

# Plastics Roadmap

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Future Opportunities and  
Needs in the UK Plastics  
Supply Chain

## Introduction

This document presents the findings from a roadmapping exercise delivered under the auspices of the Plastics Research and Innovation Fund ('PRIF'). These are recommendations for where future R&D funding could be directed to increase the circularity of the UK plastics supply chain. They are supported by full a technical report.

## Research Aims

- Identify current strengths and weaknesses in the circularity of the plastics supply chain.
- Signpost potential future development areas to strengthen the circularity of the plastics supply chain.
- Provide strategic recommendations for UK plastics sector stakeholders on areas that should be a focus for activity and investment.



## Scope

A circular economy aims to eliminate waste through smart systems, product design and the reuse of materials and products. This roadmap addresses plastic used in the following applications:

- Packaging;
- Building and construction;
- Electrical and electronic equipment (EEE) and automotive, including tyres;
- Agriculture;
- Textiles including microfibres;
- Fishing gear and aquaculture; and
- Paints.

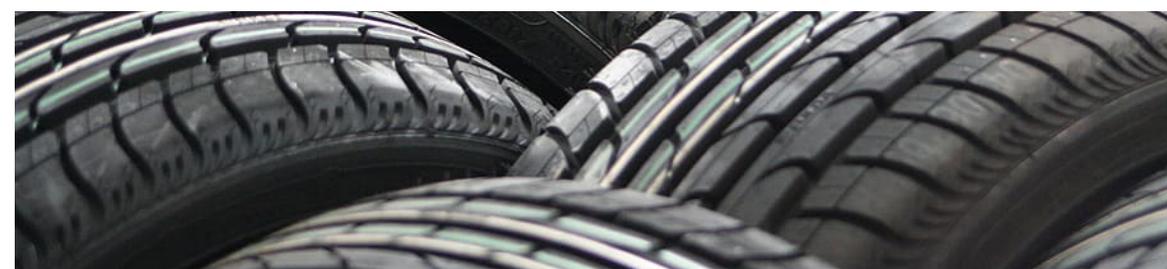


## Stakeholder Consultation

This roadmap was informed by a consultation with government bodies, industry, NGO's, academics and other stakeholders with an understanding of the UK plastics sector. Four interactive webinars and 28 in-depth interviews were undertaken in Summer 2019.

## PRIF

The £20 million Plastics Research and Innovation Fund aims to explore novel ideas and innovations with the potential to make the plastics sector more circular. This roadmap was delivered under the PRIF's Leadership and Knowledge Exchange activity stream.



# Packaging Recommendations



Exploratory Research



Technological Development

## High Priority

**1. Substitution:** assess extent to which plastic packaging across the supply chain could be substituted with reusable packaging.

**2. Optimal Composition for Recycling:** establish optimal combinations of inks, labels, glues and barrier layers used in packaging as well as the best washing system to improve mechanical recycling and obtain higher quality recycle.

**3. Digital Watermarking:** explore the role of digital watermarking regarding food-contact packaging and as a way of delivering information from the packaging manufacturer to the recycler.

## Medium Priority

**4. Develop Metrics:** around reuse, and methods for collecting data on reuse.

**5. Recycled Content in Food-contact Packaging:** develop an objective basis for the limit of recycled content in food-contact packaging. Provide clear guidance on the decontamination processes required to deliver food-grade recycled material.

**6. Recycling Small Items:** collaboration between recyclers and manufacturers of recycling equipment to investigate the capacity and case for recycling small plastics that are currently screened out and treated as residual waste.

**7. Polymer Rationalisation:** identify opportunities for polymer rationalisation (i.e. using fewer polymer types) through collaboration across the supply chain.

## Low Priority

**8. Optimal Use of Washing Plants:** research to better understand the optimal use of washing plants to clean food residues from recyclables compared to consumers washing out containers. Identify containers which are most difficult to empty.

**9. Adapt Recycling Plants:** support recycling plants in the context of a shift from multipolymer and composite packaging towards single polymer packaging.

**10. Redesign Food Containers:** look at redesigning 'problem' containers to ensure that they are fully recyclable, emptiable and easily cleaned of food residues (linked to recommendation 8).

# Building & Construction Recommendations



Exploratory Research



Infrastructure and Equipment



Technological Development



Knowledge Exchange and Training

## High Priority

- 1. Smarter Design:** with a focus on the design of plastic building components for deconstruction, modularity/ flexibility, recyclability and recycled content. Including reducing or eliminating hazardous substance content and standardising product specifications, e.g. for window and door sizes.
- 2. Building Information Modelling (BIM) and Material/Product Passports:** optimise use to store information on construction products containing plastic in buildings across their lifecycle.
- 3. Manage End-of-first-life Products:** establish supply chain collaborations for management of construction products that contain plastic at their end-of-first-life.

**4. Recycling Infrastructure:** development of recycling infrastructure that can treat highly contaminated plastic material and produce high quality secondary materials from recycling.

**5. Development of LCA Based Tools/Systems:** to provide better information to end users on the whole life benefits of material selection, and best end-of-life treatment options.

**6. Reuse and Recycling Issues:** facilitate supply chain collaboration to understand product information (product 'passport') systems, quality testing and liability type issues.

## Medium Priority

**7. High Concern Substances:** research into plastics containing these substances (e.g. brominated flame retardants) and understand how products containing them should be managed.

**8. Increase Reuse in Renovation Projects:** development and testing of incentives to increase reuse in consideration of safety and performance requirements.

**9. Resource Efficient Business Models (REBMs):** investigate feasibility of such models for plastic used in construction, e.g. leasing.

**10. Procurement Specifications:** understanding factors influencing procurement in the specification of greater circularity in construction products – leading to the development of good practice procurement guidance, specifications and contract clauses.

**11. De-risking Circular Procurement:** develop the evidence base to show the benefits of procuring via REBMs, or with increased recycled content, recyclability, and design for deconstruction.

## Low Priority

**12. Demolition/Deconstruction:** explore techniques to maximise segregation of reusable and recyclable materials during demolition and deconstruction.

**13. Segregation at Construction Sites:** test and understand approaches that overcome cost, space constraints and logistics barriers on construction sites.

**14. Pre-fabrication and Off-site Manufacture:** explore approaches to encourage increased pre-fabrication and off-site manufacture, to facilitate the capture of offcuts for recycling.

**15. Improve Awareness:** improve awareness of the issues and actions required across the value chain. E.g. the work of UK Green Building Council Circular Economy Programme.

# EEE & Automotive Recommendations



Exploratory Research



Technological Development



Knowledge Exchange and Training

## High Priority

**1. Polymer Simplification 'Designer Challenge':** collaborative project with actors across the supply chain to explore how components that are not made using the most common polymers, or have levels of additives that are inhibiting recycling, can be redesigned using common polymers and minimal additives with the same performance.

**2. Microplastics - Tread Abrasion Test:** develop a standard test for tread abrasion given that the relative contributions of the wide variety of design parameters and external conditions to overall wear are not well understood.

**3. Increase Yield From Post-shredding Treatment:** collaboration between technology providers, recycling companies and academia to pilot sensor-based technologies to increase the yield from post-shredding treatment.

**4. UK Platform/ Roundtable:** create a knowledge exchange between manufacturers, designers and recyclers to improve to communication across the supply chain.

## Medium Priority

**5. Consumer Acceptance of Recycled Plastic Aesthetics:** research into the consumer market to understand consumer acceptance of blemishes as a side-effect of using recycled parts.

**6. Microplastics - SUDS:** research investigating the efficacy of SUDS in capturing tyre-derived microplastics to help close the knowledge gap regarding what best practice for road drainage management would look like.

**7. Microplastics - Road Environment:** research to better understand the effect of different road surfaces on tyre wear and microplastic generation.

**8. Automated Product/ Vehicle Disassembly:** develop a test product or vehicle in collaboration with manufacturers and academia where all of the larger plastic components (not embedded in mechanical components) are easily removable through mechanical means (a simple reverse build operation).

## Low Priority

**9. Microplastics - Driver Behaviour:** target research at understanding how speed can be optimised to keep tyre wear emissions and tailpipe pollutants at the lowest levels possible.

**10. Impact of Manual Disassembly:** research the impact of greater use of manual disassembly on material yields - it could allow for better plastics recovery.

# Agriculture Recommendations



Exploratory Research



Technological Development

## High Priority

**1. Recyclate Quality:** determine what level of recyclate quality from agri-plastics is needed to allow more circular applications from its secondary material.

**2. Best Practice Guidelines:** on how to recycle agri-plastics could be developed to help farmers across the UK, including topics such as collection methods, best practice for storage, and local collection schemes.

**3. Circular Design:** investigate changes that could be made to the design or specification of agri-plastics (e.g. silage wrap), or whether alternative materials could be used.

**4. Contamination Removal:** develop technology which better removes contamination from thin cover agri-plastics to allow it to be recycled.

## Medium Priority

**5. Online Record System:** develop a paper-free alternative to the waste transfer note system to allow farmers to easily record to record the quantity of plastic used and sent for recycling.

## Low Priority

**6. Chemical Recycling:** establish whether this is appropriate for agri-plastics feedstocks.

# Textiles

# Recommendations



Exploratory Research



Infrastructure and Equipment



Technological Development

## High Priority

- 1. Understand the Potential for a Better Synthetics Initiative:** to define what is good and bad in terms of synthetic materials (similar to the Better Cotton Initiative).
- 2. Quality Standards:** develop sector-wide quality standards for recycled fibres.
- 3. Labelling Specifications:** research role of labelling to improve consumer choices and develop standardised and comprehensive labels ('material passports').
- 4. Textiles Returns:** explore ways to enhance consumer convenience and incentives to return garments to retailers.
- 5. Public Communication Campaigns:** to raise awareness of the impact of different materials and how to make smarter choices.

**6. Smarter Design:** for new garments, footwear and carpets to increase length of product life and for ease of recycling.

**7. Bio-plastic Production and Processing:** ensure that this is truly a low impact alternative to fossil-based materials (e.g. land take, agri- impact, associated chemistries).

**8. Sorting Technology:** development of automated polymer/material sorting technology (e.g. watermarks and tracers).

**9. Kerbside Collections:** Develop a cohesive system integrated with other waste collections, e.g. additional external vehicle containers.

## Medium Priority

**10. New Business Models:** to support manufacturers and retailers to operationalise circular practices.

**11. Collaboration:** develop greater supply chain collaboration and initiatives that incentivise product returns for reuse and recycling.

**12. Product Labelling:** e.g. on durability and how to recycle, to assist the consumer in making more sustainable choices.

**13. Public Procurement:** develop green public procurement criteria to increase circularity of textiles procurement, for example by local authorities or NHS trusts.

**14. Bio-based Materials:** research into the environmental and social impacts of bio-based materials vs plastics and existing 'natural' materials (e.g. cotton or hemp).

**15. Fabric Coatings:** develop eco-friendly fabric coatings to replace alternatives containing hazardous substances.

**16. Chemical Recycling Technology:** to improve recycling of more complex materials where multiple polymers are present.

**17. Closed-loop Reprocessing:** for cellulose-based fibres that do not produce chemical waste.

## Low Priority

**18. Consumer Awareness:** raise awareness of the importance of not hoarding and encourage the return of items for reuse and recycling (building on the work already being done by SCAP).

**19. Digital Technology:** develop new technology and make use of AI, e.g. for asset tracking and condition monitoring.

# Microfibres Recommendations

 Exploratory Research

 Technological Development

## High Priority

- 1. Loss Drivers:** investigate factors related to textile construction and condition (e.g. age) which are driving microfibre losses across fabric structures.
- 2. Fabric Design:** research how to alter clothing constructions to affect factors driving losses without compromising aesthetics or material characteristics.
- 3. Loss in Use:** design of a standard test for the emission of microfibrils from the abrasion of textiles.
- 4. Loss in Production:** research to better understand loss rates of microfibrils from key points along the textile production supply chain.

**5. Washing Machine Filters:** explore how the lifetime of washing machine filters can be extended to minimise the frequency with which filters have to be emptied/cleaned/replaced.

## Medium Priority

**6. Washing Machine Loss Testing:** adapt relative loss rate tests typically carried out using a Gyrowash to reflect absolute losses from washing machines under comparable conditions.

**7. Characterise Washing Machine Losses:** research characterising fibres shed by washing of synthetic textiles in real world conditions, the findings from which can be passed to eco-toxicologists to understand risks posed.

**8. Washing Machine Filter Testing:** research to confirm the efficacy of washing machine filters to understand how these could contribute to eliminating microfibre emissions.

**9. Washing Machine Filter Uptake:** research nature of consumer engagement with washing machine filters and constraints on uptake.

**10. Washing Machine Filter Waste:** characterise contents of material captured in filters and identify innovative means of disposal.

**11. Solutions to Loss in Production:** develop solutions to microfibre emissions along the supply chain at key loss points. For example, washing of garments with high quality filter technology before sale.

# Fishing Gear & Aquaculture Recommendations



Exploratory Research



Infrastructure and Equipment



Technological Development



Knowledge Exchange  
and Training

## High Priority

### 1. Recycling Cost-Benefit Analysis:

research to determine the costs and benefits of different means of sorting and preparation for recycling.

**2. Reuse Cost-Benefit Analysis:** research to determine the costs and benefits of extracting gear elements which can be reused, focusing on trawl gear.

**3. Demonstration Plants:** develop regional demonstration sorting, preparation for recycling, and recycling plants for clean end-of-life fishing gear and biofouled derelict fishing gear, which can cope with the various challenges associated with each of these streams.

## Medium Priority

**4. Preparation for Reuse:** develop best practice guidance for the preparation of end-of-life fishing gear to extract elements for reuse (e.g. sink lines from gill nets), and subsequent training courses for fishers in extracting reusable components.

**5. Extended Producer Responsibility:** research on how an EPR scheme could apportion costs of end-of-life and derelict gear retrieval, collection, pre-sorting, storage, preparation for recycling and recycling, between fishing gear producers, fishers and ports.

**6. Lost Gear Recovery:** commercial fleet testing of acoustic, RFID and GPS tagging for gear recovery to create accurate information for shared mapping platforms to help avoid gear conflict and facilitate the retrieval of lost gear.

**7. Lost Gear Mapping:** develop an opensource or inexpensive app to access a mapping platform for the location and extent of *in-situ* fishing gear.  
**8. Gear Design:** research innovative gear designs which avoid hard to separate polymers or lead sink lines which contaminate recycling processes.

## Low Priority

**9. International Knowledge Sharing:** undertake knowledge-sharing trips for those already involved in the industry to meet operators of more developed collection, sorting, preparation for recycling and recycling systems for fishing gear abroad. For example, in Norway, Iceland, Germany, Slovenia and Lithuania.

# Paints Recommendations



Exploratory Research



Infrastructure and Equipment



Technological Development

## High Priority

**1. Road Marking Wear:** primary research investigating road marking wear processes, products and flows.

## Medium Priority

**2. Road Marking Adhesion:** investigate the relative importance of marking thickness, surface characteristics, moisture and temperature in influencing the bonding performance of road markings, which will affect loss rates.

**3. Road Marking Product Testing:** facilitate research into the relative durability of road marking products. For example, through contributing to the establishment of a road trial site where different markings could be comparably tested, given that road marking manufacturers have an incentive to fund testing of their own products to have them certified.

**4. Building Paint Product Development:** research targeted towards seeking alternatives to polymers for some specific functions they perform in paints, seeking to avoid trade-offs with the longevity of painted surfaces and the addition of harmful alternatives.

# Common Recommendations Across Plastic Applications

		Packaging	Building & Construction	EEE & Automotive incl Tyres	Agriculture	Textiles incl Microfibres	Fishing Gear & Aquaculture	Paints
Better Decision-making	New tools, metrics, models or lifecycle analyses	✓	✓	✓	✓	✓	✓	✓
	Guidance, standards, and the development of industry-led initiatives	✓	✓	✓	✓	✓	✓	
	Role of public sector procurement		✓			✓		
Product Design	For reuse	✓	✓			✓	✓	
	For recycling	✓	✓	✓	✓	✓	✓	
	For durability					✓		✓
	For increased recycled content	✓	✓					
	Development of alternative materials					✓		✓
Ability to Recycle	Physical characteristics of materials	✓	✓		✓	✓	✓	
	Infrastructure capability and design	✓	✓	✓		✓	✓	
Supply Chain Connectivity	Traceability of materials, components and products	✓	✓		✓	✓	✓	
	Collaboration between value chains and stakeholders	✓	✓	✓		✓	✓	✓
People	Behaviour change and public engagement		✓	✓	✓	✓		
	Skills, training and leadership		✓				✓	
Drivers	Economic approaches and incentives			✓		✓	✓	
	Legislation and regulation			✓	✓		✓	

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