



WHY WE NEED BIOPLASTICS

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SUMMARY

Plastic. It's causing a lot of environmental problems, but we need it.

The quantity of plastic packaging in the food and consumer goods industries is part of the problem. Yet at the same time, tons of food end up in landfills every year. Petroleum-based plastics don't truly biodegrade or compost. However, in order to preserve food and other items, packaging is still needed.

Plastic bans by governments, cities, and stores can help to cut down on the amount of plastic we use. Clean up organizations and ocean conservancy groups can help with the existing plastic pollution. But we have been dependent on plastic in many ways for a long time. If we eliminate plastic completely, what will its replacement be? Food still needs to be preserved. Items still need protection during shipment. And people still eat on the go.

How do we resolve these issues? With a better plastic. **Bioplastic.**

There are three main objectives in creating a more sustainable, environmentally friendly plastic – better sourcing, better performance during its lifetime, and better end-of-life options.

Bioplastic checks off all of those boxes.

It is plant based and sustainably sourced, and more eco-friendly sources are discovered every year. It has several end-of-life options that create a closed loop cycle. Also, due to constant advancements in the field of bioplastics, its performance during its lifespan continues to improve allowing it to be used in greater capacities.

For the consumer packaging industry, it provides a better material for single-use products. The main advantage is that bioplastic end-of-life options divert a large amount of waste away from landfills and oceans, and do not contribute to the environmental issues that we see traditional plastics causing today. Consumers would be able to have their take-out without the guilt or environmental damage.

THE PROBLEM

The problem is plastic. But it's not just plastic, it's how we handle it, how we use it, how it's made, how we dispose of it. That combination of circumstances has made it into one of the world's biggest environmental issues.

Traditional plastics don't biodegrade or compost, and stay around for years

Conventional, petroleum-based plastic does not biodegrade. By that definition, it will not decompose or break down through the help of microorganisms or bacteria. It can, however, degrade or photodegrade. The UV exposure will break petroleum-based plastics apart into tiny fragments known as microplastics. The breaking down of the plastics into microplastics releases chemical compounds which can pollute the ground if they are in a landfill, or the water if they are in the ocean.

Every year, about 8 million tons of plastic end up in our oceans.¹ As a result, marine wild life is at risk. We've all seen it. A turtle with a straw so deeply embedded in its nose that it had to be surgically removed. A pilot whale that beached itself and died several days later because it had eaten 17 pounds of plastic bags, as well as other incidents involving the plastic diet of whales in recent years.²

Plastic has invaded sea life, so in turn, invades seafood. Microplastics don't dissolve completely. They continue to break down to 100 nanometers, so small you can't see it without a microscope. If the fish that we eat are living in and consuming these microplastics, then so are we. Even sea salt can contain several hundred microplastics per kilogram.³

Professor Richard Thompson of Plymouth University released the first research on microplastics in 2004, when it was not at the dangerous level that it is today or will be in the years to come. "We're on the edge of a major ecological disaster. Microplastics in seafood is an illustration of that. There are things we can do, but we need to do them now."⁴ Again, that was 14 years ago.

Apart from possibly ingesting microplastics from seafood, there are other ways that dangerous chemicals can get into our bodies. The chemical makeup of the plastic can be the problem.

BPA, Bisphenol A, is an industrial chemical commonly found in polycarbonate plastics. Polycarbonates are used in many durable items – water bottles, beverage containers, the linings of food cans, and in food storage containers used in homes.

¹ World Health Organization Eastern Mediterranean Regional Office. (2018). "World Environment Day 2018: A Call to Beat Plastic Pollution." Retrieved from

<http://www.emro.who.int/media/news/world-environment-day-2018-a-call-to-beat-plastic-pollution.html>

² Smithsonian Magazine. (2018). "Whale Dies in Thailand With 80 Plastic Bags in Its Stomach." Retrieved from <https://www.smithsonianmag.com/smart-news/whale-dies-thailand-80-plastic-bags-its-stomach-180969232/>

³ The Conversation. (2018). "You're Eating Microplastics in Ways You Don't Even Realise." Retrieved from <http://theconversation.com/youre-eating-microplastics-in-ways-you-dont-even-realise-97649>

⁴ Smillie, S. (2017, February). From Sea to Plate: How Plastic Got Into Our Fish. *The Guardian*. Retrieved from <https://www.theguardian.com/lifeandstyle/2017/feb/14/sea-to-plate-plastic-got-into-fish>

Food containers that are made of plastic resins 3 and 7 should not be used to heat foods, as the BPA chemicals can leach into the food through melting from high heat. BPA has been found in 93% of urine samples of people over the age of six.⁵

The consumer goods packaging industry is part of the problem (and solution)

In 2016, the amount of plastic produced was approximately 335 million metric tons.⁶ That amount increases significantly each year due to demand. Unfortunately, about half of the plastics being produced are for single-use products. If we only recycle around 14% of plastic packaging, then too much of it ends up polluting the environment in landfills or oceans.⁷

Consumers are now looking at brands to help curb our dependency on harmful plastics. And some government regulations are now requiring a more sustainable production process.

In a recent [Greenbiz](#) article, ClientEarth wildlife lawyer Tatiana Lujan stated, "With the amount of plastic waste literally choking our marine environment, there are serious risks for companies that don't move fast enough in responding to the business risk associated with plastic waste."⁸

It is a world-wide issue that all companies must take into consideration, particularly in the consumer goods industry. According to the EPA, almost 45% of landfill materials are from food and packaging/containers.⁹

Like it or not we need plastics, particularly for food storage, shipment, and longevity

It is a difficult situation because packaging is needed to protect and preserve goods during shipment, especially foods. In spite of the large amounts of packaging materials that are discarded, over 33 million tons of food in 2010 entered landfills in the United States. Improper storage resulting in spoilage accounts for part of food waste. Rotting food in landfills releases methane gas which is a greenhouse gas that contributes to global warming.

Many food items can have extended shelf lives and avoid being thrown away by the use of plastic packaging. Out of the variety of resources that could be used to package and preserve food items, plastic is by far the most efficient. Plastic packaging and wraps are lightweight and strong, provide an airtight seal when needed, and are the best materials for freezing foods.

However, this same need creates the high demand for plastics in food packaging. Add to that single-use plastic containers for on-the-go meals and drinks and there seems to be no end to the cycle.

⁵ Earth Day Network. (2018). "Fact Sheet: The Plastic Threat to Human Health." Retrieved from <https://www.earthday.org/2018/03/14/fact-sheet-the-plastic-threat-to-human-health/>

⁶ Earth Day Network. (2018). "Fact Sheet: Single-Use Plastics." Retrieved from <https://www.earthday.org/2018/03/29/fact-sheet-single-use-plastics>

⁷ United Biopolymers. (2017) News & Media: Article 21 June 2017 – Whitepaper 06/2017 Time is Right for Bioplastics! Retrieved from <https://unitedbiopolymers.com/news/whitepaper-062017/>

⁸ Holder, M. (2018, July). How should businesses tackle risks posed by the shift away from plastics? *GreenBiz*. Retrieved from <https://www.greenbiz.com/article/how-should-businesses-tackle-risks-posed-shift-away-plastics>

⁹ United States Environmental Protection Agency. (2015). Toolkit: "Reducing Wasted Food & Packaging: A Guide for Food Services and Restaurants." Retrieved from https://www.epa.gov/sites/production/files/2015-08/documents/reducing_wasted_food_pkg_tool.pdf

EXISTING SOLUTIONS AND THEIR DRAWBACKS

As plastic pollution becomes more and more visible, focus is centered on overflowing landfills and the accumulation of plastics in our waterways, rivers, and particularly in our oceans. Beaches covered with plastic debris is a common occurrence all over the world.

Plastic bans by governments, stores, restaurants, cities, etc.

In an effort to combat the plastic pollution problem governments are intervening with restrictions or bans of certain plastic single-use items. The list of businesses, cities, and entire countries where plastic bans have been enforced is long. Pressure from environmental groups and organizations is adding to the list daily.

Earthday.org has an extensive A – Z list of restaurants, regions, cities, and businesses in over 30 countries that are currently restricting the use of single-use plastics or will be in the near future. Many have goals to cut single-use plastic entirely by a specific date.

Straws, plastic bags, drink bottles, and cutlery are the main focus of these initiatives.

Clean up organizations for beaches and the oceans

Along with regional plastic bans, there are groups and organizations dedicated to physically removing the plastic on beaches and in the ocean. These groups collect the beach and ocean plastic and recycle it or dispose of it correctly, assuring it won't end up back in the ocean. Some of the cleanup companies are international entities and have several bases around the world.

[4Ocean](#)

4Ocean was founded by Alex Schulze and Andrew Cooper after a surfing trip to Bali. When they saw the amount of plastic that the fishermen had to wade through, they developed a plan to use the same type of fishing nets to collect the plastic on the coastline and on the shore. They created the 4Ocean Bracelet, which is made of 100% recycled materials, to help fund their cleanup project.

They opened their headquarters in Boca Raton, Florida and later launched cleanup teams in Bali and Haiti. 4Ocean hosts cleanup events both offshore and onshore worldwide. Cleanup crews are in operation seven days a week. They collect, rinse, and sort the trash and plastic and take what can be recycled to a local recycling center.

[The Ocean Cleanup](#)

The Ocean Cleanup project was developed by Boyan Slat after he went scuba diving in the Mediterranean and saw more plastic in the ocean than fish. Slat was 16 years old at the time. He turned his high school science project into what would become, eight years later, the Ocean Cleanup System 001.

The System 001 intends to remove 50% of the mass of the Great Pacific Garbage Patch in roughly five years. The Ocean Cleanup will sell the plastic that they collect from the ocean to be reused to make durable products and thereby make the cleanup self-sustainable. Upon the success of the System 001, the team plans to launch a fleet of cleanup systems to combat the five Garbage Patches in the world's oceans.

Surfrider Foundation

The Surfrider Foundation describes itself as the largest network of coastal defenders. They have done 831 beach cleanups to date and have successfully campaigned to reduce plastic bag use in Boston in 2017. The ordinance involved a \$0.05 charge for plastic bags, which Surfrider proposed to increase to \$0.10. The ordinance was signed into law by Boston's Mayor, Marty Walsh, at the end of 2017. Known as Ban the Bag, the movement has been taken up by many environmental and anti-plastic groups.

Surfrider has many campaigns across the United States and in Europe against single-use plastics.

Ocean Conservancy

The Ocean Conservancy, originally founded in 1972 under the name The Delta Corporation, has been through several names and campaigns for the ocean and its wildlife. They are one of the longest running ocean advocacy groups. Their campaign, Trash Free Seas, has collected 249,391,051 pounds of trash from beaches worldwide. They host International Coastal Cleanups where volunteers from 153 countries collect trash and plastic from beaches.

Groups that rally against any and all kinds of plastic

There are also a growing number of groups around the world that focus on reducing or eliminating single-use plastics to prevent the ocean plastic pollution from happening.

Some are against all plastic use and strive for "plastic-free living." They start anti-plastic campaigns encouraging people to not use straws, plastic bags, and other single-use plastics. These campaigns gain momentum and result in an offspring of smaller groups that either continue those anti-plastic movements or start new ones. They also obtain government attention and push for, and often achieve, even more plastic bans.

The following are just some of the groups fighting against plastics.

- The 5 Gyres Institute – to fight the plastic pollution of the oceans; successfully created a microbead ban in skincare and cosmetics in the US, 2017
- Bye Bye Plastic Bags – student volunteer group in Bali who promote "just saying no to plastic bags"
- Lonely Whale Foundation – #StopSucking campaign against straws
- Parley for the Oceans – avoid plastic wherever possible, intercept plastic waste, and redesign the plastic economy; working toward inventing smarter materials to use in place of plastic
- Friends of the Earth – #PlasticFreeFriday – followers join efforts to avoid plastic at least once a week
- Greenpeace – a global petition to encourage ministerial action against single-use plastic
- One Green Planet – #CrushPlastic movement which focuses on reducing single-use plastics
- Plastic Pollution Coalition – a network of partners working together to solve plastic pollution, end single-use plastics; 4Rs Pledge – refuse, reduce, reuse, and recycle; "We're moving toward a plastic-free world."
- Surfrider Foundation – encourages individuals to refuse single-use plastics, recycling, etc.
- Myplasticfreelife.com – [100](#) steps to a plastic-free life, and a book Plastic-Free: How I Kicked the Plastic Habit and How You Can Too
- Life Without Plastic – the one-stop shop for safe, high quality, ethically-sourced, Earth-friendly alternatives to plastics for everyday life
- Igotopless.org – "Our mission is to bring awareness to single use plastic #6 polystyrene coffee lids and the threat our 'to-go' culture has on our health, ocean, and future."

Although the ocean advocacy groups are doing admirable work, they are only one part of the plastic solution. Their cleanups and campaigns against plastic have successfully cut down on a significant amount of plastic pollution. But they are mostly aiming their efforts at the consumer and removing plastic after the fact.

However, plastic is still needed in several industries and cannot simply be cut out. For the consumer-packaged goods industry in particular, plastic is needed to prolong the shelf-life of foods and for the protection of food and goods during the shipping process.

Consumers can definitely cut back on, or even cut out completely, the amount of plastic that they use in everyday life, especially single-use plastics. However, it would not be as easy for a grocery store chain to do the same. The chain would need a reliable, sustainable source of alternative packaging and food protection.

While a consumer can choose not to go to fast food restaurants, or even bring their own food containers to avoid bringing home excessive plastic packaging, restaurants will not be able to stop offering take-out. They will need an alternative to current food containers, food service ware, straws, and plastic bags.

The anti-plastic campaigns are aimed at dealing with the existing plastic polluting the environment and ways to prevent more plastic from polluting the environment. However, it does not offer an answer to what material will be used in place of plastic for food preservation and storage or on-the-go meals.

Biodegradable Plastics

The confusion for many consumers is the prefix 'bio.' Consumers assume this means that the material is made from plants and returns to the Earth in the same way plants do when they die. But biodegradable plastics are petroleum-based plastics that have special chemicals added to them to make them break down faster when they are exposed to UV light.

Degrade is not the same as biodegrade in that products that degrade break into smaller and smaller pieces over time (not biological matter) and are never really absorbed into the Earth. It eventually becomes evident that these *bio* products break down the same way that petroleum-based plastics do which leads to accusations of greenwashing. So, consumers are left not trusting anything with bio in the name.

However, biodegradable plastics are quite different from bioplastics.

A BETTER SOLUTION

The best solution to the plastic problem would offer a packaging material that is not petroleum-based, does not end up in landfills or the ocean, does not harm the environment, is sustainable, and contributes to the circular economy.

In a world where plastic is everywhere, and is obviously needed by various industries, it only makes sense to make a better plastic.

That is where bioplastics come in.

There are several advantages to bioplastics when compared with traditional plastics. The two most important advantages are how it is sourced and its end-of-life options.

Source

Bioplastics, unlike biodegradable plastics, are sourced from a variety of renewable plant and organic materials known as feedstocks. First generation feedstocks typically include starch, sugar, animal fats, and vegetable oil taken from potatoes, corn, sugar cane, wheat, or cassava. These feedstocks are currently the most efficient for the production of bioplastics.

There is no real competition between growing food and growing feedstocks, as the amount of land being used for bioplastic production is less than 0.02% of the global agricultural land area that is being used to grow food.

Due to the increasing demand for bioplastics, developments and improvements are constantly being made in their material selection, which leads to second and third generation feedstocks.

Second generation feedstocks are non-food-based crops grown on non-agricultural land or the waste materials left over from first generation feedstock. These include grasses, waste vegetable oils, wood pulp, corn cobs, wheat straw, and bagasse.

Research and advances are being made in the use of third generation feedstock, which includes algae and waste streams such as CO₂ or methane.

Advantages

Instead of being dependent on limited and increasingly expensive fossil fuel-based resources, bioplastics rely on renewable, sustainable, plant or waste-based sources. There is also less or no chemical absorption with food contact and much less toxic runoff compared with petroleum-based plastics.

The production process of bioplastics uses less energy and generates less CO₂ and carbon emission than the production process of traditional plastics. In turn, less greenhouse gas is released.

End-of-life Options

Bioplastics have several options at their end-of-life cycle. They can be reused, recycled, composted, used for feedstock recovery, or used for renewable energy recovery.

Recycle

Recycling bioplastic is possible, but usually needs to be done in a facility that is equipped to handle bioplastics. The materials cannot be recycled in the regular recycling stream because mixing petroleum-based plastics and bioplastics changes the characteristics of both types of plastics, leaving the entire batch unusable. It is an additional step that requires specialized facilities, but recycling is one option.

Compost

Many bioplastic products are made to be composted at their end-of-life. However, not all compostable bioplastics are made to break down in home composts. For now, industrial composts have the high heat and controlled conditions needed to compost most bioplastics fully. There are some materials and products made explicitly to compost at home, and many more are currently in development.

Along with composting, anaerobic digestion is another end-of-life option. Micro-organisms break down (biodegrade) the organic materials in a closed space with no oxygen. Bio-gasifiers then convert the bioplastic waste into methane used in natural gas.

Feedstock recovery

Some bioplastics can be broken melted back down to be used again for a new product or it can be broken down into its starting chemical building block.¹⁰ So the chemical that was used to make the bioplastic PLA can be reclaimed and used to make more PLA.

By dissolving the polymers to their original building blocks, waste streams that are difficult, or impossible, to separate mechanically can be separated and reused.¹¹

Renewable energy recovery

Another form of recovery is to regain energy from bioplastics through incineration, or burning. Bioplastics made from renewable resources do not contain the harmful chemicals that would be a problem for traditional plastics during incineration. The burning of these materials generates a high amount of heat that can be used for energy.

However, this is a last resort scenario as there are other more environmentally friendly end-of-life options for bioplastics, which is the point of bioplastics to begin with.

Advantages

Recycling creates new products from old products. Composting returns nutrients to the Earth to help grow new feedstocks. Feedstock recovery allows the chemical building blocks to be reused. And renewable energy recovery produces the main ingredient for natural gas.

All of the above methods contribute to a closed loop cycle. Recycling, composting, feedstock recovery, and even renewable energy recovery all get something back from the original material and reduces the need to create virgin material.

¹⁰ Bioplastics Guide. (2016). End-of-Life Options for Bioplastics. Retrieved from <http://www.bioplastics.guide/ref/bioplastics/end-of-life-options>

¹¹ Wageningen University & Research. Chemical Recycling. Retrieved from <https://www.wur.nl/en/Research-Results/Research-Institutes/food-biobased-research/Research-in-the-spotlight/Waste-a-valuable-resource-for-performance-materials/Chemical-recycling.htm>

According to [Simona Maccarrone](#), materials scientist at Matmatch, in an article for The Engineer, “The bioeconomy is an essential component of the circular economy, as it provides the resource base for a vast amount of economic activities. In the circular economy, material flows are captured and reused, and biological flows are designed to re-enter and replenish nature safely.”

Non-petroleum-based bioplastics sourced from plant materials are better than current options. End products that are preferably compostable, biodegradable, or at the very least, recyclable contribute to a circular system that is better overall.

The following is a list of just a few of the technology and chemical companies that are working on advancing bioplastics by developing new bioplastic materials or products.

[United Biopolymers](#)

United Biopolymers is a business unit under United Group, based in Portugal. United Group “produces green chemicals for a sustainable world.”

Product: BIOPAR®

BIOPAR® Technology can be licensed to compounders, converters, and brand owners to design and produce what they call GuiltfreePlastics™.

Benefits:

Their technology produces bio-based, biodegradable and bio-neutral plastics that are based on up to 90% renewable materials and can be made 100% biodegradable.

GuiltfreePlastic is a sustainable option for the packaging industry as it offers functionalities that bioplastics have lacked in the past at a competitive cost.

[Full Cycle Bioplastics](#)

Full Cycle Bioplastics, based in Richmond, CA, is an Ellen MacArthur Foundation Circular Materials Challenge Winner, Think Beyond Plastic Most Innovative Company 2016, and New Plastics Economy Innovation Prize Winner among others. Full Cycle Bioplastics produces PHA bioplastic from organic waste.

Product: Full Cycle PHA

Full Cycle PHA is compostable, marine degradable, and food contact safe. “The Full Cycle solution mitigates greenhouse gas emissions, reduces plastic pollution and toxicity effects on land and in the ocean, and sustainably moves the economy towards Circularity.”¹²

¹² Full Cycle Bioplastics, 2018. Benefitting society, the economy, and our planet section. Retrieved from <http://fullcyclebioplastics.com/>

Benefits:

The end life of the products made with PHA can be upcycled into virgin PHA, creating a circular product system that does not take away from the environment during its sourcing, production, or disposal.

Research has found that PHA is an environmentally friendly alternative to traditional plastics and can biodegrade in aerobic and anaerobic environments.

[UrthPact](#)

UrthPact has two U.S. locations, Lincoln, CA and Leominster, MA. They specialize in compostable injection-molded plastic made from natural resources, not fossil fuels.

Product: Evalv

UrthPact has engineered an injection molding process specifically for plant-based plastics. Their degassing valve, Evalv, is biocompostable and can break down in as little as three months. UrthPact also manufactures fully compostable, recycled plastic flatware for restaurant and grocery store suppliers.

Benefits:

UrthPact's materials and products are plant-based, sustainable, and compostable. Their mission is "to help environmentally-conscious companies and brands find the right bioplastic choice for their products, packaging, and assemblies."¹³

[GreenDot](#)

Green Dot Bioplastics is a full-service bioplastics company, based in Cottonwood Falls, KS. Their Terratek line of materials includes starch composites, wood composites, biodegradable composites, and the first compostable bioplastic elastomer.

Product: Terratek® BD

Terratek®BD is a cost competitive biodegradable composite created from a proprietary blend of starch-based ingredients and other materials which can be used in injection molded products. Even durable products made with Terratek®BD can be composted at their end-of-life.

Benefits:

Terratek BD is tolerant of moderate to high heat, has strength, rigidity, and pliability, and could work well for food packaging and other single-use items.

¹³ UrthPact, 2018. Get in Touch page. Retrieved from <https://www.urthpact.com/contact/>

Natur-Tec

Natur-Tec is a business unit of NTIC headquartered in Circle Pines, Minnesota. Natur-Tec specializes in bio-based and compostable plastics which includes flexible film and injection molded materials.

Product:

Natur-Tec's BF703B film extrusion is a biodegradable/compostable biopolymer that is used in their compostable line of trash and garbage bags and can be used in carry-out bags and food service and consumer packaging. BF3002HT, made with modified Ingeo (a PLA made by NatureWorks), performs well in high heat and is used for disposable food service items such as single use cutlery, coffee pods, and food service ware.

Benefits:

The bio-based plastics developed by Natur-Tec do not contain any amount of conventional plastics usually used in mixtures with bio-based products. The Natur-Tec bags and cutlery are certified compostable by international standards.

Many of the above listed companies have already created solutions to some of our most pressing plastic problems. Moreover, there are even more bioplastic developers that are continually conducting research, developing new materials, carrying out tests, and improving bioplastics.

Developers are steadily increasing the amount of bio-based materials that can be used in products that have regularly depended on traditional petroleum-based sources. They are finding new feedstocks and matter to make bioplastics. They are improving on the already varied end-of-life options. With every year that passes, the potential and abilities of bioplastics increases.

Bioplastic companies are hard at work developing better, sustainable, biodegradable, and compostable plastics. But the work does not stop there. Bioplastic developers cannot do it alone.

There needs to be an infrastructure in place that accommodates the end-of-life of more kinds of plastic as we strive to make the move from traditional petroleum-based plastics to new and improved bioplastics. The disposal of these products and materials has to be taken into consideration for the entire range of plastics, and recycling and composting needs to be functional and readily available to all.

Governments have to do their part to ensure that recyclable products actually get recycled and don't end up in landfills or the ocean due to a lack of disposal options. Waste management needs to be improved to handle compostable bioplastics, which is the bio-material that is on the rise. Consumers need proper labels and to be made aware of the best way to dispose of packaging materials so that recycling systems are not contaminated and compostable items are composted.

Collaboration is key to turning around the plastics problem.

CONCLUSION

Consumers want to help the environment, but they want their to-go meals too. Beach cleanups and plastic bans will *help*, but not *solve* the problem.

Though there are many ways the consumer can reduce the plastic problem, it isn't entirely up to them. The companies that make the plastic materials, distribute plastic-made goods, and brands that use them for their products are the best bet for having a significant impact on the amount of plastic being used.

The best option is to provide the world with a better material that can replace traditional plastics.

By being a sustainably sourced closed loop cycle material, bioplastic is the future. It is plant-based with several end-of-life options and is continually advancing.

We cannot stop all plastic production. We need it. However, bioplastic developers offer several alternatives with more to come.

Plastic.

It's causing a lot of environmental problems,
but we need it.

How do we resolve the issue?

With a better plastic. **Bioplastic.**