

FLEXIBLE PACKAGING:

PLASTIC FLEXIBLES:

Design and recycling
in the informal sector



Deepdive

This document is a strategy deepdive with detailed insights, analysis and actions. For a high-level overview of the work, see the executive summary.

WEBSITE

Easily digestible overview of the different strategies for flexible packaging, and the key insights and actions for each.

[Click here](#)

EXECUTIVE SUMMARY

Short, high-level strategy document. Doesn't contain any analysis, reasoning or details for the key actions.



STRATEGY DEEPLIVES

Detailed insights and analysis, and detailed key actions for the different strategy options.



SUPPLEMENTARY INFORMATION

Supporting data and references.



OVERARCHING STRATEGY

(this deepdive relates to only one part of this overall flexible packaging strategy)

[Click here for the executive summary.](#)

CONTEXT

Flexible packaging is the fastest-growing plastic packaging category. Because it is almost uniformly single-use, with very low recycling and high leakage rates, it is also by far the most challenging market segment to address on the journey towards a circular economy for plastics.

OVERARCHING STRATEGY

Eliminating and innovating away from single-use flexible packaging must be the first and foremost part of any flexible packaging strategy — because as soon as single-use flexible waste is generated, regardless of material or geography, it is very hard to deal with. Current efforts are only just scratching the surface and a step-change in the level of commitment and effort across direct elimination of unnecessary packaging and exploration of upstream innovation solutions, such as reuse, is required from ALL stakeholders.

For the single-use flexible packaging items that cannot currently be eliminated without unintended consequences, unprecedented efforts are required to ensure they can be circulated. This can include staying with a conventional plastic and scaling recycling systems, or substitution to a different material (such as paper or compostable plastics where relevant) and then scaling those systems. Either way, what is clear is that unless simultaneous, unprecedented efforts across packaging design, infrastructure, and policy are begun immediately — efforts that push far beyond the level of activity we are currently seeing — the circulation of flexible packaging in practice and at scale is unlikely to happen in the foreseeable future.

While they are currently a necessary part of the solution, the inherent quality and yield limitations of recycling and substitution strategies mean that staying with single-use flexible packaging will always present a challenge from a circular economy perspective. This is why we need to keep driving a strong upstream innovation agenda (in line with the first part of the overarching strategy) in order to find ways to eliminate ever-increasing single-use flexible packaging over time.

URGENT ACTIONS

This work has identified 21 specific and urgent actions for flexible packaging that need to be commenced immediately by businesses and policymakers in order to make significant progress towards 2025 targets and beyond.



KEY ACTIONS FOR INFORMAL RECYCLING SYSTEMS

INFORMAL RECYCLING SYSTEMS: flexibles made from plastic, designed for recycling, and collected, sorted and recycled in practice and at scale in a geography predominantly serviced by the informal sector.

INFORMAL RECYCLING SYSTEMS

KEY ACTIONS

Businesses to:

Radically improve packaging design, in particular, shift to mono-materials for the >40% of flexibles that are currently multi-material

[See page 6 for details](#)

Policymakers, collaborative cross-sector initiatives, and businesses (through advocacy) to:

Establish an inclusive process, gathering data on existing structures and processes and identifying informal sector organisations to work with

Finance improvements in infrastructure, tech and tools through large infrastructure investments and microfinancing for the informal sector

Roll out holistic waste management legislation, including inclusive EPR legislation

[See page 7 for details](#)

Businesses to:

Radically improve packaging design, in particular, shift to mono-materials for the >40% of flexibles that are currently multi-material

All flexible packaging producers (converters, FMCGs, retailers, etc.) to transition all multi-material flexibles to mono-material flexibles, reduce non-polymer content (i.e. use of coatings, inks, glues, etc.) to <10% but ideally <5% to enable new end-markets, and adhere to local design for recycling guidelines. All to be completed by 2025.



Policymakers, collaborative cross-sector initiatives, and businesses (through advocacy) to:

Establish an inclusive process, gathering data on existing structures and processes and identifying informal sector organisations to work with

Industry and governments to gather better data on the structures and processes that make up the current informal ecosystem in their relevant local/regional context, and then use this knowledge to:

- Identify appropriate organisations to engage with to support the voice and organisation of the informal workforce (ideally existing cooperatives or membership-based organisations, but if these do not exist, civil society/non-profit organisations that can work to establish them).
- Ensure the informal sector's representation in conversations around packaging design, legislation, and planning, piloting, and implementation of waste management systems.
- Ensure transparent processes are adopted (for example, that the allocation of funds/financing or reimbursements to informal workers is transparent and fair).

Finance improvements in infrastructure, tech and tools through large infrastructure investments and microfinancing for the informal sector

Businesses with flexibles in their portfolio as well as financial institutions to immediately boost the financing that is available for efforts that support rollout of an inclusive recycling system by:

- Making microfinancing available to actors within the informal sector (i.e. cooperatives or membership-based organisations, or micro-enterprises) to go towards CAPEX investment into improved collection and sorting facilities, infrastructure, tools, etc.
- Channelling financial investments into building out the recycling infrastructure more broadly in geographies serviced by an informal sector and providing support for currently lacking services (i.e. transport of collected materials to formal recycling facilities).

Policymakers, collaborative cross-sector initiatives, and businesses (through advocacy) to:

Roll out holistic waste management legislation, including inclusive EPR legislation

Government entities (from local to national level) to ensure that waste management strategies and policies are designed to drive the waste management of all materials, rather than just focusing on a few materials (for example, PET bottles) and to tailor and implement socially inclusive EPR schemes for all packaging, governed by an appropriate body (with EPR being the only proven and likely pathway to make the economics of recycling work - see the EPR statement and position paper [here](#)). Businesses to support and engage with national governments, the informal sector and EPR experts to achieve both of the above.

Check out our EPR report [here](#).



INFORMAL RECYCLING SYSTEMS SECTORS AND GEOGRAPHIES OF PARTICULAR RELEVANCE

Plastic flexibles are most relevant for applications that require high barrier properties and where reuse or other innovative models seem to appear less likely to develop in the near future.

For example:



CONFECTIONERY



**CRISPS, BISCUITS,
& MOISTURE-SENSITIVE SNACKS**

Once direct elimination and innovation opportunities have been pursued, establishing inclusive recycling systems for flexibles is of greatest relevance in geographies where the majority of waste management is currently performed by an informal sector.

Geographic Archetype 1: Geographies with low volumes of mismanaged packaging waste, and advanced waste management systems.

For example: Established recycling systems producing high-quality recyclate; mandatory EPR.

Proxy geography: Europe

Geographic Archetype 2: Geographies with low volumes of mismanaged packaging waste, but less advanced waste management systems.


For example: Recycling systems are limited in scale or have considerable loss of material quality; emerging, limited or voluntary EPR.

Proxy geography: USA

Geographic Archetype 3: Geographies with high volumes of mismanaged packaging waste and limited/no waste management systems.

For example: Limited systems even for collection; No/limited EPR

Proxy geography: South and South-East Asia



5 KEY INSIGHTS SUPPORTING THE KEY ACTIONS

INFORMAL RECYCLING

5 KEY INSIGHTS

1

Recycling of plastic flexibles has inherent limitations.

2

Recycling of flexibles in the informal sector faces further barriers regarding scale-up timeframes and financing, and end-market development. For the very small formats (e.g. sachets) these barriers may be insurmountable.

3

Given that in many of the geographies serviced by the informal sector scaled recycling systems for flexibles are many years away, upstream innovation to move away from single-use flexibles becomes of even higher importance — and presents a significant opportunity.

4

However, despite these inherent limitations, solutions for recycling flexibles will still be required (bearing in mind that before recycling systems are pursued as a strategy, opportunities for direct elimination, innovative elimination, and reuse should always be pursued first and foremost).

5

Where recycling is pursued as a strategy in geographies serviced by the informal sector, the best option, from both a social and economic point of view, is to scale recycling systems through establishing an inclusive waste management system.



INFORMAL RECYCLING

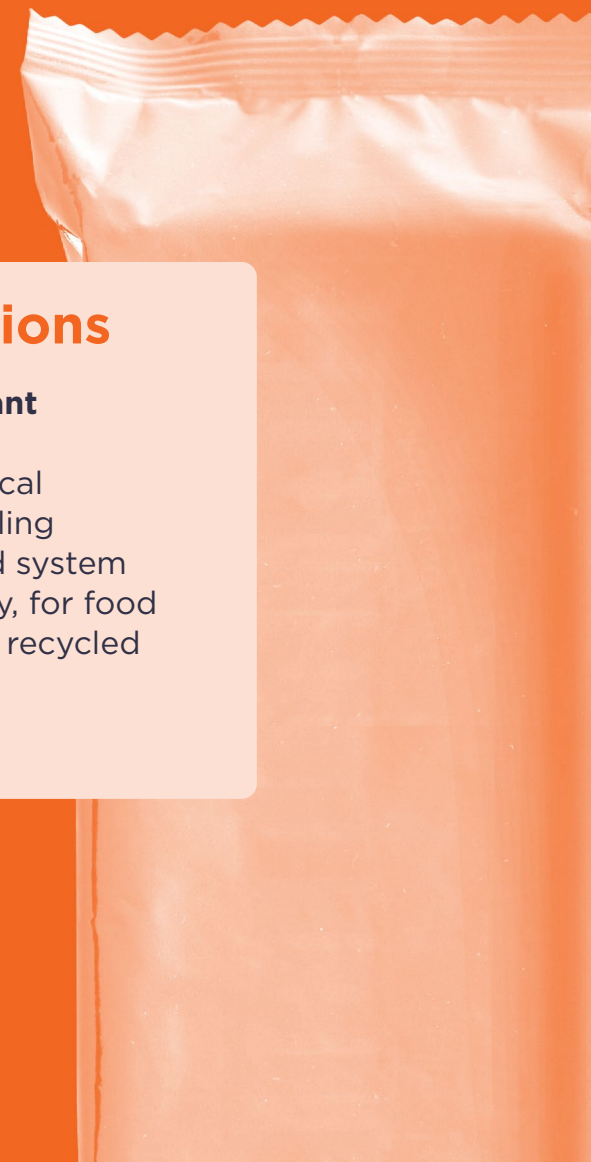
5 KEY INSIGHTS

1

Recycling of plastic B2C flexibles has inherent limitations

Even in a maximally optimised recycling scenario for B2C flexibles, there will be significant unavoidable material quality and quantity losses and therefore considerable virgin input requirements. This is due to inherent limitations that are unlikely to be overcome by technical developments and means that only a portion of the flexible packaging that is sent to recycling will make it back into high-quality recyclate. This means that even in a maximally optimised system **-45%** of the plastics going into flexibles would need to come from virgin inputs. Specifically, for food packaging virgin input requirements are likely to be higher due to the lack of availability of recycled materials that can come into contact with food.

See following page for details and references



Even in a maximally optimised recycling scenario for B2C flexibles, there will be significant unavoidable material quality and quantity losses, and therefore considerable virgin input requirements.

MECHANICAL RECYCLING comes with significant and inherent QUALITY losses:

- Even if radical design changes are made across all flexibles, a mechanical recycling process will always produce non-virgin quality recyclate.
- Given the material properties required to produce high-performance flexibles, it was broadly agreed by our expert panel that an average of 30% mechanically recycled content is pushing the upper limit for B2C flexibles.
- **This quality loss thus limits the amount of mechanically recycled content that can go back into B2C flexibles.**

CHEMICAL RECYCLING comes with significant and inherent YIELD losses:

- Even if radical design changes are made across all flexibles, a chemical recycling process will always have significant yield losses.
- Polymer yield from a chemical recycling process (i.e. the amount of polymer obtained after polymerisation relative to the amount of polymer going into the pyrolysis unit) is generally found to be between 30-50%, (i.e. there is a 50-70% loss of material from the plastic packaging system).
- While it is technically possible to make a food contact B2C flexible from 100% chemically recycled plastics, to do so across all B2C flexibles would require significant chemically recycled content to be brought in from other sectors/industries, simply transferring rather than solving the issue of 'yield losses'.

Even in a maximally optimised recycling scenario for B2C flexibles, there will be significant unavoidable material quality and quantity losses, and therefore considerable virgin input requirements.

Maximally optimised recycling system for plastic B2C flexibles**

What the global flows for plastic B2C flexibles would look like assuming:

- All B2C flexibles are collected and recycled via highly optimised mechanical and chemical recycling processes.
- The amount of plastics going back into B2C flexibles is maximised.

NOTES

**What the global flows for plastic B2C flexibles would look like assuming:

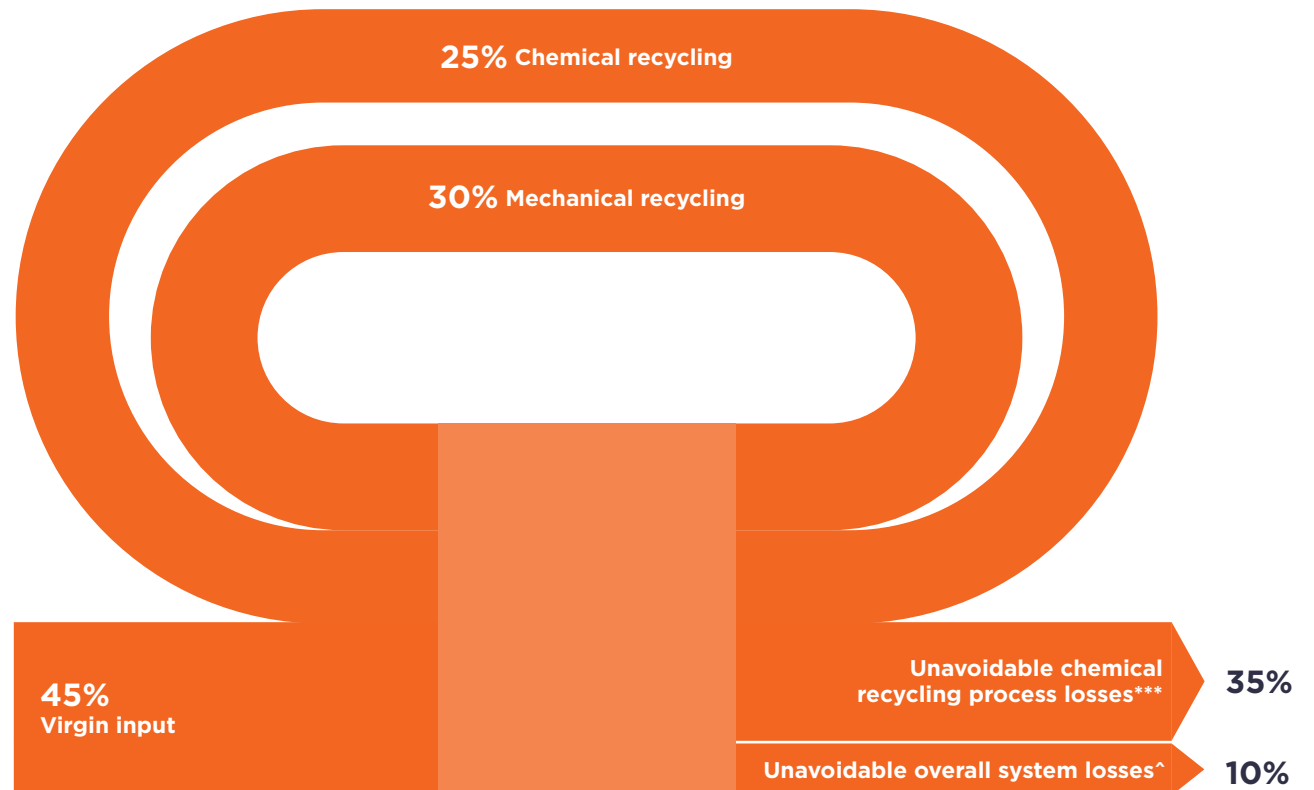
a) All B2C flexibles are collected and recycled via highly optimised mechanical and chemical recycling processes; b) The amount of plastics going back into B2C flexibles is maximised; c) All flexible packaging (including food packaging) would contain 30% mechanically recycled content; d) The average yield for chemical recycling was 40%.

***Assuming a 60% loss of material from the plastic packaging system (as gasses and waxes) in a chemical recycling process, as per yield discussion above.

^Losses such as those that occur through collection and sorting processes as well as packaging production processes. 10% is highly conservative.

NOTE: Here chemical recycling refers to pyrolysis of polyolefins, this being the predominant technology in use/being considered for scale-up.

For additional information and references see the Deepdive: [Plastic B2C flexibles: Design and recycling in the formal sector](#)



INFORMAL RECYCLING

5 KEY INSIGHTS

2

Recycling of flexibles in the informal sector faces further barriers regarding scale-up timeframes and financing, and end-market development

On top of inherent limitations, recycling of B2C flexibles in the informal sector faces further barriers. Infrastructure scale-up, development of circular end-markets, and funding mechanisms for recycling are many years off being a reality — and even if these do become a reality, for the very small formats (e.g. sachets) the majority of experts consulted agree that the barriers faced are so significant that recycling is unlikely to ever work at scale.

See following page for details and references

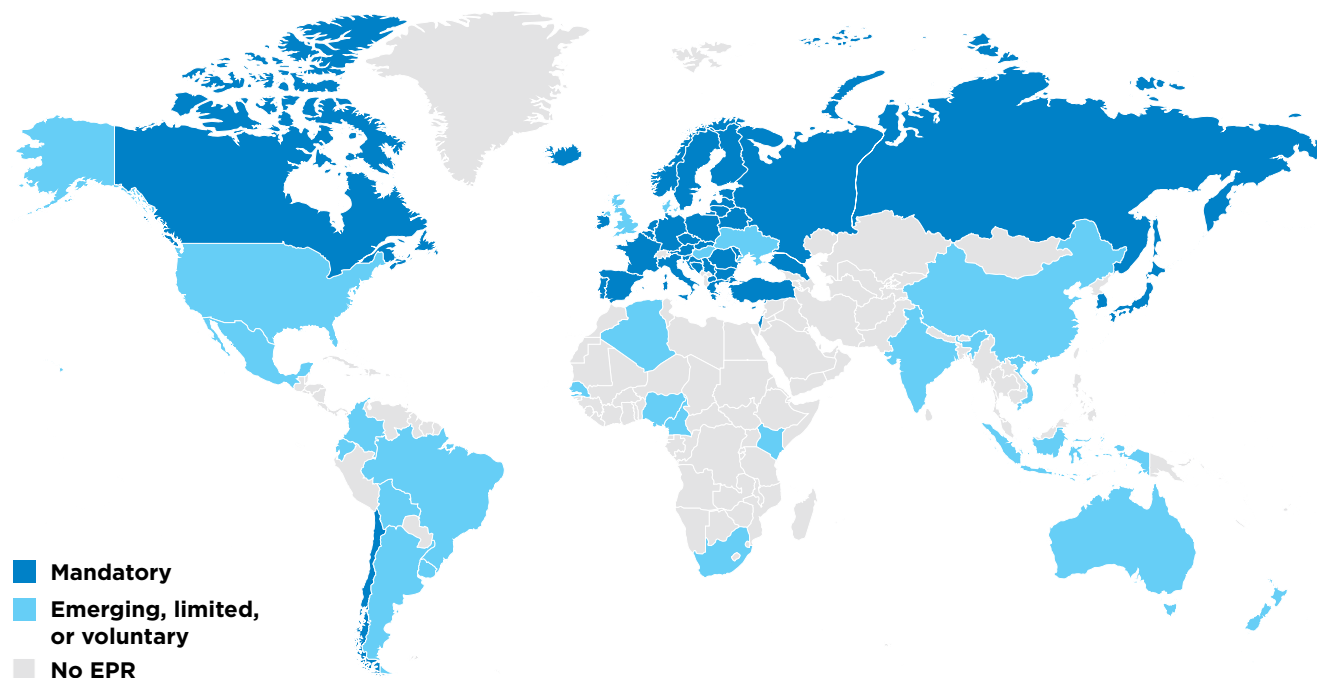


On top of inherent limitations, recycling of B2C flexibles in the informal sector faces further barriers. Infrastructure scale-up, development of circular end-markets, and funding mechanisms for recycling are a long way off.

Extended Producer Responsibility (EPR) schemes for packaging are a necessary mechanism for providing dedicated, ongoing, and sufficient funding for collection, sorting, and recycling.¹

However, implementation of well-designed and well-functioning EPR schemes takes time.

With EPR schemes in geographies serviced by the informal sector mostly classified as ‘emerging, limited, or voluntary’ or ‘no EPR’, having dedicated, ongoing, and sufficient funding in place for recycling is still some years away and will first require considerable (but necessary) time and effort.



For additional information, see the [Supplementary Information: Plastic B2C Flexibles - Informal Sector - "Collection, Sorting"](#)


1. [Ellen MacArthur Foundation](#), "EPR position paper", 2021

On top of inherent limitations, recycling of B2C flexibles in the informal sector faces further barriers. Infrastructure scale-up, development of circular end-markets, and funding mechanisms for recycling are a long way off.

Less than ideal end-markets, such as linear end-markets, and significant loss of material value are likely to be a reality for many years to come.



CURRENT END MARKETS¹

<p>Cement kilns</p> 	<p>Landfill</p> 	<p>Building material</p> 
<p>Plastics to roads</p> 	<p>Plastics to fuel</p> 	<p>Open burning</p> 

Significant loss of value or linear end markets
Current end markets are not desirable from a circular economy perspective as they return little or no value back into the economy

For additional information, see the [Supplementary Information: Plastic B2C Flexibles - Informal Sector - "Recycling, End Markets"](#)

1. **GA Circular**, Toward circularity of Post-Consumer Flexible Packaging in Asia (2017).

INFORMAL RECYCLING

5 KEY INSIGHTS

3

Given that in many of the geographies serviced by the informal sector scaled recycling systems for flexibles are many years away, upstream innovation to move away from single-use flexibles becomes of even higher importance — and presents a significant opportunity.

Given the barriers faced for recycling of flexibles in geographies serviced by the informal sector, it becomes even more important to focus on innovations that can eliminate the need for single-use flexibles. Fortunately, in such contexts, innovation is also particularly attractive.

In geographies currently serviced by the informal sector the uncertainty and risk associated with betting on recycling is particularly high, and timeframes to have established systems into place are going to be long. This means the barriers normally associated with innovation are less of an obstacle — as the uncertainty, risk, and timeframes of pursuing either a recycling strategy or innovation strategy start to be relatively similar.

There are already some promising innovation examples, with [reuse for personal care and home care products in SE Asia identified as a specific opportunity for collaborative action.](#)

See following page for details and references

Given that in many of the geographies serviced by the informal sector scaled recycling systems for flexibles are likely many years away, it makes even more sense to focus on innovations to eliminate the need for single-use flexibles.

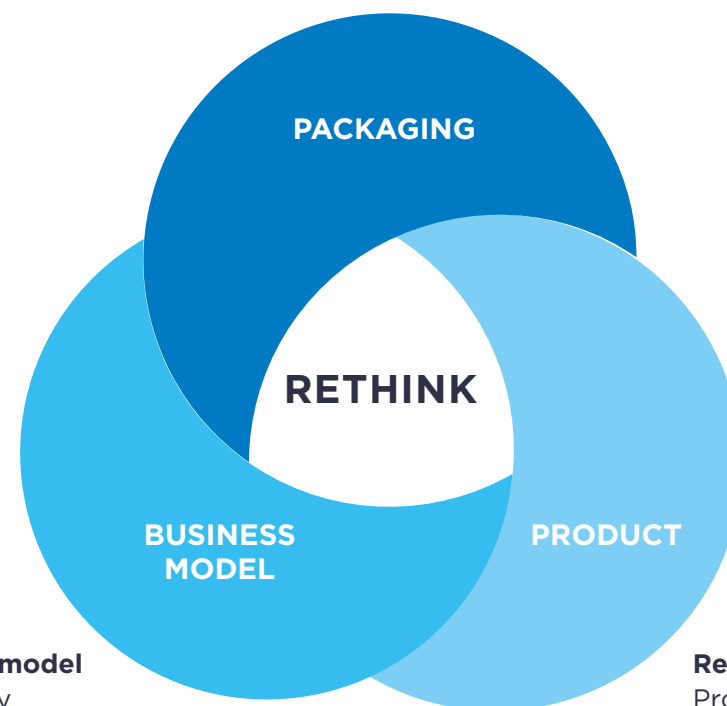
Upstream innovation is about preventing waste from ever being created in the first place.

To unlock the full opportunity of upstream innovation, it is necessary to move beyond focusing on incremental packaging improvements, towards **fundamentally rethinking how to best deliver products and services to a user.**

This involves rethinking not just the packaging itself, but also the product and the broader business model, with the aim being to identify new ways of delivering value to users, while **designing out waste** and avoiding unintended consequences.

Rethink the packaging

Packaging concept, format, components, material choice
E.g. edible coatings



Rethink the business model

Delivery model, supply chain, location of production, revenue streams
E.g. refill home care products

Rethink the product

Product formulation, concept, shape, size
E.g. edible coatings

See the [Upstream Innovation Guide pp. 28-31 and 182-183](#) for more details

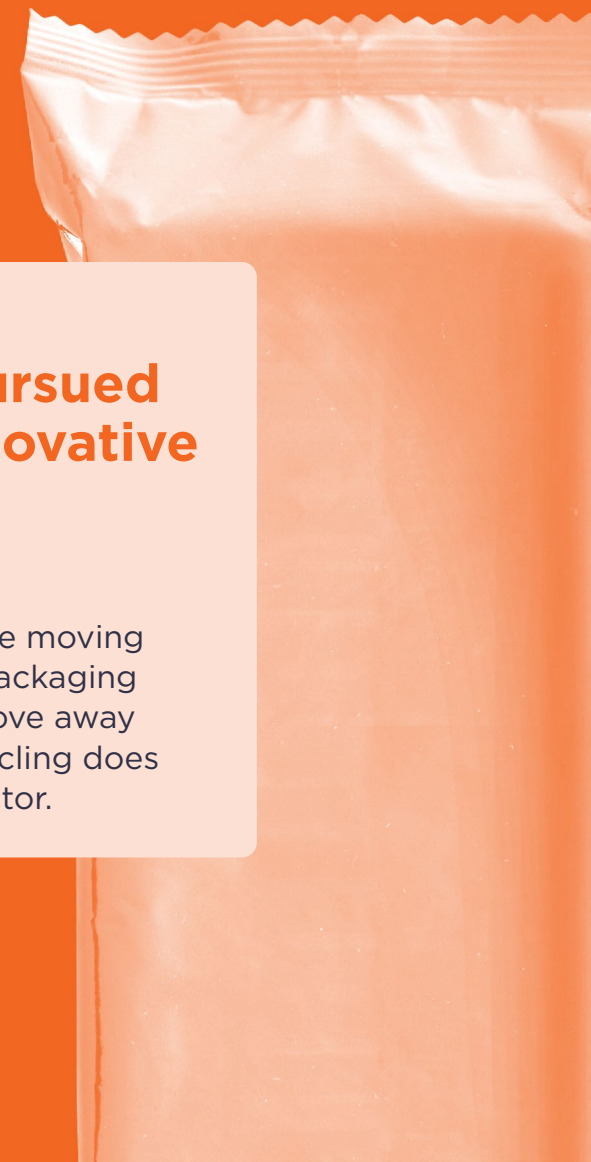
INFORMAL RECYCLING

5 KEY INSIGHTS

4

Solutions for recycling flexibles will still be required (bearing in mind that before recycling systems are pursued as a strategy, opportunities for direct elimination, innovative elimination, and reuse should always be pursued first and foremost).

Despite inherent limitations, solutions for circulating flexibles do have to be scaled. While moving away from single-use flexibles needs to remain the first and foremost part of any flexible packaging strategy, it is unlikely, even with ramping up innovation efforts, that it will be possible to move away from ALL single-use flexible packaging without unintended consequences — meaning recycling does still need to form a part of a flexibles strategy for geographies serviced by the informal sector.



INFORMAL RECYCLING

5 KEY INSIGHTS

5

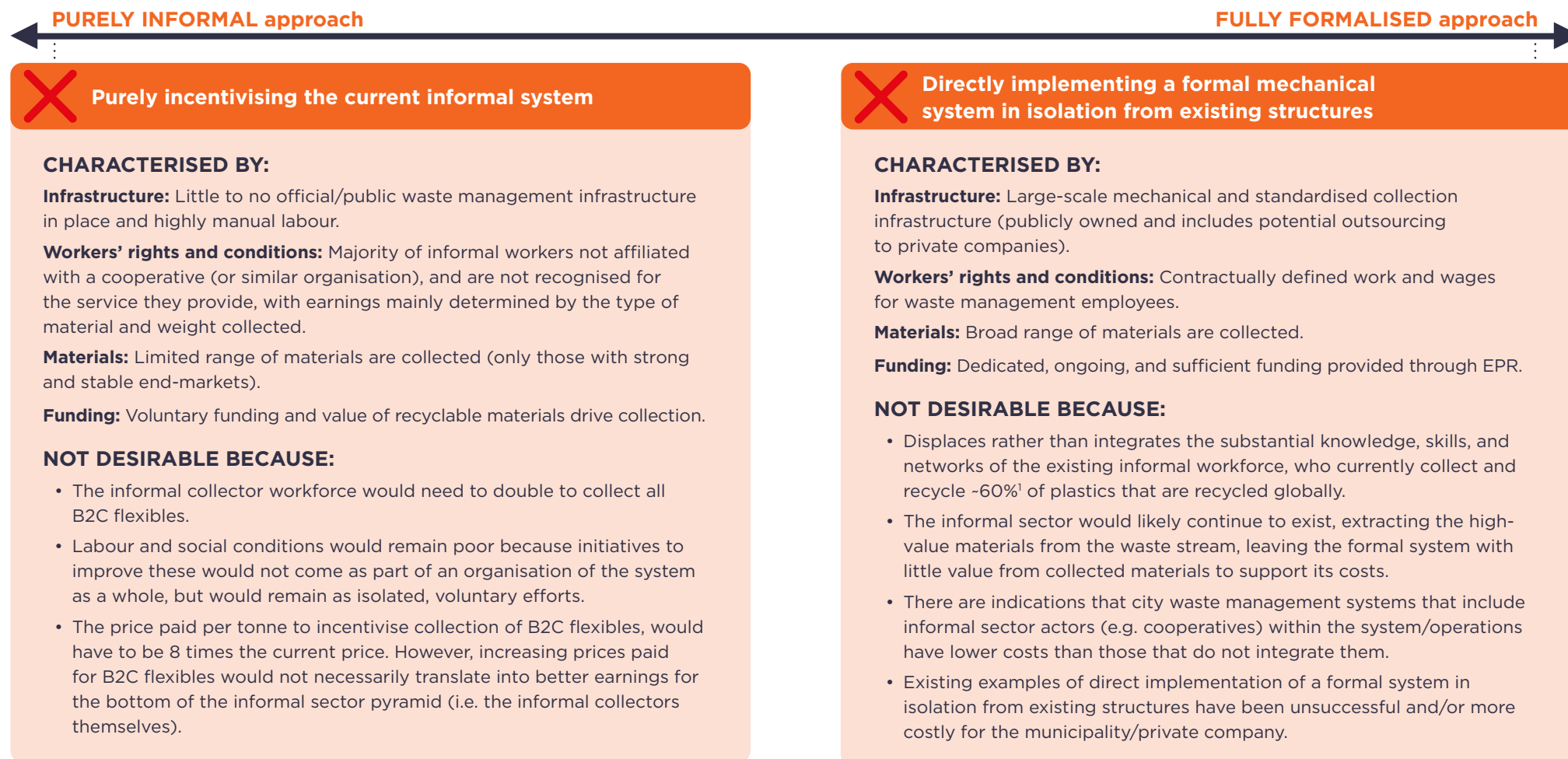
Where recycling is pursued as a strategy in geographies serviced by the informal sector, the best option, from both a social and economic point of view, is to scale recycling systems through establishing an inclusive waste management system

The best option, from both a social and economic point of view is to implement a socially inclusive process across the entire waste management system.

- Purely increasing the price paid to informal collectors per kg of flexibles collected would require a **doubling of the informal collector workforce** while leaving social issues unaddressed.
- Directly implementing formal systems in isolation from existing structures will be less likely to succeed than one that leverages existing structures.
- The majority of experts consulted agree that:
 - Implementing a recycling system for B2C flexibles in geographies serviced by an informal sector has to focus on ensuring social inclusion of the informal workforce* across the waste management sector as a whole, not only on ensuring collection/sorting/recycling of B2C Flexibles.
 - While formalisation of the waste management system as a whole may be the ultimate end-state, such an end-state must be brought about through a process that is inclusive of the informal workforce and recognises the significant role it currently plays.
 - Making recycling work for B2C flexibles sits within establishing an inclusive recycling system for all materials (i.e. the whole waste management sector), rather than focusing on flexibles in isolation

*The informal workforce encompasses anyone in the informal sector that helps to move waste materials within the value chain (e.g. collectors, aggregators, recyclers, etc.)

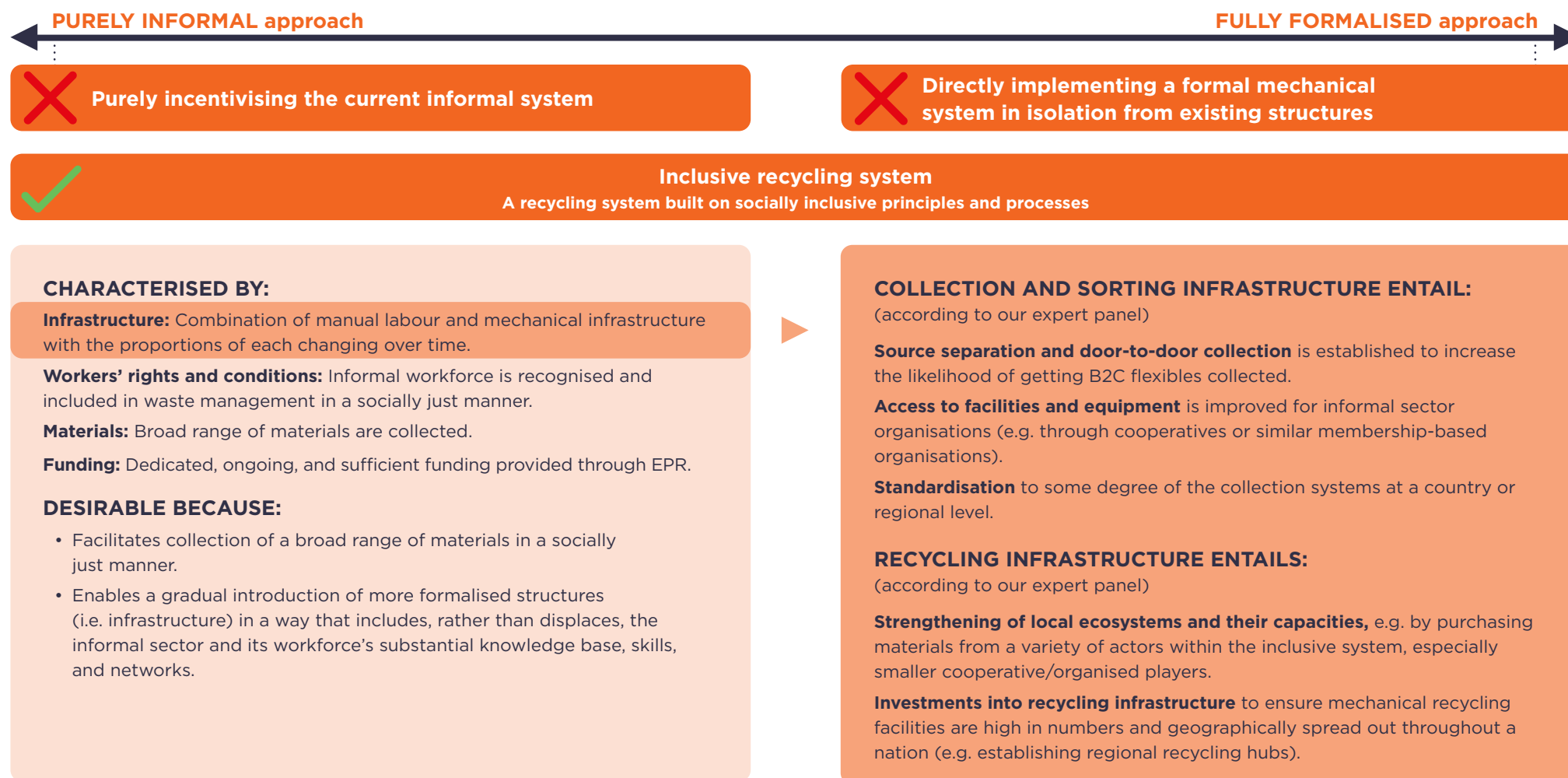
Purely increasing the price paid to informal collectors per kg of flexibles collected would require a doubling of the informal workforce while leaving social issues unaddressed. Directly implementing a formal systems strategy in isolation from existing informal structures is less likely to succeed than one that leverages existing structures.



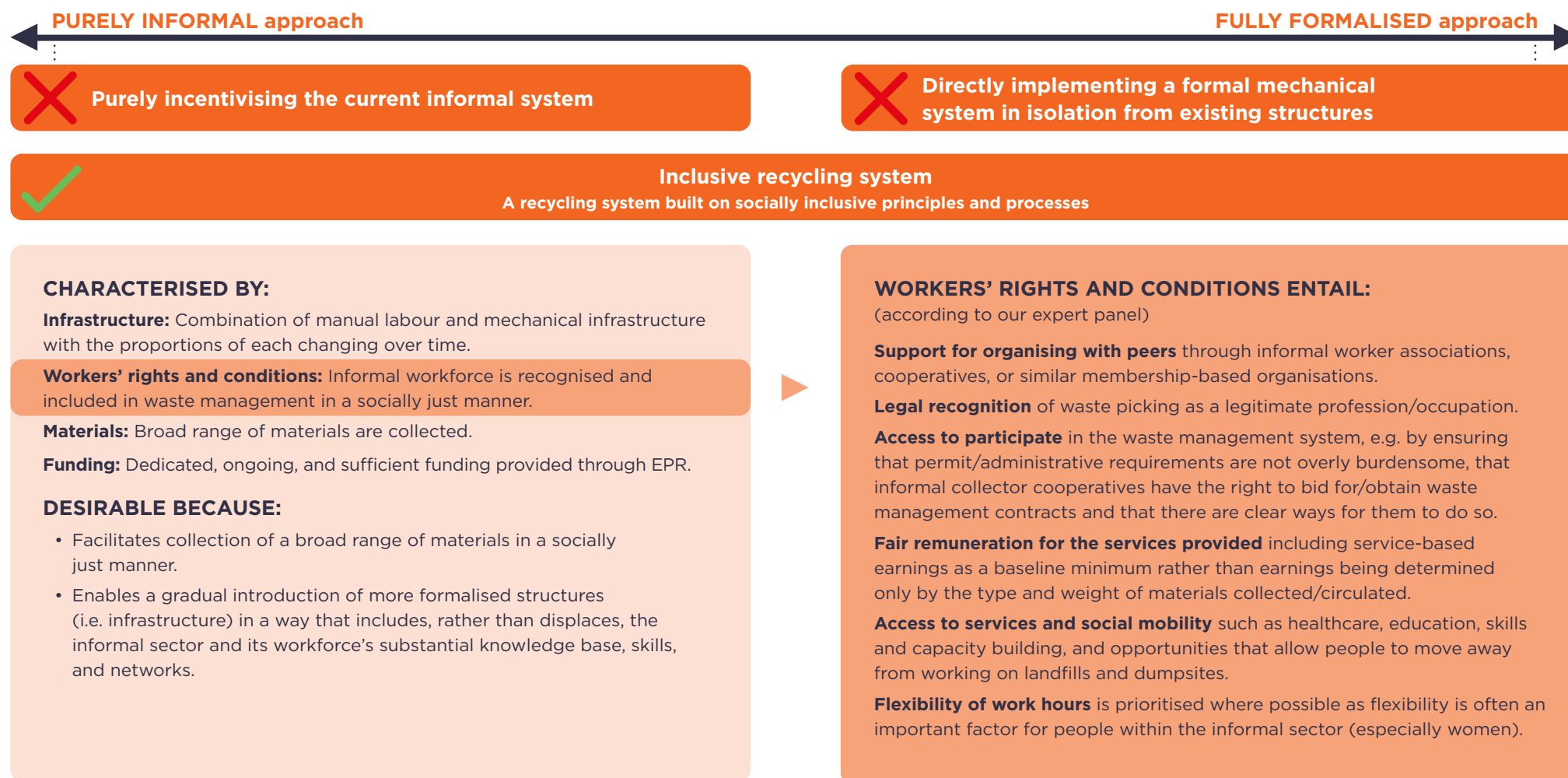
For additional information and references for all of the content, see the **Supplementary Information: Plastic B2C Flexibles - Informal Sector - "Collection, Sorting"**

1. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", 2020.

Establishing an inclusive recycling system is the best option both from a social and economic point of view and has the highest chance of succeeding. What an inclusive recycling system looks like (and the pathway towards it) may vary from geography to geography, however some high-level principles exist.



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This work has been developed in collaboration with an expert panel consisting of more than **100 organisations** including relevant expert organisations and NGOs, [Plastics Pact](#) lead organisations, and members of the [New Plastics Economy](#) initiative (which includes many of the leading producers of packaged goods, and many of the largest retailers and packaging producers).

We are deeply grateful to all collaborators and contributors for the time and expertise they have dedicated to this project.

These organisations are not responsible for any of the recommendations presented in this work. This report is the work of, and solely reflects the views of, the Ellen MacArthur Foundation. The Foundation's views have been formed on the bases of existing literature, expert interviews, workshops with the expert panel, and in-house analysis.

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ELLEN MACARTHUR FOUNDATION PROJECT TEAM

CORE PROJECT TEAM

Leela Dilkes-Hoffman

Programme Manager –
Plastics Research and Innovation

Sara Wingstrand

External Consultant – Plastics Research and Innovation

George McLoughlin

Research Analyst – Plastics Research and Innovation

Josephine Moe Christoffersen

Senior Research Analyst –
Plastics Research and Innovation

Sander Defruyt

Lead – Plastics Initiative

Rob Opsomer

Executive Lead – Systemic Initiatives

PROJECT SUPPORT

The broader Plastics Initiative team

DESIGN

James Wrightson

Creative Design Lead – Design

Matt Barber

Graphic Designer – Design

EDITORIAL

Lena Gravis

Senior Expert – Editorial

Ross Findon

Media and Messaging Lead –
Communications & Marketing

Lou Waldegrave

Senior Writer – Communications & Marketing

COMMUNICATIONS

Iulia Strat

Communications Manager –
Finance, Plastics, and Policy

Anna Sheehan

Senior Communications Executive –
Finance, Plastics, and Policy

DIGITAL

**Dan Baldwin, Mark Buckley, Yunus Tunak,
James Woolven**, and the broader digital team.

ABOUT THE ELLEN MACARTHUR FOUNDATION

The Ellen MacArthur Foundation develops and promotes the idea of a circular economy.

The Ellen MacArthur Foundation is committed to the creation of a circular economy that tackles global challenges, such as climate change, biodiversity loss, waste, and pollution.

The Ellen MacArthur Foundation is an international charity that develops and promotes the circular economy in order to tackle some of the biggest challenges of our time, such as climate change, biodiversity loss, waste, and pollution. We work with our network of private and public sector decision-makers, as well as academia, to build capacity, explore collaborative opportunities, and design and develop circular economy initiatives and solutions. Increasingly based on renewable energy, a circular economy is driven by design to eliminate waste, circulate products and materials, and regenerate nature, to create resilience and prosperity for business, the environment, and society.

Further information:

www.ellenmacarthurfoundation.org | [@circulareconomy](https://twitter.com/circulareconomy)

ABOUT THE PLASTICS INITIATIVE

Since 2016, the Ellen MacArthur Foundation's New Plastics Economy initiative has rallied businesses, governments, and other organisations behind the vision of a circular economy for plastic, in which it never becomes waste or pollution.

Focused on ambitious targets for 2025, the Global Commitment addresses plastic waste and pollution at its source, beginning with plastic packaging, while the Plastics Pact network of local and regional (cross-border) initiatives, endorses and implements circular economy solutions that work towards the vision.

Further information:

www.emf.org/plastics | [@circulareconomy](https://twitter.com/circulareconomy)

[Explore the vision for a circular economy for plastic](#)



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