Introduction: Forest Carbon Policy as policy alternative for a sustainable use of forest biomass

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Challenges of a forest bioeconomy

The bioeconomy is a key element in the transition to a net-zero economy. Using biomass promises to create value without relying on fossil resources. Both EU and Germany’s bioeconomy strategies highlight the potential of a bioeconomy contributing to sustainable economic growth, the creation of jobs, innovation and food security.

The path towards a sustainable bioeconomy faces several obstacles, though. In regard to forest biomass, a key challenge is to reconcile an increasing demand for wood in the bioeconomy with goals to protect and strengthen the role of forests for climate change mitigation. If too much forest biomass is harvested for forest bioenergy or material uses, the climate benefits from using wood may be offset by a loss of carbon storage in forests.

Analyzing the trade-off between climate mitigation with forests vs. forest bioenergy and wood products is difficult. In regard to forest bioenergy, there is a lack of scientific consensus under which conditions it contributes to climate mitigation and if this contribution is larger than from alternative wood uses [1, 2, 3]. Lesser known is that there are similar concerns in regard to material uses of wood, despite a broad consensus that material uses are typically better for mitigating climate change than energy uses. For example, Hurmekoski et al. find that an increase of wood use for construction or textiles in Finland might lead to an increase in total GHG emissions, because the reduction of fossil emissions is smaller than the loss of forest carbon [4]. There are similar results for the EU, for Japan and for Canada [5, 6, 7], while mixed effects or positive climate benefits have been found for Austria, Sweden and Switzerland [8, 9, 10].

A major source of the confusion around the climate benefits of using forest biomass is that there are different ways to assess the climate effects of wood uses at the product level. Also, estimations of climate effects strongly depend on assumptions regarding how much fossil carbon will be replaced in the future, or how climate change affects the ability of future forests to store carbon.

A forest carbon policy as approach to sustainable use of forest biomass

It is unlikely that a consensus in regard to the climate effects of using wood at the product level will be reached in the near future. Therefore, other approaches can be helpful to secure a sustainable role of forest biomass in the bioeconomy. One such option is a forest carbon policy. While there are different options how to implement such a policy [11], the most common concept combines a price for physical forest carbon emissions and a subsidy for carbon removals by forests [12, 13]. Pricing physical emissions means that there is no need to assess the complex and uncertain life-cycle emissions at product level. Rather, end-of-pipe emissions from combustion as well as emissions from wood decay are priced, along with all other emissions such as from fossil fuels.

The rationale behind this policy approach is the correction of market failures. Both, emissions and carbon removals are associated with such failures: their damages and benefits in terms of positive or negative contributions to climate change are not included in market prices of wood products. This price distortion leads to an inefficient use of wood in the bioeconomy, even when a wood-based product or fuel is carbon neutral in the short or long run.

The focus of a forest carbon policy is to allocate wood between forests, material uses and forest bioenergy in a way that minimizes overall costs of climate change mitigation. This rationale can be compared to the goal of finding least-cost combinations of wind energy, solar power and other renewable resources in the energy sector. It applies the same approach and extends it beyond the energy sector by including all wood uses including forestry. This also implies that a forest carbon policy not only efficiently balances the different wood use options (forests, material use, energy). On top of this it also leads to an efficient balance between the forest-based bioeconomy and other climate change mitigation options.

The correction of market failures and thus prices does not prescribe a certain forest management. Whether it leads to reduced harvests and the reduction of energy uses of wood depends on the circumstances. For example, if climate change makes it impossible to safely store additional carbon in some forests, then no carbon storage payments will be made and the harvest level will not fall. If, however, forest- or land owners themselves see potentials to increase forest carbon, a forest carbon policy will provide incentives to do so and provide a monetary benefit for the related efforts. Existing model results indicate that in this case the climate benefits from increasing the forest carbon storage will outweigh a possible increase in fossil fuel emissions from the reduction of forest bioenergy in the short and the long run, as long as the policy is maintained [12, 13, 14]. Even if no change in forest carbon storage occurs because of climate change risks, the carbon price will change the profitability of energy and material uses of wood in favor of the latter, thereby contributing to efficient wood cascading and climate change mitigation.

Opportunities and challenges of a forest carbon policy

A forest carbon policy is promising in many ways but also has relevant implementation challenges. Regarding opportunities, the first one is that the policy approach provides a clear solution to the forest bioenergy puzzle. As mentioned above, the policy will lead to efficient contributions of wood to climate change mitigation, irrespective of the climate effects at product level. Hence, there is no need to calculate and certify emissions based on life-cycle assessments. This could contribute to reducing the administrative burden associated with regulating firms such as bioenergy plants. Whether there is a net reduction in administrative costs will depend on potentially additional efforts required to reliably quantify and verify changes in forest carbon storage, though.

A second opportunity of a forest carbon policy is that it balances the wood demand of the bioeconomy with the goal to protect and possibly increase forest carbon storage. While the carbon removal subsidy strengthens the competitiveness of the natural carbon sink, the price on carbon emissions limits the demand from the bioeconomy for wood uses that quickly release the carbon to the atmosphere. As the price also applies to emissions from decay, it generally incentivizes allocating wood to places with longer carbon storage.

A third opportunity related to a forest carbon policy is its contribution to wood cascading. A forest carbon policy encourages efficient wood uses not only across sectors such as land use and energy, but also within every sector. Pricing forest carbon emissions from combustion will improve the competitiveness of material uses, and favor material uses with longer carbon storage over material uses with shorter carbon storage. Thus, by ‘getting the prices right’, efficient wood cascading can be achieved without having to rely on complex cascading rules. There would be no need to specify - as the EU Renewable Energy Directive currently does - which forest biomass is eligible to energy support measures, to prescribe minimum efficiency levels for electricity plants using forest biomass or to assess the economic or ecological value of wood products to implement a use hierarchy. Hence, wood cascading can potentially be implemented with lower administrative costs. Decisions about how to best use the wood would be left to the market instead of being predetermined by politics.

Implementing a forest carbon policy also comes with some challenges, though. Next to a risk of carbon leakage, it should be noted that this policy targets an efficient use of forest biomass which might not be equivalent to existing climate policy targets for the land use sector LULUCF. Even though a market-based policy approach could lead to an increase in forest carbon storage, this increase might still fall short of the policy targets. Also, the policy approach feels counterintuitive to many pointing out the (potential) climate neutrality of bioenergy. This can fuel resistance by interest groups that would be negatively affected by an efficient reallocation of wood resources, such as bioenergy plants. Finally, targeting an efficient use of forest resources via a forest carbon policy requires a level playing field with fossil resources. While in the EU the current emission trading systems contribute to such a level playing field in the energy sector, there is a lack of effective carbon pricing in sectors that uses fossil fuels for material products such as chemicals or textiles. Also, the continuing presence of subsidies for fossil fuels imply a reduced competitiveness even of efficient forest bioenergy. Therefore, this policy approach has to be complemented with removing climate-damaging subsidies everywhere in the economy and with extending carbon pricing also to material uses of fossil fuels. Under such premises, a forest carbon policy might constitute a low-cost policy route to protecting natural carbon sinks, securing sustainable forest bioenergy and climate-friendly wood cascading.

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