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The role of biomass in the decarbonisation of the heating sector

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Summary

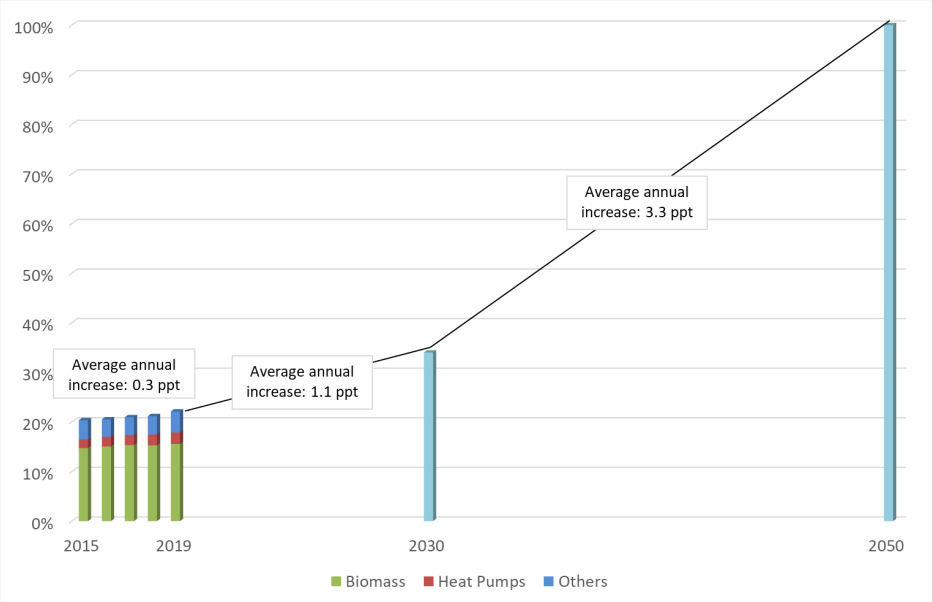
The decarbonisation of the heating sector is a key priority for achieving climate neutrality in the EU by 2050. Heating and cooling is largely based on fossil fuels, with renewable energy providing only 22 % of the EU´s gross final energy demand.

Renewable heating is currently dominated by biomass, accounting for around 80 % of the renewable energy used for heating[1]. Within the heating sector, biomass is mainly used in the form of solid biomass: in 2019, solid biomass made up for 95 % of the biomass used for heating, followed by biogas (4%) and bioliquids (1%).

Several recent studies have highlighted the limitations to the role that biomass can play in the transition towards climate neutrality[2]. Biomass resources are limited and their use should be prioritised in a “cascading use principle”, where woody biomass should primarily be used for long-lasting, high-value purposes such as wood-based products[3].

To meet the EU goal of net zero emissions in 2050, the heating sector needs to be fully decarbonised. The proposal for the revised Renewable Energy Directive foresees a binding target for the annual increase of the share of renewable energies in the heating sector of 1.1 percentage points (ppt)[4]. With an annual increase of 1.1 ppt, renewable heating/cooling would only account for up to around 36 % in 2030. This implies that the required annual rate has to almost triple after 2030 to reach 100 % in 2050 (Figure 1).

Figure 1: Share of renewable heating in the EU and required annual increase rates

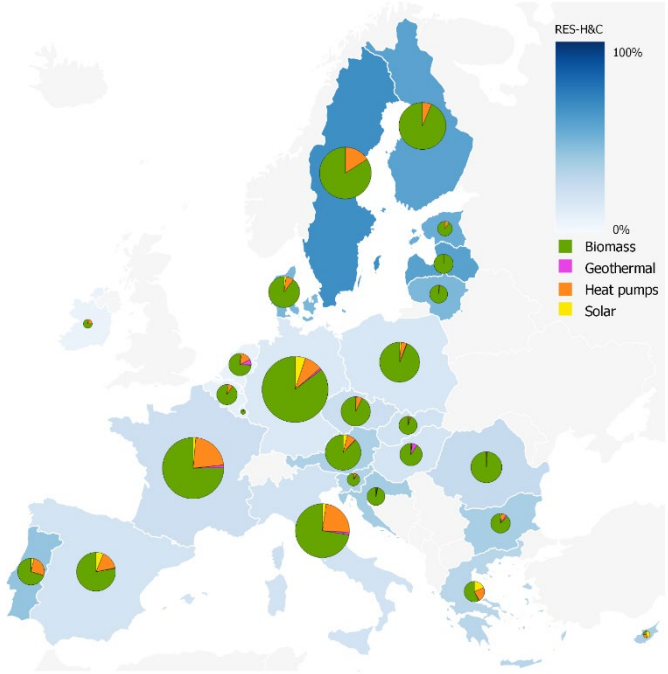


Source: Oeko-Institut based on Eurostat SHARES data.

1 Eurostat SHARES data. The report uses the data for 2019.
2 See e.g. Material economics (2021): EU Biomass Use in a Net-Zero Economy.
3 See e.g. ECOS (2022): Out of the woods. Using ecodesign to reduce the negative impacts of solid fuel heating.: https://www.coolproducts.eu/wp-content/uploads/2022/03/ECOS_Out-of-the-woods_final.pdf
4 1.5 percent if waste heat is used.

Renewable heating and cooling currently relies strongly on the use of biomass (Figure 2). Biomass is the dominating source for renewable heating in all EU Member States, in many Member States the share of biomass reaches more than 80 percent.

Figure 2: Role of biomass in renewable heating and cooling.



Source: Oeko-Institut based on Eurostat data.

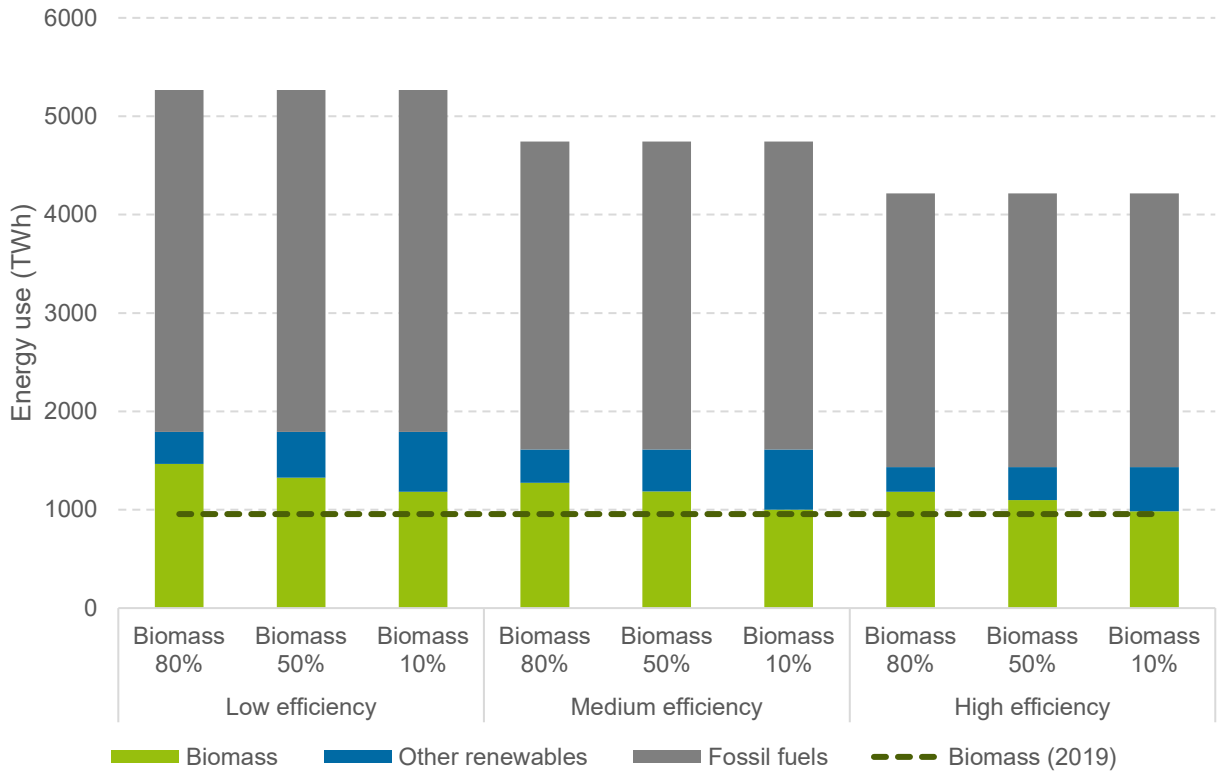
While biomass is the dominating energy source for renewable heating, the relative growth of biomass for heating purposes has been lower than for other renewable energy sources in this sector. Comparing the growth rates of the renewable energy sources used in the heating sector, biomass has by far the lowest growth rate of 145% between 2004 and 2019, followed by geothermal (170%), solar (361%) and heat pumps (706%).

In view of the required increase of renewable heating to meet the annual 1.1 ppt increase, Figure 3 compares the energy consumption for heating and cooling and the use of biomass in this sector in 2030 for different efficiency levels and different deployment rates of biomass. The figure shows that two factors are key for achieving the 1.1 ppt target while at the same time maintaining the biomass use for heating and cooling at current levels:

a) Increasing energy efficiency in the sector, seen in the “high efficiency” projections (right hand side);

b) Limiting the role that biomass takes in the annual increase of renewable heating and cooling (seen in the low biomass scenarios, where the contribution of biomass to increasing the renewable energy shares is limited to 10%).

Figure 3: Projected energy use for heating and share of biomass and other renewables in 2030.



Source: Oeko-Institut, own calculation.

The ambition of the RES target for the heating sector specified in Art. 23 of the Commission Proposal for the RED revision should be maintained or increased. The 1.1% target is important to ensure that the EU Member States are directed towards decarbonisation of heating and cooling by 2050. Even with the 1.1% target in place, a strong increase of the required annual savings in the years after 2030 is required to reach full decarbonisation by 2050. Furthermore, a rapid increase of the renewable energy share in heating supports energy security by decreasing the dependency of the EU Member States on imports of fossil energy for heating.

The policy framework needs to adapt provisions to ensure that the renewable energy share in heating increases, while maintaining the use of biomass at a sustainable level. Biomass use for heating is addressed directly and indirectly in various provisions across the Fit for 55 policy package. These provisions need to ensure a consistent framework for ensuring the sustainability of biomass used for heating.

The following elements of the policy framework could be adapted to act as drivers to ensure the sustainable use of biomass in heating and cooling:

Renewable Energy Directive (RED)

A binding target for increasing the renewable energy share in the heating and cooling sector as proposed in Art. 23 is a key element for the transition of the sector. As shown in

Figure 4, even with an average increase of 1.1 ppt per year until 2030, the efforts need to multiply after 2030 to reach full decarbonisation by 2050.

To ensure that the target for increasing renewable energies in heating and cooling does not put additional pressure on biomass use, the role of biomass for achieving the target needs to be limited with the following approaches:

- Cap on share of biomass in meeting 1.1% target (similar to approach for waste heat), i.e. *Member States may count biomass, subject to a limit of [20] % of the average annual increase*
- Cap on absolute contribution of biomass: Any biomass use going beyond the 2022 levels cannot contribute to achieving the target.

In the short term, we recommend to pursue the first option as it can be implemented straightforwardly in Art. 23 and is similar to the approach for accounting waste heat under the RES target.

With regard to sustainability criteria, we recommend to strengthen the framework through the following elements:

- Remove limitation of applicability of sustainability criteria based on the size of the installation:
  - The current thresholds of 20 MW (solid biomass) and 2 MW (biogas) for exemptions are too high and should at least be lowered.
  - A better solution would be the following adaption:
    - Apply no threshold for biogas as there is no threshold for biofuels and both substrates are produced on the same cropland;
    - Thresholds for solid biomass – if needed – should be related to the size of the forest operator (e.g. 100 ha) instead of the plant size.
- Strengthen sustainability requirements for forestry biomass:
  - As proposed by the Commission, land-use change issues from agricultural biomass should also apply to forestry biomass.
  - To be noted: the link to “areas designated for the protection of rare, threatened or endangered ecosystems or species but not yet protected” is missing in the Commission’s proposal and should be added.
- Sustainability requirements for agricultural biomass:
  - The changes for highly biodiverse grassland (1 ha, competent authority) clearly deteriorate the sustainability requirements, however, for biomass used for heating/cooling purposes this will play a subordinate role.
- Revise criteria for GHG reductions:
  - The factor “emissions from carbon stock changes caused by forestry” should be added in the GHG calculation.
- Efficiency requirements when using solid biomass fuels for energy generation:
  - Apply the efficiency requirements defined in Art. 29(11) of RED II to smaller installations with a thermal input below 50 MW and eliminate the possibility to use solid biomass in electricity-only installations.

Energy Performance of Buildings Directive (EPBD)

An ambitious implementation of the energy efficiency requirements introduced in the EPBD proposal, particularly the minimum requirements for existing buildings (MEPS), contributes to the reduction of energy demand in buildings. The reduction of the energy demand in buildings contributes to lowering the demand for renewable energies for the decarbonisation of the buildings stock.

The definition of zero emission buildings in the proposal for the EPBD incudes biomass as an option to meet the energy demand of such buildings. As biomass should be prioritised in buildings where other renewable options are not available, biomass should not be an eligible option for zero emission buildings.

As the thresholds are defined in terms of primary energy, the primary energy factors that Member States define strongly influence the energy carrier mix that can be used to meet the target. Providing guidance and boundaries for setting primary energy factors for biomass can help to set a common framework and limit the use of biomass.

Energy Efficiency Directive (EED)

The EED supports the reduction of energy demand and thus contributes to lowering the need for increasing renewable energies. An ambitious implementation of the targets of provisions thus indirectly contributes to the objective of limiting the use of biomass in the transition of the heating sector.

A key provision directly influencing the use of biomass in the heating sector is the definition of efficient heating and cooling systems. Within the definition, the use of biomass could be treated restrictively, e.g. in the form that heat from biomass is only counted towards the RE minimum shares if the biomass is used in a CHP plant. In order to exclude smaller heating networks, such as those found in so-called bioenergy villages in rural areas, from the requirement, the restriction could be limited to larger district heating and cooling systems. A threshold would then need to be defined as to when a heating or cooling system is considered large. An alternative would be to amend the definition for efficient heating and cooling systems in such a way that a maximum of X% of the minimum share of renewable energy required under the definition may come from biomass. This option could also be limited to larger heating and cooling systems.

ETS Directive

With the introduction of the ETS for buildings and transport, the approach for specifying sustainability criteria would need to be adopted: While ETS 1 operates as a downstream system, where the obligated parties are the emitters of greenhouse gases (i.e. the entities where the fuels are combusted), ETS 2 is planned to use an upstream approach. In an upstream approach, the point of regulation is further up the supply chain, e.g. the entities that place the fuels on the market.

Therefore, in an upstream approach, sustainability criteria for biomass cannot be linked to the size of the installations in which the fuel is burned. On the one hand, the obligated parties operate at an upstream level and typically have limited knowledge regarding the size of the installations of their final consumers. On the other hand, with the ETS 2 being designed to address heating in the buildings sector (next to road transport), the final emitters by default are small.With the introduction of ETS 2, sustainability criteria that are not linked to the size of the emitter thus need to be established.

1 Introduction

The decarbonisation of the heating sector is a key priority for achieving climate neutrality in the EU by 2050. Heating and cooling is largely based on fossil fuels, with renewable energy providing only 22 % of the EU´s gross final energy demand[5]. With an average increase of the renewable share in heating and cooling of less than 1 % per year over the past 15 years, the pace of phasing out fossil fuels in the heating and cooling sector needs to dramatically increase to achieve climate neutrality by 2050[6].

Renewable heating is currently dominated by biomass, accounting for around 80 % of the renewable energy used for heating[5]. Within the heating sector, biomass is mainly used in the form of solid biomass: in 2019, solid biomass made up for 95 % of the biomass used for heating, followed by biogas (4%) and bioliquids (1%).

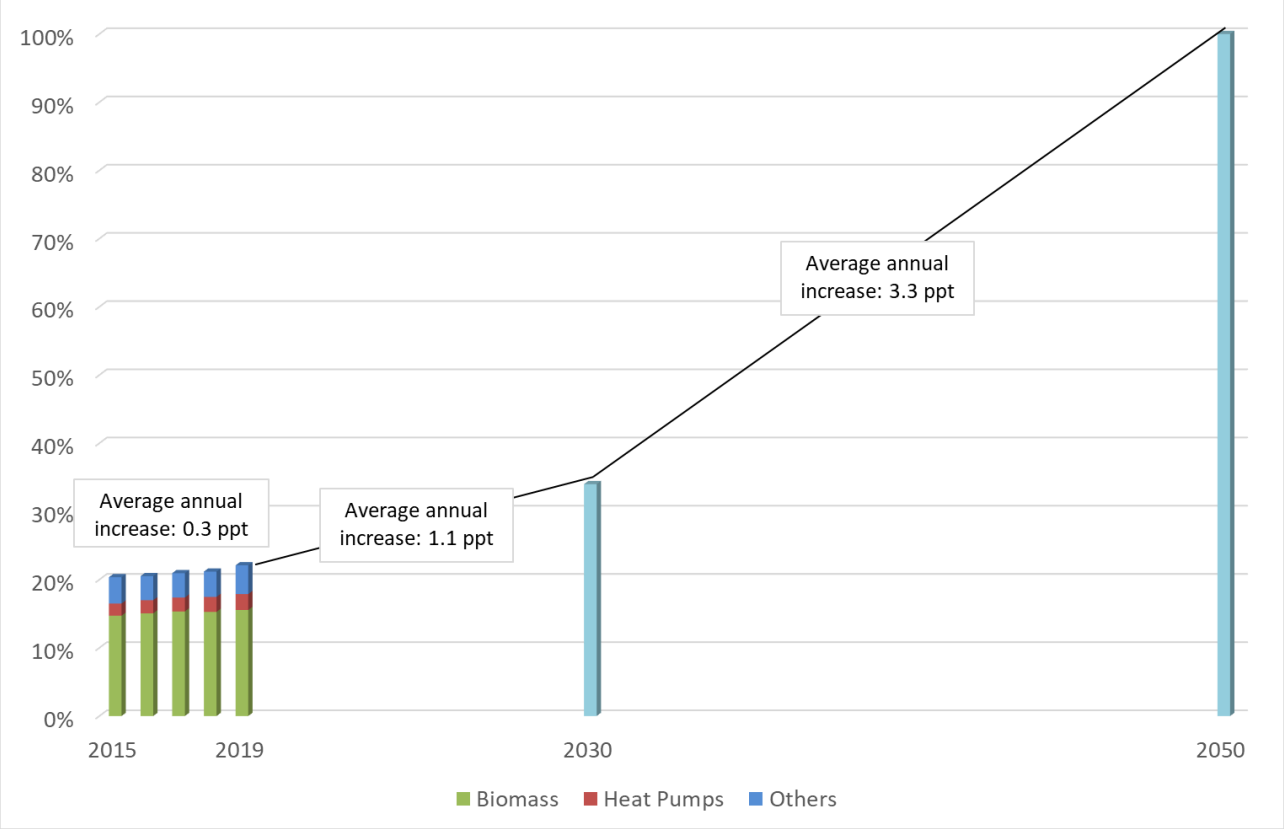
Several recent studies have highlighted the limitations to the role that biomass can play in the transition towards climate neutrality[7]. Biomass resources are limited and their use should be prioritised in a “cascading use principle”, where woody biomass should primarily be used for long-lasting, high-value purposes such as wood-based products[8].

To meet the EU goal of net zero emissions in 2050, the heating sector needs to be fully decarbonised. The proposal for the revised Renewable Energy Directive (RED III)[9] foresees a binding target for the annual increase of the share of renewable energies in the heating sector of 1.1 percentage points (ppt). With an annual increase of 1.1 ppt, renewable heating/cooling would only account for up to around 36 % in 2030. This implies that the required annual rate has to almost triple after 2030 to reach 100 % in 2050 (

5 Eurostat SHARES data.
6 Oeko-Institut and Klinski (2021): Phase-out regulations for fossil fuel boilers at EU and national level. https://www.oeko.de/fileadmin/oekodoc/Phase-out_fossil_heating.pdf
7 See e.g. Material economics (2021): EU Biomass Use in a Net-Zero Economy.
8 See e.g. ECOS (2022): Out of the woods. Using ecodesign to reduce the negative impacts of solid fuel heating. https://www.coolproducts.eu/wp-content/uploads/2022/03/ECOS_Out-of-the-woods_final.pdf
9 COM(2021) 557 final

Figure 4).

Figure 4: Share of renewable heating in the EU and required annual increase rates



Source: Oeko-Institut based on Eurostat SHARES data.

Against this background, this report analyses the role of biomass in the transition of the EU heating sector. If fossil fuels for heating are replaced to a large extent by biomass, the risk increases that the potentials for sustainably available biomass are exceeded and that pressure on natural resources and the environment increases.

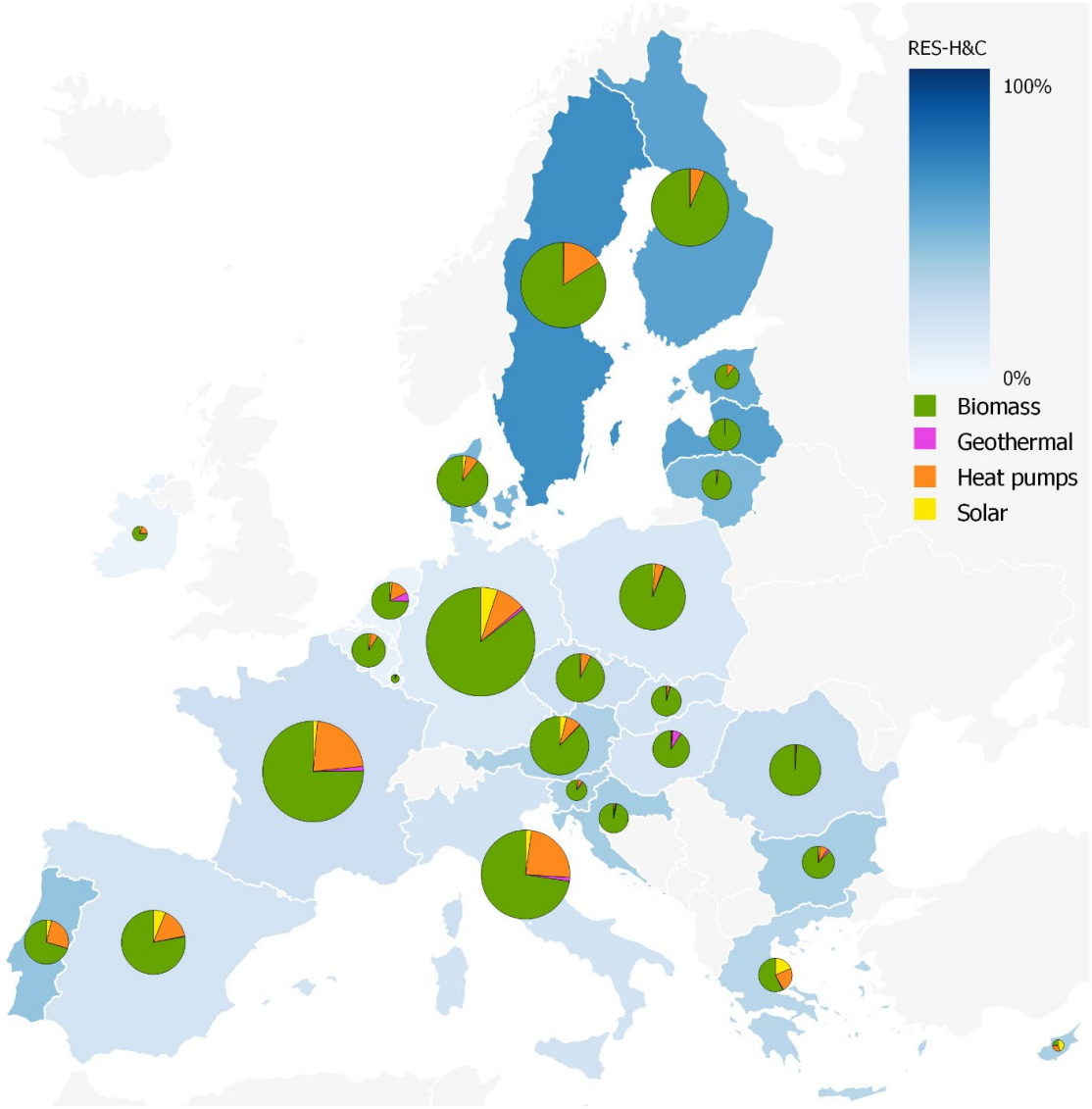
In view of the current dominant role of biomass in renewable heating and the limited potentials for sustainable biomass, this report discusses the current use of biomass for heating and provides recommendations for the provisions of the EU policy framework for heating with respect to its impact on biomass use.

2 Biomass for heating: Status quo and trends

2.1 Current use of biomass for heating

Renewable heating and cooling currently relies strongly on the use of biomass (Figure 5). Biomass is the dominating source for renewable heating in all EU Member States, in many Member States the share of biomass reaches more than 80 percent.

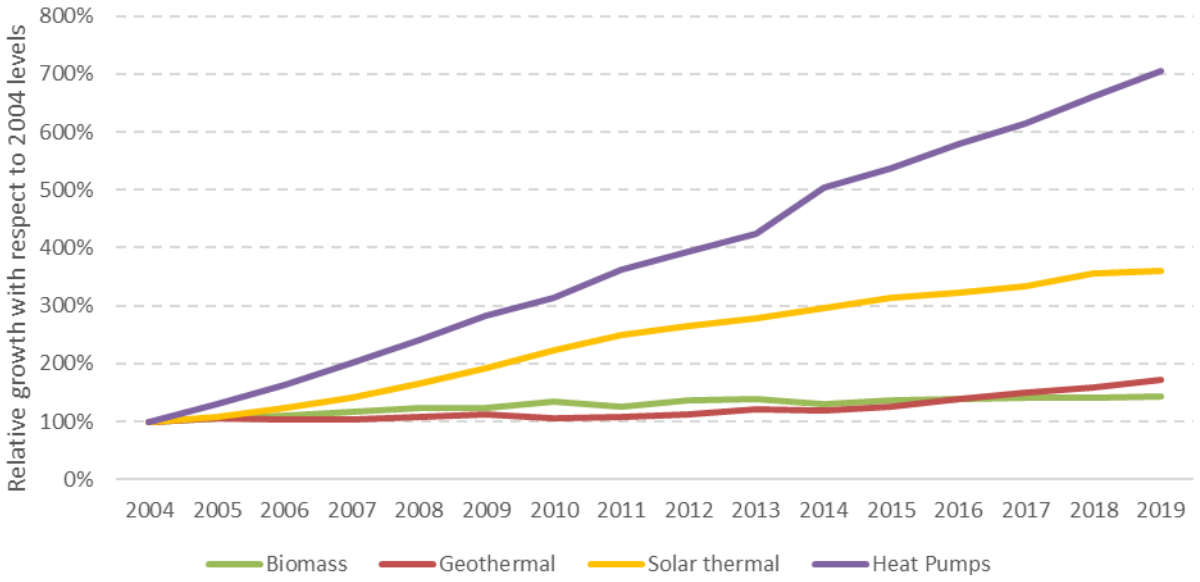
Figure 5: Role of biomass in renewable heating and cooling.



Source: Oeko-Institut based on Eurostat data.

While biomass is the dominating energy source for renewable heating, Figure 6 shows that the relative growth of biomass for heating has been lower than for other renewable energy sources in this sector. Comparing the growth rates of the renewable energy sources used in the heating sector, biomass has by far the lowest growth rate of 145% between 2004 and 2019, followed by geothermal (170%), solar (361%) and heat pumps (706%).

Figure 6: Growth levels of different renewable energies in the heating and cooling sector



Source: Oeko-Institut based on Eurostat SHARES data.

2.2 Potential role of biomass for heating until 2030

This section explores potential pathways for the development of the use of biomass for heating in the context of the 1.1 percentage point target. This means that in all pathways, the 1.1 ppt target is met, however with varying conditions.

2.2.1 Scenario specifications

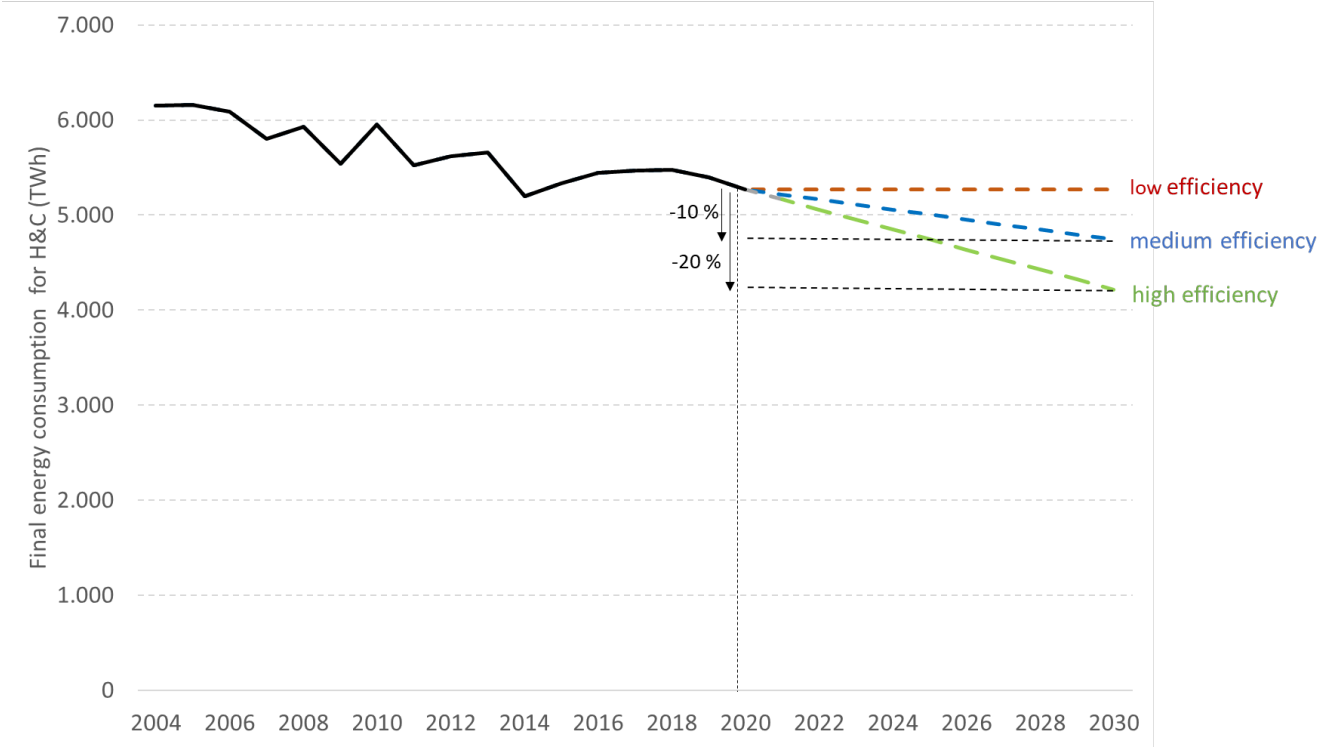
2.2.1.1 Energy efficiency

The share of renewable heating increases when reducing the total energy consumption in the sector. The renewable energy share in heating and cooling is calculated by dividing the amount of renewable energy used for heating and cooling by the total energy consumption for heating and cooling. With a constant amount of renewable energy, the share thus increases with reduced consumption.

We consider three pathways for the development of energy consumption (Figure 7):

1. Constant energy consumption: Consumption remains at 2020 levels (red line)
2. Moderate energy efficiency: Reduction by 10% until 2030 as compared to 2020. This approximately corresponds to the reduction level in the PRIMES mix scenario (blue line).
3. High energy efficiency: Reduction by 20% until 2030 as compared to 2020. This scenario assumes very ambitious additional efforts to increase energy efficiency (green line).

Figure 7: Pathways for energy consumption in heating and cooling



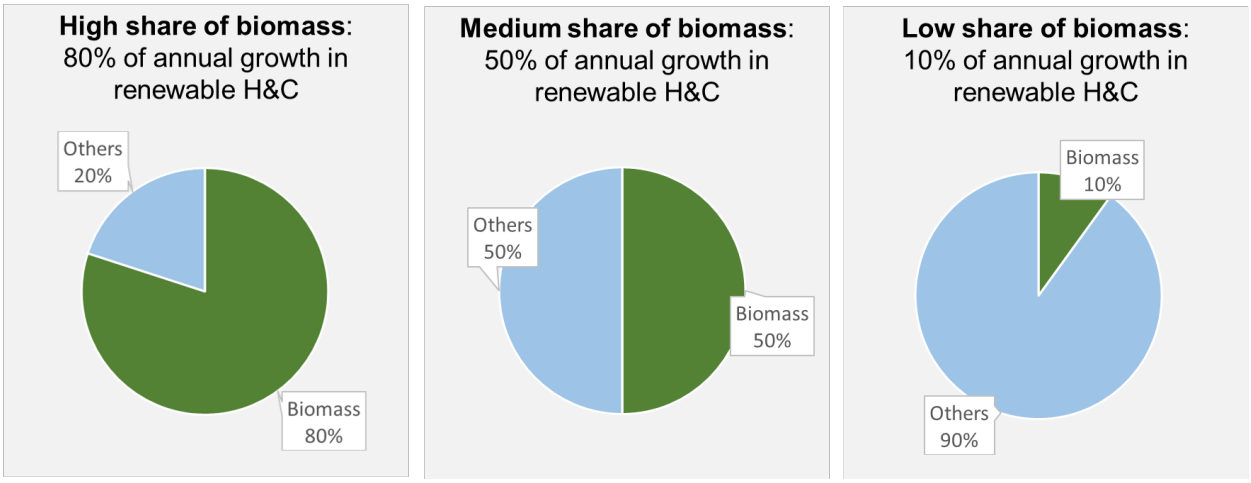
Source: Oeko-Institut, own projection. Values for 2004-2020 based on Eurostat SHARES data.

2.2.1.2 Share of biomass

For the share of biomass, three different scenarios are compared (see Figure 8):

- High biomass use: Following the current trend, biomass makes up for 80% of the increase in RES-H&C
- Moderate biomass use: Biomass makes up for half of the increase
- Low biomass use: Biomass accounts for 10% of the increase of RES-H&C

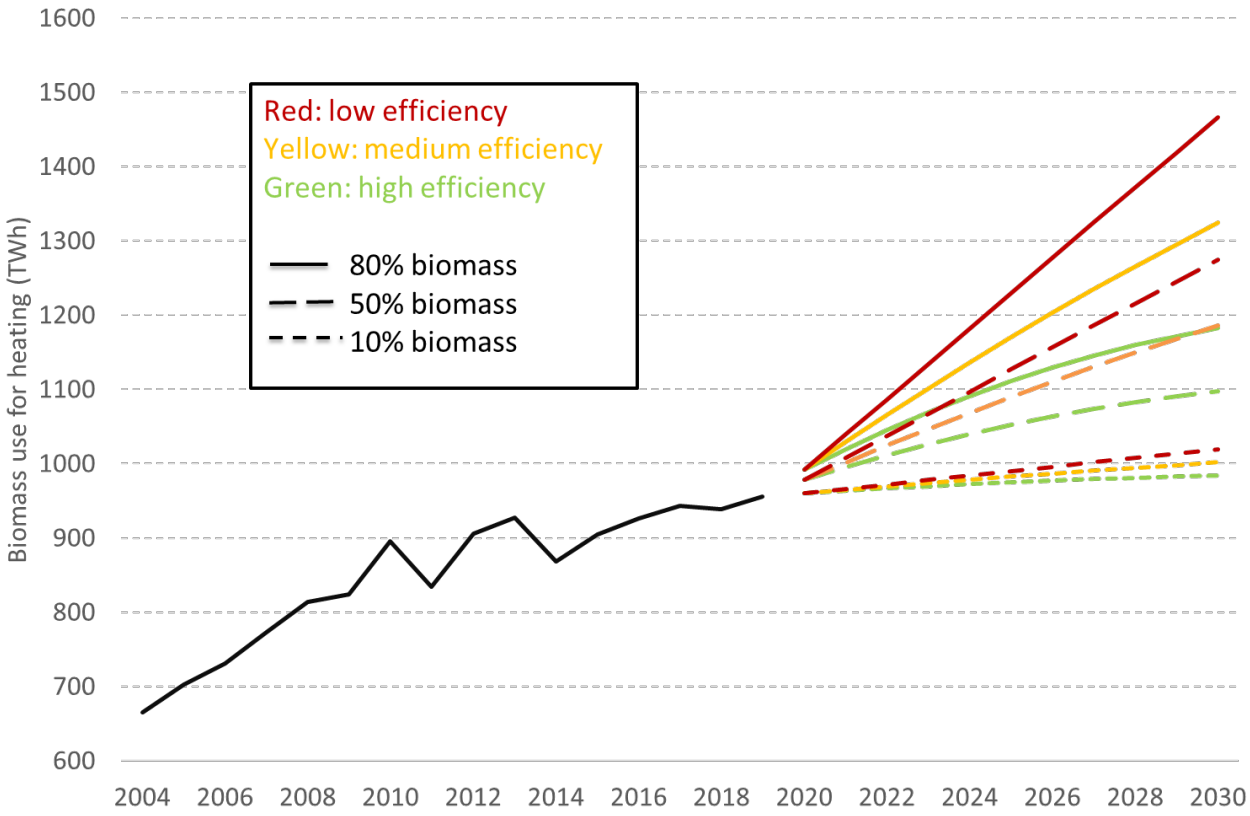
Figure 8: Pathways for role of biomass in the annual increase of renewable heating and cooling



2.2.2 Results

Figure 9 compares the biomass use for heating in the past 15 years to the projected use of biomass under the different projection pathways. The results show that if biomass continued to make up for 80% of renewable energies while meeting the 1.1 ppt target, biomass use for heating increases strongly from 956 TWh in 2019 to almost 1500 TWh in 2030.

Figure 9: Projections for biomass use for heating in the different scenarios.



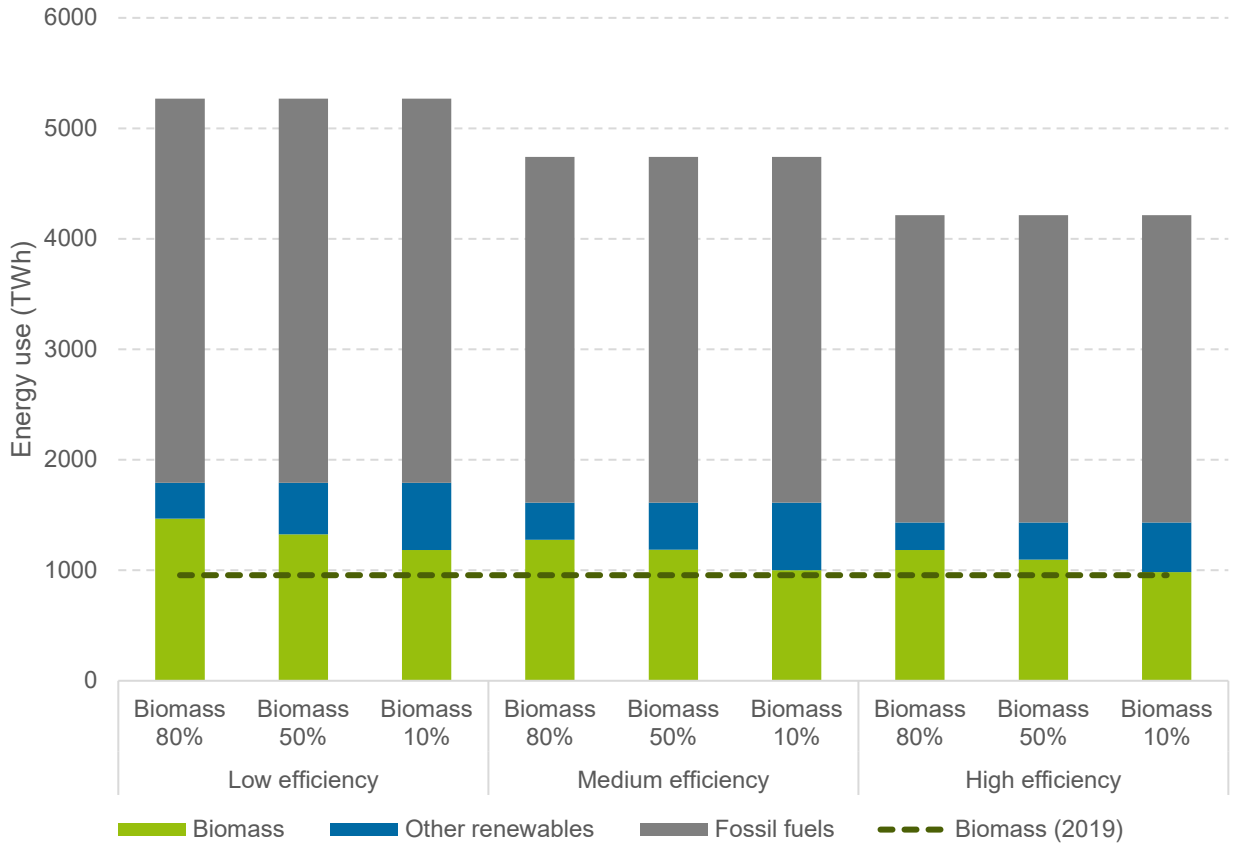
Source: Oeko-Institut, own calculation.

Figure 10 compares the nine projection pathways with respect to the level of biomass use in the year 2030. The figure shows that two factors are key for achieving the 1.1 ppt target while at the same time maintaining the biomass use for heating and cooling at current levels:

c) Increasing energy efficiency in the sector, seen in the “high efficiency” projections (right hand side).

d) Limiting the role that biomass takes in the annual increase of renewable heating and cooling (seen in the low biomass scenarios, where the contribution of biomass to increasing the renewable energy shares is limited to 10%).

Figure 10: Projected energy use for heating and share of biomass and other renewables in 2030.



Source: Oeko-Institut, own calculation.

3 Provisions to ensure sustainability of biomass for heating at EU level

3.1 Renewable Energy Directive (RED)

3.1.1 Target for renewable heating

A binding target for increasing the renewable energy share in the heating and cooling sector as proposed in Art. 23 is a key element for the transition of the sector. As shown in Figure 4, even with an average increase of 1.1 ppt per year until 2030, the efforts need to multiply after 2030 in order to reach full decarbonisation by 2050.

To ensure that the target for increasing renewable energies in heating and cooling does not put additional pressure on biomass use, the role of biomass for achieving the target needs to be limited. This can be achieved through direct or indirect mechanisms:

Direct limitation of the role of biomass:

- Cap on share of biomass in meeting 1.1% target (similar to approach for waste heat), i.e. *Member States may count biomass, subject to a limit of [20] % of the average annual increase*
- Cap on absolute contribution of biomass: Any biomass use going beyond the 2022 levels cannot contribute to achieving the target.

The first option can be implemented straightforwardly in Art. 23 and is similar to the approach for accounting waste heat under the RES target. The second option provides the most certain safeguard that no biomass use for heating going beyond current levels is counted as renewable energy in the RES target.

Options to indirectly limit use of biomass:

- Promote RES technologies other than biomass through multipliers. In a multiplier approach, the contribution of different renewable energy technologies is multiplied with a specific factor that reflects the favourability of the technology for supporting the transition[10]. Multipliers for accounting renewable heating under the RES-H target are discussed by RAP (2021)[11], where the authors conclude that due to the complexity of the approach direct options setting a cap on biomass are preferable.
- Indirect limitation through strengthening the sustainability framework (Section 3.1.2)

3.1.2 Criteria for the sustainability of biomass (Article 29)

The Renewable Energy Directive (RED II) sets mandatory sustainability requirements that must be met when using bioenergy in defined applications of certain scales. These include requirements for the preservation of areas with a high level of biodiversity and areas with a high carbon stock, as well as the reduction of greenhouse gas emissions (see Sections 3.1.2.1 and 3.1.2.2).

[10] Technologies that are considered favourable are multiplied with a factor >1, whereas unfavourable technologies are multiplied with a factor <1.

[11] RAP (2021): Making renewable heating 'Fit for 55'.

This study focuses on the energetic use of biomass for heating. The biomass used can originate from forestry as energy wood, from agriculture (e.g. biogas substrates, short rotation coppice) or arise as residues or waste (see biomass types in Box 1).

Box 1: Terminology of biomass types in RED II

Biomass is differentiated at two levels in RED II:

- Level 1: RED II distinguishes between liquid, solid and gaseous biomass types. Liquid biomass is divided into biofuels (transport sector) and liquid biofuels (other sectors). Solid and gaseous biomass are grouped together as biomass fuels. In this study, the term bioenergy is used when referring to liquid, solid and gaseous biomass as a whole.
- Level 2: In terms of the origin of biomass, a distinction is made between agricultural, forestry and fisheries biomass harvested on a specific area and residual and waste materials without an area reference (e.g. wood-processing industry, waste wood streams, etc.).

As additional biomass types, Annex IX lists feedstocks that are used for the production of "advanced biofuels and biogas" for transport. It is assumed that these feedstocks are associated with low risks for indirect land use change and that high GHG reductions can be achieved by the use of advanced biofuels.

3.1.2.1 Sustainability requirements for forestry biomass

According to Art. 29(6), five criteria apply as requirements:

- The timber harvest is legal.
- Forest regeneration takes place on the harvested area.
- Protected areas are safeguarded.
- During harvesting, care is taken to maintain soil quality and biodiversity in order to minimise disturbance.
- Harvesting activities maintain or improve the long-term production capacities of the forest.

If a country has national and/or sub-national legislation in place in the harvesting area on these points and there are monitoring and enforcement systems in place to ensure compliance, then forest biomass can be considered sustainable *per se* (cf. Art. 29(6)(a)). For implementation, a written self-declaration in which a forest enterprise assures to comply with the respective rules could be sufficient.

However, if the legal situation and the monitoring and enforcement systems are not sufficient for one or all points, it must be demonstrated that management systems in the forest sourcing area[12] ensure the requirements (cf. Art. 29(6)(b)). This means that proof is needed, e.g. via a certification system at forestry operation level.

Another requirement under Article 29(7) is to ensure that emissions in the LULUCF sector in the country of origin of the biomass are taken into account under the Paris Agreement in accordance

[12] 'Sourcing area' means the geographically defined area from which the forest biomass feedstock is sourced, from which reliable and independent information is available and where conditions are sufficiently homogeneous to evaluate the risk of the sustainability and legality characteristics of the forest biomass (RED II Art. 2(30)).

with the IPCC rules. If this is not the case, stricter requirements on carbon stocks and sinks apply in the forest sourcing area.

Box 2: Germany as example

Germany has very comprehensive legislation that meets the requirements under Art. 29(6), and accountability to law enforcement is also clearly defined. According to a recent study[13] commissioned by DG ENER, the requirements for LULUCF and thus per se for forest management are fulfilled by Germany. However, there is a major weakness in monitoring, which means that the impact during harvesting on protected goods such as soil and biodiversity cannot be clearly assessed:

Biodiversity: Forest inventories are carried out at sampling points in Germany at intervals of 5 to 10 years. However, these provide only limited data on the state of biodiversity in the forest (Reise et al. 2017[14]). Only certain forest habitat types[15] as well as animal and plant species of Annex IV (§§ 12,13 FFH Directive) are regularly assessed. In addition, a survey of breeding birds is carried out every year at national level (Wahl et al. 2020[16]). Based on this, the indicator "species diversity and landscape quality" is derived. Direct monitoring of different forest species groups at the regional level is still lacking.

Soil: The monitoring of soil condition in forests is equally only covered by national monitoring, the soil condition survey, which is repeated every 20 years at sample points.

In view of these shortcomings, an individual verification for forestry operations would be necessary for Germany under Art. 29(6)(b)(iv) to ensure compliance with the criteria for sustainably produced forestry biomass under RED II. However, in comparison with other Member States, the situation in Germany is assessed as sufficient in terms of RED II (EC 2021[13]), which the authors of this study view critically. A similar proof is required for the evaluation of other Member States.

In RED I, the sustainability requirements were applied to agricultural and forestry biomass. In RED II, sustainability requirements of RED I (= RED 2009[17]) only apply to agricultural biomass and no longer to forestry biomass. The new criteria for forestry biomass (Art. 29(6) and 29(7)) are significantly less ambitious. E.g., neither primary forests nor highly biodiverse forests are considered, and the reference data of January 2008 is missing (see Figure 11 and Hennenberg et al. 2018[18]).

[13] European Commission, Directorate-General for Energy, Technical assistance for the preparation of guidance for the implementation of the new bioenergy sustainability criteria set out in the revised Renewable Energy Directive: REDIIBIO: final report, Publications Office, 2021, https://data.europa.eu/doi/10.2833/592471

[14] Reise J et al. (2017): Analyse und Diskussion naturschutzfachlich bedeutsamer Ergebnisse der dritten Bundeswaldinventur. BfN-Skripten 427, Bundesamt für Naturschutz, Bonn.

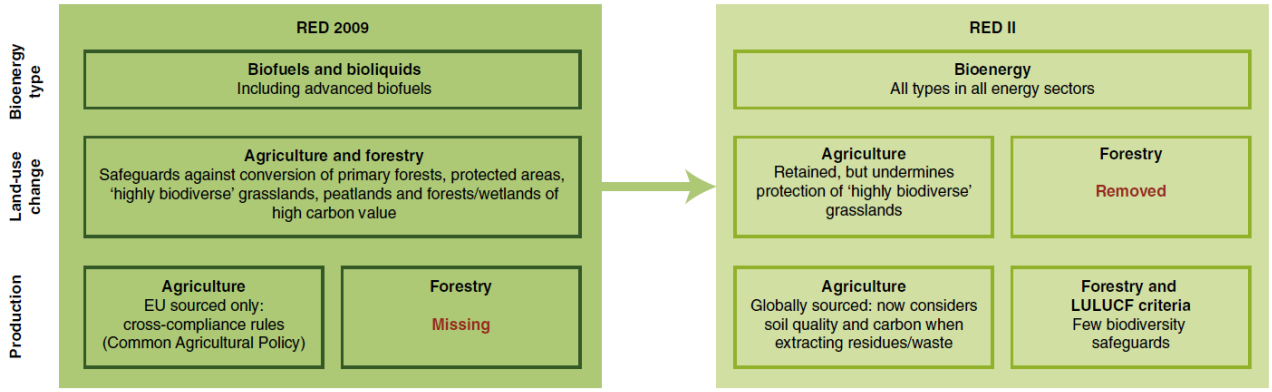
[15] See European Flora-Fauna-Habitat (FFH) Directive (92/43/EEC)

[16] Wahl J (2020): Vögel in Deutschland – Erfassung von Brutvögeln. DDA, BfN, LAG VSW, Münster.

[17] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources

[18] Hennenberg et al. (2018): Revised European Union renewable-energy policies erode nature protection. Nature Ecology & Evolution 2: 1519–1520 (2018). https://doi.org/10.1038/s41559-018-0659-3

Figure 11: Erosion of biodiversity protection from RED 2009 to RED II



Source: Hennenberg et al (2018)[18]. Several elements of RED II have been identified that lead to fewer safeguards for biodiversity protection. LULUCF: land use, land-use changes and forestry.

The Commission's proposal addresses this weakness of RED II and proposes that several articles for agricultural biomass should also apply to forestry biomass (Art. 29(3)(a), (b), (d), Art. 29(4) (a) and Art. 29(5)). This is a clear improvement, especially the reference to primary forest and other wooded land, highly biodiverse forest and other wooded land and peatland. The articles not referenced for forestry biomass by the Commission's proposal are:

- Art. 29(4)(b) corresponds to Art. 29(6)(a)(ii)
- Art. 29(4)(c) is not relevant for forestry biomass production
- Art. 29(3)(c)(i) is covered under Art. 29(6)(a)(iii)
- Art. 29(3)(c)(ii), however, is missing.
  It is important to notice this lack. In case that the Commission recognises areas designated for the protection of rare, threatened or endangered ecosystems or species they will not apply to areas used for forestry biomass production. This would affect areas listed by intergovernmental organisations or the IUCN (International Union for the Conservation of Nature). Although IUCN, for example, has not sent a list of such areas to the Commission, it would be important to keep the option.

3.1.2.2 Sustainability requirements for agricultural biomass

In RED II, the criteria that were already included in RED I apply to agricultural biomass. In this context, biomass may not originate from areas with high biodiversity value, from areas with a high carbon stock and from peat bog areas. To demonstrate compliance, the period from January 2008 until harvest must be considered.

- Protection of areas of high biodiversity value (Art. 29(3)):
  - Primary forest and other wooded land are no-go areas for the production of agricultural biomass (no changes compared to RED I).
  - Protection areas: agricultural biomass may originate from protection areas if the production of raw materials does not interfere with nature protection purposes. Protection areas cover areas designated by law or by the relevant competent authority for nature protection purposes. In addition, areas designated for the protection of rare, threatened or endangered ecosystems or

species, but not yet legally protected, can be recognised by the Commission (no changes compared to RED I).

- Highly biodiverse grassland:
  - Grassland can have a canopy of trees of up to 30% (savannas). It was added to RED II that a grassland area must be at least 1 ha. Previously, there was no limit to the size of the area.
  - Grassland is divided into natural and non-natural grassland. Natural grasslands would remain grassland in the absence of human intervention, non-natural grasslands would develop to other vegetation types in the absence of human intervention (e.g. forest).
  - Highly biodiverse natural grasslands are no-go areas for the production of agricultural biomass (no changes compared to RED I)
  - Highly biodiverse non-natural grasslands:
    - Biomass may originate from highly biodiverse no-natural grassland if harvesting of the raw material is necessary to preserve its status as highly biodiverse grassland.
    - The Grassland Regulation (EC 2014[19]) specifies in detail criteria against which the diversity status of grassland is to be assessed.
    - In RED II, it was added that a competent authority must have determined the high biodiversity value of non-natural grassland. De facto, this shifts the burden of proof from the producer to the competent authority and mapping deficits are accepted.

  These two additions (1 ha, competent authority) strongly reduce the protection of grassland with high biodiversity.
- Highly biodiverse forest and other wooded land: This area category was newly included in RED II. Due to overlaps of the area categories forest (Art. 29(4); already strict protection at 30% canopy cover), this new category is only relevant for areas with a canopy cover of 5-30%. Agroforestry systems are excluded. These areas also overlap with grassland (see above). For these areas, an assessment of the biodiversity status must be carried out by the operator or a competent authority. Thus, the protection status is higher and has priority over grasslands.

- Protection of land with high-carbon stock (Art. 29(4)): Covered are wetlands, continuously forested areas with a canopy cover above 30% and “sparse” forests with a canopy cover from 10-30%. Biomass may originate from land with high-carbon stock in case that the status of the area does not change at the time the raw material was obtained. Sparse forests are an exception. They may be converted to agricultural land if the use of bioenergy, including land-use change, meets the GHG reduction limits of RED II (no changes compared to RED I).
- Protection of peatland: Biomass may only come from peatland if no further drainage of the areas takes place (no changes compared to RED I).
- Preservation of soil quality and soil carbon: Waste and residues originating from agricultural land (e.g. straw) may only be used as bioenergy if "operators or national authorities have monitoring or management plans in place in order to address the impacts on soil quality and soil carbon” (Art.

[19] EC (European Commission) (2014): Commission Regulation (EU) No 1307/2014 of 8 December 2014 on defining the criteria and geographic ranges of highly biodiverse grassland for the purposes of Article 7b(3)(c) of Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels and Article 17(3)(c) of Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources.

29(2)). This clause *de facto* replaces the reference in RED I to requirements under the cross-compliance rules in the EU. However, the new passage is also applicable outside the EU. The guidelines in (EC 2021[13]) emphasise sustainable soil management.

- Tier 1 approach: There are national regulations for a country and the requirement is considered to be met *per se*.
- Tier 2 approach: The requirements are fulfilled with a verification at farm level.

Compared to RED I, RED II includes the area category highly biodiverse forest and other wooded land. This is positive in principle, but the effect in relation to agricultural biomass is small. Rather, a reference to forest biomass would be more important. This is addressed in the Commission's proposal (see above).

The changes for highly biodiverse grassland (1 ha, competent authority) clearly deteriorate the sustainability requirements, however, for biomass used for heating/cooling purposes this will play a subordinate role.

3.1.2.3 Applicability of sustainability requirements and exceptions

Biomass used as bioenergy under RED II must meet the sustainability requirements defined in Article 29. However, according to Art. 29(1), two exceptions apply to installations for the generation of electricity or heating/cooling from biomass fuels:

- Solid biomass fuels used in installations with a total rated thermal input of less than 20 MW do not need to comply with the sustainability requirements in Art. 29. This exemption applies to solid biomass from agriculture (e.g. wood from short rotation coppice, straw) and from forestry (e.g. woodchips from stemwood, forest residues). In the EU, about 75% of solid biomass from forests is used in plants smaller than 20 MW, and these quantities are exempt from compliance with the RED II sustainability criteria (see Hennenberg et al. 2017[20]).
- Gaseous biomass used in plants with a total rated thermal input of less than 2 MW are exempt from the sustainability requirements in Art. 29. A typical biogas plant of this size occupies approximately 450 ha of biogas substrate cultivation area per year (FNR et al. 2013[21]; Hartmann 2008[22]).

RED I focused on biofuels and bioliquids, but it already included raw materials from agriculture (e.g. biogas for transport) and forestry (e.g. wood for second generation biofuels), and there were no exceptions related to plant size as now in RED II. Hennenberg et. al. (2018)[18] thus conclude that the new threshold undermines the sustainability requirements for forestry and “opens the door for indirect effects within the EU bioenergy market: selling forest biomass complying with RED II to larger plants, but selling non-complying biomass to smaller plants”.

The Commission has now proposed to lower the limit for solid biomass to a total rated thermal input of less than 5 MW. This reduces the regulatory gap. However, thresholds for forest biomass – if needed – should be related to the size of cultivated forest areas (e.g. small forestry holders with a

[20] Hennenberg K. et al. (2017): Short analysis of the RED 2009, the iLUC Directive 2015 and the 2016 RED proposal regarding implications for nature protection. Öko-Institut, Berlin. https://www.oeko.de/fileadmin/oekodoc/OEKO-IFEU-2017-RED-proposal-evaluation.pdf

[21] FNR (Fachagentur Nachwachsende Rohstoffe) (2013): Leitfaden Biogas – Von der Gewinnung zur Nutzung. 6. überarbeitete Auflage. FNR, Gülzow.

[22] Hartmann A (2008): Wie viel Fläche wird für Biogas benötigt? Statistisches Monatsheft Baden-Württemberg 7/2008: 40-42

size of 100 ha), instead of referring to the size of the installations in which the biomass is destined to be burned (Hennenberg et al. 2018[18]. For biogas the Commission still refers to the 2 MW threshold and includes thresholds in case of biomethane production. However, a threshold value for biogas and biomethane is not comprehensible, as every single hectare for biofuel production must fulfil the sustainability requirements, and the threshold value should be removed from RED II.

3.1.2.4 Criteria for GHG emission reductions

Art. 29(10) specifies GHG emission saving targets for biomass types in the sectors. For solid and gaseous biomass used for energy purposes in the electricity and heating/cooling sectors, requirements for GHG emission savings are only applicable for new installations from 1.1.2021 onwards. From 1.1.2021, the minimum GHG emission saving is 70% and it increases to 80% for installations commissioned from 1.1.2026. For existing installations commissioned by 31.12.2020, proof for GHG emission savings is not required.

In the annex to RED II, default values for GHG emission savings are compiled for numerous bioenergy types and biomass substrates. If a default value is above the minimum GHG emission saving target, a plant operator can use the default value as proof and can dispense with its own GHG balance.

For numerous **solid biomass fuels** (incl. wood and agricultural residues such as straw) used for heating/cooling and for electricity generation, the default values are differentiated according to transport distance. For the production of wood briquettes or pellets, a distinction is also made between three production cases that differ in terms of the share of renewable energy in the production process. The following tendencies to the standard values can be recognised:

- The transport distance significantly worsens the GHG saving.
- The use of renewable energy improves the GHG saving significantly.
- If renewable energy is used in the process for electricity and heat generation, and if the transport distance is up to 2,500 km, all default values are above the minimum GHG emission saving of 80%. The GHG saving criterion is met by 2030.
- If renewable energy is used in the process for electricity and heat generation, and the transport distance is 2,500 to 10,000 km, all standard values for GHG emission saving are above 70% (threshold value until 31.12.2025) and in some cases also above 80% (threshold value from 1.1.2026).
- Wood pellets from stemwood and forest residues used for heating are above 80% (threshold value from 1.1.2026) even with a transport distance of more than 10,000 km if renewable energy is used in the process for electricity and heat production.

However, the derivation of the default values in RED II, as well as the rules for calculating actual emission savings, do not consider changes in emissions from carbon stock changes caused by forestry. If these effects are included in the GHG balance, it is questionable whether the minimum GHG saving can be achieved for forest energy wood (see text box 3).

The energy use of stemwood and forest residues for heat and electricity is not restricted by the GHG saving criterion – regardless of the transport distance – as long as renewable energies are used in the production process. If, on the other hand, no renewable energies are used, the GHG saving thresholds can generally not be met. In summary, it can be stated that the requirement for GHG savings in combination with the default values primarily generates a steering effect towards the use of renewable energies in the production process.

Box 3: Total GHG-Balance

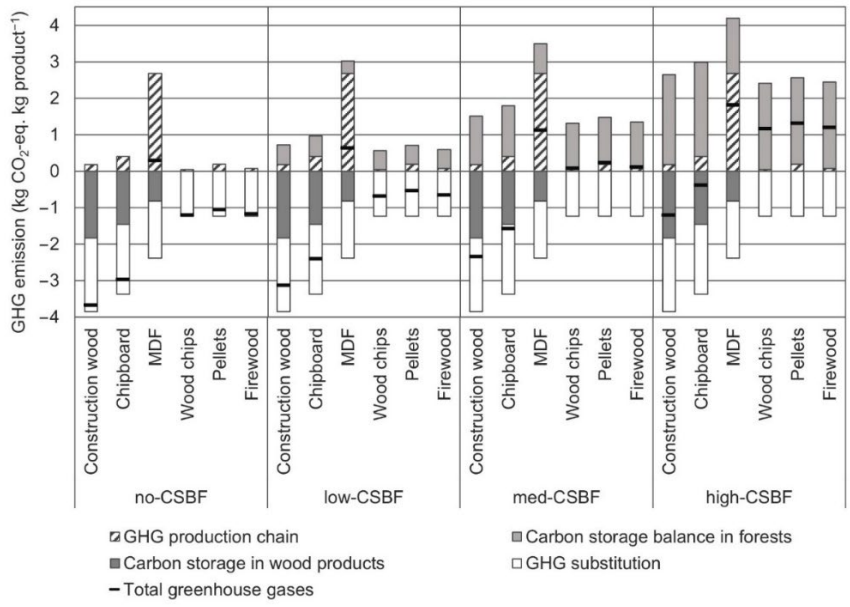
A comprehensive greenhouse gas (GHG) balance should include the following elements:

1. GHG emissions along the production chain
2. Impact of wood harvest on CO_2 sink capacity of forests (CO_2 storage balance)
3. Storage of CO_2 in wood products

As a fourth element, the GHG balance of the wood product should be compared with that of alternative products that would be used instead of the wood product (substitution effects). Substitution effects are not part of the GHG balance of the wood product, but they are carried out separately and are then compared with the wood product's GHG balance (Fehrenbach et al 2022[23]).

Fehrenbach et al. (2022) raise the question: Is it thus better to increase wood production and use, or to conserve and expand the carbon stock in forests? GHG balances of wood products mostly ignore the dynamics of carbon storage in forests, which can be expressed as the "carbon storage balance in forests" (CSBF). For Germany, a CSBF of 0.25 to 1.15 t CO_2/m³ wood can be assumed. Soimakallio (2022[24]) evaluate in their review on forest modelling studies for boral and temperate forests a CSBF[25] of 0.6-2.2 tC/tC (almost equivalent to t CO_2/m³). The full GHG balance for wood product groups reveals that – when the CSBF is integrated into the GHG balance – the GHG mitigation substantially deteriorates and wood products may even turn into a GHG source, e.g. in the case of energy wood (Fehrenbach et al. 2022[23]).

Figure Box 3: Total GHG balance of forest products



Source: Fehrenbach et al. (2022). CSBF = carbon storage balance in forests; no-CSBF: CSBF of 0.0 t CO2/m³; low-CSBF: CSBF of 0.25 t CO2/m³; med-CSBF: CSBF of 0.62 t CO2/m³; high-CSBF: CSBF of 1.15 t CO2/m³.

[23] Fehrenbach et al. (2022): The missing limb: including impacts of biomass extraction on forest carbon stocks in greenhouse gas balances of wood use. Forests 2022, 13(3), 365; https://doi.org/10.3390/f13030365.

[24] Soimakallio et al. (2022, preprint): Closing an open balance: the impact of increased roundwood harvest on forest carbon. Preprints 2022, 2022030198; https://doi.org/10.20944/preprints202203.0198.v1.

[25] Soimakallio et al. (2022) use the term „carbon balance indicator" that is equivalent to CSBF.

The GHG balance given in RED II ignores emissions from carbon stock changes caused by forestry. However, this carbon stock change is directly caused by forest management and wood harvest and it should be included in the GHG balance. We see two options:

- Include a new term in the GHG balancing methodology in the Annex:
  $E = e_{ec} + \mathbf{e_f} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr}$,
  with the new factor e_f = annualised emissions from carbon stock changes caused by forestry[26]
- Alternative: Specify for "emissions from the extraction or cultivation of raw materials" (e_{ec}) that "for forest biomass[27] emissions from carbon stock changes caused by wood extraction" shall be included.

3.1.2.5 Efficiency requirements for using solid biomass fuels for energy purposes

According to Art. 29(11) of RED II, larger power generation plants must meet efficiency standards:

- Plants with a total rated thermal input between 50 and 100 MW: electricity is produced applying high-efficiency cogeneration technology or, for electricity-only installations, meeting an energy efficiency level associated with the best available techniques.
- Plants with a total rated thermal input greater than 100 MW: Electricity is produced applying high-efficiency cogeneration technology, or, for electricity-only installations, a net-electrical efficiency of at least 36 % is achieved.
- Exception: plants applying Biomass CO_2 Capture and Storage (BECCS)

Although these requirements refer to electricity generation, they also apply indirectly to the provision of heat by solid biomass if a combined heat and power technology is used and solid biomass is employed.

In coal-fired power plants, large mass flows are converted centrally to generate electricity as well as heat that is fed into the district heating network. If part of the coal is replaced by biomass, a correspondingly large demand for biomass can arise. A prominent example is Drax Power's power plant in Selby, UK, which is currently considered the largest wood pellet-fired power plant in the world. The plant, which was originally coal-fired, uses only biomass in four units totalling 2.6 GW. A total of 7.37 million tons of biomass were fired in 2020 (see Drax 2021[28]). This is almost three times the pellet production in Germany (approx. 2.76 million tons in 2020).

3.1.2.6 Key Recommendations

The following recommendations are derived for the adoption of the sustainability framework in RED II:

- Thresholds for sustainability requirements:

[26] E = total emissions from the use of the fuel; e_{ec} = emissions from the extraction or cultivation of raw materials; e_l = annualised emissions from carbon stock changes caused by land-use change; e_p = emissions from processing; e_{td} = emissions from transport and distribution; e_u = emissions from the fuel in use; e_{sca} = emission savings from soil carbon accumulation via improved agricultural management; e_{ccs} = emission savings from CO_2 capture and geological storage; and e_{ccr} = emission savings from CO_2 capture and replacement.

[27] Here single wood fractions from forests could be addressed, e.g., stemwood.

[28] Drax (2021): Driven by our purpose. https://www.drax.com/wp-content/uploads/2021/03/Drax_AR2020.pdf.

  - In general, the thresholds used for the size of companies that are exempted are too high and should at least be lowered.
  - A better solution would be:
    - Apply no threshold for biogas as there is no threshold for biofuels and both substrates are produced on the same cropland.
    - Thresholds for solid biomass – if needed – should be related to the size of the forest operator (e.g. 100 ha) instead of the plant size.
- Which sustainability requirements apply to forestry biomass?
  - As proposed by the Commission, land-use change issues from agricultural biomass should also apply to forestry biomass.
  - To be noted: the link to “areas designated for the protection of rare, threatened or endangered ecosystems or species but not yet protected” is missing in the Commission’s proposal and should be added.
- Which sustainability requirements apply to agricultural biomass?
  - The changes for highly biodiverse grassland (1 ha, competent authority) clearly deteriorate the sustainability requirements, however, for biomass used for heating/cooling purposes this will play a subordinate role.
- What GHG reductions must be achieved for bioenergy?
  - The factor “emissions from carbon stock changes caused by forestry” should be added in the GHG calculation.
- What efficiency requirements must be met when using solid biomass fuels for energy?
  - Restrict the use of woody materials in lager plants.
  - Also apply the efficiency requirements defined in Art. 29(11) of RED II to smaller installations with a thermal input below 50 MW and eliminate the possibility to use solid biomass in electricity-only installations.

3.2 Energy Performance of Buildings Directive (EPBD)

The Energy Performance of Buildings Directive (EPBD) sets the framework for the development of an energy-efficient building stock in Europe. The aim of the EPBD is to reduce the energy demand of buildings and to increase the use of renewable energy for heating. The EPBD was introduced in 2010 and the last amendment/recast was in 2018 (Directive 2018/844). The following assessment focusses on the proposed recast of the EPBD from 15 December 2021[29].

Biomass use for heating in the EPBD proposal

The Commission proposal contains the term "biomass" only once in Article 2(13), in which different terms are defined (parts with a grey background are new):

"'*energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar* ⇨ *(solar thermal and solar photovoltaic)* ⇦ *,* ~~*aerothermal,*~~ ⌦ *and* ⌫ *geothermal* ⌦ *energy* ⌫ *,* ~~*hydrothermal*~~ ⇨ *ambient energy, tide, wave* ⇦ *and* ⌦ *other* ⌫ *ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas*~~*es*~~*;*"

If biomass is used in buildings, the energy provided is seen as "energy from renewable sources". In the recitals (number 20), biomass is listed as one option "*to cover the energy needs of an efficient building by energy from renewable sources*" on-site or by renewable energy communities, citizen energy communities and district heating and cooling.

In Article 2(2), 'zero-emission buildings' are defined as buildings "*with a very high energy performance […] where the very low amount of energy still required is fully covered by energy from renewable sources generated on-site, from a renewable energy community […] or from a district heating and cooling system*". Zero-emission is mandatory for new public buildings as of 1 January 2027 and for all new buildings as of 1 January 2030 (see Article 7). Furthermore, 'deep renovation' means a renovation transforming a building or building unit into a zero-emission building as of 1 January 2030 (before 1 January 2030 deep renovation is a renovation transforming a building into a nearly zero-energy building).

The maximum primary energy demands of zero-emission buildings in different climate zones defined in the proposed Annex III is shown in Table 3-1. In 'nearly zero-energy buildings' the remaining nearly zero or very low amount of energy is covered to a very significant extent by renewable sources.

[29] Available at https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12910-Energy-efficiency-Revision-of-the-Energy-Performance-of-Buildings-Directive_en (last accessed on 24 March 2022)

Table 3-1: Total primary energy use of a new zero-emission building as proposed in Annex III of the EPBD proposal from 15 December 2021

EU climate zone	Residential building	Office Building	Other non-residential building
Mediterranean	<60 kWh/(m²*a)	<70 kWh/(m²*a)	<NZEB total primary energy use defined at national level
Oceanic	<60 kWh/(m²*a)	<85 kWh/(m²*a)	<NZEB total primary energy use defined at national level
Continental	<65 kWh/(m²*a)	<85 kWh/(m²*a)	<NZEB total primary energy use defined at national level
Nordic	<75 kWh/(m²*a)	<90 kWh/(m²*a)	<NZEB total primary energy use defined at national level

Source: European Commission (2022)[30]

As the thresholds are defined in terms of primary energy, the primary energy factors that Member States define strongly influence the energy carrier mix that can be used to meet the target. According to Hitchin e al. (2018)[31] the primary energy factors of biomass applied for calculating the primary energy demand of a building strongly differ among Member States, ranging from 0.01 – 1.10 for biomass in general, from 0.01 – 1.20 for wood and from 0.01 – 1.26 for wood pellets. A low primary energy factor for biomass facilitates achieving the requirements of the EPBD easily, while a high primary energy factor impedes achieving the requirements.

In addition to the level of the primary energy factors, the energy efficiency requirements for buildings influence the amount of biomass used. According to Article 3, Member States shall establish national renovation plans to ensure the renovation of existing buildings. The aim is to transform existing buildings into zero-emission buildings in the long run. In this context, Member States must estimate the contribution of building renovation plans to achieve binding national targets for greenhouse gas emissions, energy efficiency targets and the indicative targets for the share of energy from renewable sources as defined in the amended RED (RED II). To achieve the long-term targets, minimum energy performance standards are introduced in Article 9. They will most likely stimulate deep renovations of the worst-performing buildings and thus reduce the final energy demand.

With respect to technical building systems, Member States can set requirements to the greenhouse gas emissions of, or the type of fuel used by heat generators provided that such requirements do not constitute an unjustifiable market barrier (Article 11). This offers possibilities for Member States to phase out the use of fossil fuels and/or of biomass for heating but leaves room for interpretation especially regarding “unjustifiable market barriers”. Setting requirements to the greenhouse gas

30 ANNEXES to the Proposal for a Directive of the European Parliament and of the Council on the energy performance of buildings (recast). Annex - COM(2021)802, available at https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12910-Energy-efficiency-Revision-of-the-Energy-Performance-of-Buildings-Directive_en

31 Hitchin, R.; Engelund Thomsen, K.; Wittchen, K. B. (2018): Primary Energy Factors and Member States Energy Regulations – Primary factors and the EPBD. Concerted Action Energy Performance of Buildings. Retrieved 25 March 2022 from https://epbd-ca.eu/wp-content/uploads/2018/04/05-CCT1-Factsheet-PEF.pdf

emissions would have an impact on the use of fossil fuels and the minimum share of renewable sources for heating and domestic hot water. However, the requirements would be met using biomass due to the low emission factors of biomass.

Summarising, the EPBD proposal currently promotes the use of biomass to achieve the zero-emission building standard. It does not include any limitations on the use of biomass. However, it opens possibilities for Member States to limit the use of biomass in national building stock as Member States can set the primary energy as well as emission factors for energy carriers used in buildings.

Possible improvements to the provisions to ensure a sustainable use of biomass for heating

The EPBD proposal includes several options to limit the use of biomass for heating:

Article 2:

'zero-emission building': In the definition of zero-emission buildings, biomass could be excluded as an option, or a maximum share of biomass could be defined. As zero-emissions buildings are by definition buildings with a low energy demand, other renewable technologies such as heat pumps can be applied.

Article 11:

As described above, Member States can set requirements related to greenhouse gas emissions of, or to the type of fuel used by heat generators. This offers the possibility to set maximum emission values, which, in combination with the respective emission factors for biomass, can limit the possibilities to use biomass for heating. Another option is to ban the use of biomass in defined buildings as long as the requirements set do not constitute an unjustifiable market barrier. "Unjustifiable market barrier" should be clarified as it currently leaves room for interpretation and causes uncertainty in the Member States.

Annex III and primary energy factors:

Higher primary energy factors for biomass would make it more difficult to meet the minimum requirements for zero-emission buildings. However, currently Member States can set the primary energy and greenhouse gas emission factors on their own.

3.3 Energy Efficiency Directive (EED)

The Energy Efficiency Directive 2018/2002 (EED)[32] mandates energy efficiency improvements within the European Union and introduces 'energy efficiency first' as an overall principle of EU energy policy. It establishes a common framework for the promotion of energy efficiency within the EU in order to meet its energy efficiency headline target of 32.5% by 2030. The target, to be achieved collectively across the EU, is set relative to the 2007 modelling projections for 2030.

As part of the Green Deal the European Commission put forward a proposal for a EED recast in July 2021. The proposal raises the level of ambition of the EU energy efficiency target and makes it binding. It doubles the annual energy savings obligation (in Article 8) to an annual savings target of 1.5% of final energy consumption from 2024 to 2030. Furthermore, the proposal widens the scope

[32] Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018L2002)

of the renovation requirements in the public sector to buildings owned by all levels of public administration (no longer just buildings owned and occupied by central governments).

The proposal also outlines stricter planning and follow-up of comprehensive assessments, including reach-out to local and regional level. Moreover, it provides more specified definitions of efficient district heating and cooling and efficient co-generation to ensure fully decarbonised heat or cooling supply in efficient district heating or cooling systems by 2050.

The following assessment focusses on the proposed EED recast from 14 July 2021[33].

- **In what way does the directive address biomass use for heating?**

In Art. 6 “Exemplary role of public bodies’ buildings” the Commission proposes to expand the renovation requirement for buildings owned and occupied by central governments to all public buildings including those at regional and local level (including healthcare, education and public housing). Member States shall ensure that at least 3 % of the total floor area of heated and/or cooled buildings owned by public bodies is renovated each year at the nearly zero-energy buildings standard defined by the EPBD. At the same time, the possibility of fulfilling the renovation obligation by alternative measures shall expire.

According to the proposed EPBD recast (see above) a nearly zero-energy building is a building where the nearly zero or very low amount of energy required is covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby. The latter includes biomass. For this reason, the expanded renovation obligation could lead to an increasing biomass demand from the public sector.

With the new Art. 24 “Heating and cooling supply”, the draft EED recast introduces a definition for efficient heating and cooling systems. Minimum requirements for the efficient district heating will be gradually increased. Over the years higher shares of renewable energy have to be used in order to meet the minimum requirements. For example, as of 1 January 2035, a heating network will only be classified as efficient if the share of renewable energy is at least 20%. From 1 January 2045, the renewable share must exceed 40%, from 1 January 2050 60%.

Member States shall ensure that where a district heating and cooling system is built or substantially refurbished, the above criteria are met. The criteria also play a role with regard to the state aid classification of support programmes. Today, the share of renewable energies in district heating in the EU is dominated by biomass. With increasing requirements, the pressure on biomass demand is likely to increase further.

- **How could the provisions be improved to ensure a sustainable use of biomass for heating?**

Several options could be considered to mitigate some of the pressure on biomass demand that is likely to result from the EED's proposal. The main issue here is the definition of efficient heating and cooling systems. Within the definition, the use of biomass could be treated restrictively, e.g. in the form that heat from biomass is only counted towards the RE minimum shares if the biomass is used in a CHP plant. In order to exclude smaller heating networks, such as those found in so-called bioenergy villages in rural areas, from the requirement, the restriction could be limited to larger district heating and cooling systems. A threshold would then need to be defined as to when a heating

[33] Proposal for a Directive of the European Parliament and the Council on energy efficiency (recast) (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0558)

or cooling system is considered large. An alternative would be to amend the definition for efficient heating and cooling systems in such a way that a maximum of X% of the minimum share of renewable energy required under the definition may come from biomass. This option could also be limited to larger heating and cooling systems..

3.4 Biomass in the EU Emissions Trading System

The EU ETS Directive influences the use of fuels for heating: The current EU ETS (ETS 1) covers installations with a total rated thermal input equal to or higher than 20 MW, thus introducing carbon pricing in district heating and process heating in installations above this threshold. Individual heating in buildings is currently not covered by the EU ETS, however, the Commission's proposal for the recast ETS Directive includes the introduction of a separate fuel ETS for buildings and road transport (ETS 2).

Currently, for most biomass combustion in installations covered in the ETS, the emissions are rated as zero. The ETS covers around 150 Mt of zero-rated annual emissions from biomass, while non-zero rated emissions are less than 1 Mt. With an emission factor of zero for biomass, the ETS is a driver for the use of biomass for heating in the sectors covered under the scheme. This includes, among others, co-incineration of biomass coal-fired CHP plants.

The proposal of the recast ETS Directive provides a clarification regarding the sustainability criteria as a precondition for the zero-rating: "The emission factor for biomass that complies with the sustainability criteria and greenhouse gas emission saving criteria for the use of biomass established by Directive (EU) 2018/2001, with any necessary adjustments for application under this Directive, as set out in the implementing acts referred to in Article 14, shall be zero" [34]. This provides a clarification of the view supported by the EU Commission that in any case the zero-rating only applies to biomass that meets the RED criteria. The Commission argues that the zero-rating is seen as a support scheme within the meaning of the RED, while "Pursuant to Article 17(1) of the RES-D, bioliquids and biofuels may only receive support and count towards the national targets where they comply with sustainability criteria set out in Article 17 of that Directive."[35]

With the introduction of the fuel ETS for buildings and transport, the approach for specifying sustainability criteria would need to be adopted: While ETS 1 operates as a downstream system, where the obligated parties are the emitters of greenhouse gases (i.e. the entities where the fuels are combusted), ETS 2 is planned to use an upstream approach. In an upstream approach, the point of regulation is further up the supply chain, e.g. the entities that place the fuels on the market.

Therefore, in an upstream approach, sustainability criteria for biomass cannot be linked to the size of the installations in which the fuel is burned. On the one hand, the obligated parties operate at an upstream level and typically have limited knowledge regarding the size of the

[34] Art. 14 "Those implementing acts shall apply the sustainability and greenhouse gas emission saving criteria for the use of biomass established by Directive (EU) 2018/2001 of the European Parliament and of the Council(*), with any necessary adjustments for application under this Directive, for this biomass to be zero-rated. They shall specify how to account for storage of emissions from a mix of zero-rated sources and sources that are not zero-rated. They shall also specify how to account for emissions from renewable fuels of non-biological origin and recycled carbon fuels, ensuring that these emissions are accounted for and that double counting is avoided."

[35] European Commission (2017): Guidance Document - Biomass issues in the EU ETS

installations of their final consumers. On the other hand, with ETS 2 being designed to address heating in the buildings sector (next to road transport), the final emitters by default are small.

With the introduction of ETS 2I, sustainability criteria that are not linked to the size of the emitter thus need to be established (see Section 3.1.2).

4 Conclusions and recommendations

The ambition of the RES target for the heating sector specified in Art. 23 of the Commission Proposal for the RED revision should be maintained or increased. The 1.1% target is important to ensure that the EU Member States are directed towards the decarbonisation of heating and cooling by 2050. Even with the 1.1% target in place, a strong increase of the required annual savings in the years after 2030 is required to reach full decarbonisation by 2050. Furthermore, a rapid increase of the renewable energy share in heating supports energy security by decreasing the dependency of the EU Member States on imports of fossil energy for heating purposes.

The policy framework needs to adapt provisions to ensure the growth of the renewable energy share in heating, while maintaining the use of biomass at a sustainable level. Biomass use for heating is addressed directly and indirectly in various provisions across the Fit for 55 policy package. These provisions need to ensure a consistent framework for maintaining the sustainability of biomass use for heating.

The renewable energy directive plays a key role to ensure that the heating sector achieves its climate and energy targets while maintaining a sustainable use of biomass:

- **The proposed binding target needs to be adopted in the renewable energy directive, supplemented with a limit for biomass:** A binding target for increasing the renewable energy share in the heating and cooling sector as proposed in Art. 23 is a key element for the transition of the sector. To ensure that the target for increasing renewable energies in heating and cooling does not put additional pressure on biomass use, the role of biomass for achieving the target needs to be limited. We propose a cap on the share of biomass in meeting the 1.1 percent target, for example *Member States may count biomass, subject to a limit of 20 percent of the average annual increase.*
- **The framework for sustainability criteria for biomass needs to be reworked:** The renewable energy directive introduces a framework that aims at ensuring that the biomass used for heating (and other purposes) is of sustainable origin. However, the framework is weak and needs to be strengthened:
    - The criteria are currently only applicable for biomass combustion in large plants. These size thresholds need to be removed or replaced by a threshold for the size of the forest operator (for example 100 hectares) instead of the plant size.
    - As proposed by the Commission, also land-use change issues that are currently part of the framework for agriculture biomass should apply to forestry biomass. The link to “areas designated for the protection of rare, threatened or endangered ecosystems or species but not yet protected” is missing in the Commission’s proposal and should be added.
    - The GHG balance of biomass currently ignores the carbon stock changes caused by forestry.

Next to the renewable energy directive, the energy performance of buildings directive (EPBD), the energy efficiency directive (EED) and the EU emissions trading scheme (ETS) can contribute to achieve heating and cooling targets while maintaining sustainable use of biomass (see Figure 12).

Figure 12: Overview of provisions to ensure sustainability of biomass for heating at EU level

	RED	EPBD	EED	ETS

Limit biomass use for heating	• Maintain or increase target for renewable H&C and limit biomass contribution to the target.
	• Strengthen sustainability framework:
	  • No exemptions based on size of installation but on size of forrest operator
	  • Include land use change requirements to forest biomass
	  • Account for emissions from carbon stock changes caused by forestry in GHG calculation
		• Limit use of biomass in zero emission buildings
		• Strengthen framework for defining primary energy factors for biomass
			• Limit use of biomass in definition of efficient district heating	• With introduction of ETS 2, define framework for sustainability criteria that apply to small installations

Increase energy efficiency		• Ambitious minimum energy efficiency standards	• Strong framework for increasing energy efficiency across all sectors	

Source: Oeko-Institut