by assessing the in-situ benefits from carbon sequestration in forests and comparing these with the benefits from using biomass for energy or for material substitution.

Biomass supply needs to remain within sustainable limits. Demand has been increasing since the early 2000s – in large part due to EU bioenergy policies incentivising the use of biomass – but sustainable supply is limited by external factors and cannot exceed its regeneration capacity. Climate change impacts and natural disturbances are increasing pressures on forest ecosystems and their resilience, and the availability of biomass. To avoid negative outcomes for climate targets, LULUCF and biodiversity objectives, or for other countries from which biomass is imported, the aggregate demand for biomass needs to stay within ecologically sustainable and regenerative boundaries. This requires prioritisation of end uses for limited biomass supply.

Applying the cascading principle should ensure the highest-value material use for biomass and reduce pressures on available supply. High-value uses include pharmaceuticals, chemicals, textiles and new low-carbon materials, and long-lasting wood products. Other materials based on woody biomass have lower value but few feasible alternatives, for example pulp and paper, or transitionary biofuels for aviation and maritime transport. The view of biomass mainly as a bulk contribution to renewable energy targets needs to shift to areas where the unique properties of biomass – both in its living form (with the highest carbon storage potential) and after harvesting – provide the greatest contribution to climate neutrality, biodiversity, and a net-zero economy.

The type, sourcing, and use case of biomass all affect its carbon and environmental impact. Any biomass harvest will cause additional GHG emissions – even if sustainability criteria set in RED III are applied – but its carbon impact differs according to its type, sourcing, and its use. Biomass from wastes and residues from wood processing or other secondary sources should be used (and prioritised over primary biomass harvested solely for energy), except if (i) a better and higher-value use case exists (according to the cascading principle), (ii) the residues would otherwise provide significant benefits to soil carbon and fertility, or (iii) its use for energy would cause adverse impacts on biodiversity.

B. CONSISTENT PRICE SIGNALS FOR EMISSIONS FROM BIOENERGY

In short: Policy signals, financial incentives, and harmonised GHG accounting of energy from biomass need to be aligned with 2030 and 2050 climate targets across all relevant policies to discourage investments that lead to carbon lock-in and stranded assets. This requires better data collection and comparable monitoring for EU member states collaboration on forest strategies.

Price signals and financial incentives, for example in RED III, are strong policy levers to provide market information on the use of biomass for energy. The forestry sector receives a stable level of subsidies totalling €16bn each year, which could otherwise support zero-carbon energy alternatives.[43] More than half of the wood harvested in the EU is used for energy, mainly for residential heating. In many cases, more sustainable alternatives to biomass are readily available, especially for energy generation. The use of wind and solar power generation and electric heat pumps for heating and cooling provide low or zero-emission alternatives that are increasing in market share and can be accelerated by shifting existing subsidies for biomass.

Financial incentives need to shift from favouring imports of zero-rated wood to supporting investments in home-grown renewable energy solutions. Misplaced incentives that do not align with long-term policy objectives create material risks for investors. Net-zero transition investments needs to be encouraged to replace infrastructure that creates long-term carbon lock-in and increases the risk of stranded assets. Simultaneously, investment opportunities for above-mentioned renewable energy alternatives will continue to increase.

Better carbon accounting should end the current zero-rating of most primary biomass for energy use under ETS rules, for example by expanding the sustainability criteria in RED III and the EU Taxonomy to exclude primary biomass use for energy. In accounting terms, the question of which sector can appropriate forest carbon sinks (part of LULUCF sector accounting), and how increasing biomass demand affects these sinks, remains a challenge for determining a sustainability threshold.

For example, electricity production is currently subject to the highest prices for carbon allowances under the EU ETS, whereas the absence of a pricing mechanism for agriculture and LULUCF means that bioenergy ‐ as long as it is sourced according to RED III sustainability criteria – is not covered by any carbon price. As a result, the EU carbon pricing regime favours bioenergy use over electrification technologies, and increases the risk of carbon lock-in, for example from continued use of coal plants while replacing feedstocks with bioenergy.

Only biomass that does not fulfil RED III sustainability criteria requires ETS allowances, according to EU Guidance, but certification of compliance by operators can be inadequate. However, all primary biomass used for energy should require ETS allowances according to their emission levels, unrelated to their sourcing. Current GHG accounting does not consider bio-recovery times of harvested trees and subsequent carbon payback periods for emissions, or different climate impacts from different use cases of biomass (for example from energy or material use).

43 EC, Directorate-General for Energy (2021), Study on energy subsidies and other government interventions in the European Union

C. A COHERENT GOVERNANCE FRAMEWORK FOR BIOMASS

In short: A comprehensive governance framework needs to prioritise the use of biomass among competing use cases. In this regard, it needs to harmonise RED III, LULUCF, NRL, ETS, the EU Taxonomy and related policies on energy, biomass, material use, climate mitigation, resilience, and nature restoration.

Bioenergy policies need to be integrated in a holistic biomass governance framework that balances energy, climate, and nature objectives for 2030 and 2050, while increasing biodiversity, ecosystem resilience, and climate adaptation capacity. A cross-sectoral whole-of-government approach should inform decisions about how the EU produces and consumes biomass, for which purposes, and how incentives and implementation mechanisms across different policies will shape overall biomass demand up to 2050.

Setting policy priorities for competing biomass demands requires comparing environmental performance, climate impacts, nature restoration and biodiversity benefits, and material value for the bioeconomy. A careful assessment of economic, societal and ecological costs, co-benefits, and trade-offs should guide which competing biomass functions to take advantage of, such as:[44]

- **remove** CO2 from the atmosphere by increasing carbon sequestration in Europe's ecosystems and ensuring long-term carbon storage both in living biomass and biomass products;
- **reduce** the climate change and environmental impacts of biomass production and consumption within and outside the EU and make biomass production systems more resilient to those impacts;
- **replace** fossil and mineral-based materials with bio-based materials and products to reduce GHG intensity / emissions;
- **restore** nature and biodiversity to maintain the diversity of European landscapes; and
- **reuse and recycle** to make the best use of bio-based materials and products in relation to their economic and environmental value.

EU policy needs to break up existing policy silos to assess the different functions and services biomass has to offer as an energy source, for material purposes, and in its living form. Aligning sustainability criteria, net-zero emission objectives, carbon accounting, and financial incentives **across RED III, LULUCF, NRL, ETS, the EU Taxonomy and related policies** would strengthen a coherent and effective implementation of National Energy and Climate Plans (NECPs).

These NECPs should align renewable energy from biomass use with LULUCF projections and targets, while ensuring biomass supply for an expanding circular bioeconomy. They should include data from nature restoration plans (e.g., on forest structure, deadwood and abundance of birdlife) as mandated in the NRL and the 2030 Forestry Strategy. The Regulation on a Forest Monitoring Framework (FMF) should be adopted to provide more granular and comparable data on forest health, restoration, and carbon sink capacity and projections. Finally, Common Agriculture Policy (CAP) Strategic Plans mandated for each member state should also incorporate the impact of national land use objectives and biomass use on climate mitigation targets.

44 EEA (2023)

RECOMMENDATIONS FOR POLICY MAKERS

A. SHIFTING FROM 'BIOMASS FOR ENERGY' TO NATURE-BASED CLIMATE SOLUTIONS

A1. Provide a cap on biomass for energy in RED III

- **Restrict the volume of primary woody biomass** that can count toward renewable energy targets in RED III. Contributions to the renewable energy share from bioenergy for power and heating should be limited in the same way they are for biofuels and be phased down over time in line with LULUCF targets for 2030 and 2050.
- **Specify a science-based definition of primary biomass in RED III,** following the Commission's definition of primary biomass based on international conventions that includes all roundwood felled or otherwise harvested and removed, including branches, roots, and stumps.
- **Prioritise the use of biogenic wastes and residues for energy** where those materials have no significant alternative uses – for example for furniture or pulp and paper production – and have no adverse environmental impacts on soil fertility or carbon sequestration, following the 'do no significant harm' (DNSH) principle of the EU Taxonomy.

A2. Prioritise biomass for carbon sinks and LULUCF objectives

- **Enhance the carbon storage potential of living biomass for LULUCF requirements** for 2030 climate targets. Evaluate the in-situ benefits of growing carbon sinks and stocks in forests and co-benefits for ecosystem health and biodiversity compared to biomass harvest for energy and materials.
- **Adopt the Regulation on a Forest Monitoring Framework (FMF) as proposed by the European Commission in November 2023 to provide an integrated, EU-wide database** on forest health and regrowth, deforestation and afforestation rates, resilience against environmental hazards, and carbon sequestration potential. Member states should include this information in their NECPs to improve science-based policy decisions, risk assessment and preparedness, and enable more effective EU-wide cooperation to set long-term forest plans for LULUCF and other policy objectives.
- **Strengthen monitoring, reporting and verification for forest biomass use for EU member states.** This should include using the FMF as an EU-wide database and monitoring system to provide up-to-date, complete and accurate oversight of national forest biomass harvest for energy use. The EUDR should provide comprehensive guidance for operators on applying harmonised traceability and reporting requirements for woody biomass.
- **Provide additional revenue streams for forest industries and owners,** as laid out in the Carbon Removals and Carbon Farming (CRCF) Regulation.

B. CONSISTENT PRICE SIGNALS FOR EMISSIONS FROM BIOENERGY

B.1 Remove financial support and incentives for primary biomass for energy

- **End subsidies and other incentives for using primary woody biomass**, i.e., roundwood and primary forest residues like tree stumps and branches harvested directly from the forest (not from industrial by-products or secondary residues).

- **Shift subsidies and financial incentives to zero-carbon fossil fuel substitutions,** including energy efficiency and other demand reduction measures, low and zero-carbon sources such as solar and wind power, energy storage and heat pumps, or synthetic fuels produced with renewable electricity (like green hydrogen).

B2. Harmonise data collection, monitoring, and GHG accounting for biomass use for energy

- **Improve GHG accounting methodologies to include emissions from burning primary biomass** for energy in sustainability criteria within climate-related EU legislation. This includes the ETS, RED III, the Corporate Sustainability Reporting Directive (CSRD) and European Sustainability Reporting Standards (ESRS) 1 on climate emissions, and Taxonomy technical screening criteria for biomass use for energy, heating, and fuels. A holistic assessment should follow science-based recommendations from the European Scientific Advisory Board on Climate Change (ESABCC) and consider emission impacts from different biomass use cases, the respective carbon debt period, and foregone carbon sequestration from harvested trees.
- **Ensure the renewable energy share (RES) of different energy sources** is calculated using comparable methodologies. This applies specifically to biomass, which is measured on energy potential (excluding efficiency losses) compared to electricity-based solutions that use final energy outputs only.

C. A COHERENT GOVERNANCE FRAMEWORK FOR BIOMASS

C1. Apply the cascading principle to maximise biomass value, including in-situ benefits

- **Make the cascading principle mandatory to prioritise biomass for high-value, low-quantity** uses for the bioeconomy (chemicals, novel materials, food and feed), and low-carbon material substitution with long-term life periods (construction, wood products). The circular use of forest residues, organic wastes and materials reduce virgin material needs and the resource footprint.
- **Exclude the use of primary woody biomass for energy** (power, heating, and cooling) from sustainable economic activities in the EU Taxonomy and align sustainability thresholds for other biomass use with best available scientific evidence.
- **Ensure the cascading principle includes in-situ benefits of living 'non-use'** biomass for ecosystem functions and climate, nature and biodiversity targets.

C2. Use NECPs to harmonise bioenergy use with LULUCF objectives

- **Ensure NECPs provide comprehensive and reliable data** on the supply, harvest, and use of biomass for energy, and its impact on the LULUCF sink. This information should be made available in a timely, accessible and transparent manner, and should be comparable among different NECPs. It should be supported by methodologies provided by the CRCF, which has been adopted, and data from the Forest Monitoring Framework, which is currently under discussion.
- **Include affected stakeholders in long-term integrated planning, and environmental sensitivity mapping.** Engage with local stakeholders affected by biomass-related land use – municipalities, forest owners, utilities, companies, industry, civil society representatives, etc. – to achieve an integrated, ecosystem-based approach. This includes using the same area for different activities and objectives; for example, combining renewable energy generation with restoration projects on degraded areas (like old mining sites) to benefit biodiversity.

ANNEX I – INVESTOR QUESTIONS

QUESTIONS FOR THE UTILITIES SECTOR

Recommendation	Questions
1. Quantify and minimise full life-cycle GHG emissions	What are the GHG emissions (gCO2/MJ or kgCO2/MWh) related to the following stages of your operation: ■ long-term loss of carbon from forests? ■ cultivation and harvesting? ■ processing (drying, pelleting or chipping)? ■ transportation (by ship, rail and truck)? ■ stack emissions at the point of combustion? What is the energy efficiency of each of your biomass power stations? How do you plan to improve this?
2. Manage composition of biomass feedstocks	What proportion of your feedstocks are: ■ sourced from forest, processing or agricultural residues? ■ harvested for the purpose of bioenergy? Can you trace the supplied wood to the forest? Are the carbon stocks of that forest increasing over time?
3. Audit supply chains	See table below.

QUESTIONS FOR THE FORESTRY SECTOR

Recommendation	Questions
1. Biomass feedstocks, in the form of residues and waste, should be carefully sourced	What proportion of the wood that you harvest becomes forest residues? How do you minimise the proportion of forest residues made up of whole trees? What proportion of forest residues is returned to the forest floor, to maintain soil health and carbon? How do you ensure that the demand for residues and waste does not artificially increase its production?
2. Harvested biomass feedstocks should be carefully sourced	How do you quantify the above- and below-ground carbon stocks of managed forests, and can you demonstrate they are maintained or increased over time? Are your carbon stocks verified through independent, third-party assessments? What proportion of your managed forest is afforested 'abandoned' land and how do you maximise this?
3. Suppliers should maximise carbon stocks of managed forests	Have you eliminated harvesting from natural, primary forests and eliminated their conversion into plantation forests? Do you allow the forest carbon to recover following a harvest? ■ What proportion of the forest carbon is removed during each harvest? ■ How long does it take for forest carbon to regrow and cover? ■ How frequently do you harvest?
4. Suppliers should exclude clear-cutting	Is any of the wood you harvest from clear-cutting?
5. Suppliers should take a cautious approach to thinning	What proportion of the wood you harvest is from thinnings? What are your criteria for the type and number of trees that are removed by thinning, such as a maximum tree diameter or limit to the proportion of a forest stand removed by thinning?
6. Suppliers should maximise the proportion of harvests used in long-lived products	What proportion of the wood you harvest is used for long-lived products and bioenergy? How do you plan to minimise the proportion of a harvest used for bioenergy, whilst maximising the proportion used in long-lived material wood products?

Source: ShareAction (2019), The Biomass Blind Spot

ANNEX II – KEY POLICIES RELATED TO BIOMASS

Seven interconnected key policies related to the use of biomass and its impacts are outlined below.

(1) The revised **Renewable Energy Directive (RED III),** adopted on 18 October 2023, raises the target for the renewable energy share in the EU's overall energy consumption to at least 42.5% by 2030 (Art. 3).[45] Renewable energy technologies include solar energy, wind power, hydro power, tidal power, heat pumps, geothermal energy, bioenergy and fuels, and waste residues for energy.

RED III strengthens sustainability criteria for biomass use: by banning sourcing from certain highly biodiverse areas; eliminating direct financial support for use of primary biomass for energy as well as electricity-only biomass installations; increasing efficiency standards for biomass power and heat plants; and applying the cascading principle to ensure higher-value uses of wood. However, it also continues to incentivise using woody biomass for energy. The inclusion of biomass as a renewable energy source causes it to be treated as carbon-neutral in the ETS (as long as it is sourced sustainably) and a sustainable economic activity in the EU Taxonomy.

Biomass for energy can receive continued financial support ('direct' support is prohibited; tax benefits are not), while the applications of the cascading principle is left to member states and easy to disregard at the local level. The term 'primary biomass' is not clearly defined, and there is no cap on biomass for energy (in contrast to biofuels). As a result, RED III increases demand for sourcing woody biomass (and growing energy crops) while reducing land use for carbon sinks, sequestration and storage, to the detriment of EU climate targets.

(2) The **Nature Restoration Law (NRL)**, adopted in the Council on 17 June 2024, aims to restore 20% of all EU land and sea areas and 30% of degraded habitats by 2030, in line with the EU Biodiversity Strategy for 2030.[46] It is the first EU-wide regulation to set quantified and legally-binding targets to restore key ecosystems, biodiversity loss, and dedicate land use for climate mitigation, adaptation, and increased resilience, including the biodiversity of forest ecosystems.[47] Member states will have to submit national restoration plans with domestic environmental priorities, with certain flexibilities for agricultural land use, a concession to farmer protests in the EU.

The NRL is relevant for biomass use as the increasing area for nature protection and restoration (from 30% of natural habitats in 2030 to 90% in 2050) will likely decrease available land use for biomass harvesting and thus increase carbon sinks and carbon stock potential. As part of nature-based climate solutions, it will also increase adaptation capacity and resilience of habitats and ecosystems to climate change.

(3) The **EU Deforestation Regulation (EUDR)** entered into force on 29 June 2023 and sets due diligence requirements for companies' supply chains to guarantee that products and commodities permitted to enter the EU market have been verified to not contribute to deforestation or forest degradation.[48] It covers seven commodities identified as major drivers for EU-caused deforestation: palm oil, soya, wood, cocoa, coffee, cattle, and rubber, along with derived products.

45 European Commission: Renewable Energy Directive
46 European Commission: Biodiversity strategy for 2030
47 European Commission. Nature Restoration Law
48 European Commission: Regulation on Deforestation-free products

The EUDR replaced and builds on the EU Timber Regulation, which focused on ensuring the legality and traceability of timber and timber products entering the EU market. It sets a new global standard for due diligence requirements for deforestation-free supply chains, strengthens indigenous people's rights, and expands the definition of forest degradation to include the conversion of primary and self-regenerating forests by fast-growing plantation forests with lower biodiversity, resilience and carbon storage capacity.[49] By improving the transparency of origin of resources and products linked to deforestation, it can help limit illegal logging, and reduce the supply of imported undocumented biomass for energy.[50]

(4) The **Carbon Removals and Carbon Farming (CRCF) Regulation,** adopted in Parliament on 10 April 2024, establishes the first EU-level voluntary certification framework for permanent carbon removals, carbon farming and carbon storage in products.[51] The certification procedure requires activities to fulfil the criteria of quantification, additionality, long-term storage, and sustainability.

For biomass use, CRCF creates market transparency and regulatory certainty by clarifying what types of carbon removals are eligible, and for what minimum timeframes these removals have to be stored to qualify, i.e.,: permanent storage via DACCS or BECCS (centuries); long-lasting wood products (at least 35 years); and carbon farming and soil reductions (at least five years).[52] This shifts financial incentives to biomass for long-term carbon storage instead of for energy use, creates additional revenue streams for farmers to integrate climate mitigation and biodiversity into their land use practices, and simplifies the quantification of living woody and other biomass carbon capture contributions to LULUCF objectives.[53]

(5) The **Regulation on a Forest Monitoring Framework (FMF)** has been proposed by the Commission to create an EU-wide coordinated forest knowledge base to address information gaps. The monitoring system would create a focal point for collecting and sharing comparable forest data obtained by Earth Observation technology and ground measurements. This system facilitates forest planning, improves risk assessment and preparedness, and enables better cooperation among member states to set long-term forest plans.[54]

For biomass use, better forest monitoring would help to provide necessary and comparable information to feed into NECPs, including monitoring data on biomass use, predictions on future demand for biomass, and the development of carbon capture and storage capacities. This data would help to ensure nature renaturation and afforestation measures in member states are aligned with EU 2030 climate and nature targets. Council and Parliament have not yet decided their respective positions, and no trilogue has been initiated yet.

(6) The **EU Taxonomy,** adopted in 2020, establishes a science-based, EU-wide classification system directed at companies, investors, and policy makers to determine whether an economic activity is environmentally sustainable and aligned with a net-zero trajectory by 2050. It increases market confidence and transparency as to what economic activities support environmental objectives, and it protects investors from greenwashing practices, strengthens incentives for more sustainable business practices and models, and redirects capital flows to finance investments for the net-zero transition.

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49 EURACTIV (2022), EU agrees new law to kick deforestation out of supply chains
50 As of 1 December 2024, a provisional agreement has been reached to delay the EUDR entering into force by 12 months to 30 December 2025.
51 European Commission, Carbon Removals and Carbon Farming
52 Ibid
53 EURACTIV (2024), The EU's new carbon removal certification scheme in detail
54 European Commission (2023), New law proposed to improve resilience of European forests

Taxonomy-aligned activities need to fulfil four criteria. First, they need to provide a significant contribution to one out of six environmental objectives: climate mitigation; climate adaptation; water and marine resources; circular economy; pollution control; and nature restoration. Second, they must fulfil technical screening criteria and sustainability thresholds. Third, they can do no significant harm (DNSH) to any of the other objectives. Fourth, they need to meet minimum social safeguards.

Biomass for energy use is included in the Taxonomy, within four economic activities: (1) 'cogeneration of heating / cooling and power from bioenergy' (combined heat and power, or CHP); (2) 'electricity generation from bioenergy'; (3) 'production of heating / cooling from bioenergy'; and 'manufacture of biogas and biofuels for use in transport and of bioliquids'.[55] The inclusion of bioenergy is based on RED III sustainability criteria and faces legal challenges demanding a scientific assessment and review of the criteria.[56] For example, the Independent Science Based Taxonomy, a tool that assesses the sustainability of the official EU Taxonomy, rates all three activities as "not science based".[57] Instead, it recommends applying higher thresholds for emission savings compared to fossil fuels (equivalent to 100g CO2e/KWh), and reducing this threshold every five years in line with a net-zero trajectory by 2050.

(7) All member states are required to provide **National Energy and Climate Plans (NECPs),** as mandated by the EU Governance Regulation on the Energy Union and Climate Action.[58] Member states need to identify coherent policies and programmes across relevant policy areas, including biomass use for energy and carbon sink capacities, and explain how related policies contribute to emission reductions. Updated NECPs had to be submitted by 30 June 2024, and NECP progress updates are required every two years.

Within these NECPs, data on bioenergy use needs to align with RED III specifications for woody biomass for energy. This requires historical data and predictions of future demand for bioenergy by sector; origin of biomass fuels, including imports and exports; an impact assessment of demand for domestic bioenergy feedstocks on land sink; and reporting and predictions for land carbon sinks, including strategies on how to meet the national carbon sink goals.

NECPs are vital to monitor national biomass use, its origin, predicted demand, and assess its impact for climate targets. However, an analysis of draft NECPs finds significant data and information gaps, and a lack of analysis of necessary policy reforms. Current plans do not identify in a transparent and comparable manner the origin, sourcing, and quantity of biomass used for energy, its impact on carbon sink targets, and policies to counteract declining sink capacity. Specifying this information will be essential to achieve EU 2030 climate targets.

55 European Commission, EU Taxonomy Compass
56 EURACTIV (2022), Campaigners begin legal fight against EU taxonomy's bioenergy rules
57 Independent Science-Based Taxonomy (2024)
58 European Commission: Governance of the Energy Union and Climate Action

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