THE LATEST ADVANCES IN SUSTAINABLE PACKAGING



PRESCOUTER

The Latest Advances in Sustainable Packaging

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INTRODUCTION

Sustainable packaging is a topic that has been discussed as far back as the 1970s, gaining more and more importance ever since. It is defined as the development, manufacturing and use of packaging which results in improved sustainability. Sustainable packaging is not always attractive in economical or practical ways, and, while unsustainable packaging may offer cheap, convenient and strong solutions, it is also resource-intensive and wasteful.

In this white paper, we start by addressing the **challenges** associated with recycling packaging materials and provide a **breakdown**, in numbers, of what packaging materials are being recycled in the U.S.

Next, we discuss the many different ways to approach sustainable packaging. The first approach we cover is **biodegradable packaging materials**. We go over the types of materials used and the current trends and market size of the biodegradable materials industry. Real-life examples of the commercialization of such biodegradable materials are also given.

Edible packaging is another eco-friendly, biodegradable packaging approach that we go over in this white paper. We delve into the world of Skipping Rocks Lab and their creation of Ooho, a **sustainable alternative to plastic bottles**.

The next approach we explore deals with innovations that reduce packaging waste or even **eliminate** the actual package. **Natural branding** using laser marking, changes in **packaging design**, and **reusable packaging** innovations are the three areas we talk about.

To conclude, we go over how **Procter & Gamble** plans to generate **zero-landfill waste** by 2020 in all its facilities. The commendable efforts from other companies to achieve zero-landfill waste are also presented.

RECYCLING PACKAGING MATERIALS: CHALLENGES AND NUMBERS

Heidi Reidel

Challenges of Recycling Packaging Materials

Food Contamination:

Between 25 and 33% of all domestic waste is packaging: most of which is food packaging. One of the biggest difficulties that faces the recycling of packaging materials is contamination with food. Consumers see something packaged in a recyclable container but may not be aware that paper or plastic products contaminated by food (like pizza boxes) are no longer recyclable. In such cases, it is more effective to use biodegradable materials.

Color:

In addition to food contamination, the color of the packaging material also determines whether it is recyclable or not. For instance, while plastic is recyclable, black plastic isn't accepted into most recycling facilities. Black plastic doesn't reflect light which is how optical scanners identify types of plastic. Glass is one of the most highly recyclable materials, but color or gradient glass can't be recycled either. Once glass has been colored, it is contaminated and can't be mixed with clear glass.

Multi-layered Packaging Materials:

Multi-layered packaging materials are another problem in the world of recycling. Products like chip bags and juice cartons use layers of different materials, like foil and plastic, which can't be separated and thus can't be recycled. Unfortunately, this is potentially the biggest problem with recycling packaging materials and there is no easy solution. For some products, there is no effective alternative. Until technology develops that can separate these materials, the only solution may be consumer education.

Recycling Stats

According to a study in 2015:

- ✓ 87 million tons of the 251 million tons of trash generated were recycled or composted, which is a 34.5% overall recycling rate.
- The most recycled materials in America are aluminum and metal cans, with a recycling

rate of 67% for aluminum cans and 71% for steel cans.

 Americans recycled 32% of post-consumer plastic bottles and 34% of glass containers. When it comes to glass containers, however, those numbers can have a lot of variation. Depending on a state's container deposit laws, that number can go from 24% to 63%. Recycling glass is particularly economic, as 80% of recycled glass can be remelted and repurposed.

Since 2005, there has been a 74% increase in the amount of post-consumer polyethylene film that has been recovered for recycling. The recycling structure for flexible packaging materials is still in its infancy, but a group of stakeholders is studying recovery solutions to help divert films, pouches, and bags from landfills. According to a press release announcement, "This research effort represents a first step in what will be a series of projects aimed at creating a mainstream recovery solution for flexible packaging."

What's Next

Though recycling faces a myriad of challenges, it appears the trend is gaining momentum and the practice is being perfected. The following articles will delve into the ongoing efforts to reduce waste and make packaging materials more eco-friendly and will also cover the latest innovations in the packaging industry.





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BIODEGRADABLE PACKAGING MATERIALS

Marija Jovic

Synthetic polymers have long been the foundation of packaging materials. However, because synthetic polymers are non-biodegradable, our reliance on them in the packaging industry has led to serious ecological problems. Here are some examples on how long it takes for some packaging to degrade:

	A Plastic Bag	10-20 years
Π	A Plastic Film Container	20-30 years
Ē	Foamed Plastic Cups	50 years
Å	Plastic Beverage Bottles	450 years

Biodegradable polymers are intended to reduce waste. Biodegradable is a type of material that can

decompose into natural elements under the action of microorganisms within a short period of time after disposal – typically a year or less. It is believed that biodegradable polymers will replace synthetic polymers at a low cost, thereby producing a positive effect both environmentally and economically.

Types of Materials Used

The property of polymers to biodegrade is defined by their structure and does not depend on the raw material from which they have originated from. For example, products made of polyethylene will not biodegrade even if they are made from bio-based polyethylene, while many aliphatic polyesters, such as polyhydroxyalkanoates, polylactic acid etc. will biodegrade irrespective of the resource used for their production. As a consequence, biodegradable polymers can be both bio-based and fossil-based, and their biodegradability will depend on their structure, not their origin. Bio-based materials can be obtained from two sources: 1) the direct production of biopolymers by microorganisms, algae or plants or 2) the production of bio-based monomers and their further polymerization. In the first group, polymers such as polyhydroxyalkanoates (PHA), polysaccharides and oligosaccharides (cellulose, hemicellulose, starch, inulin, pectin, chitin and chitosan), and others such as proteins, poly(amino acid)s, or lignin can be found. In the second group, the most widely known example includes lactic acid (and the respective polymer, PLA). Examples on biodegradable fossil-based materials can be found in some polyurethanes and polyesters, for example.

The biodegradable polymers that have found application in packaging are starch, cellulose, chitosan, poly(lactic acid) (PLA), polycaprolactone (PCL), and polyhydroxybutyrate (PHB) to name a few. Many materials can be mixes or blends containing synthetic components, such as polymers and additives to improve the functional properties of the finished product and to expand the range of application. However, if additives and pigments are also based on renewable resources, one can obtain a polymer with approximately 100% weight of biodegradation compounds.

Current Trends and Market Size

The current trends in biodegradable packaging include the use of blends of different biopolymers like starch-PLA blends, starch-PCL blends etc., as well as developing new bioplastics with improved mechanical, thermal, and barrier properties.

According to a recent market report on Biodegradable Plastics Market, production of PLA is the largest segment by type with a market share of more than 45.1%. This is due to PLA's mechanical properties and ease of processability. In terms of value, starch blends are expected to account for the largest share in the market due to their comparative high cost compared to PLA.

The largest segment by application of biodegradable plastics is in packaging, both in terms of value as well as volume, with a market share of more than 60.3%. This is due to the fact that biodegradable plastics are being increasingly used to manufacture single-use packaging materials such as shopping bags, disposable cutlery, etc.



Image courtesy of pixabay.com

The forecasted increased use of biodegradable plastics in the future is attributed to increasing environmental awareness, as well as the implementation of stricter environmental regulations.

Commercialized Biodegradable Products

Many companies like Novamont, BASF, Biomer, National Starch, and DuPont are producing biodegradable polymers. Here are some examples on the real-life use of biodegradable polymers:

Since 2011, a bottled water company, Redleaf Water, began distribution of the industry's first biodegradable and recyclable water bottle. The solution was produced by Arizona-based ENSO Plastics, LLC. The company, dedicated to providing environmentally friendly solutions, has worked for three years to perfect a bottle that can be both PET recyclable and biodegradable. The BIO BOTTLE will biodegrade naturally in aerobic and anaerobic (landfill) conditions within one to 15 years, as opposed to 450 needed for standard PET bottles.

- ✓ In 2010, a company called THE WAY WE SEE THE WORLD presented Loliware – a set of intriguing, squishy, colorful glasses made to replace the standard plastic cups. Loliware is entirely made out of agar agar, a seaweed extract. It can be thrown into the grass after it is used, as the extract that it is made from nurtures the growth of plants or you can simply eat it as it's non-toxic, all-natural and FDA approved.
- ✓ Ahlstrom has developed NatureMold[™] a new biodegradable and compostable molding material for food packaging for a wide range of food applications. The material can be utilized in the temperature range of -40°C (-40°F) to 220°C (428°F), both in the oven and microwave, with great wet strength and grease resistance. It is made of paperboard and Genuine Vegetable Parchment (GVP), which is 100% cellulose.



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EDIBLE PACKAGING: AN ECO-FRIENDLY SUBSTITUTE TO PLASTIC BOTTLES

Rebecca Alexander

It is an established fact that plastic bottles made of synthetic polymers harm the environment. These packaged plastic bottles not only take long to degrade (about 450 years) but are also difficult to recycle because of contamination by food for example. Ever wondered why plastic water bottles have an expiry date printed on them? Does the water go bad? Actually, no! The expiry date is for the water bottles. Beyond the expiry date, chemicals from the plastic bottle could potentially change the taste and quality of the water contained. These are main drawbacks of the plastic packaging materials that we currently use.

An innovative sustainable packaging start-up based in London, Skipping Rocks Lab, aims to address the above-mentioned environmental issue by replacing plastic packages with natural biodegradable materials. Their first product Ooho, a transparent biodegradable material, is a step in this direction.

What's the Idea Behind Biodegradable Bottles?

The scientific team of Skipping Rocks Lab is based in Imperial College and is part of the Climate KIC start-up acceleration program founded by the European Institute of Innovation & Technology (EIT). Their main aim is to develop a material with low environmental impact from plant and seaweeds. Skipping Rocks Lab's first product, Ooho, is a spherical flexible package that can contain water and liquids like soft drinks, spirits and cosmetics. This biodegradable, edible and pocket-friendly replacement of plastic is mainly created from calcium chloride and sodium alginate, a seaweed derivative.

Basically, a frozen blob of water is coated with a double-membraned transparent material consisting of calcium chloride and the seaweed derivative. The designer of Ooho, Pierre Paslier, considers his innovative product to be a man-made fruit where a naturally-developed double membrane carries water. Similar to an orange, a denser skin can hold smaller spherical packages to contain more amount of water/liquid.

The Environmental Benefits of Ooho

As reported on the website of Skipping Rocks Lab, around 1 billion plastic bottles reach the ocean every year, contributing to the emission of about 300 million kg of CO₂. This increasing demand for plastic bottles and its harmful effects on the environment signal an urgent need for alternatives. Ooho has surely found a supporter in Ian Ellerington, Director of Science and Innovation at the UK Department of Energy and Climate Change, who said in an article that Ooho offers a good alternative packaging with potential applications across different products considering the high demand for packaging water and other products. What more? It is cheaper than its plastic counterpart and its manufacturing cost is estimated at 1 cent per unit.

Given its potential impact, it comes as no surprise that the Skipping Rocks Lab has won numerous accolades. Its efforts have been well appreciated as evidenced by the 2016 UK Energy Globe Award, the 2015 SEA Award, the 2014 Lexus Design Award and the 2014 World Technology Award (environment) held in association with Fortune and TIME.

What's Next?

Development of a fully-automated machine to manufacture Ooho is underway and meanwhile, it is sold only at special events. Nevertheless, this innovative replacement of plastic bottles offers a cheap climate-friendly way of carrying water and other fluids. Whether one chooses to consume the spherical Ooho package or not, it is impressive to see that the packaging is in fact edible and biodegradable, just like a fruit. Moreover, Ooho can be flavoured and coloured as per requirement. Although there are some obvious hiccups (like limited shelf-life and delicate nature of Ooho) that could prevent immediate widespread acceptance, gulping down these issues with targeted research can win over the masses. Practically speaking, large-scale acceptance of Ooho will significantly reduce harmful emissions and greatly benefit the environment. Here's hoping this edible substitute paves the way to lowering plastic waste!



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NATURAL BRANDING BY LASER MARKING: A NEW WAY TO ELIMINATE PACKAGING WASTE

Marija Jovic

Natural Branding is a contactless, safe method of labeling without packaging. A high definition laser removes pigments from the outer layer of fruit or vegetable skin to create an image on the peel. The process is superficial so it does not have a negative effect on the taste, aroma or shelf-life of the product. Consumers can even eat the marked produce peel!

Last December, one of the leading fresh produce companies in Europe, Eosta / Nature & More announced that they will mark organic fruits and vegetables with Natural Branding, to lessen plastic packaging. The project will be done in close cooperation with the Swedish supermarket chain ICA. The first organic products to be sold with Natural Branding are avocados and sweet potatoes.

The Advantages of Natural Branding

Ever since the announcement in December 2016, this news resonated in the produce industry.

According to Eosta/Nature & More, some of the advantages of using this technique are:

- ✓ Labels will stay on the product
- Eliminating adhesives, inks, etc.
- Improve marking and tracking of individual produce
- Reducing energy use and gas emissions (the energy needed for marking is less than 1% of the energy needed for making a sticker)
- \checkmark Reducing the amount of plastic waste

For avocados alone, Eosta/Nature & More are expecting to eliminate 750,000 plastic units in 2017. And with more products and customers, the number can easily reach millions!

What Do the Front-Runners Say

TYKMA Electrox reached out to Eosta's Sustainability & Communications Manager, Michaël Wilde, and this is what he said regarding the reasons behind the switch to Natural Branding: "We have been following the developments regarding laser technology for more than 8 years (branding premium watermelons for Carrefour for example) and were aware of the potential for saving plastic for organic produce. In the past year, in close cooperation with the producer of the machine Laser Food and the University of Valencia, we brought the technology to the next level which now enables us to use the technique for a wide range of products without affecting shelf life, taste, etc."

In addition to that, Wilde says that after the initial investment in the laser machine, it is almost more cost-effective than stickers. "You have to invest in an extremely expensive machine, so it's very much an investment for the future. This is something we believe more and more supermarkets will take on. It saves resources, CO_2 and energy, so it does calculate."

Laser Food, the Spanish company behind the technology, used it for several years for marketing or branding, but up until now it wasn't used with the specific aim of eliminating packaging. "It was used for novelty – which is nice, but a gimmick at Easter or Christmas isn't going to pay off," says Wilde, "What we are saying is, by buying this product you're saving plastic."

Paul Hendriks, packaging expert at Nature & More, is also very pleased with the new technology. "The most sustainable way to pack is not to pack. I have been saying that for years, but it has been difficult to bring about in the supermarket. With Natural Branding, it becomes a logical option. We are very glad that ICA, as a front-runner, is taking this sustainable road with us. We think green consumers will be delighted, because research shows again and again that they disapprove of plastic packaging."



Image courtesy of Laser Food

What About the Future?

According to the Guardian, ICA is already preparing to expand this technology to other products as well, the next steps being products such as nectarines or apples. Especially of interest are products where there is already a challenge with stickers not adhering to the product very well, like melons for example.

Other supermarket chains seem to be following this trend as well. For example, a year ago, UK supermarket M&S trialed this technology on oranges; however, as citrus skin has the ability to "heal" itself, the technique was not as effective and the trial was suspended. However, the retailer then started using it on coconuts, and now has plans to expand to other products as well.

This laser technology was originally used on bio/organic products to easily differentiate them from 'standard' produce. However, as consumer awareness and interaction becomes more important, this labeling technique has the potential to expand further, to all fruits and vegetables that don't require grouping. What an impact that would be!



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THE IMPACT OF AN INNOVATIVE PACKAGE DESIGN ON SUSTAINABLE PACKAGING

Heidi Reidel

Sustainable packaging not only appeals to an increasingly eco-conscious customer base, but, if done correctly, can reduce manufacturing costs. Improving upon recycling is one solution, but an innovative packaging design can reduce packaging waste right at the source.

Small Changes, Big Results

Unilever has made it their goal to become a zero-waste company, so as a company that purchases over 2 million tons of packaging a year, the task of eliminating the environmental impact of an amount that daunting will be a challenge. In 2014, they reduced the polyethylene coating on the inside walls of their Breyers ice cream packaging. They estimated a 130 metric ton reduction of polyethylene per year. Even simply by reducing cap size and cap and bottle variety of Sunsilk shampoo and conditioner in Brazil, Unilever saved 2,300 tons of plastic.

Evaluating Components

Evaluating the components of a package design is an effective way to reduce packaging waste. Manufacturers determine which components are unnecessary and how to replace those components in a way that uses less material. For example, GlaxoSmithKline Consumer Healthcare's Os-Cal calcium supplement changed their packaging design by eliminating a secondary carton and insert and printing all their information directly on the bottle. The switch saved a significant amount of paper and CO₂ emissions.

Reusable Packaging

Another way for companies to reduce waste is to make their packaging reusable. Pizza Hut is introducing a new pizza box design that breaks down into plates and a smaller box for leftovers. Kentucky Fried Chicken put out a reusable sides container which is essentially a dishwasher and microwave-safe tupperware. PUMA switched their shoe packaging to a reusable bag. The switch reduced paper consumption by 65% and is estimated to reduce water, energy, and diesel consumption at the manufacturing level by more than 60% per year. The next article covers the topic of reusable packaging in more detail.

Package Designs that Eliminate the Package

Of course, the ideal way to reduce packaging waste is to eliminate the package. This seems like an impossibility, as packaging serves very specific and necessary purposes, but a designer named Aaron Mickelson found several innovative ways to drastically reduce or even eliminate packaging from popular household products. In a design for Tide PODS, he created a stitched-together sheet of laundry pods with brand info printed on the back in soap-soluble ink. The sheet is then rolled into a tube where the customer need only tear off a pod one-by-one until they are all gone and the packaging along with it.

He used a similar method for Glad garbage bags. The bags are rolled into a tube and removed one by one from the center like a box of tissues, but the outermost garbage bag serves as the container rather than a cardboard box. Brand information is printed on the outer bag and, like the pods, when the last one is used, the packaging disappears along with it.

Eliminating unnecessary inserts and extra cartons is a start, but if manufacturers choose to employ Mickelson's designs, it could be a game-changer for packaging. Proper recycling would be a non-issue. Of course, not all products, particularly food, can be packaged in such an innovative way. In these cases, reusable containers might serve the same purpose of eliminating waste. Creative packaging design is the key to reducing and eventually eliminating packaging waste.



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INNOVATIONS IN REUSABLE PACKAGING

Marija Jovic

"Reduce, reuse and recycle!" is the mantra one follows when designing sustainable packaging. While reduce and recycle seem to be the most prominent ones, there are very innovative ideas on how packaging can be reused as well. Reusable packaging is not a new concept in fact, and it seems it hasn't reached its full potential yet. Reusable packaging has been most commonly connected with returnable packaging that can be redeployed many times. As such, known examples include durable handheld and bulk containers, pallets, shipping racks, shopping bags, carton boxes and other related items that can be reused many times.

However, one can approach reusable packaging from a different standpoint – packaging that can be used for a different purpose that goes beyond its basic purpose – by making it useful even after consumption. And, experimenting with different types of packages and materials can lead to some really exceptional packaging ideas. In addition to being cool, these innovative designs also tend to enhance the consumer experience and infuse brand loyalty.

Some Interesting Reusable Packaging Examples

Lite2go by knoend is a product where the clear packaging becomes the lampshade for the lamp that is packaged inside. Another interesting design is made by Tom Ballhatchet; the box in which the TV is packaged in, becomes a stand with shelves! In a similar way, a wooden packaging for wine bottles can later on become a rack to store them. A T-shirt can be delivered in a package that can be easily transformed to a hanger. And cardboard packaging can become a source of new life – by embedding plant seeds in it.

An example that shows that big brands are actively looking at this topic comes from Puma and their joint project with fuseproject on "Clever Little Bag". The project received recognition through many awards, such as GOOD Design Award for two years in a row, as well as innovation and sustainability awards. The project looked at how to reduce an industry's footprint and contribute towards a greener and more sustainable world, while at the same time reducing cost. The idea was to look into shoe boxes as one of the most challenging issues. Shoe boxes contribute to millions of tons of waste a year and are usually discarded after purchasing a pair of shoes. After several months worth of work, an innovative solution was introduced.



Image courtesy of pixabay.com

The cardboard was kept for the inside of the packaging only, so the overall structure would still be rigid, and it would be possible to stack the items securely. The bag that surrounds the cardboard structure protects the shoes from the outside environment, such as dust and dirt. It is made from non-woven materials that require less work and waste, and replaces the plastic bag in which the cardboard box is usually placed in upon purchasing. Apart from being reusable and fully recyclable, this innovative solution is estimated to decrease water, fuel and energy consumption by more than 60 percent each year. According to the numbers calculated by the Clever Little Bag innovators. this innovation will lead to "approximately 8,500 tons less paper consumed, 20 million Megajoules of electricity saved, 1 million liters less fuel oil used and 1 million liters of water conserved. During transport, 500,000 liters of diesel is saved and lastly, by replacing traditional shopping bags the difference in weight will save almost 275 tons of plastic."

Sounds quite nice, doesn't it?



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P&G EXPLAINS HOW THEY WILL GENERATE ZERO LANDFILL WASTE BY 2020

Heidi Reidel

The United States has established an unfortunate notoriety for producing landfill waste. At only 4% of the global population, America is responsible for 30% of the planet's total waste generation. Approximately 31% of generated waste is and containers alone. packaging and corporations are responsible for a substantial amount of this landfill waste. As waste management itself is a commercial business, the corporate need for profit outweighs community health risks when it comes to regulation. Fortunately, corporations such as Procter & Gamble (P&G) have committed to reducing and even eliminating their contribution to landfill waste.

Zero Landfill Waste by 2020

P&G is the corporation behind a number of well-known brands, from Always to Vicks. P&G recently announced that by the year 2020, all of their manufacturing sites will send zero waste to landfills. 56% of its global sites have already achieved this milestone, and their site in Costa

Rica is completely zero waste to landfill. Globally, P&G has already ensured that 99% of materials entering their plants leave as a finished product or end up being reused.

The company has managed to find ways to divert the remaining 1% of materials from landfills, and much of that success is due to its Global Asset Recovery Purchases (GARP) team. Repurposing waste is a clever way of reducing landfill waste and profiting off of it instead. At the Always site in Hungary, scraps are sent to cement companies and incinerated for energy to make bricks. In China, waste from one facility is used to make bricks themselves. Another facility's waste is composted into nutritional soil for local parks. A site in India is turning scraps into wall partitions for homes and offices.

P&G's no-waste efforts transcend repurposed materials. It has become a culture at their facilities, encouraging employees to reduce on a personal level. The Gillette Plant in Boston implements their no waste philosophy even in the cafeteria. Signs encourage employees to recycle and compost. All packaging for takeaway items is made from corn or sugar and thus is compostable. That same compostable packaging is now being used for Gillette and other P&G products.

Environmentally Sustainable All Around

Reducing landfill waste is not P&G's only sustainability effort; they are also pushing for environmental sustainability with water. packaging, and CO₂/energy reduction. They've set a goal to reduce water use in manufacturing facilities by 20% per unit of production by 2020. P&G is also attempting to produce water efficient products to reduce consumer water footprint. Innovations concerning energy reduction include 100% wind electricity for plants that produce Fabric and Home Care products in the U.S. and Canada. P&G's packaging goals are reducing packaging by 20% per consumer use, doubling use of recycled resin in plastic packaging, and ensuring that 90% of packaging is recyclable. P&G is also looking to use more renewable energy and materials, increase facility efficiency, and reduce transportation.

P&G and Other Corporations' Environmental Goals

P&G is not the only corporation pushing for zero landfill waste. Nestle has achieved landfill-free status in all of its U.S. based facilities. Unilever North America has also attained zero landfill waste. Waste hauler. Sustainable Waste Solutions. is the only landfill-free waste and recycling the region company for of southeast Pennsylvania, the Lehigh Valley, and Delaware. This is particularly significant considering the general commercial waste company push against landfill regulation. MillerCoors, Mars Chocolate North America, and Ford, among others, are all achieving zero landfill status at one or all of their facilities.

Though it is certainly monumental for corporations to take responsibility for their output of landfill waste, the next step is the consumer. With 4.6 billion people worldwide using P&G products, they have also set a long-term goal of achieving zero consumer waste. Creating products that use less energy and water may be the next step in consumer sustainability.



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