‘Missing’ Emissions

How flawed UN biomass rules let countries make billions of tonnes of greenhouse gases disappear



Redwing have faced significant declines in Latvia in recent years due to logging for bioenergy.

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Executive summary

Burning biomass - using crops, trees, and wastes to produce electricity, heat, and fuels - has become big business. Over the last two decades major economies gave biomass companies one quarter of a trillion dollars in subsidies.[1] But biomass could be doing untold climate harm, that no one is being held accountable for. That's because a proportion of the greenhouse gas emissions from it, in the order of billions of tonnes, could be going 'missing' - not counted properly by any country. While governments hand billions of dollars to bioenergy companies to reward them for being low-carbon,[2] they aren't counting the emissions coming from bioenergy power stations properly. The scale of this problem has not been quantified before.

The accounts that countries submit to the United Nations Framework Convention on Climate Change are crucial. They are a key measure of progress towards global efforts to reduce greenhouse gases. That progress will determine whether the world is on track to limit temperature rises, and whether countries are meeting promises made at international climate meetings.

Countries account for their greenhouse gas emissions under the Paris Agreement Enhanced Transparency Framework, which refers to using IPCC guidelines. In turn, these guidelines suggest that countries calculate and quantify the emissions released by using biomass in their energy sector. But the carbon dioxide emissions from biomass used in the energy sector are only reported as a memo item - the emissions are not included in the formal tally of emissions. The reason for this is that these emissions should already be counted in the land sector of the country the biomass came from in the first place. However, countries adopt many different approaches to land use carbon accounting and forest carbon accounting is especially complex. This means that governments are supporting bioenergy, and are relying on land use carbon accounting being done properly, often in a different country where the biomass came from.

This means that large quantities of biomass emissions could be 'going missing', with no confirmation that they have definitely been counted. This is especially true because huge amounts of woody biomass are traded, and the country counting the carbon dioxide as zero when the biomass is burned for energy is different from the country with the forests that the biomass was harvested from. This analysis found that, since 1990, over 6 billion tonnes of emissions from bioenergy have been counted as zero in countries' energy sectors. This is the same as a year's worth of emissions from the United States, the world's second biggest greenhouse gas polluter (which released 6 billion tonnes of greenhouse gases in 2024).[3] Some of these emissions may have been counted in the land use sector. But the complexity of counting forest emissions, as well as a number of options for how countries account forest emissions, mean that some of these emissions may never have been counted at all.

A multi-billion dollar bioenergy industry relies on these emissions going missing. If these emissions were clearly counted in the energy sector it would quickly become clear that using biomass for energy is not carbon neutral and incentives for governments supporting bioenergy would change entirely. Most importantly, it may begin to reduce the emissions released by bioenergy and the harm to forest carbon stocks.

1. Environmental Paper Network, 2025, Major Economies Spent Almost $250 Billion on Subsidies for Burning Biomass, new BAN report finds, https://environmentalpaper.org/2025/10/burning-billions-for-biomass/
2. Ibid.

Why are biomass emissions going missing?

Most countries submit greenhouse gas accounts to the UNFCCC. These are one of the best measures of global progress towards cutting emissions that are driving global warming. When countries submit these to the UNFCCC they calculate their total greenhouse gas emissions. They are allowed to count emissions from biomass used in the energy sector as zero (as a "memo item").[4] This is permitted mainly to avoid double-counting emissions - it is assumed those emissions will already have been counted once when biomass was harvested in the land sector, and don't need to be counted again in the energy sector. This is not accurate - when wood is burned it releases carbon dioxide.[5] In fact, power stations that burn wood often release more carbon dioxide than fossil fuel power stations. Additionally, when biomass is harvested in one country, and burned in another, this becomes incredibly complex. Full accounting may be achieved if both the country producing the biomass and the country using the biomass for energy adopt economy-wide accounting for all emissions. However, the true impact of bioenergy on the climate will often be in the land use sector of a different country. In the country where it is harvested it could be reducing forest carbon stocks and increasing carbon dioxide in the atmosphere, but in the energy sector of the country it is burned, it will be treated as instantly zero-carbon. Hundreds of scientists have warned that this approach is harming the climate and not resulting in proper bioenergy accounting. They have done this in letters to world leaders and to leading global scientific bodies like the IPCC which have set standards that are flawed.[6]

But the first set of guidance on how to account for bioenergy was issued decades ago in the 1990s when the amounts of biomass being used were smaller, they were generally not traded between countries, and predominantly used in heating and cooking at home. Subsequent updates to IPCC guidance have not changed this fundamental approach to biomass emissions.

Today a far wider range of biomass is used to generate heat and electricity, and a vast amount of biomass is traded internationally.[7]

Because of the flaws and complexities in accounting for emissions from forests and land, it would be far simpler to account for bioenergy emissions in the energy sector. Counting the carbon dioxide coming out of a power station is relatively straightforward.

This could avoid any double counting because instead of accounting for all emissions in the land use sector, carbon stored in Harvested Wood Products should be accounted for in the HWP category. If those Products are exported, they should be transferred off the accounts of the exporting country and onto the accounts of the importing country. If that wood Product is then utilised for energy, the emissions should be accounted for in the energy sector of the country where they are used.

There are two major problems with the way forest emissions are accounted for when it comes to biomass. First, the loss of carbon from one part of the forest can be masked by carbon being absorbed by a much larger area. Second, countries can choose, if they wish, to account for their emissions against a future prediction of what they would otherwise have been, allowing them to 'hide' the true climate impact under a flawed baseline projection.

3. Our World in Data, webpage, accessed November 2026, Greenhouse Gas Emissions 2024, https://ourworldindata.org/grapher/total-ghg-emissions? https://ourworldindata.org/grapher/total-ghg-emissions?
4. Environmental Paper Network, 2023, Biomass Carbon Accounting Is No Longer Fit For Purpose https://environmentalpaper.org/wp-content/uploads/2023/11/EPN_2023_Biomass-accounting-not-fit-for-purpose.pdf
5. Ember, 2025, Drax is UK's top carbon polluter yet again, widening lead with 16% increase in a year, https://ember-energy.org/latest-updates/drax-is-uks-top-carbon-polluter-yet-again-widening-lead-with-16-increase-in-a-year/
6. 2021, Letter Regarding Use of Forests for Bioenergy, https://www.woodwellclimate.org/wp-content/uploads/2021/02/Scientist-Letter-to-Biden-von-der-Leyen-Michel-Suga-Moon-Re.-Forest-Biomass-February-11-2021.pdf and 2026, Scientist letter to the IPCC on the topic of carbon accounting for forest bioenergy, https://scienceonbiomass.org/
7. Supra note 4.

Biomass, forests and the wider forest landscape

Accounting for forest emissions has become very complex and challenging. Some bioenergy companies say that the emissions they release from burning wood are offset by other forests growing in the wider landscape - i.e. not the forests that the biomass has come from, but forests many miles away in other parts of the country (whichever country it is they have sourced the biomass from).

Reporting biomass emissions in the energy sector as zero, and assuming they will be counted in the land sector, compounds this issue. This is because emissions from bioenergy will be counted (if they are counted) in the forest sector of the country the biomass comes from. This means any loss of carbon stock will be among a much larger forest carbon account, where there will be losses of forest carbon due to other causes and increases of forest carbon thanks to increased absorption or restoration of forests. This means the emissions by bioenergy may be masked by other forest carbon dynamics in the country the forests are in.

Bioenergy emissions may be masked by other forest carbon dynamics in the country the forests are in.

This approach makes some sense for national greenhouse gas accounts. But in response, governments have designed sector-specific bioenergy policies that reward companies to the tune of billions of dollars. And bioenergy has been made a cornerstone of low-carbon energy strategies because countries can count it as zero in their energy sector, regardless of whether it is increasing or reducing the forest carbon stock of the country the biomass is coming from. They leave this to the country that harvests the biomass to worry about. The upshot is that bioenergy might be reducing forest carbon stocks and increasing carbon dioxide in the atmosphere, but it is treated like a zero-carbon energy technology because those carbon impacts are ignored when billions of dollars of subsidies are awarded. In fact the IPCC has warned that using national guidelines for assessing the true biogenic emissions of specific sectors (such as bioenergy) is not appropriate.[8]

This approach might also make sense for national greenhouse gas inventories, but using it to justify sector-specific or company-specific approaches is not appropriate. At present, many companies are pushing for international corporate greenhouse gas standards to adopt the same approach.[9] The companies' preferred approach would see the carbon impacts of harvesting wood for specific companies and sectors (e.g. furniture) accounted for against the carbon changes of a much wider forest area. On the other hand, many academics and environmental groups object to allowing companies to take credit for carbon absorption by the wider landscape of forests when they cut down trees from a particular area. Groups of scientific experts have explicitly warned against taking this approach in public letters.[10] In fact, debates over this approach have led to the resignation of prominent scientists, concerned over the integrity of this approach.[11]

Even fast-growing energy crops don't necessarily provide a straightforward carbon benefit - planting them disturbs carbon stored in the soil and can replace other vegetation that was storing carbon. They can displace food production, which has to take place somewhere, creating a further carbon impact. But classifying bioenergy crops as zero carbon in the energy sector makes bioenergy appear as green as wind or solar powered energy.[12]

8. IPCCC. IPCC Task Force on National Inventories, Frequently Asked Questions (Q. 2-10). https://www.ipcc-nggip.iges.or.jp/faq/faq.html
9. European Academies Scientific Advisory Council, Proper Accounting for Wood Harvest and Use in the GHG Protocol, https://easac.eu/fileadmin/user_upload/Letter_to_WRI_and_WBCSD.pdf
10. Ibid
11. Raimonde O., Bloomberg, 2026, Dispute Over Counting Forest Carbon Roils Global Standard-Setter, https://www.bloomberg.com/news/articles/2026-08-13/dispute-over-counting-forest-carbon-roils-global-standard-setter
12. Transport and Environment, webpage, accessed November 2026, Biofuels: dealing with indirect land use change (ILUC), https://www.transportenvironment.org/articles/biofuels-dealing-indirect-land-use-change-iluc



Harvesting wood for bioenergy can drive the intensification of logging, devastating precious forests.

Future baselines for forest emissions

Even if regrowing forests could one day offset biomass emissions, this does not happen immediately. This offsetting would take a very long time.[13] The European Academies Scientific Advisory Council warns that it can take decades or centuries for plants to recover the lost carbon.[14] This means that burning biomass in the energy sector increases emissions of greenhouse gases for decades or centuries too, far longer than global goals for cutting emissions. Furthermore, this regrowth would need to be additional, in order to offset additional logging driven by the demand for biomass. But remember, biomass is treated as instantly carbon neutral in the energy sector.

There's little evidence that burning biomass, especially wood from forests, actually produces any climate benefit.

Accounting issues mean many forest emissions are not counted accurately or fully. A major issue is that countries have been given permission under IPCC Guidelines to use a 'future baseline'. In recent years, some countries have opted out of this - for example the EU does not use this approach.[15] However, our analysis goes back to 1990, meaning many countries may have used the flawed approach for a long time. But under IPCC guidelines, they are allowed to do so if they wish. In most other sectors countries compare today's emissions to a historical baseline - looking at whether there has been a reduction in today's emissions compared to the past. But for forests, countries are allowed to look to the future - they are allowed to project what they think emissions from forests will be, how much will be logged, and then anything less than this projection is a saving. This incentivises countries to inflate their future emissions so as they can claim savings against that baseline.[16]

13. 2021, NRDC, A Bad Biomass Bet: Why the Leading Approach to Biomass Energy with Carbon Capture and Storage Isn't Carbon Negative, https://www.nrdc.org/resources/bad-biomass-bet-why-leading-approach-biomass-energy-carbon-capture-and-storage-isnt
14. European Academies Scientific Advisory Council, 2018, The EU's renewable energy ambitions: Bioenergy from forests is not always carbon neutral - and may even increase the EU's carbon emissions, https://easac.eu/fileadmin/PDF_s/reports_statements/Carbon_Neutrality/EASAC_Press_Release_on_Carbon_Neutrality_15_June_2018.pdf
15. Grassi G., European Commission, 2018, Forest Carbon Accounting Under the Paris Agreement: the new EU Forest Reference Level approach and implications for bioenergy, https://task38.ieabioenergy.com/wp-content/uploads/sites/5/2019/02/Grassi_IEA38_Uppsala_082918.pdf
16. Brack D., Chatham House, 2017, Woody Biomass for Power and Heat: Impacts on the Global Climate, https://www.chathamhouse.org/sites/default/files/publications/research/2017-02-23-woody-biomass-global-climate-brack.pdf



Wood pellets are burned to produce heat and electricity in many countries.

Why does it matter?

The multi-billion dollar bioenergy industry is based on the assumption that these emissions were counted properly. Assuming that bioenergy emissions were counted in the land sector, often of a different country, and that the emissions coming from a bioenergy power station are zero, distorts the perspective for the following reason:

- In the land sector the true impact may be that forest carbon stocks are reduced for years or decades, but in the energy sector the emissions look instantly zero-carbon.
- The impact of harvesting wood for bioenergy may be offset by changes in forest carbon (possibly even increases) in forests that have nothing to do with bioenergy harvesting. While this may be an appropriate approach for national-level greenhouse gas accounts, governments have used this accounting approach to design sector-specific policies which grant bioenergy hundreds of billions of dollars in subsidies.
- This is highly imbalanced and makes bioenergy look as if it is a carbon equivalent to wind and solar, which are almost instantly zero carbon. In reality bioenergy may increase carbon emissions in the atmosphere for some time, but its impacts are obscured when accounted for as part of a much larger forest carbon account, regardless of whether it is reducing or increasing emissions.

If these emissions were clearly counted in the energy sector it would quickly become clear that using biomass for energy is not carbon neutral, but instantly releases carbon dioxide to the atmosphere. The incentives for governments supporting bioenergy would change entirely. Most importantly, it may begin to reduce the emissions from bioenergy and the harm to forest carbon stocks

Global bioenergy use

The interpretation of these accounting rules outlined above has led to the vast upscaling of bioenergy globally in recent decades.[17] Data from Global Energy Monitor shows that there is a vast amount of biomass power capacity today.[18] There are 46 gigawatts (GW) of installed biomass power capacity using "agricultural waste" as a fuel, and 35 GW of capacity using wood as a fuel. Globally there are also power plants using biodiesel, paper mill waste, sewage, and refuse.

There are a number of global initiatives driving the growth of this industry, including the Belém Pledge to quadruple the use of "sustainable fuels" by 2030; the 2035 electrification target being put forward by the Joint COP31 Presidency of Türkiye and Australia; and the Roadmap for the Transition Away from Fossil Fuels. All of these global initiatives, which surround the UN climate talks, suggest, or explicitly call for, greater use of biomass. There's little evidence that burning biomass, especially wood from forests, actually produces any climate benefit.

In addition, a large number of countries subsidise the use of biomass for public heat and electricity production.[19] Governments award bioenergy companies billions, mistakenly call it low-carbon, and even suggest that with emissions capture technology burning trees with carbon capture technology could be 'carbon negative'. They base huge subsidy schemes on this approach.[20]

17. Environmental Paper Network, 2024, Burning Up the Biosphere: A Global Threat Map of Biomass Energy Development, 2024 update - Environmental Paper Network, https://environmentalpaper.org/2024/11/burning-up-the-biosphere-a-global-threat-map-of-biomass-energy-development-2024-update/
18. Global Energy Monitor, webpage, accessed November 2026, Global Bioenergy Power Tracker, https://globalenergymonitor.org/projects/global-bioenergy-power-tracker#download
19. European Academies Scientific Advisory Council, 2021, Climate impact of woody biomass, https://easac.eu/media-room/press-releases/details/easac-welcomes-that-the-jrc-report-strengthens-the-case-for-shorter-payback-periods-on-woody-biomass
20. Supra note 1.

Methodology

This analysis quantified the volume of emissions that are being counted as zero. This is possible because countries track how many emissions come from these sources, but don't include this figure in their final greenhouse gas accounts.

Our analysis looked at existing UNFCCC Party CRTs (Common Reporting Tables). These are the emissions accounts that countries submit to the UN. Using the timeframe 1990-2024 we tabulated cumulative emissions from biomass for public heat and electricity. The analysis looked at countries' accounts with the United Nations Framework Convention on Climate Change. These accounts usually date back to 1990. Not all countries provide them, and not all accounts contain a full set of data. In some cases data for certain years are missing, or certain categories of emissions have not been provided. Our analysis of emissions from biomass for public electricity and heat is therefore probably an underestimate.

Public heat and electricity are key sectors. This excludes the use of biomass for heating in domestic properties, especially for heating and cooking - which is commonplace in many developing countries. In many of these places it is the only form of fuel available. 115 country datasets were available. In some cases, countries had uploaded more than one dataset to the UN portal. In this case, only the most recent dataset was analysed. Results and Discussion. This analysis shows that 6.1 billion tonnes of carbon dioxide released from biomass powerstations have been counted as zero in the energy sector since 1990.

This analysis quantified the volume of emissions that are being counted as zero in the energy sector.

This is the same as a year's worth of emissions from the United States. It is likely that many of these emissions were not offset by regrowing forests, since it can take forests decades to recover after thinning or clear cutting. Even if they were eventually offset, they were immediately counted as zero in the energy sector when that forest regrowth would have taken a long time. This leads to a fundamental mismatch in the zero-carbon appearance of bioenergy, and its true,long-lived climate impact.



Around the world, harvesting wood for bioenergy has contributed to the degradation of forests, and the decline of critical carbon stocks.

Results and discussion

This analysis shows that 6.1 billion tonnes of carbon dioxide released from biomass power stations have been reported as zero in the energy sector since 1990. This is the same as a year's worth of emissions from the United States. It is possible that some of these emissions have not yet been offset by regrowing forests (and they may never be offset), since it can take forests decades to recover after thinning or clearcutting. It is also possible that the bioenergy in question was treated as if it was instantly zero carbon, even if in reality it was reducing forest carbon stocks and increasing the amount of carbon dioxide in the atmosphere overall. This leads to a fundamental mismatch in the zero-carbon appearance of bioenergy, and its true, long-lived climate impact.

Some of the biggest contributors were: the EU at over 3 billion tonnes, the United States with 0.6 billion tonnes, China with 0.4 billion tonnes, and one of the biggest contributions for the size of its economy and population the UK with 0.3 billion tonnes.

To have any chance of keeping global temperature rises below 1.5C, total global carbon emissions must be kept below a total of 400 billion tonnes, between now and 2050. Allowing another up to ~ 6 billion tonnes of biomass emissions to go uncounted between now and 2050 would eat up a significant share of this budget without anyone being held accountable for it.

Over 6 billion tonnes of emissions from biomass have been counted as zero in the energy sector.

5 major economies have spent nearly a quarter of a trillion dollars on bioenergy subsidies in 20 years.

21. Our World in Data, webpage, accessed November 2026, Greenhouse gas emissions, https://ourworldindata.org/greenhouse-gas-emissions
22. Cut Carbon Not Forests, 2026, Biomass Mills in Estonia and Latvia Are Sourcing From Forests With Declining Carbon Sinks, https://cutcarbonnotforests.org/wp-content/uploads/2026/02/CCNF-Biomass-Estonia-and-Latvia-Factsheet.pdf

Missing biomass emissions

1990-2024 biomass emissions, millions of tonnes, (public electricity and heat production from biomass) from countries reporting to the UNFCCC. These emissions are reported, but then counted as zero in countries' official greenhouse gas accounts.

Grand Total	**6,102.11**
European Union	3,383
USA	592
China	409
UK	389
Russia	214
Japan	173
Australia	142.7
Guatemala	116.4
Thailand	112
Switzerland	72.2
Ukraine	66.5
Canada	63
Belarus	61.7
Belize	61.2
Republic of Korea	54.1
Türkiye	40.6
Chile	31.5
Norway	21.6
Zambia	18
Malaysia	17.9
Mauritius	17.4
Brazil	13.3
Peru	7
Cuba	4.9
Kazakhstan	4.3
Burkina Faso	3.9
Guyana	2.7
Costa Rica	2.2
Uruguay	1.7
Dominican Republic	1.5
Monaco	1.2
Sri Lanka	1

Chart: Matt Williams. Source: UNFCC

Conclusions and recommendations

In 2024 global emissions came close to 60 billion tonnes.[21] Since 1990, 6 billion tonnes - or 10% of one year's worth of the entire world's emissions - have been reported as zero in the energy sector. Some of these emissions may have been counted in the land use sector. But accounting for those emissions in the land use sector masks their true impact. They may have resulted in a reduction in forest carbon stocks, but this can be hidden in a much larger pot of forest carbon fluxes, often in a different country from where the biomass was used for energy. Nonetheless, many governments have designed a sector-specific policy on this basis which treats bioenergy as if it is an instantly carbon-neutral energy technology, worth billions in low-carbon subsidies.This represents a real and significant contribution to climate change that is being counted as zero.

Recent research found exactly this - looking at the forests surrounding four wood pellet mills in Latvia and four in Estonia (in the 60km harvesting radius referred to by the biomass companies) it found that those forests had been consistently losing carbon stock for years. But the UK - the main destination country for these eight biomass factories - counted the bioenergy it generated as instantly zero carbon, even though in reality it is reducing forest carbon stocks.[22]

Current biomass accounting guidelines are no longer fit for purpose. They might be allowing some bioenergy emissions to go missing. They incentivise governments to treat biomass as if it is a zero-carbon form of energy regardless of whether it is increasing or reducing forest carbon stocks. It would make much more sense to account for the emissions as they are emitted from power stations in the energy sector.

With fires and extreme weather events spreading around the world climate change is not a future problem. It is here today. Reducing future harm means cutting emissions now. Reducing greenhouse gas emissions means knowing where they are coming from, which means counting them accurately.

In order to stop biomass emissions going missing, The RSPB recommends:

The IPCC reforms greenhouse gas accounting guidelines so that emissions from biomass burning are accounted for in the energy sector.	This could be achieved by using a figure for biomass that tracks the carbon from the forest, into the existing "Harvested Wood Products" category and, if biomass is exported, that figure is then transferred into the energy sector (if the biomass is used for energy) of the end-user country where it is counted.
Preventing the proliferation of biomass.	Using biomass from forests for energy harms nature and the climate. Safeguards should be put in place preventing countries from subsidising forest bioenergy or including it in their climate plans.
The dangers of bioenergy must be highlighted	Incorporating text in key multilateral agreements, strategies, roadmaps, and decisions to highlight the dangers of bioenergy, and to explicitly call for its exclusion in the transition away from fossil fuels.



Estonia's woodland habitats, home to Capercaillie, are being impacted by biomass harvesting.

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Protecting habitats, saving species and helping to end the nature and climate emergency.

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