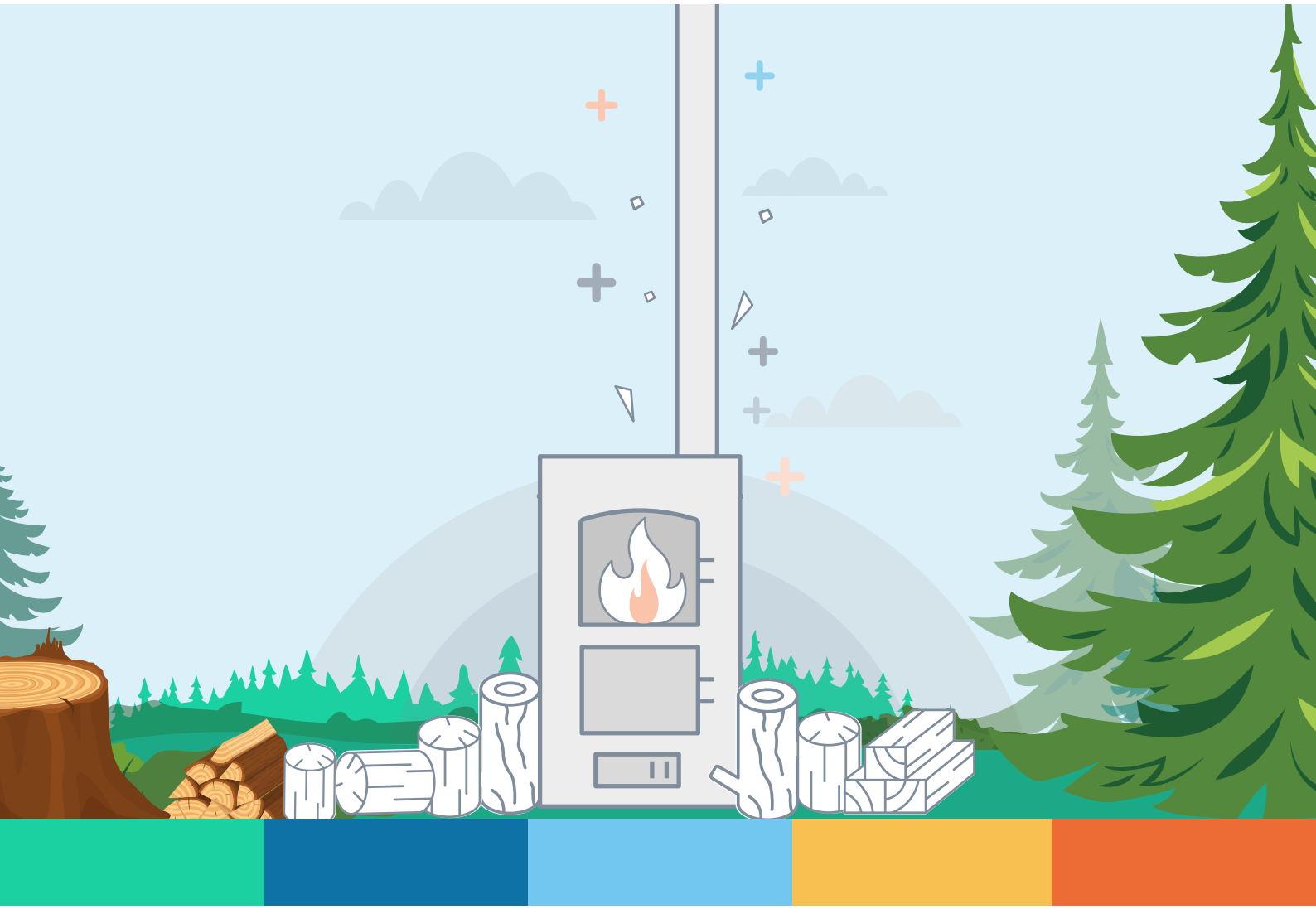
Out of the woods

Using ecodesign to reduce the negative impacts of solid fuel heating



coolproducts for a cool planet

ecos

Contents

1 Executive summary 3

2 Heat from the woods – the context 4

3 The way forward – cutting down on solid fuel heating 8

4 Conclusions – a minor role for highly efficient wood heating 14

5 Annexes 15

6 Notes and references 18

Authors:

Luka De Bruyckere, ECOS – Environmental Coalition on Standards

Gunnar Boye Olesen, Independent Consultant & ECOS Expert

Edited by:

Ivo Cabral, ECOS – Environmental Coalition on Standards

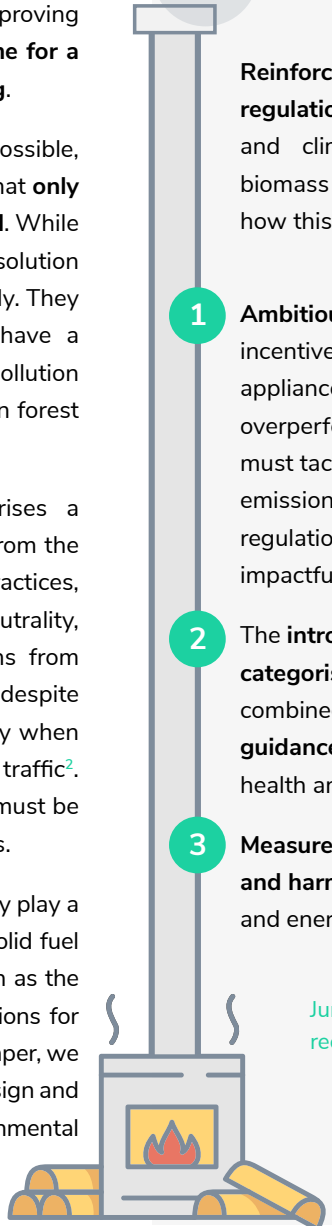
Executive summary

To curb climate change, we must transition to renewable and sustainable heating. In the EU, more than three-quarters of all the energy households consume is used for heating and hot water[1] — and fossil fuels generate most of this heat. We need to reduce heating demand by insulating our homes better, and drastically improving the efficiency of the appliances we use. **It is time for a switch to electric heat pumps and solar heating**.

For houses where a switch to renewables is not possible, solid fuel heating will still play a role, provided that **only the least polluting appliances available are used**. While wood and biomass are often seen as a potential solution for heating, they should be only be used sparingly. They are renewable under certain conditions but have a substantial climate impact and exacerbate air pollution issues, not to mention the pressure they pose on forest ecosystems.

The wood-burning policy conundrum comprises a plethora of laws and policy objectives ranging from the sourcing of wood and forest management practices, to the role of bioenergy in reaching carbon neutrality, or the design of heating appliances. Emissions from domestic heating are under-regulated in the EU despite their impacts on air quality and health, especially when compared to other pollution sources such as car traffic[2]. Policies affecting wood-burning and air quality must be well aligned to realise the EU's climate objectives.

EU ecodesign and energy labelling policies already play a role in minimising the environmental impact of solid fuel heating. A window of opportunity will soon open as the European Commission will be reviewing legislations for solid fuel local space heaters and boilers. In this paper, we analyse the current rules and identify what ecodesign and energy labelling should do to minimise the environmental impact of heating from solid fuel sources.



Reinforced ecodesign and energy labelling regulations can significantly reduce air pollution and climate impacts caused by residential biomass heating. Our recommendations outline how this can be achieved:

1. **Ambitious ecodesign requirements** must give incentives for companies to develop cleaner appliances (some stoves and boilers already overperform the current requirements). Rules must tackle aspects related to both pollutant emissions and energy efficiency. The scope of the regulations should be broadened as to include all impactful appliances.
2. The **introduction of emission-class categorisation** must be explored. It could be combined with a **fuel quality label** and **clear guidance in user manuals**, helping users reduce health and climate impacts.
3. **Measurement standards should be improved and harmonised** to explicitly support ecodesign and energy labelling regulations.

Jump straight to the policy recommendations ⟶

Heat from the woods – the context

Why solid fuel heating is a problem

We cannot afford to waste any time in the transition to clean heating. The International Energy Agency's warning is clear: no fossil fuel heating appliances should be allowed in shops after 2025[3] in order to reach net-zero emissions by 2050. **To do that, we must move away from fossil fuel boilers, electrify the heating sector[4], and decarbonise the energy grid**. This will need to go hand in hand with reducing the demand for heating altogether by better insulating our homes, while drastically improving the efficiency of the appliances we use.

It is clear for most that the path towards heating decarbonisation is paved with highly efficient electric heat pumps and solar energy. Nonetheless, some see a role for biomass in the transition, considering it a renewable solution. Is it though?

The term 'biomass' refers to any biological raw material used to produce bioenergy. It includes wood, straw, charcoal, agricultural and forestry residues, as well as entire crops. In 2019, solid bioenergy accounted for 7.2% of all energy reportedly consumed in Europe. Of this, around 17.5% was primarily used for heating via district heating systems, while 41.6% was employed in warming households directly[5]. Many households in Europe warm rooms or even entire homes with wood burned in stoves and boilers (mostly in Croatia, Slovenia, Latvia, Estonia, Romania,[6] see Annex 1). In 2019, 4.3 million solid fuel heating appliances were sold in the EU-27[7]. Assuming an appliance lifetime of 20 years based on sales numbers, **we estimate that around 80 to 90 million European households heat their homes with solid fuels, of which more than 90% use wood**.

In 2021, scientists warned that burning more wood to replace fossil fuels puts climate objectives at risk[8]. In fact, demand for bioenergy has increased by 150% since 2000 due to inadequate policies, and it is projected to continue rising in the coming years, as shown by EU countries' long-term strategies for decarbonisation. The use of biomass as a raw material is presented as a solution to climate change and resource depletion in other sectors, too (construction, packaging, furniture and textiles, among others). As a result, policy pathways currently grossly overestimate the availability of natural resources from forests and soils roughly 40-100% more than what is likely to be available[9].

Competing uses for woody biomass mean that political and economic choices must be made on the basis of a 'cascading use principle' to ensure that resources are used optimally. First, woody biomass should be available for long-lasting, high-value uses such as wood-based products. Then, it can be reused for similar or different applications and be materially recycled to create new products. Finally, and **only at the end of its useful material life, wood may be burned for energy**. This is illustrated in Figure 1.

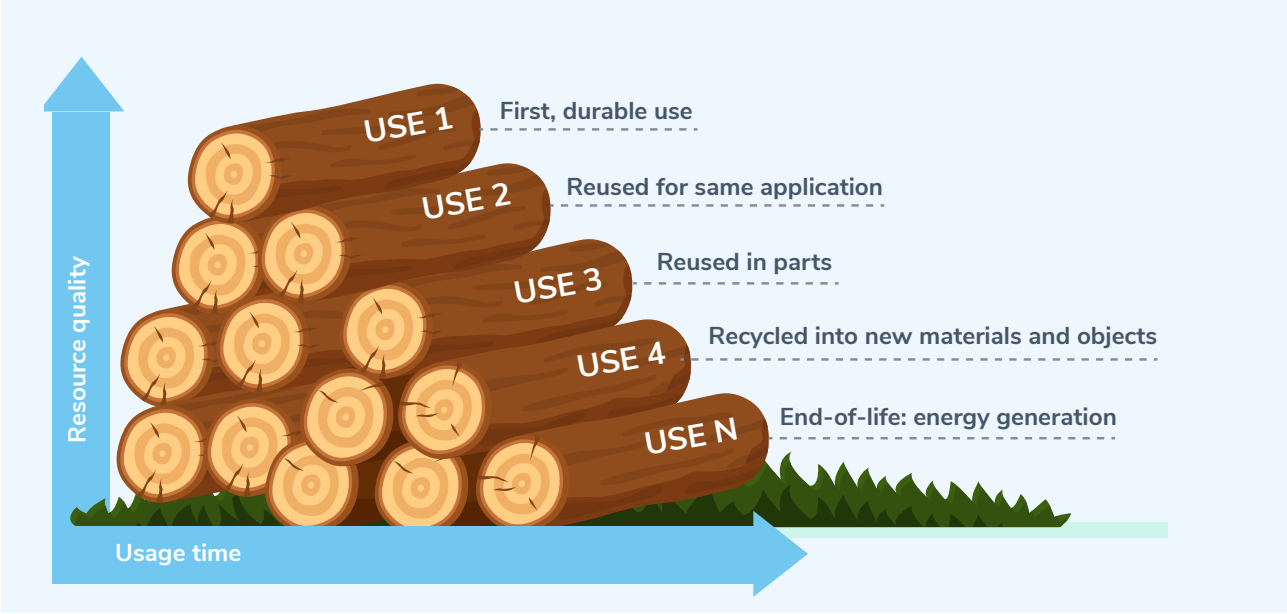


Figure 1 Illustration of the 'cascading use principle', applied to wood. Based on Sirkin and Houten (1994)

Beyond CO_2: Climate impacts of heating our homes with wood

The EU considers biomass a renewable energy source. Because trees grow back after they are chopped down, woody biomass counts towards Europe's renewable energy targets[10]. However, **the sustainability of burning biomass for energy production is questionable**.

When the EU adopted its first Renewable Energy Directive (RED) in 2009, the idea was simple: when a tree dies, it releases the carbon stored while growing. RED assumes that, for each tree we cut down, planting another one is sufficient to reabsorb the CO_2 emitted, creating a 'carbon neutral' cycle. However, when burning wood, the carbon stored by the tree during its whole lifetime is released into the atmosphere all at once. A new tree can take decades or even centuries to hold back the same amount of carbon, depending on the type of tree. Older forests not only continue to remove CO_2 but also store vast amounts of carbon in their trunks, roots and undisturbed soil[11]. In some types of forests, the largest 1% of trees store half of all the carbon[12]. Planting trees now is essential, but it will take a long time to recreate the older forests' ability to store carbon.

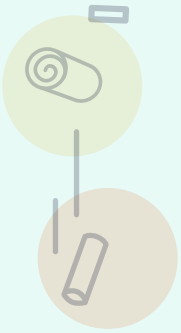
Burning wood leaves a time gap during which the extra carbon, not yet absorbed by new trees, is actually held in the atmosphere. This carbon debt should be avoided given its dangerous effect on the climate system and the limited carbon budget the world has left to keep global warming within the 1.5°C limit.

The best options to mitigate climate change provoked by forestry are to either maintain carbon stored in trees and soil, or to harvest and process wood into long-lasting products such as those used in buildings. It is key to apply sustainable harvesting practices. One of them is **'selective harvesting'**, which progressively removes single trees to maintain the forest's carbon stock and ability to continue growing.

As scientists and NGOs warn, the **traceability of wood-burning emissions** is another critical problem. Under UN rules, emissions from wood burning are not counted[13]. Emissions are theoretically reported when trees are harvested, but there is a growing trend of underreported tree logging. As a result, official records might be omitting a share of the total emissions from wood-burning.

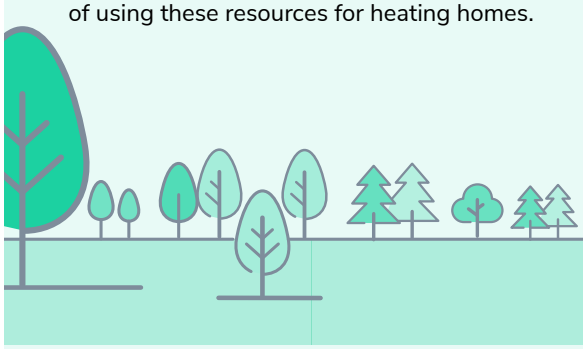
Sources of woody biomass

The European Commission's Joint Research Centre (JRC) has calculated that at least 37% to 50% of all woody biomass used for energy production in the EU comes from cutting down trees – referred to as 'primary woody biomass'. However, the JRC analysis shows that the amount of wood reported as used in product manufacturing and energy production in Europe is about 20% higher than the volume reported as sourced. JRC researchers presume that the gap is due to unreported wood used mainly for energy production. Furthermore, not all the wood used for residential heating is reported; people may fell trees on their own initiative. This means that **potentially more than half of the wood sourced for energy production comes from (parts of) trees that could store carbon or fulfil biodiversity functions**. The other half comes from secondary sourced woody biomass produced from industrial by-products coming from sawmills, wood and paper factories and recovered post-consumer wood[14]. Only 5% of all woody biomass comes from post-consumer wood that has been recovered after being used, for instance, in pallets, furniture or buildings.



It is positive that post-consumer wood and industrial by-products are reused instead of being turned into waste, but, from an environmental perspective, other sectors would make better use of woody biomass and its by-products.

The principle of 'cascading use' could be extended to biomass availability. Before employing any biomass for energy production, priority should be given to long-lasting and circular material uses in sectors lacking sustainable alternatives. For example, the construction sector could use solid by-products and post-consumer wood for panels, while paper and textile industries could rely on wood pulp instead of using these resources for heating homes.



Where demand for wood fuel cannot be met by EU domestic production, the bloc's economies simply externalise the problem by increasing imports from countries with weaker regulations and reporting rules. This may lead to undesirable **land-use change** in countries outside the EU where agricultural land is transformed to accommodate wood production. As a result, exporting countries may experience deforestation processes as other needs, such as food production, compete for land. Considering these dynamics, the EU must mitigate the demand for wood as fuel wherever possible.

The increasing demand for forest products is a leading cause for the **decrease of carbon sink capacity of European forests, projected to reach up to 30%** between 2005 and 2030, even if forest cover is increasing[15]. Pressure on European forests is already destroying their natural ability to sequester carbon. Importantly, forests - including deadwood - are needed to retain **biodiversity** as they are the habitat of many species. Deadwood helps forest regrowth and soil carbon storage, and its over-harvesting can lead to irreversible negative impacts on the forest ecosystem[16].

Lastly, when burning wood, **a whole range of pollutants is released into the atmosphere**, of which some contribute to climate change. Apart from CO_2, these include NO_x emissions and black carbon particles (see Annex 2).

In conclusion, **it is questionable whether all types of forest biomass are carbon-neutral forms of renewable energy**. There is a lack of enforceable sustainability criteria when accounting for land-use change, biodiversity impacts, and the time it takes to recapture carbon from the atmosphere[17]. In addition, excessive demand for biomass leads to unsustainable wood production and related effects of changes in land use. Burning wood for energy risks increasing emissions instead of decreasing them.

In the heating sector in particular, **alternative solutions such as heat pumps and solar heating exist** - and are much more efficient. The wide uptake of those technologies is crucial for heating decarbonisation, whereas the use of biomass to heat homes should be limited. For specific cases where wood heating is the only option, it is key to opt for the most efficient appliances and further improve their efficiency (see section 'Way forward').

Impacts on human health: the air pollution problem

Using wood to heat homes is questionable not only in terms of climate mitigation. Solid fuel heating leads to indoor and outdoor air pollution, with significant impacts on human health. Nearly half of all particulate matter emissions come from households[18]. Nonetheless, emissions from domestic biomass heating are under-regulated in the EU, especially when compared to other sources of air pollution such as traffic.

As pointed out by numerous studies, air pollution primarily leads to heart and respiratory diseases, causing more than 307,000 premature deaths a year in the EU alone. While air quality has improved, many countries are still in breach of EU air quality rules[19]. At the same time, EU limits are often not even in line with the levels the World Health Organisation (WHO) considered safe in a communication issued back in 2005. The WHO has recently strengthened its guidelines, according to which **nearly all European city dwellers are exposed to harmful air pollution**[20]. The EU is currently revising its air quality legislation to bring it in line with these new WHO limits. In addition, the European Commission's recent EU *Action Plan Towards a Zero Pollution for Air, Water and Soil* identified the review of the ecodesign and energy labelling requirements for solid fuel heating appliances as a priority, to be revised by the beginning of 2024 at the latest.

The most harmful air pollutants linked to biomass heating are Particulate Matter (PM), NO_x emissions, change into Organic Gaseous Compounds (OGC), carbon monoxide (CO) and related dioxin emissions (see Annex 3).

A recent study from the European Environmental Bureau (EEB) and Green Transition Denmark found that a single wood stove or boiler under optimal conditions (best fuel quality and stove maintenance) emits many times more PM, black carbon, methane, Non-Methane Volatile Organic Compounds (NMVOCs) and CO than any other type of heating appliance. Heating with wood produces more NO_x than oil and gas boilers, although less than most district heating plants and electricity produced from oil.

On the other end of the spectrum, air pollution emissions from heat pumps are close to zero[21] (without accounting for the emissions from electricity production). Overall emissions including those from electricity generation are decreasing due to progressive integration of wind and solar energy in the energy mix.

It should be noted that wood quality and the type of combustion process impact the volume of emissions generated. Burning humid wood in stoves, for instance, almost triples the level of organic gases emitted – mostly NMVOC, but also methane. Filling a stove with a lot of wood while reducing the airflow to prolong combustion can result in nearly three times more emissions of organic gases than optimal use. Other factors that influence emissions are ignition practices determining air supply and fire temperature.

Finally, we should not forget about the possible trade-offs. Certain new stoves emit less PM but contribute more to NO_x and black carbon emissions due to higher combustion temperatures. It is therefore critical that **good appliance design is combined with good combustion practices** to limit emissions of particles and OGCs. At the same time, combustion temperatures must remain at a reasonable level in order to keep NO_x emissions at low rates.

The way forward

cutting down on solid fuel heating

Policy recommendations for a comprehensive framework on wood-burning

The wood-burning policy conundrum comprises a plethora of laws and policy objectives ranging from the sourcing of the wood and forest management practices, to the role of bioenergy in reaching carbon neutrality, or the design of heating appliances. All aspects must be aligned to realise the EU's climate objectives.

Relevant regulations must carefully assess and tackle the impacts of burning wood for heating. This will entail legislative revisions.

Currently, **large power plants operating on solid biomass should comply with sustainability criteria set out in the Renewable Energy Directive** to count towards EU renewable energy targets.

At the moment, however, the necessary stringency and enforcement mechanisms are lacking when verifying whether large solid biomass power plants comply with sustainability criteria. To make matters worse, these criteria do not even apply to the many smaller central heating plants, or to the wood that ordinary people buy to fuel their stoves[22].

- RED sustainability criteria should be sharpened and broadened to biomass for all purposes. The European Commission should start an evaluation process, assessing whether the 'cascading use principle' is respected, thus ensuring that wood is used primarily for high-value applications before it becomes an energy source. Only an enhanced RED can make wood-burning genuinely climate-neutral, avoid the destruction of forests, and preserve the trees' capacity to sink carbon.
- Emissions from domestic heating are under-regulated in the EU. In May 2021, the European Commission adopted the ***EU Action Plan Towards a Zero Pollution for Air, Water and Soil***, a key deliverable of the European Green Deal. The plan identified as a priority **the need for ecodesign and energy labelling requirements for solid fuel heating appliances**.
- Emission limits on air pollutants exist for large power plants as set by the **Industrial Emissions Directive**, but these only apply to large combustion plants, leaving smaller plants unregulated. This situation should be corrected.
- EU-wide rules should support measures taken at the Member State level to help countries comply with national emission reduction targets set in the **National Emission reduction Commitments Directive (NECD)**. Since commitments only cover three pollutants relevant for biomass burning (NO_x, NMVOCs and $PM_{2.5}$), a broader scope of this legislation should be discussed. For instance, it could include ultrafine PM.

The need to revise ecodesign and energy labelling regulations

Currently, two separate ecodesign and energy labelling regulations govern solid fuel heating appliances, setting energy efficiency thresholds and emission limits[23]. There is a specific regulation for **solid fuel local space heaters**[24], and another one for **solid fuel boilers**[25].

Regarding the former, only as of 2022 do EU-wide emission limits apply. Regulatory discussions on the latter started before 2009, but ecodesign requirements only entered into force in 2020. Ecodesign regulations currently cover PM, NOx, CO, and OGC emissions in both cases, with many other pollutants left out with no required emission limits. It is the case of ultrafine particles, methane, condensed particles, and climate-polluting black carbon. In addition, some of the existing energy efficiency thresholds and emission limits are weak, and underlying testing standards do not reflect real-world use.

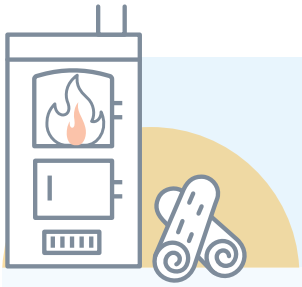
Several countries and regions, for example Germany or parts of Poland, set stricter emission limits for solid fuel heating appliances at national level. This is telling of how low the ambition of current EU-wide ecodesign regulations is. Ecodesign regulations should at least match national and regional emission limits to avoid weakening the existing environmental legislation.

Heating decarbonisation will require moving away from fossil fuel boilers and switching to electric heat pumps and solar-powered heating. Nevertheless, since wood-burning may still play a small role in the transition, these appliances must be energy- and material-efficient while polluting as little as possible. Ecodesign and energy labelling are the tools that can make this happen.

Time to strengthen ecodesign and energy labelling regulations

2022 will see the beginning of a review on ecodesign and energy labelling regulations for both solid fuel boilers and solid fuel local space heating appliances. Discussions on **boiler** ecodesign and labelling[26] rules are expected to start at some point this year. On the other hand, revisions on **solid fuel space heaters** are part of a wider package, including all types of local space heaters. Conversations regarding energy labelling of the latter[27] are ongoing, while a revision of ecodesign rules is expected to start later in the year.

Given the air pollution and climate impacts of solid fuel appliances, these revisions present a key opportunity to strengthen efficiency thresholds, tighten emission limits, and explicitly set new limits on climate pollutants. To properly implement these rules, **measurement methods should be improved**. Furthermore, requirements should be developed **for appliances that are currently exempt from the regulations**, such as boilers used for hot water and non-woody biomass heaters. Currently, manufacturers can claim that appliances are used for hot water only, or to burn non-woody biomass only. Broadening the scope of legislation would eliminate loopholes.



The following issues must be addressed to limit the climate and health-related impacts of solid fuel heating appliances:

- In line with the intentions set out in the current regulations on solid fuel local space heaters and boilers, **PM emissions should be assessed with the aim of setting stricter ecodesign requirements**. Current particle emission limits are significantly higher than emission levels registered during tests of several commercially available wood stoves. Therefore, limits must be tightened to prevent the most polluting appliances from being placed on the market.

  The particle emission limit for both wood log stoves and biomass boilers is 40 mg/Nm^3, even though tested wood log stoves produce emissions of 12-24 mg/Nm^3, and boilers only 8-20mg/Nm^3. These levels are still too high. PM **emission limits should be reduced accordingly** to incentivise better design.

  Manufacturers may opt for an alternative measurement method, including condensed particles. In that case, they must demonstrate that their appliance emits less than 5g PM/kg. Since some wood log stoves emit 1.5-3 g/kg only, wood[28] emission limits should be reduced to these levels at least.

- It is currently optional to include condensed particles in PM measurement methods. **Ecodesign should set explicit and mandatory limits for condensed particles** to ensure all PM pollution is accounted for.

- Current PM emission limits do not set any size-specific thresholds. Legislation should set explicit limits for **ultrafine particle emissions**, similar to the ones required by the German label *Der Blaue Engel*[29]. **Particle pollution should be measured appropriately**. Regulations should require product tests to **measure the number of particles emitted**, not just their weight, as it is currently allowed (see standards section).

- Today, **black carbon emissions** are only indirectly regulated through PM emission limits. This is not sufficient. **Specific limits on black carbon emission should be set to reduce climate impacts**. A brief market review carried out by ECOS indicates that commercially available stoves emit around 0.5g of black carbon per kilo of wood.

- **Organic Gaseous Compounds (OGC) emissions** should be assessed to inform the introduction of stricter ecodesign requirements. This would be **in line with the intentions set out in the current legislation on solid fuel local space heaters and boilers**.

  Current OGC emission limits are 60 mg/Nm^3 for wood log stoves, and 20 mg/Nm^3 for biomass boilers. These limits are twice as high as the emission levels of several stoves and boilers currently available on the market. Accordingly, **OGC emission thresholds should be reduced to half the current level or below**.

- **In line with the intentions set out in the current legislation on solid fuel local space heaters, NO_x emissions** should be assessed to inform the introduction of stricter ecodesign requirements.

  NO_X significantly contributes to health problems. However, current limits are higher than the performance of certain appliances (e.g. some wood fuel boilers emit 200 mg/Nm^3 during tests, which is considerably less than the 350 mg/Nm^3 limit).

- For wood log stoves, **energy efficiency limits should be increased from the current 65% to 75-80%** since many wood log stoves have efficiencies in this range. For **small pellet boilers, efficiency limits could be increased from 75% up to 85%. Large boilers on the market can perform even better with efficiencies of 80%-84%**[30], compared to the current limit of 77%.

- Wood-burning contributes to climate change. Nevertheless, solid fuel heating is granted an advantage[31] (an efficiency bonus) on labels for both local space heaters and boilers, as compared to fossil fuel boilers. This advantage should be **conditioned on much stricter criteria and more precise wording** on the label, explaining that biomass also has a climate and air pollution impact.

- **Non-woody biomass appliances, such as stoves and boilers burning straw, should be included in the scope of ecodesign and energy labelling regulations**. These appliances are particularly inefficient, generally release more pollutants, and can create a loophole in the legislation.

- **Biomass boilers used for hot water only are currently not regulated by ecodesign and energy labelling**. To avoid loopholes, these appliances should be included in the scope.

- The introduction of **emission classes on the energy label should be explored**. This would allow consumers to better identify the differences among appliances that emit less and are least harmful. Not only that, but emission classes would also drive innovation and could even steer local authorities facing high air pollution levels towards banning certain appliances. Appliances such as **automatically-fed pellet boilers**, which are less reliant on users for their operation, **should also be rewarded with better labelling scores**. This is because excessive fuel use and poor maintenance impact air and climate pollution. Emission classes could inform a progressive ban on the most emitting appliances through the Ecodesign Regulation.

- To address the air pollution and climate impacts caused by poor fuel quality, setting **ecodesign requirements for biomass fuel quality should be explored**. This measure could be complemented with a **fuel quality label**, informing consumers about air pollution and climate change impacts from fuel production and combustion. These new rules could ban the worst types of fuel from the market and reward cleaner fuels, such as certain types of pellets.

- **User manuals should give clear instructions on how to light a fire**, what type and how much fuel to use and how to maintain stoves and boilers, ideally contain a QR code leading to an online video tutorial on how to lit fires and how to prevent the most common mistakes that could result in product misuse. This would minimise the impact of user behaviour on air pollution levels.

- Following a detailed assessment of existing national emission requirements, **the right benchmarks must be set**. EU-level requirements should be aligned with the most ambitious state-level rules to avoid potential setbacks due to looser EU ecodesign requirements.

Develop appropriate standards to underpin ecodesign and energy labelling regulations

To make sure appliances effectively meet legal requirements, regulations should be underpinned by appropriate testing standards. This is not the case today: there are no harmonised standards supporting ecodesign and energy labelling regulations for solid fuel stoves and boilers. The European Committee for Standardization (CEN) rejected the European Commission's request[32] to develop relevant ecodesign standards back in 2016.

Given the lack of harmonised standards, transitional methods are specified for conformity with ecodesign requirements. Concretely, three standards can be used to ensure legal compliance of solid fuel local space heaters. Only one of them (NS/EN 14785) accounts for condensed particles, includes measurements for part load, and measures emissions from the entire burning cycle[33]. The two other methods (EN16510 and EN 15250) significantly underreport PM emissions.

A more representative measuring method should be introduced. It should include ignition and real-life use patterns, such as different types of wood used and part-load practices. The method must also **measure condensed particles** produced when flue gas is mixed with outdoor air. Importantly, the method should also account for **ultrafine particle emissions by requiring the number of particles to be counted**. Current methods measure just particle weight, missing on ultrafine particles.

Setting the right standards

Apart from the lack of harmonised European standards accounting for all relevant parameters, there is also a risk that inappropriate standards will be used. This is due to the regulatory overlap between the Ecodesign Regulation and the Construction Products Regulation (CPR), which also includes provisions for solid fuel heating appliances.

CEN is currently developing standards in line with the CPR. This is problematic because ecodesign regulations set different conditions. For example, they only grant an efficiency bonus (a reward in their score) when the appliance keeps emissions below legal limits even operating at 'part load' (working at half or less than the total possible load). However, the CEN standard grants a bonus also to appliances emitting above the limit when operating at half capacity. This is not allowed under ecodesign[34] regulations. Therefore, these standards will not provide appropriate testing methods to support the regulations.

A telling example is the so-called 'EN-PME' method, which will be used to test PM emissions under the CPR, based on standard EN 16510. This method does not account for condensed particles, part-load emissions and realistic use patterns, such as measuring the start of the fire[35]. Since the EN-PME method underreports PM emissions, it must not be used to demonstrate that ecodesign requirements are met.

Standards also risk becoming obsolete very quickly. CPR standards are foreseen to contain efficiency thresholds and emission limits copied from current energy labelling regulations. But these regulations may be strengthened soon[36]. As a result, there will be conflicting limit values as soon as new ecodesign and energy labelling regulations enter into force.

To resolve the current situation, the European Commission must issue **a new standardisation request, mandating the development of appropriate testing standards**. Legislation stipulates that ecodesign limits are 'measured and calculated using reliable, accurate and reproducible measurement and calculation methods which take into account the recognised state-of-the-art measurement methods'[37]. Only with a new standardisation request will we ensure proper enforcement.

Conclusions
a minor role for highly efficient wood heating

Burning wood to heat homes can only play a minor role in the path to heating decarbonisation, given the climate and air pollution issues associated with the large-scale use of biomass for heating. Very efficient wood stoves and boilers with low air pollution levels can be an option to avoid gas – but only in houses where heat pumps or district heating cannot be used. In cities, wood stoves should be avoided as much as possible to prevent extremely high air pollution peaks. The overall amount of wood used for heating should be minimised to prevent overshooting the limited availability of sustainably-sourced wood.

Ecodesign and energy labelling alone will not make air pollution disappear but can improve the situation dramatically. Policymakers must tighten the restrictions for hazardous emissions and set limits for air pollutants currently not covered by legislation. Revised ecodesign rules would push the least efficient and most polluting appliances off the market, while a new energy label would attract buyers towards the cleanest options available.

Upcoming revisions of ecodesign and energy labelling regulations present a vital opportunity to increase the energy efficiency of appliances and set stricter emission limits for both solid fuel local space heaters and boilers. Strengthening regulations can encourage the development of cleaner appliances, since some stoves and boilers already operate below current pollution limits.

To properly implement stricter rules, measurement methods should be improved and harmonised, and be explicitly designed to support requirements set in regulation.

The European Commission has an opportunity to provide policy solutions in line with the climate neutrality and air pollution objectives. We need foresight and bold action to make solid fuel heating a rarely-used solution instead of a widespread problem.

Annex 1
Solid fuel heating in European homes: appliances and fuel use

Solid fuel heating appliances at individual households include a heterogeneous product range, from wood-fuelled fireplaces to coal-powered[38] stoves and automatically-fed pellet boilers. Products can be divided into two categories: local space heaters and boilers. Solid fuel local space heaters include open or closed fireplaces, stoves that heat single rooms, as well as cookers. On the other hand, solid fuel boilers are used to power central heating systems or provide hot water.

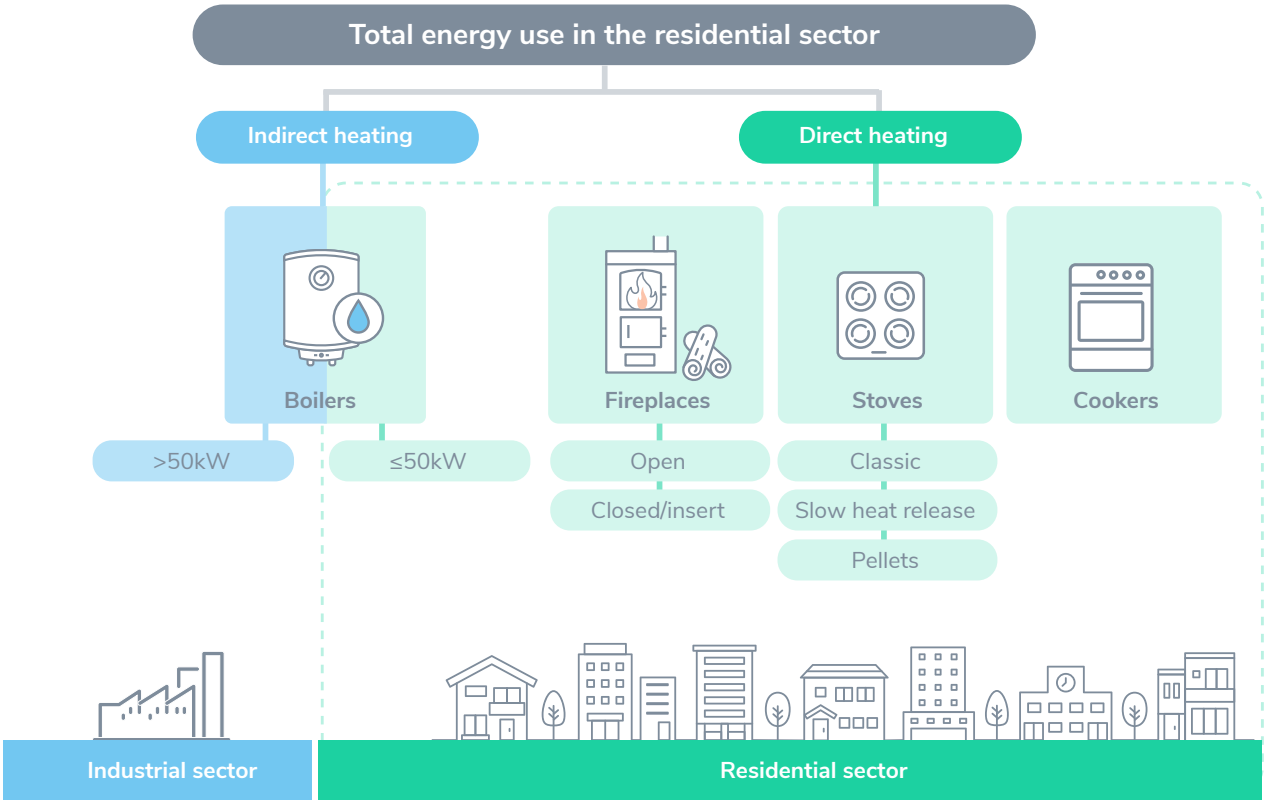
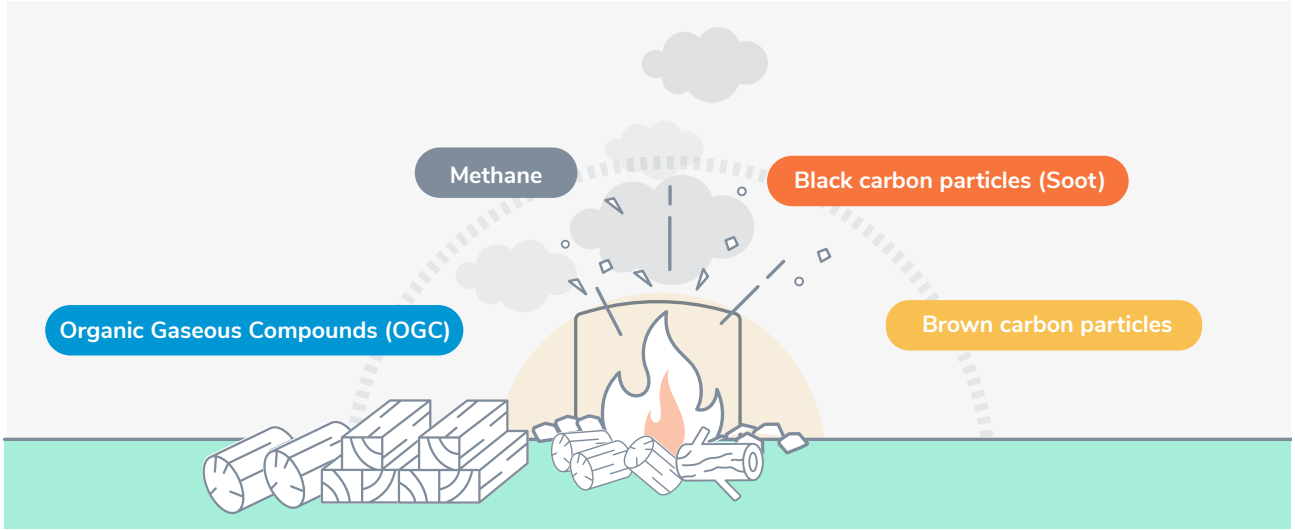


Figure 2 How is energy used in homes?

Appliances may be designed to run on one or more types of solid fuels, including different wood fuels such as wood logs, wood chips, and wood pellets; and other types of biomass such as straw, as well as coal, coke and peat products.

Annex 2

Air pollutants from biomass combustion contributing to climate change – an overview



During the wood combustion process, air pollutants are released into the atmosphere, and some of them contribute to climate change. **They are Short-Lived Climate-forcing Pollutants (SLCPs)**.

SLCPs only stay in the atmosphere for a few years or even for a few days — as opposed to CO_2, which remains in the air for centuries. However, the effect on climate change is much stronger than CO_2 (as expressed in Global Warming Potential or GWP). Reducing SLCPs is therefore key to slowing the near-term rate of climate change.

The most worrying type of SLCP stemming from wood burning is **black carbon particles**, also known as soot. Soot is composed of dark coloured particles emitted by the incomplete combustion of fossil fuels or biomass. These particles only remain in the atmosphere for a few days or weeks but have high carbon content and can travel long distances due to their small size. When soot lands on snow, for instance in the Arctic, it has a strong warming effect as it absorbs light which turns into heat, thereby accelerating the melting of polar ice[39]. Soot's exact Global Warming Potential is unclear but is estimated to be **between 460 to 1,500 times higher than CO_2**.

Organic gases, or **Organic Gaseous Compounds (OGC)**, are also released during biomass combustion. OGCs bundle methane and **Non-Methane Volatile Compounds (NMVOC)** together. NMVOCs are a set of organic compounds that contribute indirectly to climate change as they create aerosols and prompt the formation of ozone by reaction with sunlight. These are assumed to have a warming effect three times as strong as CO_2[40].

Methane is a potent greenhouse gas that warms the planet 28 times faster than CO_2 in a 100-year perspective. Accounting for the shorter time over which it breaks down, for instance, considering a 20 year-perspective instead of 100 years, methane is up to 80 times stronger than CO_2.

Brown carbon is a type of organic carbon in the form of particles. The climate impact of brown carbon still relatively unknown. There is evidence that it has a cooling effect on climate, although the impact is negligible compared to the warming effects of other particles, such as black carbon.

Annex 3

Types of air pollutants from biomass combustion which harm human health

Particulate Matter

Particulate Matter (PM) is the umbrella term for all particles found in the air. PM measurements are a proxy for assessing air pollution. Burning wood leads to PM emissions both indoors and outdoors.

Particles contain black and brown carbon (depending on the combustion process), nitrogen, and other elements. When flue gas mixes with ambient air, new condensed particles are formed, and existing particles grow in size. Particles are classified according to their size. For instance, we distinguish: coarse PM_{10} (0.01mm), fine $PM_{2.5}$ (0.0025mm), and ultrafine $PM_{0.1}$ (0.00001mm). In France, residential wood burning accounts for 27% of all PM_{10} emissions, 43% of $PM_{2.5}$ emissions and 55% of all fine PM 1.0 emissions[41]. A room heated with an average wood stove contains three times as much PM as a room without a stove[42].

The smaller particles are, the more damage they cause to human health. PM_{10} can penetrate the lungs, but **$PM_{2.5}$ and smaller ultrafine particles can even get into the bloodstream**. Long-term exposure to these particles can lead to heart and respiratory diseases. Recent research has even linked higher PM levels to a higher risk of COVID-19 infections[43].

While often underestimated due to the lack of sensitive measuring equipment, wood-burning emissions account for most particulate carbon emissions in Europe during winter[44]. People living in areas with significant PM levels are at greater risk of getting sick or even dying. Since even low levels of particle concentration affect human health, no PM level can be considered 'safe'. The WHO recommends reducing PM emissions as much as possible.

Nitrogen oxides

Some emissions such as **nitrogen oxides** (NO_x, mainly consisting of NO and NO_2) form ground-level ozone when reacting with sunlight. Accordingly, warm weather in urban areas can lead to high levels of smog. Apart from warming the climate (see box on sources of woody biomass), NO_x cause breathing difficulties, asthma, and lung diseases[45]. Studies linked NO_x to reduced lung function, airways inflammation and worsening of asthma attacks.

Organic Gases

Organic Gases, or Organic Gaseous Compounds (OGC), contain Non-Methane Volatile Compounds (NMVOC). Organic gases result from the incomplete combustion of fuels. Similarly to NO_x, OGCs contribute to the forming of ground-level ozone, damaging human health as a result. OGCs include volatile polycyclic aromatic hydrocarbons (PAHs) that can cause reduced immune function as well as kidney and liver damage[46]. In urban areas[47] and some European regions such as Flanders, wood burning is responsible for more than half of PAH exposure[48].

Carbon monoxid

Carbon monoxide (CO) is a toxic gas with no smell or colour, which makes it a particularly dangerous substance because it remains unnoticed and can even be fatal if inhaled in significant doses. In smaller amounts, it affects indoor air quality and can cause dizziness, confusion and unconsciousness.

Dioxin emissions

Dioxin emissions are produced in small quantities when there is combustion at lower temperatures, such as wood stoves (and in larger quantities in waste incineration plants). Dioxin is a toxic Persistent Organic Pollutant (POP) that breaks down extremely slowly. Emissions from wood burning add to the growing amount of dioxin pollution, a potential cause of cancer and harm to marine life (found in fish coming from certain seas).

Notes and references

[1] https://energy.ec.europa.eu/topics/energy-efficiency/heating-and-cooling_en

[2] https://eeb.org/wp-content/uploads/2021/09/Where-theres-fire-theres-smoke_domestic-heating-study_2021.pdf

[3] https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf

[4] An ECOS report published in December 2020 explains in depth how ecodesign and energy labelling policies can help electrify the overall heating sector https://ecostandard.org/publications/five-years-left-how-ecodesign-and-energy-labelling-can-decarbonise-heating/

[5] https://www.iea.org/data-and-statistics/data-tables?country=EU28&energy=Renewables%20%26%20waste&year=2019

[6] In these countries the share of household energy coming from biomass and waste is close to or higher than 40%.
See https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Share_of_fuels_in_the_final_energy_consumption_in_the_residential_sector,_2019_(%25)_T1.png

[7] Based on 2019 figures of EU production (1.76 million), import (3.05 million) and export (0,85 million) of the EU Prodcom database category 'Iron or steel solid fuel domestic appliances, including heaters, grates, fires and braziers (excluding cooking appliances and plate warmers)" In addition, a smaller number of solid fuel cookers were sold.

[8] https://www.wwf.eu/?2128466%2F500-scientists-tell-EU-to-end-tree-burning-for-energy

[9] Material Economics. (2021). EU Biomass Use in a Net-Zero Economy: A course correction for EU biomass. Retrieved from: https://materialeconomics.com/latest-updates/eu-biomass-use

[10] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

[11] https://www.fern.org/publications-insight/can-tree-planting-solve-climate-change-2172/

[12] https://onlinelibrary.wiley.com/doi/abs/10.1111/geb.12747

[13] https://www.nature.com/articles/s41467-018-06175-4

[14] The European Commission's Joint Research Centre (JRC) defines post-consumer wood as "recovered used wood from transport (e.g. pallets), private households, as well as used wood arising from construction or demolition of buildings or from civil engineering works, suitable for use as a fuel or for production of wood pellets and particle board."

[15] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52016SC0249

[16] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC122719/jrc-forest-bioenergy-study-2021-final_online.pdf

[17] At present, existing sustainability criteria such as those set by the Renewable Energy Directive (RED), the criteria of the EU Timber Regulation (EUTR), and specific certification schemes are prey to fraud and manipulation. Carbon accounting methodologies do not enable accurate emission accounting to support sustainable forest harvesting.

[18] https://www.eea.europa.eu/data-and-maps/indicators/main-anthropogenic-air-pollutant-emissions/assessment-1

[19] https://www.eea.europa.eu/highlights/emissions-from-road-traffic-and

[20] https://www.eea.europa.eu/publications/air-quality-in-europe-2021/health-impacts-of-air-pollution

[21] https://eeb.org/library/where-theres-fire-theres-smoke-emissions-from-domestic-heating-with-wood/

[22] https://www.fern.org/fileadmin/uploads/fern/Documents/2021/Unsustainable_and_ineffective_EU_Forest_Biomass_Standards.pdf

[23] Ecodesign sets minimum requirements appliances should meet to be sold on the European market. Energy labelling categorizes appliances within energy classes that reflect their relative energy efficiency so consumers can opt for more efficient appliances and manufacturers are stimulated to develop more efficient appliances.

[24] Commission Regulation (EU) 2015/1185 on ecodesign for solid fuel local space heaters

[25] Commission Regulation (EU) 2015/1189 on ecodesign for solid fuel boilers

[26] Commission Regulation (EU) 2015/1187 on energy labelling for solid fuel boilers

[27] Commission Regulation (EU) 2015/1186 on energy labelling for local space heaters

[28] Hwam catalogue 2021, www.hvam.dk

[29] https://produktinfo.blauer-engel.de/uploads/criteriafile/en/DE-UZ%20212-202001-en-criteria_V6.pdf

[30] https://www.teknologisk.dk/godkendte-biobraendselsanlaeg/39501,2

[31] Solid fuel local space heater and solid fuel boilers are granted a "biomass label factor" of 1.45 compared to 1 for fossil fuel appliances.

[32] M/550 Commission Implementing Decision C(2016) 7772

[33] Measuring the emissions during all stages of the fire is important since the start of the fire often leads to higher emissions.

[34] Concretely, the FprEN16510-2 will grant bonus factors to stoves using more energy than stoves operating in part load, allowing these to declare a higher efficiency.

[35] https://ecostandard.org/wp-content/uploads/2019/11/ECOS-position-on-Single-PM-measurement-method.pdf

[36] The Energy Labelling framework regulation stipulates that all energy labels should be rescaled to the A-G scale by August 2023. The Energy Labelling regulations for solid fuel local space heaters and boilers will thus be amended soon.

[37] Commission Regulation (EU) 2015/1185 on ecodesign for solid fuel local space heaters

[38] Some solid fuel heating appliances are powered by coal products and peat (see Annex 1). These are fossil fuels with severe climate as well as air pollution impacts that need to be phased out as soon as possible. Since this position paper focuses on biomass burned in individual heating appliances, it will not address appliances powered by coal products or peat.

[39] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Annex_VII.pdf

[40] https://www.researchgate.net/figure/Global-warming-potentials-for-NMVOCs-at-time-horizons-of-20-and-100-years-3-GWP20_fig2_262982657

[41] http://www.consultations-publiques.developpement-durable.gouv.fr/projet-de-plan-d-action-pour-un-chauffage-au-bois-a2338.html

[42] https://www.mdpi.com/2073-4433/11/12/1326

[43] https://www.nature.com/articles/s41598-021-85751-z

[44] https://www.researchgate.net/publication/228616241_Summary_of_the_CARBOSOL_project_Present_and_Retrospective_State_of_Organic_versus_Inorganic_Aerosol_over_Europe/link/0c960524b5fa489807000000/download

[45] https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

[46] https://www.sciencedirect.com/science/article/pii/S1110062114200237

[47] https://acp.copernicus.org/articles/21/17865/2021/

[48] https://en.vmm.be/publications/literature-review-of-emissions-of-modern-wood-combustion-devices-and-emissions-reducing-technologies-under-real-life-conditions

Environmental Coalition on Standards

Mundo-b, the Brussels Sustainable House
Rue d'Edimbourg, 26
1050 Brussels, Belgium
+32 2 894 46 68
ecostandard.org

@ECOS_Standard @ECOS-NGO

In cooperation with:

coolproducts.eu

@CoolproductsEU