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ENGINEERING EXCELLENCE

# Packaging Sustainability





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As pressure from consumers, regulators and competitors continues to grow, brands must focus on packaging sustainability now more than ever.

What once was viewed as a “nice to have” feature has grown to become a must for brands in many industries, and sustainability has transitioned from a separate consideration to [an integral part of every packaging decision](#). Advances in process and material technology continue to open new and exciting opportunities for brands to optimize sustainability in primary, secondary and tertiary packaging, and new tools make it easier than ever to evaluate the environmental impact of each stage of a package’s life cycle, from resource extraction through end of life.

The speed at which regulation, material science and the industry’s understanding of packaging’s environmental impact advance can make it difficult for leaders within packaging teams to keep up. This white paper will examine the latest tools available to help packaging departments evaluate progress against their sustainability goals, current best practices for material and design selection, and current and upcoming trends in the regulatory environment surrounding packaging sustainability.





# The Role of an LCA in a Holistic Approach to Packaging Sustainability

A life cycle assessment (LCA) is a comprehensive and systematic analysis of the entire life cycle of a package from material extraction through disposal at end of life.

By quantifying and assessing the environmental impacts associated with each stage, an LCA offers a holistic view of a product's footprint, enabling informed decision making that drives sustainability.

Traditional decision making often centers only immediate factors, but the cradle-to-grave perspective provided by an LCA expands a packaging team's viewpoint to include environmental impacts that might otherwise evade notice, revealing the big picture. This more complete view of the package's life cycle, including metrics such as waste generation, emissions and energy consumption, allows the team to pinpoint the stages with the highest environmental impact, commonly referred to as "hotspots." This knowledge enables targeted interventions to minimize these impacts and enhance overall sustainability. The insights gained from an LCA enable businesses to make decisions that align with long-term sustainability goals and facilitate a proactive approach that anticipates future challenges and potential changes in the regulatory landscape.

The data generated during an LCA allows packaging teams to compare options for materials and processes to identify the most environmentally friendly choice, helping them avoid "regret solutions" – choices that substitute one environmental issue for another. This data also encourages innovation by revealing opportunities for process improvement and new design strategies, enabling identification of resource-efficient materials, designs and processes that help brands align more closely with their sustainability goals.

Stakeholders, including consumers, appreciate businesses that openly address their environmental impact. An LCA arms a packaging team with information they can share with both internal and external audiences to build credibility and, for executives within a company, highlight the value of investing in sustainability. Additionally, as more governing bodies pass environmental regulations, businesses that perform LCAs can ensure compliance and have the data they need to document their compliance, reducing the risk of fines and reputational damage.



# The Role of an LCA in a Holistic Approach to Packaging Sustainability Cont.

The specifics of an LCA can vary depending on its goals and the number of materials, designs and processes it examines, but the basic steps remain the same. The process begins with defining the purpose of the LCA and the boundaries of the assessment, including the life cycle stages to be included and the functional unit of analysis (e.g. per kilogram, per product, etc.).

With that framework in place, the LCA continues with collection of data on inputs, outputs and energy consumption for each stage of the life cycle. This data forms the basis for the following stages, beginning with assessment and quantification of the potential environmental impacts of the collected data on greenhouse gas emissions, water consumption, energy use and/or other metrics defined earlier the process. This quantitative data can then be analyzed to identify hot spots, draw conclusions and make informed decisions. In addition to information that enables holistic decision making, the outputs of an LCA can come together to communicate its findings transparently to both internal and external stakeholders, showcasing packaging's impact on the brand's commitment to sustainability and responsible business practices.





### KEY TAKEAWAYS:

- The importance of recycling
- The need for clear recycling instructions on packaging
- Practical tips for designing recyclable packaging

# Optimizing Packaging for Curbside Recycling

According to [the most recent data from the EPA](#), more than 30 million tons of packaging waste went to landfills in 2018.

While recycling efforts have greatly reduced that total from its peak of more than 43 million tons in 1980, there is still much room for improvement.

For brands pursuing ways to reduce their environmental footprint, recycling is one of the most available tools to combat the packaging waste issue. [Thoughtful design and careful material choices](#) play a crucial role in ensuring that packaging not only protects products during distribution, but also has a sustainable end of life. Curbside recycling represents one of the most visible opportunities for brands and consumers to work together to keep packaging waste out of landfills, and its success relies on consistent effort from both parties.

The first and most obvious approach for brands is to use materials that are widely accepted by curbside recycling programs. Paper, corrugate and other types of fiber-based packaging are the most commonly recycled materials. Aluminum is also commonly recycled. Glass is infinitely recyclable and can be a great option for brands looking for premium packaging options, but many regions within the U.S. lack glass recycling facilities. Certain types of plastic, including PET and HDPE, are also commonly accepted by curbside recycling systems.

In addition to using recyclable materials, it is also important to label packaging with recycling symbols and instructions to help consumers understand the best way to dispose of packaging at end of life.

Beyond opting for recyclable materials, designing packaging with a single material or a small number of recyclable materials that separate easily (e.g. a plastic cap on a glass bottle) is a best practice, as both approaches make responsible disposal an easy task for the end user. More complex, multi-material packaging designs (e.g. combinations of paper, plastic and metals) can be difficult to disassemble and incentivize users to enter the entire package into the waste stream rather than put in the effort required to recycle the individual components. Multi-layered and laminated materials can also complicate the recycling process and lead to additional items being diverted to the waste stream.

Another strategy for optimizing recycling is a common one across all types of packaging optimization – rightsizing. Designing packaging to protect the product while minimizing material use offers many benefits, including making packaging fit more easily in consumers' recycling bins. This includes minimizing the use of plastic films, shrink wrap and dunnage, which are often not recyclable. Unnecessary use of inks, labels, tape and adhesives can all impede recycling efforts.



### KEY TAKEAWAYS:

- The need for reducing plastic use
- Practical tips for phasing out plastics
- Ideas for more environmentally friendly materials

# Options for Reducing or Eliminating Plastic in Packaging

Calls for brands to reduce or eliminate plastics from packaging continue to grow among both consumers and regulators, making it imperative for packaging designers and engineers to understand the available options for alternatives.

While plastic's versatility, barrier properties, light weight and other attributes have made it nearly ubiquitous in the packaging landscape in the 20th and early 21st centuries, phasing out its use in packaging is an achievable goal for most brands.

In many cases, the first option to consider is direct elimination. While plastic's useful characteristics and relatively low cost have made it a standard choice for single-use packaging, it does not serve an essential role in protecting the product during distribution in many situations. [According to the Ellen MacArthur Foundation](#), an estimated 5 to 10 percent of plastic uses in packaging are good candidates for direct elimination.

A good example is the use of clear plastic as a window to provide product visibility within the package. Removing the plastic and leaving an open window in part of the package can create the same visibility without wasteful material use. This may require designers to create a solution for securing the product within the package, but they can accomplish that with more sustainable materials or a significantly smaller amount of plastic.

Beyond direct elimination, there are many material alternatives to consider as replacements for plastic. [Paper-based packaging](#) stands as a reliable and time-tested alternative. Utilizing responsibly sourced and certified paper materials, combined with innovative design, allows for the creation of sturdy and sustainable packaging solutions. Moreover, advancements in paper manufacturing processes have enabled the production of water-resistant and barrier-coated papers, expanding their potential applications across a wider variety of packaging needs.

Other alternatives similar to paper-based materials are [natural fibers](#) such as jute, hemp, bamboo and flax, all of which can be used to make sturdy packaging components that are biodegradable after use and, under the right conditions, compostable. Another fast-growing development in the materials space is mushroom-based packaging, which is especially useful as an alternative to EPS foam and plastic trays for interior packaging components.



## Options for Reducing or Eliminating Plastic in Packaging Cont.

Traditional plastics have long been the default choice for packaging due to the factors outlined above, but recent advancements in material science have given rise to innovative biodegradable and compostable options. Materials such as PLA (polylactic acid), PHA (polyhydroxyalkanoates) and starch-based bioplastics offer comparable performance to conventional plastics while being more environmentally friendly. It's important to thoroughly vet materials marketed as bioplastics, as they aren't always the most sustainable option. In many cases, bioplastics are best reserved for brands that are unable to eliminate plastic outright, but only after they've conducted a thorough review of the types of materials available and the tradeoffs they offer from durability and sustainability standpoints.

As plastic production continues to grow, the battle against its accumulation in landfills and the natural environment also requires collaborative efforts from all stakeholders in the packaging industry. Engaging in industry-wide initiatives, sharing best practices, and participating in research and development endeavors can accelerate the adoption of sustainable packaging solutions. By fostering a culture of collaboration, the packaging industry can collectively address the challenges posed by plastic waste and work towards a more sustainable future.





Design That Prioritizes  
Sustainability

**KEY TAKEAWAYS:**

- Design's impact on sustainability
- Practical tips for more sustainable design
- Key considerations for material compatibility

# The Role of Design in Optimizing Packaging Sustainability

In the pursuit of sustainable packaging solutions, design can be a powerful catalyst for change.

A brand's commitment to minimizing its environmental footprint extends beyond material choices to include the fundamentals of how they ideate, create and commercialize packaging designs. Design that prioritizes sustainability goes beyond aesthetics to include a holistic approach that accounts for the entire life cycle of the package. Designing with sustainability as a priority allows packaging teams to create solutions that both fulfill their primary functions and minimize environmental impact from raw material extraction through end-of-life disposal. By adopting a comprehensive view, designers can identify opportunities for optimization and innovation at every stage.

A fundamental design approach to many packaging optimization priorities is rightsizing. In the context of packaging, rightsizing refers to optimizing size, dimensions and material thicknesses to accommodate and protect the product while avoiding wasteful overpackaging. Through rightsizing, designers can reduce the overall environmental impact of packaging by minimizing material usage and producing less waste at the end of the package's life. In addition, streamlining packaging dimensions and weight also helps to fit more product in each shipment at a lower per-unit weight, reducing fuel consumption and emissions tied to transportation.

The structural design of packaging holds immense potential for sustainable innovation. By reimagining the form and function of packaging, designers can create solutions that maximize functionality while minimizing waste. Smart structural design can lead to packaging that is easily collapsible, stackable or modular, reducing storage and transportation requirements and further contributing to overall sustainability.

Designing for sustainability requires careful consideration of material compatibility. Hybrid designs, which combine different materials strategically, can leverage the strengths of each while mitigating their individual weaknesses. By selecting materials based on their unique properties and optimizing their combinations, designers can create packaging solutions that are both effective and eco-friendly.

The success of sustainable packaging hinges on consumer acceptance and engagement. Design plays a pivotal role in creating packaging that is not only environmentally responsible but also resonates with consumers. By incorporating elements that enhance the user experience, such as easy recycling instructions, appealing aesthetics and functional features, designers can encourage positive behaviors and foster a deeper connection between consumers and sustainable packaging practices.

By embracing holistic design thinking, rightsizing, innovative structural design, material compatibility and user-centric approaches, packaging designers can elevate a brand's commitment to environmental stewardship. Dedication to optimizing packaging sustainability through thoughtful and innovative design helps a brand put its values into practice and demonstrates its commitment to sustainability to consumers.





## Leverage Expertise

- KEY TAKEAWAYS:**
- The value of collaborative supplier relationships
  - Importance of sourcing packaging materials responsibly
  - Suppliers' knowledge of innovative new materials and packaging technology

# Working with Suppliers to Advance Sustainability Priorities

Collaborating with suppliers is crucial in the pursuit of sustainable packaging solutions.

By involving suppliers in the early stages of the design process, packaging teams can leverage their expertise and insights into innovative solutions and cutting-edge technologies for reducing waste, carbon footprint and other sustainability metrics.

Information suppliers can provide includes any third-party certifications available for their materials and compliance with standards such as [ISO 14001](#), an internationally recognized standard for environmental management systems. They can also provide transparency and traceability for the origin of their materials, their manufacturing processes and any third-party audits they've done to verify sustainability claims.

This information can help brands confirm the packaging materials they purchase are responsibly sourced. By choosing materials that are sustainably sourced and manufactured, packaging teams can contribute to the preservation of natural resources, minimize deforestation and reduce greenhouse gas emissions. It can be impactful to reduce or eliminate plastic use in packaging by substituting more environmentally friendly materials, but implementing paper-based materials that aren't responsibly sourced can lead to deforestation – a regret solution that swaps out one sustainability challenge for another.

Additionally, responsibly sourced materials often offer improved functionality and performance. Many sustainable alternatives are designed to be lightweight and durable with a lower carbon footprint than traditional materials. This not only reduces transportation costs but also helps optimize the packaging process, leading to increased efficiency and decreased waste. As the options for sustainable packaging continue to evolve, collaborating with suppliers allows packaging engineers to stay at the forefront of these developments and incorporate them into their designs.

Thorough communication with suppliers can be especially helpful when considering post-consumer recycled (PCR) materials or biopolymers. PCR plastics, paperboard and corrugate offer closed-loop solutions that minimize waste and conserve resources. Biopolymers derived from renewable sources, such as cornstarch or sugarcane, are gaining popularity as sustainable alternatives to conventional plastics because they can break down naturally much faster than conventional materials, reducing the accumulation of packaging waste.

Collaborating with suppliers who specialize in these materials can provide access to cutting-edge technologies and materials in this domain, along with insights that help brands determine if they're viable solutions for their products' packaging needs.



**KEY TAKEAWAYS:**

- Biodegradable and compostable defined and differentiated
- Applications for biodegradable and compostable materials
- How to determine if these materials are viable for your products and packaging needs

# Opportunities for Compostable and Biodegradable Packaging

In the pursuit of sustainability, the focus on compostable and biodegradable packaging materials has gained significant traction.

When discussing these two attributes, it is helpful to start with a clear understanding of the differences between the terms.

*Biodegradable* refers to materials that can be decomposed by microorganisms such as bacteria and fungi. This designation can be tricky for both brands and consumers, as just about any material can biodegrade over a long enough time period when exposed to conditions such as sunlight, moisture and the presence of microorganisms. Few people would consider traditional plastics biodegradable, but if you consider the span of hundreds of years, the definition fits.

*Compostable* can be a much more meaningful designation, as it refers to materials that break down into non-toxic, natural elements under well-defined conditions and in a specific amount of time. Because the conditions for composability are well defined, organizations in many global territories issue certifications brands can use to market their product's packaging as compostable, but no such certifications exist for biodegradable materials.

The resulting compost can be used to enrich soil, completing a closed-loop, circular life cycle. Companies embracing compostable packaging contribute not only to waste reduction but also to the creation of valuable organic matter that supports agricultural sustainability. Still, brands must be careful when describing materials as compostable, as there is a significant difference between materials that will break down efficiently in consumers' home compost setups and ones that require the specific conditions present in a commercial/industrial composting facility.

The commonality between biodegradable and compostable materials is that they can combat the buildup packaging in landfills or, worse, as pollution in the natural environment, by minimizing the time it takes materials to break down and disappear. Products such as coffee pods, tea bags and some food items can be good candidates for compostable packaging, as the remnants of the product left behind in the packaging can also compost and contribute to healthy soil as a byproduct.

While compostable and biodegradable packaging offer promising solutions, it is essential to address challenges such as performance, cost and industrial composting infrastructure. Striking a balance between functional requirements and sustainability goals requires careful consideration and an innovative approach. Collaborative efforts within the industry can contribute to overcoming these challenges and further drive the adoption of compostable and biodegradable packaging.



## Opportunity to Save

- KEY TAKEAWAYS:**
- The intersections of sustainability and cost savings
  - Examples of packaging options that advance both

# Approaches to Improving Sustainability While Optimizing Costs

While the focus of this e-book has been on optimizing packaging for sustainability, several of the approaches covered in previous sections double as opportunities to reduce costs, making them extremely valuable for brands that perpetually seek new ways to enhance their bottom line.

Rightsizing packaging reduces material use, which reduces costs in addition to cutting waste. This approach generally results in smaller packages, which means more product in each shipment and fewer shipments overall – a great opportunity to save on distribution costs.

This is an approach that can benefit greatly from working closely with suppliers, along with support from an experienced packaging engineer. The supplier should know their materials and understand options for reducing size, and a packaging engineer familiar with the needs of your product and its distribution environment can ensure that changes made to optimize costs and sustainability don't sacrifice product protection.

Another approach with benefits to both sustainability and cost is [switching from pallets to slip sheets](#) for unitized loads. Slip sheets made from corrugate are completely recyclable and less costly than wooden pallets. Their lower profile also creates more headroom on trailers and shipping containers, enabling more product in each shipment.





**KEY TAKEAWAYS:**

- A packaging department's role in ESG reporting
- Role of ESG reporting in communicating brand values
- ESG's impact on regulatory compliance

# The Impact of Packaging Sustainability on ESG Programs

Environmental, Social and Governance (ESG) programs have been a hot topic for brands across many industries in recent years, and packaging can play an important role in shaping positive ESG scores.

Sustainable packaging programs can have a significant impact on both the environmental and governance aspects of ESG, and data from packaging teams can support ESG reporting for companies from global Fortune 500 brands to startups. Thorough reporting helps brands signal to employees, investors, consumers and other stakeholders that they take these issues seriously and are pursuing measurable goals that align with the brand's values.

Setting aggressive sustainable packaging goals and demonstrating steady progress against them can provide an excellent opportunity to show a brand's commitment to controlling its impact on the environment. Phasing out plastics and other potentially harmful materials is a pillar of many brands' sustainability goals, along with common priorities such as decreasing CO2 emissions, reducing waste within manufacturing facilities, leveraging recycled and/or recyclable materials, and sourcing materials throughout the supply chain sustainably. The data and other insights packaging teams can provide are important for demonstrating clear, measurable progress against these initiatives for reporting purposes.

Packaging departments' influence on the governance aspect of ESG is more limited, but impactful nonetheless. While governance covers a variety of topics including board composition, executive compensation and, for publicly traded companies, shareholder rights, it also includes [regulatory compliance](#). With sustainability-focused regulations such as extended producer responsibility (EPR) on the rise globally, ensuring packaging remains compliant, maintaining documentation that demonstrates the work done to ensure compliance and tracking potential regulations that may impact packaging in the future are all ways a skilled packaging team can support strong governance within the framework of an ESG program.



### KEY TAKEAWAYS:

- The rapidly evolving regulatory landscape for sustainability
- EPR definition and current state of EPR legislation
- Practical tips for EPR compliance

# An Overview of Current and Potential Regulations for Packaging Sustainability

The regulatory landscape relevant to packaging is always evolving.

Brands in the food & beverage and life sciences industries are likely very familiar with U.S. regulations that cover packaging for their products from a health and safety perspective, but regulations specific to sustainability are relatively new.

Because of the attention they receive outside of packaging circles, local- and state-level regulations restricting plastic bags, straws and other single-use plastics are the most widely discussed. These regulations are more relevant

to retailers and restaurants than they are to brands that manufacture and package goods, but they're important to understand for companies in those industries.

A larger concern for brands in packaged goods industries is [EPR regulations](#). EPR makes producers financially and operationally responsible for the end of life of their products. For packaging teams, this means responsibility for all packaging used to ship the product.

As of 2024, only four states – California, Colorado, Maine and Oregon – have passed EPR laws, but state legislatures in Maryland, Massachusetts, New York, Rhode Island, Tennessee and Washington all introduced EPR bills in 2023. A primary goal of EPR is to increase funding for recycling programs by shifting costs away from cash-strapped state and local governments and onto the producers. [A study published by The Recycling Partnership](#) found that in seven jurisdictions around the world, recycling rates for packaging and printed paper increased significantly after EPR laws went into effect. A secondary benefit may be an increase in the availability of PCR packaging materials.

As EPR laws continue to spread in the U.S., packaging teams will have a strong incentive to reduce the material used in their packaging, leverage recyclable materials whenever possible and [consider reusable packaging programs](#). Compliance with EPR regulations will likely also require brands to document, maintain and share data on the types of regulated materials they use, material weights, sales quantities and other sustainability metrics.



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## Conclusion

Opportunities to optimize sustainability can be found in nearly every packaging project.

Understanding the available options, each product's unique packaging requirements and the tradeoffs associated with packaging sustainability requires experience and deep knowledge of both packaging engineering principles and sustainability strategies. In-house packaging teams consumed by the many day-to-day priorities associated with keeping packaging lines running smoothly and ensuring quality may not have the time or the specialized knowledge a thorough sustainability program requires.

This is an area where Adept Group's skilled team can be a valuable asset. We have experts in more than 60 specialized packaging disciplines, including sustainability, and we have valuable experience helping brands like yours implement sustainability strategies and meet their goals. If you'd like to discuss the ways we can help you tackle your sustainable packaging priorities, [get in touch](#).

