The Evidence Chain Behind Recycled Food Packaging

Europe's 18 November 2026 documentation reform and the unresolved challenge of proving chemical safety across recycled-plastic supply chains

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Abstract

On 18 November 2026, two European Commission regulations take effect that materially alter the evidence environment for plastic food-contact materials. Regulation (EU) 2026/2376 revises the recycled-plastics regime, strengthening compliance documentation, traceability and import-related requirements; Regulation (EU) 2026/2412 updates the list of substances permitted in food-contact plastics. Read alongside the Packaging and Packaging Waste Regulation's August 2026 PFAS restrictions, these measures expose a difficult industrial question: how can a manufacturer demonstrate that a recycled polymer is suitable for a specific food, temperature, contact duration and production history, rather than merely declare it recycled? This article examines feedstock uncertainty, decontamination validation, non-intentionally added substances, migration, documentation hand-offs and the distinction between chemical safety and circularity. It compares the European Union and Spain with Great Britain and the United States, identifies procurement and quality-system consequences, and proposes an independently testable framework linking material genealogy to exposure-relevant evidence. The proposed research programme is a hypothesis, not an existing certification scheme.

Keywords: *recycled plastics; food-contact materials; migration; NIAS; traceability; compliance declarations; PFAS; regulatory science.*

1. A regulatory change whose real subject is evidence

Regulation (EU) 2026/2376, adopted on 28 October and published in the Official Journal on 29 October 2026, amends Regulation (EU) 2022/1616 on recycled plastic materials and articles intended for food contact. It takes effect on 18 November. The same date is the date of effect for Regulation (EU) 2026/2412, which amends the Union list of authorised substances in Regulation (EU) No 10/2011. These are enacted measures, not consultation drafts. Their coincidence is editorially significant: one strengthens the documentary chain for recycled material, while the other modifies the legal universe of substances that may be incorporated into plastic food-contact articles under specified conditions [1–3].

The distinction is more consequential than the apparent administrative character of declarations of compliance. Food packaging is not a chemically inert container. Migration depends on polymer structure, additives, degradation products, prior contamination, food composition, contact time, temperature and the article's surface-to-volume

relationship. A declaration is useful only insofar as it refers to an identifiable material and an evidence package that matches the actual application. A beautifully documented but analytically unrepresentative sample is not a safe packaging system.

The central thesis of this article is that the emerging competitive asset in recycled food packaging is a transferable chain of evidence: from the waste stream and recycling process to the converter, finished article, food application and regulatory destination. This is an analytical interpretation of the 2026 measures, not a claim that the legislation creates a single new scientific certification.

2. What the November instruments actually change

Regulation 2026/2376 revises the Union register, compliance documentation, test methods and documentation presented on release for free circulation. The amended framework provides a declaration architecture covering relevant upstream and downstream actors rather than relying solely on an isolated certificate attached to the final package. The amended Article 29 and Annex III introduce, or revise declaration forms identified as P, A, B and C, corresponding to different supply-chain functions. The detailed applicability of each form must be checked against the operator's legal role; they are not interchangeable documents [1].

The regulation also introduces an *article 5a* concerning compliance declarations across marketing stages other than retail and addresses documents relevant to certain PET imports. Supporting documentation must be made available to competent authorities within the period set by the amended text, reported as ten working days for the relevant request. Transition provisions matter revised A and B declarations have a February 2027 adaptation date, while the additional P and C documentation requirements have a May 2027 adaptation date under the conditions of the regulation. These dates should be verified against the exact transitional provision before an individual operator adopts a go-live plan [1].

Regulation 2026/2412 separately adds four substances to the plastic food-contact positive list with material-specific restrictions. An authorisation to use a listed substance is not a general authorisation to use it in any polymer, at any concentration or for any food-contact condition. For example, restrictions on polymer identity, loading, food type, temperature or specific migration may be decisive. The practical lesson is that recycled-content compliance and substance authorisation are complementary, not alternative, tests [2].

2.1. A compliance declaration is a structured claim

A declaration should make it possible to reconstruct what was supplied, by whom, under which recycling technology and manufacturing conditions, with what restrictions on subsequent conversion and intended use. The underlying evidence may include input controls, process monitoring, decontamination performance, analytical test reports, migration calculations, batch genealogy and instructions for the next operator. The exact legally mandatory elements depend on the form and activity. Treating all documentation as a generic "food-grade certificate" loses the information required to assess whether an intended application is covered.

2.2. Time and status must not be confused

Entry into force, application of a requirement, the end of a transitional arrangement and depletion of legitimately placed stocks are different legal events. The November measures should not be presented as requiring every existing article to be withdrawn immediately. Equally, a transition does not provide a general exemption from the underlying framework safety requirement. Procurement systems need a dated legal-status field for each material and shipment, not an undated yes/no flag.

3. The science: recycled polymers carry histories

Virgin polymers begin with controlled raw-material identities and manufacturing routes. Post-consumer recycled streams can carry additional uncertainty from previous contents, misuse, labels, adhesives, printing inks, cleaning products, sorting errors, degradation and repeated thermal histories. Mechanical recycling may reduce some

contaminants through washing, extrusion, vacuum or other decontamination operations, but the effectiveness depends on the chemistry and transport properties of each contaminant, polymer morphology and validated process conditions. No recycling technology should be assumed to remove every unknown substance.

Polyethylene terephthalate (PET) is important because established recycling technologies and challenge-testing methodologies have developed around it. Their existence does not justify extending the same assumptions to polyolefins, multilayer films or unfamiliar waste streams. Sorption and diffusion behaviour differ among polymers; contaminant profiles and processing conditions differ among collection systems. The phrase “100% recycled” describes an origin fraction, not chemical suitability for food contact.

3.1. Non-intentionally added substances

Non-intentionally added substances (NIAS) may arise from impurities, reaction products, oligomers, degradation products or interactions among constituents. Screening with gas chromatography–mass spectrometry, liquid chromatography–high-resolution mass spectrometry and complementary techniques can reveal signals, but a detected peak is not automatically an identified toxicant. Conversely, a non-detect does not prove absence below all relevant biological thresholds. Method coverage, extraction conditions, reference standards, reporting limits, blank contamination and uncertainty are essential to interpretation.

A defensible programme combines targeted analysis of known hazards with appropriately designed non-target screening, identification prioritisation and toxicological evaluation of consequential findings. The research challenge is to connect analytical signals to migration into representative foods and to realistic exposure. Exhaustive chemical identification of every trace constituent may be impossible; the safety case therefore needs transparent risk-based prioritisation and defensible uncertainty bounds.

3.2. Migration is a property of the system

A migration result is conditional on the food or simulant, temperature, duration, packaging geometry and test method. Fatty foods, acidic beverages, hot-filled products and long ambient storage may present very different exposure profiles. Testing an empty bottle or film under one condition does not establish suitability for every customer. Functional barriers may reduce transfer under defined conditions but must be demonstrated for the relevant substances and configurations; they are not a universal legal or physical exemption.

Industrial trials should consider accelerated ageing cautiously. Extrapolating from elevated temperature to long storage can fail where diffusion, crystallinity, polymer relaxation or reaction kinetics change nonlinearly. Test plans should be designed around the actual article and foreseeable use, with worst-case assumptions justified rather than ritualised.

4. PFAS restrictions make the problem more visible

Regulation (EU) 2025/40 on packaging and packaging waste began applying in substantial part on 12 August 2026. Its Article 5(5) establishes PFAS concentration restrictions for food-contact packaging, including 25 parts per billion for any individually measured targeted PFAS and 250 parts per billion for the sum of targeted PFAS, subject to the legal definitions, exclusions and measurement provisions. A further limit applies to PFAS including polymeric forms; laboratories must consult the operative text and applicable guidance before selecting the analytical approach [4,5].

The PPWR illustrates why recycled-content targets and chemical-safety constraints must be solved together. A waste stream may improve material circularity while bringing legacy additives or contaminants into a new use. Conversely, a newly designed barrier or coating may improve grease resistance while creating a separate migration or end-of-life question. The correct optimisation problem is multidimensional: human exposure, material functionality, recyclability, process energy, contamination control and verified legal compliance.

It would be wrong to conclude that the 2026 recycled-plastics amendment itself creates the PFAS restriction; the instruments have different legal bases and scopes. Their interaction is practical: operators need a coherent substance-and-material dossier capable of supporting both food-contact safety and packaging-specific restrictions.

5. Supply-chain traceability as an analytical system

Traceability is often reduced to lot numbers and invoices. For recycled food-contact plastics, useful traceability links input-stream provenance, sorting specification, recycler and technology identity, operating windows, output batches, conversion conditions, additives, test samples, declarations and final food applications. A chain is broken when a test report refers to a material grade but cannot be tied to the lot, process version or contact condition under discussion.

This suggests a practical evidence model with four linked layers. The material layer records polymer and input origin. The process layer records relevant decontamination and conversion parameters. The analytical layer records tests, detection limits, results and uncertainty. The legal layer records intended use, restrictions, territory, declaration version and authorisation status. An auditor should be able to travel in both directions: from a finished package to its upstream evidence, and from a changed upstream parameter to the affected customer uses.

Digital systems may help, but digitisation does not repair weak data. A blockchain record can permanently preserve an incorrect assertion; an AI model can classify an unidentified chromatographic signal without making that classification reliable. Data governance therefore requires source attribution, laboratory method versioning, human review, controlled corrections and explicit uncertainty. Such controls are relevant to food safety even when no specific software architecture is mandated.

6. Jurisdictional comparison: common science, distinct legal permission

European Union and Spain. Regulation (EC) No 1935/2004 provides the overarching framework for materials intended to contact food; Regulation (EU) No 10/2011 governs plastic materials and articles; Regulation (EU) 2022/1616 addresses recycled plastics; the 2026 amendments modify particular requirements. Regulation (EC) No 2023/2006 provides good-manufacturing-practice obligations. Spain applies the directly applicable EU measures, with competent authorities exercising official controls. A supplier’s declaration does not displace the operator’s responsibility to ensure the material is suitable for the actual food and use [1–4,6].

Great Britain. Great Britain maintains its own legal and authorisation mechanisms for food-contact materials, including an official register for regulated plastic food-contact substances. From April 2025, certain GB authorisations are published through the FSA/FSS register following ministerial decisions. A new EU positive-list entry or recycled-plastics amendment is not automatically a new GB authorisation. Northern Ireland must be assessed separately under its applicable EU-linked arrangements [7].

United States. The Federal Food, Drug, and Cosmetic Act and FDA food-contact frameworks focus on the safety and authorised status of substances under their intended conditions of use. Recycled-plastic applications require attention to the source and contamination of feedstock, recycling-process effectiveness, and the relevant food-contact authorisations or other legal bases. FDA no-objection letters for specific recycling processes, where applicable, should not be misrepresented as blanket approval of every output or article. A European declaration of compliance does not establish US market legality [8].

Other markets. A manufacturer exporting to multiple territories should maintain one scientifically consistent core dossier with separate, date-controlled legal modules. Differences may concern positive lists, recycling-process assessment, permitted conditions of contact, documentation, testing conventions and responsible economic operators. The operational advantage of a shared scientific core is efficiency; its limit is that evidence portability is not authorisation portability.

7. A contrasting British signal: ocean-bound plastic

The UK Food Standards Agency and Food Standards Scotland advised in May 2025 against using abandoned environmental plastic, including ocean-bound plastic, in food packaging because the evidence then available was insufficient to establish safety. The agencies distinguished uncontrolled environmental collection from plastics recovered through established, controlled collection systems [9]. This is a particularly instructive counterpoint to the

European documentation reform: traceability and provenance are part of the safety argument, not merely sustainability marketing.

The British advice does not prove that every environmentally recovered polymer is intrinsically unsafe. It shows that uncertainty about past contamination and the adequacy of decontamination can prevent a reliable positive safety conclusion. Research should examine whether improved collection segregation, contaminant characterisation and validated recycling can narrow that gap; until then, a circularity claim must not be used to fill missing exposure evidence.

8. What changes for ingredient suppliers and food manufacturers

Packaging suppliers are the immediate addressees of many documentary obligations, but food manufacturers bear the practical consequences of material choice. A sauce containing oil, a high-acid drink, a protein beverage subjected to heat and a dry cereal do not present the same migration conditions. The food producer must translate supplier restrictions into a packaging specification that is compatible with the product's composition, processing, storage and distribution. A packaging change may require renewed migration or shelf-life validation even when the food recipe is unchanged.

Procurement should request the appropriate declarations, identify the legal manufacturer and recycling process, review use restrictions, verify batch comparability and establish notification duties for material changes. Quality teams should align packaging specifications with HACCP-related hazard analysis where relevant, without pretending that HACCP alone substitutes for materials-law compliance. R&D should test sensory effects, oxygen and moisture barriers, light transmission, seal integrity and shelf life alongside chemical suitability.

For an ingredient and biotechnology company such as INTABIOTECH, the genuine strategic relevance lies in formulation–packaging compatibility and independent technical evaluation, not in claiming ownership of recycling technology. Functional beverages, concentrated protein systems, fat-containing formulations and long-life ingredients each create distinct interfaces with packaging. Collaborative studies with converters and laboratories could identify where a legally compliant material is nevertheless technologically unsuitable for a particular formulation, and where an apparently sustainable substitute changes food-waste risk.

9. Research & Innovation Opportunity

Research question. Can a process-aware, uncertainty-calibrated evidence chain predict which changes in recycled-plastic feedstock, decontamination, conversion and intended food use require new migration or toxicological testing? This is not a claim that traceability platforms, NIAS screening or digital compliance tools are novel; each has substantial prior development. The narrower opportunity is to validate their integration against real, independently characterised material changes and exposure outcomes.

Proposed hypothesis. A model linking batch genealogy, critical recycling-process parameters, targeted and non-target chemical fingerprints, polymer-specific diffusion behaviour and application conditions could identify material changes with consequential migration implications more accurately than a documentation-only classification. This hypothesis is plausible because contaminant transfer depends jointly on source chemistry, processing and food-contact conditions. It remains unproven; no validated predictive accuracy or proprietary advantage is asserted.

Work package 1 would map the scientific and patent/public-disclosure landscape and select representative PET and non-PET materials with documented collection and recycling histories. Work package 2 would construct matched batches with controlled changes in feedstock or process conditions, including negative and positive controls. Work package 3 would perform blinded chemical screening and migration studies under realistic and justified worst-case contact conditions, with independent laboratory replication. Work package 4 would test whether the integrated model anticipates meaningful changes in measured migration while remaining interpretable to assessors and auditors.

The project must specify false-negative thresholds, analytical detection limits, uncertainty propagation, model-drift monitoring and criteria for rejection. Failure would include missing a consequential contaminant, unstable results

across laboratories, inability to connect records to actual batches, or environmental gains that disappear once additional sorting and decontamination are counted. Regulatory acceptance cannot be assumed: competent authorities determine whether submitted evidence satisfies applicable law. The potential industrial output is a transparent qualification protocol and evidence-gap map, not an automated legal approval.

10. A management agenda for 2027

The immediate priority is a material-and-market inventory. Identify every recycled-content food-contact article, its supplier and recycler, intended food types, time–temperature conditions, applicable declarations, analytical evidence and destinations. Assign a responsible owner for checking the amended 2026 documentation requirements and transitional dates. Distinguish upstream obligations from the evidence the food manufacturer needs to retain.

Next, establish a controlled change-management procedure: a change in recycler, feedstock, decontamination technology, masterbatch, adhesive, ink, conversion temperature or final use should trigger a documented comparability assessment. Not every change demands a full new toxicological dossier, but none should be dismissed solely because a nominal polymer grade or recycled-content percentage remains constant.

Finally, separate three business claims. “Recycled” concerns material origin. “Food-contact compliant” concerns a defined legal and exposure scenario. “Environmentally preferable” requires comparative lifecycle evidence with appropriate system boundaries and, where relevant, food-waste effects. The three claims can coincide, but one does not prove the others. This distinction should be embedded in supplier qualification, product development and marketing review.

11. Conclusions

The 18 November 2026 EU measures are important because they connect regulatory compliance more tightly to the evidence that moves through a recycled-plastics supply chain. They do not make every recycled material safe, nor do they imply that every application requires the same testing. Their deeper significance is the insistence that material identity, process history, analytical evidence and intended use remain linked.

For food and biotechnology manufacturers, the practical response is to replace generic “food-grade recycled” assurances with application-specific, traceable qualification. For researchers, the opportunity is to develop and independently validate methods that connect chemical fingerprints, manufacturing changes and exposure. For regulators, the challenge is to preserve proportionate risk assessment without confusing documentation completeness with scientific sufficiency. Circularity and consumer safety are complementary objectives only when the evidence supports both.

References and primary sources

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Evidence classification: enactment dates and requirements are attributed to the cited legal instruments; analytical mechanisms are established principles of food-contact-material science; the integrated evidence-chain model is expert interpretation and a proposed research agenda, not a validated technology.

Related INTABIOTECH Knowledge Areas: Food Safety · Regulatory Affairs · Processing Technologies · Sustainability · AI & Food · Emerging Research

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