# LEVERAGING LCA'S FOR PACKAGING OPTIMIZATION

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# PACKAGING OPTIMIZATION: A CASE STUDY

## THE PACKAGING PROBLEM PERSISTS

Despite increasing technological innovation and a growing collective awareness, society continues to reckon with a prolific packaging crisis; municipalities are struggling beneath the weight of growing mounds of plastic waste, much of which is composed of everyday packaging materials such as flexible, multi layered plastic wrappers, plastic bottles, jars and more. Our reliance on these items has created a linear system in which we "take, make, waste" - resulting in unprecedented levels of plastic pollution.

As our communities, ecosystems, and waterways continue to be flooded with single use plastic packaging items, we are being forced to reevaluate our relationship with these materials and re-envision a life without them. Material manufacturers, brands, and consumers alike are committed to reducing their plastic footprint by embracing a more circular approach to packaging. Additionally, states are beginning to embrace a greater degree of regulation of packaging through policy schemes such as extended producer responsibility which will require that these companies move into a new, mandated phase of action and responsibility.

A transition away from plastic and towards more circular and regenerative materials requires collaboration across the packaging value chain which is why One Step Closer founded the Packaging Collaborative; a group of over 40+ industry organizations and brands working together to solve one of society's most pressing problems. The mission of the Packaging Collaborative is to empower the natural products industry to remove petroleum-based plastics from landfills, oceans and our planet by advancing Industrially Compostable and renewable flexible film structures. However, making this transition is complex, nuanced, and technical. It requires the use of tools like materiality assessments in combination with LCAs which allow brands to harness the power of data to make informed decisions around the impact of their packaging choices. For this reason, One Step Closer works in collaboration with organizations such as Trayak to provide data-driven insights to its members. Trayak has developed an easy-to-use platform that makes sustainable package and product design simple, mainstream, transparent and profitable for its clients. Trayak's life cycle approach quantifies the environmental impact of different package designs. Their proprietary software allows brands to evaluate design alternatives to find the solution that best meets their packaging requirements and sustainability standards.

## USING LCA'S TO MAKE DATA INFORMED DECISIONS

Life Cycle Assessments (LCAs) are powerful tools that can be used to make holistic decisions about products, services, and policies by evaluating the environmental impacts associated with a package throughout its entire life cycle. LCAs can be utilized to identify hotspots, visualize tradeoffs, substantiate environmental claims, and more. These analyses are conducted by gathering science-based data about the environmental impacts of a product throughout its life cycle; however, it's important to note results depend on assumptions and system boundaries of the LCA model. Each of the 6 real-world packaging systems included in this analysis are functionally equivalent, delivering 2lbs of fresh product, and therefore can be compared "apples-to-apples."

Material converter and OSC member Associated Labels and Packaging wanted to understand the relative environmental impacts of several packaging alternatives that utilize their innovative lidding film solutions when compared to a conventional clamshell. Each packaging alternative is unique: leveraging conventional film design, resealable film design, PCR content, or BPI-certified industrially compostable materials in an attempt to reduce overall environmental impact of the whole. Recyclable lidding film in this circumstance falls under conventional. This is because lidding film is multi-layered and even if one type of resin is used for both layers, the act of lamination defines them as number 7 or 'other plastics.' In addition, the act of collecting, sorting and converting this material for recycling (or composting) is a system challenge. Therefore, each lidding film was assumed to have the same end-of-life fate of 20% going to incineration and 80% going to landfill.

"Associated Labels and Packaging's role is to help contribute knowledge and innovation within our packaging industry. We support our customers at all stages on their journey towards environmental sustainability. This LCA specifically helps our customers make informed decisions about the impacts of their packaging structure or design. Finally, the process of material sourcing at this level opened up our perspective to the challenges proprietary information and insufficient traceability create," says Jay Ashworth, Director of Sustainability at AssociatedLP.

## THE LCA PROCESS

For this case study, Trayak utilized their streamlined LCA tool, EcoImpact-COMPASS to measure the environmental impacts associated with a packaging transition. EcoImpact-COMPASS is a screening LCA solution which offers users an easy-to-use, cost effective, and reliable way of performing LCAs. The analysis represents a cradle-to-grave LCA that examines the environmental impact of the packaging across four phases of its life cycle (raw material extraction, manufacturing, transportation, and disposal). Each case study features an "apples to apples", or functionally equivalent packaging system, comparison.

The packaging systems were modeled using unique package-specific information (materials, masses, conversion processes, transportation, etc.) provided by Associated Labels and Packaging. This process allows practitioners to identify hotspots and key areas for environmental footprint reductions. In order to determine the relative environmental impacts, Trayak analyzed 7 key environmental indicators including fossil fuel use, water use, GHG emissions with carbon uptake, freshwater eutrophication, freshwater ecotoxicity, mineral resource use, and human impact. Together, these indicators paint a holistic picture of the overarching impact of each package and provide a robust basis for comparison. Trayak's findings detail the total impact for each of the selected indicators studied in the Life Cycle Assessment.

This COMPASS tool uses life cycle inventory (LCI) data that represents an industry average for materials, manufacturing processes, and end-of-life impacts. The Life Cycle Assessment (LCA) in this report can be used for directional guidance in internal decision making and understanding trade-offs. COMPASS follows the guidelines of ISO 14040 in determining and documenting the scope, assumptions, consistent boundary conditions, and data sources.

*Note: The material phase measures the environmental footprint of extracting and processing materials. The manufacturing phase calculates the impact of the manufacturing or conversion processes that companies use to add value and create the package or product. Use phase includes the environmental impact during the useful life of the package/product. Typically, the use phase impact is due to the consumption of resources like electricity, fuel, or other consumables. For the transportation phase, the impact is calculated based on the mode of transportation (road, rail, air, sea) as well as the distances traveled. The end of life impact calculation incorporates the most likely fate of the package and its components based on typical curbside municipal waste management. Typical percentage rates for region based recycling, incineration, and landfill are used to calculate the impacts.*

**Fossil Fuel Usage**

*Fossil fuel usage examines the total quantity of fossil fuel consumed throughout the life cycle reported in gigajoules (GJ) equivalents deprived.*

| **Packaging Type** | Conventional Clamshell and Label | Conventional Film and Tray | PCR Film and Conventional Tray | BPI Certified Industrially Compostable Film and Tray | Resealable Conventional Film and Tray | Resealable PCR Film and Conventional Tray |
|---|---|---|---|---|---|---|
| **% Increase (+) or Decrease (-) from Reference** | Ref. | -20.45 % | -24.05 % | -50.51 % | -11.51 % | -19.27 % |

**GHG Emissions (with carbon uptake)**

*The total quantity of greenhouse gasses (GHG) emitted throughout the lifecycle of the packaging materials under study are reported in kilograms of CO2equivalents. This calculation follows the latest IPCC 2013 method and considers climate feedback loops.*

| **Packaging Type** | Conventional Clamshell and Label | Conventional Film and Tray | PCR Film and Conventional Tray | BPI Certified Industrially Compostable Film and Tray | Resealable Conventional Film and Tray | Resealable PCR Film and Conventional Tray |
|---|---|---|---|---|---|---|
| **% Increase (+) or Decrease (-) from Reference** | Ref. | -19.70 % | -23.15 % | -25.94 % | Less than 10% difference compared to reference (non-significant change) | -16.80 % |

**Water Usage**

*This metric accounts for water scarcity and the data represents the relative value in comparison with the average liters consumed in the world. Essentially, the total water consumed to make the package is multiplied by the region's scarcity factor which will either increase or decrease the water usage value based on the scarcity or excess availability of water in a specific region, respectively.*

| **Packaging Type** | Conventional Clamshell and Label | Conventional Film and Tray | PCR Film and Conventional Tray | BPI Certified Industrially Compostable Film and Tray | Resealable Conventional Film and Tray | Resealable PCR Film and Conventional Tray |
|---|---|---|---|---|---|---|
| **% Increase (+) or Decrease (-) from Reference** | Ref. | -23.49 % | -26.21 % | Less than 10% difference compared to reference (non-significant change) | -17.25 % | -22.81% |

**Freshwater Eutrophication**

E*utrophication is the abnormal increase in chemical nutrients that results in excessive plant/algal growth and decay resulting in an anoxic condition in fresh water systems. (The major consequences are often harmful algal blooms.) Typically, emissions of phosphorus compounds are released during the production of materials. This indicator is reported in phosphate (PO4) equivalents and is calculated with Impact World+ characterization factors.*

| **Packaging Type** | Conventional Clamshell and Label | Conventional Film and Tray | PCR Film and Conventional Tray | BPI Certified Industrially Compostable Film and Tray | Resealable Conventional Film and Tray | Resealable PCR Film and Conventional Tray |
|---|---|---|---|---|---|---|
| **% Increase (+) or Decrease (-) from Reference** | Ref. | -16.01 % | -23.57 % | +395.14 % | Less than 10% difference compared to reference (non-significant change) | -10.38 % |

**Freshwater Ecotoxicity**

*The quantity of environmental emissions resulting in aquatic toxic impacts released throughout the lifecycle reported in Comparative Toxic Unit ecosystem (CTUe). CTUe corresponds to a fraction of disappeared species over a cubic meter of freshwater (or marine water) during one year. This is a measure of the ecotoxicity impact of chemical releases to air, water, and land using aquatic toxicity factors and is calculated using characterization factors from USEtox 2.0.*

| **Packaging Type** | Conventional Clamshell and Label | Conventional Film and Tray | PCR Film and Conventional Tray | BPI Certified Industrially Compostable Film and Tray | Resealable Conventional Film and Tray | Resealable PCR Film and Conventional Tray |
|---|---|---|---|---|---|---|
| **% Increase (+) or Decrease (-) from Reference** | Ref. | -22.28 % | -16.51 % | +59.24 % | -13.28 % | Less than 10% difference compared to reference (non-significant change) |

**Mineral Resource Use**

*This indicator uses the material competition scarcity index from de Bruille (2014) as a midpoint indicator. The factor represents the fraction of material needed by future users that are not able to find a reliable substitute for the mineral. It is expressed in units of kilograms of deprived resource per kilogram of resource dissipated. It considers mineral scarcity and viable substitutes.*

| **Packaging Type** | Conventional Clamshell and Label | Conventional Film and Tray | PCR Film and Conventional Tray | BPI Certified Industrially Compostable Film and Tray | Resealable Conventional Film and Tray | Resealable PCR Film and Conventional Tray |
|---|---|---|---|---|---|---|
| **% Increase (+) or Decrease (-) from Reference** | Ref. | -17.29 % | -20.93 % | -42.53 % | Less than 10% difference compared to reference (non-significant change) | -14.64 % |

## Human Impact

*The Human Impact indicator measures the quantity of environmental emissions resulting in particulate, cancer & toxic non-cancer impacts to humans released throughout the packaging material's lifecycle. The metric reports these three measurements in Disability Adjusted Life Years (DALY) and is calculated using Impact World+ and considers severity factors of any adverse effects.*

| **Packaging Type** | Conventional Clamshell and Label | Conventional Film and Tray | PCR Film and Conventional Tray | BPI Certified Industrially Compostable Film and Tray | Resealable Conventional Film and Tray | Resealable PCR Film and Conventional Tray |
|---|---|---|---|---|---|---|
| **% Increase (+) or Decrease (-) from Reference** | Ref. | -20.27 % | -23.12 % | +15.88 % | Less than 10% difference compared to reference (non-significant change) | -16.33 % |

## Total Packaging System Weights

*Total Packaging System Weights compares the weight in grams of each packaging material scenario tested to the reference weight in order to evaluate the impact that mass has on the various indicators.*

| **Packaging Type** | Conventional Clamshell and Label | Conventional Film and Tray | PCR Film and Conventional Tray | BPI Certified Industrially Compostable Film and Tray | Resealable Conventional Film and Tray | Resealable PCR Film and Conventional Tray |
|---|---|---|---|---|---|---|
| **% Increase (+) or Decrease (-) from Reference** | Ref. | -22.56 % | -22.56 % | -24.23 % | -16.95% | -16.95% |

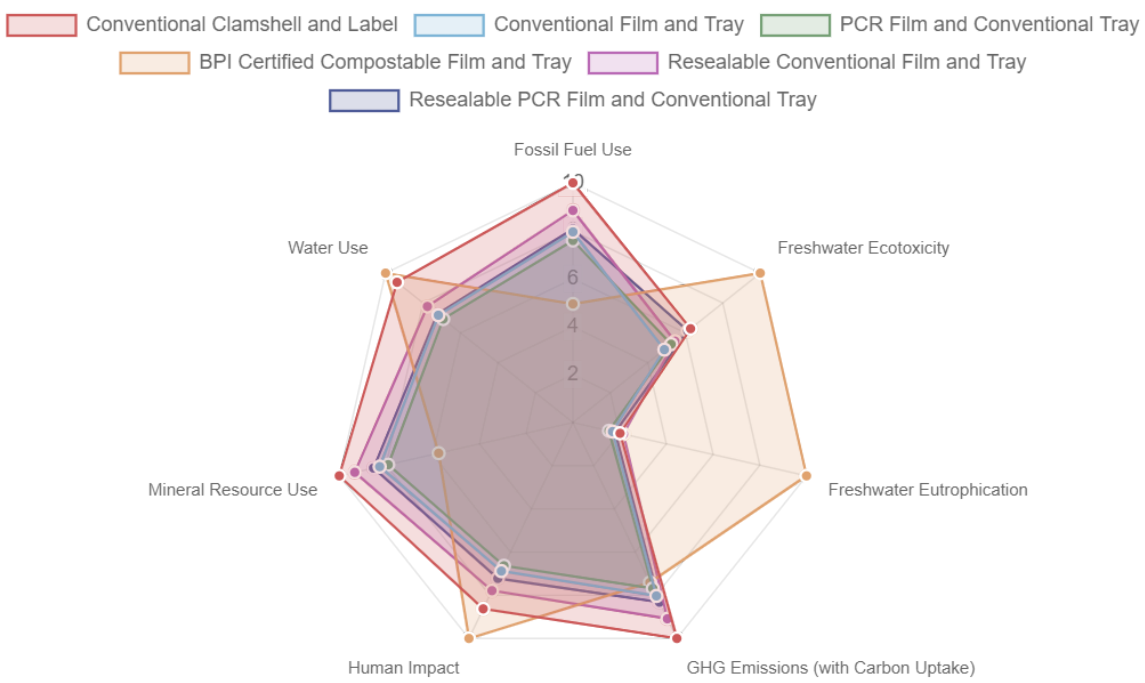


***Figure 1.*** *The overview shown as a spider chart with the selected indicators used in the assessment. It serves as a representation of how the packages compare to each other with a smaller shaded area representing less of an environmental impact.*

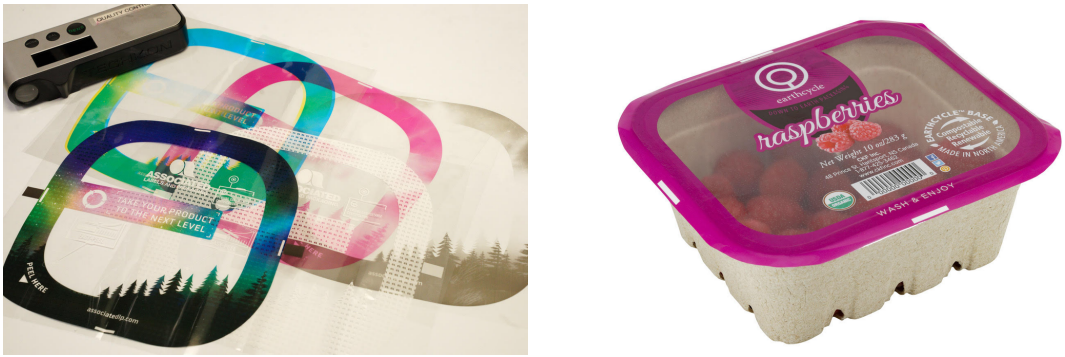


***Figure 2.*** *Measuring ink weights for BPI Certified Industrially Compostable Lidding film and fiber tray*


***Figure 3.*** *Conventional or PCR lidding film and conventional PET tray (single and resealable options available)*

## THE OUTCOME

The progress that Associated Labels and Packaging has made with sustainable packaging in the fresh-foods segment is groundbreaking as it is an area that has been historically a challenge for sustainable innovation as fresh foods have several complex packaging requirements related to their off-gassing, refrigerated storage conditions, and variable shelf-life. From this study, it is clear that there are many alternatives to the conventional rigid clamshell which offer a more sustainable lifecycle, either through reduced packaging weight, the inclusion of recycled content, or through materials with an alternate end-of-life. The data helps stakeholders further understand the differences between these choices and helps brands make decisions that align with their goals.

"Trayak strives to make sustainability mainstream and we're energized by our partnership with One Step Closer and its members," says Nathan McKee, Sustainability Analyst at Trayak. "Every packaging option has tradeoffs in performance, impact, and cost which underscores the importance of using a holistic and data-driven approach to compare sustainable strategies."

It is clear that compostable materials are continuing to gain traction in the market, and for good reason. Although the industrially compostable BOM has a greater footprint in freshwater eutrophication, freshwater toxicity and human impact, there is a dramatic positive climate impact through the reduction of fossil fuel usage and GHG emissions along with reduced mineral resource use. This benefit is further enhanced when coupled with the potential for compostable packaging to divert food waste from landfill to a compost manufacturer where it can be processed and turned back into nutrient-rich soil. However, it is important to consider consumers' limited access to composting facilities. In line with SPC estimations of consumer access to industrially compostable facilities across the United States, this analysis assumed only 11% composting of the industrially compostable tray. Understanding these trade-offs helps industry members make more informed decisions, enabling them to address the downsides through future innovation.

"Experiencing the research and discovery process of Associated's material inputs focused our company's attention to the complexity of the supply systems we are all part of," says Jay Ashworth. "Collecting LCA data makes you zoom in to what's been in front of you, yet hidden the entire time (good and bad). Once you are aware, you have to choose what you are going to do with this new found perspective."

**ABOUT OSC**

The Packaging Collaborative is a coalition of natural food brands, retailers, and component suppliers working together to achieve solutions to one of the most challenging problems facing our industry: packaging waste. Today, the Packaging Collaborative is composed of over 40 leading companies in the natural products industry. We believe that the best way to address packaging is to share our learnings and steer the industry towards leading-edge solutions. Nearly every company is trying to accomplish a similar goal, and by working together, we have the chance to drive an industry shift toward a planet-friendly approach. Learn more at www.osc2.org/packagingcollaborative

**ABOUT TRAYAK**

Trayak is a sustainability software solutions and consulting company. Trayak's mission is to provide its clients with easy-to-use decision tools that can be embedded into mainstream product and packaging development, manufacturing, and launch processes. Learn more at www.trayak.com

**ABOUT ASSOCIATED LABELS AND PACKAGING**

Associated Labels and Packaging is a family owned company in Vancouver Canada with over 40 years of experience. Our focus is on relationship building with companies making purposeful decisions for our industries development and evolution.

Our supporting role is to contribute towards a sustainable packaging systems evolution. We wish to support customers at all stages of their transformation journey to environmental sustainability. Whether starting with stepping stones in design, developg new sustainable products for a circular economy, advocating for waste systems legislation, or regenerating the communities and ecosystems that our packaging impacts.

Our products range from digital and flexographic pressure sensitive labels and packaging. Stand-Up Pouches, Lidding Film, Bar Wrappers, Shrink Sleeves, Sachets, Stick Packs, Roll Stock. Industrially Compostable, Recyclable and PCR stock options available for most packaging options. Recently we have created an industry first, a BPI Certified (#10529287) Industrially Compostable lidding film structure. Learn more about AssociatedLP's products and services at https://www.associatedlp.com/packaging/lidding-film