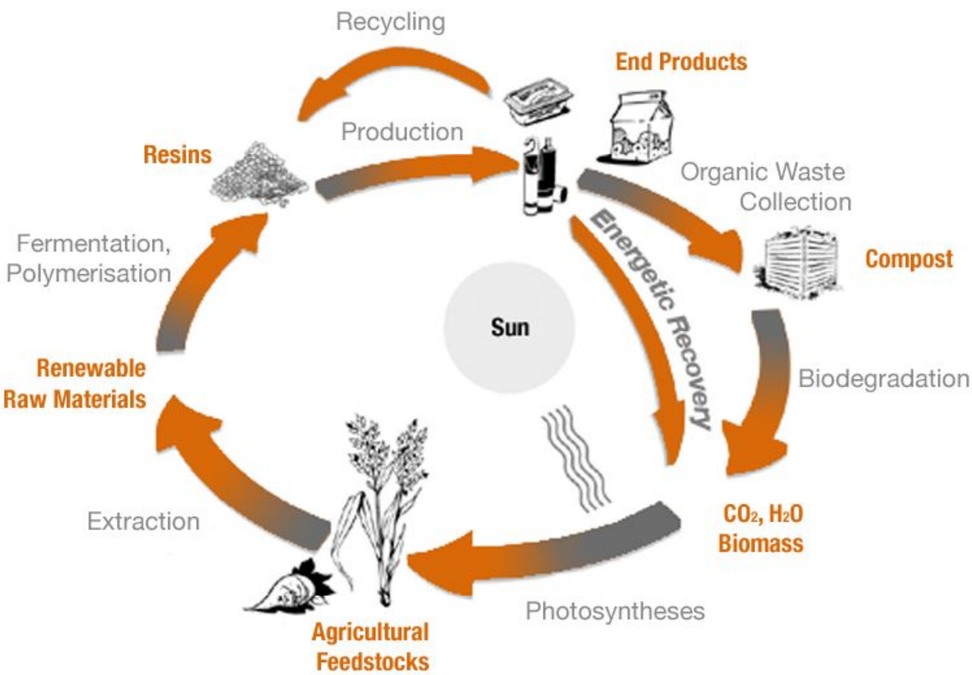
Position Paper

Life Cycle Assessment of Bioplastics







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Introduction

Topics such as sustainable development, fossil and natural resources availability, global climate change and waste reduction are increasingly dominating political and industrial agendas. Therefore, the relevance of the environmental performance of processes, products and services in decision-making is rapidly growing. The relatively new group of materials called bioplastics does offer new opportunities to contribute to these debates.

A wide range of bioplastics[1] is currently available on the market.

They are:

- Based on different raw materials;
- Produced and processed using various technologies;
- Tailored to various applications; and
- Recovered or disposed of through multiple waste management systems.

This growing market has also led to an increasing interest in the sustainability of these new materials.

Sustainability has three dimensions: economic, social and environmental. This has been known as "the triple bottom line of sustainability". This means that sustainable development involves the simultaneous pursuit of economic prosperity, environmental protection and social equity. In other words, businesses have to expand their responsibility to include these environmental and social dimensions. Sustainability is about making products useful to markets and, at the same time, having societal benefits and lower environmental impact than the alternatives currently available. It also implies a commitment to continuous improvement that should result in a further reduction of the environmental footprint of today's products, processes and raw materials used.

The key measurement tool to assess products' or services' environmental impact is the Life Cycle Assessment (LCA). Through LCA it is possible to account for all the environmental impacts associated with a product or service, covering all stages in a product's life, from the extraction of resources to ultimate disposal. LCA is the tool that allows measurement of and reporting on current impacts, alternative scenarios and improvements achieved.

[1] Bioplastics is a term used to define two different kinds of plastics:
a. Plastics based on renewable resources (the focus is the origin of the raw material used)
b. Biodegradable and compostable plastics according to EN13432 (the focus is the compostability of the final product; biodegradable and compostable plastics can be based on renewable (biobased) and/or non-renewable (fossil) resources).
Bioplastics may be
- based on renewable resources <u>and</u> biodegradable;
- based on renewable resources <u>but</u> <u>not</u> be biodegradable; and
- based on fossil resources <u>and</u> biodegradable.

LCA can provide data:

- to improve the general understanding of the life cycle of products;
- to substantiate environmental and economical decisions concerning e.g. process and products improvements, selection of products or services, selection of feedstock, energy carriers and raw materials, and selection of production locations and waste management systems;
- for corporate environmental and waste management policies as well as for regulatory and legislative measurements;
- on how to position (promote) products in the market;
- to the users and the final consumers to enable them to make more informed choices; and
- which is necessary for the identification and steering of future developments.

LCA results are increasingly being considered as a key input in decision making processes, therefore European Bioplastics has taken this opportunity to outline its position on the LCA tool and its relationship to bioplastics as follows.

European Bioplastics supports LCA and Life Cycle Thinking

European Bioplastics supports LCA and Life Cycle Thinking in order to promote, quantify and substantiate the environmental sustainability of products. It is crucial to take the complete product life cycle into account, because products may have totally different environmental impacts during different stages of their life cycle. Life Cycle Thinking (LCT) is concerned with analysing complete systems and avoiding problems being shifted from one life cycle stage to another, from one geographic area to another and from one environmental medium to another.

LCA provides data to allow better informed decisions, but as it is a complex tool it needs careful and knowledgeable use

LCA is a tool to assess products and generates one of the many inputs in decision making processes. Despite the existence of ISO standards, the number of degrees of freedom for conducting LCAs remains significant. During a study the LCA practitioner has to make many choices and define criteria which can significantly influence the final results.

LCA also has a clear subjective dimension: its results always require a weighing of the impact category scores and a final interpretation of the results.

LCA is a vital tool, but when using it as a basis for decisions it is necessary to keep in mind its limitations and partly subjective character. LCA enables substantiation and justification of a decision, but never delivers the “final result“ or the decision itself.

Despite these limitations LCA is the most comprehensive and reliable tool available to assess the environmental performance of products or services.

Besides the outcome of the LCA, it is advised to also consider other aspects in the life cycle of products such as safety, consumer use and hygiene.

"LCA derived measures" in politics or legislation as well as strong media statements on individual LCA results can have a significant impact on economic or social systems as well as for companies. It is very important that all available information is taken into account and not simply a discrete result of one single LCA. The complexity of the issue – as outlined in this paper here - does not allow simple conclusions.

Industry should be involved in LCA studies

Experts from industry should be involved in LCA studies from an early stage. They are able to deliver specific knowledge and insights that external experts need in order to conduct the LCA in a correct manner. This also applies to the bioplastics sector.

“THE” life cycle assessment of bioplastics does not exist

There is no such thing as “THE Life cycle assessment of Bioplastics". LCA applies to specified products (goods and services), taking into consideration their complete life cycle. The final conclusions about the environmental performance of bioplastic applications depend on many different parameters. These include the type of bioplastics used, the raw materials used, the production and conversion technology, the product, transport media and distances and the consumer use phase as well as the used waste collection and disposal or recycling system(s). There are no simple answers. It is not possible to make generalisations such as “bioplastics are better or worse than other materials”.

The optimisation potential for bioplastics is huge. This potential should be included in the LCA, otherwise it becomes a tool which tends to hinder innovation

Bioplastics are still in their early stage of development. They are produced in small scale or singular facilities and transport, conversion, product design and final disposal are not being optimised. They are however quite often compared with mature materials whose life cycles have been optimised over several decades. This often leads to a biased comparison.

LCA practitioners should always include possible optimization steps for innovative materials. By not including future outlooks for new materials, LCA is becoming a tool, which tends to hinder innovation in its early stage. This has never been the intention of this tool.

It is the key responsibility of the LCA practitioner to provide a balanced view. It is also recommended that the final user of the LCA results check whether improvement options have been taken into account.

The optimisation and improvement potential for bioplastics is huge:

- Switch to non-food crops (switch grass, wood) and agricultural waste streams;
- Use of innovative and more efficient processes (new technology/increase production scale);
- Further optimisation of conversion technology and product design;
- Further development and introduction of innovative end-of–life options such as composting, anaerobic digestion and chemical recycling (cradle-to-cradle); and
- Installation of use cascades in which re-use and recycling is combined with thermal recovery.

European Bioplastics acknowledges that novel products call for a careful analysis; however comparisons between mature and young innovative products should always take this basic difference into account. Projections for improvements can be made and then included in LCA.

”Newcomers” are often scrutinized, while existing materials are often much less questioned. This should be more balanced in LCAs

New materials and products derived from them, such as bioplastics are often closely scrutinized, while many existing products “on the shelf” are much less thoroughly examined. Within their life cycle bioplastics are often “put under the microscope” while the impact of e.g. oil or gas production is often modelled using fewer details (using data from generic databases) or sometimes totally ignored (accidents with oil tankers and their impact on the environment). A more balanced approach is required. European Bioplastics recognizes that novel products require careful analysis, but mature and young innovative products should be compared on an equal basis.

Comparative product LCAs should ensure that only products with the same function are compared

One of the key preconditions in comparative LCAs is that only products which have exactly the same function in the market place are compared – an aspect of LCA which is often underestimated. Only packaging for the same product and for the same delivery system may be compared. Sometimes in LCA studies generic categories of packaging are compared with no attention to their functions.

Renewable carbon accounting should form part of an LCA

Bioplastics using renewable feedstock do offer an intrinsic reduced carbon footprint depending on the amount of renewable carbon in the product. Biobased plastics use renewable or biogenic carbon as a building block. This biogenic carbon is captured from the atmosphere by plants during the growth process and converted into the required raw materials. When the product is being incinerated at the end of its useful life, the biogenic carbon is returned to the atmosphere – or in other words, cycled in a closed biogenic CO_2 loop, referred to as being carbon-neutral. Therefore the term "carbon-neutral" only refers to the biogenic carbon.

Automatic consideration of bioplastics as "carbon-neutral" and consequently leaving out the biogenic carbon from the life cycle inventory is not supported for the following reasons:

- The carbon neutral approach does not convey the immediate carbon advantage that biobased materials provide.
- The CO_2 intake is just an input like any other input in the inventory analysis. In LCA methodology, there is no scientific basis for leaving out any prior specific input. It is also not common practice in the LCA community. Flows cannot be declared per se as neutral, rather they must be demonstrated by the calculated inputs and outputs.
- The carbon input is not automatically released at the end of the product's life which for example happens in the case of incineration. Products can be durable or land filled, where the carbon is sequestered; if the sequestration lasts more than 100 years, this result may be counted as a true contribution to Global Warming Potential reduction.
- Some bioplastics can be recycled and during this process the biogenic carbon is used for a second or even third time in a new product.
- If the carbon is left out of the LCA, errors in calculations and wrong conclusions can easily be made.
- If the biogenic carbon is ignored as an input or output, intermediate results will be biased.
- During the complete life cycle of bioplastics, fossil and renewable fuels are used to drive these processes. The related carbon intake and emitted carbon dioxide must also be taken into account.

Hence biogenic carbon must be considered in a LCA, just like any other input or output and not be omitted from the study.

Bioplastics offer new recovery and final disposal options. LCA can help to evaluate these new options

Bioplastics can be treated in many different waste management systems such as energy recovery, mechanical recycling, composting, anaerobic digestion and chemical recycling. This means that bioplastics can offer more recovery options than traditional products that are not suitable for composting. As with any material, landfill should be avoided since this represents a loss of useful material and energy.

The optimum choice depends on various factors such as the composition of the bioplastic, the application, the volume on the market and the available (from a technical and legislative point of view) regional waste management infrastructure for collection and processing. Therefore the end of life of bioplastics can be rather complex and LCA should provide the required information to make the best choice.

The selected recovery or final disposal option will influence the outcome of an LCA. Therefore it has to be set up most carefully, also considering possible indirect beneficial effects. These include for instance, the possibility of obtaining homogeneous organic waste streams suitable for organic recycling in the case of compostable bioplastics, or the possibility of producing green energy in the case of incineration of renewable bioplastics.

LCA is an analytical tool, not a communication tool

LCA is a good tool with which to assess the environmental performance of products. However, it is too complex to use to communicate the environmental performance of products to final consumers. The “translation and interpretation” of the outcome of LCAs into environmental messages, which are commonly understandable calls for other tools.

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