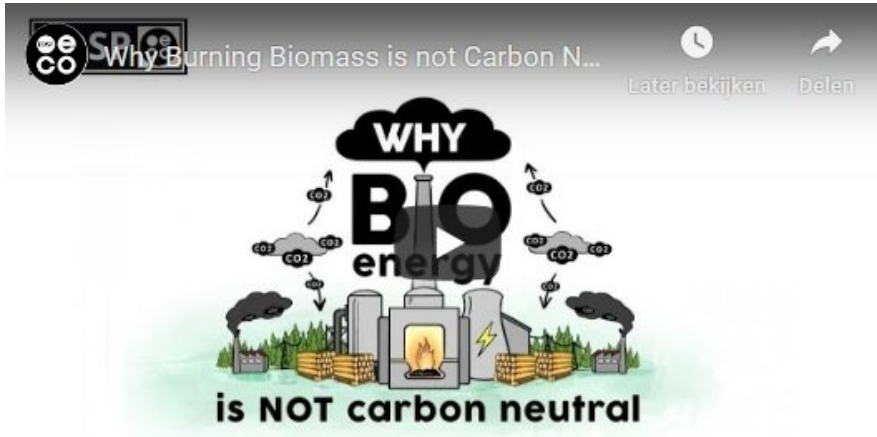


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## Research on Carbon Dioxide Emissions Caused by Burning Biomass



Trees remove carbon dioxide from the atmosphere while they grow and turn it into wood and oxygen. Small trees do not absorb much carbon dioxide but after 20 years they can absorb more than 20 kilos of carbon dioxide per year. When a tree reaches the age of 80 years it has removed more than a thousand kilos of carbon dioxide from the air and it produces enough oxygen to keep 2 people alive. When a tree dies, most of the carbon dioxide stays solid for a long time which provides a habitat for thousands of animal species and is slowly converted into breeding ground for new plants.

"Bioenergy" is energy made by burning biomass – mostly wood. This means energy is made by burning trees. Although it contains "bio", which sounds positive, it is not a carbon neutral form of energy like wind or solar energy. A common misconception is that with bioenergy you have a closed circle of carbon that is absorbed from the air by a tree and then re-released when the tree is burned.

The reality is more complicated: Wood for bioenergy usually comes from forests. Healthy forests function as storage for carbon. That means they constantly soak up carbon dioxide from the atmosphere. Without this vital function our climate would be changing even faster than it already is.

### RECENT

[2019-08-22-bioenergy-serious-mismatches-continue-between-science-and-policy-in-forest-bioenergy-english.pdf](#)

2019-08 \\ BioEnergy

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[2019-08-12-virginia-commonwealth-university-structurally-complex-forests-better-at-carbon-sequestration-english.pdf](#)

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[2019-08-08-ipcc-summary-report-for-policymakers-on-climate-change-and-land-english.pdf](#)

2019-08 \\ IPCC

[2019-08-00-eu-biomass-legal-case-main-arguments-english.pdf](#)

2019-08 \\ EUBiomassLegalCase

What happens to the carbon if we harvest wood from those forests? Well, if the wood is used for example for houses or furniture the carbon stays locked in. That means it is not released into the atmosphere for a long time. But if we burn the wood for energy, this carbon is immediately released into the atmosphere. Even though it takes trees decades to absorb the same amount of carbon dioxide.

In the past two hundred years, all the trees on earth could not process the amount of carbon dioxide that we released into the air causing the temperature on earth to increase by 1 degree. Now we are going to cut down more trees and burn them which releases even more carbon dioxide and less carbon dioxide will be absorbed because the remaining trees will not suddenly start absorbing more. This means that we will emit a lot of extra carbon dioxide in the air. This holds true even if we only harvest as much wood as regrows each year.

Extensive research concludes that burning biomass is responsible for far more CO<sub>2</sub> emission compared to burning fossil fuels. Burning biomass will result in increased and accelerated global warming & climate change. This page on our website contains multiple reports and the conclusions based on the findings.

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## Serious Mismatch Between Science & Policy

[2019-08-22-bioenergy-serious-mismatches-continue-between-science-and-policy-in-forest-bioenergy-english.pdf](#)

This report based on recent work by Europe's Academies of Science was commissioned by 16 international institutions and finds that current policies are failing to recognize that removing forest carbon stocks for bioenergy leads to an initial increase in emissions and states the periods during which atmospheric CO<sub>2</sub> levels are raised before forest regrowth can reabsorb the excess emissions are incompatible with the urgency of reducing emissions to comply with the objectives enshrined in the Paris Agreement.

*"...The classification of forest biomass as 'renewable' is based on the reasoning that, since biomass carbon came from atmospheric CO<sub>2</sub> and regrowth absorbs CO<sub>2</sub> over time, it can be regarded as 'carbon neutral' with net emissions over the harvesting/regrowth cycle of zero. The 'carbon neutrality' concept is, however, a gross misrepresentation of the atmosphere's CO<sub>2</sub> balance since it ignores the slowness of the photosynthesis process which takes several decades for trees to reach maturity. This has been pointed out*

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[2019-07-31-elsevier-understanding-the-timing-and-variation-of-greenhouse-gas-emissions-of-forest-bioenergy-systems-english.pdf](#)

2019-07 \ \ Elsevier Research

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[2019-07-08-epn-report-threat-map-are-forests-the-new-coal-english.pdf](#)

2019-07 \ \ EPN

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[2019-06-27-minlnv-beantwoording-schriftelijke-vragen-over-het-bericht-staatsbosbeheer-wil-duidelijker-bosbeleid-van-minister-dutch.pdf](#)

2019-06 \ \ GOV NL MINLNV

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[2019-06-23-wageningen-university-research-duurzame-biomassa-voor-de-productie-van-waterstof-dutch.pdf](#)

2019-06 \ \ WUR

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[2019-06-18-european-commission-staff-working-document-assessment-for-the-national-forestry-accounting-plans-english.pdf](#)

2018-12 \ \ European Commission

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[2019-06-17-nrdc-dogwoodalliance-southern-environmental-law-center-global-markets-for-biomass-energy-are-devastating-us-forests-english.pdf](#)

2019-06 \ \ Multiple NGO's

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[2019-06-14-southernenvironment-burning-trees-for-power-the-truth-about-woody-biomass-energy-and-wildlife-english.pdf](#)

repeatedly. Nevertheless, its simplicity brought with it political and economic advantages and led to the inclusion of biomass in the European Commission's definition of renewable energy in its 2009 Renewable Energy Directive (RED), being treated as 'part of the package of measures required to reduce greenhouse gas (GHG) emissions...'

"...It is thus of considerable concern that scientific analyses indicate that, far from reducing GHG emissions, replacing coal by biomass for electricity generation is likely to initially increase emissions of CO<sub>2</sub> per kWh of electricity as a result of the lower energy density of wood, emissions along the supply chain, and/or less efficient conversion of combustion heat to electricity. The resulting increase in atmospheric concentrations of CO<sub>2</sub> increases radiative forcing and thus contributes to global warming..."

"...some EU member states have already recognized that biomass electricity has a much higher carbon footprint as a 'renewable' energy than solar and wind, and have set much more stringent standards for future renewable energy subsidies. This, however, only affects the conditions on future projects, not the facilities already established and operating. Nor do such trends in Europe appear to be reducing efforts by pellet manufacturers to expand their markets outside Europe..."

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## Misguided Strategy Burning Wood Against Climate Change

[2019-08-14-tpfc-misguided-strategy-burning-wood-to-mitigate-climate-change-in-germany-english.pdf](#)

This report commissioned by multiple organizations like TPFC, WWF, ARA and DenkHausBremen clearly states the reasons why burning woody biomass to mitigate climate change is a misguided strategy.

"...Wood contains less energy than coal, oil or gas. Thus, more of it has to be burned to produce the same amount of energy. According to calculations by the Intergovernmental Panel on Climate Change, heating with wood releases almost twice as much carbon dioxide (CO<sub>2</sub>) as using gas..."

"...Advocates of burning wood don't see this as a problem. They assume that wood, being a regenerative raw material, emits only as much CO<sub>2</sub> during burning as the trees have previously absorbed from the atmosphere during growth. Wood growth (CO<sub>2</sub> sink) and wood burning (CO<sub>2</sub> source) offset one another, which is why they consider wood to be a carbon neutral energy source. But this does not account for the fact that most tree species take

2019-06 \ \ Southern Environment

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[2019-06-07-minez-minister-wiebes-beantwoording-vragen-over-milieuschade-houtstook-is-vele-malen-hoger-milieuschade-door-aardgas-of-stookolie-dutch.pdf](#)

2019-06 \ \ GOV NL MINEZ

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[2019-06-04-gov-nl-wiebes-antwoorden-op-kamervragen-pvdd-over-de-bij-stook-van-biomassa-in-centrales-dutch.pdf](#)

2019-06 \ \ GOV NL MINEZ

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[2019-06-03-tweede-kamer-hoorzitting-bomen-kappen-voor-klimaat-en-natuur-roofbouw-of-noodzakelijk-kwaad-dutch.pdf](#)

2019-06 \ \ GOV NL

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[2019-05-28-pbl-effecten-ontwerp-klimaataakkoord-dutch.pdf](#)

2019-05 \ \ GOV NL PBL

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[2018-12-17-european-environment-agency-report-renewable-energy-in-europe-english.pdf](#)

2018-12 \ \ EU Environment

Agency

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[2018-08-07-nature-land-use-emissions-play-a-critical-role-in-landbased-mitigation-for-paris-climate-targets-english.pdf](#)

2018-08 \ \ NatComs

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[2018-05-00-cib-ecf-forest-research-report-carbon-impacts-of-biomass-consumed-in-the-eu-english.pdf](#)

*decades to grow back and that they would store additional carbon, if they would not have been cut for burning.."*

*"..To mitigate climate change we need to reduce carbon emission immediately within the next 20 years. If wood is harvested just to burn it, the carbon dioxide stored in the timber is released into the atmosphere instantaneously.."*

*"..Within the next two important climate-change decades, burning fresh wood will release additional carbon emissions and adversely affect the climate.."*

*"..Forests are desperately needed to mitigate climate change. As long as the technical devices that could one day filter CO<sub>2</sub> from the air remain unproven technologies, only forests can provide us with the much needed "negative emissions". If a tree is not cut down, the carbon contained in the wood remains stored. And as it grows, the tree absorbs additional carbon. For a long time, it was assumed that young forests have a particularly strong rate of growth and that a balance between CO<sub>2</sub> capture (growth) and release (decay) would be achieved after about 150 years. Today we know that even in very old forests, biomass continues to increase and more CO<sub>2</sub> is stored every year, albeit at a decreasing rate.."*

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## Structurally Complex Forests Better at Carbon Sequestration [2019-08-12-virginia-commonwealth-university-structurally-complex-forests-better-at-carbon-sequestration-english.pdf](#)

This study report by the Virginia Commonwealth University demonstrates for the first time that a forest's structural complexity is a better predictor of carbon sequestration potential than tree species diversity. The discovery holds implications for the mitigation of climate change.

*"..the arrangement of vegetation is highly varied — sequester more carbon, according to a new study led by researchers at Virginia Commonwealth University. The study demonstrates for the first time that a forest's structural complexity is a better predictor of carbon sequestration potential than tree species diversity. The discovery may hold implications for the mitigation of climate change.."*

*"..forests that are structurally variable and contain multiple layers of leaves outperform structurally simple forests with a single concentrated band of*

2018-05 \\ CIB

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[2018-02-02-fern-covered-in-smoke-why-burning-biomass-threatens-european-health-report-english.pdf](#)

2018-02 \\ FERN

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[2014-03-03-bvor-warmte-uit-hout-dutch.pdf](#)

2014-03 \\ BVOR

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### **ATTENTION!**

We are analyzing reports and creating & posting new summaries every day. This is time consuming work but we will try to deliver multiple summaries per day. We are currently processing reports from 2019 and will work our way back into the [hundreds of official research reports commissioned the last decade.](#)

vegetation..."

*"...Many of the ecological indicators of forest growth and carbon sequestration fail to explicitly account for complexity..."*

*"...It takes tree diversity to produce a variety of leaf and plant shapes and, additionally, a critical quantity of leaves to supply the building blocks required to assemble a structurally complex forest capable of sequestering lots of carbon..."*

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## Climate Change and Land

[2019-08-08-ipcc-summary-report-for-policymakers-on-climate-change-and-land-english.pdf](#)

This report was commissioned by the IPCC and is intended for policymakers and discusses sustainable forest management and carbon sinks and storage methods.

*"...Sustainable forest management can maintain or enhance forest carbon stocks, and can maintain forest carbon sinks, including by transferring carbon to wood products, thus addressing the issue of sink saturation (high confidence)..."*

*"...Where wood carbon is transferred to harvested wood products, these can store carbon over the long-term and can substitute for emissions-intensive materials reducing emissions in other sectors (high confidence)..."*

*Where biomass is used for energy, e.g., as a mitigation strategy, the carbon is released back into the atmosphere more quickly (high confidence)..."*

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## EU Biomass Legal Case Main Arguments

[2019-08-00-eu-biomass-legal-case-main-arguments-english.pdf](#)

This legal document contains the main arguments in the EU Biomass Legal Case where the applicants seek annulment of the inclusion of "forest biomass" – essentially trees, including, stems, stumps, branches and bark – as a renewable fuel

within the  
Renewable Energy Directive (recast) 2018.

*"...burning wood for energy puts more carbon in the atmosphere than burning fossil fuels, including coal; and the vast increase in industrial logging which it necessitates destroys the very forest systems that have absorbed carbon from the atmosphere..."*

*"...Achieving net zero emissions by 2050 means balancing carbon emissions with carbon sinks, which will require massive effort in both directions. The only carbon sinks currently under human control to any degree<sup>3</sup> are natural systems, including agricultural soils and, especially, forests. Accordingly, many scientists are discussing 'natural climate solutions, especially restoring and expanding forests, as a means of increasing sequestration of atmospheric CO<sub>2</sub>..."*

*"...the Paris Agreement also emphasises the role of forests and other terrestrial sinks for carbon. Its Article 5 urges signatories to protect and expand forests and to "take action to implement and support [...] activities relating to reducing emissions from deforestation and forest degradation..."*

*"...There are significant carbon losses 'upstream' of the finished pellet, particularly pellets from harvested trees rather than sawmill residues. The carbon footprint of wood pellets includes the roots left after harvesting, which decompose, and tops, limbs, and bark that may be chipped and burned at the manufacturing plant to dry the pellets. Total biogenic emissions are around 2.85 tonnes for every tonne of pellets. Additional to these emissions are the fossil fuel emissions from growing, harvesting, manufacturing, and transporting pellets..."*

*"...Biomass power plants generally emit more CO<sub>2</sub> per unit energy than fossil-fired plants,<sup>12</sup> partly because wood tends to have a high moisture content which must be evaporated before useful energy can be generated. Accordingly, power plants combusting solid biomass for fuel tend to operate at a lower efficiency than gas, oil, or coal-fired plants, so more fuel must be burned to generate a given amount of energy which, in turn, emits more CO<sub>2</sub> per unit energy..."*

*"...Wood also has a lower energy content per unit carbon than natural gas, further increasing CO<sub>2</sub> emissions per unit energy relative to gas. Pre-drying wood fuel, and particularly manufacturing it into wood pellets, can increase combustion efficiency and thus reduce carbon emissions per unit energy when the fuel is burned, but that requires energy and emits carbon upstream..."*

*"...Despite having higher CO<sub>2</sub> emissions than coal per unit energy, burning wood for energy has often been wrongly treated as 'carbon neutral' under regulations and incentive programs. The rationale is generally that materials are 'waste' that would decompose and emit CO<sub>2</sub> anyway, or that plant sources of biomass will grow back and re-sequester an equivalent amount of CO<sub>2</sub> as was released by combustion. Burning even waste wood produces considerable net emissions..."*

*"...For instance, the net emissions impact of burning forestry residues (the tops and limbs left over from sawnwood harvesting) can be calculated as the cumulative additional CO<sub>2</sub> from burning rather than allowing material to decompose in the forest. But for temperate and cool climates in Europe, where decomposition rates are typically moderate to slow, burning wood emits much more CO<sub>2</sub> than decomposition. Modeling shows that even after ten years of power plant operation, 60% to 90%+ of the cumulative CO<sub>2</sub> from residue burning constitutes a net addition to the atmosphere..."*

*"...EC staff pointed out an obvious flaw in the bioenergy assessment conducted during development of the Directive: "...it is assumed that the CO<sub>2</sub> emitted will be compensated by the CO<sub>2</sub> captured during plant regrowth. However, compared to crops which regrow over short periods, forest biomass is part of a much longer carbon cycle. A forest stand typically takes between decades and a century to reach maturity. Recent studies have found that when greenhouse gas emissions and removals from combustion, decay and plant growth (so-called biogenic emissions from various biological pools) are also taken into account, the use of certain forest biomass feedstocks for energy purposes can lead to substantially reduced or even negative greenhouse gas savings compared to the use of fossil fuels in a given time period (e.g. 20 to 50 years or even up to centuries)..."*

*"...That conclusion contrasts with the Directive's claim that its sustainability and GHG criteria "ensure" that biomass delivers emissions reductions relative to fossil fuels.*

*Contrasting with the Directive's treatment of biogenic carbon as zero, the EC bioenergy assessment concludes that there is 'agreement in the scientific community that adequate account of biogenic CO<sub>2</sub> emissions is needed..."*

*"...A number of scientific studies have concluded that the net emissions impact of harvesting trees for energy is even greater than the net impact of burning residues that would otherwise decompose. With regard to burning forest wood to generate electricity, a number of studies have concluded that it can take from several decades to more than a century for forests to regrow sufficiently to draw net bioenergy emissions down to the point where they are equivalent*

*to net emissions if fossil fuels were burned to generate the same amount of electricity.."*

*"...The European Academies Science Advisory Council (EASAC), which serves as an advisory body to the EU, explains that it is not only slow forest regrowth but also forgone sequestration that increases the net carbon impact: "The net climate effects of harvesting a forested area for bioenergy will thus be a combination of the emissions from burning and the loss of carbon absorption potential after harvest..."*

*"...The Joint Research Centre (JRC), which serves in an advisory capacity to the EU, evaluated carbon accounting for woody biomass for the EU. JRC's report also warns that harvesting trees ('stemwood') for bioenergy can lead to a longlasting transfer of forest carbon to the atmosphere: "In the case of dedicated harvest of stemwood for bioenergy purposes and short term GHG reduction policy objectives (e.g. 2020) the assumption of "carbon neutrality" is not valid since harvest of wood for bioenergy causes a decrease of the forest carbon stock, which may not be recovered in short time, leading to a temporary increase in atmospheric CO<sub>2</sub> and, hence, increased radiative forcing and global warming..."*

*"...Accordingly, as for the Article 31(1)(a) default values, the formula treats emissions from the fuel in use as zero, and only accounts for changes to biogenic carbon stocks where emissions result from land-use change. In the absence of land-use change, it counts emissions as zero. The Directive (see Annex VIII, part B) adopts the categorisation of the IPCC, such that land use change is when there is a move from one category to another (forest land, grassland, wetlands, settlements, or other land, to cropland or perennial cropland). Significantly, there is no land use change when a forest is felled and allowed to regrow, despite the fact that it may take decades to centuries for the forest to recover...."*

*"...Further, there is no land use change when a natural, biodiverse-rich forest is felled and replaced with a managed forest (such as a mono-crop pine plantation), which has a far lower capacity to sequester carbon. Despite this, the Directive treats the emissions caused by this felling as zero. Therefore, like the default values it is not capable of capturing the fact that equivalent CO<sub>2</sub> to that emitted by combusting biomass is only sequestered over a period of decades, assuming that trees do indeed regrow and are permitted to mature to their former size..."*

*"...In contrast, when there is a land use change (such as conversion of a forest to agricultural land), the el value attempts to capture the emissions by averaging them over a 20 year period. This difference in treatment of*



*effectively the same action (namely, harvesting a forest) is entirely arbitrary and underlines the fallacy of treating biogenic emissions in the absence of land use change as zero...."*

*"...While the GHG criteria are intended to ensure a GHG saving from using biomass rather than fossil fuels as an energy source, as explained below, they cannot do that in relation to forest biomass because, in summary:*  
*1) There are no GHG criteria for existing installations; they are only applicable to new installations post-2021. Existing installations can qualify for the Article 29(1) purposes even without meeting any GHG criteria at all; and*  
*2) Even when the GHG criteria are applicable to new installations from 2021, the methods to calculate GHG emissions mandated by the Directive are inadequate..."*

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## Timing and Variation of GHG Emissions of Forest Bioenergy [2019-07-31-elsevier-understanding-the-timing-and-variation-of-greenhouse-gas-emissions-of-forest-bioenergy-systems-english.pdf](#)

This research paper discusses the greenhouse gas (GHG) impact of three forest-based bioenergy systems from the USA, Canada and Spain supplying wood pellets for electricity in the UK were evaluated by conducting lifecycle assessments and forest carbon modelling of the three forest systems. Cumulative emissions were analysed by calculating the forest carbon stock change and net GHG emissions balance of the forest-based bioenergy electricity. The analysis considered both the replacement of the existing electricity mix with bioenergy electricity and forest management with and without bioenergy use.

*"...Frameworks which consider all biogenic carbon within plants to be carbon neutral simplify implementation and are reasonably accurate for bioenergy systems where carbon sequestration and release are temporally close e.g. annual crops, but fail to capture the more complex carbon dynamics of forests..."*

*"...discussions about and criticism of forest-based bioenergy systems and accounting frameworks show the importance of timing related to biogenic carbon emissions that are not necessarily compensated for by*

*contemporaneous sequestration and the accumulation of carbon and emissions in forests, forest products or atmosphere..."*

*"...The temporal framing of forest carbon stocks and flux differs between forest type and forest management as work by others has shown. This creates additional variation and uncertainties when assessing carbon dynamics and the possible climate change mitigation potential of forest-based bioenergy..."*

*For each supply chain a suite of three assessment methods were applied:*

*1. Lifecycle assessment (LCA), to evaluate GHG emissions (including CO<sub>2</sub> and non-CO<sub>2</sub> emissions) of the supply chain processes and activities at each point of occurrence.*

*2. Forest carbon modelling, to assess the carbon balance of the forest stands, evaluating the amount and dynamics of the carbon sequestration and release in the forest system.*

*3. GHG balance assessment (incorporating LCA and carbon forest modelling in a cumulative emissions framing).*

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## Threat Map Are Forests the New Coal

[2019-07-08-epn-report-threat-map-are-forests-the-new-coal-english.pdf](#)

This report outlines the evolution of this threat and maps its frightening expansion in scale and global extent now and over the next ten years.

*"...The harm inflicted by biomass industry is outlined in the recently released position statement endorsed by over 130 non-government organisations globally.*

*The statement outlines that: Large- scale burning of forest biomass for energy*

***harms the climate***

*- it is not low carbon*

*- it is encouraged by flawed carbon accounting*

***harms forests***

*- it threatens biodiversity and climate resilience*

*- it undermines the climate mitigation potential of forests*

***harms people***

*- it undermines community rights and interests*

*- it harms human health and well-being*

***harms the clean energy transition***

*- it provides a life-line for burning coal for energy production*

*- it pulls investment away from other renewables..."*

*"...Burning trees for biomass power is misleadingly classified by its supporters as a 'clean' and 'carbon-neutral' source of energy, when in fact biomass power creates major air pollution problems at the site of combustion, and exacerbates climate change through very high per-megawatt-hour releases of CO<sub>2</sub> and other greenhouse gases..."*

*"...Countries in Asia are making the same mistakes that European countries made in encouraging large scale biomass burning for energy production. Japan and South Korea are now heading down the same wrong road that faulty European Union policies enabled, namely subsidizing power generation from forest biomass and failing to count smokestack carbon emissions resulting from wood burning..."*

*"...these dramatic increases in bioenergy use are predominantly driven by incentives intended to help utilities reduce greenhouse gas emissions, mostly by substituting wood for coal. Yet burning wood to generate energy emits even more carbon, on a per-unit-of-energy basis, than burning coal,<sup>7</sup> while increasing harvest rates in forests depletes their capacity to act as sinks and degrades the world's carbon stocks. Consequently, biomass power represents a 'doubly false' solution – not only does it fail as a low-carbon energy source, but also the carbon sequestration function of forests is lost if trees are cut down to fuel energy demand. On top of this are the high levels of embedded emissions in pellet manufacture and transport..."*

*"...the main demand driver in Europe is climate policy, specifically a flawed "Renewable Energy Directive" (RED) that classifies forest biomass as a renewable energy source alongside wind and solar. International policy and deeply flawed carbon accounting under the Kyoto Protocol create a false impression of carbon neutrality for energy from forest biomass, thus putting it in direct competition with energy sources, such as wind and solar, that truly are carbon neutral. From a utility's perspective, it is far easier to co-fire wood with coal, or to convert coal-fired power generators to burn forest biomass, than it is to embark on the path of converting its generating capacity to true, low-carbon renewable power..."*

*"...Burning biomass involves combustion of organic matter and emits CO<sub>2</sub> to the atmosphere, just as burning fossil fuels does. Per unit of energy, burning biomass emits even more CO<sub>2</sub> than burning fossil fuels. Two main arguments are used to claim that power from forest biomass is carbon neutral, or zero emissions: Tree or forest regrowth will subsequently sequester an equivalent of carbon as initially emitted, thus netting out to zero emissions. If forest biomass comprises wastes or residues that would otherwise decompose, then emissions from burning are equivalent to those that would have happened anyway, and not additional. There are significant problems with these*

*assumptions. Burning emits carbon instantaneously, whereas decomposition of residues is slow. Forest regrowth will take decades to centuries. Meanwhile that carbon is in the atmosphere causing further warming, and this occurs regardless of whether forest management is 'sustainable'.."*

*"..Burning emits carbon instantaneously, whereas decomposition of residues is slow. Forest regrowth will take decades to centuries. Meanwhile that carbon is in the atmosphere causing further warming, and this occurs regardless of whether forest management is 'sustainable'. Yet time is of the essence when addressing climate change. To meet the targets of the Paris agreement, in particular to make our best efforts to limit levels of warming to 1.5C, the carbon debt generated by burning forest biomass needs to be recovered rapidly. Instead, where full regrowth occurs, it would be many decades before net zero is reached, potentially after 2100.."*

*"..there is no guarantee of full regrowth and no one is checking up on it. Occurrences such as land use change and deforestation, or substitution of monoculture plantations for natural forests all deplete carbon in perpetuity and are not unusual.."*

*"..Serious loss of soil carbon also occurs as an effect of logging. Intensified logging regimes for biomass supply often mean reduced rotation times such that the forest never regrows to previous levels of carbon stock.."*

*"..any logging for biomass reduces the amount of CO2 that forests would have sequestered otherwise, and foregone CO2 sequestration has the same impact on the climate as increased CO2 emissions.."*

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[Dutch Government Answers To Disappearing Forests/CO2 2019-06-27-minInV-beantwoording-schriftelijke-vragen-over-het-bericht-staatsbosbeheer-wil-duidelijker-bosbeleid-van-minister-dutch.pdf](#)

This document holds the questions and answers to the Dutch government concerning disappearing forests and the consequences for the CO2 effects.

*"..PvdD party questions for the Dutch government:*

*Is it true that every year more forest volume disappears than is added? If so, what consequences does that have for the net CO2 effects of our forest?.."*

*"..Dutch government answer:*

*In hectares there is indeed a net decrease in the forest area. Scientists from Wageningen Environmental Research have published figures on deforestation*

*in the Netherlands in the Nature, Forest and Landscape journal from September 2017 ("The Dutch forest as a source of CO2"). They state that (after correction) during the 2013-2017 period the net deforestation (the balance of afforestation minus deforestation) covered an average of 1350 ha per year. The gross afforestation (ie excluding afforestation) was 3036 ha in this period. According to the article in the, the gross deforestation of these 3036 ha per year corresponds to an emission of 1.5 Mton CO2 per year. In greenhouse gas reports, deforestation is much more important than new forestry planting. In the case of deforestation, the disappearance of the entire stock is taken into account, while the build-up of the carbon stock in new forest is 40 times slower..."*

*"...PvdD party questions for the Dutch government:*

*Do you share the view that the EU position to co-fire wood in coal-fired power plants has been labeled as CO2 neutral is incorrect and must be combated? If this is not the case, why not? If this is the case, in what timeframe and manner do you wish to object to this position?.."*

*"...Dutch government answer:*

*That the use of biomass is seen as climate neutral is one principle that is laid down in guidelines for climate policy in a UN context... These agreements form the basis for the global, European and national climate policy. I know that there are other opinions, but I have to ultimately base myself on international agreements. Other insights must be discussed in the UN context and may lead to adjusted agreements..."*

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## Sustainable Biomass for the Production of Hydrogen

[2019-06-23-wageningen-university-research-duurzame-biomassa-voor-de-productie-van-waterstof-dutch.pdf](#)

This report discusses the burning of woody biomass to generate electricity to be used for the production of hydrogen.

*"...The arguments of the proponents and opponents [of burning woody biomass] have to do with the:*

- CO2 and energy balance in the chain and the moment at which you measure the carbon stock;*
- biomass additional growth in relation to consumption and the effects of harvest on the landscape and the ecosystem;*
- guaranteeing sustainability through an administrative system of certification;*
- market forces and market failures, due to the exploitation of subsidies (level playing field) and the absence of a CO2-related market mechanism;.."*

*"...[proposed] requirements for the various parties in the chain:*

*The use of biomass must lead to a substantial reduction in greenhouse gas emissions, calculated over the entire chain. The calculated reduction in greenhouse gas emissions must be at least 70% relative to the reference value for fossil fuels.*

- production of raw biomass must not lead to destruction of carbon reservoirs.*
- biomass production may not lead to long-term carbon debt.*
- biomass production must not lead to indirect land use change (ILUC) with a negative impact on carbon capture.*
- relevant international, national and regional / local laws and regulations are followed.*
- biodiversity must be preserved and, where possible, strengthened.*
- the production capacity of each forest type must be maintained.*
- forest management contributes to local economy and employment.*
- sustainable forest management is realized on the basis of a management system..."*

*"...About half of wood and other biomass consist of carbon (C) and as long as this biomass is intact, the carbon remains stored and there is therefore less CO<sub>2</sub> in the atmosphere. Through branch and leaf fall and tree death, the carbon stored in the plant ends up in and into the soil... In a managed ecosystem, like most forests, harvesting usually takes place, whereby part of the carbon stored in the forest is removed during harvest in the form of trunks, firewood and / or branch and top timber. The method of harvesting can also have effects on the amount of C stored in the soil..."*

*"...Because products made from wood last a certain time, a carbon stock is created here in the form of, for example, furniture, parquet, wooden houses and books. By reusing or recycling used wood products and using them as raw materials for other products, the time when the carbon from the wood is released into the atmosphere can be postponed..."*

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Assessment for the National Forestry Accounting Plans  
[2019-06-18-european-commission-staff-working-document-assessment-for-the-national-forestry-accounting-plans-english.pdf](#)

This report is commissioned by the European Commission and contains an assessment for the national forestry accounting plans.

*"...Member States should ensure that sinks and reservoirs, including forests, are conserved or enhanced with a view to meeting the ambitious greenhouse gas emissions reduction targets of the Union by 2030 and strategies to reduce emissions to net zero by 2050, in line with the Paris Agreement..."*

*"...To help achieve these goals, the LULUCF Regulation sets out a robust accounting system. This Regulation sets a binding commitment for each Member State to ensure that accounted emissions from land use are at least compensated by an equivalent removal of CO<sub>2</sub> from the atmosphere through action in the sector. This is known as the 'no debit' rule..."*

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## Global Markets for Biomass Energy are Devastating Forests [2019-06-17-nrdc-dogwoodalliance-southern-environmental-law-center-global-markets-for-biomass-energy-are-devastating-us-forests-english.pdf](#)

This report commissioned by NRDC, Dogwood Alliance, Southern Environmental Law Center exposes the damaging logging practices used to source the biomass industry, including the clearcutting of iconic wetland forests.

*"...Multiple independent, peer-reviewed studies have determined that burning biomass from forests for electricity creates more carbon dioxide emissions than burning coal, and that increased carbon dioxide concentrations persist in the atmosphere for decades or more..."*

*"...we must cut global emissions by half over the next decade to be on track to keep planetary warming within safe levels. Yet, climate and energy policies in countries like the United Kingdom, Denmark, the Netherlands, and now South Korea and Japan persist in treating biomass as a "carbon neutral" source of renewable energy and offering utilities lucrative incentives to increase reliance on biomass electricity. Policymakers have for years looked to "sustainable" sourcing standards to ensure their biomass imports are "green." Yet, the damaging practices documented in these investigations are all happening under the umbrella of such "sustainable" standards. "Sustainable forestry" cannot guarantee a reduction in carbon dioxide emissions within timeframes relevant to fighting climate change..."*

*"...Our forests are a giant storehouse of carbon; in fact, they contain more carbon than all our known exploitable deposits of oil, gas, and coal. Protecting forests is a critical weapon in the fight against climate change. Releasing even*

*a small percentage of this stored carbon or reducing the amount of carbon that our forests suck out of the air makes avoiding climate devastation much, much harder..."*

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### Burning Trees for Power the Truth about Woody Biomass [2019-06-14-southernenvironment-burning-trees-for-power-the-truth-about-woody-biomass-energy-and-wildlife-english.pdf](#)

This report commissioned by Southern Environment states the many and extreme dangers for biodiversity caused by the logging and burning of woody biomass.

*"...In claiming that woody biomass derived from harvesting forests is "carbon neutral," the wood pellet industry claims its demand will accelerate establishment of pine plantations in the region. These claims, however, fail to acknowledge the adverse effects of these forest conversions on the region's biodiversity. In addition to the large-scale changes in forest types, southern forests are also decreasing in area. A study by the U.S. Forest Service acknowledged a "net forest loss" in the southern U.S. Specifically, "the South is forecasted to lose between 4 million and 9 million hectares (7 and 13 percent, respectively) of forests from 1997 to 2060..."*

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### Dutch Government Answers to Burning Wood Questions [2019-06-07-minez-minister-wiebes-beantwoording-vragen-over-milieuschade-houtstook-is-vele-malen-hoger-milieuschade-door-aardgas-of-stookolie-dutch.pdf](#)

This document contains the answers from the Dutch government concerning questions about the damage to the environment caused by burning wood.

*"... PvdD party question for the Dutch government:  
Do you support the conclusion that the damage of [burning] wood pellets from Canada and North America are extra harmful? Can you indicate how many of these pellets are imported annually for (industrial) wood burning? If not, why not?..."*



*"...Dutch government answer:*

*It is factually correct that the indirect emissions of wood pellets from North America are relatively higher due to the longer distance they are transported and the fact that this transport is still mainly carried out with fossil fuels. The total import of wood pellets from North America (Canada, the US and Mexico) to the Netherlands in 2018 was 15.8 million kg (€ 2.7 million)... It is not possible to indicate what these pellets have been used for, nor whether they will be exported again, because this is not being recorded..."*

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## Dutch Government Reply to Questions on Biomass Co-Firing [2019-06-04-gov-nl-wiebes-antwoorden-op-kamervragen-pvdd-over-de-bij-stook-van-biomassa-in-centrales-dutch.pdf](https://www.rijksoverheid.nl/documenten-en-publicaties/antwoorden/2019/06/04/gov-nl-wiebes-antwoorden-op-kamervragen-pvdd-over-de-bij-stook-van-biomassa-in-centrales-dutch.pdf)

This document contains the answers from the Dutch government concerning questions about the co-firing of biomass in power plants.

*"...PvdD party question for the Dutch government:*

*Do you agree that CO<sub>2</sub> emissions from biomass co-firing in coal-fired power stations are 2.3 times as much as with gas-fired plants and that emissions are even 3 times as high when biomass is burned in smaller biomass plants? Can you indicate which share comes from the production, transport and processing of biomass? If not, why not?*

*"Dutch government answer:*

*It is a fact that CO<sub>2</sub> is released during incineration - also from biomass. However, as indicated in response to question 2, the co-firing of biomass on the basis of international agreements is seen as CO<sub>2</sub> neutral. I cannot give an exact breakdown of the CO<sub>2</sub> emissions associated with the production, transport and processing of biomass ... "*

*"...PvdD party question for the Dutch government:*

*Do you agree that the classification of burning biomass as CO<sub>2</sub> neutral is only a paper reality, if only because the transport and processing of biomass causes CO<sub>2</sub> emissions? If not, why not?*

*"Dutch government answer:*

*No, I don't endorse this view. In accordance with international agreements, firing biomass is considered CO<sub>2</sub> neutral ... "*

*"...PvdD party question for the Dutch government:*

*Can you confirm that the use of biomass from 2016 to 2020 may be 17 times as*

*much? If so, does this justify the conclusion that there might be 10 to 12 MT more CO<sub>2</sub> in the air in 2020 than what is now sketched on paper? If not, why not?*

*"Dutch government answer:*

*According to the most recent data in the National Energy Survey (NEV) 2017, the total amount of energy production through the use of biomass will increase from 78.5 PJ in 2016 to 148.9 PJ in 2020. The conclusion that this may lead to 10 to 12 I share more CO<sub>2</sub> in the air, I do not share, because CO<sub>2</sub> emissions are compensated by the planting of new vegetation that removes an equally large amount of CO<sub>2</sub> from the air..."*

*"PvdD party question for the Dutch government:*

*Do you endorse the threat and the great impact of reaching the so-called tipping points, such as those involved in the melting of land ice and the methane emissions from permafrost, possibly within a period of 15 to 30 years? If not, why not? Does the CO<sub>2</sub> emission of an ever more extensive use of biomass and biofuels have an accelerating effect on the approach of such tipping points? If not, why not?*

*"Dutch government answer:*

*Regardless of the use of biomass, the government's policy is aimed at keeping the temperature rise, in accordance with the Paris Climate Agreement, well below 2 degrees Celsius compared to pre-industrial times. Our national and international efforts must prevent the so-called turning points from being reached..."*

*"PvdD party question for the Dutch government:*

*Do you agree with the opinion of many experts (including Tropenbos Int.) That it takes an average of 60 to 100 years for the CO<sub>2</sub> emissions of wood burning to be recorded in forests again (regardless of the additional CO<sub>2</sub> emissions from transport, the release of CO<sub>2</sub> from the roots that are left behind, air pollution, the loss of biodiversity, etc.)? If not, why not?*

*"Dutch government answer:*

*It is true that time is running out to take up the emissions that are released when burning biomass in new trees. The sustainability criteria stipulate that the growth and conservation of the forest from which (solid) biomass is obtained is greater than the loss of carbon. In this way, no net debt occurs, but a reduction in CO<sub>2</sub> emissions is actually achieved..."*

*"...PvdD party question for the Dutch government:*

*Do you believe that the extensive use of biomass and biofuels still fits in*

efficiently with the urgent climate problem? If so, what do you rely on? If not, what measures follow from this?

*"Dutch government answer:*

*The government is convinced that the use of biomass now and in the direction of 2030 and 2050 is necessary for making our economy more sustainable and achieving the climate challenge. Various PBL studies also show that the use of biomass fits in with a cost-efficient transition. The government's point of departure is that only sustainable biomass really contributes to making the economy more sustainable and that sustainable biomass at a global level will be scarce in the long term. That is why the highest possible use of biomass is required in the long term..."*

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## Dutch Government Hearing Logging Trees for the Climate [2019-06-03-tweede-kamer-hoorzitting-bomen-kappen-voor-klimaat-en-natuur-roofbouw-of-noodzakelijk-kwaad-dutch.pdf](#)

This report commissioned by main parties like the Dutch State Forest Management and its former Director, Professors at the University and others concerned with the massive amount of trees being logged for biomass production.

*"...Input Staatsbosbeheer (Dutch state forest management):*

*An important part of Dutch biodiversity is linked to forest; forests are rich ecosystems. Moreover, trees are a source for CO<sub>2</sub> storage, and therefore an important key to tackling climate change..."*

*"...Input former Director Dutch State Forest Management*

*Firstly, SBB (Dutch state forest management) has fallen back on the logging method for harvesting wood in combination with tillage, as if trees are an arable crop. Euphemistically, this is also referred to as rejuvenation. The clearing as a method for forest exploitation is an outdated phenomenon: deliberately abolished long ago because of the major disadvantages for the forest ecosystem. It is a national policy that kills around two thousand football pitches per year. Bare cutting leads to a sharp decrease in soil fertility, in biodiversity and in perception value. Moreover, it is problematic for the climate because it leads to a substantial increase in CO<sub>2</sub> emissions and to the conversion of climate-robust mixed forests into monocultures of mainly pine trees that are vulnerable to climate change..."*

*"...Input Prof. Dr. Martijn Katan, biochemicus, Vrije University*

*Wood contains a lot of CO<sub>2</sub>. As a result, producing a certain amount of heat from biomass leads to twice as much CO<sub>2</sub> emissions as from gas, and to 15% more emissions than from coal. The cultivation, drying and transport of biomass also requires more energy than coal or gas. As a result, the total emissions for biomass are more than three times as high as for gas, and more than 50% higher than for coal..."*

*"...Biomass for power plants is often imported from the US in the form of wood pellets. These are largely made from tree trunks: 64% from logs of pine and 12% from hardwood. Wood waste and sawdust hardly play a role, there is too little of it to meet demand. The growing demand for biomass leads to logging of large areas of forest, including primeval forest (hardwood). Will forest owners completely replace trees with new trees? That depends on the competitive destinations for land, expectations about timber prices and subsidies, willingness to invest in long-term, etc. Economic science cannot predict what those forest owners will do. What we do know is that even with 100% replanting it takes 20-100 years for the cuttings to be so large that they have absorbed the CO<sub>2</sub> emitted by our power stations. The extra CO<sub>2</sub> from biomass therefore remains in the air until 2050 or 2100 and worsens the climate crisis..."*

*"...According to international treaties, the CO<sub>2</sub> content of the air does not increase by burning biomass. That is why biomass is considered climate neutral. This could be true if we are talking about wood waste that would otherwise be incinerated alongside the road. The however, global industrial demand for wood pellets has been since 2010 quadrupled, from five to twenty billion kilos and continues to grow. This growth does not come from sawdust, branches or dead trees. There is too little of that and it does not work efficiently. The growth comes from the mechanical harvesting and processing of complete forest plots. Before they have grown again, we are 20-100 years further. That is why the claimed "climate neutrality" is fiction..."*

*"Conclusion; Between now and 2050, replacing coal and gas with biomass will lead to a significant increase in the amount of greenhouse gas in the atmosphere..."*

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This report is commissioned by the Dutch Government (PBL) and describes the effects of the drafted climate agreement.

*"...Emissions from international aviation and shipping are not included in Dutch emissions. Also emissions due to the use of biomass are counted as zero. Emissions outside the Netherlands that are associated with the production and transport of biomass are therefore not included..."*

*"...In industry, the deployment of extra imported sustainable biomass (as expected at the top of the bandwidth) lead to an increase in emissions abroad (typically less than 0.5 Mton). The obligation to use biofuels in the mobility sector can lead to emissions abroad related to the production and transport of biomass and biofuels when imported (in the order of 0.1 - 0.4 Mton)..."*

*"...If the SDE ++ is more focused on CO<sub>2</sub> reduction instead of renewable energy, then the use of biomass in industry can also turn out lower than in this analysis is assumed..."*

*"...The role of biomass in a future CO<sub>2</sub> emission-free system is of great importance, but at the same time there are many uncertainties in both the range and application. The sustainability of the biomass is under discussion, in particular because land requires cultivation and cultivation the conversion from a natural area to agricultural land is often accompanied by loss of carbon from vegetation and soil and because the growth of wood takes time..."*

*"...The concept of cascading is used and it is indicated that applications without CO<sub>2</sub>-free alternatives are preferred, but the translation thereof into concrete policy proposals has been omitted. Optimal use of biomass that can no longer be used as material or as raw material for specific components, does not only mean utilization of the energy but also the carbon..."*

*"...Future visions show that the scarce biomass should be used as a priority for applications where there are few low-carbon alternatives, such as in aviation and shipping, use as a raw material for the chemical industry and application in combination with capture and storage of CO<sub>2</sub>. Due to the increasing scarcity of biomass would be immediate use for heat supply in homes, for heating networks and for industrial heat without CCS / CCU should be limited. However, there are no proposals in the OKA included to limit such applications; those options therefore remain visible..."*

*"...The support for this must come from the SDE ++, but the analyzes show that direct biomass combustion is still preferred based on the costs above the more innovative, sometimes second-generation technologies..."*

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## Renewable Energy in Europe

[2018-12-17-european-environment-agency-report-renewable-energy-in-europe-english.pdf](#)

This report is commissioned by the European Environment Agency and discusses the calculation flaw in which the burning of woody biomass has been assigned an emission factor of zero because of the absence of information and the measures to be brought in place to correct this issue from 2021 onwards.

*"...The term 'gross avoided GHG emissions' illustrates the theoretical character of the GHG effects estimated in this way, as these contributions do not necessarily represent 'net GHG savings per se' or are based on life-cycle assessment or full carbon accounting.*

*Taking life-cycle emissions into account could lead to substantially different results..."*

*"...The [current] approach takes into account neither life cycle emissions nor carbon accounting..."*

*"...In the absence of specific information on current bioenergy systems, CO<sub>2</sub> emissions from the combustion of biomass (including biofuels/bioliquids) were not included in national GHG emission totals in this report, and a zero emission factor had to be applied to all energy uses of biomass. This should not be interpreted, however, as an endorsement of default biomass sustainability or carbon neutrality..."*

*"...To impede further conversions of coal-fired plants into biomass plants, the criteria require that only high-efficiency cogeneration (with a yield of  $\geq 80\%$ ) counts towards national progress in RES generation, and that heat and power plants achieve at least an 80 % reduction in GHG emissions compared with fossil fuels from 2021 onwards, and 85 % from 2026 onwards (EU, 2018a)..."*

*"...In 2016, the largest amounts of gross avoided GHG emissions were attributable to onshore wind energy (137 MtCO<sub>2</sub>), solar PV energy (73 MtCO<sub>2</sub>) and heat from solid biomass (37 MtCO<sub>2</sub>). Onshore wind and solar PV energy are also the most significant contributors to avoided fossil fuel consumption and avoided primary energy consumption. In contrast, heat from solid biomass increased primary energy consumption by 3.5 Mtoe in 2016. The use of solid biomass for electricity and heating leads to a reduction in GHG emissions and fossil fuel consumption, but it drives up primary energy consumption..."*

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## Forest-based Mitigation versus BECCS CO<sub>2</sub> Removal

[2018-08-07-nature-land-use-emissions-play-a-critical-role-in-landbased-mitigation-for-paris-climate-targets-english.pdf](#)

This report shows that the effectiveness of BECCS strongly depends on several assumptions related to the choice of biomass, the fate of initial above ground biomass, and the fossil-fuel emissions offset in the energy system.

*"...Carbon removed from the atmosphere through BECCS could easily be offset by losses due to land-use change. If BECCS involves replacing high-carbon content ecosystems with crops, then forest-based mitigation could be more efficient for atmospheric CO<sub>2</sub> removal than BECCS..."*

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## Carbon Impacts of Biomass Consumed in the EU

[2018-05-00-cib-ecf-forest-research-report-carbon-impacts-of-biomass-consumed-in-the-eu-english.pdf](#)

This report was commissioned from Forest Research by the European Climate Foundation (ECF) to provide an elaborated analysis to clarify the findings of a project undertaken for the European Commission (DG ENER), known as Carbon Impacts of Biomass Consumed in the EU. The report leads to the following conclusion:

*"...Unless appropriate policy measures are taken to support sustainable bioenergy supply, particularly in the case of forest bioenergy supply, a significant increase in bioenergy use in the EU is likely to lead to a net increase, rather than decrease, in GHG emissions being contributed from bioenergy sources..."*

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Covered in Smoke

This report discusses the burning of solid biomass, mainly wood, for heating and power generation in the European Union.

*"... The European Commission Joint Research Centre (JRC)<sup>14</sup> finds that for slow growing trees, the use of stem-wood for bioenergy can generate an increase in carbon dioxide (CO<sub>2</sub>) emissions compared to fossil fuels over several decades, if all the carbon pools and their development with time are considered. Comparison of the Greenhouse Gas (GHG) balance for the use of forest materials versus coal and natural gas has concluded that the time to reach parity ranged from approximately 10 years with increased use of forest residues, to 100s of years with an increased rate of thinning, to more than 500 years when felling was increased to supply bioenergy for certain types of forest. The comparison with gas naturally leads to longer time-scales given that it generates less GHG emissions than coal..."*

*"...The EASAC report also addresses the complexity of the forest-climate relationship beyond direct impacts of forest management through the biophysical effects of albedo, forest structure, evapo-transpiration, and the release of volatile organic compounds and microbes from plant surfaces capable of forming aerosols and subsequently clouds. EASAC refers to Ellison et al.<sup>16</sup> who suggested that forests should be managed to increase their contribution to climate cooling through hydrological mechanisms and not just from a carbon-centric (i.e. use of biomass as a fuel) perspective. EASAC also found that "evidence suggests that ignoring biophysical interactions – as is currently the case in the Kyoto Protocol and the Paris Agreement – could result in mitigation projects that provide little climate benefit or, in the worst case, are counterproductive..."*

*"...Further to this, the argument of carbon neutrality overlooks emissions from:*

- Forest management
  - Planting
  - Production and application of fertiliser
  - Harvesting
  - Other general management activities
- Processing material so that it is fit for combustion
- Transport

*With respect to transport, it is generally assumed that wood and other forest materials such as bark will be used within a short distance of the growing site and that long range transport is uneconomic. However, this is not necessarily the case. As shown later in this report, large users of biomass can find it economically attractive to source material on global markets, leading to*



significant levels of emission not only from transport on land, but also from shipping..."

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## Heat from Burning Wood

[2014-03-03-bvor-warmte-uit-hout-dutch.pdf](#)

This report was commissioned by multiple woodlogging companies to determine the most effective method for producing woodchips for burning biomass.

*"..The term carbon debt refers to a temporary "imbalance" between CO2 emissions biomass and CO2 capture of forests: when biomass is harvested from forests and burned release CO2 emissions immediately, while "compensating" them takes time due to the re-growth of biomass in the forest. Only when this carbon debt is "repaid", the biomass contributes net to CO2 reduction. Depending on the type of biomass and the method of harvesting, it can "pay back" from the carbon debt can last from a few years to many decades. Critical parties such as the environmental movement argue that with such long periods bioenergy actually does not contribute to reducing climate change. The necessary scientific uncertainties still exist around carbon debt. For the time being, therefore, it is too early to speculate about any policy consequences.."*

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