Department for Business, Energy & Industrial Strategy

Department for Environment Food & Rural Affairs

STANDARDS FOR BIO-BASED, BIODEGRADABLE, AND COMPOSTABLE PLASTICS

Call for Evidence

Closing date: 14 October 2019

July 2019

Any enquiries regarding this publication should be sent to us at:

ukbioeconomystrategy@beis.gov.uk

Foreword / Introduction

The government published its Growing the Bioeconomy Strategy on 5 December 2018, a collective approach from across government, industry and the research community to transform the UK economy through the power of bioscience and biotechnology.

We committed to work with UK Research and Innovation (UKRI) and industry to seek evidence on the demand, benefits and implications of standards for bio-based and biodegradable plastics.

Following the Bioeconomy Strategy, Our Waste, Our Resources: A Strategy for England was published on 18 December 2018 which reiterated this commitment. The approach is also intended to support the objectives of other key government initiatives including the 25 Year Environment Plan and Industrial Strategy.

Global consumption of plastic material continues to grow and the UN has predicted that plastic production will account for 20% of all the world's total oil consumption by 2050, if we continue to produce at current levels. As part of our response, the Industrial Strategy Challenge Fund Wave 3 includes a £60m challenge on smart, sustainable plastics which will develop new forms of plastic and consumer-friendly packaging formats in order to help reduce waste and address other environmental impacts. Innovative solutions to this issue bring with them the potential for growth and jobs in sectors that can help provide solutions. At this stage there are no proposals on which we are seeking comments and no specific implications for any parties. We hope that this call for evidence will help provide us with information to help us make decisions on possible future actions.

We are looking for robust evidence backed by scientific theory, direct practical experience, or analysis, rather than opinion. This could include reference to relevant case studies, trials, academic literature or published statistics, as well as an indication of the level of consensus amongst experts working on this topic.

We will consider the response from industry, the research community, and other interested parties on the demand, benefits, and implications of standards for bio-based and biodegradable plastics. The evidence received will inform our next steps in this area. We aim to publish a response to this call for evidence within 12 weeks of it closing.

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General information

Why we are consulting

We are seeking evidence to identify gaps and to provide expert advice on:

a) The overall sustainability of bio-based and biodegradable plastic products, particularly when in comparison with those made from other materials. This could include all aspects of a product's life-cycle and will help in assessing whether technical standards or other related options are suitable mechanisms to add value for such products;

b) Existing relevant plastic degradation standards and how, or if, they might be promoted without any adverse effects to the environment and disposal routes;

c) The design and implementation of standards for biodegradable plastics to ensure that they fully biodegrade in a reasonable timeframe in specified environments.

There are parallel initiatives in place that are looking at the broader issues related to waste plastic pollution, therefore we are not seeking evidence on this wider topic through this Call for Evidence.

Consultation details

Issued: 22 July 2019

Respond by: 14 October 2019

Enquiries to:

Peter Cottrell
Bioeconomy and Plastics Team
Department for Business, Energy and Industrial Strategy
4th Floor, Orchard 1
1 Victoria Street
London
SW1H 0ET
Tel:020 7215 1330

Email: ukbioeconomystrategy@beis.gov.uk

Consultation reference: Standards for biodegradable, compostable and bio-based plastics: call for evidence

Audiences:

We welcome views from interested parties, with a particular focus on:

Environmental scientists interested in the movement of plastics and their interaction with natural ecosystems, working on biodegradable polymers, marine bio-degradative processes, and freshwater, marine, and terrestrial biologists.

Bioscience or biotechnology practitioners working on the development or application of bio-based or biodegradable plastics.

Standards authorities and those with standards committee experience.

Manufacturers, waste processors, and other stakeholders in industry.

Consumers and producers of biodegradable, compostable, and bio-based plastic products, in addition to certification authority experts, social scientists, NGOs, retailers and plastics re-processors.

Territorial extent:

UK-wide. The topics covered by this Call for Evidence are relevant for the whole of the UK, and we encourage input from experts across England and the Devolved Administrations.

How to respond

Respond online at: beisgovuk.citizenspace.com/im/biodegradable-compostable-biobased-plastics

or

Email to: ukbioeconomystrategy@beis.gov.uk

Write to:

Peter Cottrell
Bioeconomy and Plastics Team
Department for Business, Energy and Industrial Strategy
4th Floor, Orchard 1
1 Victoria Street
London
SW1H 0ET

Tel: 020 7215 1330

When responding, please state whether you are responding as an individual or representing the views of an organisation.

Your response will be most useful if it is framed in direct response to the questions posed, though further comments and evidence are also welcome.

Confidentiality and data protection

Information you provide in response to this consultation, including personal information, may be disclosed in accordance with UK legislation (the Freedom of Information Act 2000, the Data Protection Act 2018 and the Environmental Information Regulations 2004).

If you want the information that you provide to be treated as confidential please tell us but be aware that we cannot guarantee confidentiality in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not be regarded by us as a confidentiality request.

We will process your personal data in accordance with all applicable UK and EU data protection laws. See our privacy policy.

We will summarise all responses and publish this summary on GOV.UK. The summary will include a list of names or organisations that responded, but not people's personal names, addresses or other contact details.

Quality assurance

This consultation has been carried out in accordance with the government's consultation principles.

If you have any complaints about the way this consultation has been conducted, please email: beis.bru@beis.gov.uk.

The Issue

Definitions

1.1 There is often conflation between the terms 'bio-based', 'biodegradable' and 'compostable' so this call for evidence proceeds with the following definitions:

1.2 **Bio-based plastics** are made using polymers derived from plant-based sources such as starch, cellulose, or lignin. Bio-based plastics can be engineered to be biodegradable, equally they can be made to function exactly like conventional fossil-based plastic (i.e. to have the same durability).

1.3 **Biodegradable plastics** can be broken down into water, biomass, and gasses such as carbon dioxide and methane. Biodegradability depends on environmental conditions such as temperature, humidity, microorganisms present, and oxygen.

1.4 **Compostable materials** are a sub-set of biodegradable plastics that break down safely into water, biomass and gasses under composting conditions. Industrial composting conditions are the most optimal: temperatures of 55-70^{o}C, high humidity and oxygen. Materials that break down in industrial composters may not break down under home composting conditions.[1]

1.5 Bio-based and biodegradable plastics have a wide range of diverse applications. Bio-based plastics can be engineered to function exactly like fossil-based plastics, the only difference being that they are derived from non-fossilised biological organisms such as plants rather than petrochemicals.

1.6 Biodegradable plastics on the other hand behave differently to conventional plastics, and can be either fossil-based or bio-based. A biodegradable plastic is intended to break down in a particular environment in a safe and timely manner. This could prove useful in specific circumstances where it is hard to recover the material for recycling, or when that material could otherwise enter the recycling stream but cannot be recycled due to contamination. This would therefore prevent a fossil-based plastic being landfilled, incinerated, or littered – where it will persist for an extended period of time. There are also materials that are designed from the outset to biodegrade in horticultural/soil environment (e.g. tree guards, mulch films) and marine environments (e.g. nets and lines).

Policy Intent/Purpose of the Call for Evidence

1.7 This call for evidence focuses on bio-based, biodegradable, and compostable plastics whilst also considering a range of policy interests and the wider environmental landscape, including:

a. **Clean Growth, including growing the bioeconomy:** Ensuring the UK has a manufacturing industry that can develop and thrive in a low carbon future

[1] For a more detailed examination on the different types of plastic, you can read more in this 2018 report from WRAP: Understanding plastic packaging and the language we use to describe it

economy, which could include replacing traditional fossil-based plastics with bio-based alternatives where recycled material is not available.

b. **Circular economy:** Ensuring any new materials entering the marketplace are compatible with a more circular economy in which we keep resources in use for as long as possible, maximising the value we get from them, and recovering and regenerating them at end of life.

c. **Environmental protection:** Reducing the amount of plastic used and the environmental impact of that which is used, in both terrestrial and marine environments.

d. **Citizen clarity:** Ensuring that the information provided to citizens is clear and helpful to enable people to make informed decisions about how they manage waste.

1.8 A Defra-commissioned review conducted in 2015 concluded that more work needed to be carried out in order to assess whether a viable standard could be created for biodegradable plastic.[2] The government is therefore concerned, in the absence of agreed standards and/or due to shortcomings in those that do exist, that claims about the biodegradability of plastic-based products cannot be verified. This may lead to further confusion in the marketplace; increased levels of consumption; and even environmental harm at, and after, plastics are disposed of if left unchecked.

1.9 For example, a recent study conducted by Plymouth University showed that some 'biodegradable' plastic bags remained intact up to three years after entering the soil or the marine environment.[3] If these products do not properly biodegrade then they may continue to persist in the form of microplastics when they begin to break down. Although further research is required to establish the full environmental impacts of microplastics, there is an emerging body of evidence showing that they may pose risks to human and animal health as well as the natural environment.

1.10 We have also observed a growing interest in the use of bio-based plastics and the potential benefits that they may offer in comparison to conventional fossil-based plastics. As these new innovations garner further attention, it is imperative to provide clarity on the potential trade-offs, both positive and negative, on the environmental claims surrounding both bio-based and biodegradable plastics to prevent unintended consequences from their adoption.

Area of Focus

1.11 This call for evidence will help us consider the benefits of reviewing, updating, or developing one or more standards for biodegradable, bio-based, and/or compostable plastics - should the evidence suggest that doing so would help to address the potential issues outlined above. Such standards could include plastics that are biodegradable in any environment, including marine and/or other uncontrolled conditions. Of interest also

[2] Defra (2015) Review of standards for biodegradable plastic carrier bags
[3] https://www.plymouth.ac.uk/news/biodegradable-bags-can-hold-a-full-load-of-shopping-three-years-after-being-discarded-in-the-environment

is the relative toxicity of bio-based and biodegradable plastics when compared to fossil-based plastics and their lasting effects on the environment and human health.

1.12 It also seeks strong evidence to evaluate the overall sustainability and wider impacts of biodegradable, compostable, and bio-based plastics. This could include considering whether the feedstocks for such products, including land use and any resources required to produce them, could be more effectively used for other purposes, such as food production. These could be compared to the resource use (fossil fuels) required to produce conventional plastics.

Bio-based Plastics

2.1 We want to develop a stronger evidence base regarding the greenhouse gas and wider environmental impacts of bio-based plastics, especially when compared to conventional plastics or other alternative materials. It is generally understood that using biomass instead of fossil fuel as a feedstock has the potential to reduce the carbon intensity of a product and potentially leave a smaller environmental footprint.

2.2 More evidence is needed, however, to ascertain whether development of bio-based plastics could have unintended consequences, such as causing the adoption of land to grow feedstock that could otherwise have been used to grow food.

2.3 We welcome recommendations as to whether standards, certification criteria, and/or other approaches would provide reliable assurance of the sustainability of bio-based plastics placed on the market (see Chapter 6).

Questions

1. **Government has made clear that we want to eliminate all avoidable[4] plastic waste and to move towards a more circular economy. What role, if any, is there for bio-based plastics to play in achieving the outcomes listed in paragraph 1.7? How could the circularity of these materials be reflected or measured? What is the evidence in support of your view?**

2. **With regards to their environmental impact, and particularly greenhouse gas emissions, what quantitative evidence is available on the environmental impacts of producing bio-based plastics and managing them at end of life? How does the evidence compare to conventional fossil-based plastics?**

3. **If an accurate comparison between the environmental impacts of bio-based and conventional fossil-based plastics cannot be made at present, what barriers exist to making this comparison and what knowledge gaps would need to be addressed to enable us to do so?**

4. **Bio-based plastics currently make up a relatively small proportion of the market, representing around £50m GVA[5]. What, if any, are the barriers preventing innovative bio-based products from succeeding in the marketplace?**

5. **The potential impacts of bio-based plastics on waste processing are covered in Chapter 7. What other potential unintended consequences could arise as a result of a growth in use of bio-based plastics?**

[4] Our working definition of 'avoidable' plastic waste is when the plastic could have been reused or recycled; when a reusable or recyclable alternative could have been used instead; or when it could have been composted or biodegraded in the open environment.
[5] NNFC Market Perspective: Bio-based and Biodegradable Plastic in the UK: April 2018

Biodegradable Plastics

3.1 Plastics littered or "escaping" from controlled waste systems can accumulate in a wide range of environments, often after having been carried significant distances, which can have devastating effects on habitats and wildlife.

3.2 Intact and partially degraded plastic can alter ecosystems in a number of very different ways, potentially posing numerous threats to the environment and wildlife. Moreover, there may be some cases where the products of biodegradation could be more harmful than the original piece of plastic itself, for example if they form microplastics which are much more difficult to remove from the open environment. Concerns also exist around the impact that biodegradable plastics could have on the move towards a circular economy and whether they impact adversely when entering managed waste streams such as recycling and composting.

3.3 Innovative solutions could help reduce the environmental impacts of plastics if disposed of in the right way. However, Defra's own research[6] and a number of international studies have concluded that there is currently insufficient evidence to support any claim that the widespread uptake of biodegradable plastics would increase resource efficiency, reduce waste, or tackle plastic pollution.[7]

3.4 Some biodegradability standards exist[8] for plastics in freshwater environments, although many of these relate to wastewater treatment situations. Many in the industry view marine environments as some of the most difficult in which to evaluate and achieve biodegradability, because of their varying levels of nutrients, oxygen, and temperature. There is also a terrestrial issue to consider, with challenges such as soil health and the effect that microplastic could have on terrestrial life (such as worms).

3.5 At present our understanding is that there is an insufficient range of authorised toxicity tests within existing standards, in particular to ascertain the degree of toxicity of biodegrading plastics and the impact of microplastic particles in both terrestrial and marine environments. To some extent this is also true for conventional non-biodegradable plastics and, more generally, our understanding of the degradability of plastics in terrestrial and aquatic environments is limited.

3.6 The government is keen to understand the viability of developing effective biodegradable plastics and of robust testing methodologies to verify the ability for plastics to biodegrade. Issues of particular concern are:

a. **Fate and biodegradation of plastics:** to improve understanding of the degradation of biodegradable plastics in the natural environment, and to clarify rates of decomposition to include a particular timescale for decomposition;

b. **Environmental impact:** to improve understanding of the potential harm caused through the transport, accumulation, and degradation of biodegradable products

[6] Defra (2015) Review of standards for biodegradable plastic carrier bags
[7] Ellen MacArthur Foundation (2017), The new plastics economy: rethinking the future of plastics & catalysing action, EU Commission (2019): Science for Environment Policy
[8] See iBioIC (2019) A Review of Standards for Biodegradable Plastics

and their fragments in various environments, including uncontrolled environments, as compared to harm caused by non-biodegradable plastics;

c. **Impact on waste recycling and other forms of recovery:** to improve understanding of any potential problems caused by biodegradable plastics within the recovery streams (including recycling). This should take into account potential solutions to these issues and comparison to the impacts non-biodegradable plastics have upon other recycling and recovery waste streams;

d. **Threshold for biodegradation:** to establish the basis for inclusion of a test result threshold for deciding that a plastic has fully biodegraded or will do so, and the potential inclusion of additional tests to ensure full biodegradation in the natural environment relative to the application for which it is designed.

Questions

6. **Government has made clear that we want to eliminate all avoidable plastic waste and to move towards a more circular economy. What role, if any, is there for biodegradable plastics to play in achieving the outcomes listed in paragraph 1.7? How could the circularity of these materials be reflected or measured? What is the evidence in support of your view?**

7. **With existing technology and materials, what would be the minimum timeframe for complete biodegradation (breaking down to nothing but water, biomass, and gasses, such as carbon dioxide or methane) for plastics designed to biodegrade? We would particularly welcome an assessment in the following environments:**
   - **Deep Sea**
   - **Surface of the Sea**
   - **Freshwater**
   - **Beach**
   - **Soil – surface**
   - **Soil – lightly buried**
   - **Landfill**
   - **Industrial composting**
   - **Home composting**

8. **What evidence is available of direct impacts of biodegradable waste plastics on biodiversity, ecosystems, and the natural environment in the short-term (over the degradation period of the item), and in the long term (including cumulative effects)?**

9. **To what extent, if at all, can the existing evidence be used to extrapolate the degradation rate of plastics in different environments (e.g. in surface water vs deep sea, etc.)?**

10. **What testing regimes/methodologies are you aware of that could verify that biodegradable plastics completely degrade (breaking down to just water, biomass, and gasses, such as carbon dioxide or methane) in the open environment[9] instead of simply fragmenting into microplastics? If not, what are the key challenges to establishing such a test?**

[9] By open environment we refer to outside of the waste management system, including, but not limited to, marine, freshwater, coastal, and/or agricultural environments.

11. **Would such testing regimes/methodologies be applicable to plastics which contain prodegradant agents intended to aid the biodegradation process[10]? We are particularly interested in any evidence established in the last three years.**

12. **What evidence, if any, is available to quantify the differing environmental impacts of compostable plastics when they "escape" and then degrade in the open environment?**

13. **The potential impacts of biodegradable plastics on waste processing are covered in Chapter 7. What other potential unintended consequences could arise as a result of a growth in use of biodegradable plastics?**

[10] Such plastics are typically referred to as oxo-degradable or oxo-biodegradable plastics. These are typically conventional (fossil-based) plastics, such as High Density Polyethylene (HDPE), which include additives designed to promote the oxidation of the material to the point where it becomes brittle and fragments. This may then be followed by biodegradation by bacteria and fungi at varying rates depending on the environment.

Compostable Plastics

4.1 There are a number of existing standards[11] that cover compostable materials for both packaging and other applications. Some relate only to industrial scale composting and others cover those materials which are capable of being treated in home composting systems.

4.2 We are interested in evidence on how these standards are used and where their strengths and weaknesses lie. Key to ensuring that these standards are useful to industry is to better understand how labelling of compostable materials that comply with these standards is perceived by the public and how the labelling used affects the way in which compostable materials are consigned for recycling or disposal in the home (see chapter 6).

4.3 We also seek robust evidence on the impact of compostable materials when they are included in conventional plastic recycling or recovery operations, and on the impacts that non compostable plastics have upon food and garden waste collections. This includes the costs of extraction, disposal, and the pollution caused to soil and water (See chapter 7).

Questions

14. **What evidence, if any, is available regarding the suitability of the existing industrial and home composting[12] standards? We welcome any suggestions on how these standards could be adapted to current and future needs, if necessary.**

15. **To what extent, if at all, would a home composting standard that covers all home composting techniques, equipment and environments in the UK be possible? If so, would it be a desirable system to adopt?**

16. **The potential impacts of compostable plastics on waste processing are covered in Chapter 7. What potential unintended consequences could arise as a result of a growth in use of compostable plastics?**

[11] See iBioIC (2019) A Review of Standards for Biodegradable Plastics
[12] Existing home composting standards are international, rather than UK-specific

Existing and Potential Biodegradability Standards

5.1 Product standards are developed through national and international standardisation authorities, and there are various operational relationships between such bodies. For example, the British Standards Institution are required to adopt standards authorised by the the European Committee for Standardization, but are not required to adopt standards authorised by the International Organization for Standardization. International standards can provide a wider basis for trade, but could struggle to provide a specification appropriate for biodegradability in the variable open environments found across the world.

5.2 Biodegradable plastic standards should be designed to ensure that the potential risks to the open environment and to the waste industry are avoided or, where appropriate, minimised, whilst allowing room for innovation both in the materials and products used as well as within the waste sector itself.

5.3 Many biodegradability standards require that any extrapolation from laboratory tests to the field is demonstrated with appropriate evidence in addition to that provided through the standard. For example, one testing guidance document (ASTM D6954) cautions that, "…the results of any laboratory exposure in this guide cannot be directly extrapolated to actual disposal environments; confirmation to real world exposure is ultimately required as with all ASTM International standards". However, biodegradability technical standards committees have not so far produced detailed guidance on how to utilise standardised biodegradability test methods in the context of the open environment.

Questions

17. **A list of currently active biodegradability standards and test methods for all plastic materials in soil, marine and waste water environments is included in the report 'A Review of Standards for Biodegradable Plastics'[13]. Are there other relevant standards or test methods for those circumstances that you are aware of that do not appear on this list?**

18. **What areas, if any, would require improvement in existing standards to strengthen their effectiveness? To what extent, if at all, would the development of new standards for biodegradability constitute a viable alternative? What is the evidence in support of your view?**

19. **When dealing with biodegradation, what are the advantages and disadvantages of producing standards? We would welcome your thoughts in relation to the production of standards at the following levels:**
    - **National**
    - **Regional**
    - **International**

[13] See iBioIC (2019) A Review of Standards for Biodegradable Plastics

20. **Are you aware of any past or current work on a national, regional or international level to implement biodegradability standards?**

21. **To what extent, if at all, could biodegradability standards be beneficial for specific products (such as carrier bags) or product forms (for example those that with current technology are typically too contaminated to be mechanically recycled once disposed of)?**

Certification and Labelling

6.1 Proper labelling and communication of the right messages are essential aspects of informed consumer decision-making, and certification systems already exist for some types of biodegradable products. However, there can be uncertainty over compliance especially if it is by self-certification.

6.2 Feedback from industry has suggested that items labelled as biodegradable do not always meet the relevant criteria, leading to confusion on the market. Standards, or more robust criteria lists, could better ensure items placed on the market really do biodegrade, if correctly complied with.

Questions

22. **What standards, labelling, and/or certification schemes are currently in place to determine the level of bio-based content in bio-based plastics?**

23. **To what extent, if at all, should current labelling requirements be changed to produce new suitable standards?**

24. **To what extent, if at all, should specific labelling rules apply to bio-based plastics to certify their proportion of bio content – either to better inform consumers or for any other reason?**

25. **What evidence, if any, is available on the impacts that biodegradability certification and labelling systems may have on consumers' behaviour towards the disposal of items carrying such labels?**

Impacts on Waste Processing

7.1 Developments in this area must take careful consideration of the impact that new materials and functional qualities will have on the waste system. As highlighted above, the incorrect disposal of novel materials can have significant impacts on the quality of recyclate and the generation of pollution if they are put in the wrong waste stream or are erroneously handled.

7.2 There are four distinct areas for consideration here, based on industry feedback:

a. Novel or other incompatible plastics can cause problems during reprocessing, for example by clogging extruders or impeding proper control of the melt conditions.
b. They may also cause weaknesses in recycled products and/or cause them to be less durable.
c. Even if recycling is preferable over energy recovery and disposal to landfill, understanding the impact of bio-based, biodegradable, or compostable plastics in anaerobic digestion plants, in-vessel composters or energy from waste processes is also important.
d. We need to better understand whether the quality and safety of outputs from solid waste recovery and recycling processes (such as compost or digestate) would be impacted by an increase in the amount of bio-based and biodegradable plastic in waste streams.

7.3 Evidence and an indication of its robustness is required to assess the impacts and address the following questions:

Questions

26. What, if any, evidence is available to demonstrate the impact that biodegradable (including compostable) plastics have in the current waste management system, including on the quality and safety of composts and digestates? Does the existing evidence allow to estimate the monetary value of this impact?

27. What, if any, evidence is available on the behaviour of bio-based plastics compared to conventional fossil-based plastics in the current waste management system?

28. How, if at all, would waste collection systems need to be adapted to accommodate the niche introduction of biodegradable plastics?

29. How, if at all, would waste collection systems need to be adapted to accommodate the mass introduction of biodegradable plastics?

30. How do anaerobic digestion, composting, and energy-from-waste operators currently manage compostable plastics in areas where food waste is collected in bags/liners?

Other related issues

8.1 Respondents are welcome to provide any further evidence or information that would help inform the demand, benefits and / or implications of standards for bio-based and biodegradable plastics.

31. Is there any other information or evidence related to this topic that government should be aware of?

Next Steps

The information gathered through this Call for Evidence will allow government to build up a more comprehensive view on the demand, benefits and implications of standards for bio-based and biodegradable plastics. Further details will be set out in the Government Response to this call, and will include ongoing engagement with relevant stakeholders.

This consultation is available from: www.gov.uk/government/consultations/standards-for-biodegradable-compostable-and-bio-based-plastics-call-for-evidence

If you need a version of this document in a more accessible format, please email enquiries@beis.gov.uk. Please tell us what format you need. It will help us if you say what assistive technology you use.