Minutes of Round Table: Utilization of forest biomass for energy and the timing of carbon neutrality

organised within the Austrian part of
Task 38 of IEA Bioenergy
in the form of three discussion rounds held in Vienna
on 25 November 2010, 31 January 2011 and 8 April 2011.

Preface

The first impacts of current human induced climate change are beginning to be felt and will be followed by even more severe consequences. Specific regions and industrial sectors may benefit, but most others will face negative consequences. As a result it is necessary to develop political strategies and undertake adaptation measures at all levels to protect the climate. Decisions for the future must be made immediately and urgently on the basis of sound scientific findings. This also includes a discussion on the assessment of the role of forest biomass as a substitute of fossil energy carriers.

The combined effect of questions regarding the reporting methods within the United Nations Framework Convention on Climate Change (UNFCCC) and real or planned forest management systems results in different interpretation possibilities. One aspect in this context is the timing of emissions from using forest biomass as an energy source and its actual physical impacts on the climate. For smaller areas (e.g. forest stands) there often is a delay of emission reduction benefits for different forest biomass utilization schemes depending on parameters like forest growth and decay rates.

In general, bioenergy from forest biomass is usually seen as very positive as it substitutes fossil energy. However, there are also scientific publications showing critical aspects of greenhouse gas reduction through forest bioenergy use when taking into account relatively short term components like timing issues (shorter than the lifespan/production cycle of a forest stand).

A Round Table has been established within the Austrian part of the Bioenergy Network of the International Energy Agency (IEA Bioenergy) to investigate the use of forest biomass for energy in terms of its impacts on the carbon cycle and thus to increase the transparency of the range of results obtained from applied model calculations.

Initial situation

The political definition of Article 2 of the UNFCCC includes a commitment to restrict global warming to two degrees above pre-industrial levels. The use of forest biomass and the substitution of fossil fuels are given a central role to reach this target.

The carbon cycle within a sustainable forest ecosystem always remains in **equilibrium** in the long term. In forests, CO_2 is removed from the atmosphere via photosynthesis driven by solar energy and fixed in organic carbon-based compounds. These compounds have different lifetimes in the ecosystem and are converted back to CO_2 via biological decomposition or biomass use (for material or energy) at the end of their life cycle.

Extensive **forest ecosystems** that are **undisturbed** by human influence (e.g. in tropical countries) are, on average, in equilibrium. This means that they continually remove about the same amount of carbon from the atmosphere as they release via decomposition processes (zero net emission). If forests are exploited in an unsustainable way, then additional CO_2 is released to the atmosphere.

When discussing carbon sequestration and release of a single forest stand, however, it must be taken into account that stands go through different successive stages during their lifetime (regeneration/establishment phase, growth phase, disintegration), which influence annual carbon sequestration and release significantly. The carbon stocks in a forest stand at a specific point of time are therefore dependent on the age of the forest, the mix of tree species, the growth potential (site quality) and the forest management regime.

When the trees in an unmanaged forest reach their physiological age limit, the dead wood compartments of the forest stand increase accordingly. A forest stand at this stage enters its disintegration phase. Due to the increased dead wood stock and the combined heterotrophic respiration of dead wood (via insects, fungi etc.), less carbon is sequestered than is released, resulting in net carbon release. At this point, the forest becomes a carbon source.

Austrian forests are managed sustainably and trees are harvested before they reach their physiological age limit. A comparison of the carbon balances of managed with unmanaged forest ecosystems shows that **managed forests** do not enter their disintegration phase and do not show increased biomass mortality. As a conclusion, forest management regimes aimed at wood production ensure that the ecosystem remains in the more productive phases of the succession cycle, because trees are harvested before reaching the stages of natural death and decay. The disintegration

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phase (and associated CO_2 release) typical of unmanaged forests is partially or wholly substituted by wood harvest regimes in managed forests. Therefore, the slow CO_2 release of natural biomass cycles (during the phase of decay) is replaced by the quicker release of CO_2 from combustion (e.g. for bioenergy purposes). Managed forests do not go through a disintegration phase and thus show higher average growth and carbon sequestration rates than unmanaged forests.

In addition to the higher sequestration potential, the **substitution effect** must also be considered. This effect comes into play when the harvested wood is used to replace fossil fuels or other more energy intensive materials.

Burning fossil fuels releases large amounts of CO_2 to the atmosphere. These fuels were also created by photosynthetic processes, but have been stored underground for millions of years in the form of oil, coal and gas. In comparison, carbon release from the combustion of biomass from existing forests results in a much shorter carbon cycle.

Sustainable forest management concepts also have positive effects on the **stability, vitality and resilience** of forest ecosystems and on their ability to sequester carbon. These benefits must also be evaluated under the aspect of intensifying disturbances resulting from climate change (e.g. storms, insect infestation).

When analysing the carbon balance of sustainable forest management systems it must also be taken into account that the combustion of parts of the harvested biomass for energy purposes releases the stored carbon to the atmosphere more quickly than if this biomass were used for wood products. If biomass is used in a wood product, the CO_2 release is time-delayed until the end of its respective lifetime, while in the case of bioenergy it occurs immediately.

Within the framework of sustainable forest management systems, the spatial system boundary for safeguarding ecological, economic and social sustainability is not the forest stand, but a much higher aggregated system boundary, where the simultaneous effects of forest stands of different ages are summed up. For example, the forest area in Austria is continuing to increase and the amount harvested annually is about one fifth below the annual volume increment.

Recommendations

With a view to the UNFCCC commitment to limit global warming to less than two degrees, the sustainable use of forest biomass to substitute fossil fuels has a central role. As both a reduction and increase in CO_2 will be observed during the transition phase, measures should be taken as soon as possible.

- In view of the imminent danger of climate change it is absolutely necessary to implement all appropriate measures to substantially reduce energy consumption and the associated greenhouse gas emissions.

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- Non-renewable fossil raw materials and energy carriers result from carbon sequestration over millions of years. In general, the release of CO_2 from fossil sources should be avoided and the demand for raw materials and energy should be met by renewable sources to the greatest possible extent. The substitution of fossil fuels by forest biomass is sensible for the long term reduction of CO_2 emissions and should therefore be further encouraged. Even when specific climate change mitigation effects may occur only slowly, the long-term benefits of the use of forest biomass still prevail and justify an immediate transition.
- An assessment of climate change mitigation measures through forest management needs an objective description of all possible pros and cons, taking all additional aspects of sustainability into account: e.g. (i) substitution effects due to the use of wood products; (ii) substitution effects due to the use of forest biomass from sustainably managed forests, (iii) carbon sequestration in wood products; (iv) increased stability of forest stands and associated in-situ carbon storage with respect to disturbances; (v) enhanced resilience of forest ecosystems through climate change adaptation; (vi) effects in terms of rural development. With this in mind, appropriate system boundaries and useful time frames covering all forest production cycles need to be considered.

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