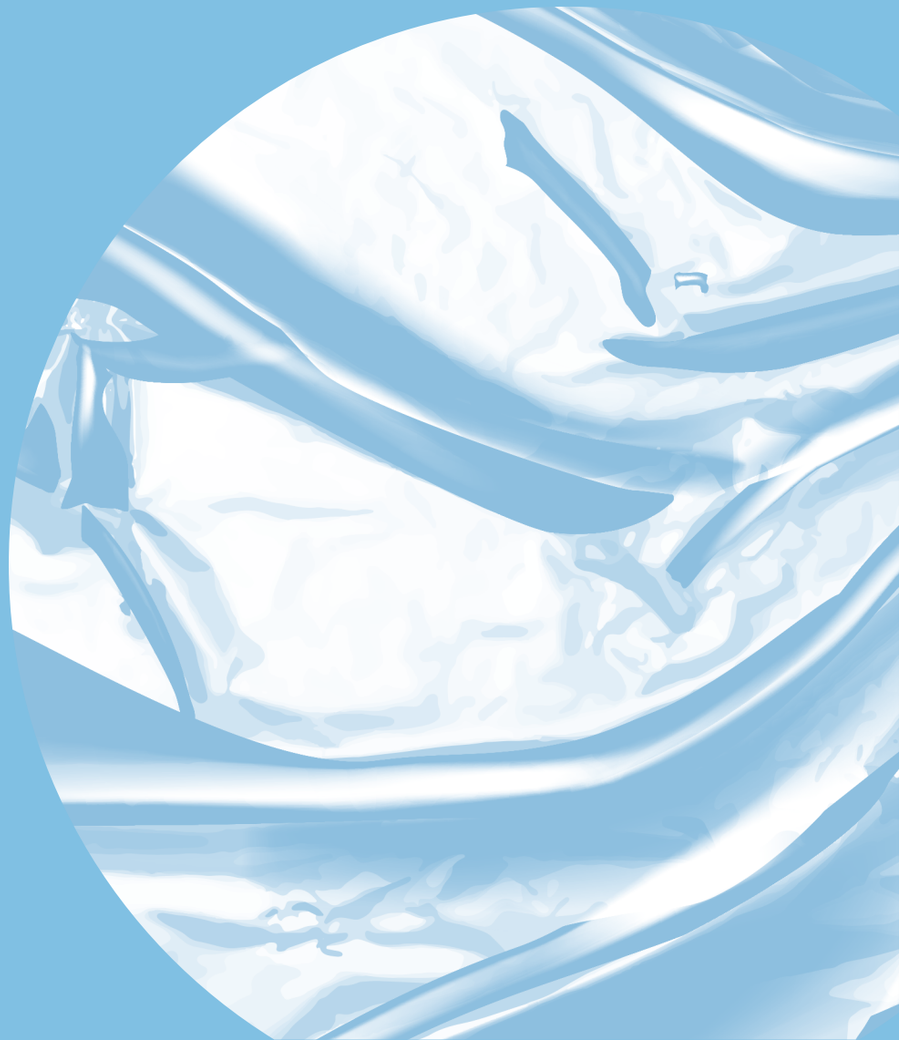
ELLEN MACARTHUR FOUNDATION

FLEXIBLE PACKAGING



31/03/2022

Supplementary information

The content presented here contains the references, calculation methodologies and background information that informed the perspective presented in the executive summary and deepdive documents of Flexible Packaging: The urgent actions needed to deliver circular economy solutions.

The content contained in the executive summary and deepdive documents is considered the finalised perspective and the information provided here should be considered to support, but never supersede, the executive summary and deepdive documents.

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 DEEPDIVES

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

SUPPLEMENTARY INFORMATION

Supporting data and references.

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FLEXIBLE PACKAGING:

MOVE AWAY FROM SINGLE-USE FLEXIBLES:

Direct Elimination

Supplementary Information

Why is this option on the table?

What does good look like?

What is the opportunity to work towards?

Why is this option on the table?

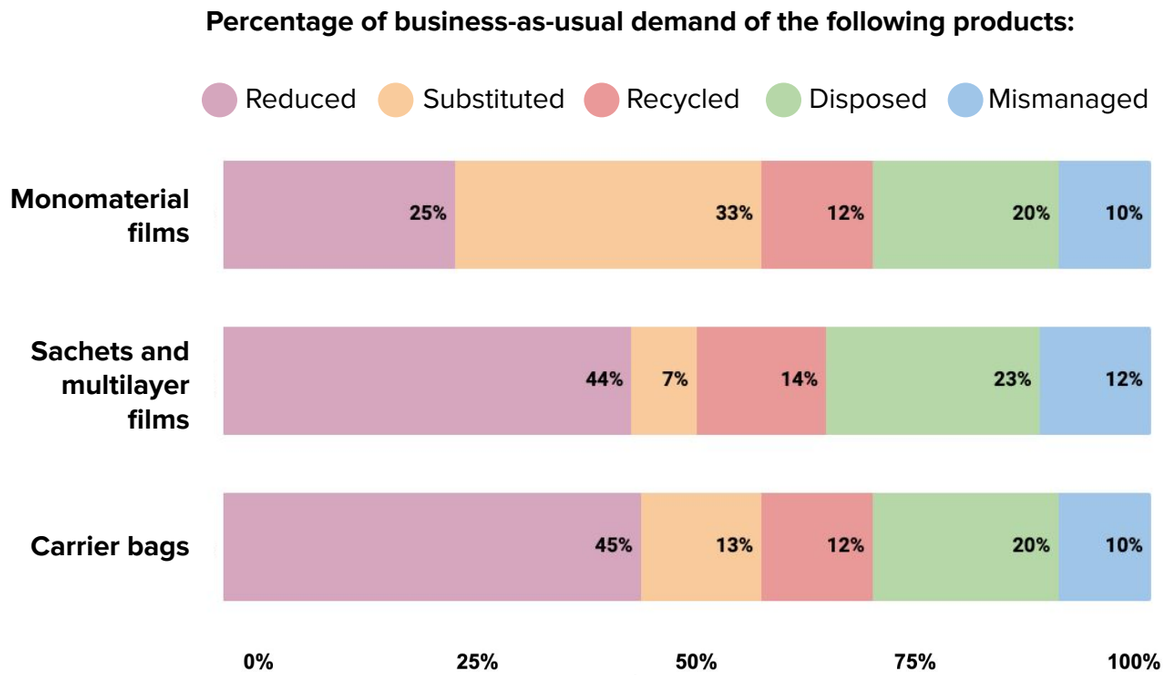


Figure 1. System interventions for B2C flexibles[1]

According to Breaking the Plastics Wave[1], one of the most analytically robust studies ever produce on ocean plastics, in parallel to scaling recycling and substitution the use of plastic B2C Flexibles also needs to be reduced in the coming years.

Direct elimination presents the most direct and efficient way of achieving this with scaled examples that could be implemented by 2025 if there is serious intention.

1. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", p. 46, 2020.

What does good look like?

DIRECT ELIMINATION: Packaging that does not serve an essential function is directly removed.

Packaging that does not serve an essential function can be regarded as unnecessary and directly removed without any significant adjustments, innovation, or loss of product value.

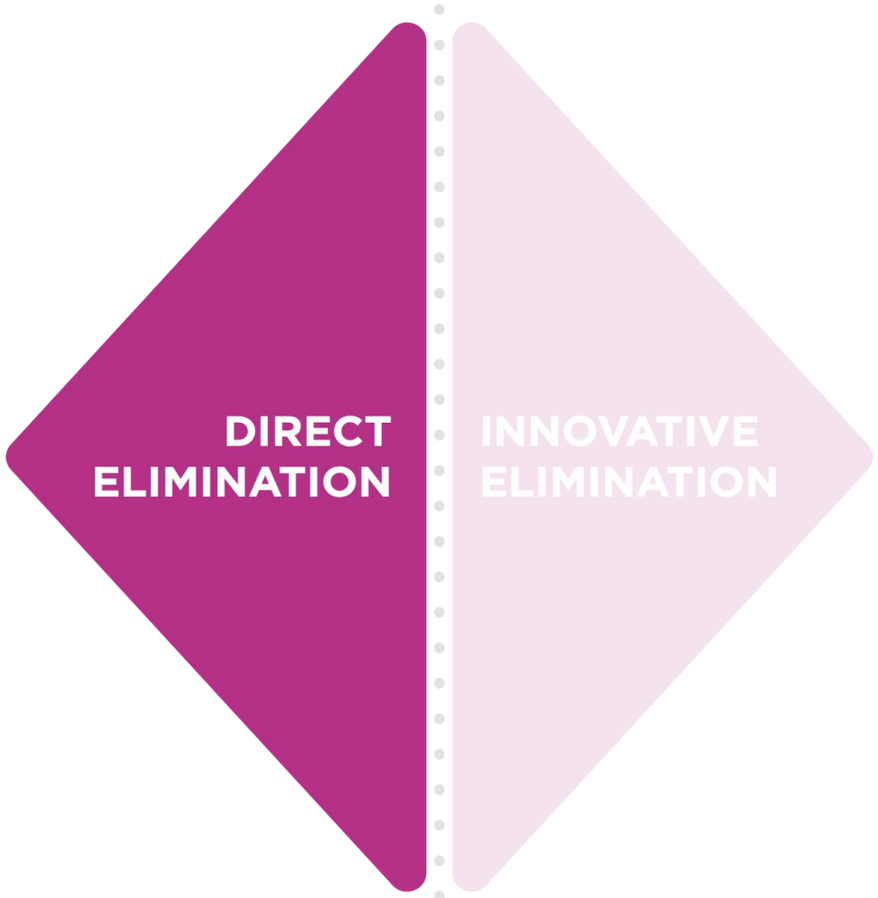
Direct elimination of a plastic B2C Flexible does not mean substitution to another material. **It means elimination of that item of packaging all together**.

Direct elimination can be carried out across a broad range of categories - from fresh fruit and vegetables, to overwraps, to multi-packs, to tear-offs, to single-portion wrappers.

There is no one example of exactly what a good system looks like, and quantifying the full potential is hard given that product and packaging portfolios vary so widely, but within most sectors there are numerous examples to take inspiration from (see the section “what is the opportunity to work towards”) .

Assessing opportunities for direct elimination of B2C flexibles should be done critically and on an ongoing basis, but should keep the entire product and packaging system in mind to avoid unintended consequences (i.e. overall increases in food waste, substantially higher carbon footprint, etc.).

See the Upstream Innovation Guide for more details and inspiration!



For packaging that **does not** serve an essential function

For packaging that **does** serve an essential function

See Innovative elimination & reuse

What is the opportunity to work towards?

Direct elimination potential
Current direct elimination efforts don't even scratch the surface — the opportunity is much, much broader than is currently being acted upon. It is estimated that the potential for direct elimination could be as large as 5-10%[1] by mass of the B2C flexibles market (millions of tonnes).*

Specifically, removing unnecessary B2C flexible packaging across the EU and US for just three product categories would eliminate 40x more material than current efforts have achieved.*

x40

Current efforts**
1,100 tonnes*

Direct elimination potential for just three specific applications in EU & US:

45,000 tonnes*

- Multi-pack wrapping for cans
- Poly bags for clothes
- Wrapping for 6 different fruit & veg types (cabbages, cauliflowers, onions, broccoli, peppers, and bananas)

Direct elimination potential by 2040 if looking worldwide and across many different sectors:

5-10%[1] of B2C Flexibles market*

The potential of direct elimination of single-use B2C flexible packaging does not lie within one big change, but within many smaller cumulative changes amongst many different product categories and geographies:

- Plastic film wrapping from board games, playing cards, around individual toys, lotions and perfumes, greeting cards, etc.
- Plastic covers from magazines.
- Plastic covers from bed sheets and pillow cases.
- Plastic tear-offs from jars.
- Plastic nets from multi-buy fruit and veg, such a lemons and oranges
- Multi-buy wrapping from chewing gum, chocolate bars, biscuits, etc.
- Pouches for hardware products such as hammers, spanners, fittings etc.

And many, many more....

*For details on numbers and calculations, see the following pages.
**As reported in the 2021 reporting cycle for the Global Commitment.
1. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", 2020, p. 11, 49.

Approach for calculation of current direct elimination efforts (1,100 tonnes)

- Data on current efforts on direct elimination of B2C flexible packaging was taken from the Global Commitment 2021 progress reporting cycle. In total, 97 signatories (companies) representing packaging producers, packaged goods companies, and retailers reported their progress on the Global Commitment targets in this dataset.

- The following criteria were applied to the dataset, to identify reported examples relevant for including in the calculation to understand the amount of B2C flexible packaging removed through direct elimination efforts:

  A. Only direct elimination examples were included (i.e. elimination of a plastic B2C flexible through substitution to an alternative material or through innovative elimination (e.g. switching to an edible coating) were *not* included)
  B. Only examples focused on B2C flexible packaging were included (i.e. B2C films, single-use carrier bags, multi-layer materials, labels, sleeves).*

- Where there was unclarity around whether a reported example was relevant, we reached out to the company to get clarity on whether the reported example was related to direct elimination and/or B2C flexible packaging. If a response from the company was not received, we decided to estimate upwards for calculation of direct elimination examples and thus the example WAS included in the calculation.

*Qualitative descriptions provided with the reported examples were also analysed to identify if an example reported as e.g. ‘other’ was related to a B2C flexible packaging

Approach for calculation of direct elimination potential for just three specific applications in EU & US (45,000 tonnes)

- Three specific applications of B2C flexible packaging was included in the calculation. These were selected due to having seen examples of these being carried out already *(see following page)*.
  A. Multi-pack wrapping on cans (canned goods and sugary canned drinks)
  B. Plastic covers for clothing
  C. Plastic wrapping on 6 different fruit and vegetable types (cabbages, cauliflowers, onions, broccoli, peppers, and bananas)

- To calculate the potential amount of B2C flexible packaging that could be removed through direct elimination for each application one example was calculated (either US or UK dependent on availability of data) using the following types of data and assumptions:
  - Data on the number of units of the particular product that is sold or consumed per year in the UK or the US
  - Assumption on the weight of one unit of the particular B2C flexible packaging
  - Assumption on the percentage of the particular product that is sold in B2C flexible packaging compared to sold without any packaging
  - Assumption on the average number of units of the particular product sold per bag or plastic wrapping (if the particular product category is well known to be sold as multi-buy, e.g. bananas, peppers, and onions)

- For each application, the chosen example was extrapolated (using both share of world GDP and share of world population) to calculate the total amount (tonnes) of B2C flexible packaging that can be removed if direct elimination was carried out across the EU and the US.

Examples of direct elimination actions

Direct elimination example:	Who has shown it is possible:
Removing plastic film wrapping from board games, playing cards, around individual toys etc.	Hasbro[1]
Removing plastic covers from bed sheets and pillow cases	ASDA[2, 3]
Removing plastic covers from magazines	Conde Nast[3], TC transcontinental[4]
Removing plastic wrapping from bell peppers	Walmart[2]
Removing plastic tear-offs from jars, water bottles, sauce bottles, cosmetic products, etc.	Sonae MC[2], Nestle[2, 4], L'Oréal[4]
Removing plastic film wrapping from lotions, perfumes, etc. in cardboard boxes	L'Occitane[2], L'Oréal[4]
Removing plastic film wrapping from broccoli	Morrisons[3], Sainsbury's[3], Marks & Spencer[3]
Removing plastic bag from bananas	Walmart[2], Albert Heijn[3], Sainsbury's[3]
Removing multi-pack plastic film wrapping from canned goods	Tesco[2], Waitrose & Partners[2]
Removing plastic film wrapping from greeting cards	ASDA[2]
Removing plastic film wrapping from cabbages	Marks & Spencer[3]
Removing plastic covers from clothes	Marks & Spencer[3]

1. **EcoWatch**, "Monopoly, Scrabble, Operation Creator to Ditch Plastic Packaging by 2022", 2019;
2. **Ellen MacArthur Foundation**, "Upstream Innovation: a guide for packaging solutions", 2020;
3. **Global Commitment** 2020 reporting cycle;
4. **Global Commitment** 2021 reporting cycle

Many opportunities for direct elimination of unnecessary packaging were estimated by our panel of experts to be possible within a 1-3 year time frame

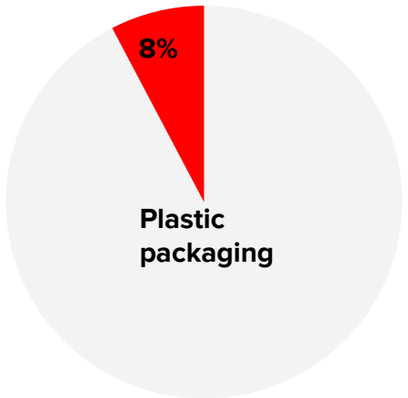
Key comments from the expert panel regarding the assessment of the 1-3 year timeframe for direct elimination:

- Generally easier to implement compared to innovative solutions
- Generally, direct elimination efforts have a fair business case
- Minimum behaviour change is required from consumers (compared to some innovative solutions such as reuse)
- Ensuring product quality and safety is an important factor to keep in mind when assessing opportunities for direct elimination (direct elimination is not applicable to all current applications of B2C flexible packaging)
- There might be some need for product and distribution infrastructure redesign, which may require collaborative action in industry. Generally, however, direct elimination will in many cases require significantly fewer infrastructure changes and lower levels of collaboration compared to other solutions

Approach for understanding the potential for direct elimination of single-use B2C flexible packaging (1/2)

Estimation of direct elimination potential for all plastic packaging

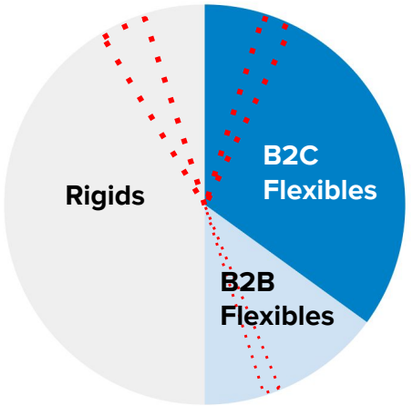
- Based on calculations of the reduction potential for plastic waste generated in 2040, under a BAU scenario, the “Breaking the Plastic Wave” study puts the direct elimination potential for plastic packaging at 8% by mass.[1]



8% of plastic packaging	**11.8 MT**

Assumptions that were made

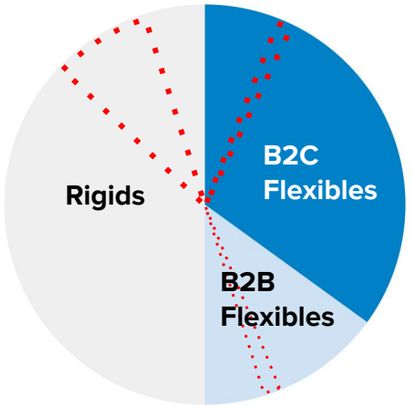
- How the 8% direct elimination potential is distributed across plastic categories is not known.
- Majority of direct elimination examples are of B2C flexible packaging (and not rigids).[2]
- Applied the assumption that 8% of each plastic category can be directly eliminated.



8% of rigid plastic packaging	5.9 MT
8% of B2C Flexibles packaging*	4.1 MT
8% of B2B Flexibles packaging	1.8 MT
Total	**11.8 MT**

Potential alternative

- If the % of B2C flexibles that can be directly eliminated is revised down, that would effectively mean that a larger portion of another packaging category can be directly eliminated.
- Because majority of direct elimination examples are of flexibles, we don’t currently believe the above is a likely scenario.



12% of rigid plastic packaging	8.0 MT
4% of B2C Flexibles	2.0 MT
8% of B2B Flexibles	1.8 MT
Total	**11.8 MT**

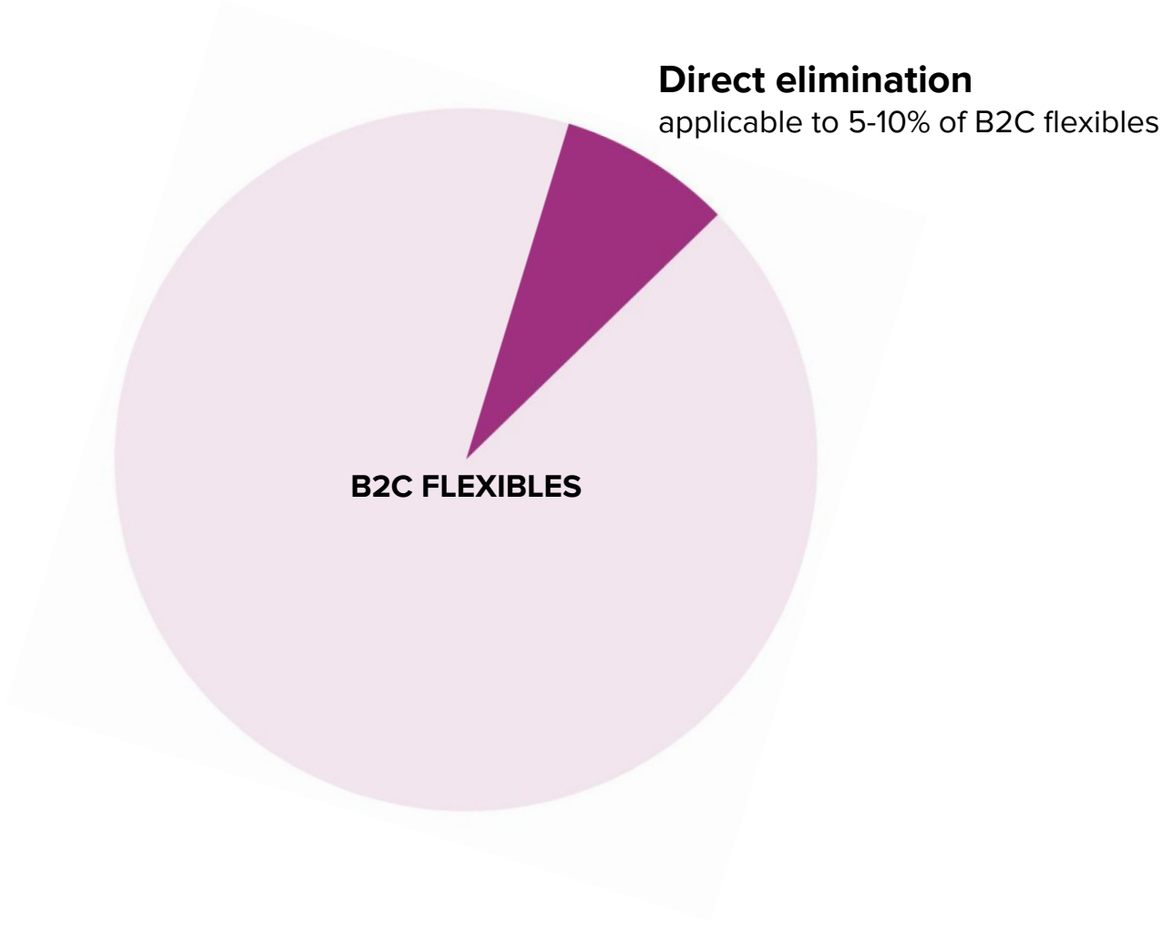
*It is recognised that direct elimination is more appropriate for some product categories than other. The 8% direct elimination potential thus refers to the average across the whole industry.

1. **The PEW Charitable Trust and Systemiq**, “Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution”, 2020, p. 49;
2. **Ellen MacArthur Foundation**, “Upstream Innovation: a guide for packaging solutions”, 2020.

Approach for understanding the potential for direct elimination of single-use B2C flexible packaging (2/2)

Where the number (5-10%) comes from

- The “Breaking the Plastic Wave” study estimates the direct elimination potential for plastic packaging to be 8% by mass.[1]
- As explained on the page above, we have assumed the direct elimination potential for B2C Flexibles to therefore be 8% by mass.
- “Breaking the Plastic Wave” has a confidence interval of (±10%) for their reduction assumptions. Applying the same confidence interval to the estimated direct elimination potential for B2C flexibles (8%) gives a range of 7%-9% direct elimination potential.
- Given high levels of uncertainty in our assumptions, we have decided to reduce specificity and broadened the range to 5-10%. This was agreed to be a reasonable assumption when tested with our panel of experts.



1. **The PEW Charitable Trust and Systemiq**, “Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution”, 2020, p. 11.

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FLEXIBLE PACKAGING:

MOVE AWAY FROM SINGLE-USE FLEXIBLES:

Innovative Elimination and Reuse

Supplementary Information

Why is this option on the table?

What does good look like?

What is needed to achieve this?

Why is this option on the table?

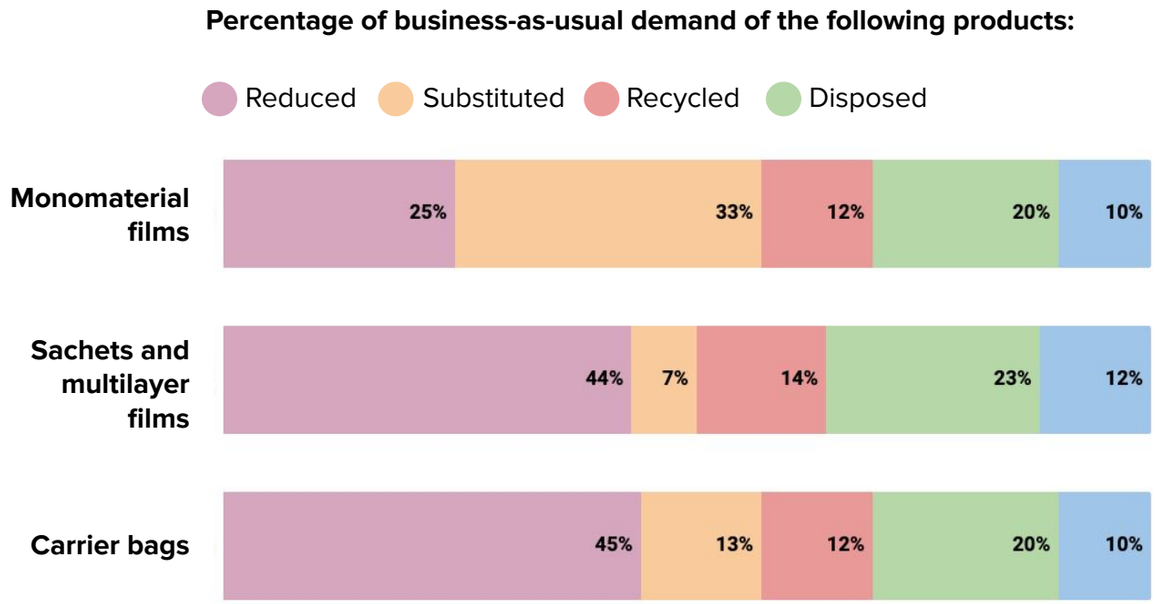


Figure 1. System interventions for B2C flexibles[1]

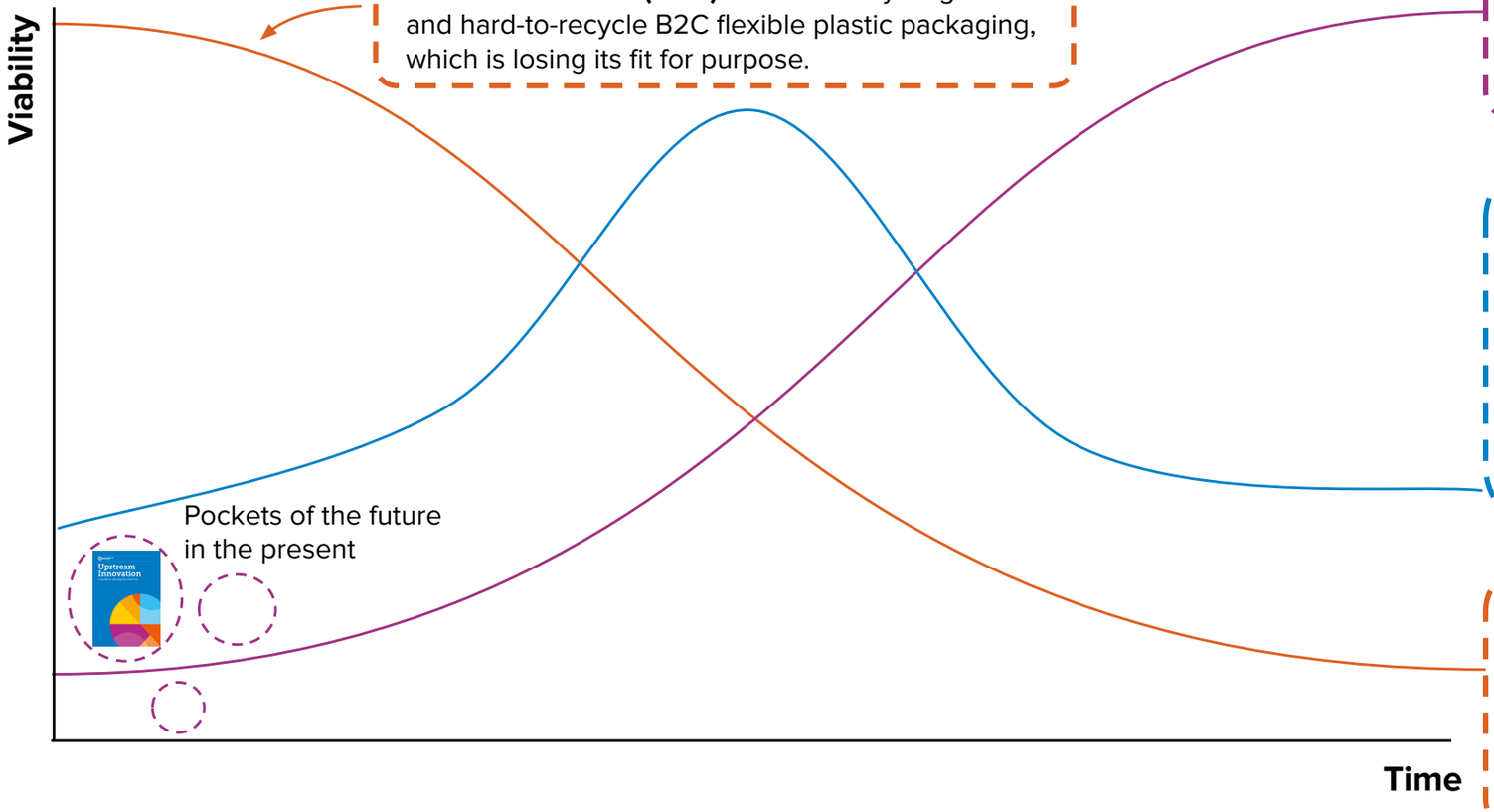
According to Breaking the Plastics Wave[1], one of the most analytically robust studies ever produced on ocean plastics, in parallel to scaling recycling and substitution the use of plastic B2C Flexibles also needs to be reduced in the coming years.

To effectively reduce leakage of B2C flexible packaging, efforts must also be channelled towards addressing the proportion of B2C flexibles for which there is no currently known solution (the mismanaged and disposed of fractions). To find solutions for these, innovation is necessary.

1. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", p. 46, 2020.

Why is this option on the table?

Transformative innovation describes innovations that are capable of bringing about a paradigm shift — shifting us from the current linear B2C flexible packaging system (BAU) to a system that is made up of solutions that design out the need for single-use B2C flexibles altogether, wherever possible. To achieve the vision of a circular economy for plastics that industry has committed to, efforts must be directed towards innovations that transform how we deliver products.



Business-as-usual (BAU) dominated by single-use and hard-to-recycle B2C flexible plastic packaging, which is losing its fit for purpose.

Fit-for-purpose future system that is grounded in the vision of a circular economy for plastic*, having moved away from single-use B2C flexibles wherever possible.

Innovations that emerge over time can either be captured by the BAU system thus sustaining it for a short period longer, or they can provide the backbone of a new, more fit for purpose system thus enabling transformative change (**transformative innovation**). Innovations that are transformative could for example be new delivery models or innovation of the product itself, thus eliminating the need for single-use B2C flexibles.

Valuable aspects of the old system are retained. Some applications of B2C flexible plastic packaging may remain, such as applications in the medical industry. And some B2C flexibles may persist for some time to come to support the transition towards the fit-for-purpose future system.

This understanding of transformative innovation has been adapted from the Three Horizon Framework[1] which provides a useful framing for the topic of plastic B2C Flexibles.
*The vision of a circular economy for plastics as outlined by the New Plastics Economy initiative
1. **Sharpe**, “Three Horizons: The Patterning of Hope”, 2013.

What does good look like?

Current efforts and dedication of resources to innovations that are transformative are not sufficient to get us to the fit-for-purpose future system that is dominated by alternative models and yet unknown solutions.

A significant share of R&D funding will need to be dedicated to innovations for reuse and innovative elimination for B2C flexible packaging, because these are the packaging formats that make up a significant proportion of the remaining leakage into the environment after currently known systems change interventions have been implemented.[1]

1. **The PEW Charitable Trust and Systemiq**, “Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution”, 2020, p. 100-103

What does good look like?

Many upstream innovations that focus on elimination and reuse have the potential to become transformative innovations. These include innovations that eliminate the need for single-use B2C flexible plastic packaging such as **edible coatings**, **solid products**, and **water-soluble packaging**, and innovations that use alternative business models, such as **reuse models**, to deliver products in reusable rather than single-use B2C flexible plastic packaging.

Edible coatings

Water-soluble packaging

Solid products (Home and personal care)

Reuse: refill on the go (dried foods), return from home, refill on the go (home care)

Ellen MacArthur Foundation, "Upstream Innovation: a guide for packaging solutions", 2020.

What does good look like?

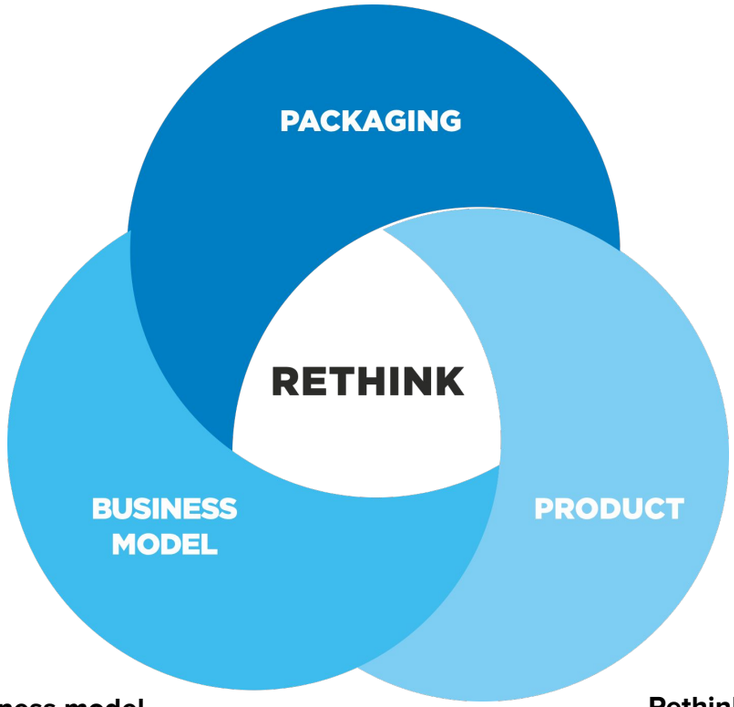
Therefore, adopting an **upstream innovation mindset** is a good place to start.

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.[1]

Rethink the packaging
Packaging concept, format, components, material choice.



Rethink the business model
Delivery model, supply chain, location of production, revenue streams

Rethink the product
Product formulation, concept, shape, size.

1. **Ellen MacArthur Foundation**, "Upstream Innovation: a guide for packaging solutions", 2020, p. 28-31 and 182-183.

What does good look like?

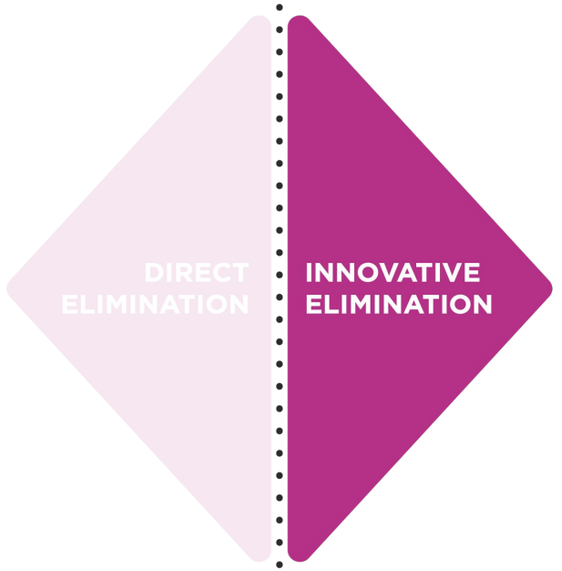
INNOVATIVE ELIMINATION (1/2)

Packaging that **does** serve an essential function is **indirectly eliminated through innovation**, with the function being achieved in a different way.*

Examples of functions that may be considered essential include necessary protection, containment, convenience, communication, and efficiency. Applying an upstream innovation mindset can uncover innovative ways in which such essential functions may be achieved in a different way.

TRENDS

- **Edible packaging**: packaging functionality is provided by a material that can be eaten with the product
- **Water-soluble packaging**: packaging functionality is provided by a material that can be dissolved in water.
- **Solid products**: liquid products are redesigned as solid products, so packaging is no longer strictly required.
- **Enhanced packaging functionality**: multiple packaging components and units are incorporated into one.
- **Localised production and digitalisation**: goods are produced locally or digitally transferred, reducing packaging requirements for transport and protection.



For packaging that **does not** serve an essential function
See Direct elimination

For packaging that **does** serve an essential function

*While upstream innovation can also include actions related to material and packaging design (e.g. minimising head space, material choices, reduction of material through lightweighting, etc.) these are not considered to rethink how a product is delivered to a user, and as such, are not covered here.

Ellen MacArthur Foundation, "Upstream Innovation: a guide for packaging solutions", 2020, p. 40-43 and 50-71

What does good look like?

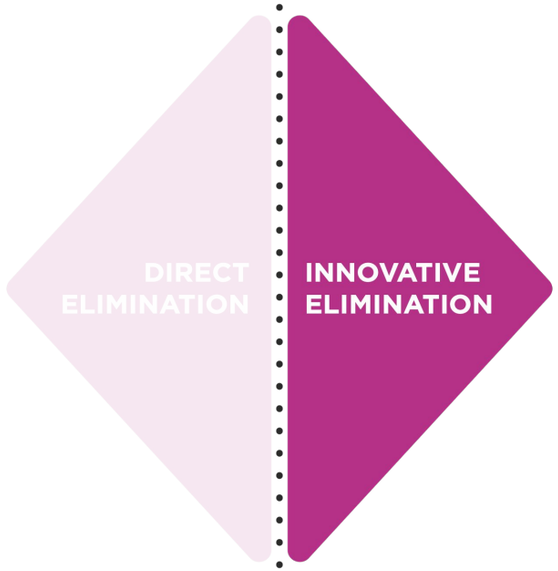
INNOVATIVE ELIMINATION (2/2)

Packaging that **does** serve an essential function is **indirectly eliminated through innovation**, with the function being achieved in a different way.*

Examples of functions that may be considered essential include necessary protection, containment, convenience, communication, and efficiency. Applying an upstream innovation mindset can uncover innovative ways in which such essential functions may be achieved in a different way.

WHAT COULD GOOD LOOK LIKE:

- Ambition: if possible eliminate the entire packaging, rather than just a packaging component.
- Remaining packaging: in cases where a secondary packaging may still be needed (e.g. to bring a solid shampoo bar home), make it optional rather than default and design it to be reusable, recyclable, or compostable
- Avoid unintended consequences: ensure that the solution is implemented in such a way that it does not create unintended consequences (e.g. increased product waste)



For packaging that **does not** serve an essential function
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Ellen MacArthur Foundation, "Upstream Innovation: a guide for packaging solutions", 2020, p. 40-43 and 50-71

There are innovative elimination solutions that could be scaled by 2025, for their relevant product categories

The implementation time, here meaning the time it takes to go from project initiation to the solution being widely available to consumers, for different innovative elimination solutions were estimated by a panel of experts:

Water-soluble packaging

Particularly relevant for: *home care products*

Approximate implementation time: *< 2 years*

- Well-known scaled examples/technologies already exist

Key R&D needs:

- Storing of products in water-soluble packaging in countries with a humid climate to ensure product safety
- Reformulating products (i.e. shampoo) to contain low enough water content

Solid products

Particularly relevant for: *personal care and home care products*

Approximate implementation time: *< 2 years*

- Well-known scaled examples/technologies already exist
- Significantly fewer infrastructure changes are required (compared to e.g. reuse systems)

Key R&D needs:

- User experience related to feel and performance of solid products (e.g. dosage, foaming, product stability)
- Storing of solid products in countries with a humid climate to ensure product safety
- Price of solid products needs to be reduced to make widely available for lower income groups

Edible coatings

Particularly relevant for: *fresh fruits and vegetables*

Approximate implementation time: *4-5 years*

- Some innovations/technologies already exist, which can be leveraged
- Likely to require some level of collaboration amongst supply chain actors (i.e. production and distribution infrastructure changes may be needed)

Key R&D needs:

- Understand better the investments required to scale technologies to allow mass implementation in e.g. fruit and veg industry
- How much handling (during supply chain processes) can products withstand?

2022 2023 2024 2025

What does good look like?

REUSE (1/2)

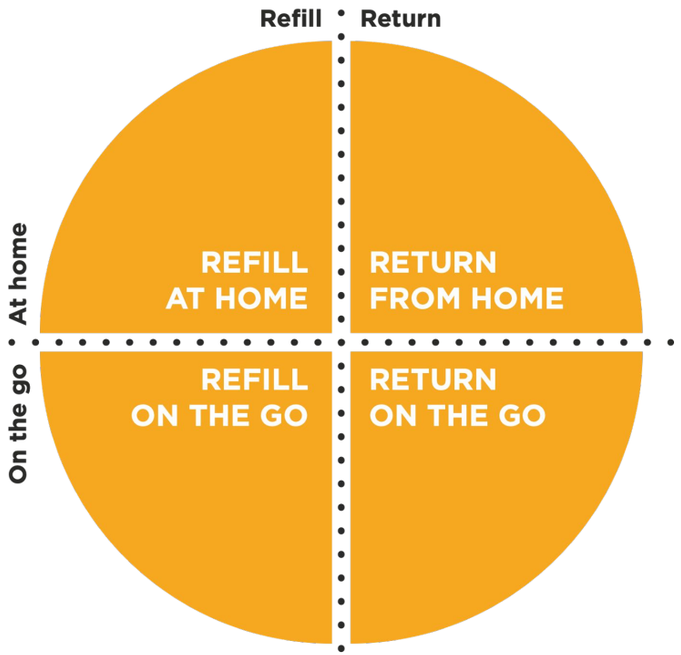
Reusable packaging is **designed to be used multiple times**, for its originally intended purpose, **as part of a dedicated system for reuse**. Reusable packaging is brought back into the economy through the washing of the entire intact packaging.*

TRENDS - REFILL

- On the go: smart dispensers - incorporated sensors that recognise when a package is in place and automatically dispenses required quantity, registers product information, and can facilitate payment.
- On the go: distributed sale points - dispensers are moved out of traditional stores becoming mobile or placed in public.
- On the go and from home: customised products or packaging - design refill system to allow for personalised product (e.g. mixing of flavours) or packaging.
- From home: auto-refill services - offering a refill subscription service.

TRENDS - RETURN

- On the go: smart systems - tagging packaging to allow for user insights, follow stock, and control deposit payouts.
- On the go: turn-key solutions - offering the reusable packaging and infrastructure as a service.
- On the go and from home: shared infrastructure - sharing reverse infrastructure between businesses.
- On the go: low footprint reusable packaging - optimising packaging design and production to lower up front cost and resource use.
- From home: auto-replenishment services - offering subscription service where empty packaging is collected upon next delivery.



*While upstream innovation can also include actions related to material and packaging design (e.g. minimising head space, material choices, reduction of material through lightweighting, etc.) these are not considered to rethink how a product is delivered to a user, and as such, are not covered here.
Ellen MacArthur Foundation, "Upstream Innovation: a guide for packaging solutions", 2020, p. 76-115.

What does good look like?

REUSE (2/2)

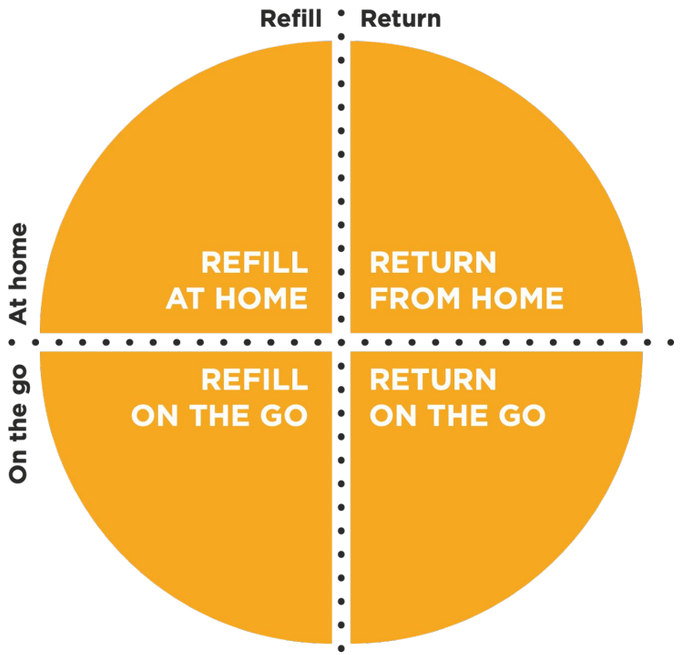
Reusable packaging is **designed to be used multiple times**, for its originally intended purpose, **as part of a dedicated system for reuse**. Reusable packaging is brought back into the economy through the washing of the entire intact packaging.*

WHAT COULD GOOD LOOK LIKE - REFILL

- On the go: provide incentives for users to bring their own packaging.
- On the go: designing dispensing equipment to be user and staff friendly, while minimising contamination and spillage.
- On the go: to maximise use of retail floor space, multiple brands share the same dispensing unit (rather than each product brand having its own unit)
- From home: supply refill without packaging or in packaging that is reusable, recyclable, or compostable.
- From home: for relevant products (e.g. home and personal care) make concentrated refills the industry standard.

WHAT COULD GOOD LOOK LIKE - RETURN

- Standardising packaging design and sharing reverse logistics across brand or products.
- Increasing customer engagement (and thus incentivising user to return packaging) through deposit/reward schemes and making return process smooth for the user.
- Design packaging to be easy to clean.



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Ellen MacArthur Foundation, "Upstream Innovation: a guide for packaging solutions", 2020, p. 76-115.

Reuse for particular product categories show strong potential, but will require significant collaboration

Based on factors such as the suitability of the products for alternative delivery models, the potential for regulatory barriers, the extent of existing knowledge and work to build from, and the potential for having significant impact on material flows (i.e. significant reduction potential), personal care and home care products in SE Asia and dried foods in EU/US were identified by the expert panel as being particularly promising for reuse systems.

Due to the significant changes in infrastructure that is required for most reuse systems, the economic viability of reuse systems still remains a key challenge for industry. Collaborative actions across industry is needed to lower such barriers, for example by aligning on standards for reuse packaging formats and infrastructure, which is generally thought to be able to improve economic efficiency.[1, 2] See more details on the different types of collaborative actions that are needed in the section *"What is needed to achieve this?"*.

Reuse for personal care and home care in SE Asia

Particularly promising because:

- Innovators working with reuse for personal care and home care products already exist in SE Asia
- Personal care and home care products are the most frequently purchased products in sachets (in the Philippines)[3]

Innovators in South and SE Asia working with reuse for personal care and/or home care products:

- Siklus
- Qyos
- Algramo
- Koinpack
- Washby
- Recube
- Hepi Circle
- Wala Usik

Refill for dried foods in EU/US

Good opportunities for collaborative actions because:

- There's existing knowledge to build on from previous (and some ongoing) successful pilots and traditional zero waste stores
- Lower regulatory barriers compared to other product types typically sold in B2C flexibles in these geographies (e.g. fresh meats)

2022 2023 2024 2025

1. **Ellen MacArthur Foundation**, "Upstream Innovation: a guide for packaging solutions", 2020, p. 78-115;
2. **Rethink Plastic**, "Realising Reuse: The potential for scaling up reusable packaging and policy recommendations", 2021;
3. **GAIA**, "Sachet Economy: big problems in small packets", 2020, p. 12.

EXAMPLE 1:
What could innovative elimination and reuse look like for personal care and home care products in SE Asia?

TODAY

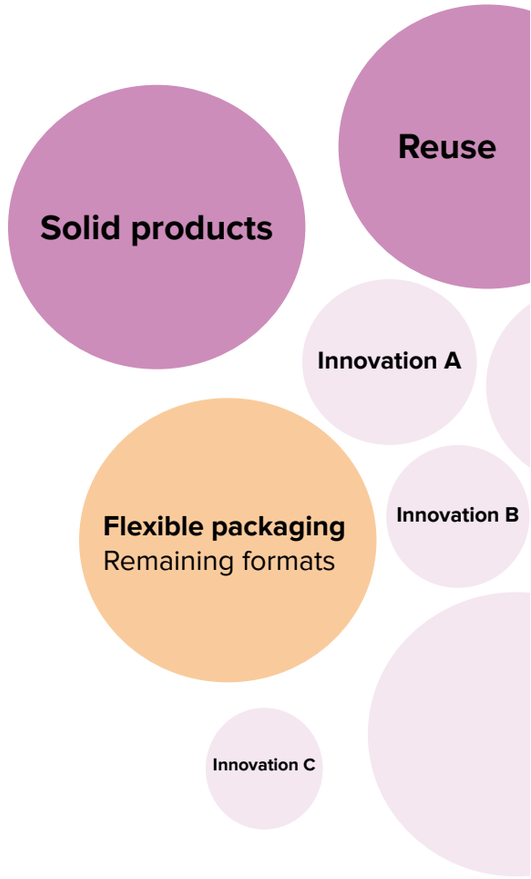
Reuse
900,000 sachets are being displaced per year through current personal care and home care reuse efforts (<0.001% of sachets used for personal care and home care products in SEA)*

Plastic sachets
Currently **146 billion plastic** sachets are used per year to deliver personal care and home care products in SE Asia*

Achieving a future where we've moved away from single-use B2C flexibles for personal care products in SE Asia wherever possible would require the following to take place:

- ❑ Businesses have set quantitative targets and dedicated internal resources for innovative elimination and reuse.
- ❑ Businesses are engaging in collaborative projects to develop systems that can scale.
- ❑ Supportive policies are in place.
  (See "What is needed to achieve this" section for more details)

FUTURE



Note: size of circles are not indicative of future market share
*For references and details on numbers, see the following page.

Approach for estimating plastic sachet use in SE Asia and amount of sachets displaced by current reuse efforts (example 1)

Currently 146 billion plastic sachets are used per year to deliver personal care and home care products in SE Asia

- In the Philippines, 1.64 sachets are used per capita per day.[1] It was assumed that this is the case 365 days per year, to get the number of sachets used per capita per year in the Philippines.
- 19% of sachets purchased in the Philippines are personal care products, and 17% are home care products.[1] This allowed us to calculate the number of sachets for personal care and home care used per capita per year in the Philippines.
- This number was extrapolated across SE Asia (using data on current population size of SE Asia*, at the time of calculation), assuming that all SE Asian countries use the same amount of personal care and home care sachets per capita per year as in the Philippines.

900,000 sachets are being displaced per year through current reuse efforts (<0.001% of sachets used for personal care and home care products in SEA)

- The number of reuse innovators in SE Asia selling personal care and home care products was estimated through research drawing on online searching, databases[2, 3], reports[4, 5], and expert interviews.
- Reuse innovators were divided into categories based on the type of reuse system set-up they follow:
  a) Mobile dispensers
  b) Bulk stores and immobile dispensing points
  c) Return models
- For one reuse innovator within each of these categories, numbers were retrieved on the approximate number of sachets they had displaced or were estimating they would be able to displace within a certain period of time (numbers were then calculated to be an estimate of sachets displaced per reuse innovator per year).[6, 7, 8]
- Extrapolating across all identified reuse innovators within each category, a total number of personal care and home care sachets displaced through reuse innovators per year in SE Asia was estimated.

*South-East Asian countries included: Indonesia, Philippines, Vietnam, Thailand, Myanmar, Malaysia, Cambodia, Laos, Singapore, Timor-Leste, Brunei Darussalam

1. **GAIA**, “Sachet Economy: big problems in small packets”, 2020, p. 12;
2. **Enviu**, “Zero Waste Showcase”;
3. **Zero Waste Malaysia**, “Zero Waste Resource Map”;
4. **GAIA**, “Business Unusual: Enterprises paving the way to zero waste”, 2021;
5. **Zero Waste Living Lab**, “Powering the shift from disposables to reusables: Synthesis issue”;
6. **Urban Links**, “USAID Grantee Celebrates Successful Zero-Waste Stores in Philippines”, 2020;
7. **Changemakers**, Network, Creating Shared Value Prize, “Siklus - driving rell solutions in Indonesia”, 2021;
8. **Enviu**, “Koinpack”, 2020.

EXAMPLE 2:
What could innovative elimination and reuse look like for dried foods in EU/US?

TODAY

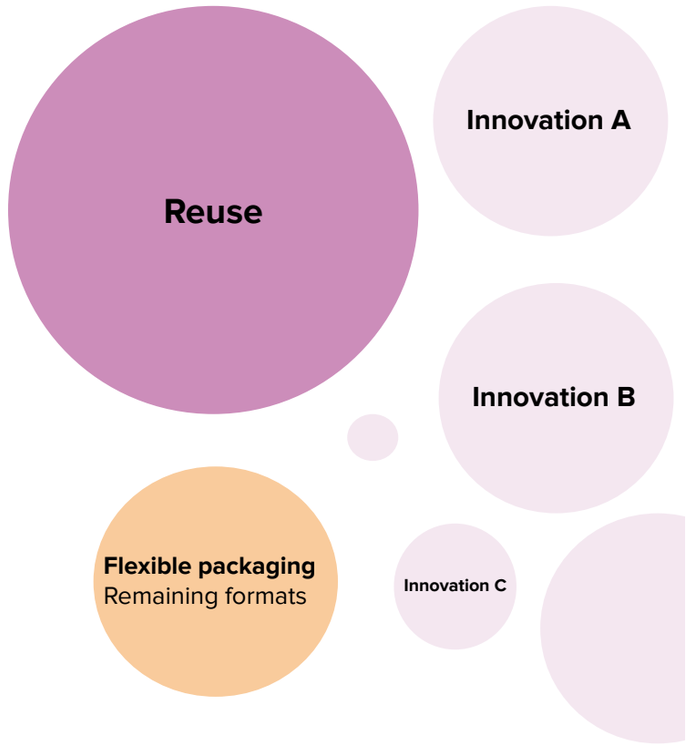
Reuse
65 tonnes of plastic B2C flexible packaging are being eliminated through current reuse efforts for dried foods (i.e. pasta and rice) per year*

Flexible plastic packaging
48,000 tonnes used per year for pasta and rice in EU and US*

Achieving a future where we've moved away from single-use B2C flexibles for dried foods in EU/US wherever possible would require the following to take place:

- ❏ Businesses have set quantitative targets and dedicated internal resources to innovative elimination and reuse R&D.
- ❏ Businesses are engaging in collaborative projects to develop systems that can scale.
- ❏ Supportive policies are in place.
  (See "What is needed to achieve this" section for more details)

FUTURE



Note: size of circles are not indicative of future market share
*For references and details on numbers, see the following page.

Approach for estimating amount of B2C flexible packaging used for dried foods in EU and US, and and the amount displaced by current reuse efforts (example 2)

***48,000 tonnes* plastic B2C flexible packaging used per year for pasta and rice in EU and US**

- 6,000 tonnes of packaging is used for pasta and rice across UK retailers per year.[1] An assumption around what percentage of this packaging is plastic B2C flexible vs paper/cardboard was made to estimate the amount of plastic B2C flexibles used for pasta and rice across UK retailers per year.
- To extrapolate this across the entire EU and US, the following data and assumptions were applied in the calculation:
  a) Data on per capita consumption of rice and pasta in the UK
  b) Assumption around the per capita consumption of rice and pasta in the EU and US (assumed to be equal to UK per capita consumption)
  c) Data on current population size of the EU and US (at the time of calculation)

***65 tonnes* of plastic B2C flexible packaging are being eliminated through current reuse efforts for dried foods (i.e. pasta and rice) per year**

- The number of current reuse pilots/initiatives providing dried foods (i.e. pasta and rice) in the EU and US was estimated based on examples reported via the 2021 Global Commitment reporting cycle, and as observed by major retailer pilots.*
- The amount of B2C flexible packaging (by weight) that can be displaced per year through one refill on the go pilot/initiative providing dried foods was estimated using reported reduction potential from a UK pilot.[2]
- A conservative estimate of the total amount of B2C flexibles (by weight) that are currently being displaced by reuse efforts in the EU and US was calculated by assuming that each of the identified reuse pilots/initiative are displacing the estimated amount described in the above bullet point.

*Traditional zero-waste and bulk stores were not included in this calculation.

1. **Greenpeace**, “Unpacked: How supermarkets can cut plastic packaging in half by 2025”, p. 23, 2020;
2. **Inside Packaging**, “A lot to unpack: supermarkets trialling refills”

See full details on the following pages

What is needed to achieve this?

STARTING NOW ⟶

Policy: creating a supportive policy landscape

Innovation agenda: setting an ambitious long term innovation agenda

Collaborative action: developing the systems that can scale

System investments: channelling investments into the systems that work, to deliver at scale

Consumer engagement: getting consumers engaged to normalise elimination and reuse

What is needed to achieve this?

To drive and scale innovative elimination and reuse, the following elements need to be mobilised. There is strong alignment behind the importance of these elements, as they have been defined in collaboration with our panel of experts representing organisations from throughout the plastics value chain.

Supportive policy landscape *to drive implementation*

a) **Supportive policies:** building off existing policies, or establishing new policies where relevant to:
   - Make the economics work (e.g. charging for single-use, subsidies, EPR Policy design by aligning and modulating EPR incentives and fees to favour reuse and other innovative solutions)
   - Other measures (e.g. mandating innovative elimination/reuse in certain sectors/applications, set reuse targets, using public procurement to drive reuse)*

b) **Absence of deterrent policies:** policies don't actively hinder implementation of elimination or reuse (e.g. requiring rethinking of hygiene and product safety policies)

Ambitious long term innovation agenda *to make transformative innovation a core part of businesses' B2C flexibles strategy*

a) **Quantitative targets:**
   - Ideally publicly communicated, quantitative portfolio ambitions for innovative elimination and reuse
   - Ambitious targets for piloting innovative elimination and reuse solutions

b) **Dedicated internal resources:** teams and finance allocated internally and elimination and reuse are deemed an R&D priority

c) **Moving together:** Multiple major brands and retailers have made commitments and communicated ambitions

*For further details and inspiration, see for example: **Consumers Beyond Waste (WEF)**, "City Playbook: Building a reuse city", 2021

What is needed to achieve this?

Collaborative action *to develop systems that can scale (1/2)*

a) **The right stakeholders:** relevant businesses (e.g. retailers), innovators and experts are involved
b) **Funding for innovation:** Government, VC, philanthropic and business funding available
c) **Identify and address research and innovation needs (specifically for reuse):** to identify the ideal system(s) for a particular product category, e.g. related (but not limited) to
   - Consumer viability: what will consumers require to engage with a reuse model?
     - For refill on the go specifically: how to increase convenience and the overall user experience? (i.e. foldable vs stackable packaging? Shared vs single-brand packaging? Combine with returnable packaging option? IoT integrated and smart dispensing units vs "traditional" bulk units?), what (economic) incentives are required?
     - For return models specifically: what return options and incentives are necessary to engage consumers? (i.e. pick-up vs drop off? Location and frequency of return points?)
     - How to ensure affordability of products supplied through reuse?
   - Product safety and hygiene viability
     - For refill on the go specifically: what level of technology in dispensing machines is required to guarantee safety, hygiene, and accommodate legal restrictions (and how might this influence required policy changes?)?
   - Environmental viability: environmental impacts and unintended consequences
     - For refill on the go specifically: if a single-use option (e.g. paper bag) is also offered at the refill site, is the model still environmentally viable? How to ensure that refill does not cause increase in food waste/spillage? How does the B2B supply chain need to be organised for the system to be viable?
     - For return models specifically: What level of standardisation (packaging formats and infrastructure) is needed for the model to be viable?
     - What is the role of flexible packaging in reuse systems?
   - Economic viability
     - For return models specifically: What level of standardisation (packaging formats and infrastructure) is needed for the model to be viable?
     - What are the financial investments needed to scale a particular system in a particular context?

*For further details and inspiration on some of these topics and questions, see for example:
Ellen MacArthur Foundation, "Upstream Innovation: a guide for packaging solutions", 2020;
Netherlands Institute for Sustainable Packaging, "Standardisation in reusable food packaging", 2020
Rethink Plastic, "Realising Reuse: The potential for scaling up reusable packaging and policy recommendations", 2021;
Zero Waste Europe, "Reusable vs single-use packaging", 2020;
Ellsworth-Krebs et al., "Circular economy infrastructure: Why we need track and trace for reusable packaging", 2022

What is needed to achieve this?

Collaborative action *to develop systems that can scale (2/2)*

d) Collaborative initiatives to (specifically for reuse)

- Define and align on standards, e.g. for reusable packaging design, data tracking, etc.
- Alignment on how to best measure reuse in order to improve ability to set quantitative targets (e.g weight vs share of business)
- Share learnings (e.g. through dedicated Reuse consortiums or working groups)
- Use learnings to continue to iterate processes to refine a particular system set-up

What is needed to achieve this?

Investment into the systems that work *to deliver at scale*

a) **Funding for infrastructure development:** public and private funding committed for large scale infrastructure development

b) **Supply-chain involvement:** all relevant stakeholders, including those that may have not played a significant role in the piloting phase are engaged

Get consumers engaged *to normalise elimination and reuse*

a) **Coordinated communication campaigns:** retailers and brands sending the same message at the same time to create a clear signal to consumers of the benefits of reuse (i.e. financial savings)

b) **The right timing:** products are on the shelves to legitimise communication efforts

c) **Sustained communication efforts:** positioning elimination and reuse as the new normal, not the fad

What could collaborative actions to develop systems that can scale look like?

What is needed:

a) **The right stakeholders:** relevant businesses (e.g. retailers), innovators and experts are involved
b) **Funding for innovation:** Government, VC, philanthropic and business funding available
c) **Identify and address research and innovation needs:** for example related to
   - Consumer viability (i.e. how can systems be made convenient for the consumer? What are key drivers and barriers to engagement?)
   - Product safety and hygiene
   - Environmental viability: impacts and unintended consequences
   - Economic viability

Specifically for reuse:

d) **Collaborative initiatives to**
   - Define and align on standards
   - Alignment on how to best measure reuse
   - Share learnings (e.g. through dedicated Reuse consortiums)
   - Use learnings to continue to iterate process to refine system set-up

There are still many unanswered questions, but these are examples of the sorts of things that could be done:

- MakeSense Philippines are working on gathering stakeholders from across the value chain to explore reusable systems to replace sachets.[1]

- Sharing learnings from reuse pilots and projects on online platforms, or through own communication channels such as done by Unilever.[2]

- Engage in design sprints (see for example the Upstream Innovation Guide resources) to identify research and innovation needs.

- Make customer insights gathering a core part your reuse piloting strategy. Use implemented pilots to understand consumer behavior and preferences in order to advance system set up, such as done by ASDA when expanding their refill options to further stores.[3]

- Sharing reuse system learnings through publications such as the report published by Ideo and Closed Loop Partners on reusable cup systems.[4]

1. **Expert statement**;
2. **Unilever**, "Reuse. Refill. Rethink. Our progress towards a packaging revolution", 2020;
3. **ASDA**, "Asda to rollout refill zones to more stores";
4. **Closed Loop Partners**, "Bringing Reusable Packaging Systems to Life Lessons Learned from Testing Reusable Cups", 2021

Setting up for success

See the Upstream Innovation Guide for more details!

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THE STORY BEHIND

Upstream momentum in Nestlé

The development of innovative alternative delivery systems, such as bulk reuse and refill options, are a key focus area for Nestlé across several product categories. For example, the company was one of the first joiners on the Loop platform (p. 100) with a double-walled Häagen-Dazs ice cream container (see photo right) that has now become an iconic example of reusable packaging with increased functionality. Also, Nestlé is actively exploring what next generation refill systems could look like, among others, through a partnership with the start-up MIWA to pilot tech-powered refill systems for Nescafé and pet food (p. 88).

COMPANY-WIDE VISION AND TARGETS
Continuously raising the organisation's ambition level to guide upstream innovation efforts
In 2018, Nestlé joined the Global Commitment and with that set quantitative targets, such as making 100% of its packaging recyclable or reusable by 2025. The announcement helped build an internal vision for packaging and created a demand for innovation across all Nestlé product categories. In January 2020, Nestlé raised the ambition level by setting a target to reduce the use of virgin plastic by one-third by 2025. Nestlé has also explicitly included reference to the company's commitment to developing a circular economy in its Corporate Business Principles (mandatory principles for all employees).

PATIENT CAPITAL
Earmarked funding for upstream innovation to shorten timelines
Nestlé has established a CHF 250 million sustainable packaging venture fund to invest in companies that focus on this area. Additionally, Nestlé has invested in in-house research with the creation of the Nestlé Institute of Packaging Sciences (an institute dedicated to packaging innovation under the mindset of 'learning fast and failing smartly') — both based in Lausanne, Switzerland. These initiatives, in addition to others, have made it easier and quicker for internal champions and external start-ups to get funding or expertise behind upstream innovation initiatives — for example, joining Loop (p. 100) and developing bulk dispensing models with MIWA (p. 88).

INTRAPRENEURIAL CULTURE
An employee innovation culture supported by crowdsourcing
Through various initiatives, Nestlé has been encouraging and directly investing in creating an intrapreneurial culture across the organisation. One of these initiatives is InGenius, Nestlé's Global Employee Innovation Accelerator. InGenius consists of a crowdsourcing platform, that helps employees collaborate and grow ideas into tangible business opportunities (see innovation process tool to right). More than 62,000 Nestlé employees from 108 countries have generated 6,400 new ideas and submitted over 92,000 votes. Today, many of Nestlé's upstream innovation efforts have their roots in internal pitching events where one or several internal champions have presented their vision,

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EXTERNAL INPUT
Creating several access points for externals
Partnerships with start-ups such as MIWA and Loop are examples of Nestlé's efforts to welcome good ideas from outside the organisation. Several access points have been created for external stakeholders to engage in the development and implementation of breakthrough packaging ideas. For example, the Nestlé Institute of Packaging Sciences collaborates with suppliers, research institutes, and start-ups to discover and develop 'environmentally friendly packaging solutions', while the Nestlé R&D Accelerator provides access to Nestlé's R&D expertise and infrastructure (including access to shared labs, kitchens, bench-scale and pilot-scale equipment) for external as well as internal teams.

INNOVATION PROCESS TOOL: AN IN-HOUSE INNOVATION PLATFORM
Nestlé's InGenius platform drives an employee innovation process that takes crowdsourced winning ideas from concept to pilot within six months. The team uses design thinking techniques, user research, and rapid prototyping to validate the idea and test the solution with real users. The employee who pitched the idea is positioned as the start-up CEO and an agile team is created around them to advance the concept via sprints, all in under eight weeks. An investor round with Nestlé's senior executives engages the start-up CEO in a live pitch and Q&A session where seed funding is available to develop viable prototypes, as well as embark on full-scale pilot tests.

Learn more on ingenius.nestle.com.

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THE STORY BEHIND

Coca-Cola's universal bottle

Coca-Cola is currently expanding delivery of soft drinks in refillable PET bottles with a universal design (p. 106). The initiative evolved from an intensive, ten-month innovation process undertaken by a dedicated cross-functional team in Latin America. The team had one task: Come up with a solution that can make refill packaging formats more efficient. In less than a year, the universal bottle was in operation in many markets in Latin America — it is Coca-Cola's fastest growing packaging format and is being scaled to other continents.

COMPANY-WIDE VISION AND TARGETS
Setting a growth expectation for upstream innovation
The launch of a company-wide vision of a 'World Without Waste', along with targets set out by the Global Commitment, acted as an impetus for Coca-Cola Latin America to invest USD 400 million in updating and scaling up infrastructure for refillable bottles. In the past, refillable bottles represented the majority of sales in Latin America, as they offer an affordable, alternative to single-use packaging, and bring significant environmental benefits, but they had been declining in most markets due to operational complexity. The president for Coca-Cola Latin America, Alfredo Rivera, saw an opportunity in launching an innovation challenge and with the investment set a long-term growth expectation for refill formats, which helped to ground it in the core business strategy.

PATIENT CAPITAL
A sponsored and empowered team
In addition to large investments in updating and scaling up infrastructure to enable refill across Latin America, a team of ten people from across the Latin American markets were selected by the leadership team to drive an innovation process on the packaging design for returnable business plan. The innovation process was triggered by a USD 25 million investment and the team members were taken off normal duties for almost ten months to focus on this project only. The capital and sponsorship from senior management left the team empowered and able to meet in person for several months to focus on the intensive innovation process.

BREAKING SILOS
Blending ideas and experiences from many markets
Many of the Latin American markets had already been experimenting with different solutions to overcome the operational complexity of refill glass bottles. For example, Chile had achieved a 75% market share of returnables and had seen very positive results from repeat sales due to a built-in reward for return. However, they were struggling operationally as the sorting of bottles was problematic and they had therefore already started to think about a universal design. At the same time in Brazil, they had seen a breakthrough in paper-based labelling technology and the upgraded lightweight refillable PET bottle. By mixing competencies from different business units and countries, the core team got the opportunity to learn from each other and blend different ideas to ultimately optimise the solution of a

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The agile team had senior representatives from marketing, finance, commercial, quality and technical areas, which helped to get a fast buy-in from the wider organisation during the innovation process.

Also, a key to success for the speedy innovation process was involving the bottlers from the outset. In fact, the CEO of Coca-Cola FEMSA, Coca-Cola's largest independent bottler, sponsored this innovation challenge on refill together with the Latin America Coca-Cola president. Having FEMSA representing all Latin American regional bottlers throughout the process made it possible to understand and integrate their needs and was key to ultimately getting the bottlers to invest in the new infrastructure for the universal bottle.

After the launch of the universal bottle in Latin America, a global workstream was formed to apply the learnings to other markets. For example, Coca-Cola has created a website where bottlers can get information about the opportunity in the universal bottle and read about the experiences and learnings from Latin America. Recently, South Africa has been identified as the next market for roll-out and the customer response to the new design is currently being tested.

INTRAPRENEURIAL CULTURE
Backbone of structures and procedures to encourage innovation
For more than ten years, Coca-Cola has been implementing a venture capital culture, inspired by the tech giants in Silicon Valley. Different tools and initiatives have been tested, such as introducing a Common Innovation Framework (CIF) to guide innov
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EXTERNAL INPUT
Investing in consultants to support the process
One of the key ingredients to succeeding in the innovation process of the universal bottle was the investment in external consultants who were specialised in agile methodology (see innovation process tool below) and could help guide and facilitate the core team in the process.

Also, Coca-Cola benefitted from partnering with NGOs at the final stage of the innovation process to get an external point of view and a validation of the solution. In Brazil, for example, the NGO TriCiclos carried out an independent LCA and has been giving input and feedback on how to further optimise returnable packaging systems.

INNOVATION PROCESS TOOL: AGILE TECHNOLOGY
The Common Innovation Framework (CIF) has guided innovation processes in Coca-Cola for almost 15 years. The goal is to build ideas into screened concepts through a process of five stages and gates: 1) Source concepts and ideas, 2) Assess strategic fit and potential value, 3) Build concept statements, 4) Screen with customers and shoppers, 5) Submit 'winners' at stages and gates. The screening is an especially important part of the process and Coca-Cola uses a variety of methodologies to recruit and develop panels to obtain input from them. In the case of the universal bottle, the team drew on the agile methodology to further guide the innovation process. It relies on breaking a big problem into small problems and incrementally

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THE STORY BEHIND

Tesco's packaging strategy

Since the start of 2018, Tesco, the UK's largest retailer, has been on a journey to transform their approach to plastic packaging. The retailer has now established a successful process for continuous packaging innovation and has dedicated a store to trialling new ideas.

COMPANY-WIDE VISION AND TARGETS
Communicating intentions, both internally and externally
The first phase in Tesco's upstream innovation journey involved setting a company-wide packaging vision. This was explicitly supported by the Tesco Group CEO, Dave Lewis, and clearly communicated throughout the supply chain. For example, in 2018, Tesco communicated to all of their suppliers that they intended to ban the hardest-to-recycle plastics from their products. All packaging materials in the business were then audited, and a preferred materials list was provided (the materials list is now updated as required). Removal of the hardest-to-recycle plastics has now been achieved for all own-brand products with work ongoing with branded products. The second phase was launched in mid-2019, with a 4R strategy developed to govern all packaging design — remove, reduce, reuse, and recycle. At this time, Tesco also communicated that, starting in 2020, they would assess the size and suitability of all packaging as part of their ranging decisions and category reviews — reserving the right not to list a product if they find the packaging to be excessive or inappropriate. This vision was set out by the Tesco Group CEO at four meetings with over 1,500 suppliers along with a target to remove 1 billion pieces of packaging by the end of 2020 (See p. 46 and p. 48 of this guide for two of the items — multi-pack films and secondary lids — removed as part of this process).

BREAKING SILOS
Cross-functional teams to identify opportunities for change
From the moment the packaging strategy was laid out, a cross-functional team (consisting of technical experts, product developers, and commercial teams working with branded and own-brand suppliers) has existed to assess every single piece of packaging in Tesco's business and identify opportunities for change. The 4R programme is also guided by a steering group of managers from across the business and governed by a cross-functional group of directors who meet once a month.

Ideas that are developed by these cross-functional teams are either directly rolled out across Tesco's operations, or, if they require testing, are trialled in a dedicated store (see the innovation process tool).

EXTERNAL INPUT
Engaging with a broad range of actors to deliver on the packaging strategy
Tesco works with a broad range of actors, including experts from industry, NGOs and charities, to achieve its packaging programme. For example, a partnership with WWF supports the 4R work on packaging, Tesco's Head of Packaging engages with a number of organisations through the UK's Plastics Pact, and Tesco has recently teamed up with Loop (p. 100) to pilot reuse-return in the UK.

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INNOVATION PROCESS TOOL: REAL-LIFE TRIAL AND ERROR OF FRESH IDEAS
Tesco has turned one of their stores near Cambridge into a dedicated store for trialling ideas to reduce waste — Tesco Bar Hill. Here, ideas can be rapidly tested and customer response understood in order to develop ideas that can be scaled to support the 4R strategy. Once Tesco identifies/understands how an idea will work best, the idea is rolled out from Bar Hill to all 2,658 UK stores. This said, it is accepted that some of the ideas tested in Bar Hill will not be rolled out — the point is to quickly establish what works and only roll out the best innovations. To feed fresh ideas into the Bar Hill shop in 2019, Tesco gathered 24 graduates from different areas of Tesco's business. The graduates participated in a ten-day workshop and generated more than 50 initial ideas which were developed into 23 defined deliverables that could support the 4R strategy, based on volume and scalability. The idea to remove multi-pack films (p. 36) was one of the ideas generated in this workshop and was first tested in the Bar Hill store before being rolled out across the UK.

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THE STORY BEHIND

X, the Moonshot Factory

One of the most iconic contemporary examples of disruptive innovation is 'X, The Moonshot Factory' — the radical innovation engine behind Alphabet (parent company of Google). While the innovation scope of X is much broader and quite different from this book, their approach can serve as inspiration on how to invent groundbreaking technologies and solutions.

Inspired by iconic innovation laboratories such as Bell labs and Thomas Edison's Menlo Park laboratory, X focuses on inventing and developing groundbreaking technologies and solutions. Since its creation in 2010, X has created all-electric delivery drones to reduce carbon emissions and air pollution, skills to bring geothermal power to homes, and storage for renewable energy in giant vats of molten salt. Ongoing projects include computational agriculture to explore opportunities to reduce emissions and waste through the food system and the ocean health project to explore new ways to protect our oceans while feeding humanity.

PATIENT CAPITAL
Merging risky project profiles with 5–10 year project timelines to achieve truly transformative outcomes
X does not focus on quick, easy, and certain wins. X explicitly focuses on inventing and launching 'moonshot' projects with the potential to solve problems that affect millions or billions of people. Consequently, X works with project timelines of astronomical proportions (up to a decade) compared to conventional corporate innovation projects. In order to be truly innovative, the projects pursued usually have the highest risk profiles, high degrees of research, and long-term time horizons.

BREAKING SILOS
A diverse pool of 'T-shaped' entrepreneurs
Rather than establishing large project teams around each effort, X has small project teams that draw on a large pool of highly skilled people who lend their expertise to many different projects. To ensure maximum innovative capacity, X focuses on hiring a diverse group of innovative and entrepreneurial individuals with deep expertise in a given field but who also have the ability to look at the broader picture and work across many different domains — 'T-shaped' candidates.

INTRAPRENEURIAL CULTURE
Engaging with a broad range of actors to deliver on the packaging strategy
To avoid having to give up on ideas at very late stages, with millions of innovation dollars down the drain, X focuses on actively killing ideas — ideally as early as possible. Creating a culture around this process and celebrating failure is key (see innovation process tool to the right).

EXTERNAL INPUT
Making contact with the real world — early and often
Rather than hiding away in a lab and hoping that the world will like what comes out of the X-labs, X actively seeks external input from the beginning in order to build something truly useful and learn as fast as possible.

UPSTREAM INNOVATION | MAKING IT HAPPEN | SETTING UP FOR SUCCESS | 175

INNOVATION PROCESS TOOL: PERFECTING THE ART OF KILLING IDEAS
X's innovation process is organised around a funneling process that aims to continuously eliminate ideas that, for technical or economic reasons, will not be able to succeed.

The first stage is about understanding a project's biggest risks. Here innovators usually get a few weeks and funding in the order of a few thousands USD. Most ideas do not move forward from this stage.

The second stage involves prototype building and modelling (both technical and economic) to understand the biggest obstacles that need to be overcome for an idea to succeed and whether overcoming these is possible at all. This stage usually takes a couple of months and only a handful of ideas survive this stage.

The third stage usually takes a year and involves further drilling into the risks and key preliminary barriers that need to be overcome. Only after this stage, which roughly half of the ideas pass through, is a full multi-year X pr

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UIG p. 174

ELLEN MACARTHUR FOUNDATION

FLEXIBLE PACKAGING:

SUBSTITUTION TO PAPER-BASED FLEXIBLES:

Design and circulation

Supplementary Information

Why is this option on the table?

What does the system to work towards look like?

- Packaging design
- Material sourcing
- Collection
- Sorting
- Recycling or Composting
- End markets

Why is this option on the table?

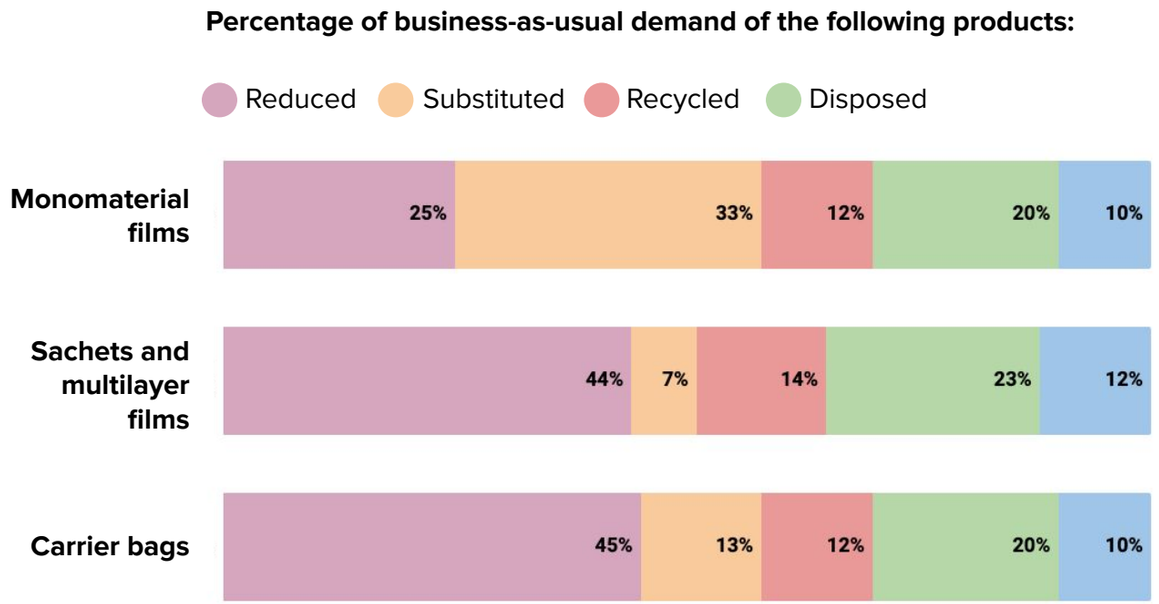


Figure 1. System interventions for B2C flexibles[1]

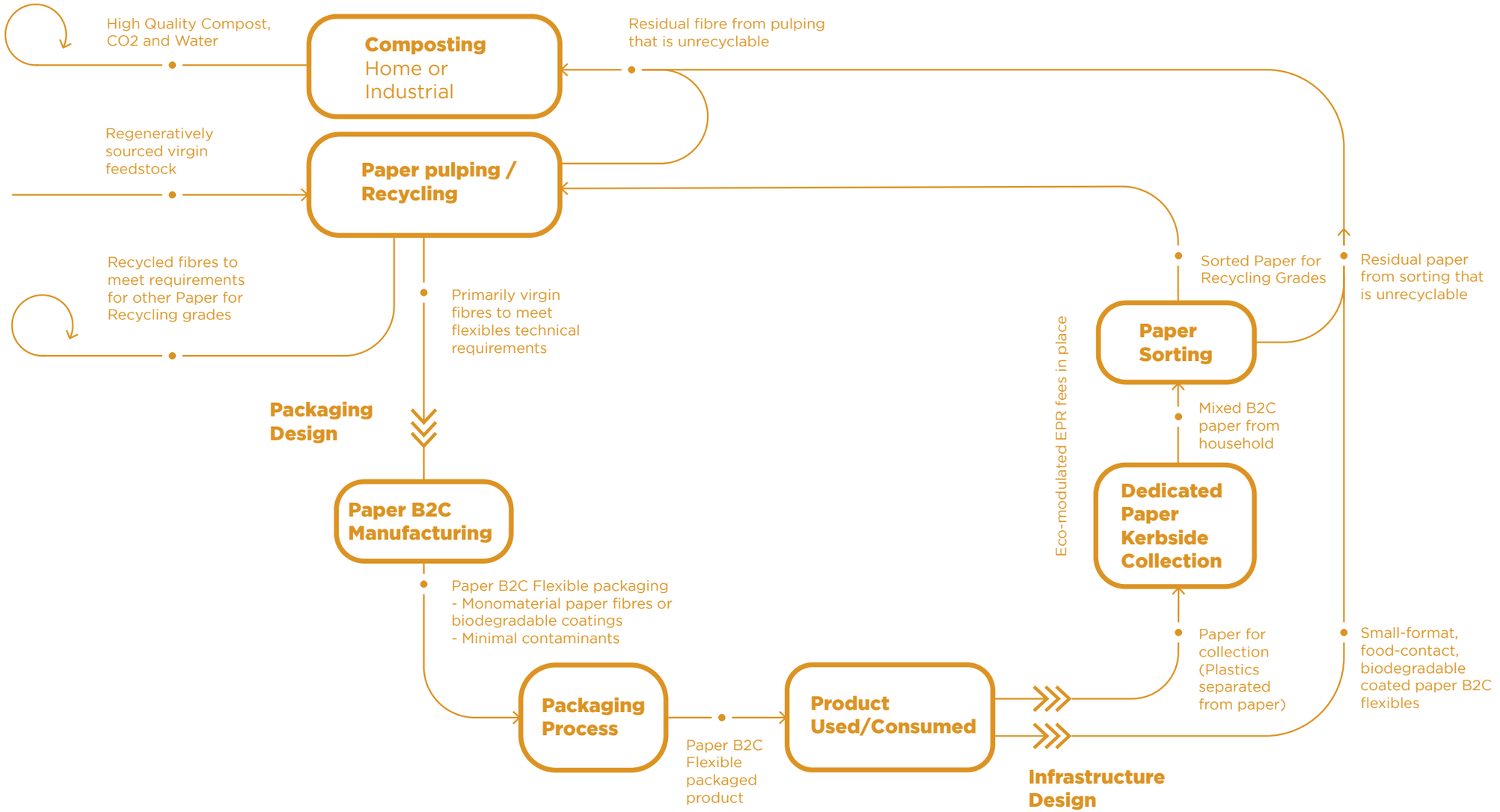
According to Breaking the Plastics Wave[1], one of the most analytically robust studies ever produced on ocean plastics, substitution to paper and compostable plastics will need to be one of the solutions deployed for plastic B2C flexibles as a compliment to elimination, innovation and recycling.

Substitution to paper could, in the appropriate settings:

- **Result in higher recycling rates globally compared to plastics** (although the majority would still be recycled in to lower quality applications, not flexible-to-flexible)
- **Allow for synergies with the food composting system**
- **Could potentially have a reduce persistence in the environment compared to plastic flexibles (although this is of course not a long-term solution)**

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

What does the system to work towards look like?



What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Recycling or Composting | End markets

1. *Single-use B2C Flexibles eliminated with a much higher ambition level than currently.*
   Reasoning: See executive summary.

2. *Product and system changes implemented to reduce complexity of packaging required*
   Reasoning: For example, shortening supply chains could mean that the packaging requires lower barrier properties, hence reducing required coatings and improving recyclability.

Argument continued on next page

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Recycling or Composting | End markets

3. *Paper B2C Flexibles designed to meet the requirements of both paper recycling systems and home/industrial composting systems.*

   Reasoning: Paper is interesting as a packaging material as it can fit within both a recycling system and a composting system. This is an advantage from the perspective of providing greater flexibility with regards to end-of-life (EOL) infrastructure availability. There is also a high likelihood some paper B2C Flexibles, even if designed for the recycling system, will end up in the composting system. Thus, whilst the optimal after-use system is recycling, to take advantage of the synergy with the composting system, and minimise the potential for contamination, designing paper B2C Flexibles with both systems in mind will be beneficial. This is of particular importance for the very small formats which are unlikely to make it through a recycling system/may be too contaminated to undergo high-quality recycling.

   a) *Paper-based solutions are either mono-material[1] or use coatings that have the same biodegradation profile as paper.*

      Reasoning: To take advantage of synergies with the composting system, coatings for paper B2C flexibles should have the same biodegradation profile as paper.

   b) *Use of inks/dyes and adhesives are avoided where possible, and if unavoidable, kept to a minimum and designed to be non-toxic, and water-soluble (e.g. non UV-cured inks).[1]*

      Reasoning: Improves the quality of the recyclate and therefore facilitate a wider range of end markets.

   c) *Paper-based solutions are designed in accordance with local design for recycling guidelines*

1. **CONAI**, “Guidelines for facilitating the recycling of packaging made predominantly from paper”, 2021, p. 33-43;

What does the system to work towards look like?

Packaging design | **Material sourcing** | Collection | Sorting | Recycling or Composting | End markets

1. *Substitution to paper for B2C flexibles comes as part of a broader a reduction and virgin reduction agenda for paper and paperboard across a business's packaging portfolio*

Reasoning:

- Today most flexible paper packaging is made from virgin wood-pulp, so a switch from plastic to paper for even **~15%**[1,2] of B2C flexibles would result in a **10%** increase **(12 million tonnes)**[3,4] in virgin wood pulp production. This would be an **~1%** increase[3,4] in the global wood production. See following pages.
- Unfortunately, the global production of all wood products, including virgin wood-pulp for paper already exceeds ecological boundaries and the majority of production does not meet international and national sourcing standards for forestry.[5] In addition, there is ever growing global demand for wood from by many major industries (such as construction, furniture and fuel industries) shifting towards wood in a bid to source 'sustainable' raw materials.[6,7] As result, the overall virgin wood-pulp production needs to decrease rather than increase.[8]

Argument continued on next page

1. The amount PEW estimates can be shifted. This includes items such as B2C mono-material films (cling film/shrink wrap) and sachets and multilayer films (sachets for powdered drinks and condiments and confectionary wrappers). Paper-based packaging usually weighing ~1.5 times more than plastic based packaging. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", 2020, p. 55-61;
2. **Statista**, "Global Paper Production", 2018;
3. **Food and Agriculture Organisation (FAO)**, "FAOSTAT Data", 2019;
4. Calculated from data for the volume of flexibles on the market from Wood Mackenzie
5. **The State of the Global Paper Industry**, 2018;
6. **Food and Agriculture Organisation (FAO)**, "Global Forest Products Facts and Figures", 2018, p. 1;
7. **Gresham House**, "Global Timber Outlook", 2020, p.3, 5;
8. **Canopy**, "Survival: A Plan for Saving Forests and Climate", 2020, p. 3-4;

What does the system to work towards look like?

Packaging design | **Material sourcing** | Collection | Sorting | Recycling or Composting | End markets

2. *The following is prioritised across B2C Flexibles and across packaging paper and paperboard more broadly:*

a) *Reduction is prioritised (e.g. removing unnecessary secondary packaging or switching to reuse within supply chains).*
Reasoning: As above and illustrated by the charts and diagrams in the following pages.

b) *If reduction is not possible, prioritise recycled content where possible* ***(currently estimated at 10%-50% for B2C flexibles)***
Reasoning: Currently, paper B2C flexible packaging is predominantly comprised of virgin fibre owing to the need for high fibre strength, therefore moving forward, utilisation of Paper for Recycling (PfR) will likely need to provide the same performance. Our understanding of the ability to include recycled content is as follows: Grade 3 - 'High Grades', such as graphic paper could utilise 10% recycled fibre (though this type of paper is less suitable for paper B2C flexible packaging owing to a lack of water resistance). Grade 4 - 'Kraft Grades' is the most suitable for use in paper B2C flexible packaging, and with a potential utilisation rate of recycled fibre of up to 50%.[1,2]

c) *Where virgin content is required, prioritise using fibre from agricultural residues (biomass which remains after the harvesting of plant crops) or other byproducts where possible*
Reasoning: See page 53.

d) *Where virgin content is required and agricultural residues are not an option, avoid sourcing from ancient and endangered forests, ensure highest possible certification standards for all wood used (current best practice is generally considered FSC 100%) and use a diversified range of dedicated crops (e.g. sourcing from a mix of certified wood, bamboo, papyrus)*[3]
Reasoning: All the materials used in products bearing the FSC 100% label are sourced from forests that have been audited by an independent third party to confirm they are managed according to FSC's rigorous social and environmental standards.[4] In addition, while the current production volumes of non-wood fibre crops are comparatively low, their suitability to local climatic conditions and lower environmental demands, mean their utilisation should be further considered.[5]

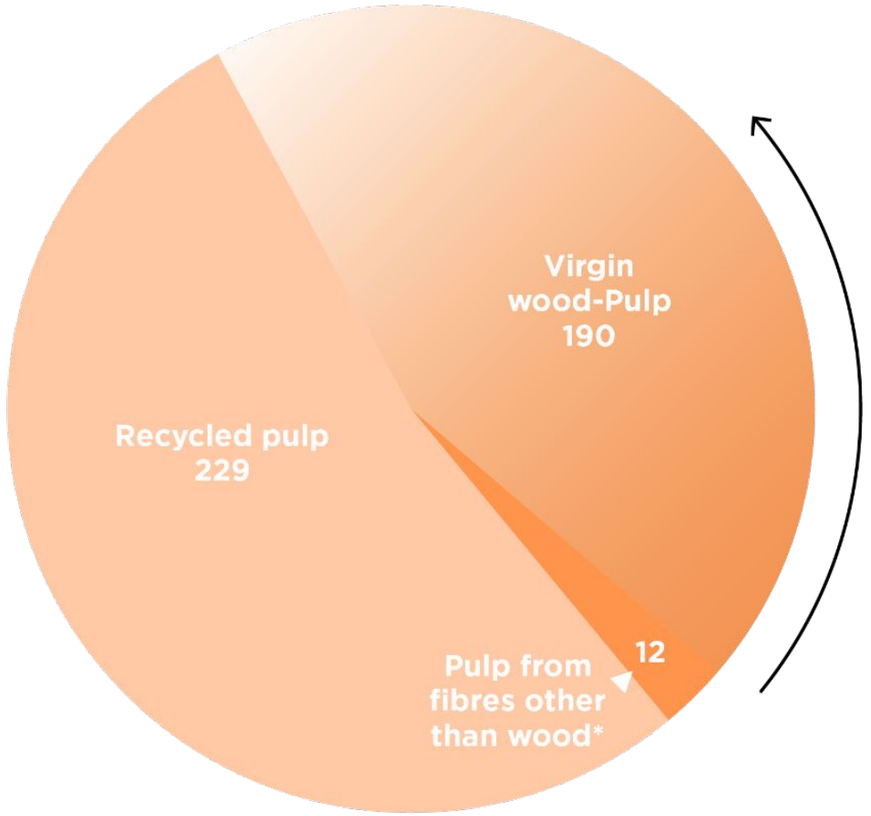
1. **EU Commission**, "End-of-waste Criteria for waste paper", 2011, p. 16-17; 2. **CEPI**, "Key statistics 2020, European Pulp and Paper Industry", p. 21;
3. **Canopy**, "Survival: A Plan for Saving Forests and Climate", 2020, p. 10-11, 38 4. **Forest Stewardship Council**, "What do the FSC Labels Mean?", 2021; 5. **Expert Opinion**

Evidence suggests that a significant share of virgin wood-pulp for paper is sourced from problematic sources making 'blind' substitution to paper a poor choice for B2C flexibles.

The global production of wood pulp for paper and paperboard already far exceeds ecological boundaries, with up to **~90 million tonnes** of wood pulp (**up to 50%** of global virgin wood-pulp for paper and paperboard demand) originating from problematic sources such as ancient and endangered forests.[1]

With the role that forests play in combating climate change and supporting biodiversity well recognised, any loss of ancient and endangered forests is a major concern.[1]

Substitution of B2C Flexibles would add to this already strained system. Given the technical requirements of the fibres required to make paper B2C flexibles, a high-virgin content is required, meaning substitution of **15%**[3] of plastic B2C Flexibles to paper would potentially require an extra **12 million tonnes**[4] of virgin wood-pulp (an ~ 10% increase in global virgin wood-pulp demand).



Definitions: FAO definitions

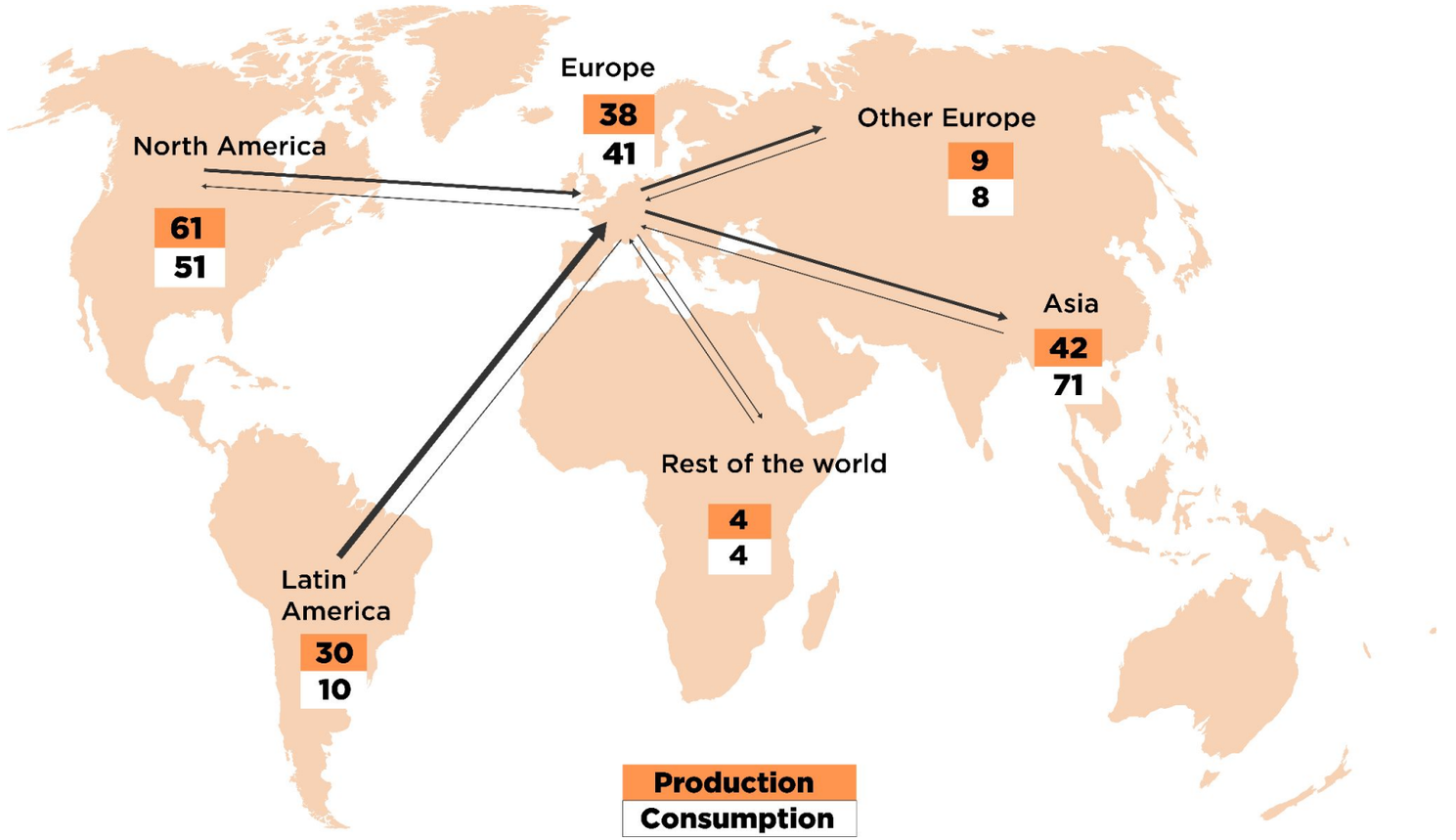
*Includes bamboo and all other non-wood dedicated pulp fibre crops
**Proportion of agricultural residues and bamboo and other crops going into pulp from fibres other than wood is unknown.

1. **Canopy**, "Survival: A Plan for Saving Forests and Climate", 2020, p. 16-17;
2. **Food and Agriculture Organisation (FAO)**, "FAOSTAT Data", 2019;
3. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", 2020, p. 55-61;
4. Calculated from data for the volume of flexibles on the market from Wood Mackenzie

Sourcing practices differ significantly around the globe

However, particular geographies can not be designated as 'safe' due to significant trading between continents meaning that a lot of wood pulp used in Europe comes from other continents and differing opinions around what constitutes sustainable sourcing and where it occurs.

Trade Flows of Market Pulp in 2020 (Million Tonnes)[1]



1. **CEPI**, "Key statistics 2020, European Pulp and Paper Industry", p. 11.

Sourcing practices differ significantly around the globe

However, particular geographies can not be designated as 'safe' due to significant trading between continents meaning that a lot of wood pulp used in Europe comes from other continents and differing opinions around what constitutes sustainable sourcing and where it occurs.

Data for the percent of wood-pulp from original vs planted forests[1]

	USA	Brazil	China	Canada	Sweden	Finland	Japan	Russia	Indonesia	India	Chile	Unassigned	
Forest Zone	Temperate	Tropical	Temperate	Temperate	Temperate	Temperate	Temperate	Boreal	Tropical	Tropical	Temperate	Tropical	Total %
Pulp for Paper Production %	26	10	9	9	6	6	5	5	4	3	3	14	100
% Planted Forest	11.7	6.5	4.05	4.05	2.7	2.7	2.25	0.7	2.6	1.95	1.35	9.1	**49.65**
% Original / Primary Forest	14.3	3.5	4.95	4.95	3.3	3.3	2.75	4.3	1.4	1.05	1.65	4.9	**50.35**

1. **Canopy**, "Survival: A Plan for Saving Forests and Climate", 2020, p. 52-53,

Paper Production System 2019[1]

Million metric tons

Application breakdown (Size order)

Packaging paper and paperboard - 242

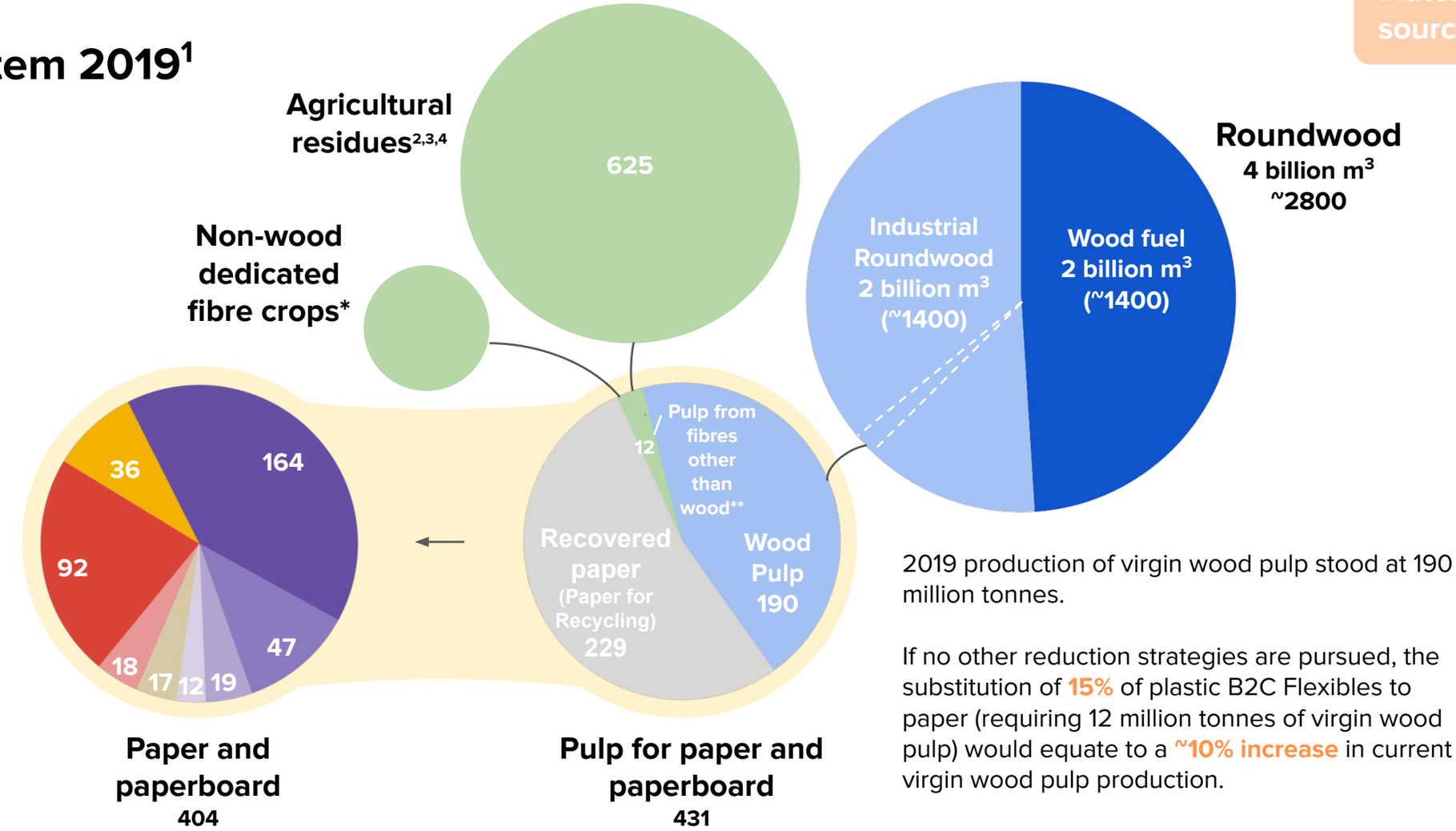
- Case materials
- Cartonboard
- Wrapping papers
- Other papers mainly for packaging

Graphic Paper - 110

- Printing and writing papers
- Newsprint

Other Categories

- Household and sanitary papers
- Other paper and paperboard n.e.s. (not elsewhere specified)



2019 production of virgin wood pulp stood at 190 million tonnes.

If no other reduction strategies are pursued, the substitution of **15%** of plastic B2C Flexibles to paper (requiring 12 million tonnes of virgin wood pulp) would equate to a **~10% increase** in current virgin wood pulp production.

Measured against 2,800 million tonnes of global roundwood production, this equates to requiring a **~1% increase** in global roundwood production.

Definitions: FAO definitions

*Includes bamboo and all other non-wood dedicated pulp fibre crops

**Proportion of agricultural residues and bamboo and other crops going into pulp from fibres other than wood is unknown.

1. **Food and Agriculture Organisation (FAO)**, "FAOSTAT Data", 2019;
2. **World Bioenergy Association**, "Global Bioenergy Statistics", 2019, p. 27-28;
3. **E. S. Abd El-Sayed et al.**, "Non-wood fibers as raw material for pulp and paper industry", 2020, p. 218;
4. **Cherubin et al.**, "Crop residue harvest for bioenergy production and its implications on soil functioning and plant growth: A review", p. 262.

Wood pulp production has been trending upwards over the past 10 years[1]

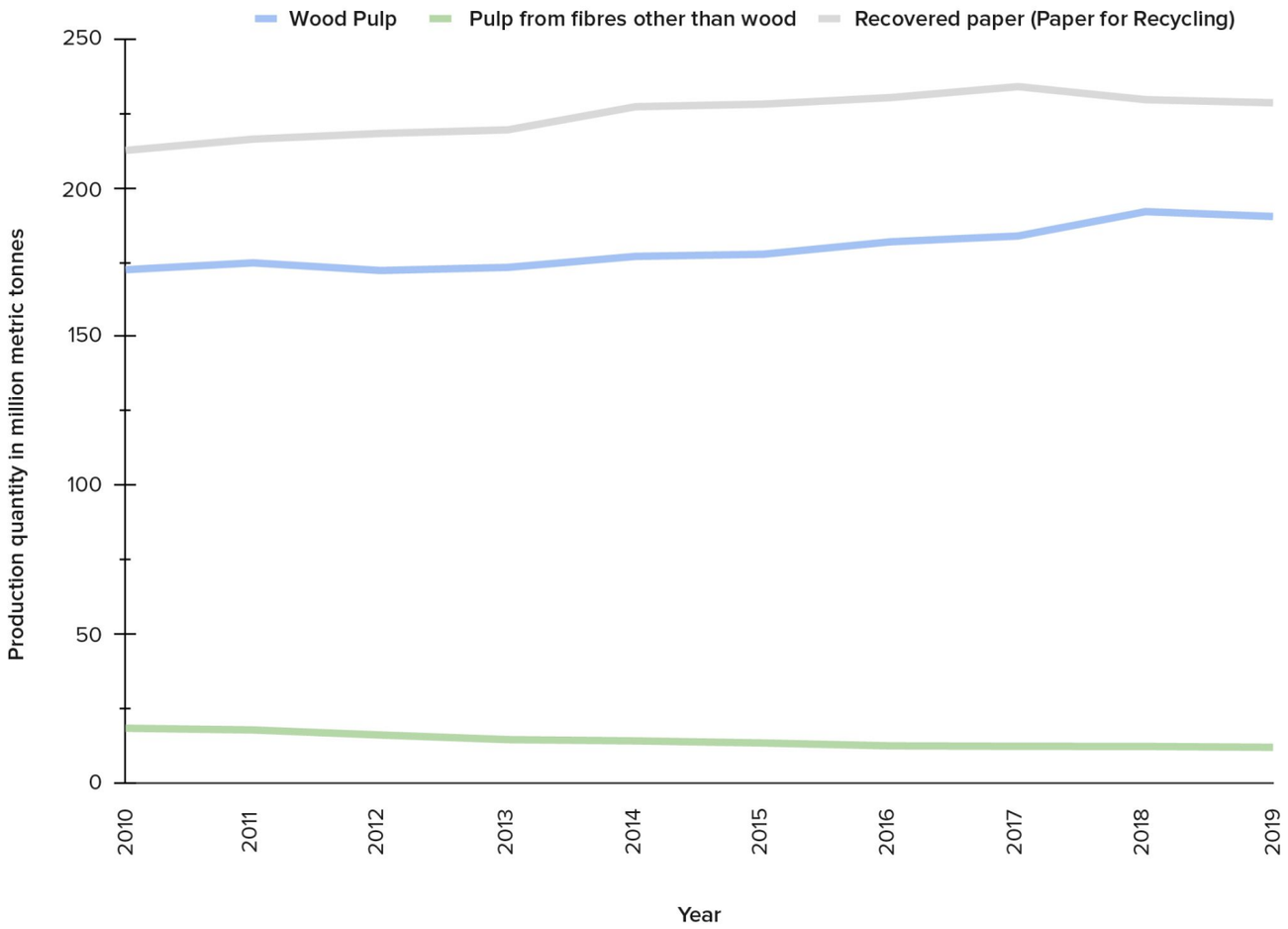
Recovered Paper (Paper for Recycling)
229 - 213 = 16 million tonnes INCREASE

Wood Pulp
190 - 172 = 18 million tonnes INCREASE since 2010

Pulp from fibres other than wood
12 - 18 = 6 million tonnes DECREASE since 2010

Pulp for Paper and Paperboard - Global Production Volume

Chart produced by EMF from FAO data



Definitions: FAO definitions

1. **Food and Agriculture Organisation (FAO)**, "FAOSTAT Data", 2019

Paper and Paperboard production has been trending upwards over the past 20 years[1]

Packaging formats
242 - 151= 91 million tonnes INCREASE

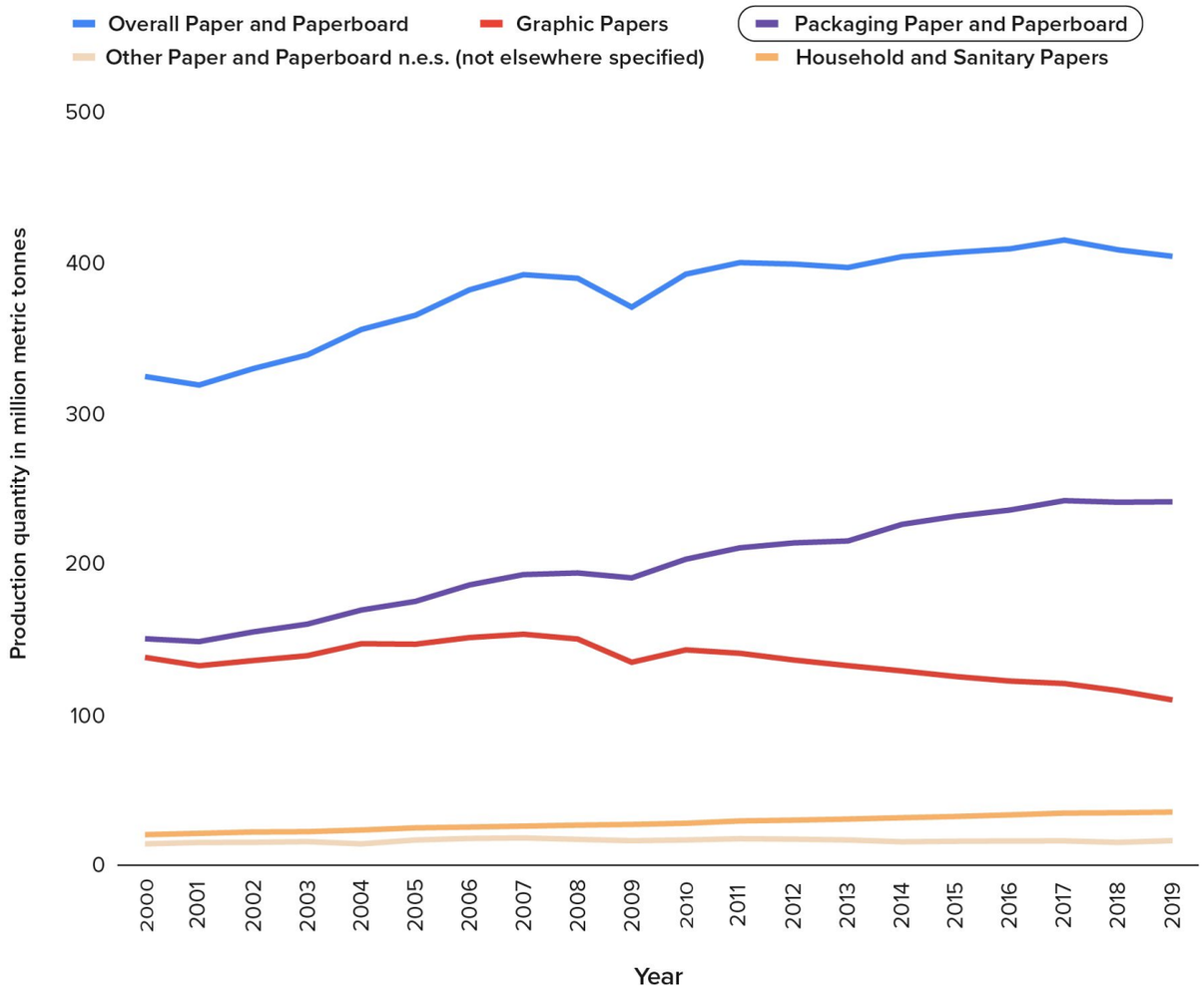
Graphic paper
154 - 110 = 44 million tonnes DECREASE

Overall for paper and paperboard
404 - 324 = 80 million tonnes INCREASE since 2000

Growth in packaging formats has negated any decline due to newsprint, printing and writing papers

Paper and Paperboard - Global Production Volume - Primary Formats

Chart produced by EMF from FAO data



Definitions: FAO definitions

1. **Food and Agriculture Organisation (FAO)**, "FAOSTAT Data", 2019

Agricultural residue opportunities

Potential of agricultural residue

- The conservative approximate global volume of agricultural (crop) residue produced per year is between **2.5 and 5 billion tonnes**[1, 2], with the volume more likely to be closer to the higher estimate.
- The amount available for industrial use, either through conversion to paper or other sectors such as bioenergy is dependent on the amount retained within the agricultural system. Studies suggest that between **30-50%**[3] of residues should to be retained to sustain soil and agricultural ecosystems. Nevertheless, there is still enormous potential given the quantity available.

  Assumption: 75% of agricultural residue is retained through regenerative agriculture methods. Leaving only 25% for alternative utilisation.

  0.25 x 2.5 billion tonnes (lower bound) = 625 million tonnes available to be used to produce materials for use.
- **625 million tonnes** would be more than enough to provide for current paper demand (even if assuming it should replace wood-pulp entirely there would still be enough to supply other economic sectors).

Challenges of utilising agricultural residue

It is important to note that there are some sourcing challenges in relation to utilisation of agricultural residues owing to the seasonality of the crops, where there are large peaks of supply that need appropriate storage.[4]

Paper mills and agricultural residue

- Existing wood-pulp paper mills can be retrofitted to utilise agricultural residue.[5]
- In order to be economically viable (OPEX), wood-pulp paper mills with the potential to be converted to utilise agricultural residues need to be within a radius of 75-100 miles from farmland.[6]

1. **World Bioenergy Association**, “Global Bioenergy Statistics”, 2019, p. 27-28; 2. **E. S. Abd El-Sayed et al.**, “Non-wood fibers as raw material for pulp and paper industry”, 2020, p. 218
3. **Cherubin et al.**, “Crop residue harvest for bioenergy production and its implications on soil functioning and plant growth: A review”, p. 262; 4. Expert Opinion;
5. **Canopy**, “Survival: A Plan for Saving Forests and Climate”, 2020; 6. **Canopy**, “Manufacturing Paper from Straw”, 2018

What does the system to work towards look like?

Packaging design | Material sourcing | **Collection** | Sorting | Recycling or Composting | End markets

1. *Dedicated collection for recycling for all fibre-based packaging types. This includes household, and on-the-go.*[1, 2]
   Reasoning: Other mechanisms, such as front of store collection without deposits, are unlikely to achieve collection rates much above **10%**[3]. In Europe, dedicated collection of paper B2C Flexibles is needed to improve the supply of paper for recycling because traditional sources (industrial and commercial) have long-since been maximised.[4]

2. *Paper not commingled with the flexible plastics stream*
   Reasoning: Separation between paper and plastics ensures higher quality sorting.[5, 6]

3. *Backed by EPR fees that reflect the actual cost of keeping paper in circulation*
   Reasoning: Mandatory, fee-based EPR is the *only* proven and likely way to provide the dedicated, ongoing and sufficient funding required to make the economics of collection, sorting and recycling work.[7] How EPR fees can be used to achieve this should be a core part of the discussion, as should how to ensure that any system put in place is inclusive (See Informal Recycling section for more information, p96).

1. **4evergreen**, "WS3 - Guidelines for Collection and Sorting", 2021;
2. **CEPI**, "Recyclability Guidelines 2019, p. 9, 11;
3. **WRAP**, "Film Consistent Collections Sprint Group Report", March 2021, p. 18;
4. **European Commission**, "Recovered Paper SORTing with Innovative Technologies (SORT IT) Report", 2011, p. 41;
5. **Materials Recovery for the Future**, "Flexible Packaging Recycling in Material Recovery Facilities Pilot", 2020, p. 5-6;
6. **Expert Interviews**;
7. **Ellen MacArthur Foundation**, "EPR position paper", 2021;

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Recycling or Composting | End markets

Paper Recycling System

Paper and paperboard recycling is the most widespread and successful recycling system globally **(with a global recycling rate of ~60%[1]).** The target for paper and paperboard recycling is to improve this rate at a regional level, aiming for the theoretical maximum of **~80%[2,3].**

Notes:

- **EU** has an overall paper recycling rate of **~74%.[1]** The rate for paper packaging is **~84%[5].** A target paper packaging recycling rate of **90%[6]** is considered achievable in Europe.
- **US** has an overall paper recycling rate of **~68%.[7]** The rate for 'paper containers and packaging, excluding corrugated boxes', is **~21%.[7]** This is more specific than the EU rate which includes corrugated card.
- **Asia** has a paper recycling rate of **~54%.[1]**
- These all compare to a global plastic packaging recycling rate of **~10%.[8]**

1. **European Declaration on Paper Recycling**, "Monitoring Report", 2020, p. 5;
2. **Elena Bobu et al.**, "Potential Benefits of Recovered Paper Sorting by Advanced Technology", 2010, p. 463;
3. **European Declaration on Paper Recycling** 2016-2020, 2017, p. 5;
4. **Bureau of International Recycling**, "Paper and Board Recycling in 2018", 2018, p. 16, 21;
5. **Eurostat**, "Recycling rates for packaging waste", 2021;
6. **4evergreen**, "EU Paper Packaging Target", 2021;
7. **EPA**, "Facts and Figures", 2018;
8. **Ellen MacArthur Foundation (New Plastics Economy)**, "Rethinking the future of plastics", 2016, p. 27;

ELLEN MACARTHUR FOUNDATION

FLEXIBLE PACKAGING:

SUBSTITUTION TO COMPOSTABLE FLEXIBLES:

Design and circulation

Supplementary Information

Why is this option on the table?

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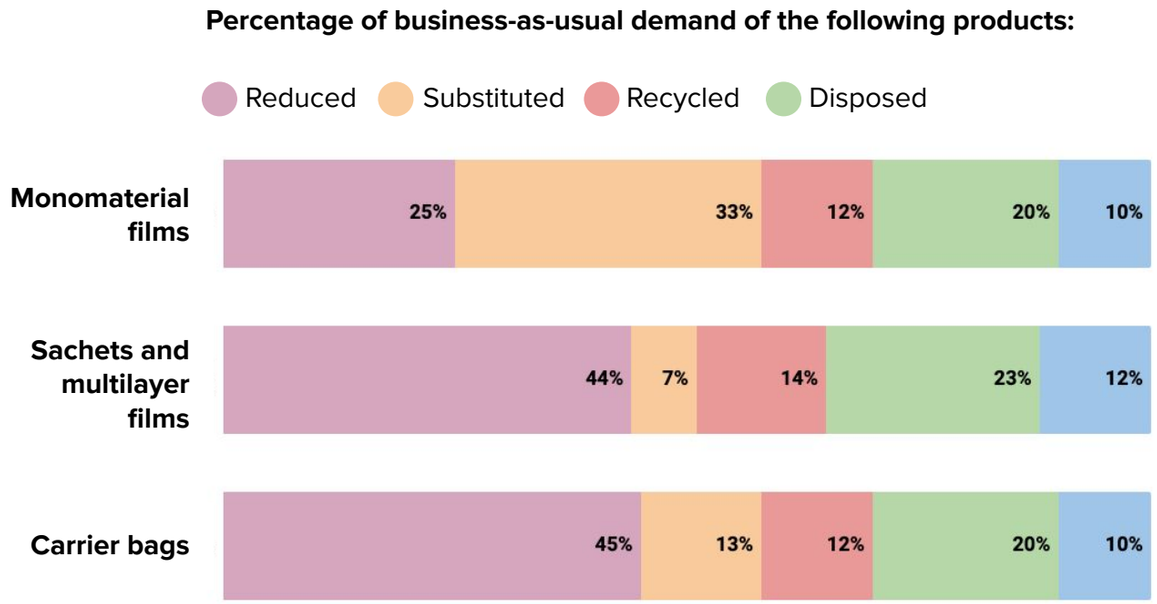


Figure 1. System interventions for B2C flexibles[1]

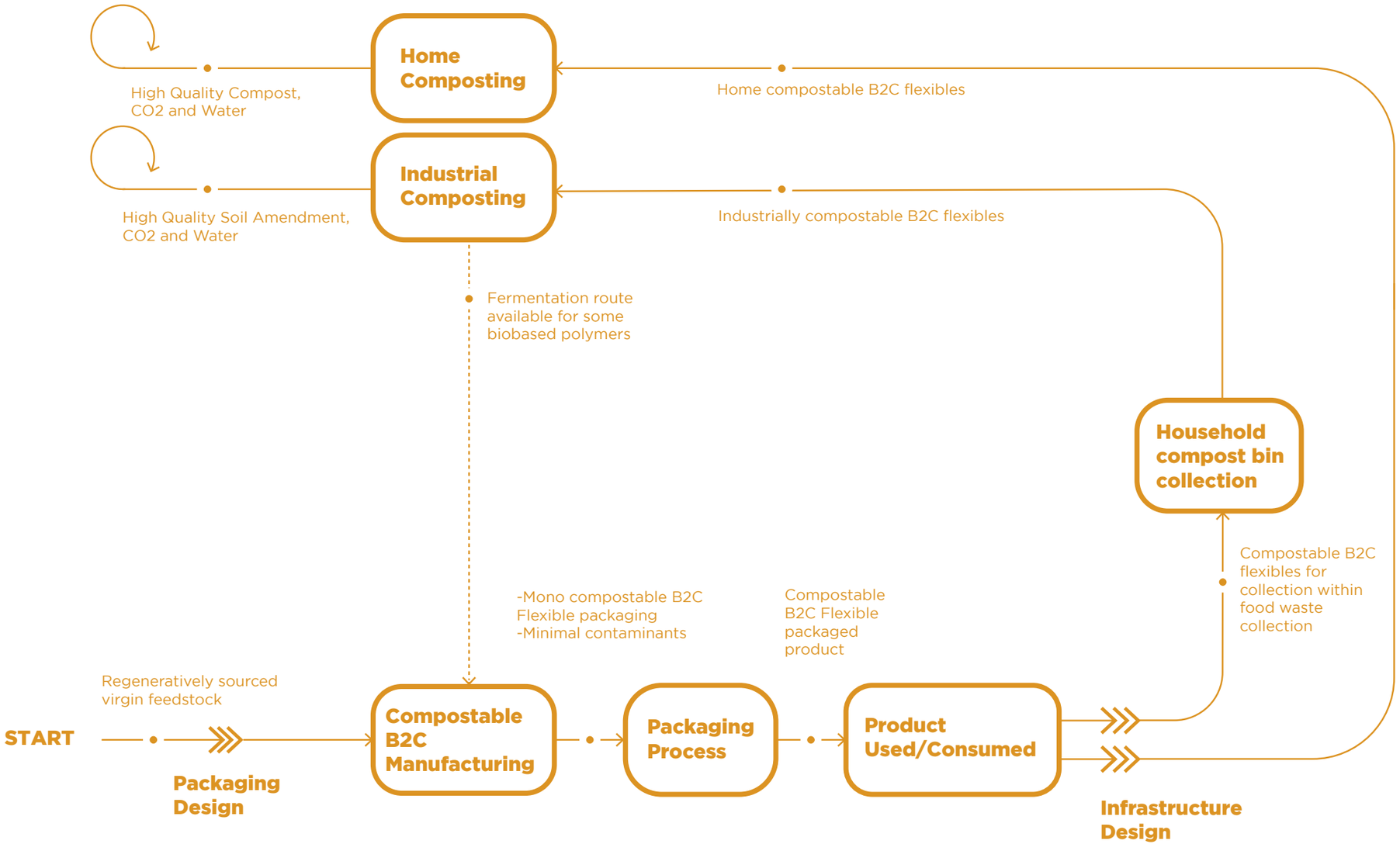
According to Breaking the Plastics Wave[1], one of the most analytically robust studies ever produced on ocean plastics, substitution to paper and compostable plastics will need to be one of the solutions deployed for plastic B2C flexibles as a compliment to elimination, innovation and recycling.

Substitution to compostable plastics could, in the appropriate settings, support a healthy soil and food system by

- **Removing existing contaminants from composting systems**
- **Help to bring more organic matter to composting systems**

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

What does the system to work towards look like?



See full details and reasoning on the following pages

What does the system to work towards look like?

The core focus of industrial composting or anaerobic digestion systems should be to return nutrients to the soil — contributing to the long-term aim of regenerating our soils and building a healthy food system.[1,2] Substitution to compostable B2C Flexibles needs to be undertaken in a manner that supports, rather than hinders, this.

Composting and anaerobic digestion (AD) facilities need to be scaled globally over the coming years in order to capture and circulate the nutrients contained in food waste.

Reasoning: Even after accounting for reduction in unnecessary food waste, by 2030, global food scraps production will amount to ~466 million tonnes per year.[3, 4] Currently, <2% of this makes it into collection and processing (composting/AD) systems.[5] This represents a loss of nutrients, and contributes to GHG emissions.

Scaling food waste collection and processing thus needs to be a top priority in the coming decades across all geographies as indicated by many countries introducing legislation to keep food waste out of landfill[6, 7, 8]

Argument continued on next page

1. **M S Ayilara et al.**, “Waste Management through Composting: Challenges and Potential”, 2020, (2.3.7.) p. 5, (3.2.1.) p. 8;
2. **Ellen MacArthur Foundation**, “The Big Food Redesign - Regenerating Nature with the Circular Economy”, 2021, p.17, 48;
3. **UNEP**, “Food Waste Index Report”, 2021, p. 4;
4. **Food and Agriculture Organisation**, “Indicator 12.3.1 - Global Food Loss and Waste”;
5. **Ellen MacArthur Foundation**, “Cities and Circular Economy for Food”, 2019, p. 8, 17;
6. **EU** Food waste legislation, 2021;
7. **UK** Food waste legislation, 2021;
8. **Australian** Food waste legislation, 2021

See full details and reasoning on the following pages

What does the system to work towards look like?

This means there is a potential scaled end-of-life route for compostable B2C Flexibles emerging — providing that compostable B2C Flexibles are used in applications/designed in such a way that their use supports the overall aim of healthy soils and food systems.

Reasoning: In total, after accounting for the potential of elimination, and a shift to reuse, by 2040 it has been estimated that ~20%[1, 2, 4] of plastic B2C Flexibles could be substituted to compostable plastic flexibles. This would amount to ~14 million metric tonnes[1, 2, 4] of compostable B2C Flexibles (given compostable plastic based packaging weighs ~1.3 times a conventional plastic B2C Flexible)[1]. If all of this is collected, it would make up only 3%[1, 2, 3 ,4] of the collected food waste stream — a large enough volume to become a significant contaminant if not designed appropriately, but a small enough volume that the food system is unlikely to adjust purely for the benefit of compostable B2C Flexibles.

Therefore, if appropriately designed, categories for which substitution to compostable B2C Flexibles could make sense are:

- Food packaging that is likely to remain highly contaminated with food (enabling circulation of food and the nutrients it contains). For example, sauce sachets, tea-bags.
- B2C Flexibles that are frequently found contaminating organic waste streams. For example, fruit stickers.

1. The amount PEW estimates can be shifted. This includes items such as B2C mono-material films (cling film/shrink wrap) and sachets and multilayer films (sachets for powdered drinks and condiments and confectionary wrappers). Compostable-based packaging usually weighing ~1.3 times more than plastic based packaging. **The PEW Charitable Trust and Systemiq**, “Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution”, 2020, p. 55-61;
2. **European Bioplastics, “**Market Data”, 2020, p1;
3. **UNEP**, “Food Waste Index Report”, 2021, p. 4;
4. Calculated from data for the volume of flexibles on the market from Wood Mackenzie

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Composting | End markets

A scaled EOL route for compostable B2C Flexibles will likely exist globally thanks to the need to put food waste collection and processing in place. However, for this to work, compostable B2C Flexibles will need to be designed in a way that meets the requirements of this emerging food waste system.

1. *Carefully consider the appropriate applications (see prior page)*

2. *As a minimum, design for full biodegradation (not just disintegration) under aerobic composting conditions in commercial scale facilities.*

   Reasoning: Composters and end markets need assurances that any non-organic material will not contaminate the final product,[1] therefore full biodegradation, not just disintegration, is required.[2] This is best achieved under aerobic composting conditions, and while this does not rule out anaerobic digestion, it can be expected that most digestate should also pass through an aerobic process (see the section on 'composting' for more information - page 69)

Argument continued on next page

1. **European Environment Agency**, "Biodegradable and compostable plastics – challenges and opportunities", p. 2;
2. **InnProBio**, "Biodegradability. Exposing some of the myths and facts", p. 1, 3;

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Composting | End markets

A scaled EOL route for compostable B2C Flexibles will likely exist globally thanks to the need to put food waste collection and processing in place. However, for this to work, compostable B2C Flexibles will need to be designed in a way that meets the requirements of this emerging food waste system.

3. *Employ clear, standardised labelling to ensure compostable B2C flexibles are correctly placed into food collection bins*

   Reasoning: To prevent contamination of the food collection stream, compostable B2C Flexibles should be very clearly labelled in a standardised manner.[1,2] Beyond certification logos, this could include the adoption of a specific colour palette or marking pattern for compostable materials.[3]

4. *Design packaging to fit into best practice composting systems for food and organics, not the other way around*

   Reasoning: See page 69

1. **European Commission**, “Section 2 - Recommendations, 2.3 - Promote the supply of accurate information on the properties, appropriate use, and limitations of BDP and to relevant user groups”, p. 26-27;
2. **Greenpeace**, “Biodegradable Plastics: Breaking Down the Facts”, p. 40;
3. **Expert Opinion**;

What does the system to work towards look like?

Packaging design | **Material sourcing** | Collection | Sorting | Composting | End markets

Our thinking has been laid out in previous reports[1, 2]

1. *Phase out of petrochemical sourcing for compostables plastics as a priority*
   Reasoning: Compostable plastic production requires virgin feedstock. Given that the composting process yields carbon dioxide, water and biomass, composting materials made from renewable feedstocks return carbon to the atmosphere that was captured during the material's production. Whereas, composting materials made from petrochemical feedstock creates a system dependent on the continuous input of finite materials — which is not a long term solution. Currently ~one-third of compostable plastics are produced from petrochemical feedstock and approximately ~two-thirds are from dedicated crop feedstock.[3]

Argument continued on next page

1. **Ellen MacArthur Foundation**, "Rethinking the Future of Plastics", 2016;
2. **Ellen MacArthur Foundation**, "Upstream Innovation Guide", 2020;
3. The amount PEW estimates can be shifted. This includes items such as B2C mono-material films (cling film/shrink wrap) and sachets and multilayer films (sachets for powdered drinks and condiments and confectionary wrappers). Compostable-based packaging usually weighing ~1.3 times more than plastic based packaging. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", 2020, p. 55-61;

What does the system to work towards look like?

Packaging design | **Material sourcing** | Collection | Sorting | Composting | End markets

2. *Prioritise feedstocks that do not compete with food systems and will be able to be scaled whilst staying within ecological boundaries*

Reasoning: In total, after accounting for the potential of elimination, and a shift to reuse, by 2040 it has been estimated that ~20%[1, 2, 3] of plastic B2C Flexibles could be substituted to compostable plastic flexibles.[1, 2] This would amount to a ~14 million metric tonnes[1, 2, 3] increase in compostable plastic demand (given compostable plastic based packaging weighs ~1.3 times a conventional plastic B2C Flexible)[1]. This would represent an 11x increase in the overall 2020 global compostables production[1, 2, 3] (current compostable plastic production is 1.22 million metric tonnes globally)[2]. If not carefully managed, such significant expansion could risk further exceeding ecological boundaries in terms of crop production.[4]

a) *Prioritise reduction (e.g. removing unnecessary secondary packaging or switching to reuse within supply chains).*
b) *Use agricultural residues/by-products where possible (Pre and post consumer food waste, wastewater, and many others)*
c) *Diversify crop use (e.g. experiment with different crops, such as dry-land crops that have low water requirements)*
d) *Take geographical context into account when selecting crops*
e) *Explore third generation feedstocks*

Argument continued on next page

1. The amount PEW estimates can be shifted. This includes items such as B2C mono-material films (cling film/shrink wrap) and sachets and multilayer films (sachets for powdered drinks and condiments and confectionary wrappers). Compostable-based packaging usually weighing ~1.3 times more than plastic based packaging. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", 2020, p. 55-61;
2. **European Bioplastics, "**Market Data", 2020, p1;
3. Calculated from data for the volume of flexibles on the market from Wood Mackenzie
4. **B M Campbell**, "Agriculture production as a major driver of the Earth system exceeding planetary boundaries". Ecology and Society. 22. 8. 10.5751/ES-09595-220408, 2017

Agricultural residue opportunities

Potential of agricultural residue

- The conservative approximate global volume of agricultural (crop) residue produced per year is between **2.5 and 5 billion tonnes**[1, 2], with the volume more likely to be closer to the higher estimate.
- The amount available for industrial use, either through conversion to paper, compostable plastics, conventional plastics or other sectors such as bioenergy is dependent on the amount retained within the agricultural system. Studies suggest that between **30-50%**[3] of residues should to be retained to sustain soil and agricultural ecosystems.
  Nevertheless, there is still enormous potential given the quantity available.
  Assumption: 75% of agricultural residue is retained through regenerative agriculture methods. Leaving only 25% for alternative utilisation.
  0.25 x 2.5 billion tonnes (lower bound) = 625 million tonnes available to be used to produce materials for use.
- **625 million tonnes** would be more than enough to provide for current compostable plastics demand.

Challenges of utilising agricultural residue

It is important to note that there are some sourcing challenges in relation to utilisation of agricultural residues owing to the seasonality of the crops, where there are large peaks of supply that need appropriate storage.[4]

1. **World Bioenergy Association**, “Global Bioenergy Statistics”, 2019, p. 27-28;
2. **E. S. Abd El-Sayed et al.**, “Non-wood fibers as raw material for pulp and paper industry”, 2020, p. 218
3. **Cherubin et al.**, “Crop residue harvest for bioenergy production and its implications on soil functioning and plant growth: A review”, p. 262;
4. **Expert Opinion**

What does the system to work towards look like?

Packaging design | Material sourcing | **Collection** | Sorting | Composting | End markets

There is a cost associated with collection, sorting and recycling of compostable B2C Flexibles which should not necessarily be borne by composting facilities. A dedicated EPR mechanism/gate-fee for compostable B2C flexibles could help to support their acceptance within the composting system.[1]

1. *Household* food waste collection and processing (composting or AD) is rapidly expanded across all geographies. Compostable B2C Flexibles are collected as part of this system.*

   Reasoning: Ensuring all household food waste is collected and composted should be a priority from the perspective of circulating nutrients to help regenerate our soils and build a healthy food system (See page 60).[2] It would make sense for compostable B2C Flexibles to be collected as part of this system.

*Household in this context being 'post-distribution'

1. **Ellen MacArthur Foundation**, "EPR position paper", 2021;
2. **Expert Opinion**

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | **Sorting** | Composting | End markets

There is a cost associated with collection, sorting and recycling of compostable B2C Flexibles which should not necessarily be borne by composting facilities. A dedicated EPR mechanism/gate-fee for compostable B2C flexibles could help to support their acceptance within the composting system.[1]

1. *The capture of compostable plastics is maximised whilst contamination by conventional plastics is minimised.*

   Reasoning: One of the key concerns of increasing the amount of compostable B2C Flexibles on the market is the potential for increased contamination of the resulting compost stream.[3, 4] Current sorting technology for composting facilities are not of a high enough standard to ensure that contamination is minimised, whilst still allowing compostable plastics to move through the system.[2] This can be considered one of the main bottlenecks with regards to the acceptance of compostable plastics within industrial composting processes.[3] Addressing this will require significant investment in sorting innovation at composting facilities, and this would need to be supported by those that are putting compostable plastics onto the market.[3]

1. **Ellen MacArthur Foundation**, "EPR position paper", 2021;
2. **Expert Opinion**;
3. **GreenBlue SPC**, "Understanding the Role of Compostable Packaging in North America", 2021, p. 25-26
4. **European Environment Agency**, "Biodegradable and compostable plastics – challenges and opportunities", p. 2

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | **Composting** | End markets

The aim of a composting process should be to produce a high-quality compost which can support the development of healthy soils[1] within a regenerative food system.[2]

1. *Composting residence times likely need to be longer than they are in many facilities currently.*

   Reasoning: From a healthy soils perspective, the quality of compost should be prioritised over the speed of production.[4] Our current understanding is that longer composting residence times lead to better quality and more stable compost due to the fermentation process being complete. It has been suggested that more mature compost provides more oxygen in the root zone, improves the availability of nitrogen, reduces the presence of phytotoxic compounds, and reduces the likelihood of methane, carbon and ammonia emissions.[4,5] As such, it is suggested that mature compost helps to improve soil fertility and biota[4,5]

   Technically, in-vessel composting is considered to be the most efficient method of obtaining high quality compost from food because it provides the best possible controlled environment (temperature, moisture, carbon-nitrogen mixes, frequent turning) which optimises aerobic conditions and reduces anaerobic pockets of methane and ammonia.[3, 7] It is scalable and can work in both rural and urban contexts.[6] Other industrial methods come with limitations when it comes to food waste composting - for example, open-air windrows and aerated static piles are primarily suited to garden waste as they can pose odour challenges and require a large area.[8]

Argument continued on next page

1. **M S Ayilara et al.**, “Waste Management through Composting: Challenges and Potential”, 2020, (2.3.7.) p. 5, (3.2.1.) p. 8;
2. **Ellen MacArthur Foundation**, “The Big Food Redesign - Regenerating Nature with the Circular Economy”, 2021, p. 17, 48;
3. **M. Vaverková et al.**, “Study of the Biodegradability of Degradable/biodegradable Plastic Material in a Controlled Composting Environment”, 2012, p. 356;
4. Expert Opinion;
5. **European Circular Bioeconomy Policy Initiative**, “Briefing paper”, 202, p. 4;
6. **WRAP**, “UK Plastics Pact, Considerations for Compostable Packaging”, p. 9;
7. **EPA**, “Biosolids Technology Fact Sheet - In-Vessel Composting of Biosolids”, 2000, p. 3;
8. **UrthPact**, “Industrial Composting: What It Is and How It Works”, 2017;

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | **Composting** | End markets

The aim of a composting process should be to produce a high-quality compost which can support the development of healthy soils[1] within a regenerative food system.[2]

2. *Anaerobic Digestion (AD) is co-located with in-vessel composting processes (or other aerobic process such as windrows) to ensure that the AD digestate is fully utilised and any remaining compostable B2C plastics are fully biodegraded.*

   Reasoning: Anaerobic digestion does not produce the quality compost required for soil amendment. It produces digestate which needs to be further composted.[3,4] Therefore for best practice, industrial composting systems, such as in-vessel composting are required as a compliment.[3, 5]

3. *Compost is post-screened to remove any remaining plastic contamination*

   Reasoning: A higher quality pre-screening stage will enable compostable B2C Flexibles to be brought through the composting process. In addition, this should be combined with a post-screening stage; helping to more comprehensively address unwanted contamination.[6]

1. **M S Ayilara et al.**, “Waste Management through Composting: Challenges and Potential”, 2020, (2.3.7.) p. 5, (3.2.1.) p. 8;
2. **Ellen MacArthur Foundation**, “The Big Food Redesign - Regenerating Nature with the Circular Economy”, 2021, p. 17, 48;
3. Expert Opinion;
4. **UrthPact**, “Industrial Composting: What It Is and How It Works”, 2017;
5. **BioCycle**, “Integrating Anaerobic Digestion With Composting”, 2014;
6. **GreenBlue SPC**, “Understanding the Role of Compostable Packaging in North America”, 2021, p. 25-26

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Composting | **End markets**

1. *Compost produced through the collection and processing of food waste is used to help regenerate soils, and replace synthetic fertilisers.*[1,2]

1. **M S Ayilara et al.**, “Waste Management through Composting: Challenges and Potential”, 2020, (2.3.7.) p. 5, (3.2.1.) p. 8;
2. **Ellen MacArthur Foundation**, “The Big Food Redesign - Regenerating Nature with the Circular Economy”, 2021, p. 17, 48

ELLEN MACARTHUR FOUNDATION

FLEXIBLE PACKAGING:

PLASTIC FLEXIBLES:

Design and recycling in the formal sector

Supplementary Information

Why is this option on the table?

What does the system to work towards look like?

- Packaging design
- Material sourcing
- Collection
- Sorting
- Recycling
- End markets

Why is this option on the table?

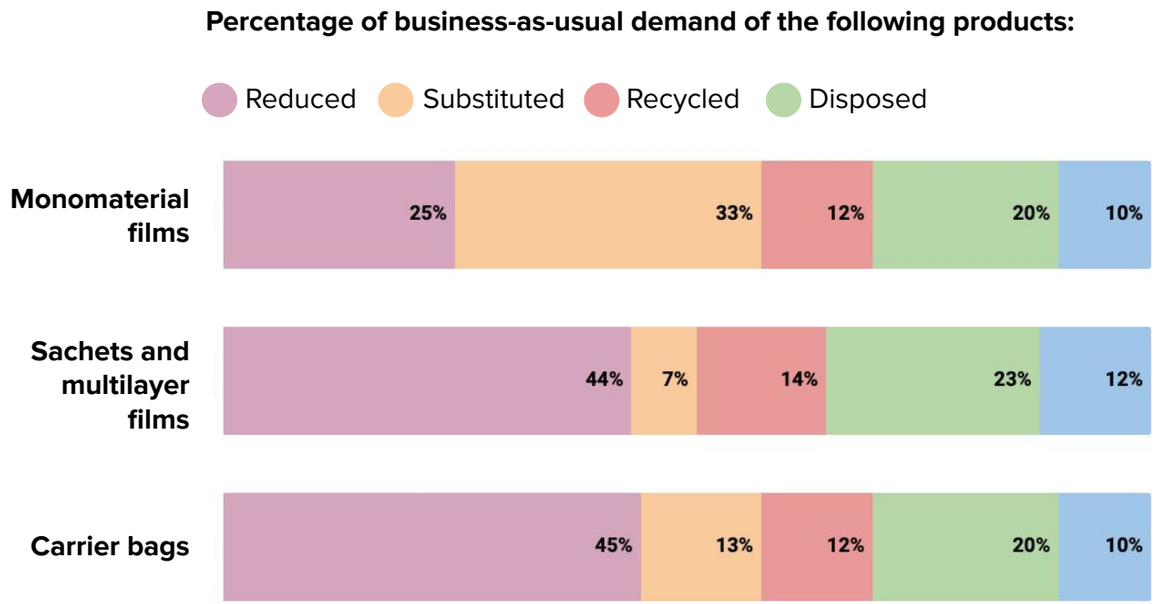
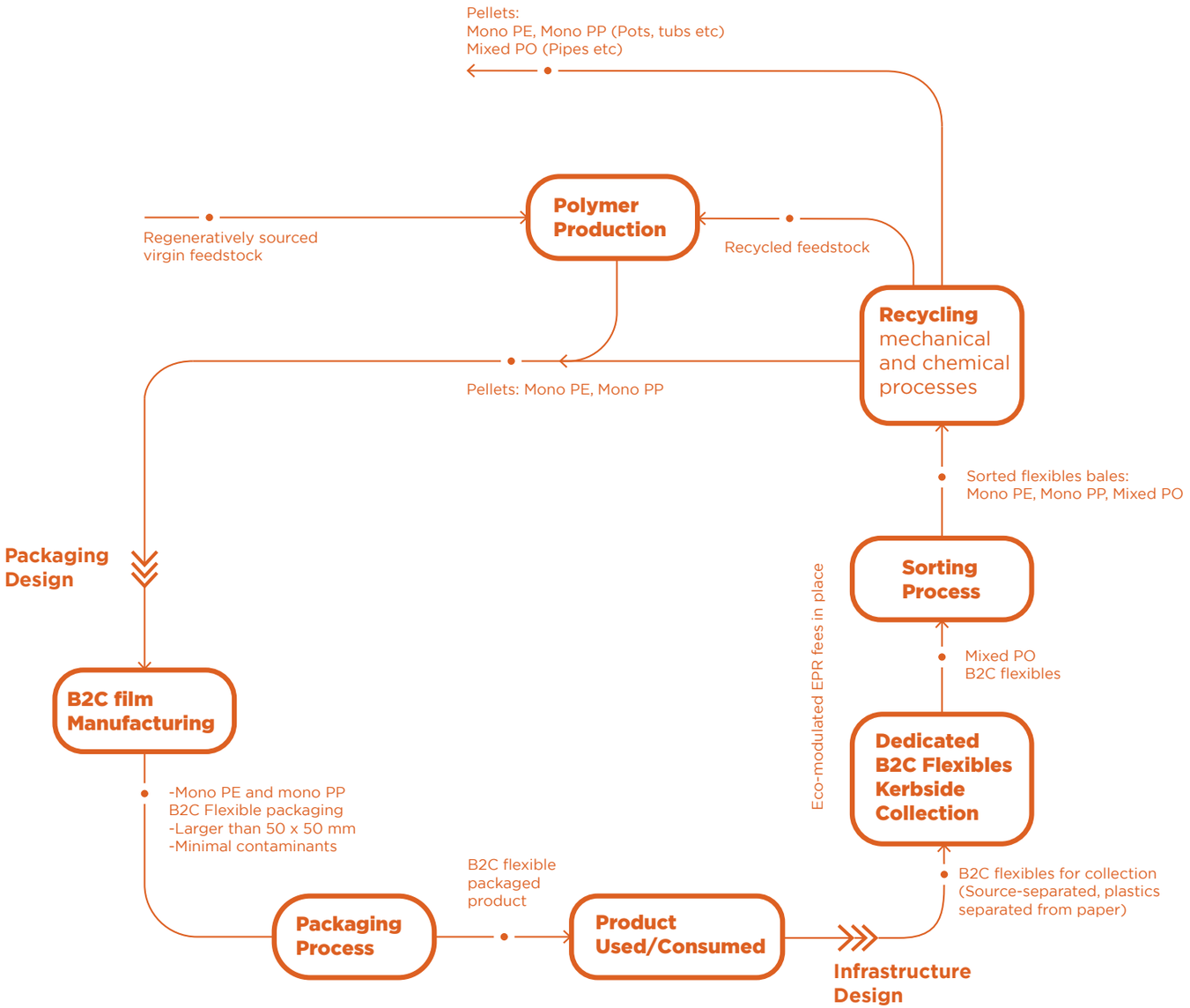


Figure 1. System interventions for B2C flexibles[1]

According to Breaking the Plastics Wave[1], one of the most analytically robust studies ever produce on ocean plastics, recycling will need to be one of the solutions deployed for plastic B2C flexibles as a compliment to elimination, innovation and substitution.

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

What does the system to work towards look like?



What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Recycling | End markets

1. *Single-use B2C Flexibles eliminated with a much higher ambition level than currently.*
   Reasoning: See executive summary.

2. *Plastic B2C Flexibles smaller than* **50 x 50mm**[1,2] *eliminated or substituted (i.e. removed entirely through innovation or shifted to materials with a higher likelihood of being collected and circulated)*
   Reasoning: Our perspective on this topic has been expanded upon previously.[2] Items smaller than 50 x 50mm are unable to be sorted into the target fraction in most sorting facilities.[2] Due to the small size and low value of these items, a successive layer of sorting technology to extract the plastics from the fines fraction is not economically viable and is unlikely to be so in the foreseeable future.[2] Also, the small size of these items means they are likely to leak out of the system into the natural environment.[2]

3. *Product and system changes implemented to reduce complexity of packaging required*
   Reasoning: For example, shortening supply chains could mean that the packaging requires lower barrier properties, hence improving recyclability.
   See the Upstream Innovation Guide p. 128.

Argument continued on next page

1. **RecyClass**, “PE Coloured Flexible Films - Design for Recycling Guidelines”, 2021;
2. **Ellen MacArthur Foundation**, “New Plastics Economy Catalysing Action”, 2017, p. 28;

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Recycling | End markets

4. *Remaining plastic B2C Flexibles designed to meet mechanical recycling requirements*
   Reasoning: It is likely that mechanical recycling will need to be the dominant recycling route (See page 82), and even for chemical recycling, redesign can increase yield.

   a) *Shifted to mono-material polyolefins (PE where possible, otherwise PP)*
   Reasoning: The materials for which there is the greatest chance of scaling high-quality recycling with viable end markets are mono-material polyolefins. **~40%**[1] of B2C Flexibles are mono-material PE, meaning PE has the highest likelihood of having a dedicated recycling stream. **~20%**[1] of B2C Flexibles are mono-material PP, meaning there is the possibility of a dedicated recycling stream.[2,3] Even for chemical recycling, redesign increases yields.[4]

   b) ***Has <10%, but ideally <5%, contaminant components by weight*** *(i.e. <5-10% dyes, glues, accepted coatings) with all contaminants being water soluble and limited to non-toxic versions that are compatible with a mechanical recycling system*[5, 6]
   Reasoning: A **>95%** target polymer content will improve the quality of the recyclate and therefore facilitate a wider range of end markets.[5]

   c) *Designed in accordance with local design for recycling guidelines*

1. **CEFLEX**, "Flexible Packaging in Europe", Website, Accessed 06/10/21, https://ceflex.eu/flexible-packaging-in-europe/;
2. **WRAP**, "Film Consistent Collections Sprint Group Report", March 2021, p. 10-11; 3. **CEFLEX**, "D4ACE Guidelines", 2020, p. 15;
4. **Ellen MacArthur Foundation**, "Lodestar: A case study for plastics recycling", 2018, p. 4; 5. **RecyClass**, **"**Recyclability Methodology", 2020, p. 19, Expert opinions;
6. **Eunomia / EU Commission**, "PPWD Impact Assessment Report - Recyclability", 2021, Section 22a

What does the system to work towards look like?

Packaging design | **Material sourcing** | Collection | Sorting | Recycling | End markets

1. *The use of plastic B2C flexibles is fully decoupled from the use of finite resources*
   Reasoning: See New Plastics Economy Vision Document.[1]

2. *Recycled content is maximised*
   Reasoning: For plastics, recycling 1 tonne could reduce emissions by 1.1–3.0 tonnes of CO_2e compared to producing the same tonne of plastics from virgin fossil feedstock.[2] Using recycled content also helps to stimulate the demand for collection and recycling.[3]

3. *Remaining virgin inputs are switched to renewable, regeneratively sourced feedstocks over time*[2]
   Reasoning: Some bio-based plastics have been shown to have a negative emissions potential compared to fossil based plastics. For example, bio-based polyethylene (PE) has been shown to have emissions of -2.2 kg CO_2e/kg polymer compared to 1.8 kg CO_2e/kg polymer for fossil-based PE.[2]

   a) *Agricultural residues or other byproducts are used as priority*
   b) *Where agricultural residues or other byproducts cannot be used, geographical context is taken into account when selecting crops.*

1. **Ellen MacArthur Foundation**, "A Vision of a Circular Economy for Plastic", 2018, p. 3;
2. **Ellen MacArthur Foundation**, "Completing the Picture How the Circular Economy Tackles Climate Change", 2019, p. 23-24;
3. **Ellen MacArthur Foundation (The New Plastics Economy)**, "Rethinking the Future of Plastics", 2016, p. 34, p. 60

What does the system to work towards look like?

Packaging design | Material sourcing | **Collection** | Sorting | Recycling | End markets

1. *There is dedicated collection for recycling for all packaging including plastic B2C flexibles (in both residential and public spaces)*
   Reasoning: Other mechanisms, such as front of store collection without deposits, are unlikely to achieve collection rates much above **10%**[1].

2. *B2C Flexibles are not commingled with the paper stream*
   Reasoning: Separation between paper and plastics ensures higher quality sorting and therefore higher quality recyclate.[2, 3]

3. *Backed by EPR fees that reflect the actual cost of keeping B2C Flexibles in circulation*
   Reasoning: Mandatory, fee-based EPR is the *only* proven and likely way to provide the dedicated, ongoing and sufficient funding required to make the economics of collection, sorting and recycling work.[4] Eco-modulation can incentivise development of the system (design of the packaging etc.) in the right direction.[4] An EPR fee for flexible plastic packaging is needed to cover the true net cost of recycling these formats — which at first estimate is around **EUR 1,100* per tonne**.[3, 5, 6]

4. *Standardisation of collection systems at a country or regional level*

1. **WRAP**, "Film Consistent Collections Sprint Group Report", March 2021, p. 18;
2. **Materials Recovery for the Future**, "Flexible Packaging Recycling in Material Recovery Facilities Pilot", 2020, p. 5-6;
3. **Expert Interviews**;
4. **Ellen MacArthur Foundation**, "EPR position paper", 2021;
5. **Fostplus**, "The Green Dot rates 2021-22", Website Accessed 05/10/21 https://www.fostplus.be/en/members/green-dot-rates;
6. **PRO Europe**, "Participation Costs Overview 2021", p. 5-70

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | **Sorting** | Recycling | End markets

1. *Sorting plants configured so that B2C Flexibles are correctly sorted into bales and don't end up in the waste fraction or other streams*

2. *Best in class sorting technology in place to produce clean PE and PP bales, as well as a PO mixed bale (this can either happen at the initial sorting centre, or mixed bales could be produced at smaller sorting centres, and then sent to larger flexibles sorting centres to be sorted into the target polymers).*
   Reasoning: The materials for which there is the greatest chance of scaling high-quality recycling with viable end markets are mono-material polyolefins. ~40%[1] of B2C Flexibles are mono-material PE, meaning PE has the highest likelihood of having a dedicated recycling stream. ~20%[1] of B2C Flexibles are mono-material PP, meaning there is the possibility of a dedicated recycling stream.[2,3]

3. *Sorting of mixed waste is in place to capture the fraction that is not source separated correctly*
   Reasoning: A significant volume of recyclables still end up in the mixed waste bin - to reach high recycling rates of B2C Flexibles, sorting of mixed waste will be required.[4]

1. **CEFLEX**, "Flexible Packaging in Europe", Website, Accessed 06/10/21, https://ceflex.eu/flexible-packaging-in-europe/;
2. **WRAP**, "Film Consistent Collections Sprint Group Report", March 2021, p. 10-11;
3. **CEFLEX**, "D4ACE Guidelines", 2020, p. 15;
4. **Expert Interview**

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | **Recycling** | End markets

1. *Waste is processed regionally (i.e. no waste export across regions)*[1, 2]
   Reasoning: International trade of waste has been highlighted as a significant contributor to ocean plastic leakage[3], and is likely to be increasingly regulated (e.g. On 1st January 2021 China banned the import of all solid waste. This came off the back of restrictions imposed in 2017 through 'Operation National Sword'. Amendments to the Basel Convention, which entered force in January 2021, can be considered a step towards reducing waste exports. These included the addition of mixed plastic waste to Annex II which requires the exporter to gain the consent of the recipient country before exporting. Sorted, single-polymer waste requires no consent.)[4,5]

Argument continued on next page

1. **WRAP**, "Film Consistent Collections Sprint Group Report", March 2021, p. 19;
2. **PEW**, "Joint Statement on Preventing Ocean Plastic Pollution", 2021, p. 2;
3. **Law, K. et al.**, "Science Advances", 2020, DOI: 10.1126/sciadv.abd0288;
4. **Yale Environment 360**, "Piling Up: How China's Ban on Importing Waste Has Stalled Global Recycling", 2019;
5. **UKP&I**, "China implements complete ban on import of solid waste from 1 January 2021", 2020;

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | **Recycling** | End markets

2. *Recycling facilities:*

   a) *Accept B2C Flexibles that adhere to 'what could good look like' design criteria (see page 76)*
   Reasoning: Currently, most flexible packaging recycling capacity is focused on recycling PE collected from industrial and B2B sources.[1, 2] The scope of materials processed in recycling facilities needs to expand to PE and PP B2C flexibles if B2C Flexibles are to be recycled.[3]

   b) *Optimise for quality AND yield*
   Reasoning: A balance needs to be found between seeking very high quality at the detriment to yield (chemical recycling), or very high yield at the detriment to quality (mechanical recycling).

   c) *Prioritise mechanical recycling where possible*
   Reasoning: In general, the more intact a material can stay whilst being circulated, the more desirable it is from a circular economy perspective — as more embedded energy and labour is preserved. It is also likely that mechanical recycling capacity can increase more rapidly than chemical recycling capacity (see next page).

1. **WRAP**, "Film Consistent Collections Sprint Group Report", March 2021, p. 19;
2. **Yale Environment 360**, "Piling Up: How China's Ban on Importing Waste Has Stalled Global Recycling", 2019;
3. **PRE and Eunomia**, "Flexible FIlms Market in Europe State of Play", 2020, p. 13-16

Due to chemical recycling's capacity and yield limitations, mechanical recycling will need to be the predominant recycling route by 2025

			Current	2025
GLOBAL[1]	**Operational Capacity**	Operational capacity for chemical processing** of polyolefins	260,000	1,500,000
		Capacity focused on plastic-to-plastic chemical recycling processes (%)	27%	15%
		Capacity for plastic-to-plastic chemical recycling processes (tpa)	67,000	**210,000**
	Yield	Potential recycled polymer output (tpa)[2]	20,000	63,000
EUROPE[1]	**Operational Capacity**	Operational capacity for chemical processing** of polyolefins	51,000	650,000
		Capacity focused on plastic-to-plastic chemical recycling processes (%)	100%	30%
		Capacity for plastic-to-plastic chemical recycling processes (tpa)	51,000	**180,000**
	Yield	Potential recycled polymer output (tpa)[2]	15,000	54,000

Under a best case scenario, chemical recycling capacity (for processes that are not targeted to produce fuels) is predicted to represent only **3%*** of the of B2C Flexibles placed on the market in Europe by 2025.[1]

* Assuming 6.3 mt are placed on the market in 2025.
** Includes chemical recycling + waste-to-fuel processes

1. Data sources: **EMF Secondary Research,** 2021; **Closed Loop Partners**, "Circular Supply Chains for Plastics Report", 2019; **Eunomia**, "Chemical Recycling: State of Play Report", 2020; **EPA,** "Assessment of Municipal Solid Waste Energy Recovery Technologies", 2020, p. 26-30; Recycling rate comparison calculated from data in: **PRE and Eunomia**, "Flexible FIlms Market in Europe State of Play", 2020, p. 13-16; Recycling rate comparison calculated from data in: **CEFLEX**, "Flexible Packaging in Europe"
2. Based on 30% efficiency for thermal cracking (Lodestar: https://www.newplasticseconomy.org/assets/doc/Lodestar.pdf)

Notes to previous page

For this analysis we have focused on the recycling of polyolefins (PO) only (e.g. it does not include chemical recycling of PET or PS) and limited 'chemical recycling' to thermal depolymerisation or thermal pyrolysis only.

Reasoning:

a) *Chemical-based monomer recycling is largely only relevant for PET which is not a material common in B2C flexibles.*

b) *Solvent-based recycling is considerably different from thermal depolymerisation and thermal pyrolysis from a technology perspective, and is still considerably limited in scale. Whilst it could potentially offer a plastic-to-plastic recycling route for B2C Flexibles that has better GHG emissions and yield profiles when compared to thermal depolymerisation and thermal pyrolysis technologies [1], it often requires carefully managed, very high purity input streams (of a clearly defined polymer composition) that are currently hard to achieve at scale for B2C Flexibles — consequently, such technologies appear to be a more immediate opportunity for B2B flexibles where input streams can be more clearly defined. Only one company is currently operating in this space at scale (APK - current operational capacity of 8000 tpa with planned additional capacity of 25,000 tpa by 2025).*

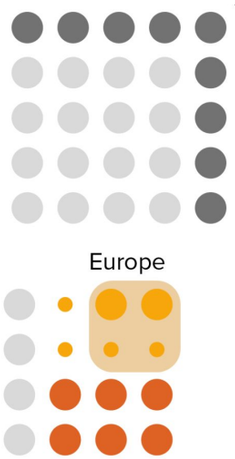
At a global level, the majority of chemical recycling operations focus on plastics-to-fuel, expected to make up **~85%[2]** of capacity by 2025, with a preference towards aviation fuel.

1. **Expert Interviews**
2. Data sources: **EMF Secondary Research,** 2021; **Closed Loop Partners**, "Circular Supply Chains for Plastics Report", 2019;
Eunomia, "Chemical Recycling: State of Play Report", 2020;
EPA, "Assessment of Municipal Solid Waste Energy Recovery Technologies", 2020, p. 26-30;
Recycling rate comparison calculated from data in: **PRE and Eunomia**, "Flexible FIlms Market in Europe State of Play", 2020, p. 13-16;
Recycling rate comparison calculated from data in: **CEFLEX**, "Flexible Packaging in Europe"

Due to chemical recycling's capacity and yield limitations, mechanical recycling will need to be the predominant recycling route by 2025

- Commercially active
- Commercially defunct
- P2P – Operational Commercial scale (>20,000 tpa)
- P2P – Operational Demonstration scale (<20,000 tpa)
- P2F – Operational

2021



Commercially active

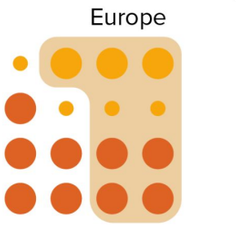
Since 2000, 25 companies have publicly announced their involvement in the chemical recycling of B2C flexible polyolefins (POs). These include both plastic-to-fuel (P2F) and plastic-to-plastic (P2P) operations.*

Of the 25, **16 can currently be described as commercially active****. The remaining 9 appear to be defunct (i.e. unverifiable, dormant, discontinued or bankrupt).

Plastic-to-plastic (P2P)

Of the 16 which can be described as commercially active, **only 6 focus on P2P rather than P2F operations, and only 2 of these currently operate on scales of ≥ 20,000 tpa*****.

By 2025



Plastic-to-plastic (P2P)

By 2025, based on published construction and permit announcements, it appears that this will grow to only 3 companies operating on scales of ≥ 20,000 tpa, all of which are planned to be located in Europe.

In North America, there are **no commercially operational or planned P2P PO recycling plants.** They are all targeting P2F (this excludes PS and PET chemical recyclers which were not included in this research).

* Thermal pyrolysis only
**As far as could be determined through secondary research.
***The 20,000 tpa distinction is based on almost all plants operating below 20,000 tpa capacity being self-described as demonstration plants.

Chemical Recycling Companies Profiled

A non-exhaustive list of 60 companies/collaborations profiled in the research exercise.[1,2,3,4] The majority are involved in PO chemical recycling, with the remainder being PET and PS focused. PET and PS focused stakeholders were excluded from the calculations.

Agilyx / Braksem	Carboliq	Gr3n (DEMETO technology)	PerPETual Global Technologies
Agilyx / Americas Styrenics (AmSty)	Climax Global Energy	GreenMantra Technologies	PolyStyreneLoop (CreaCycle technology)
Agilyx / INEOS Styrolution	CreaCycle	Ioniqa	Polystyvert
Agilyx / INEOS Styrolution / Trinseo	CuRe Technology	Itochu (RENU technology)	Proctor & Gamble (PureCycle Technology)
Agilyx / Mitsubishi Chemical	Eastman	Jeplan (BRING Technology)	Pryme
Alterra Energy	EcoFuel Technologies	Klean Industries	Pyrowave
Anhui Oursun Resource Technology	ECOPEK	Loop Industries	Quantafuel
APC - Agile Process Chemicals	Enerkem	Nan Ya Plastics (ECOGREEN)	Recycling Technologies (Plaxx)
APK (Newcycling)	Enval	NatureWorks	Reinstate Materials Group
Aquafil (ECONYL)	Equipolymers	Nexus Fuels	ReNew ELP / Mura / Dow (Cat-HTR technology)
BASF / Remondis / Quantafuel	Fulcrum Energy	Plastic Energy / Exxon Mobil	Renewology
Borealis / Renasci	Garbo (ChemPET Technology)	Plastic Energy / INEOS	RES Polyflow
Borealis / Stena Recycling	GEEP	Plastic Energy / Sabic	Sierra Energy
Braven Environmental / Chevron Phillips	Geo-tech polymers	Plastic Energy / Total	Unilever / Fraunhofer (CreaSolv technology)
Brightmark Energy	Golden Renewable Energy LLC	Plastic Energy / Viridor	Vadxx

1. **EMF Secondary research**, 2021;
2. **Closed Loop Partners**, "Circular Supply Chains for Plastics Report", 2019;
3. **Eunomia**, "Chemical Recycling: State of Play Report", 2020;
4. **EPA,** "Assessment of Municipal Solid Waste Energy Recovery Technologies", 2020, p. 26-30

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Recycling | **End markets**

1. *Recyclates go into items that can themselves be recycled (e.g. no composite products)*
   Reasoning: Composite products can be seen as a short extension to the linear economy, rather than moving us towards a circular economy. Higher value end-markets is one of the reasons for the criteria listed under ‘what could good look like for design’ on page 76.

2. *The highest possible applications for a given recyclate quality are prioritised (e.g. ideally, non-food flexible and rigid packaging are the applications prioritised for mechanically recycled B2C Flexibles)*
   Reasoning: Currently most plastic B2B flexible packaging goes towards lower-quality, higher weight, refuse bags or agricultural films. The goal is for all recycled content to be used in high-quality applications.

Deepdive Focus on Europe

EU27+4 - including Iceland, Norway, Switzerland and United Kingdom

Even in Europe, one of the most advanced regions in terms of recycling systems, getting to a mere 30% recycling rate for plastic B2C flexibles by 2025 requires massive efforts across design, policy, and infrastructure to all start by the end of 2022.

A few crucial signals absolutely need to be in place ASAP...

- A commitment from governments that **plastic B2C flexibles will be collected for recycling in the first place.**
- A commitment from EPR organisations to put in place an appropriate **EPR fee for flexible plastic packaging to cover the true net cost of recycling these formats — which at first estimate is around EUR 1,100 per tonne. (See page 90)**
- A separate **recycling rate target for flexible plastic packaging** within the 2030 recycling rate targets, to help drive the two above.

... so that stakeholders can confidently invest the required capex of at least EUR 2 bln* in (See page 95)

- **3x** increase in collected-for-recycling volumes of B2C flexibles by 2025 (from 0.8 mtpa currently to 2.5 mtpa by 2025).
- **3x** increase in sorting capacity by 2025 (from 0.7 mtpa currently to 2.1 mtpa by 2025).
- **4x** increase in recycling capacity by 2025 (from 0.5 mtpa currently to 1.9 mtpa by 2025).

In parallel, businesses need to further accelerate packaging design changes, including shifting the **>40%** of plastic B2C flexibles that are multi-material to mono-materials, reducing non-polymer content (e.g. coatings, inks, glues) to <10% but ideally <5% across all flexibles to enable new end-markets, and adhering to local design for recycling guidelines. Items smaller than 50x50mm need to be eliminated or need fundamental redesign altogether. (See page 93)

ALL of this needs to have started by the end of 2022, and happen in parallel, in order to see significant progress towards 2025 targets (given each action has a 3-to-5-year lead time (for example to plan, permit, and build infrastructure)).

*This number is highly conservative and is based purely on mechanical recycling and achieving a mere 30% recycling rate by 2025. It would likely be far higher if chemical recycling technologies are included and further investment will of course be required to move beyond a 30% recycling rate.

See the following page for references

What is needed to achieve this - Details for Europe

Packaging design | Material sourcing | **Collection** | Sorting | Recycling | End markets

1. *EPR fee for flexible plastic packaging to cover the true net cost of recycling these formats — which at first estimate is around EUR **1100/tonne**[1, 2].*

Reasoning:

- A mandatory, fee-based EPR is the *only* proven and likely way to provide the dedicated, ongoing and sufficient funding required to make the economics of collection, sorting and recycling work.[3]
- The indicative EUR 1100 per tonne fee for mono-material, technically recyclable flexibles is based on the 2022 Fostplus Belgian fee for PE films of EUR 1159 per tonne — the Belgian system being one of the few EPR schemes specifically attempting to drive the recycling of flexibles.[1]
- While the net cost of high-quality recycling of flexibles differs from country to country based on a variety of local factors, it gives a rough indication of the net cost in a European context.
- Given the current average EPR fee in Europe for plastics packaging is ~EUR 350 per tonne[1,2], with few countries having differentiated fees for flexibles, it is clear a significant increase in EPR fees for plastic flexibles will be required in almost all European countries to make the economics of collection, sorting and recycling of flexibles work.
- Multi-material flexibles drive up the cost of the overall process meaning that if they are still on the market, even higher EPR fees would be required to make the economics of the system work (e.g. EUR 1448 per tonne for other plastic films in Belgium in 2022)[1].
- Any fee should be transparent on how the fee is calculated and how it helps to achieve the recycling rate target and the money raised through it should be used to collect, sort and recycle flexible packaging.[3]
- Eco-modulation can incentivise development of the system - for example to improve design of the packaging and towards upstream solutions.[3]

Argument continued on next page

1. **Fostplus**, “The Green Dot rates 2021-22”, Website Accessed 05/10/21 https://www.fostplus.be/en/members/green-dot-rates;
2. **PRO Europe**, “Participation Costs Overview”, 2021, p. 5-70;
3. **Ellen MacArthur Foundation**, “EPR position paper”, 2021;

What is needed to achieve this - Details for Europe

Packaging design | Material sourcing | **Collection** | Sorting | Recycling | End markets

2. *Household flexibles collection needs to be implemented across all countries in Europe, rising from **0.8 mtpa**[1, 2] collected today, to **2.5 mtpa**[1, 2, 3] collected by 2025.*

Reasoning:

- Other mechanisms, such as front of store collection without deposits, are unlikely to achieve collection rates much above **10%**[4].
- Due to process losses of ~10%, B2C Flexibles collection rates would have to reach **40%** at a minimum (the total volume of flexibles put on the market in Europe is taken as **6.3 mtpa**[1, 2]) across the key countries in Europe in order to achieve a 30% recycling rate by 2025.[3]
- Given that it can easily take **2-3**[4] years to test and implement a collection system, and then achieve collection rates **>40%**, all countries that have plans but have not implemented yet (or only have partial, but not full coverage of collection systems) need to move rapidly for rollout of collection by 2023.

Argument continued on next page

1. Calculated from data in: **PRE and Eunomia**, "Flexible Films Market in Europe State of Play", 2020, p. 13-16;
2. Calculated from data received from **CEFLEX** 10/06/21
3. Calculated from the Global Commitment definition of recycling 'in practice and at scale' as a 30% post-consumer recycling rate in multiple regions, collectively covering at least 400 million inhabitants. **Ellen MacArthur Foundation**, Global Commitment Definitions, 2020, p. 13;
4. **WRAP**, "Film Consistent Collections Sprint Group Report", March 2021, p. 14, 18

What is needed to achieve this - Details for Europe

Packaging design | Material sourcing | **Collection** | Sorting | Recycling | End markets

3. *The **fifteen**[1] countries that already have some form of collection in place need to ensure separation between paper and plastics in collection, and massively boost collection rates (Average collection rate is currently only **13%**[2,3]). The **six**[1] countries that only have plans in place, and **three**[1] countries with collection only in some regions need to see countrywide collection starting by the end of 2023.*

Reasoning:

- Today, 15 countries (~60% of EU27+4), collectively representing ~320 million people have separate collection for flexible packaging.[1] Of the remaining 16 countries (~40% of EU27+4), 6 only have plans in place, 3 only include flexibles in collection in some regions, and 7 have no data.[1]
- Separation between paper and plastics ensures higher quality sorting and therefore higher quality recyclate.
- *Approximately 60% of the population of the EU27+4* live in countries where film **IS** included in the predominant form of household separate recycling collections[1]*

1. **PRE and Eunomia**, "Flexible Films Market in Europe State of Play", 2020, p. 14;
2. Calculated from data in: **PRE and Eunomia**, "Flexible Films Market in Europe State of Play", 2020, p. 13-16;
3. Calculated from data received from **CEFLEX** 10/06/21

What is needed to achieve this - Details for Europe

Packaging design | Material sourcing | Collection | **Sorting** | Recycling | End markets

1. *European-wide sorting capacity for separately collected B2C Flexibles needs to increase by **1.4 million tonnes**[1, 2] **from 0.7 million tonnes**[1, 2] **today** and be configured to produce PE, PP and mixed PO bales.*

   Reasoning: The total volume of flexibles put on the market in Europe is taken as **6.3 mtpa**.[1, 2] To have a 30% recycling rate[3], a 33% sorting rate needs to be reached if assuming a 10% loss in the process[4]. The materials for which there is the greatest chance of scaling high-quality recycling with viable end markets are mono-material polyolefins. **~40%**[2] of B2C Flexibles are mono-material PE, meaning PE has the highest likelihood of having a dedicated recycling stream. **~20%**[2] of B2C Flexibles are mono-material PP, meaning there is the possibility of a dedicated recycling stream.[5, 6]

1. Calculated from data in: **PRE and Eunomia**, "Flexible Films Market in Europe State of Play", 2020, p. 13-16;
2. Calculated from data received from **CEFLEX** 10/06/21
3. Calculated from the Global Commitment definition of recycling 'in practice and at scale' as a 30% post-consumer recycling rate in multiple regions, collectively covering at least 400 million inhabitants. **Ellen MacArthur Foundation**, Global Commitment Definitions, 2020, p. 13;
4. **PRE and Deloitte**, "Blueprint for Plastics and Packaging Waste", 2017, p. 18;
5. **WRAP**, "Film Consistent Collections Sprint Group Report", March 2021, p. 10-11;
6. **CEFLEX**, "D4ACE Guidelines", 2020, p. 15

What is needed to achieve this - Details for Europe

Packaging design | Material sourcing | Collection | Sorting | **Recycling** | End markets

1. *Recycling capacity for B2C Flexibles in Europe needs to increase by at least **1.4 mtpa**[1, 2] from a current capacity of **~0.5 mtpa**.*[1, 2]

   Reasoning: The current recycling rate for B2C flexibles is estimated to be 0.5mtpa. Most of this capacity is involved in processing larger format B2C Flexible PE films which are typically of higher quality and lower contamination than smaller format B2C Flexibles. End markets are still predominantly garbage bags and rigid applications.[1] The total volume of flexibles put on the market in Europe is taken as **6.3 mtpa**[1, 2], of which 30% needs to be recycled to achieve 'recyclable in practice and at scale' as per the Global Commitment guidance.[3]

2. *Capacity will need to expand to PP flexibles rather than just PE flexibles.*

   Reasoning: As mentioned in previous sections, **~20%**[2] of B2C Flexibles are mono-material PP, meaning there is the possibility of a dedicated recycling stream.[4, 5]

Argument continued on next page

1. Calculated from data in: **PRE and Eunomia**, "Flexible Films Market in Europe State of Play", 2020, p. 13-16, p. 19;
2. Calculated from data received from **CEFLEX** 10/06/21
3. Global Commitment definition of recycling 'in practice and at scale' is a 30% post-consumer recycling rate in multiple regions, collectively covering at least 400 million inhabitants. **Ellen MacArthur Foundation**, Global Commitment Definitions, 2020, p. 13;
4. **WRAP**, "Film Consistent Collections Sprint Group Report", March 2021, p. 10-11;
5. **CEFLEX**, "D4ACE Guidelines", 2020, p. 15;

What is needed to achieve this - Details for Europe

Packaging design | Material sourcing | Collection | Sorting | **Recycling** | End markets

3. *This will require a CAPEX investment of **1.6 billion EUR**.*[1, 2, 3]

   Reasoning: Owing to the challenges of mechanically recycling plastic B2C flexible packaging, new plants and systems will be required to produce high quality recyclate. This cost is likely to be met independently from EPR fees, which currently focus predominantly on OPEX, though this is subject to variations on a context-by-context basis.

   *This number is conservative and is based purely on mechanical recycling. It would likely be far higher if chemical recycling technologies are included.[3, 4]

4. *Roll-out will need to occur at the same pace as has been seen previously for B2B flexible packaging (a **1 million tonnes** increase in annual recycling capacity was achieved over a four year period).*[7]

   Reasoning: The system for collection, sorting and recycling of plastic B2B flexible packaging has been prioritised, growing from a capacity of 1.5 mtpa in 2014 to 2.5 mtpa in 2018[5] (rising further to 2.7 mtpa in 2021)[6].

1. Calculated from data in: **PRE and Eunomia**, "Flexible Films Market in Europe State of Play", 2020, p. 13-16, p. 19;
2. Calculated from data received from **CEFLEX** 10/06/21
3. **CEFLEX**, "High-level Roadmap for Returning Flexible Packaging to the Circular Economy - (Workstream 4, Value Chain Group 4)", p. 8;
4. **Eastman,** "Eastman to invest up to $1 billion to accelerate circular economy through building world's largest molecular plastics recycling facility in France", Accessed 17/01/2022, https://www.eastman.com/Company/News_Center/2022/Pages/Eastman-to-invest-to-accelerate-circular-economy.aspx
5. **PRE and Eunomia**, "Flexible Films Market in Europe State of Play", 2020, p. 17;
6. **PRE**, "Flexible film recycling capacity grows by almost 10% in a year despite COVID pandemic", 2021, Accessed 06/10/21, https://www.plasticsrecyclers.eu/post/flexible-film-recycling-capacity-grows-by-almost-10-in-a-year-despite-covid-pandemic

ELLEN MACARTHUR FOUNDATION

FLEXIBLE PACKAGING:

PLASTIC FLEXIBLES:

Design and recycling in the informal sector

Supplementary Information

Why is this option on the table?

What does the system to work towards look like?

- Packaging design
- Material sourcing
- Collection
- Sorting
- Recycling
- End markets

Why is this option on the table?

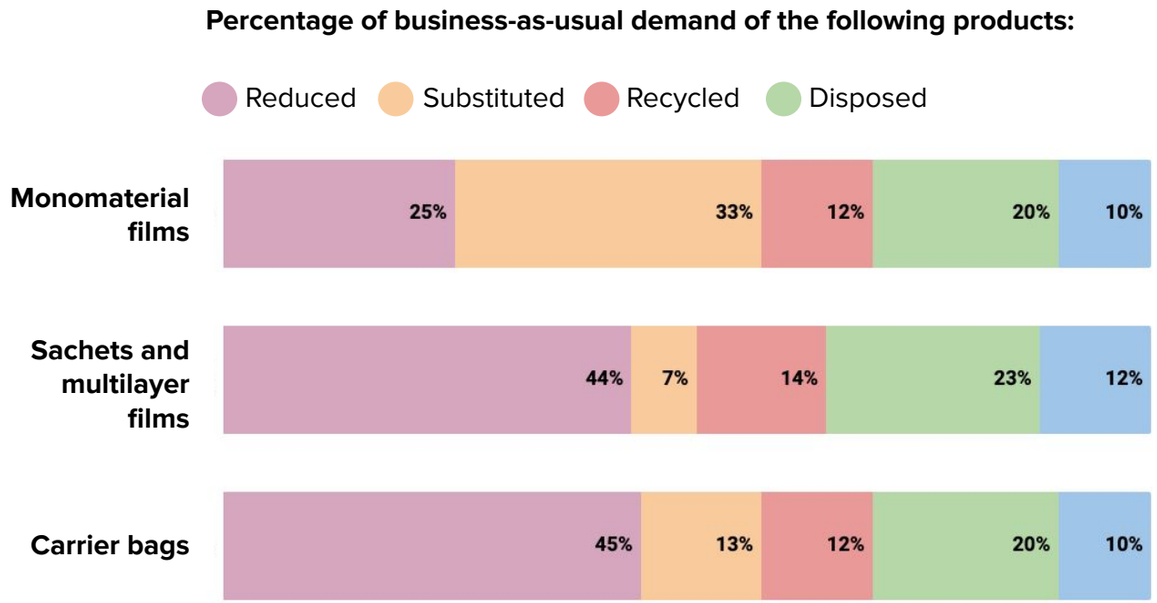


Figure 1. System interventions for B2C flexibles[1]

According to Breaking the Plastics Wave[1], one of the most analytically robust studies ever produced on ocean plastics, recycling will need to be one of the solutions deployed for plastic B2C flexibles as a compliment to elimination, innovation and substitution.

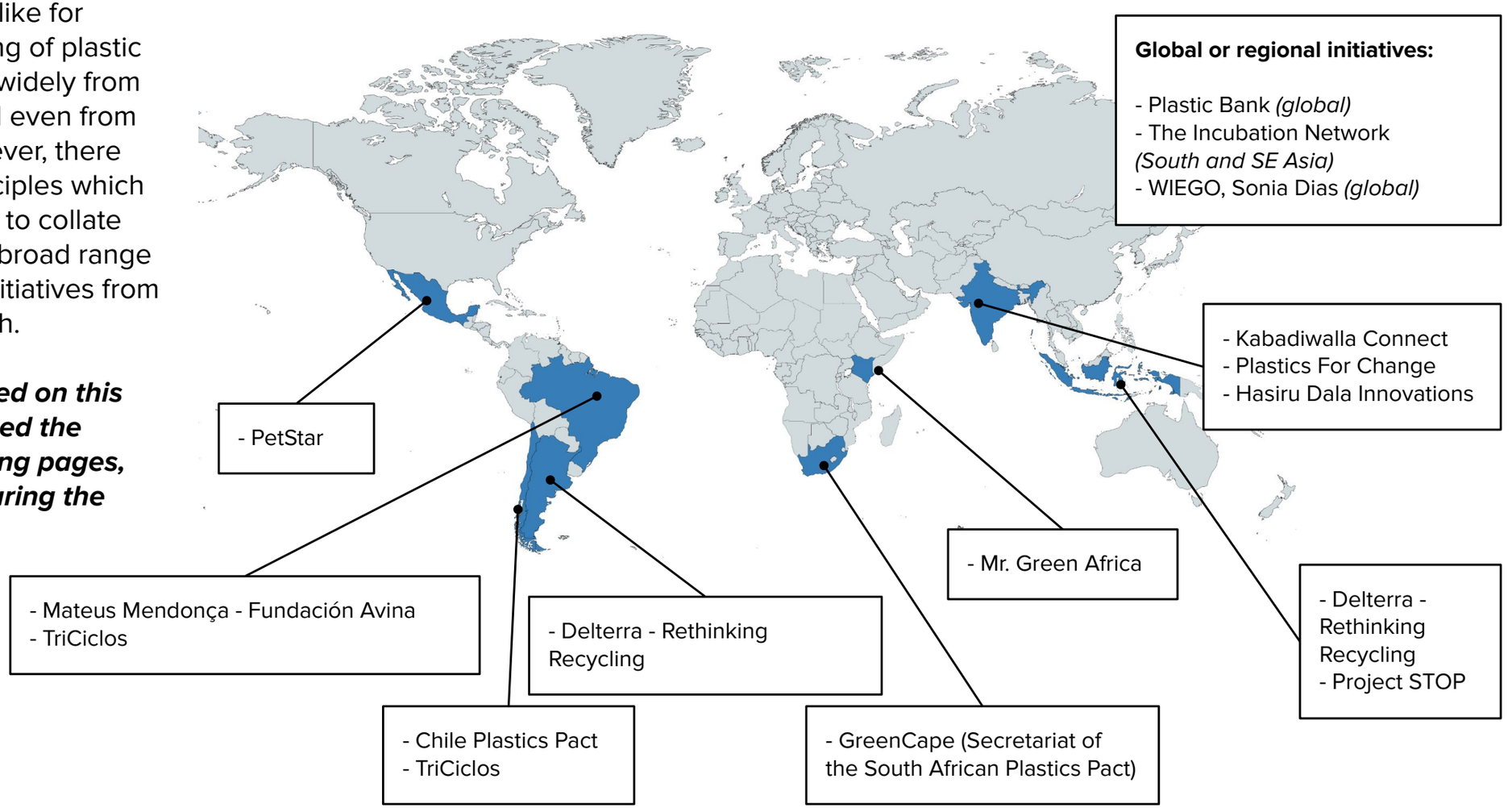
Informal sector recycling of B2C flexibles is considered as part of this. There was strong alignment amongst the consulted panel of experts, that whilst formalisation of waste management systems across all geographies is the ultimate 'end-state goal', the journey to formalisation needs to be a socially inclusive process that recognises the significant role the informal sector currently plays

1. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", p. 46, 2020.

What does the system to work towards look like?

What could good look like for informal sector recycling of plastic B2C flexibles will vary widely from country to country, and even from region to region. However, there are some general principles which we we have been able to collate through speaking to a broad range of organisations and initiatives from across the Global South.

The organisations listed on this page have not endorsed the content on the following pages, but were consulted during the research process.



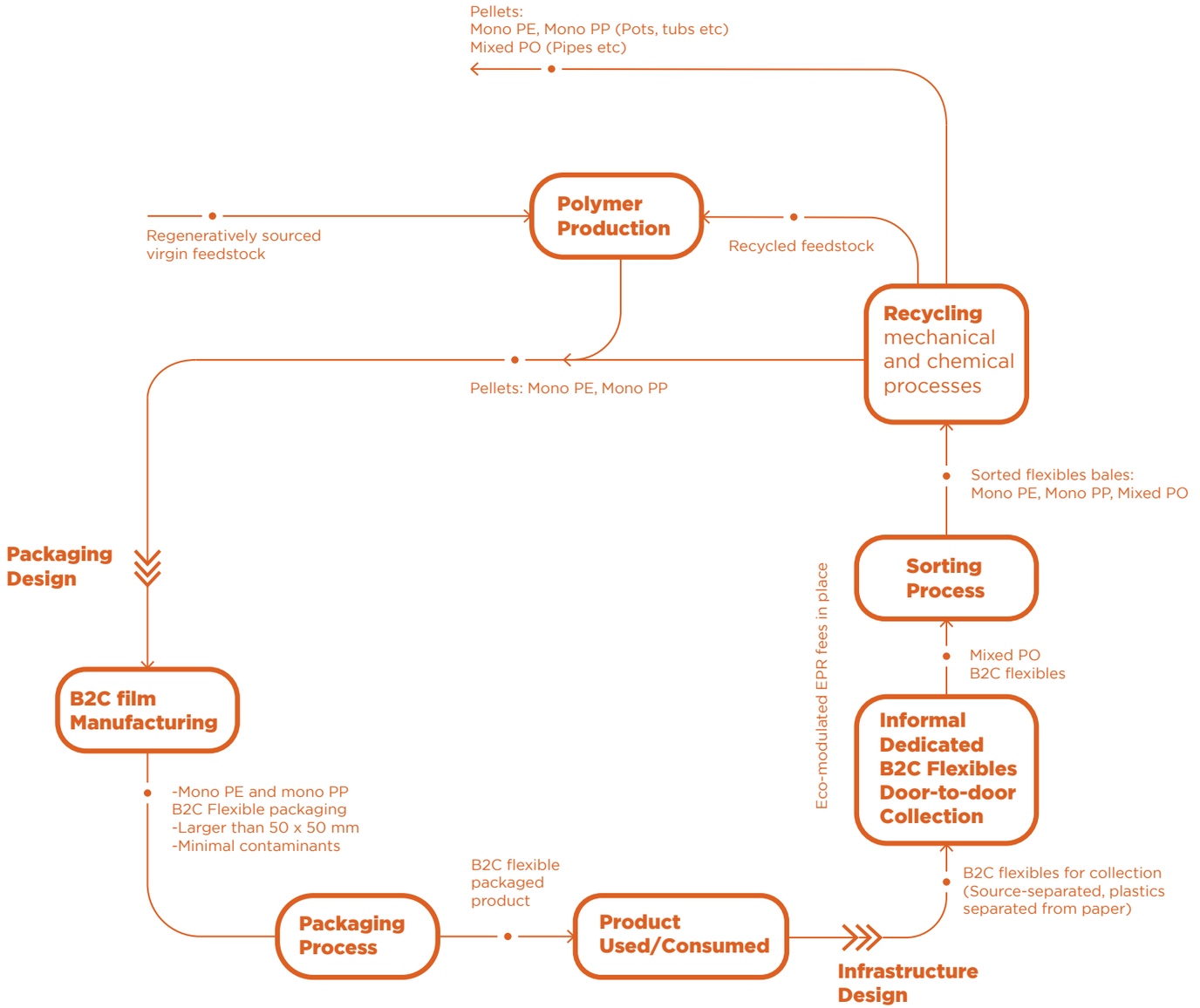
What does the system to work towards look like?

Based on our conversations, it is clear that a good system for B2C flexibles recycling in geographies serviced by an informal sector needs to meet two criteria:

1. B2C flexibles get collected and recycled

2. The system is socially just for the current informal workforce

This can only be achieved through an inclusive recycling system.



See full details, reasoning and references on the following pages

What does the system to work towards look like?

To see B2C Flexibles recycled at scale in geographies serviced by the informal sector an inclusive recycling system needs to be established

Incentivising the current informal system

CHARACTERISED BY:

- **Infrastructure:** Little to no official/public waste management infrastructure in place and highly manual labour.
- **Workers rights and conditions:** Majority of informal workers not affiliated with a cooperative (or similar organisation), and are not recognised for the service they provide, with earnings mainly determined by the type of material and weight collected.
- **Materials:** Limited range of materials are collected (only those with strong and stable end markets).
- **Funding:** Voluntary funding and value of recyclable materials drive collection.

NOT DESIRABLE BECAUSE:

- The informal collector workforce would need to double to collect all B2C flexibles.
- Labour and social conditions would remain poor.
- The price paid per tonne to incentivise collection of B2C flexibles, would have to be 8 times the current price. Price increases would not necessarily translate into better earnings for the informal collectors themselves.

Inclusive recycling system

CHARACTERISED BY:

- **Infrastructure:** Combination of manual labour and mechanical infrastructure with the proportions of each changing over time.
- **Workers rights and conditions:** Informal workforce is recognised and included in waste management in a socially just manner.
- **Materials:** Broad range of materials are collected.
- **Funding:** Dedicated, ongoing, and sufficient funding provided through EPR.

DESIRABLE BECAUSE:

- Facilitates collection of a broad range of materials in a socially just manner
- Enables a gradual introduction of more formalised structures (i.e. infrastructure) in a way that includes, rather than displaces, the informal sector and its workforce's substantial knowledge base, skills, and networks.

Directly implementing a formal mechanical system in isolation from existing structures

CHARACTERISED BY:

- **Infrastructure:** Large-scale mechanical and standardised collection infrastructure (publicly-owned and includes potential outsourcing to private companies).
- **Workers rights and conditions:** Contractually defined work and wages for waste management employees.
- **Materials:** Broad range of materials are collected
- **Funding:** Dedicated, ongoing, and sufficient funding provided through EPR.

NOT DESIRABLE BECAUSE:

- Displaces rather than integrates the substantial knowledge, skills, and networks of the existing informal workforce.
- The informal sector would likely continue to exist, extracting high-value materials from the waste stream.
- City waste management systems that are inclusive of the informal sector are likely to have lower costs.
- Existing examples have been unsuccessful and/or more costly.

*In this document the term 'informal collector' is used to refer to persons who work outside the formal waste management sector collecting waste materials and selling recyclables. We're aware that other terms, such as 'waste picker' or 'reclaimer' are also used, depending on the geography.

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Recycling | End markets

1. *Single-use B2C Flexibles eliminated with a much higher ambition level than currently.*
   Reasoning: See executive summary.

2. *Plastic B2C Flexibles smaller than* **50 x 50mm**[1,2] *eliminated or substituted (i.e. removed entirely through innovation or shifted to materials with a higher likelihood of being collected and circulated)*
   Reasoning: Our perspective on this topic has been published previously.[2] Items smaller than 50 x 50mm are unable to be sorted into the target fraction in most sorting facilities.[2] Due to the small size and low value of these items, a successive layer of sorting technology to extract the plastics from the fines fraction is not economically viable and is unlikely to be so in the foreseeable future.[2] Also, the small size of these items means they are likely to leak out of the system into the natural environment.[2]

3. *Product and system changes implemented to reduce complexity of packaging required*
   Reasoning: For example, shortening supply chains could mean that the packaging requires lower barrier properties, hence improving recyclability.
   See the Upstream Innovation Guide p. 128.

Argument continued on next page

1. **RecyClass**, “PE Coloured Flexible Films - Design for Recycling Guidelines”, 2021;
2. **Ellen MacArthur Foundation**, “New Plastics Economy Catalysing Action”, 2017, p. 28;

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Recycling | End markets

4. *Remaining plastic B2C Flexibles designed to meet mechanical recycling requirements*
   Reasoning: It is likely that mechanical recycling will need to be the dominant recycling route (See page 82), and even for chemical recycling, redesign can increase yield.

   a) *Shifted to mono-material polyolefins (PE where possible, otherwise PP)*
   Reasoning: The materials for which there is the greatest chance of scaling high-quality recycling with viable end markets are mono-material polyolefins. **~40%**[1] of B2C Flexibles are mono-material PE, meaning PE has the highest likelihood of having a dedicated recycling stream. **~20%**[1] of B2C Flexibles are mono-material PP, meaning there is the possibility of a dedicated recycling stream.[2,3] Even for chemical recycling, redesign increases yields.[4]

   b) ***Has <10%, but ideally <5%, contaminant components by weight*** *(i.e. <5-10% dyes, glues, accepted coatings) with all contaminants being water soluble and limited to non-toxic versions that are compatible with a mechanical recycling system*[5, 6]
   Reasoning: A **>95%** target polymer content will improve the quality of the recyclate and therefore facilitate a wider range of end markets.[5]

   c) *Designed in accordance with local design for recycling guidelines*

1. **CEFLEX**, "Flexible Packaging in Europe", Website, Accessed 06/10/21, https://ceflex.eu/flexible-packaging-in-europe/;
2. **WRAP**, "Film Consistent Collections Sprint Group Report", March 2021, p. 10-11; 3. **CEFLEX**, "D4ACE Guidelines", 2020, p. 15;
4. **Ellen MacArthur Foundation**, "Lodestar: A case study for plastics recycling", 2018, p. 4; 5. **RecyClass**, **"**Recyclability Methodology", 2020, p. 19, Expert opinions;
6. **Eunomia / EU Commission**, "PPWD Impact Assessment Report - Recyclability", 2021, Section 22a

What does the system to work towards look like?

Packaging design | **Material sourcing** | Collection | Sorting | Recycling | End markets

1. *The use of plastic B2C flexibles is fully decoupled from the use of finite resources*
   Reasoning: See New Plastics Economy Vision Document.[1]

2. *Recycled content is maximised*
   Reasoning: For plastics, recycling 1 tonne could reduce emissions by 1.1–3.0 tonnes of CO_2e compared to producing the same tonne of plastics from virgin fossil feedstock.[2] Using recycled content also helps to stimulate the demand for collection and recycling.[3]

3. *Remaining virgin inputs are switched to renewable, regeneratively sourced feedstocks over time*[2]
   Reasoning: Some bio-based plastics have been shown to have a negative emissions potential compared to fossil based plastics. For example, bio-based polyethylene (PE) has been shown to have emissions of -2.2 kg CO_2e/kg polymer compared to 1.8 kg CO_2e/kg polymer for fossil-based PE.[2]

   a) *Agricultural residues or other byproducts are used as priority*
   b) *Where agricultural residues or other byproducts cannot be used, geographical context is taken into account when selecting crops.*

1. **Ellen MacArthur Foundation**, "A Vision of a Circular Economy for Plastic", 2018, p. 3;
2. **Ellen MacArthur Foundation**, "Completing the Picture How the Circular Economy Tackles Climate Change", 2019, p. 23-24;
3. **Ellen MacArthur Foundation (The New Plastics Economy)**, "Rethinking the Future of Plastics", 2016, p. 34, p. 60

What does the system to work towards look like?

Packaging design | Material sourcing | **Collection** | **Sorting** | Recycling | End markets

What could good look like for collection and sorting:

- *A vast majority of the people within the informal sector work as informal collectors[1] within the collection and sorting elements of the recycling system. It is therefore particularly relevant to distinguish the characteristics of these parts of the system at both an operational and a social level, to ensure that an inclusive recycling system is actually an inclusive recycling system (i.e. that B2C Flexibles get collected and the system is socially just for the current informal workforce).*

- *Key operational and social characteristics of an inclusive collection with regards to collection and sorting are outlined on the following two pages.*

- *To note: across both the operational and social level it is necessary to have participatory processes and structures in place, that legitimately include the informal sector's voice, to form the backbone of decision-making, planning, and implementation.[2, 3]*
  Reasoning: Including the informal sector's needs, interests, and knowledge through legitimate participation can help to ensure that inclusive recycling efforts are better set up for success.[2, 4]

1. **International Labour Office**, "Sustainable development, decent work and green jobs", 2013, p. Xiv;
2. **Department of Environment Forestry & Fisheries and Department of Science & Innovation**, "Waste picker integration guideline for South Africa: Building the Recycling Economy and Improving Livelihoods through Integration of the Informal Sector", 2020, p. 4;
3. **Expert opinion**;
4. **Dias, Sonia (WIEGO)**, "The Municipal Waste and Citizenship Forum: A Platform for Social Inclusion and Participation", 2011, p. 2

What does the system to work towards look like?

Packaging design | Material sourcing | **Collection** | **Sorting** | Recycling | End markets

What could good look like for collection and sorting — OPERATIONAL (1/2):

1. ***Source separation and door-to-door collection*** *is established to increase the likelihood of getting B2C flexibles collected.*
   Reasoning: Source separation of dry and wet waste creates cleaner waste streams, reducing waste to landfill, and along with door-to-door collection can help ensure that a broader range of waste materials get collected.[1,2]

2. ***Access to facilities and equipment*** *is improved for informal sector organisations (e.g. through cooperatives)*
   Reasoning: When informal organisations (i.e. cooperatives) have appropriate access to sorting facilities and better equipment (e.g. for baling and sorting waste) they are able to work more effectively and increase the capacity of waste that can be managed.[3, 4]

1. **Expert opinions**;
2. **Department of Environment Forestry & Fisheries and Department of Science & Innovation**, "Waste picker integration guideline for South Africa: Building the Recycling Economy and Improving Livelihoods through Integration of the Informal Sector", 2020, p. 38;
3. **WIEGO**, "Just Recycling: How Waste Pickers Benefit Cities", Website, Accessed 22/07/2021, https://www.wiego.org/justrecycling;
4. **GA Circular**, "Toward Circularity of Post-Consumer Flexible Packaging in Asia", 2017, p. 67

What does the system to work towards look like?

Packaging design | Material sourcing | **Collection** | **Sorting** | Recycling | End markets

What could good look like for collection and sorting — OPERATIONAL (2/2):

3. ***Dedicated, ongoing, and sufficient funding*** *is provided through EPR to support collection and sorting services. EPR fees reflect the full cost of keeping plastic B2C Flexibles in circulation, and the EPR schemes are designed to be inclusive of the informal sector.*
   Reasoning: Mandatory, fee-based EPR is the only proven and likely way to provide the dedicated, ongoing and sufficient funding required to make the economics of collection, sorting and recycling work.[1, 2] The design of the EPR scheme must be inclusive of the informal sector - different examples of such efforts exists in Brazil[3], Chile[4], and South Africa[5].

4. ***Standardisation*** *of collection systems at a country or regional level.*
   Reasoning: Some degree of standardisation in collection system is necessary to ensure scalability at regional or country level.

1. **Ellen MacArthur Foundation**, "Extended Producer Responsibility: a necessary part of the solution to packaging waste and pollution", 2021;
2. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", 2020, p. 71;
3. **Dias, Sonia**, "Brazil's Extended Producer Responsibility and its Interface with Waste Pickers", 2021;
4. **PREVENT Waste Alliance**, "EPR Toolbox: Chile, Developing a legal framework for EPR in Chile", 2020;
5. **Department of Environment Forestry & Fisheries and Department of Science & Innovation**, "Waste picker integration guideline for South Africa: Building the Recycling Economy and Improving Livelihoods through Integration of the Informal Sector", 2020, p. 38;

What does the system to work towards look like?

Packaging design | Material sourcing | **Collection** | **Sorting** | Recycling | End markets

What could good look like for collection and sorting — SOCIAL (1/3):

1. ***Support for informal collectors to organise with peers*** *through informal worker associations, cooperatives or similar membership-based organisations.*
   Reasoning: When informal collectors organise in cooperatives or similar membership-based organisations they are better able to advocate for and gain access to economic and social rights[1], gain access to improved finance[2], and are better able to engage with local government/municipalities (and other WM stakeholders) to negotiate and to gain recognition and opportunities as service-providers.[3, 4] Support for organisation amongst the informal sector can entail providing informal collectors with the necessary tools and training to understand how to organise and engage with other WM actors[5], as well as financial support.

2. ***Legal recognition*** *of waste picking as a legitimate profession/occupation.*
   Reasoning: This is one element of providing informal collectors recognition for the work that they carry out[3], as well as facilitates certain rights to informal collectors, such as the rights to access, collect, and sell waste.[6]

1. **WIEGO**, “Waste Pickers: the right to be recognised as workers”, 2013, p. 4;
2. **Ocean Conservancy**, “Financing Waste Management and Recycling Infrastructure to Prevent Ocean Plastic Pollution”, 2021, p. 18;
3. **Department of Environment Forestry & Fisheries, Department of Science & Innovation**, “Waste picker integration guideline for South Africa: Building the Recycling Economy and Improving Livelihoods through Integration of the Informal Sector”, 2020, p. 55;
4. **International Labour Office**, “Cooperatives and the world of work no 12: Waste pickers’ cooperatives and social and solidarity economy organizations”, 2019, p. 4;
5. **Expert opinion**;
6. **Vital Ocean/SYSTEMIQ, TriCiclos, and Hasiru Dala**, “Leave No Trace”, 2020, p. 13, 58

What does the system to work towards look like?

Packaging design | Material sourcing | **Collection** | **Sorting** | Recycling | End markets

What could good look like for collection and sorting — SOCIAL (2/3):

3. ***Access to participate*** *in the waste management system e.g. by ensuring that permit/administrative requirements are not overly burdensome[1], that informal collector cooperatives have the right to bid for/obtain waste management contracts and that there are clear ways for them to do so.[2, 3]*
   Reasoning: Difficulties in achieving economies of scale, and thereby challenges with improving infrastructure and productive capacity, has been identified as a key challenge for informal collector cooperatives/membership-based organisations.[4] This makes it challenging for them to compete with well-established private waste management companies without supportive measures from government.[4, 5]

4. ***Fair remuneration for the services that the informal workforce provides*** *including fair service based earnings as a baseline minimum rather than earnings being determined only by the type and weight of materials collected/circulated.*
   Reasoning: The informal sector makes significant contributions to society through their waste management practices, and it has long been advocated for, by the informal sector, that they should be appropriately recognised for providing these economic and environmental services to society.[6, 7, 8] A way to do this is by paying informal collectors a service fee for their collection work (in addition to earnings that can be made from selling recyclable materials).[7, 3]

1. **Expert opinion**;
2. **Vital Ocean/SYSTEMIQ, TriCiclos, and Hasiru Dala**, “Leave No Trace”, 2020, p. 13;
3. **Dias, Sonia**, “The Roadmap to Sustainable and Inclusive Solid Waste Systems A Tale of two Cities”, In: La ville durable, moteur de transformation sociale?, Fondation EU-LAC, 2018, p. 44-46;
4. **International Labour Office**, “Cooperatives and the world of work no 12: Waste pickers’ cooperatives and social and solidarity economy organizations”, 2019, p. 4;
5. **Expert opinion**;
6. **WIEGO**, “Waste Pickers: the right to be recognised as workers”, 2013, p. 1;
7. **Department of Environment Forestry & Fisheries, Department of Science & Innovation**, “Waste picker integration guideline for South Africa: Building the Recycling Economy and Improving Livelihoods through Integration of the Informal Sector”, 2020, p. 17-21;
8. **Dias, Sonia**, “Waste Pickers and Cities”, 2016, p. 3-5

What does the system to work towards look like?

Packaging design | Material sourcing | **Collection** | **Sorting** | Recycling | End markets

What could good look like for collection and sorting — SOCIAL (3/3):

5. ***Access to services and social mobility*** *for the informal sector by providing access to services such as healthcare, education, skills and capacity building, and opportunities that allow people to move away from working on landfills and dumpsites (e.g. door-to-door collection, managing collection points, work in material recovery facility, etc.).*[1, 2]
   Reasoning: Waste picking is a hazardous profession in its current form, characterised by significant health risks and financial insecurity.[3, 4] Improving livelihoods and working conditions of the informal sector in plastics recycling is acknowledged by the New Plastics Economy Initiative as a key part of the vision of a circular economy for plastics.[5]

6. ***Flexibility of work hours*** *is prioritised where possible as flexibility is often an important factor for people within the informal sector (especially women).*
   Reasoning: Because of informality, informal collectors are entrepreneurs and have long been used to their earnings being directly correlated to how hard they work and not having to adhere to certain schedules, meaning that many informal collectors strongly value their independence and flexibility.[1] If the desire for flexibility is not recognised and to some extent accommodated (e.g. by clearly outlining other benefits), it could be difficult to engage with informal collectors in inclusive recycling efforts.[6, 7] Flexibility in work hours is particularly important for women due to household duties/responsibilities that often fall disproportionately on women.[8]

1. **Vital Ocean/SYSTEMIQ, TriCiclos, and Hasiru Dala**, “Leave No Trace”, 2020, p. 53, 59-68, 157;
2. **Dias, Sonia**, “The Roadmap to Sustainable and Inclusive Solid Waste Systems A Tale of two Cities”, In: La ville durable, moteur de transformation sociale?, Fondation EU-LAC, 2018, p. 44-46;
3. **Department of Environment Forestry & Fisheries and Department of Science & Innovation**, “Waste picker integration guideline for South Africa: Building the Recycling Economy and Improving Livelihoods through Integration of the Informal Sector”, 2020, p. 22;
4. **Ocean Conservancy**, “Supporting Southeast Asia's Informal Waste Sector”, 2020, p. 9;
5. **New Plastics Economy (Ellen MacArthur Foundation)**, “A vision of a circular economy for plastic”, 2016;
6. **Expert opinions**;
7. **Bünemann et al.**, “How can the informal sector get involved in the system?”, 2020, p. 6;
8. **Expert opinion**

Trying to incentivise the current informal system setup to collect B2C flexibles leaves social issues unaddressed and would be economically challenging

Social reasoning

- The number of people involved in earning an income based on the type of material and weight collected[1] rather than services performed would need to almost double.
    - Global B2C flexible packaging use is ~71 million tonnes per year.[2] Taking the conservative assumption that 20% of this is used in regions serviced by informal collection systems means that 14.2 million tonnes per year of B2C Flexibles would need to be collected through these systems. Given that it would take a waste picker ~250 days to collect 1 tonne of B2C flexibles (calculation shown on following pages), this means the informal collection workforce would have to double to collect all of the B2C flexible waste produced per year. There are currently ~11 million waste pickers.[3]

- In such a system, where earnings are mainly determined by the type of material and weight collected, not on services performed[1, 4, 5], people in the informal sector would not be appropriately recognised and rewarded for the service they provide to society.

- A majority of informal collectors within the current system work independently and are not affiliated with an organisation that advocates for their rights or improves their access to just labour conditions.[6, 7, 8]

- As a whole, labour and social conditions are likely to remain poor because initiatives to improve labour conditions would not come as part of an organisation of the entire waste management system, but would remain as isolated, voluntary efforts, and the increased prices paid for B2C Flexibles would not necessarily translate into better earnings for the bottom of the informal sector pyramid (i.e. the informal collectors themselves).[9, 10]

1. **Vital Ocean/SYSTEMIQ, TriCiclos, and Hasiru Dala**, “Leave No Trace”, 2020, p. 46-47, 59;
2. Data provided by **Wood MacKenzie**;
3. **The PEW Charitable Trust and Systemiq**, “Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution”, 2020, p. 70;
4. **WIEGO**, “Waste Pickers: the right to be recognised as workers”, 2013, p. 1;
5. **Viljoen et al.**, “Sometimes you don’t make enough to buy food’: An analysis of South African street waste pickers’ income”, 2018, p. 1-2;
6. **Expert opinions**;
7. **Velis, Costas**, “Waste pickers in Global South: Informal recycling sector in a circular economy era”, 2017, p. 330;
8. **Dias, Sonia**, “Waste Pickers and Cities”, 2016, p. 9;
9. **Ocean Conservancy**, “Supporting Southeast Asia's Informal Waste Sector”, 2020, p. 7-8, 15-16;
10. **Expert opinions**

Trying to incentivise the current informal system setup to collect B2C flexibles leaves social issues unaddressed and would be economically challenging

Economic reasoning

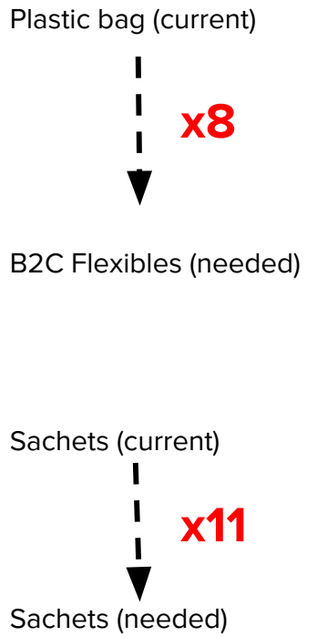
- Currently, only materials with strong and stable end markets get collected.[1] Incentivising collection of B2C Flexibles within the current system set up would require the price paid for B2C Flexibles to substantially increase (we conservatively estimate that the price offered for B2C Flexibles would need to be at least 8x what is currently paid for plastic bags and the price offered for sachets would need to be at least 11x what is currently paid for sachets (see next page)).
    - NOTE: These assumptions are conservative with the real numbers likely to be much higher
        - These calculations don't take into account the fact that collection of flexible packaging is physically much harder than rigid packaging — something that would probably need to be compensated for.
        - These calculations don't take into account what a fair living wage would be

- This would have to be driven by temporary measures (e.g. voluntary measures or weak/non-enforced EPR legislation) which would at best result in pockets of collection but is unlikely to widely scale.

1. **Vital Ocean/SYSTEMIQ, TriCiclos, and Hasiru Dala**, "Leave No Trace", 2020, p. 46-47, 59

Calculation of price increase required to incentivise collection of B2C Flexibles within the current system set up

	Region	Item	Time needed to collect 1kg (min/kg)	Price paid/kg to waste picker ($/kg)*	Earning potential ($/hr)*	Daily wage ($/day)*~	Bale price ($/tonne)*^
Price paid for PET bottles in current system[3, 4]	**SE Asia**	**PET**	40	0.38	0.57	5.7	490
Price paid for Plastic bags in current system[1, 2]	**SE Asia**	**Plastic bag**	61	0.05	0.05	0.5	65
Incentivisation scenario 1 [1, 3, 4] - Time needed to collect 1kg mixed size B2C Flexibles is an average of the time required for a plastic bag and a sachet - Informal collector would collect mixed size B2C Flexibles only if their earning potential for picking a flexible is at least half of the earning potential for picking PET	**SE Asia**	**Mixed size plastic B2C Flexibles**	88	0.41	0.28	2.8	534
Price paid for sachets in current system[3, 4]	**SE Asia**	**Sachet**	115	0.05	0.02	0.25	65
Incentivisation scenario 2 [1, 3, 4] - Informal collector would collect sachets only if their earning potential for picking a flexible is at least half of the earning potential for picking PET	**SE Asia**	**Sachets**	115	0.54	0.28	2.8	698



*USD
~If time was spent only on the one item
^Bale price is calculated by assuming a 30% increase from the price paid at collection (to waste picker) to the price paid at the entrance point to the after-use process (e.g. recycling facility, cement kiln)

In all scenarios, hours worked/day = 10
Black = number provided by source
Blue = assumption based on number provided
Red = resulting calculation

1. **Ocean Conservancy**, "Stemming the Tide", 2015, pp. 15;
2. **Vital Ocean/SYSTEMIQ, TriCiclos, and Hasiru Dala**, "Leave No Trace", 2020, p. 95;
3. **Wider Sense & Röchling Stiftung**, "The Waste of Others", 2020, pp. 19;
4. **GA Circular**, "Toward Circularity of Post-Consumer Flexible Packaging in Asia", 2017, p. 26

Directly implementing formal mechanical systems in isolation from existing structures will be slower and less likely to succeed than one that leverages existing structures

Reasoning:

- ~60% of plastics recycled globally are collected through the informal sector[1] and directly implementing a formal mechanical system would miss the opportunity to leverage the substantial network of knowledge and logistics that is in place in the existing structure.[2, 3]
- The informal sector would likely continue to exist, still extracting the high-value materials from the waste stream where possible, leaving the formal system with little value in its collected waste stream to support its costs.[4, 5, 6]
- There are indications that city waste management systems that include informal sector actors (e.g. cooperatives) within the system/operations have lower costs than those that do not integrate them.[7, 8, 9]
- There are examples where failing to recognise and work with the existing informal structures resulted not only in negative impacts on informal collectors' livelihoods, but also in the implemented formal waste management system being unsuccessful and/or more costly for the municipality/private company.[10, 11]

1. **The PEW Charitable Trust and Systemiq**, "Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution", 2020, p. 70;
2. **GTZ**, "The Waste Experts: Enabling Conditions for Informal Sector Integration in Solid Waste Management: Lessons learned from Brazil, Egypt and India", 2010, p. 5;
3. **GTZ**, "The Economics of the Informal Sector in Solid Waste Management", 2011, p. 30-33;
4. **Department of Environment Forestry & Fisheries, Department of Science & Innovation**, "Waste picker integration guideline for South Africa: Building the Recycling Economy and Improving Livelihoods through Integration of the Informal Sector", 2020, p. 27;
5. **Vital Ocean/SYSTEMIQ, TriCiclos, and Hasiru Dala**, "Leave No Trace", 2020, p. 47;
6. **Vanke Foundation**, "In the context of mandatory classification policy: The interactive relationship between scavengers and the urban domestic waste recycling system", 2020, p. 20;
7. **Correal, M. & Laguna, A.**, "Estimación de costos de recolección selectiva y clasificación de residuos con inclusión de organizaciones de recicladores: Herramienta de cálculo y estudios de caso en América Latina y el Caribe";
8. **Expert opinion**;
9. **Ocean Conservancy**, "The Next Wave: Investment Strategies for Plastic Free Seas", 2017, p. 49;
10. **Wilson, D.C. et al.**, "Role of informal sector recycling in waste management in developing countries", 2006, p. 806;
11. **Samson, M.**, "Lessons from Waste Picker Integration Initiatives: Development of Evidence Based Guidelines to Integrate Waste Pickers into South African Municipal Waste Management Systems", 2020, p. 36

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Recycling | End markets

What could good look like for recycling:

1. ***Strengthening of local ecosystems and their capacities*** *e.g. by purchasing materials from a variety of actors within the inclusive system, especially smaller cooperative/organised players.*
   Reasoning: Purchasing recyclable materials from smaller informal organisations (i.e. cooperatives, micro enterprises, membership-based organisations) helps to support these initiatives.[1]

2. ***Investments into recycling infrastructure*** *to ensure that mechanical recycling facilities are high in numbers and geographically spread out throughout a nation by having regional recycling hubs.*
   Reasoning: The further one gets from a recycling center the costlier it gets to transport collected waste to get recycled.[2] When the number of recycling centers in a nation is scarce and centred near metropolitan areas, this means that materials collected outside that area are less like to actually be recycled.[2]

1. **Expert opinion**;
2. **Vital Ocean/SYSTEMIQ, TriCiclos, and Hasiru Dala**, “Leave No Trace”, 2020, p. 145

What does the system to work towards look like?

Packaging design | Material sourcing | Collection | Sorting | Recycling | End markets

What could good look like for end markets:

1. *Recyclates go into items that can themselves be recycled (e.g. no composite products)*
   Reasoning: Composite products can be seen as a short extension to the linear economy, rather than moving us towards a circular economy. Higher value end-markets is one of the reasons for the criteria listed under 'what could good look like for design'.

2. *The highest possible applications for a given recyclate quality are prioritised (e.g. ideally, non-food flexible and rigid packaging are the applications prioritised for mechanically recycled B2C Flexibles)*

NOTE: *The reality of end markets in the geographies relevant to the informal sector are currently far off the ideal. Currently, B2C flexibles (especially the smaller formats), if collected and sorted, go to end markets such as cement kilns, pyrolysis, and other applications that represent a significant loss in value (e.g. building materials).[1] Whilst having some form of end market is better than none at all, what is the reality now shouldn't be taken as the end goal. Serious efforts must be made to move towards ideal end markets as outlined above. This is both a matter of changing packaging design (i.e. material and packaging choices should be continuously improved) as well as investing seriously in building the appropriate recycling infrastructure.*

1. **GA Circular**, "Toward Circularity of Post-Consumer Flexible Packaging in Asia", 2017, p. 6