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Date: **Tuesday, 04th March 2025**

Deliverable 7.7

Report on Standardisation

This project has received funding from the Bio-based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 101023306

UNLOCK

Report on Standardisation

Technical References

Project Acronym	UNLOCK
Project Title	Unlocking a new feather bioeconomy for keratin-based agricultural products.
Project Coordinator	Sarah Montes, CIDETEC
Project Duration	48 months

Deliverable No.	7.7
Dissemination level [1]	PU
Work Package	7
Task	7.2 Exploitation and Business Plan
Lead beneficiary	Farrelly and Mitchell
Contributing beneficiary	OWS, TECNO
Due date of deliverable	28/02/2025
Actual submission date	05/03/2025

[1] PU = Public
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services)
CO = Confidential, only for members of the consortium (including the Commission Services)

Document history

V	Date	Beneficiary	Author
1	14/02/2025	Farrelly Mitchell	Karen McGillicuddy, Daniel Traas
2	19/02/2025	CIDETEC	S. Montes (revision)
2.1	25/02/2025	TECNO	L. Villacian (revision)
2.2	03/03/2024	OWS	S. Verstichel, E. Beeckman (revision)
3	04/03/2024	Farrelly Mitchell	Daniel Traas (final revisions)

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Summary

This report provides a comprehensive analysis of standardisation in bio-economy value chains, focusing on Project UNLOCK's innovative technologies for feather-based products. To-date, the project has identified and aligned with several key European standards relevant to bio-based products, biodegradability, and sustainability claims. The report highlights the benefits of standardisation, such as ensuring product quality, enhancing consumer trust, and facilitating regulatory compliance. It also discusses challenges in implementing standards, including resistance to change, costs of certification, and the complexity of navigating multiple regulations. Specific barriers to value chain standardisation in the UNLOCK project are identified, such as integration challenges across different sectors and high investment requirements. Farrelly Mitchell provides recommendations for optimising standardisation benefits, including disseminating project learnings and encouraging implementation by key actors. The report concludes that while there are significant cost implications for complying with sustainability standards, standardisation of bio-economy value chains remains crucial for the proliferation and commercial replication of UNLOCK's innovative processes.

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Introduction

1.1 Introduction

Standardisation plays a pivotal role in adapting and replicating the feather-based value chains across selected target countries and sectors by providing a common framework which ensures the consistency, quality and safety of the processes and products developed through this project. This report aims to explore the significance of standardisation, detailing its benefits, challenges, and impact on the developing a market for innovative technologies such as the outputs of the UNLOCK project. By examining current standards, the report will highlight how standardisation can ensure efficiency, enhance consumer trust, and facilitate regulatory compliance. Additionally, it will provide recommendations, emphasising the importance of adopting and adhering to established standards to drive progress and establish markets for these new products. The report will simultaneously align the standardisation of the value chains with the lived experience of the project to-date.

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1.2 Background

Application of the relevant standards to products developed through the UNLOCK project is an important mechanism for validating the new technologies that were used in this project, to ensure the products are safe, reliable and ready for adoption across the European Union (EU). The EU places significant importance on standardisation as a means of ensuring that products meet high safety, health, and environmental standards. Standardisation creates the standard which is a common framework that needs to be followed to facilitate compatibility and quality. Certification is the process to independently verify that a product or process complies with the requirements of the standard; facilitating market access and consumer trust and confirming products are safe, reliable, and compliant with regulatory requirements.

The current European Standardisation Strategy presented in February 2022[1] outlines the critical role standards will play in enabling European industry to address current challenges and support the green transition. Businesses use these standards to ensure their products adhere with EU regulatory requirements, achieve interoperability, and guarantee safety for both citizens and the environment. Standards enable businesses to compete effectively in the EU Single Market and in global markets.

[1] European Standardisation Strategy 2022

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Discussion

2.1 Current Standards

A comprehensive analysis of the existing standards applicable to the UNLOCK outputs was presented in Deliverable 6.6 – Feather Processing Compliance and Existing Safety Rules. The key European (EN) standards relevant to this Project are summarised in the tables below.

Firstly, there are a number of product specific standards which certify that the products are suitable for their intended use and they are biodegradable in soil, thereby reducing plastic pollution and environmental impact.

Table 1 Product Specific Standards

Type of Product	Standard No.	Standard Name	Description	Applicable to:
Mulch Films	EN 17033	European standard EN 17033 on biodegradation of plastic mulch films in agriculture	Details the requirements for biodegradable mulch films used in agriculture and horticulture. Includes test methods and evaluation criteria regarding the biodegradation, ecotoxicity, film properties, and constituents of the biodegradable mulch films. Also recommends to clearly mark biodegradable mulch films and their packaging. [2]	Mulch Films
Textiles standards	ISO 11721	Textiles — Determination of resistance of cellulose-containing textiles to micro-organisms through soil burial tests		Nonwoven Geotextiles

[2] New EU standard for biodegradable mulch films in agriculture published – European Bioplastics e.V. (european-bioplastics.org)

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Secondly, there are other standards which can be used to support sustainability claims. Directive (EU) 2024/825[3], which entered into force on 26 March 2024, supports consumers in making choices around sustainability. It protects consumers against unfair practices relating to sustainability claims, by requiring traders to provide clear, relevant, and reliable information on the sustainable nature of products. This Directive prohibits unsupported "green claims" such as "biodegradable" and "biobased" - such claims need to be supported by clear, objective, publicly available and verifiable commitments and targets and should be verified through third-party certification. Table 2 outlines key European standards that can be applied to support claims made regarding saying the products are "biodegradable", "compostable" or "biobased".

Table 2 Standards Relating to Sustainability Claims

Type of Product	Standard No.	Standard Name	Description	Applicable to:
Biodegradable	EN 17033[4]	European standard EN 17033 - Plastics. Biodegradable mulch films for use in agriculture and horticulture. Requirements and test methods	Details the requirements for biodegradable mulch films used in agriculture and horticulture. Includes test methods and evaluation criteria regarding the biodegradation, ecotoxicity, film properties, and constituents of the biodegradable mulch films. Also recommends to clearly mark biodegradable mulch films and their packaging.	Mulch Films
Compostable	EN 13432[5]	European standard EN 13432 - Packaging. Requirements for packaging	Defines the requirements for industrially compostable packaging and includes both the criteria and a test scheme. They must be	All UNLOCK Products

[3] Directive (EU) 2024/825
[3] EU Directive 2024/825 as regards empowering consumers for the green transition | Fieldfisher
[3] MEPs adopt new law banning greenwashing and misleading product information | News | European Parliament (europa.eu)
[4] BS EN 17033:2018
[5] BS EN 13432:2000

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Type of Product	Standard No.	Standard Name	Description	Applicable to:
		recoverable through composting and biodegradation. Test scheme and evaluation criteria for the final acceptance of packaging	recognisable as biodegradable / compostable by the end user.[6]	
Biobased	Suite of standards (see Tables 3, 4 and 5 for details)	Standards for Biobased Products	These standards describe methods for biobased content determination, requirements for sustainability assessment and how to communicate about them in the value chain. This is to ensure that producers present and promote biobased products in a clear and understandable way[7]	All UNLOCK Products

The bio-based standards can be categorised into three sets. The first set relate to the standard methods for bio-based content determination, and are outlined in Table 3 below:

Table 3 Standards for Biobased Products - Biobased Content Determination

Standard No.	Standard Name	Description
CEN/TR 16721[8]	Overview of methods to determine the bio-based content	This Technical Report gives guidance on the applicability of the different methods
EN 16785-1[9]	Bio-based content - Part 1: Determination of the bio-based content	Details the requirements for determining bio-based content of a given product using radiocarbon (Carbon-14) analysis and elemental analysis.

[6] Compostability – what does it really mean? – Sulapac
[7] Standards for Biobased products
[8] CEN/TR 16721:2014
[9] EN 16785-1:2016

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Standard No.	Standard Name	Description
	using the radiocarbon analysis and elemental analysis	
EN 16785-2[10]	Bio-based content - Part 2: Determination of the bio-based content using the material balance method	Focuses on a material balance method to determine the renewable content of a bio-based product.
EN 16640[11]	Determination of the bio-based carbon content of products using the radiocarbon method	Describes how to measure the carbon isotope C14 (radiocarbon method)[17]. There are three test methods specified in EN 16640 for measuring radiocarbon content – liquid scintillation counting, beta-ionization, and accelerator mass spectrometry (AMS).
EN 17351:2020[12]	Determination of the oxygen content using an elemental analyser	Provides a way to measure the oxygen content in bio-based materials, which can be useful for assessing their composition and properties[20].
EN 16766[13]	Biobased solvents – requirements and test methods	Sets the requirements for bio-based solvents in terms of their bio-based content, their technical properties and test methods[21].

The second set of standards relate to sustainability assessment, and are set out in Table 4 below:

Table 4 Standards for Biobased Products - Sustainability Standards

Standard No.	Standard Name	Description
EN 16760	Bio-based products Life Cycle Assessment (LCA)	Provides guidance and requirements to assess impact over the life cycle of biobased products with the focus on how to handle the specificities of the bio-based part of the product[14].
EN 16751	Bio-based products Sustainability criteria	Sets horizontal sustainability criteria applicable to the bio-based part of all bio-based products, covering all

[10] EN 16785-2:2018
[11] EN16640:2017
[12] EN17351:2021
[13] EN 16766:2018
[14] CEN - EN 16760 - Bio-based products - Life Cycle Assessment | GlobalSpec

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Standard No.	Standard Name	Description
		three pillars of sustainability; environmental, social and economic aspects[15].
CEN/TR 16957	Bio-based products Guidelines for Life Cycle Inventory (LCI) for the End-of-life phase	This Technical Report provides guidance on how to compile an inventory for the end-of-life phase in LCA of bio-based products[16].

The third set of standards related to terminology and communication of information on biobased content business to business (B2B), or to the final consumer, and are set out in Table 5 below:

Table 5 Standards for Biobased Products - Terminology and Communication Standards

Standard No.	Standard Name	Description
EN 16575	Bio-based products – Vocabulary	Defines general terms to be used in the field of bio-based products, including horizontal aspects relevant for bio-based product standards.[17]
EN 16848	Bio-based products - Template for B2B reporting and communication of characteristics - Data sheet	Specifies requirements for transparent and non-misleading B2B communication of characteristics of bio-based products by means of a specific data sheet.[18]
EN 16935	Bio-based products - Business-to-Consumer (B2C) communication and claims	Specifies requirements for transparent and non-misleading B2Ccommunication of characteristics of bio-based products by means of labelling and claims[19].
CEN/TR 17341	Bio-based products Examples of reporting on sustainability criteria	This document provides examples of business to business (B2B) reporting in accordance with EN 16751 Bio-based products – Sustainability criteria[20].

[15] BS EN 16751:2016 Bio-based products. Sustainability criteria (en-standard.eu)
[16] PD CEN/TR 16957:2016 Bio-based products. Guidelines for Life Cycle Inventory (LCI) for the End-of-life phase (en-standard.eu)
[17] NEN-EN 16575:2014 en
[18] CEN - EN 16848 - Bio-based products - Requirements for Business to Business communication of characteristics using a Data Sheet | GlobalSpec
[19] CEN - EN 16935 - Bio-based products - Requirements for Business-to-Consumer communication and claims | GlobalSpec
[20] CEN/TR 17341 - Bio-based products - Examples of reporting on sustainability criteria | GlobalSpec

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These European standards identified above are considered the most applicable to Project Unlock, with some other standards that exist in this area outlined in Appendix 1.

2.2 Benefits of Standardisation

Alignment with Standards

Standardisation offers numerous benefits; it ensures that products, services, or processes meet specific quality criteria, leading to higher consistency, performance and reliability. Certification provides an independent verification of compliance with the requirements of the chosen standard and serves as validation of quality of the product. This in turn enhances the reputation of a business and builds consumer trust. By adhering to standardised processes, organisations have a structured approach in-place for achieving and maintaining regulatory compliance. Adhering to certification standards can help identify and mitigate risks, improving overall safety and reducing the likelihood of defects or failures. Standardisation facilitates interoperability allowing different systems and entities to work together seamlessly to achieve a common goal. It also leads to enhanced efficiency through streamlining processes, improving productivity and reducing costs. It creates a solid foundation for developing new technologies, processes and products. This is particularly important in the area of green transition. Standardisation can steer markets towards more sustainable practices and facilitate the adoption of new, eco-friendly technologies[21]. Finally, standardisation supports international trade by providing a common framework, simplifying compliance with European and international regulations[22]. Certification to specific standards can be a prerequisite for entering certain markets, both domestically and internationally. It can also provide a competitive edge, differentiating a business from its competitors and boosting the business' reputation, signalling to customers and

[21] A new study shows how standards have a significant impact on the green transition - Danish Standard
[22] Better regulation for the green transition | OECD

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partners that the processes employed and products made meet the highest quality and sustainability benchmarks.

Standardisation plays a crucial role in the roll out of innovative technologies such as those produced by project UNLOCK:

- These standards have provided a consistent framework to develop and implement sustainable practices and technologies. Having such standards to aim for encourages the consideration of the environmental impact of the various processes, ensuring a focus on the sustainability, examining circularity, resource and energy efficiency (e.g. electricity consumption during the manufacture of the seed trays), using environmentally friendly materials (e.g. using biodegradable pigment to ensure opacity of the mulch films) and eliminating environmental pollution risks.
- Measuring biodegradability, compostability, biobased content of the products and the environmental footprint of the processes involved in the production of the 4 UNLOCK products allows us to show these products meet specific quality and environmental criteria. Having these measurements endorsed by certification will allow for the marketing of these products and processes as green innovations. Certification to these standards verifies that customers can trust that these products are genuinely sustainable.
- Verification of the sustainability claims through certification ensures compliance with Directive (EU) 2024/825 guaranteeing transparency regarding the environmental characteristics of the 4 UNLOCK products.

Standardisation of UNLOCK's Value Chains

Aside from alignment and certification with international standards, UNLOCK's value chains can benefit from another method of standardisation – that is, standardisation or optimisation of processes within the value chain. The implementation of these actions across each of UNLOCK's value chain will improve efficiency and allow for the successful replication of Project outcomes.

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- Integration: Where possible, it would be advantageous for the value chain to be somewhat integrated, i.e., having feather treatment located adjacent to a poultry slaughterhouse. This reduces the risk of potential degradation to the feathers, removes the need for transport of raw feathers, and guarantees a level of feather quality and quantity that would be required for processing.
- Feather Sterilisation: Within the value chains, a consistent approach to sterilisation is required. While sterilisation is required under the ABP legislation, within two of UNLOCK's processes, it occurs twice – once at the slaughterhouse and again in the reactor. Moving forward, the approach must be to approve the sterilisation method within the reactor with the regulatory body to remove this double sterilisation for efficiency purposes. Cedrob have already done this for the sterilisation method within their demo plant.
- Feather Quality: Uniform quality standards for the feather feedstock should be adopted to ensure consistency in intermediate and end-product manufacturing.
- Stakeholder Engagement: Standardised approaches for engaging various stakeholders, from poultry farmers to plastic manufacturers to end-users should be implemented to assist in the development of the biobased value chain.
- Biorefinery Standards: The development of standardised approaches to operational procedures and processes within the biorefineries, and the transfer of this knowledge, will allow for a more seamless replication of the outputs of the UNLOCK project.[23]

[23] Value chain transformation in the transition to a sustainable bioeconomy | ECONSTOR

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2.3 Challenges and Barriers

Implementing new standards often necessitates changes in existing processes, this can be met with resistance from industry. This resistance to change is mainly due to concerns regarding costs and time required to implement these changes. Certification processes can be lengthy and the initial investment required to implement standardised processes can be significant. Navigating the intricate web of regulations and standards can be daunting. Different industries and regions are using different standards with different requirements. Standards and regulations are not static; they evolve over time, which makes it challenging to stay up-to-date. Achieving certification requires significant time, effort and financial investment. This can be particularly challenging for small and medium-sized enterprises with limited resources. Once certification is achieved, maintaining compliance can be an ongoing challenge. Maintenance involves regular audits and updates to ensure continued adherence to standards. In some circumstances rapid technological advancements may outpace the development of relevant standards. Emerging technologies can be complex and multifaceted making it challenging to create comprehensive standards that address all aspects of the innovation. Ensuring that new standards do not stifle innovation while still maintaining quality, safety and sustainability can be a delicate balance[24].

Challenges Posed by Standardisation for Project UNLOCK

A number of challenges regarding standardisation where encountered during this project:

- The testing to support standardisation is very lengthy as it is measuring biodegradation over time. For biodegradation tests in compost, the maximum duration is 6 months (industrial composting) to one year (home composting), while biodegradation tests in soil can be extended up to 2 years. Any changes

[24] The Role of Standards in Innovation | NIST

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to the test materials then led to further lengthy testing to determine the impact on biodegradability / compostability of the materials.

- As well as the European standards list in Section 3 there are also a number of well-established industry standards that are also suitable for the products of UNLOCK, such as OK biodegradable and OK soil certification standards (see Appendix 1 for a more comprehensive list of examples). In addition, the COMMISSION DELEGATED REGULATION (EU) 2024/2787 of 23 July 2024 amending Regulation (EU) 2019/1009 of the European Parliament and of the Council has been updated as regards the inclusion of mulch films in Component Material Category 9. What this essentially means is that biodegradable mulch films can be marketed as fertilising products, so long as they achieve 90% biodegradability within 24 months in soil.
- Even when standardisation is achieved there are other market demands that affect the commercial viability of the UNLOCK products. For example, there may be difficulty with using the UNLOCK products in food production as it limits the ability to label food as vegan given the use of poultry feathers.
- Overlap and inconsistencies in the existing standards can make it challenging for actors to understand their standardisation needs

Barriers to Value Chain Standardisation

A number of barriers exist to value chain optimisation and standardisation in the context of UNLOCK and its future replication. A number of these were previously explored in Deliverable 2.3. These barriers include:

- Challenges in the integration of different sectors, such as poultry farming, biotechnology and manufacturing, and the various actors involved, can make the standardisation of approaches within the value chain more cumbersome – for example, gaining access to quality feather feedstocks may be a hurdle[25].

[25] Creating Inclusive Biobased Value Chains; A Reflection on the LINK Methodology

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- The high-level of investment required in the feather management and biorefinery technologies is a barrier to entry into UNLOCK's value chains, therefore increasing the difficulty of replication.
- Market and economic barriers exist, for example, competition from existing bioplastics or resistance from end-users to change from tried and proven practices.

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Conclusion

3.1 Recommendations

The following recommendations have been prepared to optimise the benefits identified in Section 4 and to minimise the impacts of the challenges and barriers identified in Section 5.

- Further disseminate the learnings from this project to allow adoption of the processes for the feather value chain to be developed in selected target countries and sectors.
- Encourage implementation by key actors, through providing clear information regarding the standardisation requirements and how they are being achieved in this project.
- It would be useful if the European Committee for Standardisation (CEN) could prepare an overarching standard for sustainable products, which would have requirements for the use of the common sustainability claims, i.e. biodegradable, compostable (industrial) and biobased. The current situation is fragmented and overly complex.
- The European Committee for Standardisation (CEN) could then develop online training materials to support implementation of these standards to allow for greater uptake among early adaptors to new technologies which support the green transition.
- The cost to purchase each of the standards is prohibitive for small businesses, and this is just at the start of the process when they are trying to determine which approach is most suitable for the processes and products they would like to certify.
- Continue to raise awareness among suppliers and customers of the advantages of choosing products subjected to standardisation as a means of supporting the green transition.

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3.2 Conclusions

The costs involved in aligning the products of Project UNLOCK with the sustainability requirements of the European standards are not insignificant. In particular, the cost of bio-based raw materials are higher than those of petroleum-based plastics. From a technical perspective, it can be demonstrated that these products offer sustainable alternatives to the products currently available on the market, making this a valuable endeavour. However, policies from the European Commission need to be generated in order to make these sustainable alternatives more commercially viable and attractive to end-users.

Despite this, standardisation of UNLOCK's value chains is a worthwhile endeavour, and will allow the outcomes of the Project to proliferate outside of the Project partners, increasing the chance of replication of processes in commercial enterprises.

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Appendix 1

A.1 Other Standards / Labels

Table 6 Other Standards and Labels Used in the EU

Standard	Country	Description
EU Ecolabel[26]	EU wide	The EU Ecolabel is an official European Union voluntary label for environmental excellence. Established in 1992, it certifies products with a guaranteed, independently-verified low environmental impact throughout their lifecycle—from raw material extraction to production, packaging, distribution, and disposal. It helps consumers, retailers, and businesses make sustainable choices by showcasing true 'green' products that meet high environmental standards. The iconic "EU flower" symbol represents these environmentally friendly products. Eligible products include products used for gardening[27]. The rules for this scheme are established through Regulation (EC) No 66/2010[28].
Seedling Certification Scheme[29]	EU wide	The Seedling certification is an internationally recognised mark for compostable products. It is part of a certification system developed by European Bioplastics for products made of industrially compostable materials. When products made of industrially compostable materials meet the requirements of standards like EN 13432 and, if applicable, additional criteria in EN 14995, ISO 18606, ISO 17088, or ASTM D 6400, they can bear the "Seedling" mark, signifying their environmental friendliness.
OK biodegradable label[30]	EU wide – based in Austria / Belgium	OK biodegradable is a certification program developed by TUV AUSTRIA that focuses on the biodegradability of products in specific environments, given specific environment experience different ideal biodegradation conditions there are three different categories: • OK biodegradable SOIL: This label guarantees that a product will completely biodegrade in soil without harming the environment.

[26] EU Ecolabel - Home (europa.eu)
[27] EU Ecolabel Product Groups and Criteria (europa.eu)
[28] Search results - EUR-Lex (europa.eu)
[29] Seedling certification scheme – European Bioplastics e.V. (european-bioplastics.org)
[30] OK biodegradable (tuv-at.be)

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Standard	Country	Description
		• OK biodegradable WATER: Products certified under this label guarantee biodegradation in natural freshwater environments, contributing to waste reduction in rivers and lakes. • OK biodegradable MARINE: While most marine debris originates from land, marine biodegradability is valuable for any product, as it may eventually end up in the sea. These certifications help consumers make informed choices about environmentally friendly products
Compost Label[31]	Germany	The Compost Quality Assurance Organisation was founded in order to monitor the quality of compost and digestate products. Through quality control and support of the producers of compost and digestate products in the marketing and application sectors, the organisation aims to promote composting and anaerobic digestion as a key element of a sustainable biowaste management. Bundesgütemeinschaft Kompost e.V. (BGK) has provided quality assurance for compost since 1992.
DIN certification for home compostability[32]	EU wide – based in Germany	The DIN CERTCO certification program offers the "DIN Tested - Garden Compostable" mark for products designed to be composted in home and garden environments. If your product successfully passes the relevant tests, you can use this mark, providing credible and verifiable proof that your materials are safe for home composting. The testing requirements include chemical characterisation, complete biodegradability, disintegration, and plant compatibility.
DIN-Geprüft, for industrial compostability[33] **DIN-Geprüft Biodegradable in Soil**	EU wide – based in Germany	DIN-Geprüft industrially compostable: This test mark verifies industrial compostability according to DIN EN 13432 and other standards. DIN-Geprüft Biodegradable in Soil verifies soil biodegradability according to EN 17033

[31] Compost Label RAL | Ecolabel Index, Gütesicherung Kompost
[32] Products from Biodegradable Materials for Home and Garden Co | TÜV Rheinland (dincertco.de)
[33] Industrial compostable products | TÜV Rheinland (dincertco.de)

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