



# Identifying UK Academic Capability in Plastics Research

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Final Report for KTN

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## Report for KTN

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## Foreword

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Recent years have seen an extraordinary growth in the level of interest in the issue of plastic waste and litter, and in the willingness of a wide range of stakeholders to work together towards a cleaner and greener future. The UK Government has a strategic ambition of zero avoidable waste by 2050, which is well articulated in the Government's 2018 Resources and Waste Strategy, in which a number of policy commitments were stated that aim at reducing plastic waste, including the target of eliminating avoidable plastic waste by the end of 2042.

Research and innovation have a critical role to play in helping achieve these commitments. There is a need to understand and strengthen academic research capability and infrastructure to drive the collaborations and partnerships required to support business and the third sector to see through the changes needed to deliver a more circular economy for plastics.

KTN, the UK's largest innovation network, published in 2017 '*An industry guide to polymer research*', which presented information on where significant research in polymers (plastics and elastomers) was being undertaken within the UK. This was aimed at giving industry an overview of the research activities in the UK that may be of potential relevance to address their needs. In 2018, the £20m Plastics Research and Innovation Fund (PRIF) launched by the government provided £8m direct funding for academic research projects, recognising the important role that academic research can play in this goal. A number of other funding streams were deployed under the PRIF initiative, including the formation of the UK Circular Plastics Network (UKCPN) by KTN, aiming to bring the diverse plastics community together and realise the best means for reducing plastics waste. Keen to develop a strategy to support the activities of UKCPN, KTN commissioned Eunomia to produce an updated follow up to the 2017 publication.

This new report takes a measured look at some of the research projects and institutions looking to reduce the impact of polymers on the environment, and when combined with the 2017 report, illustrates the breadth of academic research, expertise and capabilities in plastics circularity in the UK.

Given the large number of academic institutions working in plastics circularity, this report does not include all relevant institutions in the UK. As a complimentary exercise UKCPN has developed a dynamic UK Plastics Circularity Landscape Map, the first edition of which has now been published. If you work for an institution that is not featured in this report but would like to be included in the landscape map, please contact us via the UKCPN website using the following link: <https://www.ukcpn.co.uk/contact-us/>



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# 1.0 Introduction

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## 1.1 Background and Aims

Plastic products have become ubiquitous in modern lifestyles and economies due to their low cost, high versatility and functionality. These benefits come at a growing cost to the environment as plastics can persist for hundreds of years, causing physical and chemical pollution that harms wildlife and may risk human health. Businesses, consumers and government now recognise that it is time to re-invent the UK plastics economy to create a more 'circular' system.

A move towards a circular system demands a holistic approach where product life cycles, plastic supply chains, behaviours and new business models are considered by, and integrated into future industry-led innovation. This will include technical, economic and social interventions that together enable a system shift towards a more circular approach to plastics.

KTN has identified a knowledge gap around emerging technologies and innovative social and economic approaches focused on increasing the circularity of plastics in the UK. Therefore, the aim of this report is to identify key UK academic institutions that are active in this space and explore the research that they are undertaking.

The intention is that by increasing the visibility of these activities, future collaborations between academia and businesses will be facilitated and business uptake of research outputs will be encouraged. KTN may also use the findings to inform future events and advise the allocation of Government funding. These outputs will contribute to the overarching aim of accelerating the move towards a circular plastics economy within the UK.

The research that comprises this report was undertaken prior to the outbreak of the COVID-19 pandemic.

## 1.2 Scope

The following sub-sections outline the scope of this report.

### 1.2.1 Publicly led Research

The focus of this report was on publicly led UK institutions carrying out research and innovation activity on the circularity of plastics. The definition of 'publicly-led UK institutions' included universities and Research and Technology Organisations (RTOs).

## 1.2.2 Broad Range of Research Activities

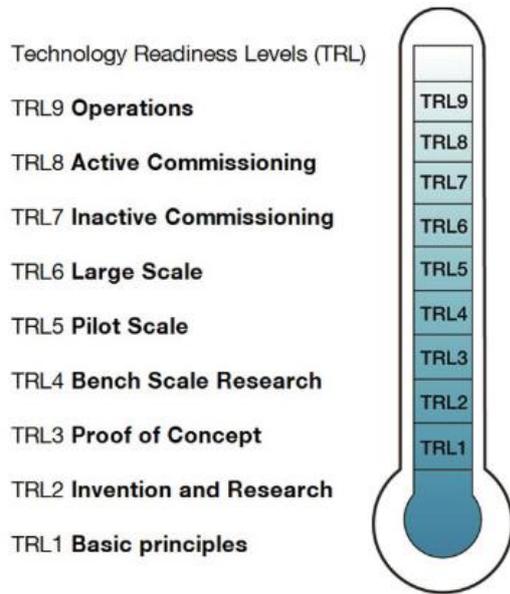
Research was categorised into one of six research themes, as set out below. These themes cover a broad range of technological, economic and social approaches to increasing the circularity of plastics and are described in more detail in Section 2.0.

	<b>Innovative materials</b>
	<b>Circular product design and pathways</b>
	<b>Business strategies to enable a circular economy</b>
	<b>Economic and social interventions to encourage behaviour change towards plastics</b>
	<b>Development of metrics and data to better understanding amounts of plastic in the supply chain and environment</b>
	<b>Effects of plastics on the environment, human, animal and plant health</b>

### 1.2.3 Technologies at Low to Middle Stages of Maturity

Technology Readiness Levels (TRLs) are a type of measurement system used to assess the maturity level of a particular technology. The different TRLs are presented in Figure 1-1. Emerging innovative technologies – the focus of this report – are considered to be those between Basic Principles (TRL 1) and Pilot Scale (TRL 5).

**Figure 1-1: Technology Readiness Levels**



Source: Gov.uk<sup>1</sup>

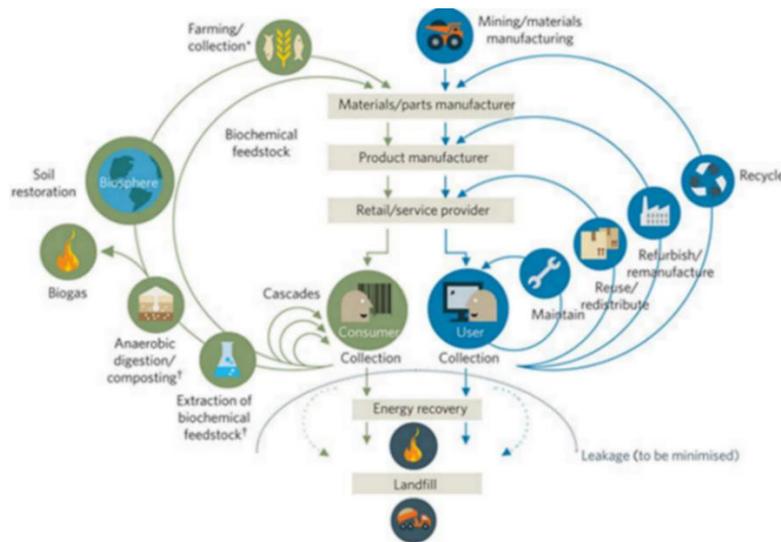
### 1.2.4 Circular Economy Flows

The ‘butterfly diagram’ developed by the Ellen MacArthur Foundation (Figure 1-2) shows a set of concentric circular flows related to both technical and biological ‘nutrients’. Material which is not managed within these circles is considered as ‘leakage’. Consistent with this diagram, the thermal treatment of plastics for energy recovery/recovery of fuels and the landfill of plastics are not included in the scope of this research. This does not extend to the effects of plastics on humans and environment that result from these activities. For example, research on the impact of air pollution caused by Energy from Waste (EfW) facilities would be included.

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<sup>1</sup> GOV.UK (2014) Guidance on Technology Readiness Levels, <https://www.gov.uk/government/news/guidance-on-technology-readiness-levels>

**Figure 1-2: Representation of the Circular Economy**



Source: Ellen MacArthur Foundation (2013)<sup>2</sup>

### 1.3 Method and Limitations

The information presented in this report has come from a combination of primary and secondary data sources. These are outlined below:

- **Primary Data:** interviews were held with a range of universities and RTOs using a topic guide that was developed by the research team in collaboration with KTN. 27 interviews were conducted in total during February and March 2020.<sup>3</sup> The topic guide for these interviews included questions on current research activity, key partners, sources of funding and demand for their research (amongst other topics).
- **Secondary Data:** this included universities and RTOs' websites, as well as online databases with information on research grants and equipment. For example, Konfer<sup>4</sup> and UKRI's Gateway to Research.<sup>5</sup>

The universities and RTOs featured within this research are listed in Section 3.0. Given the extent of activity in this space, this report does not claim to have identified every UK-based university and RTO active in circular plastics research and innovation. Whilst there will be relevant organisations missing from the featured list, that is not to say that their research is less important.

<sup>2</sup> Ellen MacArthur Foundation (2013) *Towards the Circular Economy Vol.1: Economic and Business Rationale for an Accelerated Transition*, January 2013, [www.ellenmacarthurfoundation.org/business/reports/ce2012](http://www.ellenmacarthurfoundation.org/business/reports/ce2012)

<sup>3</sup> Not all of those interviewed were considered relevant for inclusion in this report.

<sup>4</sup> <https://konfer.online/>

<sup>5</sup> <https://gtr.ukri.org/>

## 2.0 Overview of Research Themes

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This section provides a definition of each theme with examples of relevant research.

### 2.1 Innovative Materials

As the environmental impacts associated with the mismanagement of plastic have become better understood, there has been an increased focus from academia, business and government to develop alternative materials to serve the same purpose.

Examples of work in this area include:

- New polymers and super-polymers (including composites)
- Plastic alternatives/substitutes for plastic products, such as bio-plastics, and plastics within products



### 2.2 Circular Product Design and Pathways

Circular product design focuses on the development of methods and tools that enable products to be designed in such a way that they can be used several times. This enables the continued exploitation of the benefits that plastics bring to both society and the economy, whilst minimising their leakage into the environment.

Examples of work in this area include:

- Maximising recycled plastic content
- Modular design to extend the life cycle of a product
- Designing with end-of-life in mind
- Developing end-of-life solutions including through sorting and recycling technologies (mechanical and chemical)



### 2.3 Business Strategies to Enable a Circular Economy

Circular economy principles are implemented in organisations through business strategies that revolve around resource reuse, sharing, recycling and the extension of product life. Research in this field focuses on how plastics used in business applications can be retained for their practical use, economic benefit and convenience, but also reused or disposed of in such a way so as to avoid harm to the environment.

Examples of work in this area include:

- Sharing platforms/economy
- Remanufacturing
- Product life extension (e.g., repairing, reselling)
- Resource recovery



## 2.4 Economic and Social Interventions to Encourage Behaviour Change Towards Plastics

Solutions to improving the way we use and manage plastics is behavioural as well as technological. Indeed, changing behaviours is regarded as one of the most important, yet most difficult, elements of the movement towards plastics circularity. This research theme looks at consumer-facing interventions to reduce demand and influence methods of disposal.

Examples of work in this area include research relating to the following:

- Taxes
- Incentives
- Communications



## 2.5 Development of Metrics and Data to better Understand the Amount of Plastic in Supply Chains and the Environment

Understanding the true quantities of plastic waste throughout the supply chain and being lost to the natural environment is important for several reasons. It provides a baseline against which progress can be measured and it reveals the weak points in the supply chain where greatest attention is needed to improve plastic management.

Examples of work in this area include:

- Understanding volumes, flows and quantities of plastics
- Identifying hotspots and leakages
- Supply chain life-cycle analysis (LCA)



## 2.6 Effects of Plastics on the Environment, Human, Animal and Plant Health

Research in this area explores the impact of a wide range of plastic uses, from burning of non-recyclable plastic waste and subsequent greenhouse gas emissions, to the impacts of microfibres on marine and freshwater ecosystems. Due to the visibility of plastic pollution, research into this area has historically received high levels of interest from the public.

Examples of work in this area include:

- Length of time plastic remains in the environment
- Plastic toxicity, pollution, absorption into food chains



## 3.0 Research Institutions

This section provides a high-level overview of institutions active in research relating to circular plastics. Institutions have been included in Please note that for institutions that were not interviewed research themes included in the table and profiles were selected based on publicly available secondary data. Their respective research areas are represented by ticks against the themes described in Section 2.0 above.

The remaining of this report features the profiles of institutions included in Table 3-1 and provides an overview of their research activities. Some of the institutions are cross-institution and/or cross-departmental, within centres, departments and institutes. Each research group, centre, institute or school is featured with its host university. The institutions that were interviewed can be identified by a small microphone icon in the top right corner of their profile. Please note that for institutions that were not interviewed research themes included in the table and profiles were selected based on publicly available secondary data.

**Table 3-1: Overview of Featured Research & Development Academic Capability**

						
<b>BioComposites Centre</b> Bangor University	✓	✓				
<b>Institute of Materials and Manufacturing</b> Brunel University London	✓	✓				
<b>Ocean Plastic Solutions Network</b> Imperial College London	✓	✓	✓	✓	✓	✓
<b>MRC Centre for Environment &amp; Health</b> Imperial College London					✓	✓
<b>Research Centre in Sustainable Energy</b> Queens University Belfast		✓		✓	✓	
<b>Plastic Waste Innovation Hub</b> University College London		✓		✓	✓	
<b>Centre for Sustainable and Circular Technologies</b> University of Bath	✓	✓				



**Degradable Biomaterials and Sustainable Polymers Research Group**  
University of Birmingham

✓

✓

**School of Engineering**  
University of Birmingham

✓

✓

✓

**Water Sciences Research Group**  
University of Birmingham

✓

✓

**Cambridge Institute for Sustainability Leadership**  
University of Cambridge

✓

✓

**Cambridge Creative Circular Plastics Centre**  
University of Cambridge

✓

✓

✓

✓

✓

✓

**Exeter Centre for Circular Economy**  
University of Exeter

✓

✓

✓

✓

✓

✓

**Natural Resources Institute**  
University of Greenwich

✓

✓

✓

**Plastics Collaboratory**  
University of Hull

✓

✓

✓

✓

**School of Design**  
University of Leeds

✓

✓

✓

✓

**Textiles and Fashion Group, Department of Materials**  
University of Manchester

✓

✓

✓

✓

**Sustainable Materials Innovation Hub**  
University of Manchester

✓

✓

✓

✓

**Sustainable Consumption Institute**  
University of Manchester

✓

✓

**Sustainable Chemicals Group**  
University of Nottingham

✓

✓

**Oxford Martin School**  
University of Oxford

✓

✓

✓

✓

**International Marine Litter Research Unit**  
University of Plymouth

✓

✓

✓



<b>Centre for Enzyme Innovation</b> University of Portsmouth		✓			✓	
<b>Grantham Centre for Sustainable Design</b> University of Sheffield		✓	✓	✓		
<b>National Oceanographic Centre</b>	✓	✓	✓	✓	✓	✓
<b>Centre for Environment and Sustainability</b> University of Surrey			✓	✓		
<b>Centre for Circular Design</b> University of the Arts London		✓	✓	✓		



# Bangor University

## BioComposites Centre



<b>Region</b>	Wales
<b>Key Partners</b>	Bangor University's Sustainability Lab, BEACON Project (with Swansea and Aberystwyth Universities), WRAP Cymru, Supermarkets
<b>Key Capabilities</b>	On-site research laboratories, pilot-scale equipment, Bio-refining Technology Transfer Centre
<b>Sources of Funding</b>	Innovate UK, H2020, Welsh Government, EU ERDF (European Regional Development Fund), commercial
<b>Keywords</b>	Bio-materials, LCA, recycling, TRLs 3-8
<b>Sectors</b>	Resins, Coatings, Plastics, Chemicals and Built Environment

### Overview

The BioComposites Centre aims to facilitate and undertake research for innovation using bio-materials in industry. The Centre was established with the specific remit to collaborate with and provide research services for businesses. Accordingly, a significant area of their research responds to end-user demand and focuses on exploiting the functionality of new polymers.

The Centre's work is targeted at developing bio-based materials in a wide variety of applications to reduce demand for fossil fuel-based polymers. Enhancement of barrier or permeation properties of polymers is essential across a wide range of industries. Therefore, one of the primary aims of the Centre's research is improving the barrier performance of single-layer substrates whilst simultaneously retaining and increasing recyclability. Most of the research is at Technology Readiness Level (TRL) 3, sometimes reaching 4-5 as potential component polymers are developed and undergo an LCA.

All research projects are collaborative and linked to industry. The centre has competitively won over £2.7m of research projects linked to packaging and has been designated as a Key Enabling Technology (KET) centre, which carries out applied research (TRLs 3-8) in technologies deemed fundamental to the UK's future technological growth. The Centre has also won awards for projects in the food packaging sector such as the Green Life award for Bread4PLA, where PLA was polymerised from waste bread. The Centre works closely through the Bio-based and Biodegradable Industries Association (BBIA), the trade association for the biopolymer sector. Through this link the centre has responded to UK Government calls for evidence, for example around the use of LCA.

Recent work funded via Innovate UK includes HDT BioPol (the development of Biobased coffee cup lids for the replacement of HIPS with Wells Plastics) and SafeBioPack, (an EPSRC (Engineering and Physical Sciences Research Council) project working with Tesco and Parkside Flexibles to develop of novel packaging products with Malaysia). The Centre has experience of pilot scale production and prototyping of new packaging formats with improved functional performance such as antimicrobial surfaces. It has also developed in-house test methods that help to screen the bio-degradation profiles of new materials in their early stages of development.

The Centre aims to raise awareness of the recycling properties of different materials through the development of impact case studies that show the potential for increasing recycling rates of plastics whilst retaining the necessary properties for use in businesses.

<b>Website</b>	<a href="http://www.biocomposites.bangor.ac.uk/">http://www.biocomposites.bangor.ac.uk/</a>
<b>Principal Contact, Role</b>	Dr. Rob Elias, BioComposites Centre Director



## Brunel University London *Institute of Materials and Manufacturing*



<b>Region</b>	London, England
<b>Key Partners</b>	Lancaster University, Bangor University, University of Exeter, University of Greenwich, industry partners
<b>Key Capabilities</b>	Wolfson Centre for Materials Processing, specialist equipment for polymer recyclability
<b>Sources of Funding</b>	Innovate UK, Newton, GCRF, Horizon 2020, EPSRC, BBSRC, Industrial and Consultancy
<b>Keywords</b>	Materials Testing, Extrusion, Injection Moulding, Thermoforming, Bio-materials, Recycling, TRLs 2-8
<b>Sectors</b>	Plastics, Food Packaging, Agri-food, Built Environment, Construction, Manufacturing, Resins, Coatings

### Overview

The Institute of Materials and Manufacturing – which encompasses the Wolfson Centre for Materials Processing – aims to improve the performance of materials by manipulating their polymer structures and optimising their characteristics whilst gaining efficiencies and reducing dependencies on limited, non-renewable feedstocks.

The plastics-specific research within the Institute addresses issues such as balancing the durability and usability of polymers, extending the lifespan of food materials in plastic packaging, improving recyclability and sorting techniques, and identifying natural fibres to reinforce bio-materials (e.g. starch and other bio-additives).

To ensure that the Institute facilitates the provision of materials that match the needs of businesses and deliver the necessary focus on usability, the majority of projects are collaborations with the private and public sectors. These sectors provide funding and testing opportunities for new and recycled materials.

Specialist on-site equipment at the Institute includes injection moulding, extrusion technology, microscopy and thermal, mechanical and barrier testing. The Institute also benefits from being a part of the Wolfson Centre for Materials Processing where there is specialist equipment for the synthesis, characterisation and processing of novel polymer materials and biodegradable and compostable plastics. Equipment for testing of polymer recyclability, including pilot-scale materials processing and development, scanners and instruments to identify UV sources for testing circular product innovations.

<b>Website</b>	<a href="https://www.brunel.ac.uk/research/Institutes/Institute-of-Materials-and-Manufacturing">https://www.brunel.ac.uk/research/Institutes/Institute-of-Materials-and-Manufacturing</a>
<b>Principal Contact, Role</b>	Professor Hamid Bahai, Institute Director



<b>Region</b>	London, England
<b>Key Partners</b>	Sky PLC, University of Bristol, industry partners
<b>Key Capabilities</b>	Ocean modelling, spatial monitoring and remediation, treatment, recycling and process engineering, molecular chemistry, materials science, product design, behaviour, business models and societal change
<b>Sources of Funding</b>	EPRSC
<b>Keywords</b>	Chemical Recycling, Mechanical Recycling, Business and Consumer Behaviour, Plastic Economy, Plastic Policy
<b>Sectors</b>	Food Packaging, Recycling, Waste Treatment

### Overview

Founded in 2016, Imperial College's Ocean Plastic Solutions Network is a cross-faculty team combining engineering and environmental science capabilities to develop approaches that address the root causes of ocean plastic pollution. Research focus areas include:

- Advanced modelling methods to understand how currents and eddies in the oceans influence the transport and deposition of plastics;
- Development of processes to maximise recovery and treat currently unrecyclable material, allowing consumers to increase material reuse and businesses to increase resource recovery;
- Material innovation to preserve plastic performance (whilst reducing toxicity) and develop bio-plastics for food packaging; and
- Development of incentives and other policies to encourage the transition to products and processes that are better for the environment; and
- informing the development of incentives and other policies to encourage the transition to products and processes that are better for the environment

A key project currently being undertaken with industry partners is titled 'Holistic integration of technology, design and policy for a greener plastic future' which aims to create a technical, socio-economic and policy roadmap detailing how the UK can prevent waste plastics from entering the environment. The project is divided into two main strands of research. The first strand is focused on addressing the design, manufacture and recycling challenges associated with polymer recycling. Technologies corresponding with this strand are typically in the range of TRL 1-4. The second strand of research is focused on the behaviour of governments, businesses and the general public and their interaction with plastic. The strand studies policy, business models and psychological factors in order to obtain maximum utilisation of plastic and drive-up recycling rates. By combining these two strands of research, the Network aims for plastic to be utilised for a maximum lifetime before energy and resource intensive recycling options are used to produce new materials. The project is being run in collaboration with private sector partners with primary use expected in the food packaging sector. Further applications may be determined for the textiles and polymer producing industries.

<b>Website</b>	<a href="https://www.imperial.ac.uk/ocean-plastic-solutions/">https://www.imperial.ac.uk/ocean-plastic-solutions/</a> <a href="https://www.imperial.ac.uk/greener-plastic-future/">https://www.imperial.ac.uk/greener-plastic-future/</a>
<b>Principal Contact, Role</b>	Professor Jason Hallett, Prof. of Sustainable Chemical Technology



<b>Region</b>	London, England
<b>Key Partners</b>	Imperial College London (Faculty of Medicine, Environmental Research Group and UK Small Area Health Statistics Unit), University of Cambridge, MRC Toxicology Unit, NIHR Health Protection Research Unit in Environmental Exposures and Health, NIHR Health Protection Research Unit in Chemical and Radiation Threats and Hazards, Public Health England (PHE)
<b>Key Capabilities</b>	Advanced Geographical Information Systems (GIS), statistical modelling techniques, equipment and city-wide sensors for exposure monitoring, experimental data collection
<b>Sources of Funding</b>	UK Research and Innovation (UKRI), MRC, NERC, Wellcome, H2020, Industrial Partners
<b>Keywords</b>	Environmental Health, Air Pollution, Epidemiology, Toxicology
<b>Sector</b>	Built Environment, Construction, Chemistry, Medical and Healthcare, Materials, Industrial Mathematics, Manufacturing, Sustainability and CE, Textiles, Food and Drink

#### Overview

The Centre for Environment and Health is a multi-disciplinary centre – formed as a collaboration of relevant departments and expertise at Kings College London and Imperial College London – which investigates the health effects of ubiquitous environmental hazards. The Microplastics research theme within the Centre aims to provide a holistic understanding of the risks of microplastics to human health with a focus on air quality impacts.

The Centre’s microplastics research is oriented around three key elements: external exposure, internal exposure, and toxicity. External exposure research aims to characterise and quantify airborne microplastics in health-relevant size fractions. For this, the Centre has focused on improving automation in microplastic sample analysis through use of Raman imaging and chemometrics. For internal exposure research, the Centre is developing complimentary methods for the detection of microplastics and their associated chemicals in complex environmental and biological matrices. This supports work on the occurrence of microplastics in human lung tissue in collaboration with the MRC Toxicology Unit. In terms of toxicity research, the Centre is utilising in vitro models of the human airway.

Recent funding from NERC will expand the Centre’s work on airborne microplastics to include national-scale deposition monitoring, size-resolved and focused measurements, the assessment of vertical transport, and environmental fate. This follows on from work documenting the first atmospheric microplastic deposition in London. Work on toxicology will continue in the new Health Protection Research Unit, in collaboration with PHE.

The Centre aims to translate their empirical research into advice and an evidence basis for policymakers and industry by working closely with relevant stakeholders. One staff member has participated in expert Working Groups ([SAPEA](#), [GESAMP](#)) on plastic pollution and provided [evidence](#) to the [EC Group of Chief Scientific Advisors](#). Work has also been broadcast through various media channels, including radio and television.

<b>Website</b>	<a href="http://www.environment-health.ac.uk/">http://www.environment-health.ac.uk/</a>
<b>Principal Contact, Role</b>	Dr Eduardo Seleiro, Scientific Manager MRC Centre for Environment and Health Dr Stephanie Wright, Lead for Microplastics research theme



# Queen's University Belfast Research Centre in Sustainable Energy



<b>Region</b>	Northern Ireland
<b>Key Partners</b>	Industry partners (particularly food group consortiums of producers, distributors, wholesalers)
<b>Sources of Funding</b>	UK Research and Innovation (UKRI)
<b>Key Capabilities</b>	Access to the Polymer Processing Research Centre, Advanced Mass Spectrometry Equipment
<b>Keywords</b>	Plastic waste, Recycling, System thinking, Social behaviour, re-manufacturing, re-design,
<b>Sector</b>	Agri-food, Food and Drink

## Overview

Queen's University Belfast is one of the eight institutions working on the Plastics Research Innovation Fund project to re-think plastics production and use. The ACCEPT project (Advancing Creative Circular Economies for Plastics via Technological-Social Transitions) involves academics with expertise in psychology, engineering (chemical, mechanical and aerospace), healthcare, risk and inequality, manufacturing, law, anthropology and social innovation. This multi-disciplinary programme – whose leader is Director of the Research Centre in Sustainable Energy – aims to integrate their research in plastics into the wider circular economy debate using whole-systems thinking. This requires an understanding of the drivers and barriers of stakeholders at every stage of the supply chain. A key part of the project involves working with small-medium enterprises (SMEs) to find commercially viable solutions to the plastic crisis.

There are three core goals of the project:

- To identify and explore the social behaviours behind the creation and use of plastics, waste and recycling;
- To quantify waste creation and map plastics' journey into the waste stream; and
- To determine how to add value to plastic waste to enable remanufacture, repurposing and redesign.

A primary research output will be an evidence base for policymakers. The project aims to introduce a framework for viewing plastic as a valuable resource with further use beyond its initial product. Moreover, the project provides quality assurance for feedstock pyrolysis as an end-of-life solution. The project utilises the expertise and equipment of multiple individuals and institutions within the university, such as the Polymer Processing Research Centre and the LCA equipment and facilities within the Chemical Engineering faculty.

<b>Website</b>	<a href="https://www.qub.ac.uk/sites/CreativeCircularEconomies/">https://www.qub.ac.uk/sites/CreativeCircularEconomies/</a>
<b>Principal Contact, Role</b>	Professor David Rooney, Centre Director, ACCEPT Project Leader



# University College London

## Plastic Waste Innovation Hub



<b>Region</b>	London, England
<b>Key Partners</b>	Institute of Making, LWARB, Recycling Technologies, British Plastics Federation, Veolia, Mace
<b>Key Capabilities</b>	Multi-disciplinary research, public interfaces, research laboratories, high - performance liquid chromatography (HPLC), nuclear magnetic resonance (NMR) spectroscopy, mass spectrometry (MS), bead mill
<b>Sources of Funding</b>	UK Research and Innovation (UKRI)
<b>Keywords</b>	Biodegradable, Laminate Films, Recycling, Enzymes, Circular Economy, Systems Thinking, Compostable, Plastic Packaging, Life-Cycle Assessment (LCA), Material Flow Analysis (MFA), End-of-Life, Plastic Waste
<b>Sectors</b>	Packaging, Built Environment, Construction, Engineering, Waste Management, Chemicals, Textiles, Consumer Products, Food and Drink, Policy, Agriculture

### Overview

The Plastic Waste Innovation Hub is taking a design-led approach to reducing plastic waste with the aim to create and test new interventions in eliminating plastic waste whilst also developing new business opportunities and research partnerships. One of the main research objectives of the ‘Designing Out Plastic Waste’ project – through which the Hub was created – is to develop enzyme-catalysed recycling technology for laminate films.

Research is being undertaken within multiple departments at UCL including the Department of Chemical Engineering, The Bartlett Faculty of the Built Environment, and Institute of Sustainable Resources. The range of disciplines involved includes psychological studies into behavioural change, the testing of biodegradable materials to ascertain their ecological impact, the development of plastic-recycling enzymes, and the undertaking of LCA’s of ubiquitous plastic products (e.g., tree shelters and feminine hygiene products).

The research of the Hub is guided and advised by a Steering Committee of professionals from a variety of sectors including manufacturing, retail, policy, local government, sustainability charities, and waste management. The Hub frequently engages with the public through talks, workshops, and radio programmes, as well as collaborating with numerous industry partners to ensure that the solutions and models developed fit within existing systems (e.g., ensuring recyclability of new materials). Many of the Hub’s projects are designed to have a significant impact in outreach and education at all levels, from influencing small-scale consumer actions to informing government policy.

<b>Website</b>	<a href="https://www.plasticwastehub.org.uk/">https://www.plasticwastehub.org.uk/</a>
<b>Principal Contact, Role</b>	Dr Beth Munro, Research Manager



# University of Bath

## Centre for Sustainable and Circular Technologies



<b>Region</b>	South West, England
<b>Key Partners</b>	University of Birmingham, University of Oxford, University of Manchester, Industry partners (listed here: <a href="https://www.csct.ac.uk/case-studies/">https://www.csct.ac.uk/case-studies/</a> )
<b>Key Capabilities</b>	Polymer synthesis/development, polymer characterisation, validation of plastic components for a number of applications
<b>Sources of Funding</b>	UK Research and Innovation (UKRI)
<b>Keywords</b>	Bio-materials, waste-to-resource, polymerisation catalysis
<b>Sectors</b>	Medical and Healthcare, Manufacturing, Electronics, Sensors and Photonics

### Overview

The Centre brings together academics from the Departments of Biochemistry, Engineering (Chemical, Electrical and Mechanical), Chemistry, Pharmacy and Social and Policy Sciences to research multiple strands of sustainable chemical technologies. The primary aim of the Centre's research is to identify and develop new polymer materials from renewable feedstocks to reduce dependence on fossil fuel-based materials. These sources include natural sugars, a variety of waste food products, and by-products of manufacturing and chemical processes. Research is primarily conducted with a long-term focus, with emphasis on identifying unintended consequences of new materials (e.g., using abundant crops to reduce competition for land and avoid impacting food security).

The Centre's research is focused at TRL 1-4. Research varies from the observation of polymer characteristics and diverse chemical structures, to laboratory recreation and component validation through utilisation of those structures. Applications of the research are varied across multiple sectors, including bio-medical equipment, polymer electrolytes, smart coating and flexible electronics. The Centre is well-connected to partner academic institutions for usage of equipment not on-site, including the Universities of Birmingham and Greenwich.

<b>Website</b>	<a href="https://www.csct.ac.uk/">https://www.csct.ac.uk/</a>
<b>Principal Contact, Role</b>	Dr Antoine Buchard, Reader



# University of Birmingham

## *Degradable Biomaterials and Sustainable Polymers Research Group*



<b>Region</b>	West Midlands, England
<b>Key Partners</b>	N/A
<b>Key Capabilities</b>	Mass Spectrometry, NMR Spectroscopy, Magnetic Resonance Imaging, Chromatography (within the School of Chemistry) plus Gel-permeation chromatography, differential scanning calorimetry, ellipsometry, goniometry, mechanical analysis, dynamic mechanical thermal analysis, dynamic and static light scattering, atomic force microscopy, confocal microscopy, fluorescence spectroscopy, rheology, thermogravimetric analysis
<b>Sources of Funding</b>	Government, industry, EU, charities
<b>Keywords</b>	Sustainable Polymers, Catalysis, Depolymerisation, Chemical Recycling
<b>Sectors</b>	Energy, Pharmaceuticals, Medical

### Overview

The Degradable Biomaterials and Sustainable Polymers Research Group utilises the expertise and facilities of the University of Birmingham's Chemistry Department to work on 'green' strategies, sustainable polymers and plastic recycling. The Group aims to take a holistic focus, ensuring that new materials and/or methods of recycling do not generate or worsen environmental issues (for example, intensifying energy use for thermo-chemical recycling).

The Group's work is primarily focused on degradable polymers, encompassing both the design of polymers that degrade in specific environments (from medical to environmental), and the manipulation of catalysts to effectively breakdown different plastic waste streams. In terms of design, the Group focuses on polymer molecules that can target stereospecificity, mediate challenging transformations, degrade for recycling, and have high temperature stability and functional group tolerance. Through this focus, the Group aims to improve material functionality and subsequently increase the uptake of new materials from renewable sources.

The TRL of the work spans from Level 1 to Level 8, at which outputs of the work evolve from the fundamental and theoretical research to commercialised patents. The Group mostly utilises the new School of Chemistry facilities which facilitate the study on the composition and structure of materials, as well as being used to characterise their electrochemical, photophysical and rheological properties.

<b>Website</b>	<a href="https://www.dovegrouplab.com/">https://www.dovegrouplab.com/</a>
<b>Principal Contact, Role</b>	Professor Andrew Dove, Research Group Leader



# University of Birmingham

## School of Engineering



<b>Region</b>	West Midlands, England
<b>Key Partners</b>	University of Nottingham, University of Bath, University of Surrey, industry partners (including Toyota and SME's)
<b>Key Capabilities</b>	Access to lab-scale up to commercial semi-pilot scale
<b>Sources of Funding</b>	Public and private
<b>Keywords</b>	Waste Management, Recycling Technologies, Bio-based Materials, Polymer Testing
<b>Sectors</b>	Energy, Built Environment, Construction, Materials

### Overview

Plastics-specific research within the School of Engineering focuses on waste streams and recycling technologies, the development of innovative bio-based materials, the testing of polymer properties, and the manipulation of biodegradable polymers.

The School's research predominately focuses on undertaking a life-cycle analysis of different processes (pyrolysis of plastics, chemical recycling, feedstock recycling, pre-treatment approaches), and exploring how value can be added to end products with a view to encouraging circularity. The maturity level of their research is between TRL 2-3, with some outputs reaching 5 as they collaborate with industry partners. The School has multiple other research strands including:

- The potential of natural waste products (e.g., orange peel) to replicate properties of proteins and polymers in fashion applications;
- The possibility of using common waste products (e.g., carpet offcuts, wall sockets, water bottles) for replacing virgin materials in construction;
- Improving segregation and decontamination of recycling streams; and
- Product disassembly for component reuse.

The School has an underlying focus on 'real world' application to ensure that the research outputs are commercially viable and future-proofed if taken up by industry (e.g., that sustainable feedstocks are competitive with oil prices). One of the main resource-focused programmes of the School is the Alternative Raw Materials with Low Impact (ARLI) Programme. This partners with SMEs to encourage and foster innovation in smaller companies that do not always have the necessary technical and commercial expertise.

<b>Website</b>	<a href="https://www.birmingham.ac.uk/schools/engineering/index.aspx">https://www.birmingham.ac.uk/schools/engineering/index.aspx</a>
<b>Principal Contact, Role</b>	Professor Gary Leeke, Professor of Chemical Engineering



# University of Birmingham

## Water Sciences



<b>Region</b>	West Midlands, England
<b>Key Partners</b>	The Leverhulme Trust, Birmingham Water Council
<b>Key Capabilities</b>	ECOLaboratory, Thermo-Gravimetric-InfraRed-Gas Chromatography/Mass Spectrometry, advanced GPS, and material identification and tagging equipment
<b>Sources of Funding</b>	Public and private
<b>Keywords</b>	Microplastics, Ecosystem Pollution, Standards
<b>Sectors</b>	Water, Food and Drink

### Overview

Water Sciences is an interdisciplinary research group focused on coupled groundwater and surface water systems which investigates the multifaceted impacts of global environmental change on hydrological fluxes, biogeochemical cycling, and contaminant transport. The Group researches methods to measure and maintain healthy natural capital and aims to translate its findings into actionable, culturally-relevant solutions.

The Group has been working for over five years to revise the standard OECD guidelines – developed initially for dissolved chemicals – to manage the unique problems arising from particulate pollutants (including microplastics). The Group are currently undertaking a global investigation into freshwater microplastics and their transport, fate and ecotoxicological impacts. This involves developing a database of freshwater microplastic distribution, investigating microplastics movements and flows, and assessing microplastics uptake and bio-magnification in food webs.

The Group has full access to the Environmental Change Outdoor Laboratory. In the Laboratory, artificial mesocosms of watercourses are controlled to replicate and up-scale laboratory experiments and investigate how pollution affects ecosystems.

<b>Website</b>	<a href="https://www.birmingham.ac.uk/research/water-sciences/index.aspx">https://www.birmingham.ac.uk/research/water-sciences/index.aspx</a>
<b>Principal Contact, Role</b>	Professor Stefan Krauze, Prof. of Ecohydrology and Biogeochemistry



# University of Cambridge

## Cambridge Institute for Sustainability Leadership



<b>Region</b>	East of England
<b>Key Partners</b>	Polymateria, Lucozade, Sky PLC, the Natural Hydration Council)
<b>Key Capabilities</b>	Sustainability Leadership Solutions, Policy
<b>Sources of Funding</b>	Public and private
<b>Keywords</b>	Sustainability leadership, plastic waste, policy, business sustainability
<b>Sectors</b>	Food and Drink

### Overview

The Cambridge Institute for Sustainability Leadership (CISL) develops leadership and solutions for a sustainable economy through multi-disciplinary research, building the capacity of institutions and individuals and facilitating collaboration. The Institute's Centre for Policy and Industrial Transformation researches how society and industry can be reshaped to resolve global environmental crises, develop equitable social benefits, and secure economic opportunities.

CISL research into eliminating plastic waste has focused on developing business change case studies in order to increase understanding of how the removal of single-use plastics can fit into systemic, high-impact, and commercially viable change in business strategies. Through the project 'Future of Plastic Packaging', the CISL has organised multiple collaborations to help companies work towards eliminating plastic packaging waste. As part of this, CISL convened the Eliminating Plastic Packaging Waste Working Group in 2018 – an industry-led Group that brought together members from the bottled water and soft drinks value chain. The group of producers and academics built a roadmap for eliminating packaging waste, shared expertise in business model innovation and, through recognising the need to avoid 'quick fixes', set ambitious goals for the future transformation of the sector.

<b>Website</b>	<a href="https://www.cisl.cam.ac.uk/">https://www.cisl.cam.ac.uk/</a>
<b>Principal Contact, Role</b>	Dr Nina Seega, Research Director for Sustainable Finance



**University of Cambridge**  
**Cambridge Creative**  
**Circular Plastics Centre**



<b>Region</b>	East of England
<b>Key Partners</b>	The Cambridgeshire and Peterborough Waste Partnership (RECAP), Cambridge CleanTech, Energy Transitions IRC, Centre for Circular Economy, Centre for Global Equality, Centre for Science and Policy, Cambridge Institute Sustainability Leadership, British Antarctic Survey
<b>Key Capabilities</b>	Access to expertise and facilities across the University
<b>Sources of Funding</b>	UKRI
<b>Keywords</b>	Plastics, Sustainable Feedstocks, Materials, Manufacturing, Recycling Processes, Tracking, Material Flows, Waste Management, Behavioural Change
<b>Sectors</b>	All

**Overview**

The Cambridge Creative Circular Plastics Centre was set up in 2019 following the award of a UKRI Plastics Research Innovation Fund award. The Centre acts as a nucleus for a global network of partners and coordinates a range of research projects, workshops and forums to tackle contemporary challenges from the manufacture of more sustainable materials to driving innovations in plastic recycling.

The primary research themes of the Centre are:

- Sustainable feedstocks and materials;
- Manufacturing and recycling processes;
- Tracking plastics material flows; and
- Waste and management.

The different themes all consist of different teams, capabilities and partners. The research undertaken includes developing understanding of cultural perceptions of waste and how to incentivise behaviours, tracking and mapping UK plastic waste flows, and developing bio-plastic alternatives. A recent example of the Centre’s successful conversion of research into outputs is a patent filed on utilisation of photocatalysts for sunlight-driven conversion of waste plastics to hydrogen fuel. Capabilities of the Centre include access to numerous departments across the University.

<b>Website</b>	<a href="https://www.energy.cam.ac.uk/Plastic_Waste">https://www.energy.cam.ac.uk/Plastic_Waste</a>
<b>Principal Contact, Role</b>	Professor Erwin Reisner, Professor of Energy and Sustainability



# University of Exeter

## Exeter Centre for Circular Economy



<b>Region</b>	South West, England
<b>Key Partners</b>	Defra, Environment Agency, Ellen MacArthur Foundation, Greenpeace UK, Marine Conservation Society, AFC Energy, AKZO Novel, Plastics Europe, UK universities, internal university links, international universities, local authorities
<b>Key capabilities</b>	Systems and business modelling, ecotoxicology, biodiversity, ecosystem services assessment, LCA, community and social analysis, plastic/microplastics preparation, characterisation, recycling
<b>Sources of Funding</b>	BBSRC, EPSRC, ESRC Impact – Social Policy Network Funding, EU Horizons 2020, GCRF, NERC, National Geographic, Research England, Sea-life Foundation, UKRI
<b>Keywords</b>	Circular Economy, Behaviour Change, Biodiversity, Environmental and Socio-economic Impact Analysis, Citizen Science, Marine Litter, Plastic, Microplastics, Policy, Governance, Recycling, Systems Mapping and Modelling
<b>Sectors</b>	All

### Overview

The Exeter Centre for Circular Economy (ECCE) at the University of Exeter plays a role in the synthesis and integration of a wide range of interdisciplinary plastics research across institutes, centres, and individual research strands. The Centre combines circular economy theory and practice, marine sciences, and polymer engineering applied to systemic innovation in order to develop the future plastic economy.

The primary plastics-focused research being carried at the centre is the ExeMPLaR (Exeter Multidisciplinary Plastics Research) project for which the ExeMPLaR Hub was established. It aims to address the accumulation, impact and costs of plastics in the environment whilst maintaining and developing future applications of plastic for high-value purposes. In doing so, the Centre hopes to inform and educate policy makers, polymer chemists, manufacturers, recyclers and the wider population on the principle of ‘safer by design’.

Additional funded research initiatives include:

- The National Geographic ‘Sea to Source’ River Ganges Plastic Expedition;
- The presence of microplastics in marine turtles (in partnership with the SeaLife Trust);
- The VALSPEC project (VALorisation of polymer waste through SPECTroscopy) which aims to demonstrate the suitability of near-infrared spectroscopy for monitoring and detecting contaminants in the polyethylene recycling process; and
- ‘Data-Driven Intelligence for a Circular Economy’, which aims to investigate how data can shape decisions about the manufacture and utilisation of plastic products to accelerate the transition to a circular manufacturing system of the future.

<b>Website</b>	<a href="http://business-school.exeter.ac.uk/research/centres/circular/">http://business-school.exeter.ac.uk/research/centres/circular/</a>
<b>Principal Contact, Role</b>	Professor Peter Hopkinson, Co-Director of Exeter Centre for Circular Economy



<b>Region</b>	London and South East of England
<b>Key Partners</b>	Brunel University, Bangor University, Nextek Ltd, Solutions 4 Plastic, Amcor, overseas enterprises
<b>Key Capabilities</b>	Temperature and atmospheric control, and monitoring and measuring respiration rates in fresh produce, Simulation of the environments within food supply chains, shelf-life assessments, quality assessments, food safety (to be extended to food grade safety RE), migration of contaminants in (recycled) packaging, value chain analysis, impact assessments (social, economic, and environmental)
<b>Sources of Funding</b>	Innovate UK, BBSRC, AHDB, Newton Fund, commercial consultation and sponsorship
<b>Keywords</b>	Modified Atmosphere, Food Waste, Circular Packaging, LCA, VCA
<b>Sectors</b>	Agri-food, Food and Drink

**Overview**

In 2013, the Natural Resources Institute set up the Produce Quality Centre (PQC) for UK based research on fresh produce handling. Whilst packaging has been a focus of the Centre for 4/5 years, its focus on reducing plastic pollution is more recent (approximately 2 years). Currently, the Centre focuses on understanding how the characteristics and recyclability of plastic packaging affects the quality of perishable produce and the subsequent impacts on food waste.

The Centre's research focuses on increasing the recyclability (and recycled content) of food packaging whilst maintaining the necessary qualities to retain the quality of food. This includes measuring produce quality to optimise packaging conditions for storage, assessing the trade-off between convenience and sustainability of plastics, and addressing food contamination within plastic recycling. The Centre is also investigating whether compostable food packaging can contribute to a circular economy by enabling the simultaneous disposal of packaging with food waste. The Centre is equipped with testing equipment for packaging quality and effectiveness, such as controlled atmosphere chambers to control and monitor atmospheric gases.

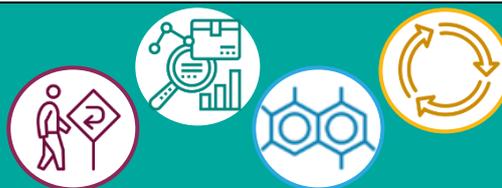
The wider Institute is a multi-disciplinary research centre with experience of working with global supply chains and containing experts in social economics as well as plant physiology and biochemistry. As such, it can combine the chemical testing and physiological assessments of crop responses to packaging with social science research into patterns of food waste and recycling behaviours (including life-cycle and value chain analysis). To ensure that their research is applicable along the supply chain, the Institute has a strong emphasis on stakeholder engagement, particularly with agricultural producers (both in the UK and overseas in developing countries). To implement a circular economy, the Institute understands that advances must be organisational, technological and will depend on effective knowledge exchange.

<b>Website</b>	<a href="https://www.nri.org/">https://www.nri.org/</a>
<b>Principal Contact, Role</b>	Dr Lorraine Fisher, Enterprise Development Fellow



# University of Hull

## Plastics Collaboratory



<b>Region</b>	Yorkshire and the Humber, England
<b>Key Partners</b>	International Sustainable Development Research Society, Waitrose, Morrison's, National Aquaculture Centre, Reckitt Benckiser, The Deep, William Jackson Food Group, CIWM, East Riding of Yorkshire and Hull Councils, Garthwest, Del Monte, Humber Nature Partnership
<b>Sources of Funding</b>	Public and private
<b>Keywords</b>	Citizen Engagement, Policy, Consumer Behaviour, Marine Plastics, Waste-to-Resource
<b>Sectors</b>	Food and Drink

### Overview

The Plastics Collaboratory is a long-term project within the University's Energy and Environment Institute. It is a multi-disciplinary academic partnership including a broad range of expertise including politics, chemistry, logistics, social linguistics, environmental sciences, psychology, marketing and engineering. The Collaboratory aims to understand the pathways and interactions of plastics in the environment, identify the gaps and leaks in a circular plastics economy, and explore and develop new pathways to enhanced circularity in plastics use. The Collaboratory has a strong focus on supply chains and existing recycling infrastructure. In particular it emphasises the necessity of engaging stakeholders to ensure that solutions address needs at every stage of the production and consumption life-cycle.

Ongoing projects include:

- 'Plastics Citizen' within the School of Education which aims to engage young people to understand perceptions and consumer attitudes towards plastic waste.
- The 'River of Plastics' project which quantifies the movement of plastics through fluvial and marine processes, to identify hotspots, sources and flows.
- 'Evolving a Circular Plastics Economy' – hosted by The Collaboratory and one of the eight Plastics Research Innovation Fund projects – which aims to develop commercially viable reprocessing methods for the regeneration of useful chemicals from plastic waste.

<b>Website</b>	<a href="https://circularplastics.hull.ac.uk/">https://circularplastics.hull.ac.uk/</a>
<b>Principal Contact, Role</b>	Dr Pauline Deutz, Reader in Geography, Lead Researcher



# University of Leeds

## School of Design



<b>Region</b>	Yorkshire and the Humber, England
<b>Key Partners</b>	Global textile industry partners, universities across Europe, Asia and the USA
<b>Key Capabilities</b>	Laboratories for polymer processing, fibre, yarn, and fabric prototyping), fabric finishing, garment assembly, extensive analytical and materials testing capabilities
<b>Sources of Funding</b>	EPSRC, AHRC (Arts and Humanities Research Council), BBSRC, Innovate UK, H2020, industry
<b>Keywords</b>	Sustainable Materials, Bio-materials, Fibres, Textiles, Colour, Microfibres, microplastics
<b>Sectors</b>	Textiles, Fashion, Plastics, Green Chemistry, Healthcare

### Overview

The School of Design aims to use design, science and technology to stimulate innovation and to develop new ideas and solutions to issues faced by industry and society. The School's research addresses the broad themes of the economy, environment, health and culture.

Core strengths relevant to plastics include the engineering of new materials and bio-polymers, advanced textile product design, new manufacturing processes, alternative colouration methods and innovation for circular economies in fashion and textiles. The School's projects include microfibre release from textiles during laundering, the development of sustainable dye chemistry, polymer recycling and the design of remanufactured fashion products. Major recent research includes:

- The creation of the £1.76m 3D Weaving Innovation Centre (3D WIC) supported by the ERDF;
- Leading the AHRC £5.4m Future Fashion Factory research and development (R&D) partnership. This is part of the UK's Creative Industries Clusters Programme which explores and develops new digital and advanced textile technologies to boost the design of high-value creative products; and
- The £1.75m Clothworkers' Centre for Textile Materials Innovation for Healthcare (CCTMIH). This is developing new bio-materials and biodegradable/bio-resorbable polymers for medical devices.

In addition to the projects outlined above, the School has a focus on education and training. In particular, training is targeted at future managers and innovators with a view to disseminating knowledge and operationalising new business models relevant to circular economies. There is a strong emphasis on collaborative R&D, with the School working across different academic disciplines addressing well-defined industry and societal challenges. This involves working closely with a wide network of international industry partners as well as governmental organisations to ensure results positively impact society.

<b>Website</b>	<a href="https://ahc.leeds.ac.uk/design">https://ahc.leeds.ac.uk/design</a>
<b>Principal Contact, Role</b>	Professor Chris Carr, Professor in Textile Technology



**University of Manchester**  
**Department of**  
**Materials, Textiles &**  
**Fashion Group**



<b>Region</b>	North West, England
<b>Key Partners</b>	Henry Royce Institute, Graphene Engineering Innovation Centre, industry partners, NGOs, internal university links, UK universities
<b>Key Capabilities</b>	Materials characterisation, research and innovation
<b>Sources of Funding</b>	UKRI, industry, EU
<b>Keywords</b>	Bio-materials, novel textile materials, Fashion Management and Marketing, Imaging and Characterisation, Nano and Functional Materials, Polymers and Composites, Textiles and Apparel
<b>Sector</b>	Built Environment, Construction, Chemistry, Energy, Medical and Healthcare, Materials, Electronics, Sensors and Photonics, Manufacturing, Digital and Creative, Design, Sustainability and CE, Textiles, Food and Drink

**Overview**

The Department of Materials at the University of Manchester is the largest department of materials in Europe. Its investment in materials includes the creation of the Henry Royce Institute and the Graphene Engineering Innovation Centre. The Department offers multi-disciplinary research activities in eight themes – bio-materials, coatings and ceramics, fashion management and marketing, imaging and characterisation, metallurgy and corrosion, nano and functional materials, polymers and composites, and textiles and apparels. Plastic specific research occurs across all eight themes. Examples include developing biodegradable materials as an alternative to petroleum-derived plastics and exploring the place of bio-derived materials in the supply chain (including the necessary recycling infrastructure, both chemical and mechanical).

The Textiles & Fashion Group addresses multiple materials (including plastics), environmental and social sustainability issues within the textiles and fashion industries. Their research explores consumer attitudes towards reuse, perceptions of fast fashion, the chemical recyclability of different textiles materials, the sharing/rental economy, and the impacts of microplastics derived from clothing.

Research across all themes is focused on meeting the needs of consumers and industry. The Group frequently collaborates on projects with NGOs and textiles producers to understand how policy and innovation will affect stakeholders across the global textile supply chain. With access to a range of facilities and equipment due to the wide variety of themes, the Department is able to test a variety of materials and support research into concepts regarding consumer behaviours.

<b>Website</b>	<a href="https://www.materials.manchester.ac.uk/">https://www.materials.manchester.ac.uk/</a>
<b>Principal Contact, Role</b>	Dr Claudia Henninger, Lecturer in Fashion Marketing and Management



University of  
Manchester



**Sustainable Materials Innovation Hub  
at the Henry Royce Institute**

<b>Region</b>	North West, England
<b>Key Partners</b>	Department of Materials, Green Materials Laboratory, Manchester Environmental Research Institute, Manchester Institute of Biotechnology, Sustainable Consumption Institute, Graphene Engineering Innovation Centre, NGOs, industry partners
<b>Key Capabilities</b>	Sustainable materials advice, assessment and innovation
<b>Sources of Funding</b>	European Regional Development Fund (ERDF), UKRI, industry
<b>Keywords</b>	Waste Management, Sustainable Plastics, Plastics and Packaging, Industry Engagement
<b>Sector</b>	Built Environment, Construction, Chemistry, Materials, Manufacturing, Design, Sustainability and CE, Textiles, Food and Drink

**Overview**

The Henry Royce Institute supports UK materials research, aiming to accelerate commercial exploitation of innovation and deliver positive economic and societal impact for the UK. The Institute enables national materials research fore-sighting, collaboration and strategy by catalysing industrial collaboration and exploitation of materials research, and fostering materials science skills development, innovation training and outreach. By aligning itself to the UK Government Industrial Strategy, and with the knowledge and facilities to contribute to a wide range of research and development areas, the Institutes research focus evolves with changing national priorities.

In Spring 2021, a new £10m Sustainable Materials Innovation Hub (SMIH) for Greater Manchester (GM) will be launched at the Henry Royce Institute. By bringing together scientific, economic and social research efforts, the SMIH aims to support small to medium businesses across Greater Manchester in finding sustainable innovations to waste management, building a circular economy, and exporting innovation and best practice (both nationally and internationally). Through collaborating with other academic institutions and industry, the SMIH also aims to develop an understanding of the behaviours of individuals and businesses that may inhibit the adoption of innovation. The SMIH will have three linking laboratories in the Royce building, equipped with the capability to characterise, synthesise and process polymers. This will facilitate innovation in new sustainable polymers, improve methods of recycling, and validate emerging sustainable materials that appear on the market.

<b>Website</b>	<a href="https://www.royce.ac.uk/smi-hub/">https://www.royce.ac.uk/smi-hub/</a>
<b>Principal Contact, Role</b>	Professor Michael Shaver, Professor of Polymer Science, Hub Director



# University of Manchester

## Sustainable Consumption Institute



<b>Region</b>	North West, England
<b>Key Partners</b>	UK universities (including the University of Sheffield), Tesco, Co-operative, M&S WRAP, WWF
<b>Key Capabilities</b>	Social research
<b>Sources of Funding</b>	Public and private
<b>Keywords</b>	Consumption, Socio-cultural Change, Innovation, Politics, Social Justice, Business Models
<b>Sector</b>	Agri-food, Digital and Creative, Design, Sustainability and CE, Food and Drink

### Overview

The Sustainable Consumption Institute aims to understand the processes of consumption and production in areas that are integral to society. Their research lies in five key fields: consumption, socio-cultural change, innovation, politics and social justice. Recent research has focused on examining the processes of societal change – from areas including climate change and resource scarcity to social inequality and environmental injustice – in order to identify how long-term and large-scale changes to sustainable consumption can be achieved. To identify the most important processes that lead to, or hinder, societal change, the Institute believes research must be comparative of societies, cultures, social groups and sectors.

The Institute’s plastics research includes investigating successful business models that can reduce the both the production of plastics and plastic use at source, and researching the societal factors which contribute to plastic waste (e.g., why people litter or how households consume and dispose of plastic products). By understanding these practices, researchers hope to develop practical ways of incentivising people, governments and businesses to change their habits to more environmentally-friendly practices.

<b>Website</b>	<a href="https://www.sci.manchester.ac.uk/">https://www.sci.manchester.ac.uk/</a>
<b>Principal Contact, Role</b>	Dr Helen Holmes, Lecturer in Sociology



<b>Region</b>	East Midlands, England
<b>Key Partners</b>	Biome Technologies PLC, Lucite International, University of Cambridge, Centre for Process Innovation (CPI), EPSRC Future Bio-manufacturing Research Hub, Unilever, Severn Trent
<b>Key Capabilities</b>	GSK Carbon Neutral Laboratory, Centre for Sustainable Chemistry, Green Chemicals Beacon of Excellence, Sustainable Processing Laboratory, Synthetic Biology Research Centre, Future Food Beacon of Excellence, EPSRC-SFI Centre for Doctoral Training in Sustainable Chemistry, Smart Products Beacon
<b>Sources of Funding</b>	BBSRC, EPSRC, IUK, Consultancy
<b>Keywords</b>	Novel Polymers, Advanced Manufacturing, De- and Re-polymerisation
<b>Sectors</b>	Food and Drink, Materials, Processes, Chemistry

#### Overview

The Sustainable Chemicals Group at the University of Nottingham is a multi-disciplinary collection of academics from the Schools of Chemistry, Biological and Life Sciences and the Faculty of Engineering. Their work is targeted at innovation that aims to reduce reliance on fossil fuel-based feedstocks and create a more circular and sustainable bio-based economy.

The Group's plastics work largely focusses on developing bio-based and bio-degradable plastic alternatives for packaging, including innovative new materials such as elastic paper. Sustainable Chemicals also have projects looking into microwave depolymerisation for recycling plastics and techno-economic analysis and life-cycle assessment of competing materials.

The Group has access to the University of Nottingham's facilities which are supported by funding from Research England. This includes the Nanoscale and Microscale Research Centre (nmRC). The Group is a partner of the EPSRC Future Bio-manufacturing Research Hub. The University also has a long-standing relationship with Lucite – a designer and developer of acrylic-based products and durable plastics.

<b>Website</b>	<a href="https://www.nottingham.ac.uk/research/beacons-of-excellence/green-chemicals/index.aspx">https://www.nottingham.ac.uk/research/beacons-of-excellence/green-chemicals/index.aspx</a>
<b>Principal Contact, Role</b>	Simon Gerrard, Corporate Partnerships Senior Executive, Industrial Biotechnology and Sustainable Chemistry



# University of Oxford

## Oxford Martin School



<b>Region</b>	South East, England
<b>Key Partners</b>	Department of Chemistry (University of Oxford), The Smith School of Enterprise and the Environment (University of Oxford), Faculty of Law (University of Oxford), World Economic Forum, Unilever, SCG Chemical, Eonic Technologies, Covestro, DSM, NGOs
<b>Key Capabilities</b>	Chemistry and materials (bio-based, recyclable and biodegradable plastics), environmental economics, international public law
<b>Sources of Funding</b>	Oxford Martin School, EPSRC, industry sponsorship
<b>Keywords</b>	The Future of Plastics, Biodegradable Plastics, Bio-based Plastics, Circular Economy Plastics, Sustainable Polymers, CO2 Polymers, CO2 Utilisation
<b>Sector</b>	Build Environment, Construction, Agri-food, Chemistry, Materials, Manufacturing, Sustainability and CE

### Overview

The Oxford Martin Programme Future of Plastics (2019-2023) is a consortium carrying out cross-disciplinary fundamental research through to later stage TRL research across a variety of fields. These fields include environmental economics, public international law and polymer chemistry/materials science. The Programme aims to develop new plastic materials, examine the stocks and flows of plastics across the globe, and propose policy and regulatory levers to accelerate a sectoral transition to a circular economy where plastics can be re-used, recycled or degrade without environmental harm.

Core areas of the Programme's research include developing technology to improve the sustainability of plastics, carrying out techno-economic and life-cycle assessments, reviewing the legal framework surrounding waste management, assessing the role of extended producer responsibility (and similar schemes) in the formulation of new business models, and analysing the trade-offs between environmental and socio-economic goals.

The Programme also researches the development of recyclable and/or biodegradable materials that can replace single-use plastics. To this end, research strands include the preparation of new sustainable and recyclable thermoplastics and resins (bio-based/CO2-based) and exploration of new polymers for homecare applications which are fully biodegradable. Key project outputs include numerous white papers and policy briefings, including the White Paper, 'Science to enable sustainable plastics', and the World Economic Forum Plastics transformation map.

<b>Website</b>	<a href="https://www.oxfordmartin.ox.ac.uk/future-of-plastics">https://www.oxfordmartin.ox.ac.uk/future-of-plastics</a>
<b>Principal Contact, Role</b>	Professor Charlotte Williams, Professor of Inorganic Chemistry



## University of Plymouth International Marine Litter Research Unit



<b>Region</b>	South West, England
<b>Key Partners</b>	Supermarkets, UK universities, international universities, Water Industry Research, United Nations Environment Programme, DEFRA, CEFAS
<b>Key Capabilities</b>	Clean lab, textile emission laboratory, various spectrometers, particle size analyser, Scanning electron microscopy, business/commercial collaborations, environmental psychology and behaviour change, environmental law
<b>Sources of Funding</b>	NERC/UKRI, Defra, INTERREG, Economic and Social Research Council, Leverhulme Trust, EU Horizon 2020, National Geographic, eXXpedition, Argans Limited, Blue Marine Foundation, charitable and industrial funding
<b>Keywords</b>	Microplastics, Plastic, Fibres, Marine Pollution, Ecotoxicology, Textiles, Environment, Behaviour Change, Policy
<b>Sectors</b>	Sustainability and CE, Textiles, Materials, Environment, Chemistry, Biology.

### Overview

The University of Plymouth's International Marine Litter Research Unit (IMLRU) aims to further understand the impact of litter on the environment and society, identify solutions to mitigate the impacts of litter, and define the pathways necessary to reduce litter in the environment.

The IMLRU's 2004 paper 'Lost at Sea: Where is all the Plastic?' was the first to describe microplastics in the ocean, establishing a new field of academic enquiry on a previously been an under-researched aspect of marine pollution. The IMLRU have continued to contribute to understanding of microplastics, from showing that they are ingested and retained by marine organisms (2008), to illustrating their widespread global distribution in some of the most remote locations on Earth, including in Arctic ice and the deep sea (2014).

IMLRU also focus on developing solutions to the plastic problem. Previous research has included reviewing options to stem the flow of plastic to marine and freshwater environments and the determining the best ways to reduce our reliance on single-use plastics and transition towards a more circular economy.

IMLRU's research has influenced global policies, helped to guide industry best practice, and contributed to a major shift in public awareness and behaviour. For example, it directly contributed to the UK ban of cosmetic microbeads (2018). The IMLRU also provided evidence to Government inquiries into the taxing of plastic bags and the sustainability of textiles used in the fashion industry. In 2019, IMLRU ground-breaking research and policy impact relating to microplastics pollution resulted in the award of the Queen's Anniversary Prize for Higher and Further Education, the highest honour that can be bestowed upon a higher education institution.

<b>Website</b>	<a href="https://www.plymouth.ac.uk/research/marine-litter">https://www.plymouth.ac.uk/research/marine-litter</a>
<b>Principal Contact, Role</b>	Professor Richard Thompson OBE FRS, Head of the International Marine Litter Research Unit and Director of Marine Institute, University of Plymouth



## University of Portsmouth Centre for Enzyme Innovation



<b>Region</b>	South East, England
<b>Key Partners</b>	Montana State University Geobiology Laboratory, US Department of Energy National Renewable Energy Laboratory, Diamond Light Source, GlaxoSmithKline (GSK), industry partners
<b>Funding</b>	UKRI
<b>Key words</b>	Enzymatic Digestion, Plastic Recycling
<b>Sector</b>	All

### Overview

The Centre for Enzyme Innovation focuses on researching transformative enzyme-enabled solutions for the circular recycling of plastics and quantifying rates of plastic production, recycling and waste. By analysing the breakdown of plastics from enzyme processes in the natural world, the Centre aims to discover new enzymes, engineer their activity for maximum stability and efficiency in breaking down plastic waste into usable polymers, and deploy these enzymes for usage in recycling and waste management at scale.

The research is considered as a potential solution to the management of contaminated and multi-stream waste. Consequently, the Centre's findings have been cited in the UK Clean Growth Industrial Strategy and they have partnered with GSK for the usage of their fermenting factory facilities. The Centre's multiple industry partnerships ensures that enzyme research is focused on the breakdown of polymers that industries are currently utilising.

The work of the Centre is currently at TRL 1-3 and aims to ascend to TRLs 4-7 as the enzymes reach commercial readiness. Though the Centre is mostly working in biochemistry, their biological recycling processes are developed in conjunction with research into mechanical, chemical and thermal recycling technologies. As a result of university, industry and government funding, the Centre has developed miniaturised bacteria sequencing technology, electron microscopes and enzyme stability measures. The Centre also benefits from the use of the faculties at the university's Institute of Marine Sciences and the Diamond Light Source in Oxford.

<b>Website</b>	<a href="https://www.port.ac.uk/research/research-centres-and-groups/centre-for-enzyme-innovation">https://www.port.ac.uk/research/research-centres-and-groups/centre-for-enzyme-innovation</a>
<b>Principal Contact, Role</b>	John McGeehan, Professor of Structural Biology, Centre Director



## University of Sheffield Grantham Centre for Sustainable Futures



<b>Region</b>	Yorkshire and the Humber, England
<b>Key partners</b>	Academia, businesses and policy makers
<b>Key Capabilities</b>	Integrated analytical tool for life-cycle analysis
<b>Sources of Funding</b>	UKRI and industry
<b>Keywords</b>	LCA, Responsible Consumption and Production, Bio-plastics Standards
<b>Sectors</b>	Agri-food, Medical and Healthcare, Food and Drink

### Overview

The Grantham Centre for Sustainable Futures structures its research around the UN Sustainable Development Goals (SDGs). Its research themes encompass cities, food security, climate action, biodiversity, water and energy. Its plastic-specific research is focused on contributing to SDG 12: Responsible Consumption and Production. The Centre has a strong commitment to public engagement as part of its outreach.

The Centre was awarded funding from the UKRI Plastics Research Innovation Fund to form a multi-disciplinary research team into the project 'Plastics: Redefining Single-Use'. The project aims to challenge the perceived wisdom of a throw-away culture of degradable plastics, stimulate creative thinking across disciplines, and explore novel solutions to problems caused by plastic. The goal is a move towards a zero-waste, circular economy for plastics by reusing more, reducing use and recycling better.

Another strand of the Centre's research is examining the need for regulatory standards on new bio-plastic materials to avoid corporate 'greenwashing'. To this end, the Centre is undertaking life-cycle analysis of new bio-plastics and engaging with consumers to ascertain perceptions of different materials, with the aim to develop transparent, accurate and evidence-based standards.

<b>Website</b>	<a href="http://grantham.sheffield.ac.uk/">http://grantham.sheffield.ac.uk/</a>
<b>Principal Contact, Role</b>	Deborah Beck, Grantham Centre Manager



<b>Region</b>	South East, England
<b>Key Partners</b>	Planet Ocean Ltd, Defence Mission Systems, L3 ASV, University of Liverpool, University of Southampton, University of Exeter
<b>Key Capabilities</b>	Research ships, ocean observatories, moorings, and autonomous underwater and surface vehicles. Informative facilities including the National Oceanographic Library, British Oceanographic Data Centre, Marine Autonomous Robotics Systems. Environmental sampling equipment, state of the art analytical equipment, advanced modelling capability
<b>Sources of Funding</b>	UK Government (especially UKRI Research Councils), Industry, EU
<b>Keywords</b>	Plastics, Microplastics, Anthropogenic Contaminants, Organic Pollutants, Biology, Chemistry, Bio-geochemistry, Physical Oceanography, Hydrodynamic Modelling
<b>Sector</b>	All

**Overview**

The National Oceanography Centre (NOC) is an independent organisation researching marine geoscience, physics, climate, modelling and ecosystems. The plastics-specific research of the Centre evaluates the environmental fate and effects of conventional and novel polymeric materials (hydrocarbon and bio-based polymers). With particular research emphasis placed on understanding the behaviour, degradation and movement of microplastics.

The NOC Microplastics Research Group was established in 2015. Research, both in the UK and overseas, focuses on microplastic sources, transport and fate within the marine environment, pathways into and through ecosystems, and health effects on aquatic organisms. The NOC staff have substantial experience in field sampling of microplastics at sea and inland. Furthermore, the Centre is equipped with an  $\mu$ FTIR (a micro-Fourier Transform Interferometer which enables infrared analysis of microplastics), a dedicated clean (trace element) lab and experimental labs for carrying out a range of environmental analyses and experimental studies. The Centre also hosts the National Marine Equipment Pool, which is the largest centralised marine scientific equipment pool in Europe, with a diverse range of scientific instruments and equipment capable of sampling from the sea surface to the deep ocean.

NOC research feeds into both policy and business models – informing perceptions of both public and industrial stakeholders, as well as supplying evidence bases for public bodies (including DEFRA and the Environment Agency). In addition to this, personnel from the Centre lead the UK Microplastics Network.

<b>Website</b>	<a href="https://www.noc.ac.uk/">https://www.noc.ac.uk/</a> <a href="https://noc.ac.uk/science/microplastics">https://noc.ac.uk/science/microplastics</a>
<b>Principal Contact, Role</b>	Dr Alice Horton, Principal Investigator – Anthropogenic Contaminants



## University of Surrey

### Centre for Environment and Sustainability



<b>Region</b>	South East, England
<b>Key Partners</b>	WWF, Wates Group, Heathrow Airport, Aviva, WRAP
<b>Funding</b>	Public
<b>Keywords</b>	Plastic Governance, Corporate Greenwashing, Consumer Perceptions
<b>Sectors</b>	Food and Drink

#### Overview

The Centre for Environment and Sustainability applies inter-disciplinary approaches to the analysis of complex environmental systems. The purpose of their research is to integrate engineering and science-based disciplines with insights from the economic and social sciences to develop action-oriented, policy-relevant responses to long-term sustainability issues.

The Centre leads two of the University's research themes of Sustainability and Urban Living. In terms of work directly related to plastics, the Centre is undertaking research on the discourse and governance of plastics circularity. This relates to addressing current concerns regarding corporate greenwashing, the unintended consequences of new materials, and consumer misperceptions and misinformation. Many of the Centre's project partnerships are with overseas institutions and NGOs.

<b>Website</b>	<a href="https://www.surrey.ac.uk/centre-environment-sustainability">https://www.surrey.ac.uk/centre-environment-sustainability</a>
<b>Principal Contact, Role</b>	Moira Foster, Centre Administrator



# University of the Arts London

## Centre for Circular Design



<b>Region</b>	London, England
<b>Key Partners</b>	Centre for Sustainable Fashion, Worn Again Technology, industry partners
<b>Funding</b>	AHRC and private
<b>Keywords</b>	Circular Textiles, Polyester Fibres, Textiles Chemical Recycling, Second-Hand Clothes, Consumer Behaviour
<b>Sectors</b>	Textiles, Materials, Design

### Overview

Whilst the Centre for Circular Design was formally established in 2017, the leading researchers within the organisation have been collaborating in this field since 1999. The Centre’s primary goal is to integrate textiles into the wider circular economy debate.

The Centre’s research encompasses designing new polyester fibres from which chemical dye can be removed to increase re-use, developing chemical recycling technologies, manipulating existing materials for greater recyclability, and enabling disassembly and reuse of designed products. In addition to the aforementioned research which encompasses engineering and physical sciences, the Centre also collaborates with researchers and institutes from across the political and social science disciplines. Social science research includes understanding public perceptions around second-hand products and developing clearer communication of product characteristics to improve ‘buying right first time’ to reduce return rates.

Industry funding and collaborations with other universities has enabled concepts, designs, materials, and infrastructure resulting from the Centre’s work to be scaled up and adopted by the private sector. The Centre is currently leading a collaborative project with multiple other universities – ‘The Business of Fashion, Textiles and Technology’. This is one of nine Creative R&D Partnerships, developed as part of the UKRI and Arts and Humanities Research Council-funded Creative Industries Clusters Programme.

<b>Website</b>	<a href="https://www.circulardesign.org.uk/">https://www.circulardesign.org.uk/</a>
<b>Principal Contact, Role</b>	Dr Kate Goldsworthy, Reader, Chelsea College of Arts