Packaging and Sustainability: Achieving More Sustainable Confectionery Packaging

The efforts of the confectionery industry to be more sustainable should focus on lowering the environmental impact of food waste, more so than striving to reduce packaging and disposal.

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Although everything we as humans do has some sort of impact on the environment, we have the ability to lower this impact. Progress in our sustainability work has been made, but there is much work to do. The efforts of the confections industry in being more environmentally friendly are best focused on lowering environmental impact, more so than striving to end plastic waste and materials through disposal.

In embarking on the path to achieve more sustainable packaging, it is important to take a step back and look at what we have accomplished thus far, as well as look toward the work we need to do. In this article, we explore a brief history of sustainability, detail sustainable sourcing and disposal in place and operating today, and look at fundamental shifts needed to make meaningful progress in achieving a more sustainable confectionery industry.

A BRIEF HISTORY ON WAVES OF SUSTAINABILITY

Essentially, we have transitioned through four principal waves of sustainability over the last century (Figure 1). The first wave took place in the 1920s. Consumer packaging at that time was comprised of glass, metal, wood, paper, fiber and pottery. This was years before cellophane's widespread use as a packaging material for food.

The second sustainability wave took place during the late 1960s, arising due to environmental stresses. First published in 1962, author Rachel Carson's Silent Spring novel documented the harm of pesticides, opening our minds to how much environmentally was going wrong. The Cuyahoga River in Cleveland, Ohio, was literally burning due to pollutants, while weather inversions were trapping toxic emissions in London and New York City.

Environmental successes in this second wave included the founding of Earth Day April 22, 1970 and the creation of the Environmental Protection Agency signed into law by President Nixon December 2 of that year. Curbside recycling also began during this wave, although food packaging at that time was limited.

The third sustainability wave began in the late 1980s, when packaging began to take center stage as businesses became ➤

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more engaged in packaging's global supply and disposal. Corporate sustainability movements such as Triple Bottom Line, People-Profit-Planet and Corporate Social Responsibility emerged.

Much progress was made during this wave to reduce the environmental impact of packaging. Driven by cost-cutting and compliance, packaging was converted from glass to plastic, lightweighted and aligned with Duales System Deutschland's Green-Dot, which ultimately became Extended Producer Responsibility (EPR), a strategy to add all of the environmental costs associated with a product throughout its life cycle to the market price of the product.

The term "greenwashing" entered our vernacular, referring to deception used to persuade the public that an organization's products, aims and policies are environmentally friendly. Ultimately, more than 300 definitions of sustainability were found to be in use during this wave (Brundtland and Khalid 1987).

Currently, we are in a fourth sustainability wave. The good news is that the positives are outweighing the negatives. On the positive side, this wave has been characterized by an emphasis on lowering the environmental impact on the entire food system, including the impact of food as well as packaging waste, and the development of the UN Sustainable Development Goals on food waste and packaging.

Another positive note is a better understanding that packaging has emotional power, and the unique position and power of retailing to influence purchasing decisions. Material science is being applied to sourcing and disposal, with advances being made in bio-derived plastics, limited scope compostables and better chemical and mechanical recycling.

The somewhat confusing and negative side of this fourth wave involves public material battles within the packaging industry, a lack of a proactive approach to chemicals of concern, an attitude that "we have been here before" from leaders and a lack of focus on the general need for recyclables collection and sorting.

Additionally, consumers are being guided by social pressure instead of science, with misguided, not fact-based purchasing decisions. Furthermore, legislation and investment lack a scientific basis for decision making while brands are being bullied into bad actions.

The confusion created by the various definitions of sustainability has been compounded (Boz et al. 2020). In the U.S., we have a 1970s-era recycling system unable to handle much of the flexible packaging associated with the confections industry, and into this void has fallen "snake oil" solutions that often serve to justify them- ➤

The Four Waves of Sustainability

Wave	Time period	Sustainability issues
1st wave	1920s	Packaging comprised of glass, metal, wood, paper, fiber and pottery Years before cellophane was in widespread use for food packaging
2nd wave	Late 1960s	Rachel Carson's Silent Spring published documenting pesticide harm Major water and air pollution occurring Founding of Earth Day April 22, 1970 Environmental Protection Agency signed into law December 1970
3rd wave	Late 1980s	Packaging takes center stage Corporate sustainability movements, corporate social responsibility emerges Packaging converted from glass to plastic and lightweighted Extended Producer Responsibility (EPR)
4th wave	Present	"Snake oil" solutions not based on sustainability merits Greenwashing and eroding consumer trust Material science begins to be applied to sourcing and disposal Increased food waste awareness and lowering impact on entire food system

Figure 1

selves while not based on sustainability merits. For example, we are now inundated with new inventions such as packaging from food (mushrooms, seaweed) and are faced with unhelpful new terms and schemes such as those of TerraCycle, a recycling business facing legal difficulties over recycling claims.

Although challenging, for those interested in truly committing to lowering the environmental impact of packaged food, and specifically with confections, this noise is best ignored. A focus on packaging to prevent food waste while being more sustainable in this effort is what is needed. We outline some important details regarding this focus below.

TOWARD A MORE SUSTAINABLE CONFECTIONS INDUSTRY

Preventing Food Waste

The first positive in the fourth wave above is a focus on lowering the environmental impact of the entire food system. This focus represents significant progress and much of the industry's recent efforts. Looking at packaging in the light of food waste prevention pinpoints the strategic role packaging plays. This is powerful for the packaging industry and confectionery producers that link their consumer branding to our planet's health. Additionally, we are seeing investment in more sustainable packaging science to prevent food waste within the confections industry, aided by data-driven attention on the power of packaging. This attention will make the confection industry more sustainable as well as address chronic ingredient shortages.

Interestingly, the confections industry is often ignored in food waste analyses, and data about the industry's waste generation is lacking. This is an oversight because much of the approach to sustainable package design, extended shelf life and food waste reduction exercised in the confections industry can be applied to other categories. Furthermore, packaging's role in moving the dial on a more sustainable food system, including that of confections, is more appropriately focused on preventing food waste. The rationale behind this expanded focus is that the environmental impact of food waste exceeds that of packaging. In fact, if food waste were a country, it would rank third in CO_2-equivalent emissions behind China and the United States. More sustainable packaging prevents food waste.

Oxidation of unsaturated fats and moisture loss/gain (Figure 2) characterize the role of packaging in providing barrier pro-

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Preventing Moisture Loss or Gain

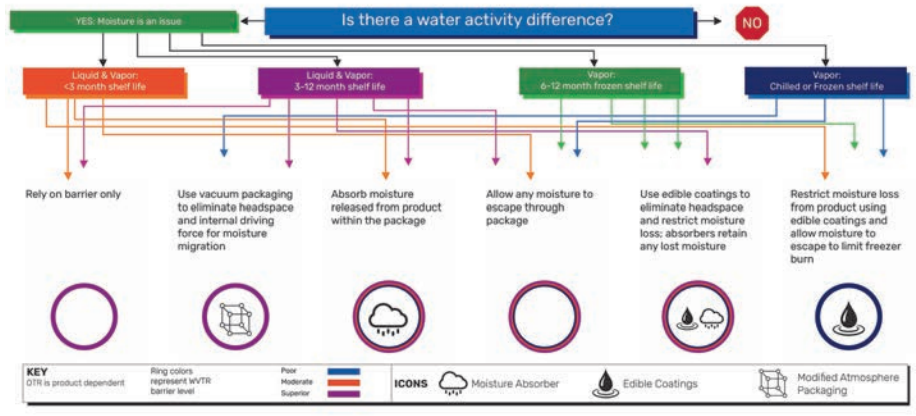

Figure 2 *Credit: Kate Dembowski*

Assessing the environmental impact of packaging is complex and requires careful attention to what is included in assessment analyses.

tection, while tensile strength and impact-resistance align with what is needed in high-speed production and distribution environments. For example, to prevent the oxidation (Figure 3) of unsaturated fats, retard moisture loss and keep microbes under control, different packaging solutions are employed based on desired product shelf life. Therefore, a life cycle assessment (LCA) that includes both food waste along with packaging is essential. Assessments have shown that the environmental impact of food waste far exceeds that of packaging (Poore and Nemecek 2018).

A Focus on Materials

Assessing the environmental impact of packaging is complex and requires careful attention to what is included in assessment analyses. At a minimum, both sourcing and disposal need to be considered. Additionally, specifics must be determined such as distance from source to packaging converting, use within a food manufacturer and collection/disposal/reuse/recycling and the environmental cost or energy created in its decomposition or destruction.

Sourcing

Much of the focus on sustainability in packaging has focused wisely on sourcing. This is because 95 percent of the environmental impact of packaging is due to the material source versus its disposal. Thus, reducing packaging has the most impact on the environment regardless of material. Reducing headspace and increasing product/package direct contact reduces the amount of packaging necessary. It is important to carefully consider the ramifications of price-pack-architecture and similar rightsizing of packaging that result in less food waste but proportionally more packaging per product weight and/or improved barriers.

For example, as a candy bar size increases from 0.35 oz mini-size to 0.65 oz fun-size to a full-size bar, the package-to-product ratio declines, therefore, less packaging is used per ounce for larger size bars. Also, because of the proportionally higher surface area with the smaller size bars, the barrier requirements are higher for smaller bars than for larger size bars. If the material is identical, the shelf life will be lower and more barrier may be needed in the outer secondary packaging. Interestingly, smaller packaging size reduces food waste, which is further complicated by commitments made to reduce calories.

Sourcing can be viewed as principally originating from four sources:

1. Biomass-derived (trees and crops), including paperboard, polylactic acid

Preventing Oxidation

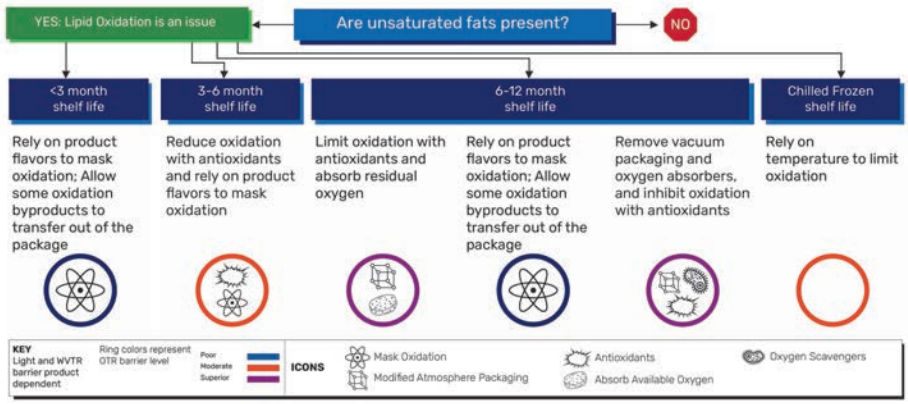

Figure 3 *Credit: Kate Dembowski*

(PLA) materials and some coatings
2. Biomass-derived (agricultural waste), including bPET, bPE plastics and some coatings
3. Fossil-derived (oil), including PET, PE, PP, PBAT plastics and some coatings
4. Earth-derived (extraction), including sand for glass, bauxite for aluminum and iron for steel

Switching from one material to another within these four sources does not significantly alter environmental impact because growing and harvesting (in the case of trees and crops) and extraction (in the case of oil) have a fairly equal impact. However, switching to a recycled version, using less within a category or sourcing from a closer proximity does significantly lower the environmental impact. Progress in using nanocellulosics derived from agricultural waste versus using corn, mushrooms and seaweed as sources holds promise.

Other factors to consider when moving from source to source that can be determined via a thorough LCA can be seen in Figure 4. The last social factor, toxicological impact of chemical use, is a focus of concern since chemicals used as processing aids, inks and coatings such as bisphenol A (BPA) can impact human health (Sand 2022; Groh 2021).

Disposal

Recycling, reuse, waste-to-energy, landfilling and decomposition are all options for more sustainable packaging disposal (Figure 5). Some in the confections industry have successfully converted to recyclable structures, such as Nestlé *YES!* and *Smarties* brands now being sold in recyclable packaging (Figure 6). Design innovations that allow for a mono-material or ease of consumer separation of layers enable increased recyclability. As infrastructure expands and consumer awareness of store drop-off recycling programs increases to handle collection and sorting of small recyclable packaging, it is anticipated that more of these materials will be recycled.

Recycling using local store drop-off collection such as that being used by MBOLD, a coalition of Minnesota-based food and agriculture businesses and nonprofits, will make a more significant impact (2022). In short, disposal is an energy-efficient means of packaging collection, sorting, recycling and reuse.

Of note, there is less environmental impact when switching from a recyclable plastic-coated paper-based thicker structure to a metallized thinner-gauge plastic structure that allows waste-to-energy incineration and results in less food waste and manufacturing efficiency. Conversely, shipping reusable or recyclable packaging larger distances has an unfavorable environmental impact. Lastly, switching from one non-recyclable structure to another has minimal impact unless the amount of material used can be decreased.

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Sourcing Considerations

Environmental	Social
• Greenhouse gas emissions	• Food security
• Eutrophication	• Land use change impact
• Stratospheric ozone depletion	• Local and/or indigenous communities
• Loss of biodiversity	• Occupational health and safety
• Soil carbon depletion	• Water management
• Soil erosion	• Co-product and waste management
• Deforestation	• Labor rights
	• Toxicological impact of chemical use

Figure 4

More Sustainable Packaging

Figure 5 *Credit: Kate Dembowski*

By focusing on the value chain, we begin to see a new, more sustainable confections system involving product, process and packaging.

FUNDAMENTAL SHIFTS IN MORE SUSTAINABLE PACKAGING

While sourcing and disposal can be optimized for reduced environmental impact, much of this low-lying fruit has already been picked over the years, thanks to the efforts of packaging professionals. However, fundamental shifts in packaging are needed to make more progress. This involves product/process/packaging driven by the value chain.

To gain a glimpse into a world with a fundamental sustainability shift, consider what the confections industry would look like without it. Where and how would sweetness, savory and deliciousness be sourced, and how would these ingredients be processed and delivered to consumers? The value chain includes consumers who want what they want when they want it, retailers who want readily stocked and tracked merchandise, and post-consumer recyclers who want to handle only higher-value packaging. By focusing on the value chain, we begin to see a new, more sustainable confections system involving product, process and packaging. Consider the following examples.

Example 1: Flipping the Barrier

Flipping the barrier from primary to secondary packaging and providing confections consumers with a minimal or no barrier at all on products, would involve applying well-honed confectionery skills in edible coatings (chocolate is a wonderful water vapor barrier). While all candy certainly cannot be unwrapped, some clearly can. Examples include unwrapped *Rollo's*, *Butterfinger* and *Starburst*. If this concept was extended to allow for reusable high-barrier bags to provide protection for longer-term storage at distribution and retail, with minimal barriers for short-term use by consumers, a new packaging system could emerge. This would enable using reusable high-barrier packaging with minimized consumer packaging. If the system is not altered, and minimal barriers are placed on primary packaging without a change in outer or secondary packaging, high food waste or much shorter shelf life will result. Instead, food waste can be reduced while packaging is minimized (Sand 2019).

Example 2: Beta Packaging

Beta packaging is designing packaging to change once the product leaves the manu-

Recyclable Packaging Alternatives

Strategies to employ recyclable packaging verified as recyclable

Package coating and forming innovations

Design innovations: recycled packaging, integrated lidding

Product coating and wrapper coating innovations

Figure 6

facturer. This is in contrast to the current practice in which we strive to ensure packaging is as stable as possible from manufacturer to consumer. Instead, beta packaging focuses on package alteration from manufacturer to consumer, for example, allowing the packaging itself to add ingredients. There are multiple scenarios for this advanced form of active packaging.

One scenario involves the injection of key flavors or ingredients at a secondary manufacturing facility. Another involves sensing and then adding preservatives to extend the shelf life of the food if needed. A third example is the use of packaging to enrobe fragile compounds, which are then released into the food when needed or after distribution. This third example allows for the same product to be packaged while differing package variations can release unique and protected ingredients, an intriguing concept, since this capability could enable agility and align with consumption and marketing goals for both consumers and retailers.

Essentially, beta packaging allows for packaging to extend the shelf life of foods, creating more environmentally efficient processing and packaging. Other examples of re-thinking the concept of reducing packaging can include delivering food to consumers through in-store factories and also mobile confection processing factories.

SUMMARY

The confection industry has a unique ability to relay positive imagery and goodwill to consumers through its branding efforts. Conveying this positive imagery towards a more earth-friendly, sustainable perception through packaging disposal is a challenge. The industry is making much progress in the direction of increased sustainability and, with this, promise in the fundamental shifts necessary to achieve a more sustainable confections system. □

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