NEW PLASTICS ECONOMY

DISCOVER THE WINNERS

INNOVATION PRIZE

SUMMARY

WHY A PLASTICS RETHINK?

Love them or hate them, plastics are everywhere around us. In fact, demand for them is expected to double in the next 20 years. Yet our plastics system is broken. Only 14% is collected for recycling, resulting in a loss of USD 80-120 billion per year to the global economy. Most plastic items are used only once before being discarded, often ending up polluting the environment. **If nothing changes, there could be more plastic than fish in the ocean by 2050.**

SO, HOW DO WE FIX THIS?

If we want to free our ocean from plastics, we have to do more than cleaning up. We have to **fundamentally rethink the way we make and use plastics** so that they don't become waste in the first place. We need to build a circular economy for plastics, in which the materials are reused, recycled or safely biodegraded, instead of being landfilled or polluting the environment. To do this, we need better materials, clever product designs and new, circular business models.

The Ellen MacArthur Foundation, together with the Prince of Wales's International Sustainability Unit, launched the **$2m New Plastics Economy Innovation Prize** in May 2017. The prize is funded by Wendy Schmidt, Lead Philanthropic Partner of the New Plastics Economy Initiative.

MEET THE WINNERS

Meet the **winners of both the $1m Circular Design Challenge** (run with OpenIDEO) which were announced at the Our Ocean conference in Malta on October 5, 2017 and the **winners of the $1m Circular Materials Challenge** (run with NineSigma) which are being announced at the World Economic Forum in Davos on January 23, 2018.

ABOUT THE INNOVATION PRIZE

The prize focuses on the 30% of plastic packaging items are either too small or too complex to be recycled and often find their way into the ocean. It is split into two challenges: (1) The **Circular Design Challenge** focused on small-format packaging items (10% of all plastic packaging) such as shampoo sachets, wrappers, straws and coffee cup lids, which are currently not recycled and often end up in the environment. The **Circular Materials Challenge** is seeking ways to make all plastic packaging recyclable and invites innovators to find alternative materials that could be recycled or composted.

While the winning innovations represent the type of solutions needed to build a plastics system that works, these teams cannot drive the transition alone. Major businesses, governments, and investors must also make clear commitments and collaborate towards a circular economy for plastics.

Today, the list of leading brands, retailers, and packaging companies working towards using 100% reusable, recyclable or compostable packaging by 2025 or earlier has grown to 11 – **Amcor, Ecover, evian, L'Oréal, Mars, M&S, PepsiCo, The Coca-Cola Company, Unilever, Walmart** and **Werner & Mertz** – together representing more than 6 million tonnes of plastic packaging per year. This is a major step forward, and the Ellen MacArthur Foundation calls on the whole industry to follow their lead and make commitments that ensure packaging is not just recyclable, but also in practice recycled, reused or composted.

CIRCULAR DESIGN CHALLENGE

CATEGORY 1

Rethinking grocery shopping.

Today's supermarkets are full of single-use plastic packaging to keep our groceries safe and fresh. Yet by rethinking the way we get products to people around the world, innovators can design out waste.

WINNERS

MIWA - Czech Republic &
Algramo - Chile

MIWA

CZECH REPUBLIC

MIWA introduces an app that lets shoppers order the exact quantities of the groceries they need, which are then delivered in reusable packaging from the producer to their closest store or to their home.

HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

One of the success factors of plastics packaging is its ability to adapt to various customer needs, from large-scale packs in our supermarkets to the small packaging items like sachets more common in emerging markets. Yet many plastics packaging items found in our shops today are not economically recyclable and often end up polluting the environment.

MIWA introduces a digital solution that connects all stakeholders along the value chain – from the farm that produces the food to the customer that buys it. It allows anyone with a mobile phone to order any desired amount of a product to be delivered in reusable packaging to either their nearest store or directly to their home. This solution does not only design out unrecyclable plastic packaging, it also helps to minimise food waste.

WHAT'S NEW?

We have seen package-free stores before, but MIWA takes the concept one step further. Connecting the producer with the consumer it eliminates single-use packaging along the product's value chain. The system can be scaled to work in supermarkets as well as local stores and farmers markets.

Three questions for Petr Baca from MIWA

WHAT MADE YOU COME UP WITH THIS IDEA?

I became interested in waste prevention, which is a simple enough idea but pretty difficult to apply in everyday life. This is where MIWA comes in: to remove many barriers people face when trying to reduce waste and to show that it is possible.

MANY OTHERS ARE PROPOSING PACKAGING-FREE GROCERY STORES. WHAT MAKES YOUR IDEA STAND OUT?

We encompass not just one shop but all shops. Our technology can fit in almost anywhere - from small shops to large supermarkets. The MIWA system's distinctiveness lies in its adaptability and flexibility, as it covers all members of the supply chain from producers to consumers.

WHAT EXCITES YOU THE MOST ABOUT THE NEW PLASTICS ECONOMY ACCELERATOR PROGRAMME?

Having a combination of a logistics solution and an in-store experience that eliminates plastic waste, we are excited to get together with like-minded individuals and organisations to shake up our existing production and consumption habits, which are long overdue for an update.

FIND OUT MORE
www.miwa.eu

Algramo

CHILE

Algramo is a social enterprise that offers products in small quantities in reusable containers across a network of 1,200 local convenience stores.

HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

Algramo offers to customers in Chile affordable quantities of everyday products without single-use, non-recyclable packaging. Targeting economies where recycling infrastructure is limited and small packaging items such as sachets often end up in the environment, Algamo introduces a reusable packaging system with dispensers and affordable containers.

WHAT'S NEW?

Drawing on its existing system across 1,200 convenience stores and reaching more than 200,000 customers already – plus new, IoT-powered technology – Algramo has developed a promising dispenser system for small volumes of liquid products at low cost. While dispenser systems are not new in themselves, Algramo is at the forefront of making them a frugal and robust system intended for markets where single-use sachets are the most prominent form of packaging, and therefore where designing them out will have the biggest impact.

Three questions for Brian Bauer from Algramo

WHAT MADE YOU COME UP WITH THIS IDEA?

I have taken ideas from my graduate studies in industrial ecology and life cycle assessment and merged them with Algramo's innovative business model to create a solution that can replace sachets and other single use plastic packaging by dispensing products into small reusable containers.

MANY OTHERS ARE PROPOSING DISPENSER SOLUTIONS INSTEAD OF SINGLE-USE SACHETS. WHAT MAKES YOUR IDEA STAND OUT?

Algramo exclusively targets low-income markets where affordability is everything. We believe we can deliver liquid products normally sold in sachets at a lower price, which is a double win since it simultaneously fosters a circular economy mindset and saves people money. Few competing vending machine distribution models use digital technologies that provide customer value and enable fast scale-up of distribution at low cost.

WHAT EXCITES YOU THE MOST ABOUT THE NEW PLASTICS ECONOMY ACCELERATOR PROGRAMME?

Algramo's goal is to deeply embed a circular systems approach into its use of plastics. We envisage becoming a success story for our responsible use of plastic. We see the advice from the New Plastics Economy Accelerator programme being an important source of knowledge, expertise, and industry connections, which will help us achieve these objectives.

FIND OUT MORE
www.algramo.com

CIRCULAR DESIGN CHALLENGE

CATEGORY 2

Redesigning sachets.

Hundreds of billions of sachets are sold each year to get small quantities of personal care and food products, such as shampoo and soy sauce, to people mostly in emerging markets. Those sachets are not recycled and many end up polluting the ocean.

WINNERS

Evoware - Indonesia &
Delta - United Kingdom

Evoware

INDONESIA

Evoware is a startup that designs food wrappings and sachets (containing, for example, instant coffee or flavouring for noodles) made out of a seaweed-based material that can be dissolved and eaten.

HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

The ability of single-use sachets to provide people everywhere with a single dose of instant coffee, shampoo, or medical supplies has many benefits, but because they are so small they often escape collection and end up on beaches, in rivers, or the ocean. Evoware introduces seaweed as a solution, which is a great example of how a biological feedstock can be used for a technical purpose and then safely biodegraded. Evoware plans to increase its local capacity and is positioned to expand internationally since seaweed has the capacity to grow on almost every coastline.

WHAT'S NEW?

Evoware has created an edible alternative to the commonly used multi-layered plastic sachet. It manufactures the material directly from plant matter, making it not only edible but also nutritious. You can literally eat your burger with the wrapping still on, or dissolve your coffee granules along with their sachet in hot water and drink it. In addition, Evoware has designed a version, made using damar resin from South Asian fig trees, that holds liquids, creating readily compostable packaging for personal care products and medical supplies.

Three questions for David Christian from Evoware

WHAT MADE YOU COME UP WITH THIS IDEA?

The inspiration came from a childhood experience when I woke up late for school and to save time had instant noodles for breakfast. Preparing them can be speeded up when there are no small sachets to be opened. The second inspiration comes from the fact that Jakarta, where I live, often suffers from flooding due to plastic waste clogging up the water system. These experiences have challenged me to turn research into real solutions for the market.

MANY OTHERS ARE PROPOSING EDIBLE PACKAGING INSTEAD OF PLASTIC. WHAT MAKES YOUR IDEA STAND OUT?

We use seaweed without chemical additives in applications where its ability to dissolve in hot water or be eaten adds functionality and value. Among unaltered biomaterials, seaweed has one of the best mechanical properties while still being energy efficient and very economical. In addition, its cultivation does not need land acquisition or deforestation as is often the case when land-based plants are used to provide bio-sourced materials.

WHAT EXCITES YOU THE MOST ABOUT THE NEW PLASTICS ECONOMY ACCELERATOR PROGRAMME?

We are excited about the programme because it provides a lot of the support we need to scale up our business. It enables us to meet outstanding mentors and widen our network. The advice and guidance of mentors with invaluable international business experience gives us the confidence to enter the global market.

FIND OUT MORE
www.youtube.com/watch?v=24T6ruz1GhU

Delta

UNITED KINGDOM

Delta offers a compact technology that allows restaurants to make and serve sauces in edible and compostable sachets.

HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

The Delta team has created an edible sachet into which condiment sauces, for example, can be packaged when they arrive in bulk at a restaurant. This enables the sauces to be transported efficiently and economically right up to the point of sale. Should the packaging leak into the environment, it will rapidly compost. As a bonus, the packaging material is derived from seaweed, which captures CO2 as it grows.

WHAT'S NEW?

The sachet has a shape that allows easy handling and stacking into secondary packaging, and can have varied thickness and number of layers depending on its purpose. What matters more is the innovative business model in the form of a service solution that puts a machine on clients' premises. The machine produces the packaging close to the customer, and fills it with what the client wants, be it ketchup for a fast food restaurant or shampoo for a hotelier. Since all edible films have poor barrier properties, this approach is a necessity to avoid the problem of short shelf-life. A licensing model can ensure fast roll-out and customisation of solutions to different brands and applications.

Three questions for Rodrigo Gonzalez from Delta

WHAT LED YOU TO COME UP WITH THIS IDEA?

Delta is an evolution of our previous product (Ooho!). We were originally inspired by the way nature encapsulates liquids using membranes, from egg yolks to cells or fruits. We investigated old food technology, such as spherification for making fake caviar, and started the project whilst at Imperial College London by applying those techniques to packaging. We've been working for three years as a startup to bring the technology to the manufacturing stage.

MANY OTHERS ARE PROPOSING EDIBLE SOLUTIONS FOR CONDIMENTS AND OTHER PRODUCTS, BUT THE SHELF LIFE IS JUST NOT LONG ENOUGH. WHAT MAKES YOUR IDEA STAND OUT?

Delta's technology is based on local manufacturing. Our compact machines produce sachets daily, directly at the point of sale to lower the supply chain requirements for a natural material.

WHAT EXCITES YOU THE MOST ABOUT THE NEW PLASTICS ECONOMY ACCELERATOR PROGRAMME?

Being part of a pioneering programme that really believes in the circular economy with partners representing the many aspects of the system on the brink of change. The Ellen MacArthur Foundation is one of the few organisations getting its message heard loud and clear, and it creates hope for innovators like us out there that we will solve this.

CIRCULAR DESIGN CHALLENGE

CATEGORY 3

Reinventing coffee-to-go.

More than 100 billion disposable coffee cups are sold globally every year, yet today almost none of them (nor their lids) are recycled.

WINNERS

CupClub - United Kingdom &
TrioCup - United States

CupClub

UNITED KINGDOM

Cup Club introduces a reusable cup subscription service, in which reusable cups can be dropped off at any participating store.

HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

For most people, reusable cups are an intuitive way to eliminate the waste from the single-use containers we spread around us every day. After all, over 40 billion single-use cups are wasted in the US and Europe alone every year. But there is an elephant in the room: keep cups and reuse schemes for coffee generally don't work. This is the problem Cup Club is devoted to solve. The business model – to sell the reuse service to multiple stakeholders – means that the system can scale and does not rely on brand loyalty. Once proven, it can be rolled out across other service types where packaging waste is a big issue, for example food boxes and drinks bottles.

WHAT'S NEW?

Cup Club combines a set of proven technological solutions (RFID tagging, mobile interface, Internet of Things) to track individual cups and reward their users for being in the system. The team has drawn a lot of lessons from early pilots and know that cup 'leakage' and lack of retention are among the biggest challenges with such systems. The strategy to solve them is to put in place a network of interaction points – checkouts, drop-points, handsets, cups – designed to help customers stay in the system and to enhance their experience of it. This can potentially be coupled with individual brand campaigns to further improve participation.

Three questions for Safia Qureshi from Cup Club

WHAT LED YOU TO COME UP WITH THIS IDEA?

To think we can put so much energy, resources and time into products that are used just once is mankind's greatest arrogance. To address this, we decided to design a returnable packaging system that really works.

MANY OTHERS ARE PROPOSING REUSE SYSTEMS FOR COFFEE CUPS. WHAT MAKES YOUR IDEA STAND OUT?

We have combined a product, service and business model that together enable multiple retailers and brands to transition to a returnable packaging system infrastructure at a city scale. We have what it takes to be the city bike rental equivalent of the coffee scene.

WHAT EXCITES YOU THE MOST ABOUT THE NEW PLASTICS ECONOMY ACCELERATOR PROGRAMME?

Learning from pioneers and experts in the plastics and packaging industries. Meeting leadership teams, improving aspects of the business and its functions, growing strategic partnerships and building Cup Club to become the world's first integrated city-scale returnable packaging infrastructure.

FIND OUT MORE
www.cup-club.co.uk

TrioCup

UNITED STATES

TrioCup offers a disposable paper cup made with an origami-like technique that removes the need for a plastic lid. The team has chosen a 100% compostable material and is working on an alternative that is also 100% recyclable.

COVERING DRINKING HOLE

An additional benefit of the rim lock was that the flap could be locked at both sides of the cup, making it possible to cover the drinking hole when the cup was not in use.

This feature was helpful for temperature control, when drinkers wanted their coffee to stay hot longer.

#16 - #25 PROTOTYPE

The lock system was modified so that the flaps locked against the cup's rim, instead of the flaps locking against themselves. A light brown color was also chosen for the cup as a reminder of its environmental friendliness.

HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

The 'to-go' culture has long been part of modern life. Sadly, it produces a lot of waste, including polystyrene coffee cup lids that cannot be recycled. TrioCup solves this problem and at the same time makes the to-go cup more spill resistant than the ubiquitous cup-lid combination. It has the potential to design out the need for hundreds of thousands of tonnes of polystyrene that would otherwise be landfilled or leaked into the environment, while at the same time making life easier for coffee lovers. While paper cups are still not widely recycled, work is ongoing to create a recycling pathway for the cup. Preparing for all possibilities, the cup's liner is made from a material that also makes the cup industrially compostable.

WHAT'S NEW?

The core of this innovation is the design itself, which is the result of a lot of prototyping and iteration. Many innovators have had the same idea but this one is very solid by comparison. The folding scheme is quick to do (on a par with attaching a lid to a mug) and offers excellent spill resistance. The mugs stack well, and while space efficiency is a bit lower than with standard cups, this is offset by not needing any lids. Initial estimates indicate it has the potential to be cost-competitive with conventional cups and lids to manufacture.

Three questions for Tom Chan from TrioCup

WHAT LED YOU TO COME UP WITH THIS IDEA?

Initially I was a big fan of Japanese bottled beverages, yet I always thought throwing the used bottles into the trash was too wasteful. As a result, I wanted to create a more environmentally friendly beverage container and decided to do so for the more popular and less reusable container: the paper coffee cup and lid. Upon starting this endeavor, I realised that there were already patented all-paper cups that were not successful in the marketplace. Because of this, my team and I expanded the cup's purpose to encompass more than just waste-reduction. We decided to also focus on cost-efficient manufacturing and user-friendliness, with spill-protection as one of the unique properties.

MANY OTHERS ARE PROPOSING ORIGAMI-INSPIRED PAPER CUPS. WHAT MAKE YOUR IDEA STAND OUT?

TheTrioCup blends a simple, logical, tri-fold lid design onto the paper cup that is visually stylish and distinct. However, this design does not come at the expense of higher manufacturing costs, as the lid integrates seamlessly into existing coffee cup production methods with only minor adjustments. Furthermore, the cost of the extra paper needed to make our cup is more than covered by saving the cost of the plastic lid, ensuring our cup can be cheaper than the typical coffee cup and lid.

WHAT EXCITES YOU THE MOST ABOUT THE NEW PLASTICS ECONOMY ACCELERATOR PROGRAMME?

The New Plastics Economy Accelerator Programme is the perfect partner for us, as it brings together extensive information to guide our efforts from the Evidence Base and a widespread network from the Dialogue Mechanism. It would allow us to collaborate with packaging manufacturers, businesses involved in plastic collection and reprocessing, and global consumer goods companies. The programme will allow us to learn how to develop a regenerative business from the TrioCup, as well as how to scale up our manufacturing in a cost effective manner in order to break into the market.

CIRCULAR MATERIALS CHALLENGE

CATEGORY 1

Make unrecyclable packaging recyclable.

In nature, a small number of common building blocks are used to create different structures for all necessary purposes: hair, leaves, or organs. What if the same principle could be used in plastics packaging?

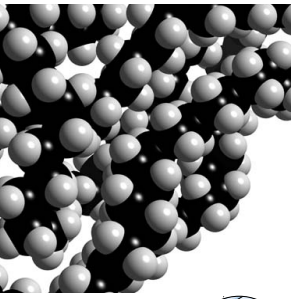
WINNERS

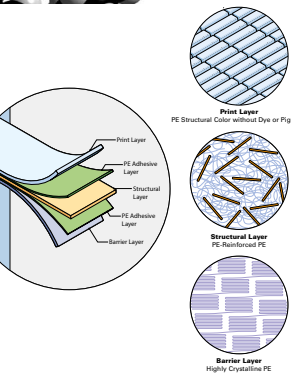
University of Pittsburgh - United States
Aronax Technologies Spain - Spain

University of Pittsburgh

UNITED STATES

The **University of Pittsburgh** team applies nano-engineering to create a recyclable material that can replace complex multi-layered packaging that is unrecyclable. This mimics the way nature uses just a few molecular building blocks to create a huge variety of materials.





HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

The idea is to make food packaging (such as snack food bags and food pouches) from layers of a single material, polyethylene, which is easy to recycle. Each layer can be given different properties by changing its nano-scale structure, which when combined, create a much better material that can even be coloured without pigments. It aims to replace packaging made from layers of different materials, which are growing in popularity today but are very difficult to recycle. Since this innovation aims at accomplishing the task currently done by combining materials like PET, polyethylene and aluminium, but using only one, recyclable material, it combines the the best of two worlds.

WHAT'S NEW?

The approach is to alter the nano-structure of polyethylene in ways that allows it to mimic the properties of the various layers (such as PET, EVOH, or even aluminium) in current laminate packaging while not changing the chemistry (it's still polyethylene). So, when the material is collected, shredded, and melted, it reverts to simple molten polyethylene and can be reprocessed without difficult separation steps.

Three questions for Eric Beckman from the University of Pittsburgh

WHAT LED YOU TO COME UP WITH THIS IDEA?

Over the past few years I had noted with interest that industries such as automobiles, home appliances, and even aluminum cans were transforming their business models from traditional products to services, where goods are designed to be recovered and reused. By contrast, the paradigm of the chemical industry has, for 150 years, been short lifetime and single use. I wondered whether one could transform a molecule from a product to service, with the most interesting applications of this (to me) being textiles and packaging. The question for each was how one could design these products to be inherently recoverable and reusable?

WHAT IS THE AIM OF YOUR INNOVATION?

Packaging is a one of the toughest challenges if we want to create a circular economy (tens of million of tonnes of packaging waste goes to US landfills each year). We hope that our design can not only set a new standard for high-performing and recyclable plastics, but will stimulate people to think about other ways in which we can transform molecular products to services through good design.

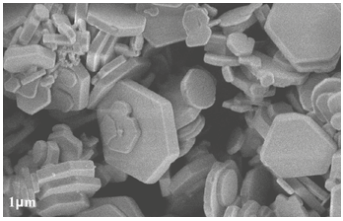
WHAT EXCITES YOU THE MOST ABOUT THE ACCELERATOR PROGRAMME?

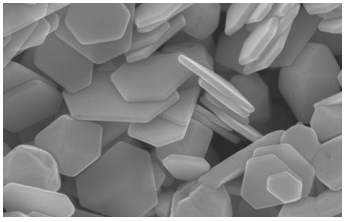
Europe is way ahead of the US in translating basic science to applications of circular economy principles. It will be exciting to engage with the accelerator programme to both put our own ideas into practice and experience the cutting edge in circular economy thinking.

Aronax Technologies Spain

SPAIN

Aronax Technologies Spain proposes a magnetic additive that can be applied to a material, creating better air and moisture insulation – making it suitable to protect sensitive products such as food and medical products, while still being possible to recycle.





HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

The additive – small, plate-like particles of silicates and iron oxide – will provide plastics with much better abilities to block gases such as oxygen. This works in a similar way to how state-of-the-art aluminium coating does today in non-recyclable multilayer materials, but in smaller quantities. The additive can be used in both recyclable and compostable plastics. Two examples of where this material could replace multilayers are toothpaste tubes and food and drink pouches.

WHAT'S NEW?

Because of the magnetic properties of the additive particles, they can make it easier to identify and separate the packaging at the recycling stage. In addition, thanks to their magnetism, the particles could potentially be recovered separately in the future, by melting or dissolving the packaging and retrieving a purified polymer, while collecting the particles to be used again.

Three questions for David Espinosa from Aronax Technologies

WHAT MADE YOU COME UP WITH THIS IDEA?

I have been recently working on a design of a novel type of surgical glove with a plate-like additive, similar to a scaled armour, to make it pierce-proof against needles. I realised that the same 'armoured scale' principle could be applied to the Circular Materials Challenge to replace aluminium as a barrier.

WHAT MAKES YOUR IDEA STAND OUT AND HOW WILL IT HELP TO ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY FOR PLASTICS?

The plastics industry involves several processing steps and uses expensive equipment. This innovation has several advantages:

- It is expected to use existing processing equipment without major adaptations
- It allows mechanical separation and recycling, and could even enable separate recovery of the coating through a an additional process step
- It uses only safe and common compounds
- It can provide the insulation requirements necessary to replace multi-material laminates

WHAT EXCITES YOU THE MOST ABOUT THE ACCELERATOR PROGRAMME?

There are many problems and influencing factors only known to those with experience in the industry. The accelerator programme will allow us to discuss these with experts and get their guidance on how to make the invention a commercial reality. Most challenges stop at the award phase, leaving the winners with some money and no further help on how to convert that idea into a product. I think the accelerator programme will partially fill the gap between a concept with an award and a commercial success.

CIRCULAR MATERIALS CHALLENGE

CATEGORY 2

Combining materials that nature can handle.

When collecting, sorting and recycling packaging is difficult, one option is to develop materials that can be safely broken down by biological processes such as composting, or making entirely new materials in a biorefinery.

WINNERS

Full Cycle Bioplastics, Elk Packaging, and Associated Labels and Packaging - United States

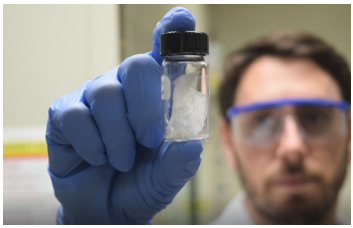
VTT Technical Research Institute of Finland - Finland

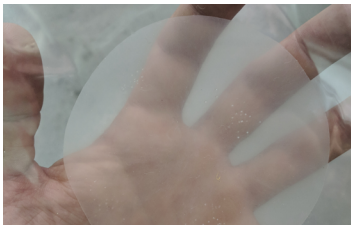
Fraunhofer Institute for Silicate Research - Germany

Full Cycle Bioplastics, Elk Packaging, and Associated Labels and Packaging

UNITED STATES

Working together, **Full Cycle Bioplastics, Elk Packaging, and Associated Labels and Packaging** make a compostable high-performance material from renewable materials, agricultural by-products and food waste to pack a broad range of products from granola bars and crisps to laundry detergent.





HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

Bio-based compostable plastics have not been able to compete with multi-layer packaging films made from several different materials when it comes to their ability to protect food and other sensitive packaged goods. This innovation is a fully bio-based and compostable version of a multi-material film that can be used in everyday packaging like granola bar wrappers, laundry detergent sachets, and crisp bags. After use, the packaging can be composted along with any uneaten food inside it.

WHAT'S NEW?

This is the first multi-layer packaging film made using cost-competitive, compostable PHA (a naturally occurring biopolymer) produced from organic waste, together with cellulose-based materials made from plant matter. It will provide an effective alternative to oil-based products, with greatly enhanced after-use options. Because the PHA is made from organic waste, composting the material after use can effectively provide the raw material for making new plastic.

Three questions for Andrew Falcon from Full Cycle Bioplastics

WHAT MADE YOU COME UP WITH THIS IDEA?

Having spent the early part of my career working in traditional plastics and packaging, I was increasingly frustrated by the unintended consequences of widespread plastics consumption: bad packaging design leading to inefficient recycling; plastic pollution; lack of alternative materials; and the volatility associated with being tied to the oil-based economy. In searching for alternatives, I learned that one of the biggest challenges in society is to find economically viable solutions to manage the growing volumes of organic waste and its associated greenhouse gas emissions. Our solution can address both critical issues.

WHAT MAKES YOUR IDEA STAND OUT AND HOW WILL IT HELP TO ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY FOR PLASTICS?

We address both plastic pollution and organic waste at a systems level. Transforming organic waste into a high value material will keep it out of landfill and reduce its greenhouse gas emissions. We not only offer a bio-based plastic made from a cost-competitive process, we overcome its inherent weak spots (such as lower than desired oxygen barriers) by combining it with other compostable materials to create a viable alternative to the non-recyclable, multi-layer films on the market today.

WHAT EXCITES YOU THE MOST ABOUT THE NEW PLASTICS ECONOMY ACCELERATOR PROGRAMME?

The opportunity to work with global leaders in products, materials, and packaging in a collaborative setting is inspiring. The plastics economy is complex and involves multiple players and industries. Aligning the interests of companies involved in waste, materials, conversion, and products is typically a barrier to real change. The Circular Materials Challenge provides a unique opportunity to bring together diverse stakeholders and unite them around a common purpose.

VTT Technical Research Institute of Finland

FINLAND

The **VTT Technical Research Centre of Finland** has created a compostable multi-layer material from agricultural and forestry by-products, which could be used to package products like muesli, nuts, and cheese.

HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

The VTT material solution looks like plastic and performs like plastic, but comes from Nature's own resources. It can be made from the very same material as a regular piece of paper as it uses cellulose-based raw materials like wood. It can also be made from fast-growing plants like rice straw and sugar cane tops, recycled fibres, textile waste, and agricultural residues.

Cellulose is inherently safe, renewable, recyclable and biodegradable. Thanks to its good barrier properties against gases, grease, mineral oils and moisture, VTT's material is well-suited for many food-packaging applications. These include: snack bags and stand-up pouches for dry goods such as cereal and nuts; a flexible packaging for air-sensitive products like chocolate, biscuits, and thin cuts of meat or cheese; and potentially some liquids and moist food. In theory, such cellulose-derived packaging could replace up to 15% of the current plastic barrier film market.

WHAT'S NEW?

The VTT material is built from two sorts of transparent wood cellulose: a fibrous cellulose (HefCel); and a plastic type cellulose (MMCC). These two materials have complementary barrier properties and VTT has combined them into a compostable three-layer film, which looks and performs like plastic but is entirely bio-based and compostable. The films are processed in a way that does not introduce any unwanted or toxic chemicals.

Three questions for Ali Harlin from the Technical Research Centre of Finland

WHAT LED YOU TO COME UP WITH THIS IDEA?

VTT's bio-based solution comes from decades of research, experience, and know-how in lignocellulosic (biomass) raw materials. These materials are very suitable for packaging and are already widely used in cardboard. As there are no well-functioning bio-based materials with good barrier properties available in the food packaging market, we started to investigate the potential of cellulose for this purpose.

WHAT MAKES YOUR IDEA STAND OUT AND HOW WILL IT HELP TO ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY FOR PLASTICS?

Cellulose – the most abundant renewable polymer on the planet – provides an environmentally benign alternative to fossil fuel based multi-layered plastic packaging. The major issue we faced was the moisture sensitivity of fibrous cellulose films. To overcome this, we created a plastic-like cellulose film with excellent moisture barrier properties. By combining the two, we obtained a unique material with the required properties. Once commercialised, cellulose-based films have the potential to diminish the use of fossil-based materials, reduce the pollution of waterways by microplastics, and mitigate food losses.

WHAT EXCITES YOU THE MOST ABOUT THE NEW PLASTICS ECONOMY ACCELERATOR PROGRAMME?

The Accelerator Programme is an amazing opportunity for us to get multidisciplinary insights to develop and improve our packaging material. Its next phase helps us scale up faster and be better able to provide an environmentally feasible food-packaging alternative to both emerging and industrialised markets.

FRAUNHOFER INSTITUTE FOR SILICATE RESEARCH

GERMANY

The **Fraunhofer Institute for Silicate Research** has developed a coating with silicate and biopolymers that can be used in many different food packaging applications and is fully compostable.

HOW DOES THIS INNOVATION ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY?

The Fraunhofer Institute for Silicate Research has been developing high-barrier coatings based on materials with glass-like structures, called ORMOCER®, for many years. These materials combine the key properties of their components: high transparency, hardness, chemical and thermal stability (glass-like); low processing temperatures, high functionality, toughness (polymer-like); and flexibility (silicone-like). A coating made from this hybrid material greatly improves the gas and vapour barriers of packaging. However, the original ORMOCER® is not bio-based or biodegradable. Since the main problem of bio-based plastics is lack of good barriers, Fraunhofer has developed a new class of biodegradable coatings called bioORMOCER®, which provide compostable alternatives to non-recyclable, multi-layer packaging.

WHAT'S NEW?

The new coatings can improve the performance of bio-based and biodegradable packaging, which alone cannot guarantee the required minimum shelf life of many food products. The coatings will therefore directly enhance the ability of biodegradable materials to compete with non-recyclable, multi-layer films.

Three questions for Sabine Amberg-Schwab from Fraunhofer ISC

WHAT LED YOU TO COME UP WITH THIS IDEA?

The huge environmental problems caused by non-recyclable plastics made us very concerned and we asked ourselves the question: how can we contribute with our development work to making packaging materials more fit for purpose? While compostable packaging films are already commercially available, they struggle to find use in food packaging as they do not have all the desired properties, including providing a sufficient barrier against water vapour or oxygen, tensile strength, and abrasion resistance. Our idea was to improve the properties of bio-based and biodegradable films by developing a biodegradable coating.

WHAT MAKES YOUR IDEA STAND OUT AND HOW WILL IT HELP TO ACCELERATE THE TRANSITION TO A CIRCULAR ECONOMY FOR PLASTICS?

Our innovation is a good example of a circular material. We use organic waste like fruit residues to make our coatings and therefore do not compete with food crops. From these biological residues biopolymers are extracted, which are chemically modified to function as new bio-based and biodegradable precursors for our coatings. The coatings are transparent and drastically improve the ability of bio-based plastics to preserve food, while still being compostable.

WHAT EXCITES YOU THE MOST ABOUT THE ACCELERATOR PROGRAMME?

Participating in the accelerator programme is an excellent opportunity to promote our coatings and establish contacts with possible business partners. We are excited to work with pioneers and experts in the plastic, packaging, and recycling industries and know that all partners will benefit from a valuable knowledge transfer. We are convinced that our innovation has the potential to significantly contribute to a more sustainable packaging industry.

HONOURABLE MENTIONS

With over 60 proposals sent to the **Circular Materials Challenge**, it was inevitable that some very good proposals would not be in the winning group. The following exciting innovations, which are also key components of enabling a new plastics economy, receive honourable mentions.

AD Biocomposites/ITENE - Spain

Searious Business/Brightlands Materials Center - Netherlands

Carson Meredith Group, School of Chemical & Biomolecular Engineering, Georgia Institute of Technology - United States

AIMPLAS - Spain

AD BIOCOMPOSITES / ITENE

Spain

PLA is the most common bio-based plastic on the market, and is already used in numerous applications. It is renewable, recyclable, and industrially compostable. Yet it has only limited use compared to other polymers, due to some drawbacks in mechanical and gas barrier properties. The nanoengineered BlockPLA™, a variant developed by AD Biocomposites and ITENE, improves these properties without reducing compostability. BlockPLA™based plastics could be used, for example, in transparent food wrapping films and yoghurt pots; both are markets where most of the plastics used today cannot be easily recycled and new packaging solutions are needed.

SEARIOUS BUSINESS / BRIGHTLANDS MATERIALS CENTER

Netherlands

The team and its partners (including TNO, CeDo, DSM, Avantium, and Ioniqa) is investigating how to combine different polymers into materials that can be chemically split back to monomers. The monomers could then be used to make new, virgin-quality plastics. This is an exciting approach to tackle the challenges with multi-material plastics since it could make it possible to combine materials and at the same time improve recycling. The depolymerisation technology works for several established polymers (PET, PLA, PCL) as well as new ones (PEF, PHB) coming into the marketplace.

CARSON MEREDITH GROUP, SCHOOL OF CHEMICAL & BIOMOLECULAR ENGINEERING, GEORGIA INSTITUTE OF TECHNOLOGY

United States

This team is combining two of nature's most abundant polymers, cellulose and chitin, into a layered material that combines their properties to make a film that is transparent, strong and has high gas barriers. Both polymers could be sourced from the enormous resources of agro-forestry residues and fishing by-products produced in the world, and are completely compostable, making this material an excellent example of a circular use of biological resources.

AIMPLAS

Spain

Composting is one of the few known ways of processing multi-layer materials after use, since the mix of different polymers makes them unfeasible to recycle. AIMPLAS proposes a low-cost method of making thermoplastic PVOH, a high oxygen barrier, water soluble and compostable material, which is an alternative to the barrier material commonly used in multilayer barrier packaging. This innovation could significantly contribute to reducing the cost of high-performance, compostable plastics, making them more viable alternatives to multi-layer packaging that can't be recycled.

ABOUT THE NEW PLASTICS ECONOMY INITIATIVE

The New Plastics Economy is an ambitious, three-year initiative to build momentum towards a plastics system that works. Applying the principles of the circular economy, it brings together key stakeholders to rethink and redesign the future of plastics, starting with packaging. The initiative is led by the Ellen MacArthur Foundation in collaboration with a broad group of leading companies, cities, philanthropists, policymakers, academics, students, NGOs, and citizens.

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