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5 main recommendations to improve JRC reports on LCA for plastics

In the context of the current political momentum and public attention on plastics, the Rethink Plastic alliance (RPa) welcomes the JRC's efforts towards clarifying parts of the debate related to alternative feedstocks for plastic production. We however regret the rather narrow scope of the proposed method as it merely attempts to provide an environmental assessment regarding the substitution of one plastic product with a plastic product made from another raw material. This narrow scope unfortunately weakens the environmental relevance of this project. LCA is a comprehensive enough tool to compare the environmental performance for true alternatives such as reusable products, provided the functional units chosen for the assessment allows for such comparison to be made.

As indicated in the comments provided by ECOS as a member of the Rethink Plastic alliance, the JRCs proposed methodology could be further refined to account for more realistic scenarios and additional impact categories. The below section details the improvements required to build a solid methodology that adequately addresses environmental aspects of plastics throughout their entire lifecycle.

1. Carefully determine the functional unit

"Non-discriminatory" functional unit

Reusable alternatives exist for many single-use items, as well as **different distribution and consumption models**, and their relevance should not be excluded by poorly chosen functional units. For example, if a functional unit presumes a certain shelf life, it is implicitly weakening the performance of non-packaged goods.

Multifunctionality

The JRC report refers to the **multiple functions** a certain item can accomplish, while it is uncertain that the item will be used accordingly. For example, a compostable plastic bag might not necessarily always be used to collect biowaste, nor will it necessarily find its way to an industrial composting or anaerobic digestion plant to then be potentially used as compost on agricultural land. All of these scenarios depend on the consumer and local waste management practices and vary considerably throughout Europe. Therefore, RPa recommends a conservative approach to the multifunctionality of plastic products.

2. Add important impact categories

Biotic resource depletion

Resource depletion is defined at the very beginning of the document as encompassing either renewable or non-renewable resources. However, biotic resources are not mentioned further in document, although they represent an important aspect, in particular when it comes to bio-based products. Although biomass can be regenerated, a certain period of time is necessary for it to be renewed and to be able to be sourced for the manufacturing of bio-based products. This means that at any given time, there is only a **limited stock of biomass available**. The proposed methodology should therefore include biotic resource depletion as an impact category to be included in LCA. Such considerations have recently already been put forward by your JRC colleagues from the Bioeconomy and the Land use unit[1].

Indirect effects

ECOS and the Rethink Plastic alliance welcome the inclusion of indirect Land Use Change (iLUC) impacts within the Climate Change impact category in the proposed methodology. The suggested calculation method for accounting for such indirect effects provides for useful GHG contribution factors and contributes to a more comprehensive LCA approach. We see the inclusion of **consequential elements into the methodology as a positive step** in taking LCA towards comprehensive assessment, especially when it comes to informing policies, like it is the case for this project.

3. Make more realistic scenarios in the life cycle inventory

Additives in plastics

The JRC report acknowledges the presence of additives in plastic products and their contribution to the overall GHG emissions associated with the production of plastics. However, impacts during the use or at the end-of-life related to these additives were disregarded. This is an important gap in the LCA assessment of plastics proposed in the JRC methodology.

Additives can migrate and leach out of plastic products, thus potentially impacting human life and the environment[2]. A recent literature review has established a database of Chemicals associated with Plastic Packaging (CPPdb) and assessed the toxicity of these chemical substances[3]. The study found that out of the chemicals potentially present in packaging, 68 chemicals were identified as being most haz-

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[1] Crenna, E. Sozzo, S. Sala, S. (2018) Natural biotic resources in LCA: Towards an impact assessment model for sustainable supply chain management. Journal of cleaner production No 172, 3669-3684.

[2] Hahladakis, J.N. et al. (2018) An overview of chemical additives present in plastics: Migration, release, fate and environmental impact during their use, disposal and recycling. Journal of Hazardous Materials 344, 179–199.

[3] Groh K.J. et al. (2019) Overview of known plastic packaging-associated chemicals and their hazards. Science of the Total Environment No 651, 3253–3268.

ardous for the environment and 64 were identified as being most hazardous for human health. Furthermore, the presence of certain additives such as flame retardants strongly influence the end-of-life options of plastic products[4].

It is imperative that the final methodology addresses these aspects by taking into account the **toxicity of additives**, and the **impact of legacy chemicals** present in plastics on recycling rates.

Output recycling rate and recycled content

The present modelling of the end-of-life stage for post-consumer waste adequately identifies the points where target materials are lost during collection and recycling, and accurately states that product design and composition greatly influence whether a material will actually be recycled. However, the recyclate obtained at the end of the recycling process is not necessarily of sufficient quality for all applications. The modelling fails to address the fact that converters may have certain quality requirements which can lead recyclers to **add specific substances** such as plasticisers, additives, fillers, or virgin material to the shredded material in order to obtain recycled granulates with the properties required by their customer. Furthermore, since sorting is most often not implemented by polymer type, some recyclates are mixes between various types of polymers which require specific additives such as heat stabilizers or crosslinkers and compatibilizers to be able to mix[5]. Therefore, we recommend to make more realistic assumptions with regards to the output recycling rate beyond the recyclability assessment, possibly by including an overall loss factor to account for the missing step between the output from the recycling plant and the production of a new product based on recycled feedstock.

Closely linked to this issue, we regret that the case studies for bottles and insulation board assume 100% recycled content scenarios. The quality specifications for most applications are such that a true 100% recycled content cannot be realistically reached for most types of plastic. Furthermore, it can be argued that **100% recycled content cannot exist in the absence of a detailed traceability system** where the exact inputs to the recycling system can be verified. The traceability system foreseen in the modelling requirements is based on EN 15343, a standard that uses a mass-balance approach for declarations related to recycled plastics. However, no verifiable claim can be made on a specific bottle based on this approach: to be certain that a bottle is based on 100% recycled plastic, this would require the full segregation of the input material at the start of the process. To ensure figures for recycled content more closely mirror reality, the traceability system suggested should be based on controlled blending requirements.

[4] Ragaert, K. Delva, L. Van Geem, K. (2017) Mechanical and chemical recycling of solid plastic waste. Waste Management No 69, 24-58.
[5] Ibidem.

4. Better account for certain Life Cycle Stages

Product use

Rethink Plastic urges the JRC to include the **use phase** in their assessment. This will help capture benefits related to the extension of plastic product lifetime and will also help adequately compare single use products with their reusable alternatives, whatever the feedstock considered.

End-of-Life

The current assumptions on the end of life of plastic products should be more realistic. The widespread littering of plastic items in Europe and across the globe has been widely documented in the media and scientific literature. In Europe, littered items found on European beaches have been the core reason for the proposal of the Single Use Plastics directive. Furthermore, **littered items have considerable impacts on soil**[6] **and marine ecosystems** and continue doing so as they degrade into smaller plastic particles. Plastic litter poses threats to animal life as they can become entangled or ingest plastic fragments[7]. These risks should be taken into account in the JRC methodology as a direct consequence of an item being littered.

In addition, more credible assumptions should be made with regards to the **actual recycling** of plastic products, both mechanical and organic recycling. Even when a product is in principle recyclable, it does not mean that it will effectively be recycled. The actual recycling of various plastic products will depend on how post-consumer waste is collected and sorted, as well as the potential of the recyclate to be used for a new product[8].

Similarly, it can't be arbitrarily assumed that biodegradable plastics will necessarily end up in the environment they are supposed to biodegrade in as consumer behavior and practices in local waste management facilities strongly vary. In various countries, industrial compostable bags according to EN 13432 are separated before the composting process[9]. The default value of biodegradation rate of 90% is also not realistic as there is no guarantee that products claimed to be industrial compostable actually comply with EN 13432, nor that products claiming to be soil biodegradable actually comply with EN 17033. In addition, for EN 13432, the time-frame to reach 90% is 12 weeks, a timeframe that may not be realized by actual practices in industrial composters throughout Europe. Furthermore, there is an

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[6] Yooeun, C. and Youn-Joo, A. (2018) Current research trends on plastic pollution and ecological impacts on the soil ecosystem: A review. Environmental Pollution No 240, 387-395.

[7] Nerland, I.L. Halsband, C. Allan I., Thomas K.V. (2014) Microplastics in marine environments: Occurrence, distribution and effects. Report of Norwegian Institute for Water Research, Report no. 6754-2014. NIVA, Oslo. 71 pp.

[8] Ragaert, K. Delva, L. Van Geem, K. (2017) Mechanical and chemical recycling of solid plastic waste. Waste Management No 69, 24-58.

[9] Inter alia based on a survey among approximately 1,000 German composting plants conducted by DUH in 2015/16.

increased risk for biodegradable plastics to be littered due to consumer confusion on the actual behavior of such plastics in the environment[10].

5. Choose environmentally relevant case studies

The environmental goals and relevance to policy making of the present exercise are not mirrored in the choice of **candidate articles for the final LCA case studies.** Many of the suggested articles are very low value added items (e.g. loose fill chips, printers housing panel, food trays), both from an economic and environmental perspective. It can be questioned whether resources should be spent in order to assess how environmentally beneficial it would be to switch feedstocks for the production of loose fill chips, given that their very use could be avoided in most cases.

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[10] UNEP, 2015. Biodegradable plastics and marine litter : misconceptions, concerns and impacts on marine environment