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Discussion paper

Defining cascading use of biomass

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Background

The cascading use of biomass is becoming more important on the political agenda in Brussels in recent years. The European Commission discussed cascading use of biomass in a working document for the forest-based industries (EC 2013), and several associations recently formulated a joint statement (AEBIOM et al. 2013). The re-use and recycling has in principal been preferred to the energy use of materials for many years – for example through the waste hierarchy in Europe (2008/98/EC) – without achieving any widespread impact in the sense of actual existing cascading use of biomass, with the exception of paper and wood recycling.

Support for cascading use of biomass has been largely channelled into research projects and mainly directed towards theoretical concepts. On the one hand, there are no plans for any structural promotion of cascading use being brought to bear by either the European Union or national legislation. On the other hand, strong incentives for the direct energy use driven by the Renewable Energy Directive (2009/28/EC) from the European Parliament and the national implementation by means of the German renewable energy act (EEG 2008) hinder the cascading use of biomass.

There are many theories and concepts about cascading use based on different conceptions of what cascading means (Keegan et al. 2013; Dornburg 2004; Fraanje 1997). Along with repairable products and second-hand products, these concepts also include complex combinations of main and by-products in so-called primary and secondary cascades (Sirkin & ten Houten 1994). We can therefore establish that cascading use overlaps with other topics such as the circular economy and recycling, and the term can equally have different meanings in different contexts. These different concepts all have one thing in common: at some stage at least one product is used as a material.

This discussion paper is intended to introduce to the second workshop on cascading use of biomass, scheduled for 1 April 2014 in Brussels. The workshop is part of the R&D-project “Increasing resource efficiency by cascading use of biomass – from theory to practice” (FKZ 3713 44 100) on behalf of the Federal Environment Agency (Umweltbundesamt, UBA) and funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety.

The aim of this paper is

- to come up with a definition of cascading use for discussion so as
- to develop a shared understanding of the term and
- make it available for more practical recommendations for action and political strategies.

Definition

The UBA glossary of key terms about resource conservation (Kosmol et al. 2012) defines cascading principle as a

strategy for using raw materials or the products made from them in chronologically sequential steps as long, often and efficiently as possible for materials and only to recover energy from them at the end of the product life cycle. It is based on the use of so-called 'cascades of use' that flow from higher levels of the value chain down to lower levels, increasing the productivity of the raw material.

The authors see the necessity to sharpen this definition for the application on actually performed cascading uses in practice. Following proposals shall serve as a basis for discussion:

Cascading use of biomass takes place when **biomass** is processed into a **bio-based final product** and this final product is used at least once more either **for materials or energy**.

Cascading use of biomass is described as **single-stage**, when the bio-based final product is directly used for energy.

Cascading use of biomass is described as **multi-stage** when biomass is processed into a bio-based final product and this final product is used **at least once more** as a material. It is only after at least two uses as a material that energy use is permitted.

In 'material use' biomass serves as a raw material for the production of all kinds of goods, as well as their direct use in products. This distinguishes it from energy use, where biomass serves purely as an energy source, and the use for food and feed purposes (Carus et al. 2010).

The figure below distinguishes clearly between single-stage and multi-stage cascading use.

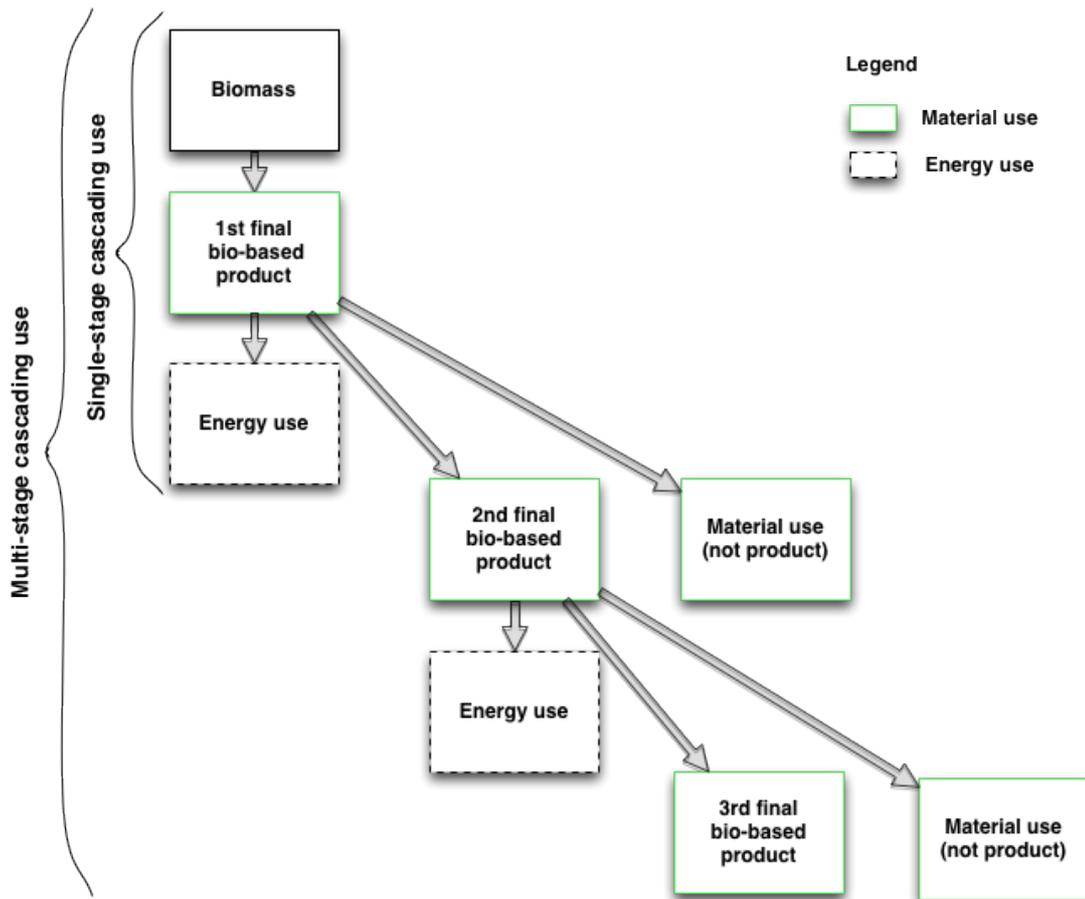


Figure 1 Distinction between single-stage and multi-stage cascading use of biomass

Discussion

The above-mentioned definition of cascading use leads to the following consequences:

- Conceptually, all sources of biomass being the starting point of a cascade would be treated equally, whether they be biogenic main, by- or intermediate products from primary agricultural, marine or forestry production, material or energy use, or from the food and feed industries.
- Requiring a “final product” for material uses, the above-stated definition stresses the product use for final consumption more than other definitions (e.g. those of Kosmol et al. 2012 or Arnold et al. 2009). Since most material biomass chains include numerous and often traded intermediate products, the consideration of the “final product” is important. If a definition would allow intermediate products to be a “use phase”, it would qualify almost any biomass use as a cascade. It is far clearer to require a processing into a bio-based final product (either completely or partially bio-based). This definition excludes all forms of intermediate products without a real material use by private or industrial consumers.
- The requirement for further material use deliberately avoids a requirement for a second bio-based final product. It means that it is not only material recycling that counts, but material use can also be satisfied by intermediates, fillers and excipients that are incorporated into material process chains. The waste hierarchy of the

directive on waste (2008/98/EC) should be considered properly in order to characterize the steps of cascading use in a generally attuned way, when using terms like re-use, preparation for re-use, recycling, recovery (energy or other).

- Energy use should be the viable option at the end of the cascading use at least for the majority of cases. This should not exclude some types of use, which result in the loss of the material (e.g. detergents) as long as the requirements of the definition above are met.
- It is clear that a direct energy use of biomass (energy use without prior material use) is not considered as a cascading use.

Political dimension

The question of whether single-stage or *only* multi-stage can be accepted as cascading use is a political matter of major importance. Single-stage cascading use already involves a significant increase in resource efficiency compared to direct energy use and allows for the inclusion of many existing bio-based value chains. Multi-stage cascading use results in a greater increase in resource efficiency, but has so far only been achieved for a very small number of biomass sources or can only be achieved with a limited number of value chains.

Understanding cascading principle as a *strategy* to increase resource efficiency, both single and multi-stage cascading can be supportive for an overarching efficiency objective. New ways of biomass material use – even if they don't include multi-stage from the beginning – implicate the potential to increase cascading use. However, the focus of this project is the analysis of multi-stage cascading concepts – hurdles and barriers, environmental impacts and possible incentives.

Glossary

During the last years, different standards and definitions for bio-based products have been developed by the European Committee for Standardization (CEN TC 411 - prEN 16575):

Bio-based: derived from biomass

Biomass: material of biological origin excluding material embedded in geological formations and/or fossilized

- Biomass can have undergone physical, chemical or biological treatment(s).
- The correct spelling of 'bio-based' is with a hyphen ('-'). It is however in common usage sometimes spelt without a hyphen.
- The methods to determine and communicate "bio-based" as a characteristic are detailed in specific standards of CEN/TC 411.
- The commonly used biomass, also called bio-based resources, is starch, sugar, vegetable oils, (hemi-) cellulose (timber, natural fibres and other by-products) and special biomolecules such as lignin or natural rubber.

Bio-based product: product wholly or partly derived from biomass

- The bio-based product is normally characterised by the bio-based carbon content or the bio-based content. For the determination and declaration of the bio-based content and the bio-based carbon content, see the relevant standards of CEN/TC 411.
- Product can be an intermediate, material, semifinished or final product. "bio-based product" is often used to refer to a product which is partly bio-based. In those cases the claim should be accompanied by a quantification of the bio-based content.

More information on the CEN standardization process can be found here:

<http://www.cen.eu/cen/Sectors/Sectors/Biobased/Pages/default.aspx>

<http://www.biobasedeconomy.eu/research/kbbpps/>

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