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Rethinking UK Packaging Policy to Unlock Bio-Based Innovation, National Resilience and Economic Growth

BBIA

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01 Executive Summary

Modern Society Depends on Packaging

Modern society depends on packaging to function effectively, enabling products to be safely stored, transported, and delivered at scale — supporting everything from global food systems to healthcare and e-commerce. It protects goods from damage and contamination, extends shelf life, reduces waste, and ensures that critical items like medicines and sterile equipment reach people in a usable condition.

However, most packaging today is still derived from fossil-based materials, creating a significant environmental challenge. The short use phase of many packaging formats, combined with limited reuse and recycling, results in large volumes of waste and persistent pollution. As demand for convenience and distribution continues to grow, addressing the reliance on fossil-based packaging and reducing waste has become one of the most urgent priorities for building a more sustainable, circular economy.

Scale of the UK Packaging Waste Challenge

The UK generates around 12 million tonnes of packaging waste annually, yet only 53.7% of plastic packaging was recycled in 2024. Incinerating UK plastic produces an estimated 3 million tonnes of fossil CO_2 each year - comparable to the carbon footprint of cities like Manchester or Glasgow. Recovery rates, particularly for films and small plastics, remain low (7%) and are expected to stay poor even after mandatory film collections in 2027, highlighting the need for alternative materials that reduce fossil use and improve circularity.

Policy Context Supporting Bio-Based Materials

Government policies and industry initiatives, including The UK's Modern Industrial Strategy 2025, the Engineering Biology Vision, the National Materials Innovation Strategy, The UK Packaging Pact, and the Delivering a Net Zero National Health Service Strategy, position bio-based materials as central to economic growth, resilience, and resource efficiency.

UK Innovation Strength and Market Opportunity

The UK is well placed to lead advanced bio-based materials innovation, having invested over £450 million via UKRI in bio-based chemicals and materials research between 2018 and 2024. Independent analysis suggests the sector could become a £4.2 billion domestic industry, supporting 35,000 skilled jobs across R&D, manufacturing, and supply chains. The bio-based packaging market is projected to reach $585.4 million by 2033, with a 7.4% CAGR from 2025–2033.

Public Investment and Emerging Technologies

UKRI has also committed £60 million through the Smart Sustainable Plastic Packaging Challenge and £50 million via the National Materials Innovation Programme (launched by Minister Vallance in February 2026, with an emphasis on sustainable bio-based and biodegradable packaging), to support projects such as seaweed-based packaging, plant-protein barrier coatings, biochar foams, and compostable bio-based materials.

Cost Barriers and Market Competitiveness

Despite this, bio-based packaging is up to 2.5 times more expensive than fossil-based alternatives due to feedstock, processing, production scale, infrastructure, and immature supply chains, with the current tax system widening the gap.

Packaging Policy Reform and Regulatory Landscape

The UK is at a critical point in reforming its packaging-waste system. With the Plastic Packaging Tax, Simpler Recycling, Extended Producer Responsibility (EPR) and the UK Emissions Trading Scheme (ETS) underway, it is vital that regulations support, rather than hinder, the shift from fossil-based packaging, particularly in hard-to-recycle segments.

Policy Misalignment and Unintended Consequences

Recent research shows current policy measures fall short of enabling bio-based innovators to meet government ambitions. Analysis of the ETS, EPR, and PPT highlights misalignment between policy and environmental goals.

The present policy framework primarily evaluates materials based on recyclability metrics rather than full lifecycle environmental performance. As a result, many bio-based materials incur significantly higher compliance costs. This can increase costs for bio-based materials by hundreds of pounds per tonne, widening an already significant price gap with fossil-based alternatives.

Economic Risks of Inaction

These policy signals conflict with wider government strategies promoting advanced materials, engineering biology, and biomanufacturing. Independent analysis indicates that failure to support the domestic bio-based sector has already contributed to the loss of over 4,000 skilled jobs and £300–500 million in annual economic value, with further company closures and investment relocation likely if conditions do not improve.

Evidence Base on Bio-Based Material Performance

Evidence from industry and research programmes indicates that many commonly cited concerns about bio-based packaging, such as contamination of recycling streams or microplastic formation, are not supported by current data. For example, modern sorting technologies can effectively manage volumes of novel materials, and materials designed for composting do not generate microplastics under controlled conditions (see appendix for further details).

The BBIA and its members are committed to continued evidence generation through monitored trials and collaborative research with government and waste-management stakeholders.

Timing Challenges and Urgency for Intervention

The core issue is one of timing. We recognise that Defra's PackUK Roadmap includes a commitment to "review inclusion of bioplastics and compostables" in 2029, and we appreciate that the integration of bio-based materials within a circular economy framework presents genuine technical and policy complexities. We also acknowledge the significant implementation burden currently being managed by PackUK.

A comprehensive review in 2029 may be well intentioned, but for many businesses currently attempting to scale manufacturing and attract investment in the UK, that timeline is simply too distant. Without earlier intervention or transitional adjustments, the policy environment risks accelerating company failures and relocation decisions long before any formal review takes place.

Industry Position and Policy Recommendation

BBIA therefore requests an immediate cross-departmental review of how bio-based packaging materials are treated across the UK's environmental tax and regulatory system, to ensure policy coherence and avoid unintended barriers to British innovation. The objective is not preferential treatment, but a proportionate framework that recognises the huge amount of taxpayers' money invested in development of bio-based materials, lifecycle carbon benefits and enables emerging solutions to compete fairly during this critical stage of sector development.

We propose:

1

Establishment of a technical RAM bio-based and biodegradable materials working group to:

- Review evidence from existing bio-based, compostable and natural polymer trials.
- If/where evidence gaps exist, jointly plan work required to close gaps
- Propose specific RAM adjustments and timelines
- Develop guidance on categorisation and claims for bio-based, compostable and natural polymer packaging.

2

Establishment of a dedicated taskforce between policymakers (DEFRA, HMT, DESNZ) and bio-based material producers to map out a practical roadmap for the treatment of biogenic carbon across all environmental taxes (e.g. PPT, EPR, ETS).

By taking these steps, the UK can position itself as a global leader in sustainable materials, while ensuring that packaging regulation is an enabler—not a barrier—to the transition away from fossil-based materials.

02 Understanding Bio-Based Materials

Across government, industry, and consumer sectors, there remains significant confusion about the differences between bio-based and biodegradable materials[1]. This confusion is compounded by the absence of standardised terminologies, which prevents clear and consistent communication among key stakeholders. As a result, bio-based and biodegradable materials are often grouped together under a single umbrella, obscuring their distinct benefits, performance characteristics, and environmental benefits. This conflation limits the ability to appropriately recognise and fairly treat each material type through tailored policies, regulations, and tax incentives.

A common example of this misunderstanding is the term *'bioplastic'*. Frequently used as a catch-all label, it fails to differentiate between plastics derived from biological sources (bio-based), those capable of breaking down under specific conditions (biodegradable), and those that combine both attributes. Such lack of clarity has far-reaching consequences for policy development, market growth, and consumer perception, ultimately slowing the shift toward genuinely more sustainable material systems.

02.01 The breadth of bio-based and biodegradable materials

The following defines the differences in bio-based materials and exemplifies how they fit within the UK waste hierarchy and contribute to a truly circular economy (see Figure 1).

Bio-based materials: Are derived wholly or partly from renewable biological sources such as plants, algae, or microorganisms. Their primary environmental advantage lies in the potential reduction of fossil resource dependency and associated greenhouse gas emissions. Bio-based materials:

- Can be chemically identical to fossil-based plastics (e.g. bio-PET, bio-PE), and therefore behave identically in production and recycling systems, or
- Can be novel materials with different polymer structures, have mechanical recycling ability, and/or alternative end-of-life pathways
- Bio-based does not automatically mean biodegradable or compostable.

Biodegradable materials: Can undergo biodegradation. Biodegradation is the microbial conversion of the organic constituents of a material or substance to carbon dioxide, new microbial biomass and minerals under aerobic conditions - or to carbon dioxide, methane, new microbial biomass and minerals under anaerobic conditions. The rate of biodegradation depends on environmental conditions and on the type and properties of the material. A material's biodegradability is linked to the chemical structure of the polymer chain and does not depend on the origin of the raw materials; hence biodegradable materials may be derived from either fossil-based or biomass feedstocks. Therefore, not all bio-based materials are biodegradable, and not all biodegradable materials are bio-based.

Compostable materials and finished products: Can undergo biodegradation during composting to yield carbon dioxide, water, minerals and biomass. Within this broad definition, two important subcategories are:

- **Industrially compostable:** Finished products that break down in industrial composting environments within a defined timeframe and under specified conditions, leaving no toxic residue. A finished product can be made from one or more materials, and may include additives such as pigments, inks and adhesives. In the UK, standards accepted by industry and environmental regulators include EN 13432, EN 14995 and ASTM D6400. Rules on wastes

[1] BB-REG-NET, Plastic definitions in UK regulations, 2025

acceptable at organic recycling facilities include that compostable finished product must be certified compliant with one of these standards by an independent certification scheme provider.

- **Home compostable:** Finished products that break down in home composting environments within a defined timeframe and under specified conditions. A finished product can be made from one or more materials, and may include additives such as pigments, inks and adhesives. In the UK, standards accepted include EN 17427, AS 5810–2010, NF T51–800 or equivalent criteria such as TÜV Austria's 'OK compost HOME' scheme.

Natural polymers: As defined by UK and EU REACH and the Single-Use Plastics Directive (SUPD), are created in nature and are not chemically modified. They are explicitly excluded from the regulatory definition of '*plastic'.* These materials are inherently biodegradable and compostable in all environments. Examples include novel materials derived from seaweed, plant proteins or other naturally occurring polymers that retain their natural polymer structure, and do not undergo chemical modification.

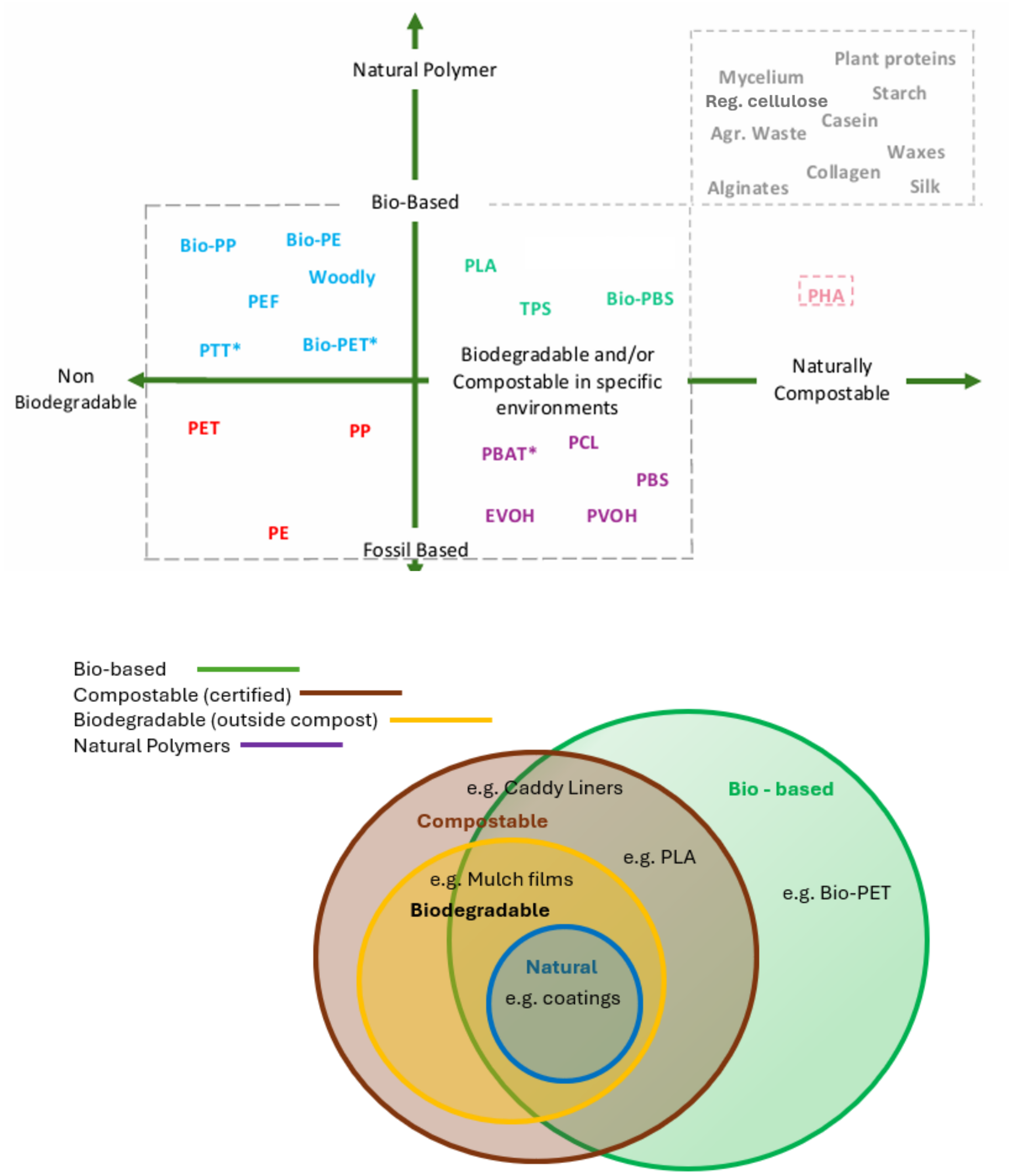

Figure. 1. The breadth of bio-based and biodegradable materials

02.02 Common Misconceptions and End-of-Life Diversity

Bio-based and biodegradable materials are pivotal in driving the transition towards a truly circular economy. The UK's forthcoming Circular Economy Growth Plan must embed bio-based and biodegradable innovation within national efforts to design out waste, keep materials in use, and regenerate natural systems. Unlike conventional, fossil-derived products, which rely on finite resources and often contribute to long-term environmental pollution, bio-based alternatives are derived from renewable bio-based resources. These materials can be engineered to meet specific end-of-life requirements, including mechanical and chemical recyclability, biodegradability, or compostability, offering a versatile solution to reduce waste and environmental impact (Figure 2).

Mechanically recyclable: Drop-in bio-based materials, including bio-derived polyethylene (bio-PE) and bio-based polyethylene terephthalate (bio-PET), are chemically identical to their fossil-based counterparts. This chemical equivalence allows them to be processed through existing mechanical recycling streams without the need for any modifications to current waste management infrastructure[2]. By eliminating the need for specialised recycling pathways, these materials offer a practical and highly scalable solution for reducing the carbon footprint of plastic packaging, and help address critical regulatory frameworks, including the European Strategy for Plastics (PPWR), which mandates that by 2030 all plastic packaging must be reusable or readily recyclable[3]. In addition, wood cellulose-derived materials are emerging as highly promising alternatives. These materials exhibit recyclability through both mechanical and chemical recycling pathways, combining environmental sustainability with the structural strength and protective qualities required for films, flexibles, containers, bottles, and trays.

Chemically recyclable: Chemical recycling encompasses a diverse range of technologies designed to recover value from plastics by breaking them down into their constituent components[2]. Key approaches include solvolysis, where polymers are dissolved to separate individual components; depolymerisation, which breaks polymers down into monomers; and thermal processes, such as pyrolysis and gasification, which convert plastics into oils, gases, or other chemical feedstocks[4]. Many innovative bio-based plastics, including polylactic acid (PLA), which belongs to the polyester family, are particularly amenable to chemical recycling via depolymerisation, which enables the recovery of high-purity and quality monomers[5]. These monomers can then be repolymerised into new materials with properties comparable to virgin plastics, supporting the development of high-quality, circular products. This process not only preserves material value but also supports circular material flows, helping to reduce reliance on fossil resources.

Organically recyclable: Organic recycling is the process through which independently certified compostable finished products are (after use, discard, collection and transportation) transformed into compost or digestate and renewable energy. At its core, composting is a key subset of organic recycling, harnessing natural biological processes to return nutrients, organic matter and microbes to the soil. This system mirrors nature's own circular economy: it replenishes nutrient rich soils, supports ecosystem health, and completes the biological loop, ensuring that what might otherwise be considered waste becomes a valuable resource and feedstock for new growth. By diverting organic materials from landfill or incineration (a legal requirement from 2026 in the UK[6]), organic recycling actively reinforces the principles of DEFRA's Waste Hierarchy.

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[2] BB-REG-NET, Addressing persistent plastic pollution, 2025
[3] European Commission, EU Plastic Strategy, 2018
[4] Saumitra Saxena, Pyrolysis and beyond: Sustainable valorization of plastic waste, Applications in Energy and Combustion Science, 21, 2025
[5] Paul Mckeown and Matthew D. Jones, The Chemical Recycling of PLA: A Review, Sustainable Chemistry, 1(1), 1-22, 2020
[6] DEFRA, Simpler recycling in England, 2024

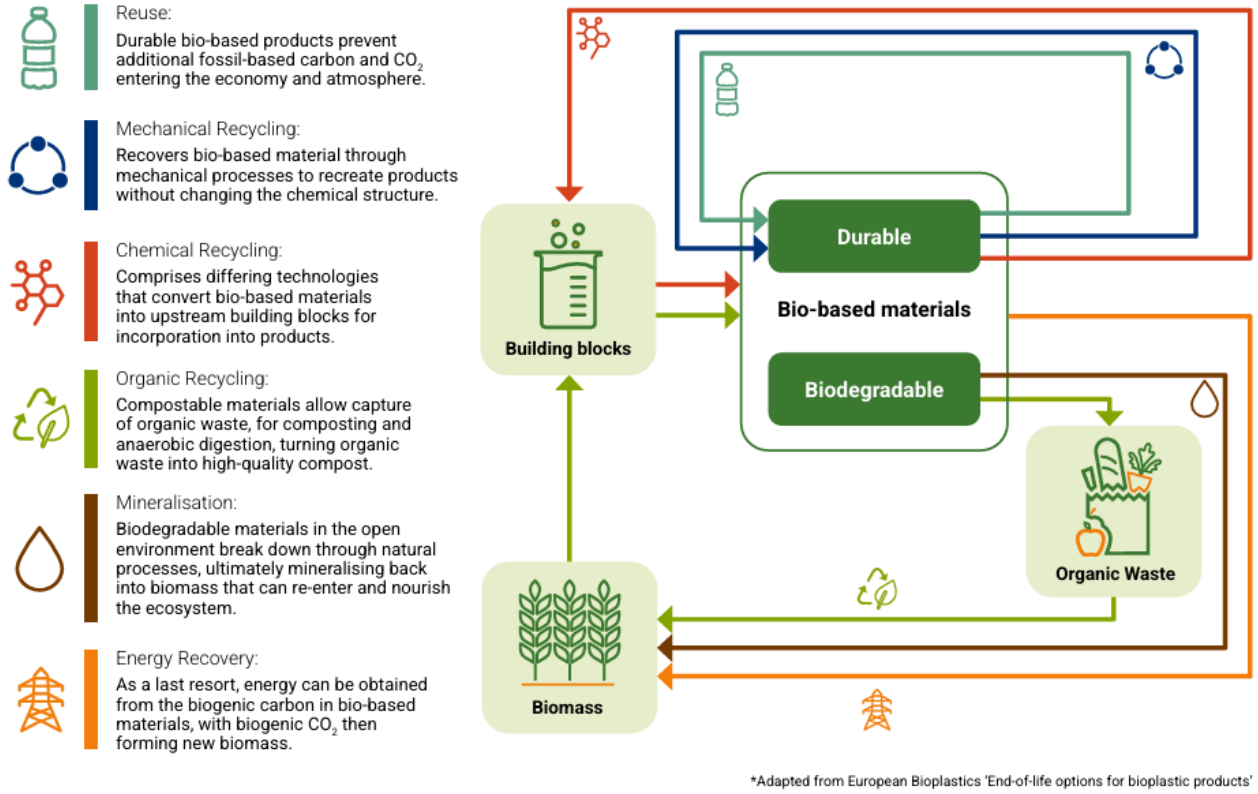

Figure 2. Optimised material flow of bio-based and biodegradable materials

03 UK Packaging and Packaging Waste Policy Context

Packaging waste in the UK remains a major environmental issue. Annually, the UK generates around 12 million tonnes of packaging waste[7]. Under the most recent methodology (2024), about 75.2% of all packaging waste placed on the market was recycled or recovered[8]. Looking at material breakdowns, paper and cardboard remain the largest component; in 2024, the recycling rate for paper and cardboard reached 86.4%. In contrast, plastic packaging remains more problematic, with only 53.7% of plastic packaging waste was recycled in 2024[10]. In response, the UK government and businesses are introducing measures such as Extended Producer Responsibility (EPR), deposit return schemes, and a shift toward reusable or recyclable designs.

In the UK, various current and anticipated government policies and industry initiatives, including The UK's Modern Industrial Strategy 2025[9], the National Materials Innovation Strategy[10] The UK Packaging Pact[11], the Delivering a Net Zero National Health Service Strategy[12] see bio-based chemicals, materials and products as being central to delivering economic and environmental benefits**.** The UK is exceptionally well-positioned to lead the next wave of advanced materials innovation. Market research indicates that the UK bio-based materials sector has the potential to grow into a £4.2 billion domestic industry[13], supporting more than 35,000 UK jobs in design, R&D, production, and supply-chain activity.

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[7] https://fiauk.co.uk/updated-uk-statistics-on-waste
[8] https://www.gov.uk/government/statistics/uk-waste-data/uk-statistics-on-waste
[9] Department for Business and Trade: The UK's modern Industrial Strategy, 2025
[10] Henry Royce Institute, National Materials Innovation Strategy, 2025
[11] Waste and Resource Action Plan (WRAP), UK packaging Pack, 2025
[12] NHS, Delivering a net zero national health service, 2020
[13] National Materials Innovation Strategy - Henry Royce Institute

03.01 Extended Producer Responsibility (EPR) and Recyclability Assessment Methodology (RAM)

The UK's EPR framework[14], introduced under the Packaging and Packaging Waste Regulations[15], aims to shift the financial burden of packaging waste management from taxpayers to producers. Under EPR, producers pay fees based on:

- The type and weight of packaging they place on the market, and
- The recyclability of that packaging as determined through the RAM.

RAM is intended to reward packaging that is collected, sorted and recycled in practice and at scale in the UK, and to penalise packaging that cannot be effectively managed at the end of its useful life.

EPR Fee Structure and Material Categories

Under EPR, packaging falls into defined material categories, each with a base fee. The core categories include, Paper, Fibre-based composites, Plastic, Steel, Aluminium, Glass, Wood, Other (non-plastic). From 2026 onwards, these fees will be eco-modulated based on RAM recyclability ratings.

RAM and Eco-modulation

The Recyclability Assessment Methodology (RAM) provides the analytical basis for determining whether packaging placed on the UK market is recyclable in practice and at scale. It underpins key policy instruments - including Extended Producer Responsibility (EPR) fee modulation, On-Pack Recycling Label (OPRL) rules[16], and the development of consistent household collections, by establishing a transparent, evidence-based procedure for assessing recyclability across the entire end-of-life system. RAM evaluates packaging as it flows through the UK collection, sorting, and reprocessing infrastructure and classifies it as recyclable only where the full system can reliably support material recovery, utilising the following methodology:

1. **Collection at Scale**

RAM first assesses whether the packaging type is collected from households by at least 75% of local authorities. This threshold reflects the policy principle that packaging should only be considered recyclable if consumers have routine access to collection services. Formats that fail this criterion are automatically deemed non-recyclable for the purposes of EPR and consumer labelling.

2. **Sortability in UK Materials Recovery Facilities (MRFs)**

Packaging that meets the collection threshold is then evaluated for its ability to be correctly sorted using the technologies commonly deployed in UK MRFs, including near-infrared (NIR) optical sorting, magnetic separation, eddy current separation, and mechanical screening systems. Items must be detectable, separable, and sufficiently large enough to remain within the sorting flow. Packaging formats that cannot be reliably sorted—such as carbon-black plastics, small-format items, or formats with obstructive full-sleeve labels—are classified as non-recyclable.

3. **Reprocessability Within Established Recycling Streams**

Where sortability is confirmed, RAM assesses whether the material/ finished product can be processed at scale by UK recyclers without compromising product quality or contaminating established streams. This stage evaluates melt behaviour, pulping characteristics, contaminant risks (e.g., adhesives, inks, composite layers), and the availability of domestic reprocessing

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[14] Extended producer responsibility for packaging: who is affected and what to do - GOV.UK
[15] The Producer Responsibility Obligations (Packaging and Packaging Waste) Regulations 2024
[16] OPRL launches new labelling rules | Resource Magazine

capacity. Materials such as PET and HDPE bottles, steel and aluminium cans, and clean paper and card typically pass this stage, while multilayer composites, PVC, and certain barrier materials frequently fail.

4. **Component-Level Compatibility**

RAM requires all components (e.g. labels, caps, and sleeves) and constituents (e.g. adhesives, coatings, and additives) to be compatible with the dominant recycling stream or to be removable through established processes. A product may be assigned a non-recyclable status if any component materially interferes with sortation or reprocessing, even if the primary substrate is recyclable. This design-for-recycling discipline is a core feature of the methodology and aligns UK policy with emerging European recyclability standards[17].

5. **Final Classification and Policy Application**

RAM produces a binary recyclability determination ("recyclable" or "not recyclable") for policy purposes. Only packaging that meets all criteria is eligible for favourable EPR fee bands.

The overarching end RAM ratings are:

- Green: Collected, sorted and fully recyclable in current UK infrastructure
- Amber: Partially recyclable or with limited infrastructure – pays the base fee
- Red: Not recyclable in practice – subject to surcharges rising to up to 2× base fee by 2028

Factors other than recycling

The Producer Responsibility Obligations (Packaging and Packaging Waste Regulations 2024[18]) set out in some detail how the scheme administrator (now PackUK) should decide modulation fees under RAM. The regulations set out that the purpose of the modulated fees are "to reflect the extent to which household packaging supplied…is *environmentally sustainable* and "*to incentivise … packaging which is more environmentally sustainable*". Packaging is deemed to be "*environmentally sustainable*" if it is designed and manufactured to reduce its impact on the environment and the generation of waste. The regulations further set out that the scheme administrator can take into account one or more of five factors in determining sustainability.

a) whether the packaging is reusable.
b) the extent to which the packaging is reused.
c) the recyclability of the packaging.
d) the environmental impacts of the manufacture, transportation and use of the packaging.
e) the environmental impact of the packaging when it becomes waste.

To date, PackUK has chosen to discharge its responsibilities to determine modulation by focussing entirely on c), the recyclability of the packaging as set out above. The effect of this is to discriminate strongly against all materials which do not fit into a narrow framework of widely used conventional packaging types such as certain plastic polymers, certain metal formats, paper and card, regardless of what its sustainability characteristics may be. While this approach might make sense to discourage formats used in small quantities for legacy reasons (such as High Impact Polystyrene used for coffee cup lids) which have no particular environmental benefit and are readily replaceable by alternatives which fit the UKs existing recycling system (e.g. by PP or fibre in the case of coffee cup lids), not taking into account other factors at all is a blocker to UK innovation into packaging alternatives that have significant environmental benefits but are not immediately scaled into the existing recycling system.

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[17] Ecodesign for Sustainable Products Regulation - European Commission
[18] Part 5, Chapter 3, section 64

The UK's plastic recycling infrastructure has been designed around fossil-based materials. Capacity constraints, market volatility, and recent reductions in some reprocessing capacity make the system understandably risk-averse to change. However, relying exclusively on the current infrastructure as the benchmark for future regulation risks locking in outdated technologies and materials, undervaluing materials that support net-zero and circular economy goals, and overlooking opportunities to adapt or extend infrastructure to accommodate new materials.

Current sorting methodologies for target materials can accommodate innovative bio-based materials – since sorting lines use NIR technology to positively select desired items, while non-target bio-based materials are left in the residual stream, and typically sent for incineration. Contamination risk arises only from false picks of non-target items, and many materials are sorted multiple times before onward processing, reducing this risk further.

A more forward-looking approach is needed, where EPR and RAM frameworks recognise both current system performance and credible pathways for scaling sustainable, bio-based materials.

As PACK UK has set out in its June 2025 modulation statement[19] that the regulations regarding RAM will not be updated until 2028 (a long way away considering the EU Commission has brought forward their review of biobased to 2027), this 3 years of uncertainty will likely drive out bio-based innovation from the UK market, including from award winning UK start-up companies. For bio-based products modulated with a red rating under the current policy, this sends negative financial and policy signals to the market – knocking investor confidence and fuelling further expansion of materials within some cases likely worse environmental criteria. This approach is counter-intuitive to the intention legislation - which in all other respects is framed in terms of modulation being in place to encourage an environmentally sustainable approach - not to inhibit development of novel packaging types.

03.02 Plastic Packaging Tax (PPT)

The Plastic Packaging Tax[20] places a tax on plastic packaging that does not contain at least 30% recycled content. It is intended to incentivise the use of recycled plastics and stimulate a circular economy for plastics. In practice:

- Plastic recyclers struggle with competition from cheap virgin and imported recycled plastics.
- PPT offers no benefit for biodegradable materials, which could be used to replace virgin fossil plastics but cannot currently be counted towards the recycled content threshold.
- PPT does not align definition of "natural polymer" with all other EU and UK regulation, citing only cellulose as a natural polymer. This ignores all other natural polymer materials that are inherently "plastic-free" as defined by UK and EU REACH.
- PPT does not differentiate between fossil-based and bio-based feedstocks, effectively treating them as equivalent.

[19] https://assets.publishing.service.gov.uk/media/68a599d29dc94e840696a3a6/Packaging_Extended_Producer_Responsibility__pEPR__Producer_Disposal_Fees_Modulation_Statement.pdf
[20] Plastic Packaging Tax - GOV.UK

As a result, the current design of the PPT inadvertently subsidises fossil-based materials that can meet the 30% recycled content requirement, while offering no recognition or incentive for switching to renewable feedstocks. This is particularly relevant in the plastic film/flexible packaging category, which has greater issues to achieve mechanically recycled content and may only reach chemically recycled mass-balance content by 2028.

Recognising bio-based content as an alternative to recycled content in this context could provide a meaningful incentive to adopt sustainable alternatives to fossil-based polyolefins. This approach is already under consideration by the European Commission through PPWR Article 8 and is being developed by JRC and CEN, and we would urge DEFRA to align with these ongoing efforts.

03.03 Emissions Trading Scheme (ETS)

The UK Emissions Trading Scheme (ETS) is expected to include packaging in scope from around 2028, with costs linked to verified greenhouse gas (GHG) emissions associated with materials and processes, if incinerated at end-of-life. For bio-based materials, especially where certified life cycle assessments (LCAs) demonstrate significantly lower or even net negative emissions, ETS could offer an important opportunity:

- Recognising bio-based materials' lower GHG footprint
- Creating an explicit carbon price advantage over fossil-based plastics

However, there is currently limited clarity on how bio-based materials will be treated within the ETS. Without clear provisions, there is a risk that the potential benefits of lower-carbon materials may not be realised. If the system simply applies average emissions for "plastics" prorated across non-recycled volumes, the ETS effectively becomes a tax, with no mechanism for bio-based materials to gain from their lower biogenic carbon emissions. Clear guidance on the treatment of bio-based materials and a defined roadmap will be essential to ensure that ETS delivers genuine incentives for low-carbon alternatives. We explore this more in Section 5 of this report.

03.04 Relationship to EU Packaging and Packaging Waste Regulation (PPWR)

In the EU, the Packaging and Packaging Waste Regulation (PPWR) includes mechanisms that will, by 2028, set criteria under Article 8 for when bio-based feedstocks may substitute for recycled content under certain conditions (e.g. availability, price, food-grade requirements). Alignment or at least coherence with PPWR will be important for UK industry, particularly:

- To avoid diverging definitions and incentives
- To recognise bio-based feedstocks as legitimate contributors to circularity in specific circumstances
- To ensure organic recycling is treated consistently as an acceptable end-of-life pathway for certified compostable packaging.

This would help provide regulatory clarity for businesses operating across both markets, reduce compliance complexity, and support continued investment in sustainable packaging innovation.

04 Bio-Based and Biodegradable Materials and EPR and RAM

04.01 Status Quo

Currently bio-based and biodegradable materials, typically fall into one of three EPR categories and face the following 2026 base fees[21]:

- Plastic: £455/tonne
- Other (non-plastic): £225/tonne
- Fibre-based composites: £525/tonne
- Paper / board category*: £210/tonne

Bio-based and biodegradable materials that fall within the *plastic, Fibre-based composites*** or *other* categories are currently facing red modulation because they do not yet fit the narrow definition of recyclability in the existing mechanical recycling system – a system defined by incumbent fossil-based plastics and infrastructure. Based on indicative projections, the cost per tonne for materials classified as *plastic* and *other* are shown in Table 1. In addition, now that 'bioplastics' are considered *plastic* and not *other* this is the biggest challenge in terms of cost impact. There is no longer the short term 'other incentive' at least going into 2026 reporting.

Table 1. Projected costs per tonne for materials

Category	2025	2026	2027	2028
Plastic (Amber rated through RAM)	£423	£455	£455+	£655***
Plastic (Red rated through RAM)	£423	£545	£728+ (=base x 1.6)	~ £1310 (=base x2)
Other (Red)	£259	£270	£360+ (=base x 1.6)	£450+ (=base x 2)
Paper / board	£196	£210	£210+	£210+

***Expectation of increased based fees from the collection of films and flexibles

Note: fees from 2027 onward are not yet known, and subject to change.

These red-rated materials face steep upward modulation from the base fee, effectively doubling fees for some materials by 2028. Amber materials remain at the base fee. Green materials are expected to receive discounted fees, funded by surcharges on red-rated materials.

In the short term, there are incentives for some materials to be classified as *Other*, as the 2026 base fees are lower than plastic. However, by around 2027 the advantage is eroded for red-rated *Other* materials relative to amber-rated plastics, particularly as red surcharges escalate.

This dynamic disincentivises investment in scaling new materials that could, with support, become widely recyclable or compatible with infrastructure or release less fossil carbon at end of life. This includes, for example:

- Mechanically recyclable thermoplastic bio-based plastics, which are technically compatible with existing plastic recycling infrastructure but not yet present in sufficient volumes, and
- Compostable materials and natural polymers used in independently certified compostable final products and accepted at a variety of composting facilities across the UK, which are designed primarily for organic-waste pathways, but are assessed as '*hard to recycle*'.

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*bagasse/moulded fibre and any PLA lined paper under 5% lining falls into this category

** FBCs aren't necessarily RED - can be GREEN or AMBER depending on % lining on the fibre. Paper / Board category can be GREEN where evidence of pulpability testing e.g for sugarcane fibre bagasse

[21] Year 2 illustrative waste disposal fees: Extended producer responsibility for packaging - GOV.UK

Table 2. is derived from the 2025 EPR cost calculation data released by DEFRA and the results of the FlexCollect[22] flexible film trial released in September for plastic film. This shows the higher cost of recycling plastics than treating them as residual waste (mostly being burnt for energy). The differential is particularly large in the case of plastic film. The logic of this table is that any bio-based materials that cannot be recycled and are labelled clearly as "Do not recycle" should receive a lower EPR charge than plastics that are labelled recyclable. When EPR fees are updated to account for the high costs of flexible films being recycled at scale, the EPR fees for plastics will have to be increased. The costs for dealing with any bio-based materials treated as residual will not, however, change so bio-based material EPR fees should not increase. The only reason for increased EPR fees for bio-based materials would be if they materially and negatively impact recycling of other plastics. This is discussed further below.

Table 2. EPR Fees 2025

Material	Approximate recycling costs per tonne of material recycled including sale value	Approximate Residual costs (collection+processing) per tonne from residual measured collected tonnes	2025/2026 EPR fees, accounting for recycling rate and overheads
AL	-£ 290	£ 255	**266**
Paper and card	£ 310	£ 250	**196**
Plastic	£ 535	£ 250	**423**
Plastic Film	£ 1,671	£ 250	
FBC	£ 560	£ 245	**461**
Glass	£ 170	£ 250	**192**
Steel	£ 155	£ 250	**259**
Wood	£ 265	£ 245	**280**
Other	£ 160	£ 220	**259**

04.02 Unjustified concerns over bio-based materials

Concerns about bio-based materials are frequently cited to justify stricter regulatory treatment. These include potential contamination of existing waste streams, microplastic formation, adequacy of standards and certification schemes, and methodologies for fair and unbiased life-cycle assessments.

Bio-based materials do not cause measurable disruption to existing recycling systems[23]. Industry experience supports this view. BBIA members report no verified cases of bio-based products disrupting plastics recycling, indicating contamination risk is negligible[24]. By contrast, restrictive regulation poses significant economic risk to the UK bio-based sector. Current waste-sorting systems can handle innovative bio-based materials. Modern lines use near-infrared (NIR) technology to identify and extract target materials, while non-target items—including new bio-based materials—remain in the residual fraction. Contamination occurs only if non-target items are mis-sorted, but multiple sorting stages further reduce this risk. Testing by RECOUP[25] shows many bio-based materials can be successfully differentiated, and limited market penetration does not materially impact costs or efficiency. Higher modulation fees would only be justified if significant volumes of bio-based polymers were mis-sorted into positive recycling streams. Legislating against novel materials with clear environmental benefits, without evidence of disruption, would be disproportionate. Policy should reflect actual system impacts rather than precautionary assumptions that could stifle innovation.

[22] Household collections — Flexible Plastic Fund
[23] https://bbia.org.uk/wp-content/uploads/2026/02/BBIA_EPR-RAM-Policy-Paper_Final.pdf
[24] https://bbia.org.uk/wp-content/uploads/2026/02/BBIA_EPR-RAM-Policy-Paper_Final.pdf
[25] RECOUP | Home

Materials designed for composting do not generate microplastics, and bio-based polymers generally pose no greater risk than fossil-based plastics[26,27,28]. Evidence shows that for materials designed to be composted this is not the case. What is also certain is that bio-based materials of all types provide no more risk in this regard (and in many cases a lower risk) than fossil-based plastics. The issue of microplastics is one in need of more research, but it is not an issue that should be used to justify a negative approach to bio-based materials today.

In addition, any evidence gaps on lifecycle impacts and standards, can be addressed through monitored trials, regulatory sandboxes, and collaborative data sharing without imposing punitive measures[29,30,31].

Overall, the evidence suggests that the practical risk of harmful contamination is negligible. By contrast, the economic risk posed by restrictive or disproportionate regulation to the UK bio-based sector is both immediate and significant. A precautionary regulatory stance that assumes harm in the absence of evidence risks slowing innovation, deterring investment, and delaying the development of materials that could deliver clear environmental benefits — including reduced fossil resource dependence, improved organic waste recovery, and expanded circular economy pathways. Regulation should be proportionate to demonstrated risk, not hypothetical risk.

04.02 Deep Dive into Mechanically Recyclable Bio-based Materials

Many bio-based packaging materials are mechanically recyclable thermoplastics, and therefore there is no need to develop entirely new sorting or reprocessing technologies (See Figure 3). They can, in principle, be recycled through existing plastic recycling systems if:

- Sufficient volumes are present to justify sorting and reprocessing, and
- They are recognised as technically compatible within RAM.

These materials differ chemically from "drop-in" bio-PET or bio-PE, which are identical to fossil-based polymers and are assessed identically under EPR and RAM. Nonetheless, they are capable of being recycled using existing infrastructure.

For such materials, there should be explicit acknowledgment within RAM that they are able to fit the system technically.

The Impact of EPR and RAM on Recyclable Bio-based Packaging in the UK

While interest in recyclable bio-based packaging is growing, the category remains too small in market penetration and recovery infrastructure to register as amber or green under the UK's RAM assessment, meaning that - despite being NIR-detectable for sorting and actively striving to reach scale - it is still effectively penalised during its early development stage.

However, as is the case with most companies in the bio-based and biodegradable materials sector, this demonstrates clear technical recycling ability and compatibility with existing infrastructure, but it does not prove recyclability in practice and at scale, which ultimately depends on volume and economics. MRFs are likely to prioritise sorting the materials present in the greatest volumes and with the highest value, while reprocessors are typically set up to recycle specific materials and have built their businesses around steady feedstock volumes and established end markets. For any new material to break into this system, both the volume and the economic case must be demonstrated alongside the technical capability - something that can only happen if

[26] Degradation of compostables in full-scale composting trials - REA
[27] Tackling Persistent Plastic Pollution
[28] https://bbia.org.uk/wp-content/uploads/2026/02/BBIA_EPR-RAM-Policy-Paper_Final.pdf
[29] Do LCA standards limit comparison?
[30] Tackling Persistent Plastic Pollution
[31] Navigating standards for bio-based and biodegradable materials

regulation and existing infrastructure enable that growth. This challenge mirrors the situation faced by post-consumer PE and PP films and flexibles (as shown through the FlexCollect Project[32]): although they are technically recyclable, insufficient capacity, high costs and weak end markets have been a high barrier for recycling.

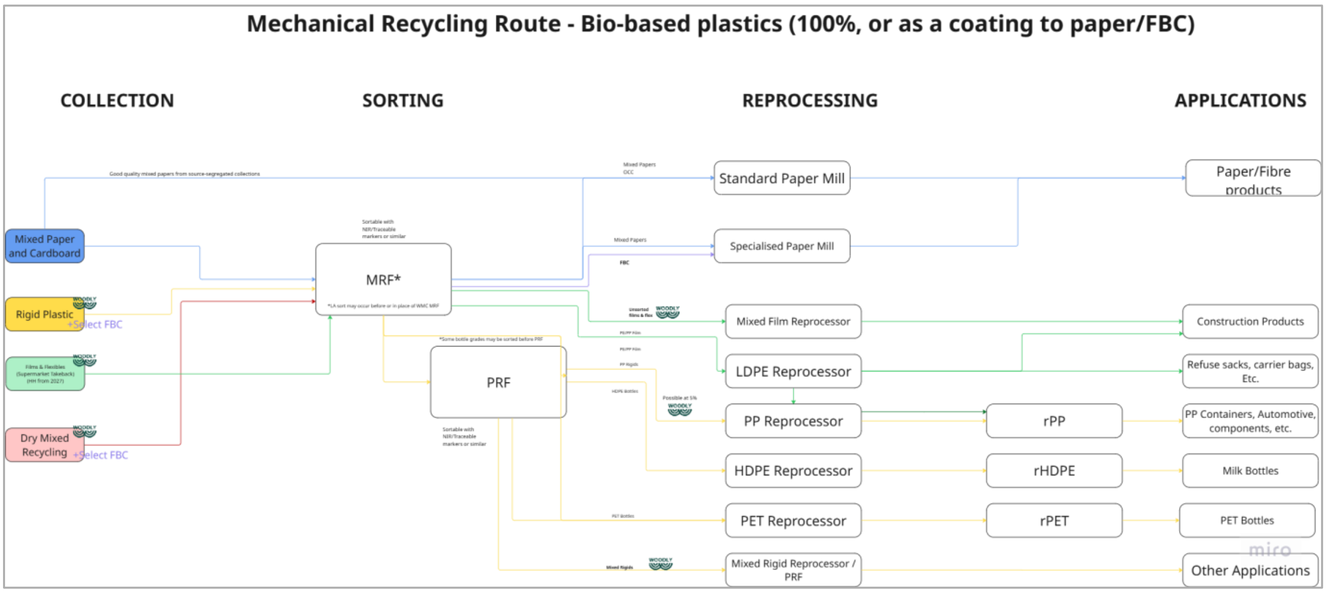

Figure 3. Recycling route for mechanically recyclable thermos bio-based plastics

04.03 Deep Dive into Compostable Materials

Compostable materials and finished products are a subset of biodegradable materials and finished products designed to breakdown in industrial or home composting environments within a timeframe specified in industry and regulator-accepted standards (e.g. EN 13432), leaving no toxic residue. In the UK, compostable materials and finished products – independently certified as conforming to at least one of the standards EN 13432, EN 14995 or ASTM D6400 – are suitable for organic recycling. (In the UK there are different industry and regulator-accepted standards for home compostable packaging and non-packaging products.)

Unlike other packaging materials which individually require different recycling routes (paper, plastic etc), independently certified compostable finished products share the same end of life outcome, meaning that multiple materials – such as paper fibres and bio-based+compostable plastic laminates – can be combined in a single, finished product without disrupting compostability and the finished product's intended end-of-life.

When used for food-contact applications, compostable finished products offer a unique systemic benefit: they complement organic waste collections, acting as a vehicle for capturing food residues that would otherwise be lost from the system.

Existing closed-loop collection systems – such as those piloted by foodservice operators and event venues – demonstrate that compostable packaging can reduce contamination in both organics and recycling streams, whilst also facilitate increased capture of food waste. With this in mind, commercial waste collection options for compostable packaging are expanding in the UK. This is in response to increased demand from businesses, creating 'density' and enabling viable collections of compostable materials for industrial composting.

[32] FPF FlexCollect Report 2025 — Flexible Plastic Fund

Despite the tangible environmental benefits, the policy and regulatory landscape is not currently aligned to support the adoption of compostable materials and finished products, in applications/formats and contexts where their use would be beneficial on a systems and sustainability basis.

Industrially compostable finished products are designed for end-of-life through organic waste systems alongside food and garden waste (the route the finished product would take would depend on its format and context of use, e.g. whether it has been used to package food or in conjunction with any food that was fit for human consumption but becomes 'animal by-product' when it becomes waste). They can deliver important benefits:

- Reducing contamination by non-compostable plastics in organic waste streams
- Enabling higher-value recovery of organic resources
- Addressing applications where food contamination makes mechanical recycling difficult or uneconomic

However, RAM and EPR are heavily oriented towards dry-recycling outcomes, and compostable solutions are treated as non-recyclable, with little recognition.

State of the UK's Compostables Market

The global compostable packaging market size was valued at USD 74.01 billion in 2023 and is projected to reach USD 113.88 billion by 2030, growing at a CAGR of 6.5% from 2024 to 2030[33].

Figure 4 shows the recycling route for compostable materials and products.

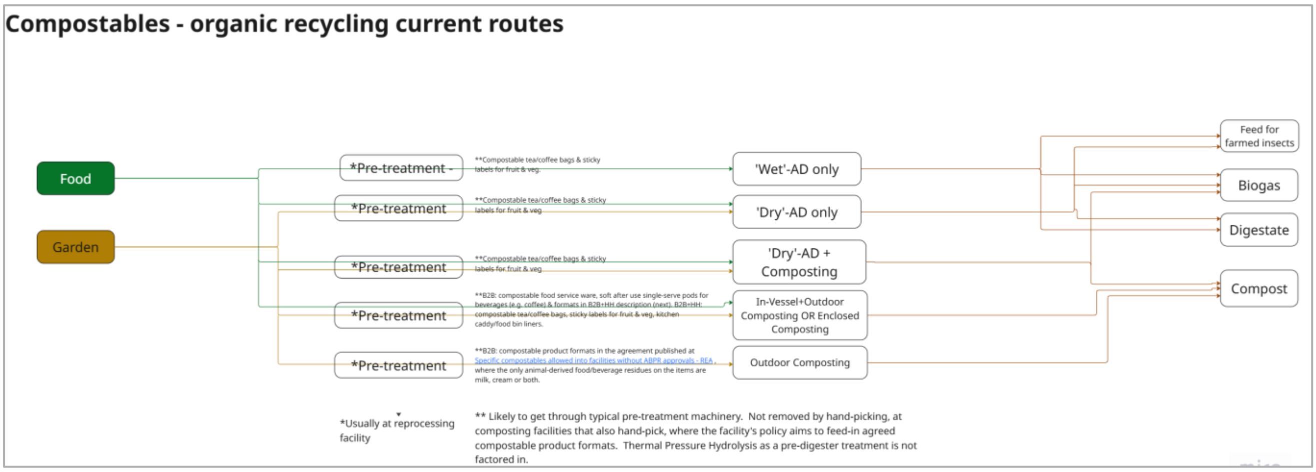

Figure 4. Recycling route for compostable materials and products

The Impact of EPR and RAM on Compostables in the UK

Under the UK's Extended Producer Responsibility (EPR) framework for packaging, producers pay modulated fees based on the recyclability of materials as determined through the Recycling Assessment Methodology (RAM). While this system aims to incentivise circular design, its current parameters fail to recognise compostable packaging as a legitimate recycling route.

To date, many compostable packaging products fall into the "other" category within the EPR fee matrix – benefiting from a temporarily lower fee in the short term. However, under the RAM, these products are classed as 'red', meaning they are considered "not recyclable".

[33] Compostable Packaging Market Size & Share Report, 2030

The most recent update to the technical positions under RAM has moved *bioplastics*, such as PLA, into the "plastics" category. This not only impacts pure bioplastic products but also moves composite compostable materials from "paper/board" into "fibre-based composite". This change in definition dramatically increases fee liability for producers of compostable packaging.

This duality creates long-term disadvantage for producers and brands. As fees increase and the RAM criteria tighten, compostable packaging risks being financially penalised, despite offering measurable system-wide benefits. The resulting cost uncertainty discourages innovation and deters brands from adopting compostable solutions that could otherwise support long term circularly economy goals and lead to growth of this innovative sector. This means that the RAM does not yet recognise organic recycling as a legitimate recycling pathway – a major oversight in a country which is simultaneously expanding mandatory food waste collections under Simpler Recycling[34]. By failing to consider the potential for integration of compostable packaging into this system, UK policy effectively hinders progress towards a circular economy.

Closed-Loop Exemptions

Recent amendments to the EPR Statutory Instrument allow producers to offset fees if packaging is collected and recycled back into the same food-grade application (for example, HDPE milk bottle back into HDPE milk bottle). However, this excludes compostables despite closed loop organics systems existing that could allow packaging producers to implement self manged systems for the products they put on the market.

While this is positive for circularity in established plastic loops, it:

- Strongly favours fossil-based rigid plastics with mature, well-documented closed loops.
- Excludes bio-based and natural polymer alternatives from similar recognition, even where technically feasible or where separate closed loops could/have been created.

This further strengthens incentives to maintain fossil-based plastics and serves as a deterrent for producers to adopt new sustainable alternatives. This inconsistency stifles innovation by preventing investment in new collection models, including take back schemes and composting infrastructure. It discourages brands that would otherwise pilot scalable, traceable compostable waste systems – precisely the kinds of solutions needed to drive decarbonisation and circular design in packaging.

If the UK's EPR and RAM frameworks are to truly deliver on the intent – to drive sustainable packaging design and investment in recycling infrastructure – they must evolve to recognise the role of compostable packaging as part of a diversified circular system.

Commercial Collection – Current Position

Over the last decade, commercial collection systems for compostable packaging delivered to in-vessel composting (IVC) have developed in parallel with the growth of the compostable packaging market, driven by demand from the foodservice sector. In response, a number of waste management companies have established dedicated commercial collection services for post-consumer compostable packaging across large parts of the UK. In addition to operators offering regular bin or bagged collections, one operator offers a national post back scheme for compostable packaging using existing courier routes. This demonstrates how compostable packaging collections are being made accessible to smaller, rural or remote businesses, and potentially households, even where existing infrastructure is limited. For large foodservice operators, on-site biodigesters provide an alternative solution, enabling food waste and

[34] Simpler Recycling in England: policy update - GOV.UK

compostable packaging to be processed together at the point of generation. The output can be used on-site, making this approach particularly attractive for campus-based organisations, where waste generated is concentrated and land is available.

Household Collection - Current Position

At household level, opportunities to include compostable packaging within organic waste are more limited but do exist where local authorities already utilise IVC as a treatment route. In these cases, there is technical scope to accept certified compostable packaging alongside food and garden waste, providing materials are clearly specified and contamination is managed and acceptably low.

Certified compostable liners for collecting waste are widely accepted where waste is destined for IVC. A small number of local authorities – Aberdeenshire and Milton Keynes – explicitly also accept certified compostable packaging and communicate this through their online guidance on acceptable inputs. In other cases, authorities may confirm acceptance informally when queried, but do not actively promote compostable packaging through written communication, resulting in low awareness and inconsistent participation. 57 local authorities in the UK collect food and garden waste together and will be sending this to IVC or dry-AD (there's 4 of the latter type operating). In principle these authorities could incorporate compostable packaging into household organic waste streams with limited changes to collection infrastructure, subject to clear guidance, communication, and alignment with treatment operator requirements.

Household Collection - Future Integration and System Evolution

Looking ahead, the integration of compostable packaging into household organic waste collections must acknowledge the current limitations of the UK food waste infrastructure particularly the widespread use of anaerobic digestion (AD) as the primary treatment route. Existing food-waste-fed AD plants are not currently configured to process compostable packaging and instead rely on systems designed to remove all packaging as contamination. As a result, compostable materials are treated in the same way as conventional plastics, limiting their practical compatibility with existing household food waste collections.

However, international experience demonstrates that these constraints are not inherent, and that compostable packaging can be successfully integrated into household collection systems when collection policy, material/final products standards and treatment infrastructure are aligned. Italy provides a well-established example of this approach at scale. E.g. through the widespread mandating of certified compostable liners for household food waste collections, Italian municipalities have created a consistent input stream that has enabled treatment infrastructure to adapt over time. As a result, in addition to liners, compostable packaging is routinely accepted alongside biowaste and processed using (most commonly) a combination of AD with composting of digestate, or dedicated composting facilities, without requiring separate collection systems. The Italian experience highlights a key systematic insight: the principle operational challenge is not the presence of compostable materials in food waste, but the co-collection of organic waste with conventional plastic packaging. Where non-compostable plastics dominate the non-food fraction of food waste, treatment facilities are forced to design systems around removal of those plastics with compostables treated as collateral contamination. Conversely where non-compostable plastics are largely excluded from the food waste stream, certified compostable materials can be treated though AD treatment either with suitable pre-treatment, composting following 'dry'-AD treatment (integrated, on-site) or separate composting of depackger run-off, depending on local infrastructure.

This suggests the pathway to future integration in the UK is less about creating new collection systems for compostable materials, and more about improving consistency and material clarity within existing food waste collections. Measures such as clearer labelling, restrictions on non-compostable plastic liners or mandating independently certified compostable liners, could progressively reduce contamination by non-compostable plastics and create conditions in which compostable materials become compatible with both AD and composting routes.

Existing sorting technologies, such as density separation and NIR (near-infrared) sorting, can efficiently separate and sort compostable packaging from conventional plastics in waste streams. As most compostable plastics are mainly polyesters, the NIR-spectra of those polymers (including their blends) are distinctly different from PE, PP, PS and even PET[35].

TotalEnergies Corbion is a global leader in the production of Polylactic Acid, better known as Luminy® PLA. They have carried out two successful dynamic sorting tests at TOMRA 's German testing centre in August 2022[36]. Pellenc ST is a manufacturer of optical sorters dedicated to the recovery and valorisation of materials. They have carried out extensive testing on the sortation of compostable plastics within the European project SEALIVE[37]. All polymers tested have been perfectly separated from fossil-based plastics in the lab, and PLA has been well sorted in a Spanish materials recovery facility (MRF) operated by Urbaser. This sortation did not create any loss of other plastics from that MRF. Additionally, lab tests have shown the ability to separate the compostable plastics from each other in 4 main classes: PLA, PHA (including PHV and PHBV), PB+ (including PBS, PBSA, PBAT), and Cellulose Acetate. This opens the door to many end-of-life opportunities for compostable packaging, including composting and recycling, and especially so, since most sorting lines in the UK and Europe already use the required NIR system.

Several projects are also underway to demonstrate such recycling at scale.

- **MoeBIOS[38]:** MoeBIOS proposes to implement a new value chain that incorporates advanced sorting, conditioning, and valorizing processes within the existing infrastructure of industrial recycling facilities. The project targets bioplastics that lack established recycling processes, such as PLA, PHA, PBS, and PEF, with the potential inclusion of PBAT. The recycling processes aim to reach at least the same quality and functionality as the original materials.
- **PROSPER[39]:** Demonstrating the technical and financial viability of recycling Bio-Based and biodegradable Plastic Packaging.
- **ReBioCycle[40]:** Aiming to improve circularity and resource efficiency via the practical application of the circular bioeconomy concept in the biobased and biodegradable plastics value chain; Scale up effective sorting and recycling schemes for biobased and biodegradable plastic materials; Increase the recycled content in new products from biobased and biodegradable plastics.
- **RePHASe[41]:** The project 'Recycling PHA for Second life' (RePHASe) studies hydrolysis as a PHA depolymerisation technology. The scientists are investigating whether the process, which has been proven in small batch quantities, can be scaled up using a continuous set up where water and catalysts are preserved and recycled into the process.

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[35] Geronimo Reyes, Domestic Mixed Plastics Packaging Waste Options, Final Project Report, WRAP, June 2008. https://www.academia.edu/5023812/Domestic_Mixed_Plastics_Packaging_Waste_Management_Options
[36] EUBP_PP_Biodegradables_Sorting_Material_recycling
[37] Contribution to the Future of Bio-based plastics | Pellenc ST
[38] Closing theloop of the BIOsEnd of Life - MoeBIOS
[39] Prosper
[40] ReBioCycle – A new european blueprint for circular bioplastics upcycling solutions
[41] UK university researching PHA chemical recycling — GO! PHA

Composting

As part of an Innovate UK funded project (Compostable Coalition UK[42]) Envar Composting Limited designed and undertook a suite of operational experiments and collected data to better understand the degradation profile of intermediate materials and finished products certified as "compostable" under one of the independent certification bodies' certification schemes. Most of what was supplied were finished packaging products and intermediate materials (polymer films) used for making packaging products, while at least one product supplied was a format not classed as packaging. The main trial and data collection took place over a period of three months, beginning in late December 2022. The material provided data which shows that compostable packaging does break down in an industrial composting setting with a steady degradation profile over time. The degradation profile is affected by how the material is managed and the extent it is spread throughout the composting mass. Despite some of the materials remaining visible at the final stage of the composting process, it was found that contamination levels of the final compost as per the industry standard tests showed the screened compost was compliant with quality requirements set in PAS100. Analysis looking at all types of microplastics also showed that compostable material microplastics were not present in sampled, screened compost, indicating a full breakdown. The analysis concluded that through the operational control of the composting process, compostable materials independently certified compliant with standards (EN 13432, EN 14995 or ASTM D6400) are compatible with the desired environmental outcomes of our society. The compostable packaging trial showed that materials break down effectively in the composting process and residues are either returned to the process or recovered in a safer, less carbon intensive way than traditional alternatives.

The compost supported plant germination and growth when tested according to the PAS100-specified test, and the PAS suite of tests and results showed that the compost met each of PAS100's minimum quality requirements. The use of the compostable packaging and non-packaging in targeted, food-relevant product formats reduces the risk of biowaste contamination by non-compostable plastics. This protects the environment from potential harm by displacing traditional plastics which arrive at composting facilities and are difficult to entirely remove during waste pre-treatment and at other opportunities during the composting process. When present in an industrial composting context, the traditional plastics that are removed from the process are less likely to be sent for mechanical recycling as they do not have a large value and chemical recycling for traditional plastics is not yet well developed in the UK. By composting food waste relevant compostable packaging and non-packaging products instead, the value is to the environment and to the end compost product producer. The Advanced Chemistry and Research Unit at SOCOTEC tested a compost sample from EnVar, processed with 5% compostable materials [they represented 5 % of the waste's mixture at the start of the composting process, on a volume per volume basis], was analysed using sieving, density separation, wet peroxide oxidation, microscopy, and FTIR to detect biodegradable microplastics. The results showed no detectable compostable polymer microplastics in the 0.3–5 mm range, with all quality control checks meeting required standards.

Renewable Energy Assurance Ltd's report (published February 2024) on 'How Compostable products are recycled in the UK' presents information on the numbers of industrial composting processes that are both certified by their Compost Certification Scheme (CCS) and accept independently certified compostable items. REAL's data showed that twenty-nine CCS certified composting facilities confirmed that they accept independently certified compostables. This includes twenty processes in England, four in Scotland, three in Northern Ireland, and two in Wales.

[42] compostableuk.info - Closing the Loop for Compostable Packaging

Sixteen of the processes accept only compostable liners, five accept only compostable packaging, and eight accept both compostable liners and packaging, as shown by Figure above. Adding up REALs' figures for compostable liners and compostable packaging separately, twenty-four certified composting processes accept wastes that include compostable liners and thirteen certified composting processes accept wastes that include compostable packaging. As of May 2024, their website showed a total of 171 composting processes producing at least one grade of compost certified under their scheme.

Anaerobic Digestion (AD)

As part of their UKRI funded project, the Compostable Coalition UK ran trials to explore the biomethane potential (BMP) of compostable foodservice products within standard wet and dry anaerobic digestion and thermo-pressure hydrolysis (TPH). The findings from these trials provide critical insights into the future of compostable materials.

Wet AD: This is the most common form of AD where biomass and biowaste is converted into a slurry (typically <10 per cent dry solids (DS)) ahead of being pumped to mixed digesters to generate biogas and digestate which can be spread to land as a biofertilizer. First generation de-packaging equipment at AD plants cannot readily tell compostable packaging apart from non-compostable packaging so large amounts of compostable packaging are rejected before they have a chance to enter the digesters. Material streamed out by depackaging will be sent to EfW in nearly all cases where bio-based compostable materials will release no fossil CO2 on burning. Estimates vary, with losses likely to be between 60 and 90 percent. For example, compostable liners often begin to degrade in the collection part of the food waste supply chain so will have a better chance of passing through the depackager. However, rigid cardboard and moulded biomass containers such as cups and plates will have a much higher reject rate. Also, rigid bioplastics that are depackaging-machine-indistinguishable from petroleum plastics will again have a very high reject rate. This is a lost opportunity as compostable packaging has a high biomethane potential in wet digesters. Tests of a mixture of typical packaging including biobags, bagasse plates, CPLA drink lids and napkins etc, when pulped, generated a biomethane potential of 142 m^3 CH4 / tonne fresh weight (the "BMP"). This compares favourably with the benchmark BMP for anaerobic digestion of approx. 100-110 m^3 for maize silage. The higher yield is mostly attributable to the higher DS of the compostable packaging but nevertheless demonstrates the potential of this material as a source of biogas.

Thermal hydrolysis AD: Thermal hydrolysis is an advanced form of pre-treatment before digestion that focuses on optimising the limiting step in AD, i.e., hydrolysis. The best example of thermal hydrolysis is in sludge management where biosolids are sterilized in a steam environment at temperatures > 160°C at many larger wastewater treatment plants (WWTPs). This process disrupts cellular membranes and chemically breaks apart organic polymers which enhances biomethane output. There are relatively few examples of this process being applied to more complex biowaste and compostable packaging. However, a process called "thermo-pressure hydrolysis" (TPH) was demonstrated at the Derby food waste AD facility between 2019 and 2021 where compostable packaging was seen to be effectively hydrolysed and transferred to the digesters[43]. To confirm the efficiency of this process, samples of compostable packaging were sent to the TPH pilot plant in Dorset operated by Aerothermal. Four test campaigns occurred in addition to some additional in-house testing. The results for three comingled compostable packaging trials

[43] AeroThermal Group

yielded extraordinary BMP results of between 246 and 317 m³. Importantly, the hydrolysis process left behind very little residue when screened at 12mm that was estimated to be <2 per cent of the total mass of material entering the TPH vessel. In parallel with these TPH trials the performance of a range of specific compostable packaging materials were tested to assess if there were differences between compostable packaging types. The results of these trials are summarised in Table 3.

Table 3. Trail results for compostable packaging using Thermo-Pressure Pre-treatment

Compostable packaging type	TPH / liquefaction efficiency	BMP (m3 CH4/t fresh weight)
"Biomass based packaging, Cardboard, bagasse etc"	90%	314
PLA coffee pods	86%	337
Corn starch carrier bags	96%	100
PLA based tea bags	100%	Not measured
Food waste (approx. 25% DM)	95%	110

This data demonstrates that general biomass-based packaging responds very well to thermal hydrolysis. Two exceptions were high temperature resistant bioplastics and wood, which demonstrated more resistance to thermahydrolysis, as judged by the mixed compostable packaging trials and the individual component tests. The <2 per cent reject yield from the mixed compostable packaging trial was mostly wood. When compared with the full-scale experience at the Derby demonstration, where approx. four per cent reject including plastics was recovered during an extended test, this suggests that the bulk of compostable packaging in the food waste stream is amenable to thermal hydrolysis with a very high rate of biomethane recovery.

Furthermore, it is evident that the digestate will also be suitable for recycling to the soil with a high recovery rate. It is also of note that the compostable packaging itself is a far more potent source of biomethane than the food it contains when thermally hydrolysed. In conclusion, the potential of compostable materials as a valuable resource for anaerobic digestion is clear. Wet anaerobic digestion offers a promising pathway with high biomethane yields, but losses due to de-packaging are a major hurdle. However, the standout performer is thermo-pressure hydrolysis, which demonstrates exceptional efficiency in breaking down compostable packaging and maximising biomethane recovery, while also producing a high-quality digestate suitable for land application. These findings highlight the importance of advanced treatment technologies in unlocking the full potential of compostable materials as a sustainable and renewable resource.

04.04 Deep Dive into Natural polymers

Some of the highest performing materials originate in nature, including cotton, beeswax, and paper. Today, new technologies are enabling us to harness natural materials in more sophisticated ways, creating a new generation of nature-based solutions capable of replacing single-use plastics: natural polymers.

Natural polymers are defined under EU and UK REACH and SUPD regulations as polymers that are created in nature and not chemically modified. As such, they are explicitly excluded from the legal definition of "plastic" and present a scalable, in-market alternative to single-use plastics across many sectors.

Natural polymers are inherently:

- Plastic-free, PFAS-free, and microplastic-free
- Biodegradable and compostable in all environments
- Effective where reuse and mechanical recycling are impractical, particularly for food contaminated single-use formats
- Compatible with existing fibre recycling systems or, when certified compostable, with organic recycling streams
- Available as soluble or edible films that replace hard to recycle flexible plastics

Environmental Advantages of Natural Polymers

Natural polymers offer clear environmental advantages over conventional plastics, as demonstrated by comprehensive life-cycle assessments. Unlike their synthetic counterparts, they do not generate toxic residues or microplastics at end of life, addressing long-standing concerns around chemical migration and contamination from fossil-based packaging [44] [45]

Their production also avoids the carbon-intensive polymerisation processes required for plastics and removes the need for toxic additives that continue to affect the safety and recyclability of conventional plastic systems[46].

End of Life Pathways for Natural Polymers

Certified compostable products made entirely or partly from natural polymers can be composted or anaerobically digested alongside food waste, allowing them to return safely to the biosphere and support circular economy models that decouple material demand from resource use. Their compatibility with organics recycling also enables higher-value recovery from food and green waste by reducing contamination between plastic and organic streams (Figure 5).

Compatibility with Organic Recycling

Natural polymers are suitable for all major organic recycling pathways*, including anaerobic digestion (AD), in vessel composting (IVC), open windrow composting, and home composting. Unlike some certified compostable plastics, they break down effectively in both industrial and household environments, offering a uniquely flexible end-of-life route.

[44] Impacts of food contact chemicals on human health: a consensus statement - PubMed
[45] Microplastic Exposure From Packaging pg 6, 11. Toxicity of Microplastics pg 11, The Lancet 'Countdown on health and plastics' 2025
[46] Energy intensive - pg 4, 5, The Lancet 'Countdown on health and plastics' 2025
* Natural polymers such as proteins, starch, and cellulose are inherently compatible with anaerobic digestion (AD), behaving in much the same way as food waste that is sent to compost. Proteins and carbohydrates typically account for around 50–70% of the organic matter in a conventional anaerobic digester, illustrating how readily these materials are processed. However, when applied as coatings on paper or board, the overall processability of the product would largely depend on the base substrate. However, the natural polymer coating itself would be expected to break down under standard AD conditions.

Recyclability with Fibre Systems

When natural polymers are used as coatings or barrier layers on paper and board, they can be recycled through standard dry mixed recycling (DMR). Waste processors report no fibre contamination, and trials show that the fibres can be fully recovered without the need for additional sorting equipment or operator training. Materials are treated in MRFs in the same way as conventional paperboard food-service items. Where food contamination prevents mechanical recycling, natural polymers provide an alternative circular route through organic recycling.

Extensive testing by Xampla, Notpla, Traceless and others has demonstrated compatibility with CEPI and PTS recyclability protocols for both extrusion coated and water-based formats. OPRL has confirmed that boards coated with natural polymers, achieving CEPI scores of up to 99.5, qualify for "Recycle" labelling.

Behaviour in Plastics Recycling Environments

In the small number of cases where natural polymers enter plastic recycling systems they degrade naturally rapidly under the heat and grinding conditions used in plastics reprocessing. This prevents contamination and avoids disruption to existing plastic recycling operations. Figure 5 illustrates End-of-Life Pathways for Natural Polymers.

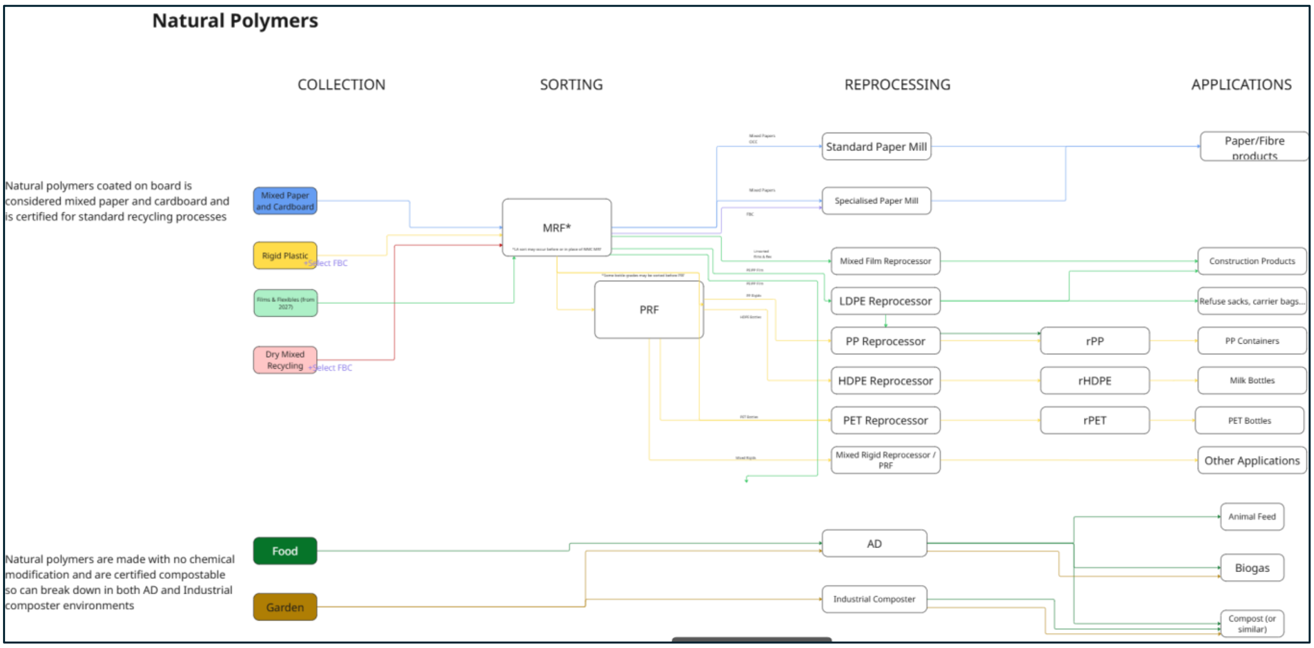

Figure 5. Organic and mechanical recycling route for natural polymers

Integration with Wider Material Systems

In real-world applications, natural polymers are often paired with fibre-based substrates or certified compostable materials. Fibre-based formats remain fully recyclable, while compostable formats are compatible with all organic recycling systems. Even if natural polymers are mistakenly combined with fossil plastic packaging, a scenario expected to be rare, early testing indicates they break down during processing does not contaminate the fossil plastic stream.

State of the UK's Natural Polymers Market

Commercial natural polymer solutions are already operating at scale, offering a practical route toward the 80% reduction in ocean plastic pollution achievable through systemic change[47] Companies such as Notpla (UK), Xampla (UK), Traceless (Germany), and ZeroCircle (India) are already in market with natural polymer alternatives to some of the most polluting plastics; including coatings for paper and board and single-use items. These solutions are especially valuable where reuse systems are limited, industrial composting infrastructure is lacking, and food contamination complicates traditional recycling.

Market Growth and Economic Opportunity

Natural polymers have the potential to reap large economic rewards. The paper and board functional coatings segment was valued at $8.5bn in 2023, forecasted to grow to nearly $11bn by 2028 according to Smithers[48].

Demand will continue to increase as brands and consumers prioritise plastic-free products, supported by initiatives such as the WRAP Plastics Pact, now active in 20 countries and over 900 organisations.

Impact of EPR and RAM on Natural Polymers in the UK

Despite their environmental and functional benefits, natural polymers face significant structural barriers under the UK's Extended Producer Responsibility (EPR) and Resource Efficiency and Materials (RAM) frameworks.

Challenges in Regulatory Classification

- **Categorised as "other" or "plastic" under EPR/RAM:** These categories carry higher fees intended for high impact fossil plastics. Misclassification artificially inflates costs for natural polymer producers, discouraging the adoption of lower impact alternatives.
- **Penalised due to the absence of a clearly defined material class:** EPR/RAM frameworks do not recognise natural polymers, compostable natural materials, or soluble/edible films as distinct categories. This results in disproportionately high fees on low impact materials, inconsistent packaging data reporting, a lack of operational guidance for local authorities and a regulatory disadvantage for biomaterial innovators. This contradicts the core objectives of EPR, which are to incentivise lower impact materials and reduce plastic pollution.

A dedicated category for 'Natural Polymers', as defined in UK REACH, within EPR RAM would align incentives with environmental outcomes, supporting innovation and investment, and reduce misreporting. It would also provide clarity for waste operators and enable faster scale-up of genuinely plastic-free solutions.

[47] UN Environment Programme, UN Roadmap to Cut Global Plastic Pollution
[48] The Future of Functional & Barrier Coatings for Paper & Board to 2028 - Smithers

05 Emissions Trading Scheme and EPR

Introduction

The UK Emissions Trading Scheme (UK ETS) is one of the UK's flagship decarbonisation policy instruments. The UK ETS works directly to tip the balance between continuing to emit and using or investing in lower carbon technology[49]. It does this by creating a market for carbon allowances, allowing those who decarbonise to trade allowances with those who continue to emit. This process will guide the UK to the most cost-effective path to net zero across the sectors the ETS applies to.

The UK ETS currently covers the heavy industry, power and aviation sectors – approximately 25% of UK territorial emissions. By setting a limit – the cap – on emissions from these sectors, and creating a carbon price, the scheme incentivises investment in decarbonisation in line with climate targets across the UK. The Authority is expanding the scheme to incentivise additional sectors of the economy.

The UK Emissions Trading Scheme (ETS) is expected to include packaging in scope from around 2028, with costs linked to verified greenhouse gas (GHG) emissions associated with materials and processes, if incinerated at end-of-life.

The UK government has proposed this change to align the scheme with the country's 2050 net zero target and international climate policy trends. The scheme will apply to facilities processing three tonnes or more per hour of non-hazardous waste or ten tonnes or more per day of hazardous waste Operators will be required to monitor, report, and verify emissions using approved methods and submit annual reports, but will not be subject to compliance obligations.

The introduction of carbon pricing through the UK Emissions Trading Scheme (ETS) creates an additional cost associated with the fossil carbon contained in plastic packaging. A key policy challenge is determining how these ETS costs should be fairly and accurately passed on to obligated producers through the Extended Producer Responsibility (EPR) system.

To ensure the system sends the correct decarbonisation/defossilisation signals and reflects real environmental outcomes, the structure used to allocate ETS costs must consider not only the fossil carbon content of plastics but also the real-world recycling outcomes of different packaging formats.

Below we outline why greater granularity in plastic packaging categories is necessary and proposes approaches to ensure ETS costs are allocated equitably.

The Need for Greater Granularity in Plastic Packaging Categories

The degree to which plastic packaging generates ETS costs is determined by two key factors:

- The fossil carbon content of the material.
- The proportion of that packaging that is incinerated rather than recycled.

Different plastic packaging formats have significantly different recycling outcomes. However, the current EPR framework treats plastic packaging as a single category with three modulation levels (green, amber, and red), based primarily on technical recyclability rather than actual recycling rates. This creates a misalignment between the policy framework and real-world outcomes.

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[49] UK Emissions Trading Scheme (UK ETS): a policy overview - GOV.UK

Limitations of Technical Recyclability

In practice, recycling rates vary widely even for materials that are technically recyclable. This is due to several factors:

- Human behaviour and product use (e.g. food contamination affecting recyclability)
- Practical collection challenges (e.g. films are much harder to collect and recycle than rigid plastics)
- Processing complexities
- Market demand constraints for recycled material (e.g. PET pots, tubs and trays produce lower-quality recyclate with weaker demand)

As a result, formats rated highly for recyclability may still have low actual recycling rates. For this reason, passing ETS costs solely according to technical recyclability would be inequitable and would fail to reflect the true carbon impacts of different packaging types.

Illustrative Plastic Format Categories

To better reflect recycling outcomes, plastic packaging could be divided into more granular categories. An illustrative approach includes four format groups:

- Bottles
- Pots, Tubs and Trays (PTTs)
- Small and other formats
- Films

These categories exhibit substantially different recycling rates and therefore different likely carbon outcomes. Using available data and projections:

- Projected post-consumer plastic recycling rate by 2030: approximately 57%
- Current recycling rate (2023): approximately 32%

However, recycling performance varies significantly across packaging formats. For example, films and small formats together represent roughly 35% of the plastic packaging placed on the market but could account for approximately 60% of ETS costs, because these formats are recycled less frequently and are therefore more likely to be incinerated

Linking ETS Costs to Format-Specific Recycling Outcomes

To send the correct decarbonisation/defossilisation signals through EPR, ETS cost allocation should reflect the recycling performance of different formats. An illustrative charging structure could be:

Plastic Format	Indicative ETS Charge Level	Rationale
Bottles	Low	High recycling rates
Pots, Tubs and Trays (PTTs)	Medium	Moderate recycling rates
Small and Other Formats	High	Very low recycling rates
Films	High	Low recycling rates and difficult collection

This structure would ensure:

- Costs reflect actual environmental outcomes
- Producers are incentivised to move toward formats with higher recycling performance
- Alternatives such as bio-based materials that do not generate ETS costs receive the appropriate market signal

While this approach introduces slightly greater administrative complexity, the resulting policy accuracy and fairness justify the trade-off.

ETS Treatment of Energy Used in Plastic Recycling

Another important issue is the use of plastic as a fuel during recycling processes. Some recycling methods, particularly chemical recycling processes such as pyrolysis, require significant energy inputs. In some cases, 30–40% of the recovered plastic may be used as fuel during primary processing to generate energy.

When plastic is combusted in this way, fossil carbon is still released into the atmosphere. Therefore, the associated emissions should also incur ETS costs. If these emissions are excluded from the calculation:

- It could distort market signals
- Recycling routes with lower ETS exposure but similar carbon emissions could be artificially favoured
- The system could unintentionally incentivise less efficient decarbonisation/defossilisation pathways

Conclusion

To ensure ETS costs are passed through the EPR system in a fair and effective way, several actions are required:

1. Establish detailed recycling rate data by plastic packaging format.
2. Develop improved modelling of recycling processes, including the proportion of plastic used as fuel in energy-intensive recycling technologies.
3. Incorporate both fossil carbon content and format-specific recycling outcomes when determining ETS cost pass-through.
4. Determine ETS fee levels by packaging format and recycling method, ensuring that the system reflects real carbon emissions and supports decarbonisation objectives.

By improving data granularity and aligning ETS cost allocation with real recycling outcomes, policymakers can ensure that the EPR system delivers fair cost allocation, accurate carbon pricing signals, and stronger incentives for low-carbon packaging design.

06 Summary and Recommendations

Summary

The UK government has invested hundreds of millions of pounds of taxpayer money into bio-based and sustainable materials innovation, yet current packaging regulations are preventing many of these innovations from scaling commercially.

Between 2018 and 2024 more than £450 million of public funding was invested through programmes such as UKRI research grants and packaging innovation challenges to develop alternatives to fossil-based plastics. These investments were intended to create a new domestic industry, potentially worth £4.2 billion and supporting around 35,000 skilled jobs.

However, the policy framework governing packaging waste - including Extended Producer Responsibility (EPR), the Plastic Packaging Tax (PPT), and the future Emissions Trading Scheme (ETS) - has created a regulatory environment that penalises the very materials taxpayers funded to develop.

Key Problem: Regulations Reward Incumbent Materials

Current rules assess packaging almost entirely on whether it fits the existing recycling infrastructure, which was designed around conventional fossil-based plastics. Because many new bio-based or compostable materials are not yet widely processed within this system, they are automatically classified as “non-recyclable” under the Recycling Assessment Methodology (RAM).

This results in significantly higher regulatory fees and taxes, even where the materials have strong environmental benefits.

As a consequence:

- Innovative materials receive “red” classifications under EPR, triggering the highest compliance costs.
- Bio-based plastics are taxed the same as virgin fossil plastics under the Plastic Packaging Tax, despite lower carbon impacts.
- Compostable and natural-polymer materials are often treated as conventional plastics for regulatory purposes.

These policy signals effectively reward fossil-based packaging systems while penalising new sustainable alternatives.

Public Investment at Risk

The UK has already funded major research programmes into sustainable materials, including:

- seaweed-based packaging
- plant-protein coatings
- compostable polymers
- bio-derived plastic alternatives

Yet many of these innovations cannot reach commercial scale because the regulatory system increases their cost relative to fossil plastics, which remain cheaper and better integrated into existing recycling systems. In practice this means that taxpayer-funded innovation risks being stranded in laboratories or pilot projects.

Economic Consequences Already Emerging

The report indicates that policy misalignment has already contributed to:

- Loss of more than 4,000 skilled jobs
- £300–£500 million in annual economic value disappearing from the UK
- Companies relocating research and manufacturing abroad.

Without changes, the UK risks funding early-stage innovation while other countries capture the commercial benefits.

Structural Policy Failure

The core issue is that the regulatory system focuses narrowly on current recyclability, rather than considering:

- lifecycle carbon impacts
- renewable feedstocks
- organic recycling pathways
- future infrastructure development

This approach locks the market into existing fossil-based systems and discourages investment in emerging technologies.

Conclusion

The UK has already spent substantial taxpayer funds building a world-leading research base in sustainable materials. However, inconsistent packaging and waste regulations now prevent these innovations from entering the market, undermining both environmental goals and economic returns.

Without policy reform, the UK risks wasting public investment, losing industrial leadership, and exporting the commercialisation of British innovation to other countries.

Recommendations

We propose:

1. **Establishment of a technical RAM bio-based and biodegradable materials working group to:**
   - Review evidence from existing bio-based, compostable and natural polymer trials.
   - If/where evidence gaps exist, jointly plan work required to close gaps
   - Propose specific RAM adjustments and timelines
   - Develop guidance on categorisation and claims for bio-based, compostable and natural polymer packaging.

2. **Establishment of a dedicated taskforce between policymakers (DEFRA, HMT, DESNZ) and bio-based material producers to map out a practical roadmap for the treatment of biogenic carbon across all environmental taxes (e.g. PPT, EPR, ETS).**

By taking these steps, the UK can position itself as a global leader in sustainable materials, while ensuring that packaging regulation is an enabler—not a barrier—to the transition away from fossil-based materials.