IEA Bioenergy

Response to Chatham House report "Woody Biomass for Power and Heat: Impacts on the Global Climate"

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The report published by Chatham House addresses three issues related to the use of woody biomass for energy: climate effects and carbon neutrality, greenhouse gas accounting, and sustainability criteria. Particular attention is placed on the use of wood pellets produced in the Southeast United States (SE US) to supply power in Europe, which in 2014 comprised about 2% of total harvest removals in the SE US, less than 1% of total US forestry products by weight and less than 0.5% of total US forest products export value. About 95% of EU energy wood consumption is currently based on domestic raw material, and less than 2% is based on wood pellets imported from the US (Aebiom, 2016).

The Chatham House report is comprehensive and includes many references to the scientific literature. However, it fails to present an accurate description of the current state of understanding informed by climate science, integrated modelling and forestry disciplines. Instead it presents a misleading description of bioenergy, and refers to extreme cases that do not represent current practice and that provide the worst climate outcomes. It fails to acknowledge the benefits bioenergy can provide in supporting urgently-needed energy system transition to reduce reliance on fossil fuels in order to meet climate targets. ***We disagree with several of the conclusions and recommendations in the report.***

Concerning **climate effects and carbon neutrality**, we identify several flaws in the report.

Misplaced focus on emissions at the point of combustion

The claim that "the use of woody biomass for energy will release higher levels of emissions than coal, and considerably higher levels than gas" overlooks a vital difference between energy supply from fossil fuels and from biomass. Burning fossil fuels releases CO_2 that has been locked up for millions of years. By contrast, burning biomass simply returns to the atmosphere the CO_2 that was absorbed as the plants grew, and there is no net release of CO_2 if the cycle of growth and harvest continues into the future (Figure 1). The report blurs this distinction between fossil and biogenic carbon, which is misleading.

To understand the climate impacts of bioenergy, the full life cycle of biomass must be considered - the growth and harvest in the forest, as well as the combustion phase (Ter-Mikaelian et al. 2015). Fossil carbon emissions are typically small for forest based bioenergy systems since supply chain energy use is low, including where international transport is involved (Eriksson et al.,2007; Lindholm et al., 2011; Gustavsson et al., 2011; Lamers & Junginger, 2013; Hansson et al., 2015). The climate impacts are therefore mainly related to how the forest carbon cycle is affected by management changes to provide biomass for bioenergy in addition to other forest products. With respect to the forest, the key issue is the change (if any) in average carbon stock across the whole forest landscape.

Besides the fact that bioenergy and other renewable options can displace current fossil fuel use, their implementation also influences investments in fossil fuel-based technologies and infrastructure, which has implications for future fossil carbon emissions. The benefits of bioenergy in supporting energy system transition is discussed below.

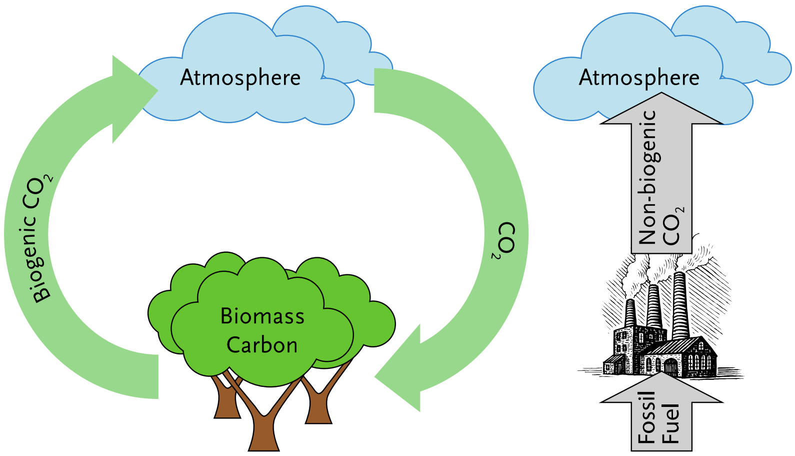

Figure 1. The Intergovernmental Panel on Climate Change (IPCC) distinguishes between the slow domain of the carbon cycle, where turnover times exceed 10,000 years, and the fast domain (the atmosphere, ocean, vegetation and soil), where vegetation and soil carbon have turnover times of 1-100 and 10-500 years, respectively. Fossil-fuel use transfers carbon from the slow domain to the fast domain, while bioenergy systems operate within the fast domain (Ciais *et al*., 2013). Figure: National Council for Air and Stream Improvement.

Inaccurate interpretation of impact of harvest on forest carbon stock

Biomass extraction for energy is one of many interacting factors influencing the development of forest carbon stocks, including forest product markets, forest ecosystem structure and management, and natural conditions. Silvicultural operations and harvest activities are coordinated across a forest landscape to maintain a healthy forest and to obtain a continuous flow of wood for society, while maintaining or increasing wood volume in the forest. Carbon losses in some stands are balanced by carbon gains in other stands, so that across the whole forest landscape the fluctuations in carbon stock even out (Figure 2). The impacts of biomass extraction for bioenergy on forest carbon stock should therefore be assessed over long periods at the landscape scale.

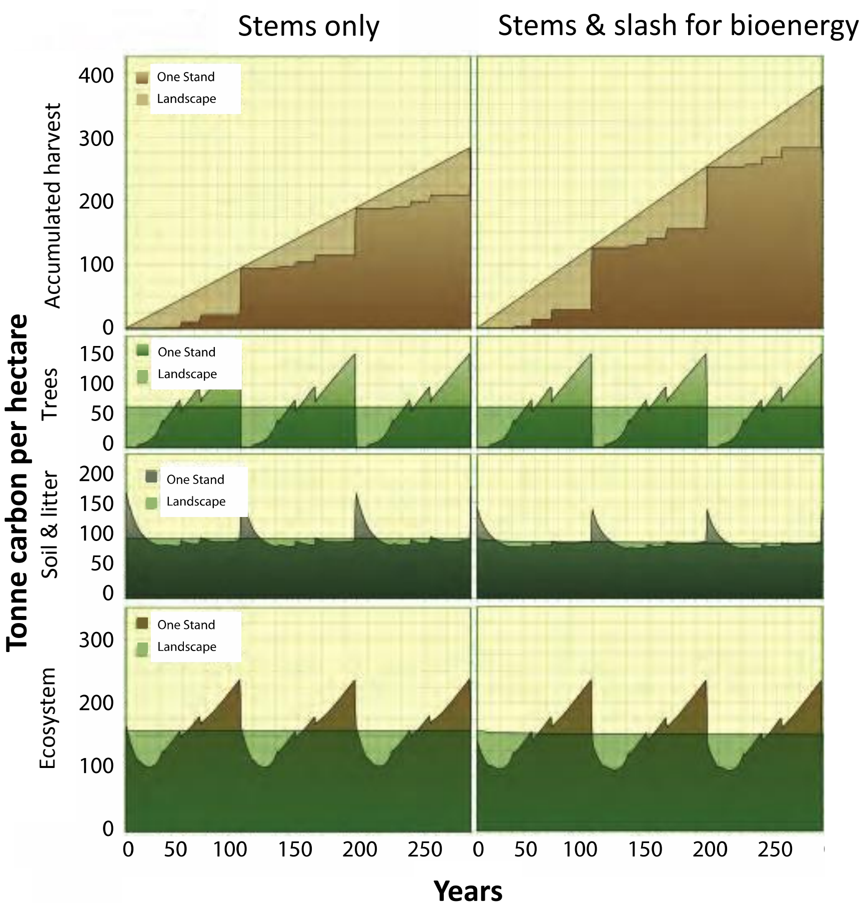

Figure 2. Development of carbon stocks in a forest stand and in the forest landscape. The large fluctuations observed at the stand level, where carbon sequestered during tree growth is subsequently lost from the stand at harvest, are not observed at the landscape level where staggered harvest delivers a continuous supply of timber that is used in the forest industry to produce sawnwood, paper, forest fuels and other forest products. The gradual implementation of slash removal at harvest sites will have a relatively small influence on the development of the carbon stock in the forest as a whole, which is affected by many other factors that can change in response to bioenergy incentives. Figure source: P. Eliasson, SLU.

Unrealistic counterfactual scenario

Impacts of bioenergy are commonly quantified by comparing to a reference "no-bioenergy" scenario that describes the fate of bioenergy feedstocks and forests in the absence of the bioenergy market. In most cases, it is not plausible to suggest that the forest would remain unharvested and continue to grow in the reference scenario as extraction of biomass for bioenergy is not the main economic driver to harvest the forest.

The critical question is: "What would have happened to the biomass and the forest if the biomass was not used for bioenergy"? The Chatham House report correctly notes that harvest residues would be burned in the forest or left to decay, in either case returning most of the carbon to the atmosphere. However, the report further claims that low-quality logs used for bioenergy are trees that would have continued to grow, sequestering more carbon. In reality, most low quality logs are a byproduct of the extraction of higher value logs or derived from silvicultural operations performed to help achieve management objectives. Thinning, where some trees are cut to promote better growth of the remaining trees, is the main method of influencing growth and development in forests. It can have positive or negative influence on carbon sequestration rates of the forest stand. Neglect or delay in thinning is detrimental to production of high-quality logs. Thus, using biomass from thinning operations for bioenergy is beneficial to the carbon balance of the forest-product system and enables silviculture operations enhancing future production of high-value timber, which is typically much less greenhouse-intensive than alternatives such as concrete, steel or bricks (Sathre and O'Connor, 2010).

There are a range of alternative reference scenarios that could be considered in comparison to the “bioenergy” scenario. These could include converting forests to agricultural land or for real estate development – especially if the forests land is privately owned. Ultimately, determining the correct (mix of) alternative scenarios is difficult and to some extent arbitrary – but choosing the ‘no use’ scenario as the only reference scenario is, in most cases, unrealistic. As discussed further below, the climate effects of bioenergy are more variable than suggested by studies that exclude economic factors and fail to consider the diversity and dynamic characteristics of forests and the forest sector.

Misguided focus on short-term carbon balances

It is the cumulative emissions of CO_2 that largely determine global warming by the late 21st century and beyond (Pachauri et al., 2015). In relation to temperature targets, the exact timing of CO_2 emissions is less important than how much carbon is emitted in total, although it will influence the rate of warming over time. It is, for example, less important whether carbon in forest residues is emitted to the atmosphere soon after the forestry operations take place (such as when it is used for energy) or is emitted some decades later (such as when the residues are left in the forest to decay). As noted above, what matters most is whether increasing use of forest biomass for energy leads to systematic changes in the forest carbon stocks.

The Chatham House report contests the IPCC position that cumulative CO_2 emissions are more important than timing of those emissions, referring to "... increasing concern over the possible existence of ‘climate tipping points’, when global temperature rise triggers a possibly irreversible change in the global climate from one stable state to another at a higher temperature." The possibility of climate tipping points is reason for deep concern. But it is not a strong argument for considering only short-term carbon balances when evaluating bioenergy or any other climate change mitigation option.

As when focusing on emissions at the point of combustion, a strict focus on short-term carbon balances blurs the distinction between fossil and biogenic carbon; it prevents consideration of the long-term benefit of stopping the transfer of fossil carbon from the slow domain to the fast domain, by shifting to bioenergy systems that operate within the fast domain (Figure 1). We assert that it is critical to focus on the global emissions trajectory required to achieve climate stabilization, acknowledging possible tradeoffs between short- and long-term emissions reduction objectives. A strong focus on short-term carbon balances may result in decisions that make long-term climate objectives more difficult to meet.

Overstated climate change mitigation value of unharvested forests

Unharvested forests have declining mitigation value over time because carbon sequestration rate diminishes as forests approach maturity. The Chatham House report claims that studies on growth rate of individual mature trees contradict the well-known age-related decline in stand productivity, which reveals a misconception about connections between trees, stands and landscapes (Bernier et at., 2014; Bugmann and Bigler 2011). Stand-level measurements show that carbon accumulation slows down as forests get older. Landscape-level measurements show that forest carbon sequestration is determined by the balance between growth and removals (via harvest or disturbance). The mitigation value of unharvested forests cannot be quantified with high confidence due to uncertainty about forest growth responses to environmental changes including climate change (Girardin et al. 2016, Hemper, et al. 2012). In addition, sequestered carbon is vulnerable to future reversal through fires, storms, droughts and insect attack. In contrast, managed forests continue to accrue climate benefits by providing bioenergy feedstocks to displace fossil fuels, and wood products which substitute for GHG-intensive building products, so that over multiple cycles of forest harvest and re-growth the climate change mitigation value of forests sustainably managed for production of timber and bioenergy is greater than the mitigation value of unharvested forests (Colombo et al. , 2012; Hennigar et al., 2008; Klein et al., 2013; Lippke et al., 2011; Ximenes et al., 2012.)

Overall, the Chatham House report places an unhelpful focus on the ambiguous concept of carbon neutrality.

We assert that the carbon neutrality debate distracts from the broader and much more important question of how forests and associated industries can contribute to climate change mitigation while serving other environmental, economic and social functions. Therefore, rather than debating the carbon neutrality of bioenergy, we should be concerned with the net climate change effects of bioenergy assessed in the specific context where biomass is produced and bioenergy is used.

With regard to ***bioenergy and forest products markets and systems***, we point out the following errors:

Misleading assertion on biomass feedstocks used for bioenergy

In the US South East, pulpwood quality logs have recently become the dominant feedstock for wood pellet production. This is not the situation in the EU, which is the region supplying the most wood pellets globally. More importantly, in 2013, only 6% of the woody biomass used in the EU for energy was supplied as pellets (Aebiom, 2016). The vast majority of forest biomass used in Europe for bioenergy is obtained from forests managed for multiple purposes, including the production of pulp and sawlogs, and provision of other ecosystem services (Figure 3). Bioenergy feedstocks mainly consist of byproducts from the production of sawnwood and pulp and paper, and small diameter trees and residues from silvicultural treatments (e.g., thinning, fire prevention, salvage harvest) and final felling. In-forest residues are, for example, used on a substantial scale in Scandinavia for heating purposes.

The report emphasizes the negative climate impacts of harvesting high biomass old-growth forests. In reality, old-growth forests in US (and Europe) are protected; biomass for energy is a byproduct of harvest of secondary forests and forest plantations. In SE US, increased demand for pellets could lead to some conversion of naturally regenerating pine stands (which are not old growth forests) to pine plantations, but this is unlikely to lead to reduced carbon stock on a landscape level (Abt, 2013, based on Abt et al, 2012).

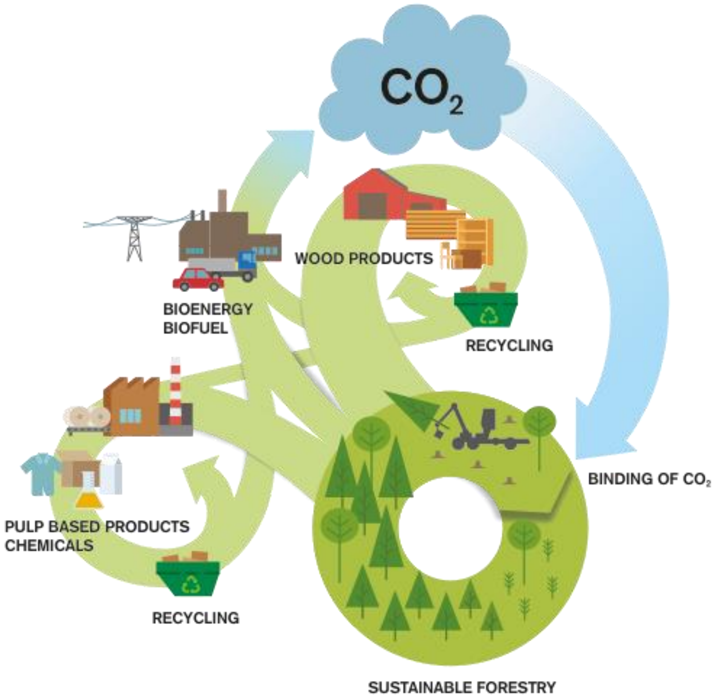

Figure 3. When forest biomass is used to produce pulp, paper and other wood products, bioenergy is produced simultaneously. Biomass from forestry operations and byproducts from wood processing are used to make electricity, heat and fuels. This bioenergy is used to meet internal process energy needs in the forest industry and is also used outside the forest industry. Figure: Sveaskog.

Dismissal of impacts of bioenergy markets on forest management

Studies that capture economic and biophysical dynamics and interactions show how forest management varies depending on the characteristics of demand, forest structure, climate, forest industry profile, forest owners' views about emerging bioenergy markets, and the outlook for other forest product markets. Such studies can thus reveal how adjustments across affected systems (including the forest, product uses, markets and processing technologies) can influence on forest carbon stocks and GHG emissions.

The Chatham House report questions the validity of such modeling studies, referring to data showing area of forest in southeastern US remaining stable, at the same time that the pellet market has grown, as evidence that markets do not influence forest management and carbon stocks. However, this is a weak argument because the forest area could have decreased under other market conditions. The US Department of Agriculture (USDA) Forest Service identifies the greatest risks to SE US forests as urban expansion and land development, lack of market demand for wood products, and increases in invasive species, fires and other disturbances related to climate change (Wear et al., 2013).

We argue that model-based studies provide important insights. Forest management is linked to economic incentives and market expectations of forest owners for different forest products (Abt et al., 2012; Nepal et al., 2012; Miner et al., 2014). Emerging bioenergy markets, along with the outlook for other forest product markets, influence the decisions of forest managers. A market for bioenergy can support investment in forest improvement – to enhance health and productivity of the forest, which in turn influences the forest carbon stocks (Abt et al., 2010; Cintas et al., 2017; Daigneault et al., 2012; Levers et al., 2014; Nepal et al., 2014; Raunikar et al., 2010; Sedjo & Tian, 2012; Trømborg & Solberg, 2010; White et al., 2013). For example, forest owners that are optimistic about future forest product markets may implement measures to protect their forests against disturbances, replanting and tending the forest and introducing more productive tree species and provenances. They may also be less inclined to convert forested areas to agriculture or other land uses, and may rather extend the forested area (Galik and Abt, 2016).

Databases with real-world observations are available showing how forest management planning in anticipation of increased forest wood demand can support increased wood harvest and steady growth in forest carbon stocks. The case of Sweden is illustrated in Figure 4.

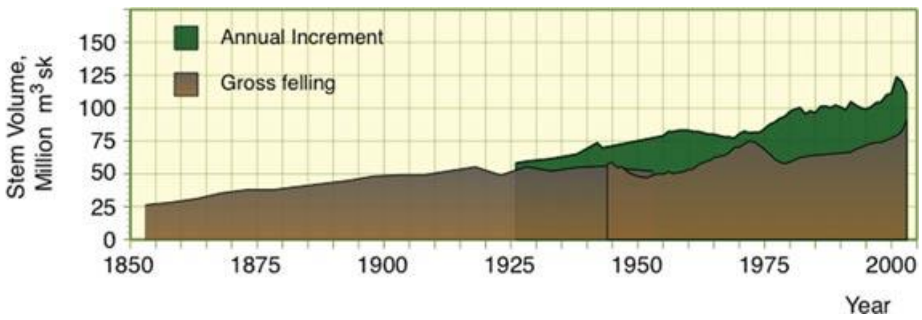

Figure 4. Historic overview of gross felling (1853–2003) and—placed behind the area showing gross felling—annual increment (1926–2003) in the Swedish forest. The method of estimating felling changed between 1945 and 1955, resulting in two overlapping curves. Source: Berndes et al. (2011)

Failure to identify the benefits of bioenergy in supporting energy system transition

Modelling of transformation pathways presented in the IPCC 5th Assessment Report found that bioenergy contributes significantly to the energy supply in most scenarios that meet ambitious climate targets (Clarke et al., 2014). However, while the Chatham House report mentions the benefits of bioenergy as a dispatchable energy source, it overlooks the role bioenergy could play in supporting the urgently needed energy system transition. Global energy supply currently depends heavily on fossil fuels. In 2014, fossil coal, oil and gas provided 81% of global primary energy use, and the use of fossil fuels is projected to increase even though the share of renewable energy sources may increase. Efficient use of energy and switching to energy efficient supply chains based on renewable energy resources are key elements to mitigate climate change and improve energy security. Unlike other renewable resources, biomass can be stored and converted to different energy carriers. In the power sector, bioenergy can provide flexibility to balance expansion of intermittent and seasonal wind and solar resources (Arasto et al., 2017). Biomass can efficiently supply high-temperature process heat for industry, and support district heating systems for communities. In addition, liquid and gaseous biofuels can, together with electrification and vehicle energy efficiency, help achieve rapid and deep reduction in fossil fuel use in the transport sector, including marine and aviation applications.

Furthermore, the Chatham House report neglects the important question of whether uptake of bioenergy influences investment in fossil fuel-based technologies and infrastructure, which has implications for future carbon emissions. This is a serious shortcoming, as it is essential to consider the effects on the current and future energy system when developing energy and climate policy.

With respect to **GHG accounting for bioenergy**, the report notes weaknesses in the current approach and its implementation under the Kyoto Protocol. Bioenergy is accounted for within the land sector, through the *Forest Management Reference Level* approach, with incomplete coverage because only some countries account for their GHG emissions in the second (2013-2020) commitment period. The report makes recommendations to overcome these weaknesses, including improved transparency and expansion of coverage such that all parties include the land sector in their national accounting. We support these recommendations, which align with our own (Berndes et al., 2011).

However, we strongly disagree with the final "last resort" recommendation, t*o account for carbon dioxide emissions from biomass burned for energy within the energy sector*.
As the report notes, this would require adjustment in land sector accounting to avoid double-counting emissions. This would entail considerable disruption to the established GHG accounting framework, requiring revision of the methodology and additional burden in data collection in order to adjust the forest carbon stock change values to remove the component related to biomass used for energy. But more importantly, it would create a disproportionate disincentive for bioenergy, as emissions at the point of biomass combustion could indeed be higher than those from fossil fuels, and thus would create a disincentive for countries to import biomass to displace fossil fuels, including biomass known to provide large climate benefits (Pingoud et al., 2010).

Concerning ***sustainability criteria***, the report fails to acknowledge a number of points:

'Forest bioenergy' is not a single entity

Forest bioenergy includes a large variety of sources and qualities, conversion technologies, end products and markets. Forest bioenergy systems are often components in value chains or production processes that also produce material products, such as sawnwood, pulp, paper, and chemicals. Bioenergy is therefore not readily separated from other activities in the forest sector. Hence, drawing general conclusions on which woody biomass feedstocks to support, and which not, based on a very limited analysis of individual forest bioenergy systems is inappropriate and unjustified.

Sustainability criteria for forest bioenergy are strict

The Chatham House report explains the proposed sustainability criteria in the EU, the implemented criteria in a number of member states, and a number of voluntary certification schemes. It concludes that these "are not satisfactory" but fails to acknowledge that the sustainability criteria formulated by the UK, the Netherlands and others go further than any of the individual existing sustainable forest management (SFM) certification systems. The Dutch system allows use of Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification (PEFC) certificates to demonstrate compliance with (part of) the required SFM criteria, but in addition, it requires a GHG accounting system in the supply chain, and includes first attempts – albeit rough – to prevent long-term forest carbon stock losses, prevent indirect land-use change and stimulate cascading (Netherlands Enterprise Agency, 2016). While one can question whether mandatory sustainability criteria will be able to ultimately safeguard sustainable forest management in a broader sense (as many aspects of sustainable forest management are not addressed by them), they do provide a more comprehensive set of overall sustainable production criteria for woody biomass than the currently existing voluntary SFM certification systems.

Sustainability criteria for forest bioenergy cannot guarantee forest carbon stocks on a landscape level

The Chatham House report concludes that sustainability criteria for forest bioenergy "… fail to account, comprehensively or at all, for changes in forest carbon stock (apart from direct land-use change)." This criticism fails to acknowledge that certification systems governing management on a stand-level are inherently unable to guarantee what happens on a landscape level. Maintenance of carbon stocks on the landscape level can only be assured by governance that applies at landscape scales. For example, total forest carbon could be governed by setting an annual allowable cut, or through round-table agreements by various wood-processing sectors on how much to harvest, but not by just putting the burden on a single end product. Also, we point out that absence of such governance mechanisms does not necessarily lead to decreasing carbon stocks. Markets with no such regulation such as the US Southeast fiber basket have in past decades shown increasing forest carbon stocks. As Dale et al. (2017) point out: "Overall forest stocks in the Southeast US have increased for the last 50 years and are projected to continue increasing if conversion to non-forest uses is low (Wear et al., 2013), while also supporting significant removals for sawtimber, pulpwood and wood-pellet production (Oswalt et al., 2014; Woodall et al., 2015; USDA Forest Service, 2016)." Also, Coulston et al. (2015) confirm that carbon stocks have continued to accumulate between 2010-2015, but point out that carbon uptake may slow down in the future due to aging of forests.

In addition, the report recommends that the GHG assessment should be underpinned by life cycle assessment (LCA) that includes changes in forest carbon stock as well as supply-chain emissions. We agree that these aspects should be included in the assessment of climate change effects of bioenergy and note that this aligns with the LCA-based GHG methodology presented in the International Standard on sustainability criteria for bioenergy (ISO 13065, ISO, 2015). As discussed above, it is appropriate that forest carbon stock is quantified at the scale at which it is managed, that is, at the landscape scale. Progress is being made in standardizing LCA methods, creating national inventory databases, developing product category rules to harmonize methods and facilitate application of LCA. LCA-based methods that include carbon stock assessment are already applied in ISO 13056. We do not agree that practical challenges in undertaking comprehensive LCA justify restrictions on feedstock eligibility, as further discussed in the next section.

Finally, we note the need for application of comparable assessment approaches to all energy sources, and ideally to all land uses.

A misguided policy recommendation

Ultimately, the report's general conclusion is that *"Sustainability criteria should be used to restrict support to mill residues that are produced from legal and sustainable sources". **We strongly disagree with this recommendation***. The impact of bioenergy implementation on net GHG emission savings is context- and feedstock-specific, as many important factors vary across regions and time. A generic categorization system, which specifies only some forest biomass types as eligible bioenergy feedstocks, prevents the effective management of forest resources to economically meet multiple objectives, including climate change mitigation. This recommendation excludes forest residues (e.g., small tops and branches), a feedstock source that is typically associated with relatively short carbon payback times (see Lamers and Junginger (2013) and Bentsen (2017) for a comprehensive overview of studies). The report admits that "the use of forest residues for energy also implies no additional harvesting, so its impacts on net carbon emissions can be low," but at the same time fears that "if slow-decaying residues are burnt, the impact would be an increase in net carbon emissions, potentially for decades." First of all, this shows again a misguided focus on short-term carbon balances; in fact, a payback time of 1-2 decades is not problematic to achieving climate targets. Second, it ignores the fact that there are significant amounts of residues available in temperate and (sub-)tropical regions (Daioglou et al., 2016) which typically will decay rapidly. Also, in forests with slowly-decaying residues, forest management may prescribe burning residues on site for fire prevention, e.g. in British Colombia (Hall, 2011, Lamers et al. 2014). Using these residues for energy production provides immediate climate benefits (Lamers et al. 2014). Excluding forest residues (and other woody biomass feedstocks) could, therefore, cause more harm than good with regard to climate change mitigation.

Conclusions

The global energy supply is dominated by fossil fuels, which contribute 65% of global GHG emissions. Transition to efficient supply chains based on renewable energy resources is key to meeting climate change targets. Modeling by IPCC has demonstrated many pathways to reaching emissions reduction and temperature stabilization. Most of these pathways involve a large share of bioenergy. Biomass is a renewable resource with large potential for expansion, and unlike other renewable resources, biomass can be stored and converted to different energy carriers. It can thus play a critical role in facilitating transition to low-carbon energy systems.

Support for bioenergy should be based on objective assessment of bioenergy options based on their specific features and context. Bioenergy policies should facilitate utilization of sustainably-sourced biomass, to allow the global potential for bioenergy to be realized. Sustainability safeguards must be implemented in concert to ensure that climate change mitigation and other benefits are delivered and tradeoffs are minimized.

In summary, the Chatham house report does not present an objective overview of the current state of scientific understanding with respect to the climate effects of bioenergy. The major conclusions and policy-specific recommendations are based on unsubstantiated claims and flawed arguments. We urge Chatham House to reconsider their recommendations and engage in a more thoughtful and substantive discussion on bioenergy and climate change mitigation.

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