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## Research on the Sustainability of Burning Biomass



By including bioenergy in renewable energy targets, the EU is promoting direct and indirect subsidies for it, claiming that it is a sustainable alternative to fossil fuels.

Extensive research shows that large-scale bioenergy is far from sustainable, as it relies on a major expansion of industrial agriculture, of monoculture tree plantations, and of industrial logging. These industrial activities deplete and pollute soils and water, destroy forests, grasslands and wetlands, and destroy the livelihoods of workers, farmers, Indigenous Peoples and other communities.

The sustainability criteria for forest biomass are minimal, and woefully inadequate. There is no requirement for the regulatory or management systems actually to promote (let alone achieve) sustainability. The sustainability criteria thus tolerate highly damaging actions, such as clearcutting a mature biodiverse natural forest for biomass fuel to be replaced with a monoculture pine plantation.

There is no justification for the failure to adopt more robust sustainability criteria for forest biomass: the effect of harvesting a forest can be as destructive as converting the forest to another land use. More

### RECENT

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fundamentally, there are simply no additional sustainability criteria which a Member State could impose.

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### 37 NGO's Send Letter to the Dutch Government on Biomass [2019-11-25-ngos-letter-to-dutch-government-biomass-is-not-a-lifeline-for-coal-english.pdf](#)

In this letter 37 NGO's urge the Dutch House of Representatives to ensure that no further subsidies will be granted for burning biomass either in coal power stations or in dedicated biomass plants and to redirect the biomass subsidies already granted towards non-emissive renewable energy. Despite the fact that 800 scientists, many different studies (and counting) and EASAC having concluded that cutting down trees to burn in power stations is not compatible with the need to try and stabilise the climate, the EU hasn't budged. Most of the NGO's that cosigned the letter are from Estonia and the (southwestern) U.S. which are two areas whose forests have been heavily effected by the subsidies granted for the burning of woody biomass in the EU.

*"Both the Baltic States and the southern USA are already experiencing unsustainably high rates of logging, and logging practices which cause significant harm to biodiversity and to the future of diverse and resilient forest ecosystems in the regions. The new and potentially fast-growing demand for wood pellets from the Netherlands will exacerbate this situation."*

*"[...] a 2018 peer-reviewed study shows that even biomass energy from forestry residues is not compatible with the timescale for greenhouse gas emission reduction required to meet the Paris Agreement goal of keeping global warming to 1.5 degrees."*

*"In Estonia, total logging volume reached a record 12.5 million tons in 2018, and is expected to rise further this year and beyond."*

*"The current logging intensity is having a negative impact on landscape's ability to absorb carbon and is predicted to turn the LULUCF sector from being a sink into a source of carbon emission by 2034."*

*"In Lithuania, clearcutting operations inside regional and national parks, including Natura 2000 sites are happening with government authorisation and without environmental impact assessments, harming wildlife and plant biodiversity."*

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2019-09 \\ EASAC

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Paid Pro-Biomass LobbyFacts Research - The Scientists  
[2019-11-22-edsp-eco-pro-biomass-lobbyfacts-research-part-3-scientists-martin-junginger-english.pdf](#)

This report describes the paid pro-biomass lobbying activities of scientists in the Netherlands and is part of an extensive study on the paid pro-biomass lobbyfacts in the Netherlands. Researchers, professors and the directors of universities, (former) members of the House of Representatives, ministers and officials from the government are paid directly or indirectly through biomass projects that are allocated by the companies who benefit from burning woody biomass through subsidies paid by the government and the European Union. This specific article focuses on the Copernicus Institute of Utrecht University. Other institutes are discussed in following chapters.

*"Cramer lobbied the criteria into The Hague government chambers so Essent (RWE) could start a global production and trade in biomass. This was received with protest. Several members of the House of Representatives rejected the proposed directive as being without obligation and demanded stricter guarantees and conditions for the future subsidies that Cramer intended to provide for the production of biomass. They insisted on more control and sanctions to guarantee sustainability. Cramer ignored all criticism. According to her, the business community would be wary of using 'wrong' biomass and of being publicly disgraced. In her view, this would be enough motivation for companies to cooperate with sustainable criteria. She also spoke of a first step. Together with the producers, Cramer wanted to ensure that the criteria were "practically feasible". After that we can do check ups, she said. However, she did not state that she was in a conflict of interest because her own research institute had determined the criteria that resulted from a close and paid collaboration with RWE Essent."*

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EU Clean Energy Policies Lead Forest Destruction  
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2019-07 \ \ WUR

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[2019-05-00-probos-beschikbaarheid-van-houtige-biomassa-uit-bos-landschap-stedelijk-groen-dutch.pdf](#)

2019-05 \ \ Probos

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[2019-04-00-natural-climate-solutions-averting-climate-breakdown-by-restoring-ecosystems-english.pdf](#)

This report is based on research from the consulting firm Trinomics. It provides the most comprehensive and up-to-date assessment of government subsidies and other forms of financial support offered to biomass energy producers in the European Union. We focus on the 15 E.U. member states most heavily reliant on bioenergy and cover the period from 2015 to 2018. The Technical Appendix contains Trinomics' full report, including a detailed description of methods, analyses, and results.

*"...Despite the biomass industry's claims that it sources wood "sustainably," on-the-ground investigations by media and independent watchdogs over the past decade have exposed the ecologically damaging logging practices—including the clearcutting of iconic wetland forests—used in the United States to source wood for pellets exported by Enviva, the world's largest wood pellet manufacturer. Significant and troubling evidence shows that biomass headed for the E.U. energy market comes from the logging of mature hardwood forests in places like the U.S. Southeast. The investigations also spotlight the vast quantities of whole trees and other large-diameter wood—biomass feedstocks most damaging to the climate—that are entering the industry's supply chain. Enviva's pellets are shipped to E.U. power companies, such as Drax Power in the United Kingdom and Ørsted in Denmark. These unsustainable sourcing practices not only destroy carbon stocks but also damage biodiversity in the North American Coastal Plain, a region designated as a global biodiversity hot spot..."*

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## Forest Degradation & Forgone Removals Increase the Carbon Impact of Intact Forest Loss by up to 626 Percent

[2019-11-05-sciencemag-degradation-and-forgone-removals-increase-the-carbon-impact-of-intact-forest-loss-by-626-percent-english.pdf](#)

In this research article it is shown that to fully account for gross carbon emissions from all deforestation across the pantropics it is required to factor in adverse effects of clearing forests. Four are considered here; forgone carbon sequestration, selective logging, edge effects, and defaunation. When these factors were considered, the net carbon impact resulting from intact tropical forest loss between 2000 and 2013 increased by a factor of 6 (626%). For this reason the researchers argue that a comparable analysis for extratropical regions is urgently required, given that approximately a half to two-thirds of carbon removals on Earth's intact ecosystems occur outside the tropics.

2019-04 \ Natural Climate

Solutions

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[2019-03-25-wetenschappelijkbureaugroenlinks-maak-een-einde-aan-de-co2-neutraliteit-van-houtstook-dutch.pdf](#)

2019-03 \ WB GL

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[2019-03-20-pfpi-aps-technologies-are-more-polluting-than-fossil-fuels-per-unit-of-energy-produced-and-should-not-be-subsidized-english.pdf](#)

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2019-02 \ EU Commission

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[2019-02-10-easac-forest-bioenergy-carbon-capture-and-storage-and-carbon-dioxide-removal-english.pdf](#)

2019-02 \ EASAC

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[2019-02-06-shareaction-investor-report-the-biomass-blind-spot-english.pdf](#)

*"Financial support and implementation have predominantly focused on areas with high historical rates of deforestation (i.e., "de-forestation frontiers") and hence high predicted rates of emissions in the near future. This is widely believed to deliver more immediate and more clearly demonstrable emission reductions than conserving intact forest areas, which tend to be treated as negligible sources of emissions as a result of the short time scales and conservative assumptions under which REDD+ operates. The relative value of retaining intact tropical forest areas increases if one takes a longer-term view and considers the likely state of the world's forests by mid-century"*

*"Far from being stable and free from threat, intact tropical forests have been severely reduced by industrial human activities in recent decades. Agricultural expansion, logging, mining, and anthropogenic fires reduce the global extent of intact forests by 7.2% between 2000 and 2013, yet the carbon emissions associated with intact forest loss have not been comprehensively estimated.*

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### NGOs Letter to Danish Parliament Regarding Forest Biomass [2019-10-09-ngos-letter-to-the-danish-parliament-and-climate-minister-regarding-forest-biomass-english.pdf](#)

In this letter to the Danish parliament, international NGO's, representing millions of activists in the United States, Estonia, Lithuania, the U.K., and Germany, urge government 1) to impose a levy on biomass, 2) to phase out the subsidy for burning biomass from wood, and 3) to determine a date for phasing out biomass as soon as possible. All this in order to avoid extensive harm to the world's forests and the acceleration of climate change that will be caused by treating biomass as a green energy resource. Nearly 70% of Denmark's renewable energy supply (2017) is met by burning woody biomass, as a result of which 30% more carbon is being emitted than is required to report. On top of that, TV2 investigation series made it apparent that voluntary sustainability standards agreed upon by the biomass industry are falling short of genuinely protecting forests, climate, and communities.

*"While the European Commission, and Denmark, do not count emissions from power plants that burn wood, this is based off an outdated inventory paper from the International Panel on Climate Change dating back to 1990. More recently, countless opinions from the world's leading 9 scientists have detailed "serious errors" in said greenhouse gas accounting of biomass."*

2019-02 \ \ ShareAction

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[2013-08-07-rvo-bio-energie-input-houtige-biomassa-dutch.pdf](#)

2013-08 \ \ RVO

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### **ATTENTION!**

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*"In Estonia, forestry regulations are weak and poorly enforced. For example, clearcutting of Natura 2000 sites has been authorised by the state, as have been logging operations during the nesting seasons of birds."*

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## Estonia Logging and Pellet Production

[2019-10-02-biofuelwatch-estonia-logging-and-pellet-production-english.pdf](#)

This report from Biofuelwatch (august 2019) investigates logging sites and practices in Estonia, in particular the ones associated with Graanul Invest, the 2nd biggest pellet producer, after Enviva, in the world. As the demand for wood pellets is on a sharp increase due to the existing subsidies for burning wood for energy, signs of over-exploitation of Estonia's forests are becoming more numerous and alarming as logging activities are pushed into protected areas.

*"The Nature Conservation Commission of the Estonian Academy of Sciences warned: "Today's forest management as a whole is unsustainable in its present trend, does not guarantee biodiversity conservation, takes little account of ecosystem services and therefore needs to change."*

*"According to information from our local guide and Estonian Fund for Nature, both the clearcutting and the selective logging of the oldgrowth forest area had been permitted under Estonian regulations, with Natura 2000 subsidies continuing to be paid to the landowners even for the clearcut site."*

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## Call for Action to Restrict Climate Damaging Bioenergy

[2019-09-11-easac-environmental-experts-call-for-international-action-to-restrict-climate-damaging-forest-bioenergy-schemes-english.pdf](#)

This press release from EASAC followed soon after they'd published their paper "Serious mismatches continue between science and policy in forest bioenergy" and offers a short summary of their main findings.

*"Biomass taken from forests was unconditionally classed as "renewable energy" under the EU Renewable Energy Directive (RED) in 2009. [...] It used to be taken for granted that using biomass is inherently good for the climate because the carbon in the biomass came from the atmosphere and can be reabsorbed as forests grow, so that biomass could be seen as 'carbon neutral'. That concept may have had some validity in 2009 when the idea was that unused forestry residues would be the main source of bioenergy. However, the large renewable energy subsidies made available in some member states have led to a huge increase in forest biomass use- including to replace coal in large power stations. The process of harvesting forests to produce wood pellets has been industrialised to a scale of many millions of tonnes per year and transported over thousands of kilometres."*

*"Yet under the regulations, these important differences are ignored and all types of forest biomass are treated as 'carbon neutral' and the CO<sub>2</sub> emitted when burnt counted as zero."*

*"With the urgency of action following the Paris Agreement to limit warming to 1.5 C, payback periods of more than a decade have become incompatible with climate change goals."*

*"[T]he current accounting rules under the UN Framework Convention on Climate Change (UNFCCC) allows imported biomass to be treated as zero emissions when burned (on the assumption that the exporting country has recorded the forest carbon loss in their land use reporting). This provides an accounting loophole which allows an importing country to zero-rate its bioenergy emissions- creating the impression that national emissions are reduced while in reality offloading the responsibility for reporting the net increase in emissions to the exporting country."*

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Synthesis Best Available Science & Forest Carbon Policy  
[2019-09-09-dogwoodalliance-synthesis-of-best-available-science-and-implications-for-forest-carbon-policy-english.pdf](#)

This report synthesizes and analyzes the best available climate science on the impacts of industrial forest practices in North Carolina. The first part of this report, the one we'll be focusing on, discusses how industrial forest practices disrupt nature's carbon cycle and provides an overview of three key climate impacts—loss of carbon storage, increased emissions from logging and wood products, and loss of carbon sequestration capacity.

Emissions associated with logging and wood products in North Carolina averaged 44.59 MMT CO<sub>2</sub>-e per year between 2000 and 2018. It represents the third largest source of emissions statewide. If, on the other hand, "climate smart practices" were implemented across the board 3 additional gigatons of CO<sub>2</sub> could be stored on forestlands in North Carolina alone.

*"Industrial forest practices, including clearcutting, timber plantations, application of chemicals and fertilizers, and construction of dense networks of logging roads disrupt natural forest carbon cycles by reducing the buildup of carbon stored in vegetation and soils, reducing carbon sequestration capacity and generating major quantities of greenhouse gases."*

*"Short rotation timber plantations for paper, pellets, and low-quality timber have created vast carbon sequestration dead zones."*

*"Through microbial processes fertilizers [to maximize the growth of trees] generate N<sub>2</sub>O, a gas with a global warming potential 300 times stronger than CO<sub>2</sub>. Recent estimates of this effect suggest that for every metric ton of fertilizer applied, between 1.75% and 5% of that weight is converted into N<sub>2</sub>O emissions."*

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### Serious Mismatches Between Science & Bioenergy Policy [2019-08-09-easac-serious-mismatches-continue-between-science-and-policy-in-forest-bioenergy-english.pdf](#)

This report considers how current policy might be reformed to reduce negative impacts on climate and argue for a more realistic science-based assessment of the potential of forest bioenergy in substituting for fossil fuels. Since the length of time atmospheric concentrations of CO<sub>2</sub> increase is highly dependent on the feedstocks, the authors argue for regulations to explicitly require these to be sources with short payback period.

Furthermore, they re-emphasize the reasons why current policy is achieving the opposite of that intended, and why the urgency of its revision has increased following the conclusion of the Paris Agreement.

*"Currently around half of the European Union (EU)'s 'renewable' energy comes from solid biomass with the amount of electricity generated from biomass increasing annually from 60.7 terawatt-hours (TWh) in 2009 to 94.7 TWh in 2017 (Eurostat, 2019)."*



*"Classifying biomass as renewable has had major consequences. Concerns over the intermittent nature of solar and wind have led governments to seek a 'renewable' supplier of baseload capacity which can be provided by existing infrastructure. This has led to the substitution of coal by imported wood pellets at a number of facilities across the EU."*

*"This expanding biomass pellet business depends largely on its treatment in regulations that classify forest biomass as 'renewable', so that many countries have turned to biomass to meet their renewable energy targets."*

*"When climate mitigation policies were being developed, the delay in achieving net reductions in emissions was left out of the regulations. [...] Payback periods of decades increase the risk of overshooting Paris Agreement targets."*

*"Assessing the net effects of switching from coal to forest biomass, [...] the reduction in the carbon stock of the forests harvested should be included. [...] Increasing forest stock harvesting of stemwood (whether thinnings or clear-cut) increases atmospheric CO<sub>2</sub> levels for decades to centuries depending on the counterfactual scenarios. [...] Even scenarios with 65% residues and only 35% of additional harvests exceeded emissions from a coal reference scenario"*

*"The improved efficiency in photovoltaics has underlined the inherently low efficiency of exploiting photosynthesis for energy, since the amount of electricity that can be produced from a hectare of land using photovoltaics is at least 50–100 times that from biomass."*

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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.

*"...Sustainability criteria in the RED regulations include conditions that biomass should achieve a specified percentage of GHG emission savings relative to fossil fuel. This can be easily misinterpreted to mean that switching from coal to wood is immediately climate beneficial... It is seldom pointed out that this merely limits the emissions along the supply to less than the emissions from burning coal, and ignores the carbon emissions when the wood is burned..."*

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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.

*"...the sustainability criteria is "to avoid unintended sustainability impacts". The criteria fall far below this goal; they do not impose any requirements to ensure that forest biomass was grown or harvested in a sustainable manner. Instead, they rely on the source country to deal with sustainability considerations..."*

*"...Essentially, a source of forest biomass will meet the sustainability criteria if the country of origin has forestry laws or regulations. If there are no forestry laws or regulations in place, an even lower standard applies: the existence of a "management system" will satisfy the sustainability criteria..."*

*"...The sustainability criteria for forest biomass are minimal, and woefully inadequate. There is no requirement for the regulatory or management systems actually to promote (let alone achieve) sustainability. The sustainability criteria thus tolerate highly damaging actions, such as clearcutting a mature biodiverse natural forest for biomass fuel to be replaced with a monoculture pine plantation. There is no justification for the failure to adopt more robust sustainability criteria for forest biomass: the effect of harvesting a forest can be as destructive as converting the forest to another land use..."*

*"...More fundamentally, there are simply no additional sustainability criteria which a Member State could impose that would meet the objective of Recital 101. The only criteria that would come close to minimizing the biodiversity*

*harms of forest harvesting, and help to minimize GHG emissions, would be to rule out the use of forest biomass altogether, or to confine qualifying biomass to only those materials that would in any case be burned for disposal, whether or not the energy was captured. This they cannot do: the Member States' discretion to adopt stricter criteria cannot extend to adopting criteria that undermine the purposes of the parent instrument – which include the promotion and development of biomass..."*

*"...Member States do not have the discretion under Article 29(14) to alter this definition of biomass through the imposition of additional sustainability criteria. Consequently, for biomass fuels (and biofuels and bioliquids) produced from forest biomass, the sustainability criteria cannot ensure GHG savings relative to fossil fuels and cannot ensure that the biodiversity of forests are protected..."*

*"...It follows from the fact that Article 29(7)(a)(i)-(iii) are alternatives that biomass can comply with the LULUCF criteria merely by coming from a country that is a party to the Paris Agreement. This is an exceptionally weak requirement which includes all biomass sourced from any of the 184 countries who have (to date) ratified the Paris Agreement, without even any requirement that the party in question is complying with its Paris Agreement obligations..."*

Read the summary:

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

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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:*

- CO<sub>2</sub> 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 CO<sub>2</sub>-related market mechanism:.."

"..Forest is the most important source of woody biomass in the Netherlands. In the Netherlands there is approximately 373,480 ha of forest. That is approximately 11% of the land area. Currently, that area is diminishing due to deforestation for the development of heathland and drifting sands, as well as due to delay / omission of forest compensation after urban or infrastructural developments ... For sustainability, it is important that the harvest is lower than the additional growth, so that the forest sustainably sustained remains. When harvesting in forests, it is therefore important to know what is growing, so that the forest remains sustainable. The national average can be used as a guide number, but this can differ per growing location. A current determination of the additional growth can provide insight into the responsible harvest level ..."

"..It is important that the current sustainability requirements are now valid, but in all probability during the transition process in the coming years / decades will be tightened or adjusted to the then prevailing circumstances. In the longer term, for example, it is conceivable that the use of biomass will be seen primarily as sustainable if it is used for higher-quality applications than for bioenergy..."

"...[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..."

"..Healthy soil is of great importance for a sustainable harvest of wood and biomass. Important aspects of a healthy soil are nutrient management and physical soil quality ... With an increase in the harvest level and the harvesting of branch and top timber, the discharge of these nutrients is substantially increased. This can lead to a decrease and even a shortage of available

*nutrients, especially in forests on poorer poor soils ... These nutrients are important for the functioning of the forest as an ecosystem (preservation of biodiversity) ... "*

*"...Heavy harvesting machines are nowadays often used for harvesting. These machines can disrupt the soil and therefore the soil fauna and flora..."*

*"... if nature areas are converted for the production of biomass, this will have serious negative effects on biodiversity in the short term (direct effects) ... With these kind of conversions, it can take centuries for the effects of land use change on biodiversity to be restored..."*

*"...For energy applications, the harvest of branch and top timber is in the spotlight. However, this can have a number of disadvantages. Nutrients are removed with the branch and top timber, which can lead to shortages. On nutrient-poor soils, the harvest of take-and-top timber can lead to a negative nutrient balance. It can also have a negative effect on insects and other species bound to deadwood .... Dead wood is important for many plants, mushrooms and insects ... Maintaining standing dead trees is also good for biodiversity ... "*

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## Soil Compaction and Deformation in Forest Exploitation

[2019-07-25-wageningen-university-probos-soil-compaction-and-deformation-in-forest-exploitation-english.pdf](#)

This report was commissioned by the Dutch Government and was intended for the green sector (forest, nature and urbangreen managers) and the policymakers to create awareness in the forest sector on the effects of forest exploitation on the soil and how to protect and preserve forest soils during forest exploitation.

*"...Every year an average of 1 million m3 of industrial round wood is harvested in the Dutch forest. In most harvest operations the use of machines is common practice. There is a growing awareness among forest managers that the use of machines in forest operations can have negative consequences on the forest soil, causing soil compaction and deformation. This may lead, among other things, to degradation of soil structure, reduction of the soil's water storage capacity, lack of oxygen in the soil, death of fine roots and reduced rooting, all impacting biodiversity and forest productivity..."*

*"...Soil compaction and deformation occur during forest exploitation with heavy machinery due to complex interactions of soil pressure, shearing forces and vibrations into the soil. These effects do not only take place right underneath the machine but can also influence the soil up to 0.75 meter sideways of the wheels. Soil compaction does not only occur at the actual moment of machine traffic. Also, one to two years after machine traffic further soil compaction can occur..."*

*"...there is a general lack of knowledge in the forest sector on the (exact) impact of forest exploitation machines on the soil. Also, practical knowledge on how to prevent or counteract negative effects of forest exploitation on the forest soil is missing..."*

*"...Although in this chapter, chemical, ecological and productivity effects are discussed separately, it is important to note that these effects are all intertwined. Complex interactions between these aspects together form the forest ecosystem and shape the overall effect of machine traffic on the forest productivity, biodiversity and general vitality..."*

*"...Soil disturbance can have a negative impact on soil biodiversity, leading to decreased stand fertility, productivity and vitality on the long term..."*

*"...compaction also leads to destruction of pore continuity, increasing soil bulk density and decreasing soil porosity and air conductivity. Gas exchange between the soil and the atmosphere is hampered, which leads to an altered CO<sub>2</sub> and O<sub>2</sub> exchange between soil and atmosphere. This altered gas exchange can be problematic. Oxygen (O<sub>2</sub>), which is essential for soil life and chemical processes, cannot get into the soil and carbon dioxide (CO<sub>2</sub>) cannot get out. Low O<sub>2</sub> levels decrease the presence of soil life and limit growth of plants and trees..."*

*"...Lack of oxygen also causes problems for mycorrhizae, which have a symbiotic association with tree roots to obtain the energy needed for decomposition of organic material, from which in turn nutrients become available for tree roots to take up. Therefore, soil compaction can hinder nutrient uptake by trees through mycorrhizae and therefore effect forest productivity and vitality. In addition, the activity of microorganisms decreases with increasingly anaerobic conditions, which leads to a loss of soil biodiversity and may indirectly influence forest (tree) vitality..."*

*"...Besides the effects on nutrient uptake via mycorrhizae, soil compaction has negative effects on the absorption of minerals by the plant's root system. The low oxygen levels in compacted soils for example cause denitrification to occur, losing nitrogen as it evaporates during the process. In a leaching*

*experiment simulating long term impacts of forest operations, found that concentrations of nutrients in solution like  $Ca^{2+}$ ,  $K^+$ ,  $Mg^{2+}$  and  $Al^{3+}$  were lower in disturbed forest floors and compacted forest soils, hence decreasing the amount of nutrients available for plant uptake. Moreover, trees have difficulties taking up enough nutrients for growth under lower oxygen levels because oxygen is required to provide for the energy needed for transport and absorption processes within the plant..."*

*"...Overall, soil compaction negatively affects forest growth. Many of the effects discussed in the previous paragraphs, like decreased gas exchange capacity or rooting ability, have an influence on forest regeneration and growth. For instance, water shortages cause the plant to close its stomata, hence hampering photosynthesis. Reduced photosynthesis means a plant can produce less sugars needed for plant growth. Consequentially, plant growth, even forest productivity, can be reduced..."*

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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 was commissioned by the EPN as a wake-up call to those governments that are subsidising coal to biomass conversions; will persuade investors that financing biomass power is not sustainable; and will persuade energy analysts, retailers and consumers to distinguish forest biomass, as a high-carbon renewable energy technology, from lower-emitting technologies like wind and solar.

*"...Where logging is an accepted use at a lower intensity, the advent of high intensity harvests for biomass may lead to serious depletion of nutrients in the ecosystem and impede regeneration..."*

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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.

*"...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..."*

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## Proforestation Mitigates Climate Change

[2019-06-11-frontiers-research-proforestation-mitigates-climate-change-and-serves-the-greatest-good-english.pdf](#)

In this paper it is argued, based on multiple studies on carbon sequestration in forests, that proforestation is the best way available to mitigate climate change and prevent loss of biodiversity. Proforestation (growing existing forests intact to their ecological potential) – is a more effective, immediate, and low-cost approach than afforestation and reforestation, and could be mobilized across suitable forests of all types. Forests are already responsible for the largest share of the carbon removal and since technologies for direct CDR from the atmosphere and bioenergy with carbon capture and storage (BECCS) are far from being technologically ready or economically viable (Anderson and Peters, 2016), forests in general, and proforestation in particular, are considered ever more important for mitigating climate change. On top of that they provide unparalleled ecosystem services such as biodiversity enhancement, water and air quality, flood and erosion control, public health benefits, low impact recreation, and scenic beauty.

*"If current management practices continue, the world's forests will only achieve half of their biological carbon sequestration potential (Erb et al., 2018); intensifying current management practices will only decrease living biomass carbon and increase soil carbon loss."*



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## The United Nations Emissions Gap Report [2019-05-14-un-environment-the-emissions-gap-report-2017-executive-summary-english.pdf](#)

This report, which is the eighth Emissions Gap Report produced by UN Environment, focuses on the "gap" between the emissions reductions necessary to achieve these agreed targets at lowest cost and the likely emissions reductions from full implementation of the Nationally Determined Contributions (NDCs) forming the foundation of the Paris Agreement and discusses "bioenergy" in combination with "carbon dioxide capture and storage".

*"Bioenergy with carbon dioxide capture and storage could have a large impact on water use, requiring about 720 km<sup>3</sup> per year or roughly 3 percent of the fresh water currently appropriated for human use (Smith et al., 2016)"*

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## Availability of Biomass from Forests in the Netherlands [2019-05-00-probos-beschikbaarheid-van-houtige-biomassa-uit-bos-landschap-stedelijk-groen-dutch.pdf](#)

Probos and Borgman Beheer Advies have been commissioned by the Dutch Enterprise Agency to create a report on the demand for woody biomass in the form of chips and shreds in the Netherlands will develop and what part of this biomass can be accounted for (ie sustainable) harvested from the Dutch forest, landscape and urban greenery. [\[Be aware: both Probos and Borgman Beheer Advies are major players in our paid pro biomass lobby research\]](#)

*"More than a quarter of all renewable energy is generated from wood. Of this wood 57% consists of fresh wood from forest, landscape and urban areas in the form of firewood and chips or shreds."*

*"On account of current figures about the harvest and utilization, it becomes clear that 78 percent of the potential [of woody biomass] is already being utilized."*

*"In the short term (2018-2020) we expect an increase of 244 kt. of dry matter compared to the situation in 2017 (301 kt.). This means that the demand for fresh woody biomass for energy in the Netherlands will increase by almost 81 percent in the short term."*

*"The demand for locally available woody biomass is expected to almost triple if the policy remains unchanged to approximately 900 ktonnes of dry matter in 2030, while the demand does not rise further towards 2050."*

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### Averting Climate Breakdown by Restoring EcoSystems [2019-04-00-natural-climate-solutions-averting-climate-breakdown-by-restoring-ecosystems-english.pdf](#)

This report commissioned by Natural Climate Solutions calls for a great increase in the attention and spending devoted to Natural Climate Solutions, as part of a massively enhanced global effort to prevent both climate breakdown and ecological collapse.

*"[...] plantations on this scale would require around a doubling of the total nitrogen currently used in agriculture. The excessive use of nitrogen fertiliser already has disastrous ecological consequences. A large proportion of any greenhouse gas savings from BECCS will be negated by nitrous oxide emissions. Productive biomass plantations are also likely to require irrigation water, which is already in deficit in many areas. If forests are converted to biomass plantations, any carbon saved is likely to be more than offset by carbon losses from the soil, incurred during conversion."*

*"Plantations have a lower capacity for carbon storage than natural forest, tend to harbour a much lower diversity of wildlife, and often cause major social and ecological harms."*

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### Burning Woody Biomass is Not CO<sub>2</sub>-Neutral [2019-03-25-wetenschappelijkbureaugroenlinks-maak-een-einde-aan-de-co2-neutraliteit-van-houtstook-dutch.pdf](#)

In this document the scientific think tank of GroenLinks (GreenLeft party) argues against the status of burning woody biomass for our energy supply as carbon neutral, and in effect, against subsidizing the burning of woody biomass. They suggest CO<sub>2</sub> emissions caused by the burning of biomass should be added to the total sum of emissions of the country where the biomass is actually burned. And the CO<sub>2</sub>-balance should be checked by taking up the preliminary CO<sub>2</sub> uptake in the LULUCF balance of the country where the biomass stems from.

*"Through international agreements on Land Use, Land Use Change and Forestry (LULUCF) every country is committed to keep track of the amount of CO<sub>2</sub> that's being stored and lost in their soil and forests. [...] But these measures don't safeguard against losses of stored CO<sub>2</sub> in forests, since there is no penalty in place for the exporting countries, whereas importing countries, like the Netherlands, subsidize the burning of trees. This policy functions as an incentive to cut down more trees than is sustainable considering the CO<sub>2</sub> balance and biodiversity [...]."*

*"According to current agreements on LULUCF the CO<sub>2</sub> balance of a forest worsens once trees are being cut down."*

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## APS Technologies More Polluting Than Fossil Fuels

[2019-03-20-pfpi-aps-technologies-are-more-polluting-than-fossil-fuels-per-unit-of-energy-produced-and-should-not-be-subsidized-english.pdf](#)

This document is a call from PFPI to legislators to support act H.853, an "Act to Assure the Attainment of Greenhouse Gas Emissions Goals in the Alternative Portfolio Standard (APS)", stating that "these technologies are more polluting than fossil fuels per unit of energy produced and should not be subsidized through Massachusetts' clean energy programs."

"Massachusetts established the Alternative Energy Portfolio Standard (APS) in 2009 to complement the state's Renewable Energy Portfolio Standard (RPS). While the RPS is designed to increase the use of renewable energy for electricity, the APS is intended to reduce greenhouse gas emissions from the heating sector. However, the inclusion of biomass and garbage incineration in the APS undermines this goal. "

*"Rather than burning trees for energy, Massachusetts should be protecting its forests and growing more trees to enhance natural carbon sequestration, in keeping with the goals of the Paris Climate Agreement and recommendations*

*of the U.S. Climate Alliance, of which Massachusetts is a founding member."*

*"Removing biomass burning and garbage incineration from the APS will protect our health, our climate, and our natural environment, and will accelerate the transition to clean, renewable heating technologies in Massachusetts."*

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## Europe's RED Policy is Built on Burning American Trees [2019-03-04-vox-europes-renewable-energy-policy-is-built-on-burning-american-trees-english.pdf](#)

This Vox-article discusses how it came to be that Europe's banking on biomass to meet their obligations under the Paris agreement is causing forests to be felled in the US (and elsewhere) and how large scale deployment of biomass for energy is in fact failing to meet any carbon reduction targets at all.

*"The question of which energy sources we can call carbon neutral isn't about whether some model shows that planting trees later eventually makes up for burning them now. The only question that matters is how long does that take, and how much more carbon could be absorbed if trees were allowed to keep growing instead of being harvested and burned. [...]"*

*"But the larger problem is that the financial accounting implied by "residues" doesn't match with the carbon accounting. Each additional "waste" tree still means incrementally less warming and a more stable world for future generations, a benefit of incalculable value that is, therefore, not calculated into its price."*

*"At a critical moment when countries need to be 'buying time' against climate change, this approach amounts to 'selling' the world's limited time to combat it."*

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## EU Dragged to Court for Backing Forest Biomass as RED [2019-03-04-euractiv-eu-dragged-to-court-for-backing-forest-biomass-as-renewable-energy-english.pdf](#)

This article, which was published early march 2019 on [www.earactiv.com](http://www.earactiv.com), reports about a group of plaintiffs from Estonia, France, Ireland, Romania, Slovakia, Sweden, and the US, filing a lawsuit against the European Union to challenge the inclusion of forest biomass in the bloc's renewable energy directive. The group argues that EU institutions have failed to take account of scientific evidence showing that forest biomass harvesting and combustion for energy purposes exacerbates climate change by causing deforestation outside of Europe.

*"Even though the directive requires that bioenergy generate large greenhouse gas reductions, "its accounting rules ignore the carbon emitted by burning biomass itself," they continue, saying this "would still allow global industrial wood harvests to more than triple."*

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## Durable Usage of Woody Biomass in the Netherlands

[2019-02-20-gnmf-aanbevelingen-hoogwaardige-inzet-houtige-biomassa-dutch.pdf](#)

This report has been prepared by the Gelderland Nature and Environment Federation and contains the recommendations for the municipal Climate and Energy Implementation Program and the Regional Energy Strategies (RES).

*"When woody biomass is burned to generate bioenergy, more than twice as much CO<sub>2</sub> is released as when burning natural gas. It'll take 50 to 100 years for newly planted trees to recapture these added emissions."*

*"Use woody biomass (prunings) from forest, landscape and urban areas as a soil improver, [...] so that CO<sub>2</sub> is captured for a longer period of time"*

*"A high-quality application [of prunings] is to use it as a soil improver (including as a structure material used in composting). In addition to CO<sub>2</sub> capture, this application leads to higher soil fertility. The use of fertilizer is thereby reduced, and therefore also the use of gas (and CO<sub>2</sub> emissions) that is needed in the production of fertilizer."*

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## EASAC Forest Bioenergy BECCS and CO<sub>2</sub> Removal

[2019-02-10-easac-forest-bioenergy-carbon-capture-and-storage-and-carbon-dioxide-removal-english.pdf](#)

As global emissions of carbon dioxide (CO<sub>2</sub>) continue to exceed levels compatible with achieving Paris Agreement targets, attention has been focusing on the role of bioenergy as a 'renewable' energy source and its potential for removing CO<sub>2</sub> from the atmosphere when associated with carbon capture and storage (CCS). This new commentary of EASAC updates its findings from 2017/2018, based on peer-reviewed papers and environmental reviews that have been published since then. The overall conclusion is that the use of biomass, even when combined with carbon capture and storage (BECCS) remains associated with substantial risks and uncertainties, both over its environmental impact and ability to achieve net removal of CO<sub>2</sub> from the atmosphere. The large negative emissions capability given to BECCS in climate scenarios limiting warming to 1.5°C or 2°C is not supported by recent analyses [...]"

*"Detailed life cycle studies have confirmed the dominant effect of the reduction in forest carbon stocks as a result of increased wood harvesting, and the long periods required (decades to centuries) before the initial increase in emissions is reabsorbed."*

*"While the simple concept of carbon neutrality had merely presumed that carbon released into the atmosphere when biomass was burnt would be reabsorbed through regrowth at some stage, the limited amount of time remaining before Paris Agreement targets are exceeded on current trends<sup>2</sup> means that the payback period is highly significant"*

*"Currently there is no requirement in the EU's Emission Trading Scheme (ETS) to consider the length of the payback period when reporting biomass emissions as zero."*

*"Deployment of BECCS at the scale in IPCC models could potentially help mitigate climate change, but at the expense of further exceeding the planetary boundaries related to biosphere integrity, land use and biogeochemical flows, while bringing freshwater use closer to its boundary."*

*"Energy policy should not overlook the inherently low efficiency of exploiting photosynthesis (the basic process driving conversion of CO<sub>2</sub> to biomass) for energy since the amount of electricity that can be produced from a hectare of land using photovoltaics is at least 50–100 times that from biomass."*

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## Investor Report the Biomass Blind Spot

[2019-02-06-shareaction-investor-report-the-biomass-blind-spot-english.pdf](#)

Carbon emissions from burning wood have been ignored by utility companies and policy makers for two reasons. Firstly, because it is incorrectly seen as a "renewable" resource. The carbon emissions from combustion are assumed to be recaptured as trees regrow. However, at the point of combustion, wood emits more CO<sub>2</sub> than coal. It takes decades for this carbon to be reabsorbed by forest growth. Given that we urgently need to reduce greenhouse gas (GHG) emissions over the short-term to reach a net zero energy system by 2050, biomass is not compatible with achieving this. The second reason is related to international carbon accounting rules. UNFCCC's reporting guidelines require GHG emissions related to bioenergy to be counted in the land-use sector, where the tree is felled rather than at the point of combustion. [...] This paper challenges the assumption that carbon is recaptured by forest regrowth, at the rates required to offset emissions from combustion. Converting natural forests into a managed or plantation forest reduces their stored carbon. In addition, the methods used to grow and harvest biomass feedstocks also have an enormous impact on how quickly forest carbon can recover."

*"Carbon emissions resulting from the reduction of carbon stored in forests are substantial and are therefore particularly important to quantify. Evaluating the impact of commercial forestry on forest carbon stocks requires assessments of both the above- and below-ground carbon over time." (see figure to compare impacts between different types of forest management)*

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## EU Report on Biomass for Energy in the European Union

[2019-02-00-european-commission-brief-on-biomass-for-energy-in-the-european-union-english.pdf](#)

This report on biomass for energy from the European Union (2016) sums up how much of the various sources for bioenergy is being produced and used in several EU nations. What is perhaps most striking is that in 2016, the share sourced from forestry was already higher than that foreseen in the NREAP

projections for 2020, while the share from agricultural by-products and waste lagged behind the 2020 projections.

*"In 2016, the share sourced from forestry was already higher (81 Mtoe) than that foreseen in the NREAP projections for 2020, while the share from agricultural by-products and waste lagged behind the 2020 projections (76 Mtoe)."*

*"Global production reached 29 million tonnes in 2016 of which more than 50% was produced in the EU. The EU is also the main consumer globally (23 million tonnes)."*

*"In some Member States, the consumption of wood pellets relies mostly on imports, e.g. the UK (94.7%) and Italy (81%)."* (back then the Netherlands still had a small consumption of woody biomass)

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### Dutch Government (RVO) Bio Energy Input Woody Biomass [2013-08-07-rvo-bio-energie-input-houtige-biomassa-dutch.pdf](https://www.rvo.nl/en/bio-energy-input-woody-biomass)

This report commissioned by the Dutch Government discusses the absence of sustainability & durability requirements for the logging and burning of woody biomass.

*"In theory biomass is a renewable resource, but there are limits to its availability. There's just not an endless supply of land, nutrients and water on this planet. [...] The burning of biomass can't be scaled up to meet our current energy demands."*

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### All Research Papers on Deforestation & Woody Biomass <https://biomassmurder.org/research/index.html>

We have collected and read all the research reports and official documents from the past decades and have started to make summaries for each subject and published the summaries on the following pages:

[Biomass Research Abbreviations](#)



[Biomass Research Availability](#)

[Biomass Research Biodiversity](#)

[Biomass Research Carbon Dioxide](#)

[Biomass Research Certification](#)

[Biomass Research Ecotoxicity](#)

[Biomass Research Health Risks](#)

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