Top Takeaways and Outstanding Questions from the Life Cycle Assessment (LCA) Webinar

Featuring Catherine Rae from Empauer

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1 Life Cycle Assessment (LCA) is a standardized technique (ISO 14040) that comprises four main steps: defining goal and scope, collecting data (inventory analysis), assessing environmental impacts, and interpreting findings.

2 Compared with a 'full' LCA a 'screening' or 'streamlined' LCA offers a relatively quick and inexpensive way of accessing valuable sustainability related information that can inform decisions in various areas of one's business -- marketing, sales, R&D, and sustainability strategy.

3 LCA can drill down in detail with respect to packaging's environmental impacts. For example, the webinar case study (milk powder packaged with a plastic laminate pouch versus a steel can) compared the impacts of these materials based on: component (material) processing, conversion to specific formats, conversion losses at end-of-life, and transportation.

4 When discussing environmental impacts we see considerable focus on carbon dioxide (CO2), and more broadly, greenhouse gas (GHG) emissions. Including other greenhouse gases, such as methane, is critical due to the much higher greenhouse effect. The common practice of measuring a 'carbon footprint' is certainly important, but it's also important to consider a wider range of impact categories such as freshwater consumption, land use and human toxicity.

5 LCA puts impacts in comparative perspective in the context of some or all of the packaging's life cycle. This helps detect impact 'hot spots' -- the areas where it likely makes the most sense to prioritize an organization's sustainability resources.

6 As Circular Economy (CE) concepts, such as material 'loops' gain traction globally, LCA is a useful tool to test CE assumptions, and help ensure that new business models and initiatives realize the reduction in negative environmental impacts they seek to provide. At the same time, the LCA community must continue to test LCA's assumptions and methodologies.

7 There are many LCA providers and tools -- there is even a fairly long list of screening LCA tools just for packaging. To better understand their differences, and how they might provide you with value, many providers offer 'demo' or 'trial' periods at no charge. Another good way to get informed is via a good webinar, which then provides you with access to subject matter experts and contacts in the field.

Outstanding Questions

PAC thanks presenter Catherine Rae for the following responses to outstanding webinar attendee questions:

1. How to compare in LCAs materials which are in their infancy phase (low production, not optimized conversion, logistics and EOL) with mature materials? e.g. packaging made from biobased vs fossil based polymers. In many, maybe even in all, LCAs this aspect is not taken into account leading to biased comparisons.

Some biopolymer manufacturers make their data available for LCA tools. For example, Ecodex includes a dataset for PLA. However, with any new materials and processes it does take time for datasets to be developed.

2. How does one set the boundaries for LCA when modeling a circular economy? For example, how many cycles to evaluate to compare a circular economy to a linear take make dispose economy?

In reality, at the moment any circular system is likely to have some proportion of materials leaving the system. You can model 'top up' rates for the incoming materials, the processing and logistics for an estimated number of cycles and end of life for material leaving the system in order to compare to linear systems.

3. Is there any consideration given to wastage due to damage or spoilage of various packaging alternatives?

In Ecodex the percentage losses at various stages of the life cycle can be taken into account. For example, different packaging types might have different losses at the filling station, different levels of damage during distribution, and different storage requirements or shelf life leading to different levels of spoilage. All of these can be accounted for separately in Ecodex.

4. How do you approach making assumptions about consumer behavior, with regards to particular recycling rates, and especially for new products, in building and presenting an LCA?To add, consumers may not be aware of the proper disposal methods of packaging and this could influence the actual circularity of the packaging.

Assumptions about consumer behavior could be made based on market research for your products in particular, or typical national recycling rates for a particular material / packaging format. To see how significant this assumption is to your final results, a sensitivity analysis is recommended; create new scenarios where the rate is perhaps doubled or halved and compare to your original. If there is a significant difference, then you may want to invest a little more time in understanding actual behavior, or invest in consumer education to ensure they are aware of the most appropriate disposal method.

5. How do you decide how much is going to landfill versus incineration?

This depends on the infrastructure available in the final consumption location. Often local infrastructure is one or the other. Where there is a mix, for example if you are looking at a large region, there may be national figures indicating the proportion of waste treated by each method.

6. How do you factor in the recyclability of the packages in the model? Recycling data is very localized, do commercially available software packages have this level of information?

With Ecodex, end of life treatment rates need to be entered into the software by the user as there are no default settings. This is because recyclability and whether waste disposal is to landfill or incineration is dependent on local infrastructure. There are also other factors which need to be taken into account, such as the format of the packaging (e.g. a PET bottle is more likely to be recycled than a PET film) and where it becomes waste (e.g. secondary packaging becoming waste at the recycler will have a much higher likelihood of being recycled than consumer packaging, and packaging from products consumed in the home are more likely to be recycled than for those consumed 'on the go'). See also Q4.

7. A lot of these LCAs are oversimplified by only modelling recycling and landfill as possible EOLs. In reality up to 30% of plastic packaging is ending up in our waterways, lakes and oceans. Plastics do also break down to microplastics and so leaking all kinds of additives. These EOL's are not included, leading to a significant underestimation of the impact of the plastic option. So I doubt if the pouch has a lower impact.

With a full LCA it is possible to take such things into greater consideration. The simplifications involved in a screening LCA in order to obtain results in a time frame suitable for decision-making mean that currently leakage to oceans is typically not modeled. In Ecodex, we do see the impact of plastic additives 'leaking' in landfill, which shows up as higher ecosystem quality impacts.

8. One of the criticisms of LCA is that the social impacts from things like litter, ocean waste, etc are not really considered. How can we past that issue? Are there changes coming to LCAs to try and address?

As more research is done in this area, datasets may become available to include these situations in LCA models.

9. How is the Ecodex database kept up to date? Are compostable packaging materials such as cellulosic films included in the database? Oe a resin switches from oil based to biobased or pyrolysis oil.

Materials may be added to the Ecodex database at the request of a client, either for specific use by that client or for all users, depending on the situation. Updates to datasets are based on data availability.

10. How does Ecodex compare to other streamlined LCA tools? Lots out there and what is different about Ecodex? Is it a yearly subscription, or pay on a case-by-case basis?

There are many streamlined tools available. One stand-out factor for Ecodex is the ability to include the product in the LCA model, which is not common amongst packaging LCA tools. The product typically has a much higher impact than the packaging, so it is very important to understand the whole system and ensure that packaging is optimized, and not light-weighted too far that it no longer performs the critical function of protecting the product.

Usage models for Ecodex are flexible. For users who see the opportunity for extensive use in their business a yearly subscription is available and training and support is provided as part of that subscription. For smaller organizations which might only want to do a couple of LCAs we can provide consulting services. If you are interested, please contact us for a discussion around your business requirements.

11. Thanks for the informative presentation. Main differences between LCA platforms are usually due to allocation. Which allocation methods are used in Ecodex? How would Ecodex compare to other streamlined and full LCA methods?

Allocation of impacts between co-products is done on an economic basis in Ecodex. Allocation of recycling benefits and impacts are included at material inputs, as the manufacturer can specify recycled content, rather than at end of life where we are less certain of consumer behavior. This stresses the importance of driving the recycling industry by creating a market for recycled materials, not just hoping that someone will recycle the package. It is also a question of system boundaries. The boundary is considered in this case to be the start of the recycling process; after this point it is the beginning of a new life cycle for the new item it will become. Other LCA tools may take a different approach, so it is important to understand such difference and treat any comparison of results from different tools with caution.

12. Is there any reliable freeware available to do the LCA?

'Free' LCA software that I am aware of is not streamlined and does not contain datasets, so you need to have a good understanding of the LCA process and be able to obtain data, which may not be free. See also Q16.

13. A lot of the data that comes out of LCA tools is very difficult to understand. How can we communicate it to marketing teams for example as simply as possible?

Communicating the result visually is important as big tables of numbers become meaningless to most audiences. Graphs and infographics with the key points are a great way to communicate to marketing teams and supply chain partners.

14. Does LCA account for spoilage after opening? Is the value of re-sealability considered?

If your LCA is only looking at packaging, then it is difficult to account for this. However, Ecodex allows the user to include the product in the LCA model, including the consumer use phase, so we can model the percentage losses with the consumer. If a re-seal function in the packaging results in less product spoilage and loss, then the effects will be accounted for.

15. How can we determine the parameter distributions to run a sensitivity analysis? It is not performed usually in food-related LCA

If you know that certain input values are typically within a range, then your sensitivity analysis should include scenarios at the top and bottom of this range. If you are uncertain of a value (for example, recycling rates for a packaging format), then you can model a reasonable estimate as your main scenario, then you may like to test a significantly higher or lower number to see how much impact this has on your results.

16. What are the most important parameters we should look for while purchasing a screening LCA tool?

It is important to look for a tool that is certified to the ISO standard (ISO14040 series), as this ensures that the tool developers have included all appropriate life cycle stages and that embedded data is suitable. After this point, does the tool meet your current and likely future needs in terms of datasets, ease of use, adaptability and user support?

17. Do you think that LCAs will take material market value in consideration at one point? For example, if a material is recyclable but it's low value on the market making it unlikely to be recycled, which would not reflect reality.

In modeling end of life it is important to take a realistic approach, rather than an idealistic approach, because you are correct that 'recyclable' does not necessarily equate to 'recycled'. This is part of the reason why Ecodex allocates the benefits and impacts of the recycling process to the material input (i.e. including recycled content as a raw material) rather than at end of life. See also Q11.

18. What is "impact on ecosphere" and how much control do LCA users have on detailing these variables? Supporters of steel cans say that moving away from plastics will help to reduce production of environmental toxins and that moving away from disposable packaging altogether helps de-burden municipal recycling and landfill systems.

Impact on Ecosphere / Ecosystem Quality is a combination of three standard LCA impact categories – acidification (air pollution that contributes to acid rain), eutrophication (water pollution that contributed to algal blooms) and eco-toxicity (materials toxic to humans or other flora / fauna). It is not user specified. These are grouped together to simplify reporting as they are less well known impacts, but are important to consider so that our results give a more holistic assessment of environmental effects.

19. Re: making assumptions for new products, where the consumer behavior for disposal can't be predicted with past data. I'll give an example: the aluminum Nespresso capsule. They have a recycling program, but when they were developing the LCA for this, how could they accurately predict how many capsules they'll get back before starting the program?

Predictions might be made based on similar materials. Where no appropriate information exists to guide estimates, an LCA can still be performed. A series of sensitivity analyses should be included to determine the significance of the estimate. In this case for example, you could model 0%, 20%, 40% recycling as a first pass to see the effect on the results. This then shows how important recycling is the overall results and may guide decisions on consumer education campaigns.

20. Do you have data for compostable and other emerging technology available on a chemical basis? How do you validate the quality and relevance of data for emerging technologies? How do you assess end of life when it comes to compostable materials?

Data for emerging technologies can be limited. Sometimes the manufacturer will conduct a full LCA and so the data becomes available. A peer review of the full LCA report is usual, which provides confidence in the results. Compostable materials at end of life are treated similarly to recycled materials. The composting process is considered to be the start of a 'new life' of the material.

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