Capgemini

UNPACKING THE **FUTURE OF PACKAGING**

BIOPLASTICS ARE POISED TO TRANSFORM THE PACKAGING INDUSTRY BUT MANUFACTURERS MUST BE PREPARED TO ADDRESS A RANGE OF CHALLENGES

Societies are striving to become more sustainable, and the amount of waste generated by people and industries has come under intense scrutiny. Packaging has been identified as a prime candidate for waste reduction – especially packaging made using traditional, petroleum-derived plastics. Fortunately, more sustainable materials are being developed and introduced that provide all the benefits of traditional plastic packaging while contributing to the goal of waste reduction.

But for these more environmentally responsible alternatives to make a real, meaningful impact, companies that use packaging – and their customers – need to know these new options exist and demand they be used. Packaging suppliers and users must also be aware that some alternatives come with their own challenges, so it's a good idea to stay abreast of emerging materials science. And packaging manufacturers must look beyond product performance and cost to ensure they're ready to address a broad range of issues – from supply-chain resilience to consumer awareness and buy-in – that could impact their business.

TRADITIONAL PLASTIC PACKAGING:
POPULAR YET PROBLEMATIC

Packaging serves several important purposes – including containing the product, providing labeling and branding space, and securing it for safe and convenient transport. Since the mid-20th century, plastics have emerged as an important material for packaging and there are many good reasons for this. For example, plastic is light, it's easy to fabricate – even into complex shapes – and it's water resistant. That makes it ideal for a broad range of applications – including bottles for liquids, clamshells and trays, custom inserts that secure products inside boxes, cling wrap, and packing fillers such as peanuts and airbags.

But traditional plastic packaging also comes with a price.

Extraction and processing of petroleum used for traditional plastics generates carbon dioxide emissions that contribute to climate change.

Plastic packaging that's improperly disposed of at the end of its life can damage ecosystems – for example, by clogging bodies of water. The Ocean Cleanup, a non-profit organization dedicated to addressing global water pollution, notes there are currently more than five trillion pieces of plastic littering the world's oceans, with 1.15 to 2.41 metric tons of plastic added each year.

When plastics break down into microparticles and nanoparticles they can be ingested by living organisms. In *Should we worry about the accumulation of plastics in human organisms?* – a 2022 article published by *The Lancet* – researchers noted that people are likely ingesting plastics on a daily basis, at a rate that could top thousands of particles per day.

Packaging made from these plastics is particularly problematic. In studying the issue, Capgemini has determined almost 50 percent of all plastic produced is used for packaging. At the same time, packaging only constitutes about 10 percent of all plastics collected for mechanical recycling – which means most of the plastic used for packaging is being improperly disposed of at end of life. And because most packaging tends to be discarded after a single use, its lifespan is relatively short. This makes several issues worse, from the energy consumed to extract and process petroleum to the volume of plastic waste packaging generates.

FROM PETRO TO BIO

Biobased polymers – also known as bioplastics – have been identified as an effective way to address these challenges because they can easily be substituted for traditional, petroleum-derived plastic packaging. These bioplastics have developed in four generations.

The first generation consists of bioplastics produced from oilseed, starch, and sugar crops. These same crops have also been used for biofuel. While effective, this generation's reliance on arable land and other resources put it in direct competition with growing plants for food. As an example of the problems this can create, when American farmers started growing corn to supply the bioethanol industry, the country had to start importing corn to meet its food needs.

The second generation of biobased polymers is manufactured from plant waste such as straw, sawdust, and bagasse – a waste product from sugarcane. The waste material is referred to as lignocellulose and while it's less problematic than creating bioplastics from edible plants, there are competing uses for this waste. For example, lignocellulose is the most abundantly available raw material for the production of biofuels and certain types may also be used for fertilizer.

The third generation consists of bioplastics manufactured using protein- and carbohydrate-based polymers harvested from microalgae. These are biodegradable and environmentally friendly – and can even be sourced from invasive species such as certain types of seaweed. However, this solution is currently difficult to scale up to full industrial production for several reasons, including land development and fertile soil planning.

The forth generation of bioplastics is made from proteins and lipids sourced from animal byproducts and waste – including casein, whey, fats, gelatin, chitin, and chitosan. For example, whey from cheese making can be used to produce plastic films, livestock waste such as pig manure can be used to make polyurethane, and chitosan can be used as a coating to provide paper packaging with a moisture barrier. However, similar to the first and second generations, the raw materials for these bioplastics are also in demand for other applications – from cosmetics, to fertilizer, to food supplements.

SUCCESS STRATEGIES FOR LEVERAGING **BIOPLASTICS** IN PACKAGING

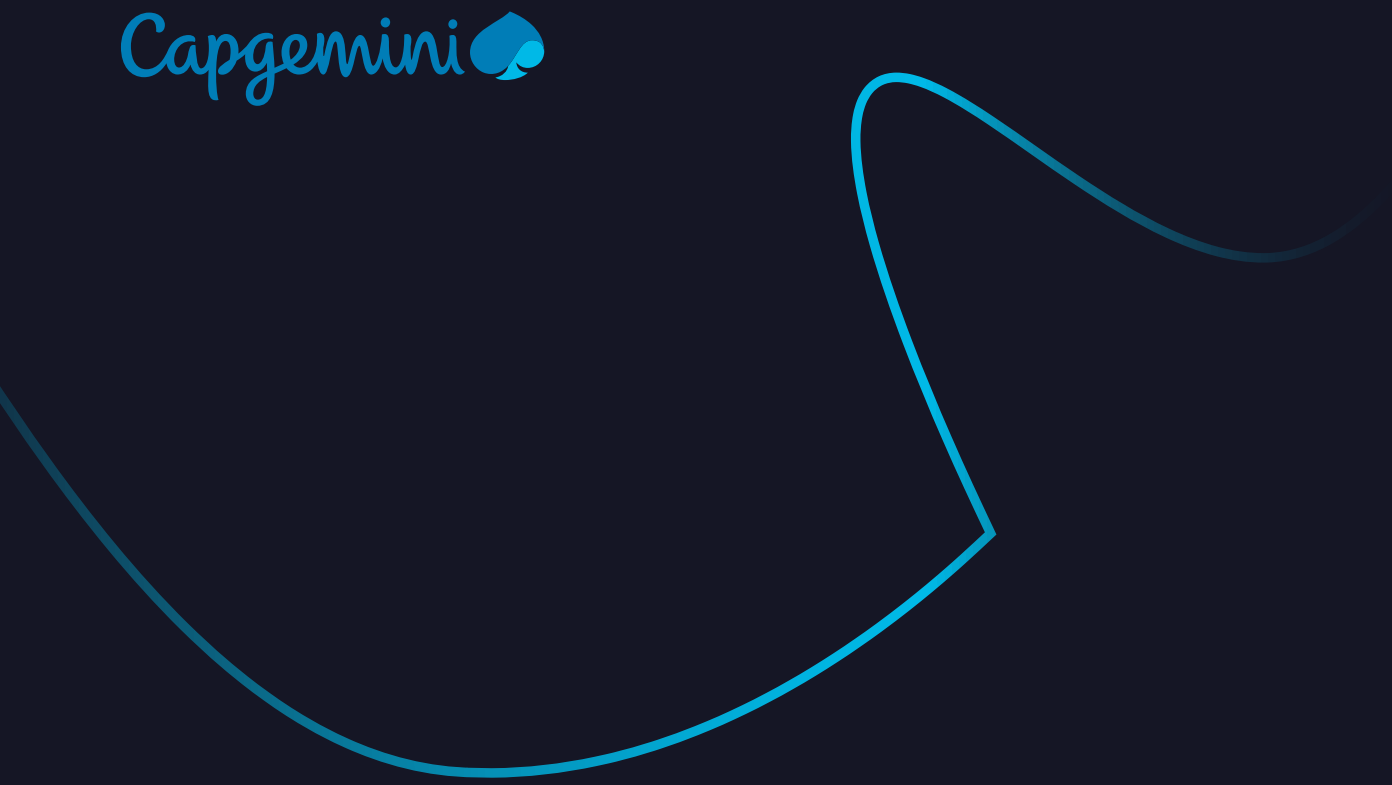
Bioplastics will play an increasingly important role in the evolution of the packaging industry. As the sector looks to take advantage of these materials, here are some strategies Capgemini recommends.

Packaging suppliers should diversify as broadly as possible the bioplastics used to produce any given type of packaging, to limit their exposure to supply-chain disruptions.

Bioplastics producers should consider the entire lifecycle of the raw materials used – from extraction to recycling – with the goal of enhancing the value of the product while minimizing waste.

The environmental benefits of bioplastics will not be realized if higher prices discourage their adoption, so packaging manufacturers must remain aware of the cost implications of any changes they make to the products they create. Ideally, the price of packaging made with biobased polymers should be comparable to the same type made with petroleum-derived plastics. This is especially important when the packaging will be used for consumer goods, where price sensitivity could affect purchasing decisions.

Above all, the evolution to more sustainable packaging materials is a significant and ongoing transition that affects not only packaging manufacturers, but also their customers – and their customers' customers. Capgemini therefore advises packaging manufacturers to craft an agile, resilient business strategy and to collaborate closely with their key suppliers, partners, and customers to help everyone successfully navigate this transformation.



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To learn more about Capgemini's research into the use of bioplastics for packaging products and its business strategies for packaging manufacturers, please contact:

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