#GC4320100

The Circular Materials Challenge:

Recyclable Alternatives to Multi-Material Laminated Packaging Films

THE OPPORTUNITY:

As part of the New Plastics Economy Innovation Prize, the Ellen MacArthur Foundation is asking the question *how can we make all plastic packaging recyclable?* Addressing one of the most difficult to recycle packaging material classes, the Circular Materials Challenge is seeking alternatives to non-recyclable multi-material films used in packaging. We aim to find new materials with the potential to be used in packaging films for consumer products, and be collected, sorted and recycled or composted in commonly used recycling infrastructures. We are open to all opportunities from early stage to more mature innovations that, with further development, could be manufactured at scale. Winners will receive $200,000 and exclusive access to a 12-month acceleration programme, with the opportunity to receive mentoring and support from New Plastics Economy participant organisations, to advance their innovations and demonstrate that their materials have the potential to be a viable alternative to non-recyclable multi-material laminated packaging.

THE TIMELINE AND AWARDS:

Phase 1: 'Identify New Solutions' - Proposal Submission

20 October 2017	**Submission Deadline. Responses due by 20 Oct 2017 at 5:00pm US EDT**
January 2018	Up to 5 winners receive award of $200,000 each. Winners and recipients of 'honourable mentions' announced at an award event, where they will get the opportunity to showcase their innovations to investors and invited organisations from the packaging, consumer products and recycling industries. Winners will be invited to Phase 2 to advance their solution in the 12-month New Plastics Economy Accelerator Programme.

Phase 2: 'Accelerate New Solutions'

January 2018:	Up to 5 winners start the New Plastics Economy Accelerator Programme, operated in collaboration with Think Beyond Plastic™. During Phase 2, winners will be mentored by a tailored group of experts, including selected participant organisations. The accelerator programme offers exclusive access to industry experts, tailored mentorship, guidance to commercialisation, feedback on specific user requirements, performance expectations, scalability requirements, as well as need-specific access to material innovation labs for testing and development. During Phase 2, participants are expected to demonstrate a proof of concept, a Minimum Viable Prototype or commercial scalability, aiming at showing that the material has the potential to be an alternative to multi-material laminated packaging.
December 2018:	Complete and submit an outcomes report.
January 2019:	All Phase 2 outcomes showcased at a demo day and investor forum attended by investors and invited industry organisations.
Post Phase 2:	At completion of Phase 2, participant organisations will evaluate the opportunities to collaborate with winners.
IP Ownership:	The individuals/organisations submitting proposals will retain the rights to all IP created in Phase 1 and Phase 2.
Technical Resources:	The technical terms and material properties used in this document are defined in the Appendix.

Visit the Challenge Website (https://ninesights.ninesigma.com/web/circular-materials) to see Official Challenge Rules and submit an Entry.

Questions: Contact the Solution Provider Help Desk
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Challenge Description

The Circular Materials Challenge seeks to catalyse innovation, and help to advance the development of new materials with the potential to become commercially viable, recyclable or compostable alternatives to the non-recyclable multi-material laminate films used in packaging. The Challenge aims to stimulate the development of materials that could be captured and recycled or composted effectively rather than being incinerated or ending up in landfills or the natural environment after one short use, and at the same time have sufficient barrier properties to be used to package consumer products, such as food or personal care products. By identifying such materials this Challenge will bring us one step closer to creating a plastics system that works.

The solutions could be a completely new material, a new formulation or variant of existing materials, or existing materials used in a new way to create **a recyclable mono-material*** or **a fully bio-based*, compostable* mono- or multi-material*** that has the potential to:

- provide barrier properties suitable for packaging liquid, moist or dry products
- be used to manufacture packaging for consumer products (for example, has suitable mechanical properties and is safe to use in food applications). Example packaging applications could include sachets, pouches, snack bags and food wrappings
- be collected, recycled or composted after use, as part of a feasible collection and sorting route (either in widely used existing systems or a system that could be developed and used widely)

If the material is recyclable* it should have the potential to be recycled in a technically feasible way, without prohibitively high costs of material separation. It may contain benign* additives (such as removable coatings) that do not contaminate or harm future material applications or the environment.

If the material is compostable* it should be made of 100% bio-based* components, and not contain a metal foil layer. It may contain benign additives that do not contaminate or harm the environment (such as removable coatings, or thin metal barriers in compliance with EN13432 standards – although fully metal-free materials are encouraged). It may be anaerobically digestible.

The challenge is open to all opportunities from early stage to more mature innovations that have the potential to manufactured at scale.

Multi-material laminated film is used in a wide range of packaging applications. We acknowledge it will be difficult to find one material that works in all these applications. The challenge is open to materials that could be used in a small number of applications, although we would be most interested in materials that could be used in a variety of contexts.

Background

Combining an unrivalled range of properties with low cost, plastics have become an integral part of our daily lives. Yet, projections based on the growth in production and the current volume of plastics escaping formal collection systems predict that the world's oceans could contain more plastics than fish by 2050. Packaging, the single largest application of plastics and the biggest source of ocean plastics, is particularly challenging.

Forty years after the launch of the first universal recycling symbol, only 14% of plastic packaging is collected for recycling globally. After a short first-use cycle, 95% of plastic packaging material value, or USD 80–120 billion annually, is lost to the economy. A staggering 32% of plastic packaging escapes collection systems, generating

* See Appendix Circular Materials Challenge - Technical resource

significant economic costs by reducing the productivity of vital natural systems such as the ocean and clogging urban infrastructure. The cost of such after-use externalities for plastic packaging, plus the cost associated with greenhouse gas emissions from its production, has been conservatively estimated at USD 40 billion annually.

The New Plastics initiative, led by the Ellen MacArthur Foundation, aims to move the plastics value chain into a positive spiral of value capture, stronger economics, and better environmental outcomes.

So how can we make all plastics materials recyclable?

One of the most challenging segments of plastic packaging is multi-material laminated films. This group of materials has outstanding functional properties, combining several micro-meter thick layers of different materials that enable both light-weighting and excellent barrier properties. Unfortunately, multi-layer materials are very hard to recycle. So the vast majority of multi-material packaging end up in landfill, incinerated, or escape into the environment.

Replacing unrecyclable materials to make packaging feasible to recycle or compost is a crucial upstream intervention to create a more circular plastics economy, where plastics are designed to be reused, recycled or composted, and prevented from escaping into the environment.

About this challenge

Ellen MacArthur Foundation 'Circular Materials Challenge' Timeline

* See Appendix Circular Materials Challenge - Technical resource

Phase 1: Proposal submission and evaluation

We invite proposals describing alternatives to multi-material laminated films, explaining how it can be used in packaging and how the material could be recycled or composted (see 'How to Submit' below).

20 October 2017 – Submission Deadline
A panel of judges from the New Plastics Economy initiative and its participant organisations will evaluate all proposals and select the most promising submissions.

January 2018:

- Up to 5 winners receive award of $200,000 each
- Winners and recipients of 'honourable mentions' are announced at an award event, where they will get the opportunity to showcase their solutions to investors and invited organisations from the packaging, consumer products and recycling industries
- Winners will be invited to Phase 2 accelerator to advance their solutions

Phase 2: 12-month Accelerator

Phase 1 winners enter the New Plastics Economy Innovation Accelerator, a 12-month programme specifically designed to advance their innovation. The programme provides customised mentorship by industry experts on topics ranging from specific guidance on industry needs and requirements, to relevant science, business basics, global IP protection, strategic partnerships, investor strategies, CEO experience, and others. It will offer access to material innovation labs for testing of viability and scalability, and guidance support as needed. The accelerator programme will be operated in collaboration with Think Beyond Plastic™.

During Phase 2, participants are expected to demonstrate a proof of concept, a Minimum Viable Prototype or commercial scalability, aiming at showing that the material has the potential to be an alternative to multi-material laminated packaging. Important criteria to validate include mechanical properties relevant to packaging processing, such as tensile strength and printability, and total resource efficiency for manufacturing and using the new material in packaging (e.g. weight of new film). The exact demonstration will depend on the nature of the solution, its technology readiness level, the potential application and other factors.

January 2018

- Up to 5 winners enter the New Plastics Economy Innovation Accelerator
- Exact programme timeline to be confirmed before start of the accelerator

December 2018

- Complete and submit report on Phase 2 outcomes to the Ellen MacArthur Foundation

January 2019:

- All Phase 2 outcomes showcased at a concluding event attended by investors and invited organisations from the packaging, consumer products and recycling industries
- Exact details to be confirmed before start of the accelerator

Post Phase 2:

- Opportunity for ongoing mentoring, collaborations or partnerships with Ellen MacArthur Foundation Partner Organisations

* See Appendix Circular Materials Challenge - Technical resource

Evaluation Criteria

The submissions will be assessed by an judging panel according to the following criteria:

- Potential for the material to be used in packaging consumer product applications, and subsequently recycled or composted. The technical assessment will be made according to the long-term potential on the following dimensions:
    - gas and moisture barrier properties (especially oxygen, carbon dioxide, water)
    - mechanical properties affecting machinability for conversion and packing
    - ease of sourcing the material (considering, e.g. the existence of complementary feedstocks and potentially feasible bio-based options)
    - conversion yield and efficiency to derive the material from its source or feedstock
    - the potential for all or some of the material to be sourced from recycled materials or by-products from other processes
    - possibility for the material to be separated into a recyclable or compostable fraction after being collected in a mixed materials stream
    - the ability to be recycled or composted in a technically feasible way
    - the possibility to create, or drop into, a valuable post-use material stream
- Potential for the solution and team behind it to benefit and advance by being included in the 12-month accelerator programme

Materials with a broad potential applicability (i.e. the potential to replace large volumes of multi-material laminates) and/or materials for challenging applications (such as liquid food or personal care products) may receive higher scores for some criteria.

Approaches not of interest

Based on the vision of the New Plastics Economy Innovation Prize, the following solutions are excluded:

- Solutions that would rely on recovery by landfill, incineration, energy recovery or plastics-to-fuel technologies in the long term (anaerobic digestion is acceptable)
- New end-use applications of currently existing multi-material laminate films, or existing commercial solutions such as the use of compatibilisers to blend multi-material laminates or other different materials as one resin
- New low-barrier biodegradable materials
- Materials that have known safety issues, or contain widely acknowledged substances of concern* (A minimum requirement is the ECHA list of 'Substances of very high concern' candidates)

* See Appendix Circular Materials Challenge - Technical resource

How to Submit

You must complete and submit the online response form by 5pm US EDT on 20 October 2017. You will be able to upload supplemental documents with your response.

Your response should provide a short description of the following:

The Material and its potential applications

- the proposed new material and it's chemical and physical properties, and their advantages over currently used materials
- examples of potential product applications where your material is used as packaging

Technical information

- data or estimates of the barrier properties (such as moisture, carbon dioxide, and oxygen) and ruggedness in the anticipated product applications
- data or estimates of mechanical properties relevant to packaging processing, such as tensile strength and printability
- from what feedstock(s) it could be sourced and manufactured (including an indication of whether any recycled component could be used), including an estimate of conversion yield and efficiency
- how the material could be separated into a recyclable / compostable fraction
- how the material could be recycled or composted in an existing, a modified or a new way
- how the material could create, or fit into, a valuable post-use material stream
- status of material development and key obstacles to be overcome (if required – e.g. do you see any potential obstacles for getting the material approved for use in the market?)

Additionally, if compostable:

- a clear explanation of why a compostable alternative is a good choice in the indicated product applications
- under what conditions will the material biodegrade at a reasonable rate
- how the material could be biodegraded under anaerobic digestion conditions (if applicable)

Supporting data:

- any experimental or real world data or references to support the above points

* See Appendix Circular Materials Challenge - Technical resource

A plan for Phase 2:

- describe the key steps or tests you would do in Phase 2. These will depend on the technology readiness of your material. They could be a proof of concept, creating Minimum Viable Prototype or a demonstration of commercial scalability. They should be the next steps needed to demonstrate your solution could be a potential alternative to multi-material laminated films and/or to show it has the potential to be used for packaging in a certain application
- describe your Phase 2 goals and how you would define success in Phase 2
- describe how the award and the opportunity to work with the New Plastics Economy Accelerator Programme will accelerate your technology
- outline how your technology could be advanced after Phase 2

About you:

- brief overview of the organisation(s) and/or key individual(s) submitting the proposal
- a description of your / your organisation's experience with materials, packaging or recycling
- overview of previous funding and/or awards

All responses must be submitted online at the Ellen MacArthur Foundation commissioned NineSights portal, the NineSigma open innovation community, following the prompts in the Response Form. The completed Response Form will serve as an introduction to the respondent's idea, approach to realization of the idea, and expertise, and should provide data to verify at least a bench-scale demonstration.

If you require assistance to submit, please contact the Solution Provider Help Desk (grandchallenge@ninesigma.com).

About this Challenge

By submitting a response, you agree to the Official Rules which includes the following requirements:

- You agree that your submission does not contain any confidential information.
- You acknowledge that the Ellen MacArthur Foundation reserves the sole and absolute right and discretion to award prizes as stated, including awarding less than 5. A judging panel will evaluate entries and determine award winners. Their decision is indisputable.

* See Appendix Circular Materials Challenge - Technical resource

Appendix Circular Materials Challenge – Technical Resource

The following section clarifies terms and properties used in the Circular Materials Challenge brief. Please note that there might be different definitions used for the terms listed below, but that those included here are the only ones valid for the Challenge. For the purposes of this challenge, a 'material' is below referred to a flexible film material (made up of one or several distinct physical components).

Product applications

- Multi-material laminate films are used in a broad range of applications, and while it is unreasonable to expect a 'one-size-fits-all' solution, broad applicability is encouraged. An important aspect of the proposed new materials is the volume of packaging materials they could potentially replace.
- In addition, a greater need for innovation is seen for applications where multi-material laminate films are especially difficult to replace. Below are some example application categories and an indicative preference in the evaluation of proposals based on the level of difficulty.

1. Liquid or high-moisture food and hygiene content (e.g. mayonnaise, shampoo, juices and soft drinks, pet food);
2. Dry or low-moisture fresh food stuff (e.g. coffee, crisps, granola);
3. Dry product content.

Bio-based material

- A material made from, or are reasonably to make from, 100% biological and renewable feedstocks with reasonable chemical modification.
- Biological feedstocks include, but are not limited to, marine microorganisms (such as cyanobacteria), ligno-cellulosic biomass (such as forest or crop residues), food or food processing waste, or wastewater sludge.
- Feedstocks that require production conditions that compete with food production are discouraged.

Mono-material

- A material containing only one polymer (such as polyethylene). The use of small amounts of benign additives (such as removable coatings) is acceptable.
- The mono-material can be layered if mixing the layers yields a single polymer resin with acceptable dispersity for use in similar applications as the original material.

Multi-material laminate

- A material containing more than one polymer or polymer type, in a laminated structure (for example a LDPE and PET laminate).
- The materials are held together by adhesives or by the means of manufacturing (e.g. coextrusion).
- The laminate materials require considerable effort beyond mechanical shredding to separate, which under typical economic conditions would be cost prohibitive.

Recyclable

- There is no widely accepted definition for what makes a material 'recyclable'.
- For the purposes of the Circular Materials Challenge, we refer to 'recyclable' as when a used film material can be mechanically reprocessed into a new resin with the same or comparable properties as the original material. The new resin should be viable to use as a raw material in a new product or as a component incorporated into a product. This definition excludes energy recovery and the use of the product as a fuel. (C.f. the ISO 18601 and ISO 18604 standards)
- 'Chemical recycling', whereby the polymers in the material are chemically transformed into their monomeric building blocks or other feedstock that could be used to make new polymers, is excluded from this definition. However, it is viewed as a benefit if the proposed material could be chemically recycled as well as mechanically. Note that washing / cleaning of recycled material is not considered chemical recycling.
- Potential for '**closed loop recycling**' is encouraged. In this context 'closed loop recycling' means that the recycled material can be used for the same packaging application as the original material, within reasonable limits. Reasonable limits could be, for example, that a certain amount of virgin material needs to be added to the recycled material to ensure the new application's requirements are met.
- Recycling options that are limited to '**downcycling**' are discouraged. In the context of the Circular Materials Challenge, 'downcycling' means every form of reprocessing, or use of reprocessed material, where the integrity of the original material is diminished by either physical stress or mixing with other materials such that the nature of possible post-recycling applications is significantly different from the original application.
- In the context of this challenge, **composting** is seen as a form of 'outer loop' recycling. As it by definition destroys the original material without significant material or energy recovery, applications should be chosen carefully (see "**Compostable**" below).
- It is acknowledged that the participants cannot control or foresee how their materials would be treated on the market, but a high potential of closed loop recycling versus limitations to downcycling is favourable.

Compostable

- Compostability means that a material can be degraded through metabolic action in aerobic conditions. The degradability of materials that are commonly referred to as biodegradable does however vary widely and are dependent on both the material formulation and the environmental conditions. Material compostability is therefore defined as either 'industry compostable' or 'home compostable'.
- Industry compostability means that the material degrades in a controlled environment, under elevated temperatures and managed oxygen levels and biological activity. Industry compostable materials should fulfil the requirements needed to be certified according to the European (EN13432) and American (ASTM D6400) norms.
- Home compostability means that the material degrades under ambient conditions in an uncontrolled environment. Home compostable materials should fulfil the requirements needed to be certified by Vincotte OK Compost Home standard or a similar outfit.

* See Appendix Circular Materials Challenge - Technical resource

- Note that it is not a requirement to already have obtained any of the above certifications to be eligible to enter the Circular Materials Challenge.
- Compostability is particularly encouraged for applications where there is a high likelihood of the used packaging containing residual food or other compostable materials that are difficult to separate from the packaging.
- The ability to also biodegrade under anaerobic digestion conditions is favourable.

Benign

- In the context of the Circular Materials Challenge, benign refers to a material or additive that has no negative impact on
    - a recycling or composting process. This could mean that any additives or part of the material that is not compatible with the process can be separated and recovered prior to it at a reasonably low cost;
    - the natural environment if it should inadvertently end up there. This could mean that the material is inert or degrades into biocompatible components.
- A benign substance should also not be, or transform into, any substance of concern.

Toxic substances

- Any substance widely acknowledged as toxic or carcinogenic.

Substances of concern

- Any substance appearing in the ECHA list of 'Substances of very high concern' candidates.
- In addition, substances are highly discouraged if they appear on unofficial lists of substances of concern, such as
    - The Cradle2Cradle Banned List of Chemicals
    - The ChemSec SinList

* See Appendix Circular Materials Challenge - Technical resource