Standards for biodegradable, compostable and bio-based plastics: call for evidence
Response to BEIS call for evidence by Wildlife and Countryside Link
October 2019

Wildlife and Countryside Link (Link) is the largest environment and wildlife coalition in England, bringing together 54 organisations to use their strong joint voice for the protection of nature. Our members campaign to conserve, enhance and access our landscapes, animals, plants, habitats, rivers and seas. Together we have the support of over eight million people in the UK and directly protect over 750,000 hectares of land and 800 miles of coastline. This response is supported by the following Link members:

- ClientEarth
- CPRE, the countryside charity
- Environmental Investigation Agency
- Greenpeace
- Keep Britain Tidy
- Marine Conservation Society
- Salmon & Trout Conservation
- The Wildlife Trusts
- Whale and Dolphin Conservation
- WWF

EXECUTIVE SUMMARY

Without a significant turnaround in resource consumption trends and shift towards circular and zero-waste economies, the twin ecological crises of climate breakdown and the biodiversity emergency cannot be addressed. We welcome that the Government is scrutinising the role that bio-based, biodegradable and compostable plastics have to play in the shift to a low carbon and circular economy, in light of the Government's recent declaration of a climate emergency and commitment to eliminate all avoidable plastic waste.

After reviewing comprehensive available evidence on these materials, we conclude that the Government must take the most precautionary approach to their introduction and lock-down on their unregulated growth, given the wide-ranging risks they can pose throughout the product lifecycle - from sourcing through to end-of-life.

In line with the waste hierarchy, the building blocks of a circular economy must be reduction then reuse, followed by recycling. Rather than substituting conventional fossil-fuel based plastics with alternative materials (including those that degrade), we urge the Government to focus on plastic prevention, reuse and refillable solutions.

Key points from our consultation response include:

- **A simple substitution of one single-use material for another is no solution to the pollution or resource overconsumption crisis.** These alternative plastics do not solve the problems

associated with pollution in marine, terrestrial and aquatic environments as they generally require conditions to break down which will never be found in the natural environment. Furthermore, they continue to fuel demand for fossil fuel feedstocks and biomass at a time when demand for these resources is already causing undue pressure on ecosystems and communities around the world.

- **Scaling up bio-based plastics could pose unacceptable social and environmental risks.** Replacing the forecasted 'business as usual' growth of fossil-based feedstocks for plastics with biomass feedstocks would significantly increase the existing burden on our planet's ecosystems, in particular on forests and agricultural systems and communities.
- **Biodegradable plastics present an inefficient use of resources, and should not be promoted at scale as they pose a paradox.** Once a material has fully broken down, its value is lost to the economy, yet in order to ensure they do not cause harm if they leak into the natural environment, it is necessary for them to be designed to fully decompose as quickly as possible.
- **Plastic alternatives and labelling are confusing citizens and businesses, with misleading claims about green credentials.** There are grounds for fear that this could lead to an increase in incorrect disposal choices being made which could contaminate existing recycling streams, and potentially lead to an increase in incineration and littering.
- **There may be very limited niche applications where these non-conventional plastics are well suited, but only if the very highest standards can be assured** for their biodegradation within the environments they are being introduced for (i.e. plastic mulching in agricultural soils) and widely available and accessible end-of-life facilities (i.e. for home compostable packaging used for items where there is a high chance of contamination with food waste). Until these conditions can be assured, we caution against their introduction; and moreover support reduction and reusable alternatives as preferable solutions in line with the waste hierarchy.
- **We urge the Government to focus on reducing resource consumption and increasing reusable solutions as the primary response to the pollution and climate crisis.**

DETAILED RESPONSE

Bio-based plastics

1. Government has made clear that we want to eliminate all avoidable[1] plastic waste and to move towards a more circular economy. What role, if any, is there for biobased 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?

The introduction of any 'non-conventional' material should be done on the most precautionary grounds, given the wide-ranging risks associated with these penetrating the market without a comprehensive understanding of the full-life cycle impacts, from sourcing through to end-of-life; and

[1] 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.

robust processes in place to mitigate any risks or problems arising. This is not currently the case, and we urge the government to lock-down on the unregulated growth of bio-based, biodegradable and compostable plastics - estimated to grow from around 2.1 million tonnes in 2018 to 2.6 million tonnes in 2023 according to industry sources (equivalent to around 25%).[2]

We are aligned with the Government's objective of eliminating all avoidable plastic waste and moving towards a circular economy. However, we challenge the Government's definition of 'avoidable' plastic waste as being one where "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". We support a more commonsensical understanding of 'avoidable waste' - namely those that do not have an essential functional role to play - including those that can be recycled, composted or biodegraded.

Below, we assess the role of bio-plastics in achieving the outcomes listed in paragraph 1.7:

a. *Clean Growth, including growing the bioeconomy:* *Ensuring the UK has a manufacturing industry that can develop and thrive in a low carbon future economy, which could include replacing traditional fossil-based plastics with biobased alternatives where recycled material is not available.*

We strongly support an urgent transition from our fossil fuel economy. The world's developed oil and gas reserves already take us beyond the carbon budget associated with achieving the Paris Agreement's ambition to limit temperature rises to 1.5°C above pre-industrial levels.[3] However, expansion into bio-based plastics is not aligned with a just transition to a low carbon economy. Most bio-based plastics are produced from agro-based feedstock,[4] requiring an estimated 600,000 hectares to produce 1.6 million tonnes of plastics in 2013 – a fraction of the total demand for plastics (< 0.5 per cent of 2015 total).[5] Increasing land-use for bioplastic production could bring about competition with agriculture, cause biodiversity loss and raise land rights concerns.[6] Emissions associated with land use change (i.e. deforestation) could release 9-170 times more CO_2 than the annual GHG savings bio-based plastics provide, and put pressure on other natural resources such as water.[7] Land use change from forests to commodity crops used to produce the majority of bio-based plastics will also have negative climate consequences, since forests absorb considerably more CO_2 than maize or sugarcane.[8]

In line with the waste hierarchy, the building blocks of a circular economy must be reduction then reuse, followed by recycling. Rather than substituting conventional fossil-fuel based plastics with alternative materials (including those made of bio-materials or recycled content), we urge the Government to focus on plastic prevention, reuse and refillable solutions. We therefore do not support the outcome of replacing traditional fossil-based plastics with bio-based alternatives where recycled material is not available.

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[2] European Bioplastics, 2019. https://www.european-bioplastics.org/new-market-data-the-positive-trend-for-the-bioplastics-industry-remains-stable/

[3] Oil Change International, http://priceofoil.org/content/uploads/2019/05/SeaChange-final-r3.pdf

[4] Ißbrücker, C., 2018. How much land do we really need to produce bio-based plastics? https://bit.ly/2DhduC5

[5] Bioplastics, 2015. Frequently Asked Questions on Bioplastics, available at https://docs.european-bioplastics.org/publications/EUBP_FAQ_on_bioplastics.pdf

[6] CE Delft, 2017. Biobased Plastics in a Circular Economy Policy suggestions for biobased and biobased biodegradable plastics.

[7] Piemonte, V. and Gironi, F. 2011. Land-use change emissions: How green are the bioplastics? Environmental Progress & Sustainable Energy, 30(4):, 685-691.

[8] https://www.uni-bonn.de/news/329-2018

It is also worth noting that currently most bio-based plastic is still partially composed of fossil-based plastic. For example, the NaturALL bottle used by major beverage companies is currently 30% bio-based plastic, and 70% fossil-based plastic.[9] Therefore, encouraging growth of bio-based plastics could simultaneously increase demand for petrochemical feedstocks from fossil fuels like oil and gas.

More fundamentally, for the UK to ensure industry can develop and thrive in a 1.5°C world, it is necessary to rethink the concept of 'clean growth'. It is well evidenced how current resource consumption patterns - particularly those of industrialised nations like the UK - far exceed planetary boundaries.[10] There are hard limits to the amount of resources we can use, and the promotion of a zero-waste economy would help allow development without physical expansion,[11] as well as working towards the Government's goal of avoiding avoidable plastic waste.

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.*

A circular and zero-waste economy is urgently needed in order to address the climate and biodiversity emergencies. A significant level of investment is needed for the UK to close the recycling gap for plastics that are already theoretically widely recyclable, let alone those materials which are not. The UK's recycling record to date - averaging just 30-34% of consumer plastic packaging[12] - has largely relied on the export of plastic waste to countries with lower labour and energy costs, and increasingly to countries with the highest levels of ocean plastic pollution,[13] without oversight of how much is ultimately recycled or the working conditions involved.[14]

While some bio-based plastics such as bio-PET are chemically identical to their fossil-based counterparts and can therefore be recycled in the same way, this is not the case for all bio-based plastics, which generally require recycling in separate streams to fossil-fuel-based plastics and failure to separate them from other polymers could cause contamination. Scientists report a "serve incompatibility" of PLA - the most common bio-based plastic - with PET recycling streams given the different behaviour of PLA at higher temperatures – with contamination occurring at levels of two percent PLA.[15] Moreover, there are technological challenges associated with separation.[16] If sorting and processing cannot be done economically because of low volumes, bio-based plastics will most likely be incinerated or sent to landfill.[17]

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[9] https://www.wur.nl/upload_mm/1/e/7/01452551-06c5-4dc3-b278-173da53356bb_170421%20Report%20Bio-based%20Plastic%20Facts.pdf

[10] For example, see http://data.footprintnetwork.org/#/

[11] For example, see https://medium.com/age-of-awareness/shifting-from-quantitative-to-qualitative-economic-growth-950b430de557

[12] Independent, 2018. UK now exporting more waste to countries with highest levels of ocean plastic pollution. Available at: https://www. independent.co.uk/environment/uk-plastic-pollution-oceansrecycling-export-waste-malaysia-vietnam-thailand-a8400761.html

[13] Mirror, 2018. Britain's plastic shame: UK sends tonnes of household waste overseas to be sorted by kids paid £3.60 for 12 hours work. Available at: https://www.mirror.co.uk/news/world-news/britainsplastic-shame-send-tonnes-12784714

[14] N.B. Grocery plastic packaging = 43% of plastic packaging used across all sectors: Grocery and non-grocery retail, construction & demolition, agriculture and commercial and industrial sectors. It accounts for around 64% of the plastic packaging used in the UK retail sector. Source: WRAP, 2016. Plastics Market Situation Report. Available at: http://www.wrap.org.uk/sites/files/wrap/Plastics_ Market_Situation_Report.pdf

[15] Alaerts, L. 2018. Impacts of Bio-Based Plastics on Current Recycling of Plastics, Sustainability, 10:1487.

[16] Green Alliance, 2017. Getting it right from the start: Developing a circular economy for novel materials. Available at: https://www.green-alliance.org.uk/resources/Novel_Materials.pdf

[17] All Things.Bio, 2017. How to dispose of bio-based plastics. Available at: http://www.allthings.bio/dispose-bio-based-plastics/

Therefore we do not think that it is realistic to assume that bio-based plastics like PLA have a meaningful role to play in the transition to a circular economy.

Where bio-based plastics are sourced from waste streams that would have otherwise been sent to landfill or incineration, this presents a more circular use of resources. The economic and environmental viability of using waste feedstocks to produce bio-based plastics will depend on the volume, quality and cost of transportation of feedstocks to reprocessing facilities. Seasonal changes affect the availability of certain feedstocks, for instance in agriculture. Many processes for converting waste feedstocks depend on enzymes that can be very resource intensive to produce.[18] We therefore urge caution from these being encouraged at scale, particularly if the products are single-use and thus continue to perpetuate linear business models and consumption patterns. For example, Mexican company Biofase is using the waste from avocado harvests and consumption to manufacture single use cutlery and straws.[19]

An alternative example might be where plastic is diverted from agricultural waste streams to be down-cycled into long-lived items. For example, in response to Greenpeace and EIA's 2019 supermarket survey, Lidl noted that suppliers based in South West England are part of an initiative that collects and recycles plastic waste into items such as sheep pens and hen houses. Similarly, M&S are working with suppliers on sustainable growing mediums and encouraging plastic recycling into plastic lumber for items such as fence posts.

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

Promoting the production and consumption of bio-based plastics, particularly single use packaging and products, plays no role in achieving this ambition. It has been repeatedly demonstrated that bio-based plastics do not necessarily break down in the natural environment any faster than conventional plastics, and therefore these products will pose the same level of risk to terrestrial and marine wildlife and ecosystems.

Similarly, Frederik Wurm, a chemist at the Max Planck Institute for Polymer Research (MPIP), warns that drinking straws made from PLA are "the perfect example for greenwashing." They are more expensive than other plastic drinking straws, but don't readily biodegrade on a beach or in the sea.[20] UNEP notes that increasing use of biopolymers will not reduce the amount of plastic waste reaching the ocean or landfill.[21] Although some bio-based plastics are also biodegradable (PHA, bio-PBS, bio-PVOH), biodegradability is not a necessary criterion.[22]

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.*

Consumers are confused with terminology - bioplastics, bio-based, biodegradable and compostable are often used interchangeably and suggest that these are more environmentally friendly. A social

[18] Green Alliance, 2018. Novel Materials presentation. (Obtained over email).
[19] See: https://www.biofase.com.mx/
[20] Frederik Wurm, quoted in Green Biz. Available at: https://www.greenbiz.com/article/are-bioplastics-really-better-environment-read-fine-print
[21] UNEP, 2015. Biodegradable plastics and marine litter: Misconceptions, concerns and impacts on marine environments. Available at: https://bit.ly/2JMknwv
[22] Van den Oever, M., 2010. Bio Based And Biodegradable Plastics Facts And Figures: Focus on food packaging in the Netherlands. Wageningen Food & Biobased Research – WUR

media poll run by Surfers Against Sewage indicated that 92.5% of respondents were more likely to buy a product if it was labelled as bio-based, biodegradable or compostable.[23]

Once purchased, further communication on the different end-of-life routes for each materials is required. Research by BBC Wales found that small businesses in Wales had invested in bio-based options in an attempt to be more sustainable, but were unaware these products were sent to landfill instead of recycled.[24] It is not just small businesses that have fallen foul of the waste disposal issue. After a vow to reduce its single-use plastic consumption, Parliament switched to bio-based and compostable alternatives. Yet, between October 2018 and May 2019, all of the bio-based and compostable waste created was sent for incineration. This was due to contamination of other materials and a lack of sufficient IVC facilities in London. As a result, Parliament are reportedly investing £68,000 in developing specific waste streams across its estate,[25] which is far beyond the means of many other businesses using similar products.

In a recent YouGov survey, 38% of respondents said they knew what (packaging) could and could not be recycled. In relation to plastics specifically, 67% of respondents indicated they put "all or almost all" plastic in their recycling bins even though they may not be sure whether it's possible to recycle.[26] This demonstrates the existing confusion over recycling with standard polymers. As bio-based and compostable plastics are often similar in appearance to standard plastics, citizens are likely to treat them in the same way if greater clarity on disposal options are not provided. Examples from the Thornton's Budgens store in Belsize Park are shown below. The PLA plastic packaging is advertised as 'plastic free', and does not contain information on-pack about how the product should be disposed of (see photos below).

[23] Surfers Against Sewage polling undertaken in October 2019 on Twitter, Facebook and Instagram (information now unavailable due to format). The polls totalled 2645 votes, 2447 votes for yes (92.5%), 188 votes for no (7.1%)
[24] https://www.bbc.co.uk/news/uk-wales-47238220
[25] https://www.foodservicefootprint.com/footprint-investigation-parliament-burnt-by-compostable-pledge/
[26] https://www.thegrocer.co.uk/plastic/consumers-confused-over-plastic-recycling-research-shows/597987.article

Furthermore, there is a growing body of evidence suggesting that labels and certification that an item is 'bio-based' can falsely lead customers to believe these will degrade in the natural environment, resulting in a greater likelihood of littering.[27] In focus groups carried out by Keep Scotland Beautiful, participants believed biodegradable plastics were harmless so were acceptable to litter. There was even a belief that the items may benefit wildlife and the environment.[28]

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?

As noted above, bio-based plastics do not perform favourably from a carbon perspective. Most bio-based plastics are produced from agro-based feedstock,[29] requiring an estimated 600,000 hectares to produce 1.6 million tonnes of plastics in 2013 – a fraction of the total demand for plastics (< 0.5 per cent of 2015 total).[30] Increasing land-use for bio-based plastic production could bring about competition with agriculture, cause biodiversity loss and raise land rights concerns.[31] Emissions associated with land use change (i.e. deforestation) could release 9-170 times more CO^2 than the annual GHG savings bio-based plastics provide, and put pressure on other natural resources such as water.[32]

A study conducted at the University of Bonn in 2018[33] attempted to make a comparison between the environmental impacts of bio-based plastics and conventional plastics, specifically with the intention of understanding the climate implications of policy approaches aimed at sustainably controlling the two materials. Their conclusion was that consuming bioplastics from food crops in greater amounts is not effective strategy to protect the climate.

In addition, there are currently limited end-of-life recycling and processing options for PLA - the most common bio-based plastic - which means they commonly end up being landfilled or incinerated, therefore increasing their emissions' footprint even further.

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?

We believe there is enough evidence - including but not limited to that already presented - that bio-based plastics do not perform favourably to warrant the Government to take a strong precautionary

[27] Klöckner, C.A. (2013). A comprehensive model of the psychology of environmental behaviour—A meta-analysis. Global Environmental Change, 23(5), 1028-1038
[28] Zero Waste Scotland. 2013. Rapid evidence review of anti-littering behaviour and anti-litter policies
[29] Ißbrücker, C., 2018. How much land do we really need to produce bio-based plastics?
[30] Bioplastics, 2015. Frequently Asked Questions on Bioplastics
[31] CE Delft, 2017. Biobased Plastics in a Circular Economy Policy suggestions for biobased and biobased biodegradable plastics.
[32] Piemonte, V. and Gironi, F. 2011. Land-use change emissions: How green are the bioplastics? Environmental Progress & Sustainable Energy, 30:4, pp:685-691.
[33] More Bioplastics do not necessarily contribute to climate mitigation, accessed online: https://www.sciencedaily.com/releases/2018/12/181207112714.htm

approach. If further studies are to be undertaken, Government must halt the expansion of the bio-based plastic market until those have been undertaken and critically assessed by a range of expert stakeholders.

4. Bio-based plastics currently make up a relatively small proportion of the market, representing around £50m GVA[34]. What, if any, are the barriers preventing innovative bio-based products from succeeding in the marketplace?

A wide range of legitimate sustainability concerns are making large companies question the adoption of bio-based plastics. These include concerns about sourcing credentials and supply chains, a lack of end-of-life facilities at scale, consumer awareness of the correct disposal routes and other sustainability issues already highlighted in this response.

Research by the Environmental Investigation Agency (EIA) and Greenpeace UK found that major supermarkets in the UK would not pursue bio-based plastics due to these significant sustainability concerns.[35] Asda reported in 2018 that "Our current view on more traditional bio-based plastics such as PLA is...not favourable. Any PLA that enters conventional waste streams contaminates recycling. PLA, and other starch based polymers are only industrially compostable (not home compostable) and therefore need a specialist collection stream which currently doesn't exist in the UK. Even if PLA did make it to a specialist 'industrial composter' it is actually fished out as it forms a 'plastic clump' in the green (garden) waste it is meant to be processed alongside. Therefore we need to fully understand these materials in much more detail before we would be comfortable using them. It is also important that customers are clear about what these materials are and how they can be handled. Our customer research shows that labelling packaging as bio-based, biodegradable, or compostable leads customers to think plastic would disappear quickly within their garden, and from parks and streets."

Similarly, following a trial, Iceland stopped plans to move into bio-based plastic such as PLA, and committed to instead focusing on reducing plastic altogether. Lidl and Sainsbury's noted concerns of land use change, with Sainsbury's also noting recyclability criteria. M&S highlighted the importance of "sustainable feedstocks that do not contribute adversely to land use, are non-GM and do not compete with food crops". Morrisons noted there is no effective end-of-life solutions for these alternative materials. Tesco are assessing opportunities on a case by case basis to ensure bio-based materials are explored where they are not diverting product from the food chain (animal/human), and that they are sustainable, recyclable and/or recycled.

We urge the Government to follow the lead of these companies through taking a strongly precautionary approach.

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?

Besides the impact on waste processing, there are a number of areas which present potential unintended consequences in the increased production and usage of bio-based plastics. Most bio-

[34] NNFC Market Perspective: Bio-based and Biodegradable Plastic in the UK: April 2018
[35] Research by EIA and Greenpeace in follow up to 2018 report 'Checking out on Plastics'. Not yet published (2019)

based plastics are produced from agro-based feedstock,[36] requiring an estimated 600,000 hectares to produce 1.6 million tonnes of plastics in 2013 – a fraction of the total demand for plastics (< 0.5 per cent of 2015 total).[37] Increasing land-use for bio-based plastic production could bring about competition with agriculture, cause biodiversity loss and raise land rights concerns.[38] The resulting pressure on arable land, which is already being seen in some regions, can drive water scarcity, species extinction, desertification and the loss of natural habitats.[39]

As the impacts of climate change are increasingly felt, it is critical to consult evidence about declining crop yields and the usage of land to meet the demands of human food consumption. Food security is a serious and continuing issue. The UN's Food and Agricultural Organisation (FAO) reported in 2017 that 821 million people, or one out of every nine people were undernourished and consuming less than the recommended 2,100 calories per day.[40] Bio-based plastics are traditionally made from non-nutritionally dense crops such as corn or sugarcane. The growth in bio-based plastics from these crops could drive up demand and divert existing land from growing other more nutritious crops especially if farmers can increase their incomes. In some regions, including in Africa and Asia,[41] food security has already been identified as a major concern as populations and climate impacts on agricultural productivity increase. Better knowledge of climate change impacts on crop productivity in vulnerable regions is crucial to inform policies,[42] which would include the consideration of land conversion and land use change to meet growing demand for the bio-based plastics industry.

Emissions associated with land use change (i.e. deforestation) could release 9-170 times more CO2 than the annual GHG savings bio-based plastics provide and put pressure on other natural resources such as water.[43] Bio-based feedstocks are generally grown using methods of industrial agricultural production and therefore significant amounts of toxic pesticides are used, which can pollute water and soil, and impact wildlife habitats. One example of this is in Brazil, where sugar cane is being grown as a source for bio-based plastics. The sugar cane industry has been linked to the use of pesticides which are currently not in use in the European Union due to their associated risks to human health and the environment.

The industrial production of feedstock for bioplastic risks creating socio-economic impacts in producing countries, by fuelling export led commodity crop economies that extract resources and make a few people richer and the majority poorer.

As well as issues associated with sourcing, when processing bio-based feedstocks to produce plastics, significant amounts of energy and water are used, as well as hazardous chemicals/additives.[44]

[36] Ißbrücker, C., 2018. How much land do we really need to produce bio-based plastics?
[37] Bioplastics, 2015. Frequently Asked Questions on Bioplastics
[38] CE Delft, 2017. Biobased Plastics in a Circular Economy Policy suggestions for biobased and biobased biodegradable plastics.
[39] Plastikatlas: Daten und Fakten über eine Welt voller Kunststoff, 2019 P34
[40] FAO, IFAD, UNICEF, WFP and WHO, Ed., *The state of food security and nutrition in the world*. Rome: FAO, 2018.
[41] Piemonte, V. and Gironi, 2011. Land-use change emissions: How green are the bioplastics?. Environmental Progress & Sustainable Energy, 30:4, pp:685-691.
[42] Sultan, B. 2012 Global warming threatens agricultural productivity in Africa and South Asia. Accessed here: https://iopscience.iop.org/article/10.1088/1748-9326/7/4/041001/pdf
[43] Piemonte, V. and Gironi, F. 2011. Land-use change emissions: How green are the bioplastics?. Environmental Progress & Sustainable Energy, 30:4, pp:685-691.
[44] Álvarez-Chávez, C.R., Edwards, S., Moure-Eraso, R. and Geiser, K., 2012. Sustainability of bio-based plastics: general comparative analysis and recommendations for improvement. Journal of Cleaner Production, 23(1), pp.47-56.

It is also worth noting that currently most bio-based plastic is still partially composed of fossil-based plastic. For example, the NaturALL bottle used by major beverage companies is currently 30% bio-based plastic, and 70% fossil-based plastic.[45] Therefore, encouraging growth of bio-based plastics could simultaneously increase demand for petrochemical feedstocks from fossil fuels like oil and gas.

As far as we are aware, so far no comprehensive certification for precautionary, ecological agriculture compatible, bio-based plastic feedstocks exist.

In short, replacing the forecasted, 'business as usual' growth of fossil-based feedstocks for plastics with biomass feedstocks, would significantly increase the existing burden on our planet's ecosystems, in particular on forests and agricultural systems and communities.

Biodegradable plastics

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?

a. Clean Growth, including growing the bioeconomy: *Ensuring the UK has a manufacturing industry that can develop and thrive in a low carbon future economy, which could include replacing traditional fossil-based plastics with biobased alternatives where recycled material is not available.*

As per our answer to question 1, we strongly support an urgent transition from our fossil fuel economy. As noted, the world's developed oil and gas reserves already take us beyond the carbon budget associated with achieving the Paris Agreement's ambition to limit temperature rises to 1.5°C above pre-industrial levels.[46] However, expansion into biodegradable plastics is not aligned with a just transition to a low carbon economy.

Biodegradable plastics break down under certain conditions through the actions of naturally occurring micro-organisms, within a timeframe specified by industry standards. The main standards used to demonstrate plastic biodegradability under industrial conditions are EN 13432:2000 and ASTM 6400-12. Both require the test material to yield 90 per cent of its organic fraction within 180 days. Other criteria cover the material's disintegration under test conditions and its potential toxicity. Biodegradable plastics can be sourced from fossil fuels - for example, Polybutylene Adipate Terephthalate (PBAT), Polycaprolactone (PCL) - or bio-based, for example Polylactic Acid (PLA), Polyhydroxyalkanoates (PHA) as well as starch blends.

Clearly, an increase in biodegradable plastics sourced from fossil fuels would not be consistent with the Government's stated intention to develop a low carbon economy. For reasons expressed in length in answer to question 1, we do not believe that bio-based plastics have a role to play either.

In addition to sourcing concerns, there are also climate implications at the end-of-life for these products. Biodegradable materials require anaerobic conditions to decompose. If disposed of via landfill, anaerobic microbes will decompose biodegradable polymers into methane and carbon

[45] https://www.wur.nl/upload_mm/1/e/7/01452551-06c5-4dc3-b278-173da53356bb_170421%20Report%20Bio-based%20Plastic%20Facts.pdf
[46] Oil Change International, http://priceofoil.org/content/uploads/2019/05/SeaChange-final-r3.pdf

dioxide.[47] Methane is among the strongest greenhouse gases contributing to climate change, which would again undermine the Government's commitment to the Paris Agreement and ambition to achieve Net Zero by 2050.

In line with the waste hierarchy, the building blocks of a circular economy must be reduction then reuse, followed by recycling. Rather than substituting conventional fossil-fuel based plastics with alternative materials (including those that degrade), we urge the Government to focus on plastic prevention, reuse and refillable solutions.

There is discussion around the use of biodegradable plastic mulching in agriculture that can be tilled back into the soil. These may be preferable to conventional non-biodegradable polluting alternatives, but only if the very highest standards are met with independent testing to ensure they fully breakdown in soil and marine environments and ecotoxicity testing. While preferable to plastic being tilled into the soil, burnt or leaking into the natural environment, such solutions are not as resource efficient as reuse nor prevention.

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.*

As emphasised in question 1, a foremost focus on reduction and reuse, in addition to recycling, will be needed to close the loop on plastics in the economy.

While biodegradable plastics can be recycled, they need separating from other polymers, requiring investment in sorting technologies. According to UNEP, their promotion as a greener alternative is unjustified in the absence of effective provision of industrial composting or anaerobic digestion facilities.[48] There are also concerns that novel additives used to promote biodegradation may pose a challenge to the recycling sector.[49]

Biodegradable plastics are not aligned with the waste hierarchy, which considers saving resources and reducing the environmental impact through reuse and recycling of products as pivotal. Once the material has been composted rather than recycled, it is lost to the economy, and thus not aligned with the Government's intention of maximising the value of materials.

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

Even under the most optimistic biodegradation time horizons, biodegradable plastics could cause death and injury to marine life through entanglement and ingestion. A study found that once ingested by sea turtles, biodegradable plastic mass reduced by just 4.5-8.5 per cent over 49 days.[50] Existing biodegradability standards and test methods for aquatic environments do not involve

[47] Cho, H.S., Moon, H.S., Kim, M. et al., 2011. Biodegradability and biodegradation rate of poly(caprolactone)-starch blend and poly(butylene succinate) biodegradable polymer under aerobic and anaerobic environment, Waste Management, 31: pp:475–480.
[48] UNEP, 2018. Exploring the potential for adopting alternative materials to reduce marine plastic litter
[49] Lambert, S. and Wagner, M., 2017. Environmental performance of bio-based and biodegradable plastics: the road ahead, Chem. Soc. Rev, 46, pp: 6855-6871.
[50] Müller, C. et al, 2012. Experimental degradation of polymer shopping bags (standard and degradable plastic, and biodegradable) in the gastrointestinal fluids of sea turtles. Science of the Total Environment, 416, pp: 464-467

toxicity testing, or account for the potentially adverse impacts of polymer degradation or microscopic plastic particles arising from fragmentation.[51]

Currently, there is no standard providing pass/ fail criteria for marine bio-degradation. US legislation ASTM D7081 defined marine degradable plastics as materials that, besides full biodegradation in a composting test, reach 20 per cent biodegradation in a marine test within six months, and at least 70 per cent disintegration within three months. This was withdrawn without replacement.[52]

A 2015 report by UNEP warned that the "adoption of plastic products labelled as 'biodegradable' will not bring about a significant decrease either in the quantity of plastic entering the ocean or the risk of physical and chemical impacts on the marine environment, on the balance of current scientific evidence".[53]

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.*

As described at length in answer to question 1, customers are confused by terminology surrounding so-called 'bioplastics', which can lead to incorrect end-of-life disposal, which can contaminate existing recycling streams; and misconceptions that they can degrade in the natural environment which can lead to littering.

A 2015 report by UNEP "Biodegradable Plastics & Marine Litter: Misconceptions, Concerns, and Impacts on Marine Environments" concluded: "A further disadvantage of the more widespread adoption of 'biodegradable' plastics is the need to separate them from the non-biodegradable waste streams for plastic recycling to avoid compromising the quality of the final product. In addition, there is some albeit limited evidence to suggest that labelling *a product as 'biodegradable' will result in a greater inclination to litter on the part of the public."*

7. <u>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:</u>

Biodegradable plastics pose a paradox. In order to ensure they do not cause harm if they leak into the natural environment, it is necessary for them to be designed to fully decompose as quickly as possible. This is not currently the case, as demonstrated by a study found that once ingested by sea turtles, biodegradable plastic mass reduced by just 4.5-8.5 per cent over 49 days.[54] However, by enforcing requirements for faster biodegradation as required to protect the natural environment, the Government would be falling into contradiction of its stated desire to create a "more circular

[51] Harrison J. P. et al, 2018. Biodegradability standards for carrier bags and plastic films in aquatic environments: a critical review. R. Soc. open sci. 5: 171792. http://dx.doi.org/10.1098/rsos.171792

[52] ASTM, 2014. Standard Specification for Non-Floating Biodegradable Plastics in the Marine Environment (Withdrawn 2014).

[53] https://www.packagingnews.co.uk/features/comment/david-wilson-biodegradable-plastics-sustainable-problem-24-05-2018

[54] Müller, C. et al, 2012. Experimental degradation of polymer shopping bags (standard and degradable plastic, and biodegradable) in the gastrointestinal fluids of sea turtles. Science of the Total Environment, 416, pp: 464-467

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." Once a material has fully broken down, its value is lost to the economy. Biodegradable plastics thus present an inefficient use of resources, and should not be promoted at scale.

Rather than trying to square this circle, we want a ban on biodegradable plastics and a Government focus on reduction and reuse instead.

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)?

Even under the most optimistic biodegradation time horizons, biodegradable plastics will pose the same - and perhaps even additional - risks to the natural environment. Numerous studies over multiple years have consistently shown how so-called biodegradable plastics do not break down any faster in the natural environment than conventional plastics. This is not surprising, as most require industrial conditions to fully break down which will never be found in the natural environment. Below, we present evidence of these problems.

Polylactic Acid (PLA) - both a bio-based and biodegradable plastic - does not readily biodegrade in freshwater or marine environments. Research has shown negligible weight loss of PLA samples that had been placed in aquatic medium for 112 days under conditions of constant light at a temperature of 30°C.[55] PLA degradation has also been analysed in a simulated marine environment of pure PLA and three different composite PLA forms: PLA with buriti 15 fibre (PLA/B); PLA with the cellulose plasticizer triacetin (PLA/T); and PLA with buriti and triacetin (PLA/B/T). After 600 days, all samples showed colonisation by microorganisms and were being degraded.[56] The authors do not discuss whether the PLA and PLA composites completely degraded, or degraded into micro-fragments.

The degradation times for Mater-Bi carrier bags in soil, compost, marsh and in the sea have been tested. In laboratory conditions, after three months the samples from soil and compost exhibited 37% and 43% weight loss, respectively. However, in field conditions the samples showed little deterioration after three months whether in soil, compost, marsh or in the sea. The authors conclude "replacing plastic-based carrier bags with bioplastic bags would not automatically reduce or solve environmental problems typically associated with the widespread usage of plastic carrier bags".[57]

More recent testing undertaken by Mater-Bi's producers Novamont, judged as "reliable" by the Italian Plastics Institute and independently verified by The Verification Body (Certiquality), gives two variants of the material a marine degradability accreditation based on the ISO DIS 19679 test method.[58] Although the results of this test are promising, the risk is it gives industry the permission

[55] *Lambert, S; Wagner, M. 2017. Environmental performance of bio-based and biodegradable plastics: the road ahead. Chemical Society Reviews. 46(22):6855-6871*

[56] Pelegrine, K et al. 2015. Degradation of PLA and PLA in composites with triacetin and buriti fiber after 600 days in a simulated marine environment. Journal of Applied Polymer Science. https://onlinelibrary.wiley.com/doi/abs/10.1002/app.43290

[57] Accinelli, C et al. 2012 Deterioration of bioplastic carrier bags in the environment and assessment of a new recycling alternative. Chemosphere. 89(2):136-43

[58] http://materbi.com/en/wp-content/uploads/sites/2/2015/12/scheda-shopper_EN_LR.pdf

to continue with "business as usual" and not tackle the overarching issue of our throwaway lifestyles where consumption of single-use items cannot be sustained over the long-term regardless of the material.

Further investigations have been undertaken on the degradation of three types of biodegradable plastics in soil: poly (butylene succinate)-starch (PBS-starch), poly (butylene succinate) (PBS) and PLA. After 28 days, both PBS-starch and PBS were degraded by 1% to 7%, but PLA remained intact. The bioplastics were also powdered to examine their degradation rates in soil, and also whether their presence influenced microbial activity and nitrogen circulation. PLA was found to remain intact in the soil, even if powdered, and significantly decreased nitrogen circulation activity. [59] Existing biodegradability standards and test methods for aquatic environments do not involve toxicity testing, or account for the potentially adverse impacts of polymer degradation or microscopic plastic particles arising from fragmentation.[60] Similar to traditional plastics, biodegradable plastics are highly likely to fragment into small pieces, contributing to microplastic pollution.[61] Microplastics are present in all marine habitats, from the ocean surface to sea ice to the seabed, and can be ingested by species throughout the marine food chain. They can persist in organisms' digestive systems, release, absorb and transfer contaminants and allow toxins to be transferred up the food chain.[62,63]

There is scientific evidence of adverse effects of microplastics in a range of marine and freshwater species, including impacts on growth and reproduction in species that perform vital ecosystem functions and are important in commercial fisheries.[64] Filter-feeding marine megafauna such as fin whales and basking sharks are at risk from high levels of microplastic ingestion and recent studies have documented plastic additives and Persistent Organic Pollutants (POPs) in the tissues of fin whales, basking sharks and whale sharks.[65]

The impacts of microplastic ingestion on marine fauna include gut blockage, physical injury, oxidative stress, altered feeding behaviour and reduced energy allocation, with resulting impacts on growth and reproduction.[66] In addition to physical impacts, there is the potential for transfer of toxins associated with plastics. Microplastics can concentrate persistent, bioaccumulative and toxic (PBT) chemicals such as PCBs (polychlorinated biphenyls) and DDEs (metabolites of DDT, dichloro-diphenyl-trichloroethane) from seawater.

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[59] Adhikari, D. et al. 2016. Degradation of Bioplastics in Soil and Their Degradation Effects on Environmental Microorganisms. Journal of Agricultural Chemistry and Environment. 05(01):23-34

[60] Harrison J. P. et al, 2018. Biodegradability standards for carrier bags and plastic films in aquatic environments: a critical review. R. Soc. open sci. 5: 171792. http://dx.doi.org/10.1098/rsos.171792

[61] Yashchuk, O. et al, 2012. Degradation of Polyethylene Film Samples Containing Oxo-Degradable Additives, Procedia Materials Science, 1, pp:439-445 https://www.sciencedirect.com/science/article/pii/S2211812812000600

[62] Galloway, T. & Lewis, C. 2016 (and references therein). Marine microplastics spell big problems for future generations. PNAS, 113, 2331-2333;

[63] GESAMP, 2015. Sources, fate and effects of microplastics in the marine environment: a global assessment (Kershaw, P. J.,ed.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 90, 96 p.

[64] Galloway, T. & Lewis, C. 2016 (and references therein). Marine microplastics spell big problems for future generations. PNAS, 113, 2331-2333.

[65] Germanov, E., Marshall, A. et al. 2018. Microplastics: No small problem for filter-feeding megafauna. Trends in Ecology & Evolution, 33, 227-232. Available here

[66] GESAMP, 2015. Sources, fate and effects of microplastics in the marine environment: a global assessment. (Kershaw, P. J., ed.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 90, 96 p.

With 41% of UK species in decline,[67] Government should be urgently working to avoid these risks to biodiversity through taking a strongly precautionary approach to biodegradable plastics.

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.)?

Current research indicates different biodegradable materials degrade in open air, soil and the marine environment at differing rates.[68] As per our response to question 7, we urge the Government to take a strongly precautionary approach to biodegradable plastics. If more research is to be undertaken, we call for the expansion of the biodegradable market to be halted by the Government until the results have been assessed by a range of expert stakeholders.

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[69] instead of simply fragmenting into microplastics? If not, what are the key challenges to establishing such a test?

There is limited research in this area, so as stated elsewhere, we believe this warrants the Government to take a strongly precautionary approach with prevention of market access. There are a number of emerging businesses promoting prodegradant agents alongside claims of complete degradation to organic materials without the creation of microplastics during the degradation process. The main challenge with these emerging technologies is that the different environmental conditions under which testing is conducted are simulated and therefore relatively controlled. Therefore the simulation of different conditions will never be able to reflect the uncontrolled variability of external environmental conditions.

For example, Polymateria is one such company who are sponsoring work with the British Standards Institute to establish a PAS specifically looking at *'Biodegradation of plastic in the case of littering in the natural environment".* This PAS is focused on establishing a standard which supports the requirements of Polymateria's specific technology however it is critical to reinforce the point that nothing should be designed to be leaked into the natural environment and there must be an emphasis on reduction and design for reuse underpinned by circular economy principles.

11. Would such testing regimes/methodologies be applicable to plastics which contain prodegradant agents intended to aid the biodegradation process[70]? We are particularly interested in any evidence established in the last three years.

[67] State of Nature Partnership. 2019. State of Nature report

[68] Napper, E & Thompson, R., 2019. Environmental Deterioration of Biodegradable, Oxo-biodegradable, Compostable, and Conventional Plastic Carrier Bags in the Sea, Soil, and Open-Air Over a 3-Year Period. Environ. Sci. Technol. 53 (9): 4775-4783

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

[70] 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

The same testing regimes/methodologies must be applicable to all plastics (both bio and fossil-fuel based) which claim to be biodegradable. The priority is to establish a consensus on an optimal biodegradation process including a degradation timeframe, the impact of which has no negative impact on the natural environment.

However, we reiterate our point that nothing should be designed to be left in the natural environment – instead we should focus on prevention, reduction, re-use and circularity of materials.

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?

Compostable plastics are a subset of biodegradable plastics that biodegrade within the conditions and timeframe of the composting process. 'Industrially compostable' plastics are defined by the standard EN 13432 which requires the packaging sample is mixed with organic waste and maintained under test composting conditions for 12 weeks after which time no more than 10% of material fragments are allowed to be larger than 2mm, and an absence of any negative effect on the composting process. Home compostable materials must be treatable at ambient temperatures. The timeframes for biodegradation and disintegration can be longer. There are no current standards for home compostable plastics.

Industrial composting facilities range between 50°C and 60°C. For hygiene purposes, temperatures need to remain above 60°C for a week. Many compostable plastics take around 60-90 days to compost industrially, but some facilities operate on shorter cycles (i.e. 30 days). Home compostable products must be treatable at ambient temperatures. The timeframes for biodegradation and disintegration can be longer. Parameters such as moisture content, aeration, pH, and carbon to nitrogen ratio do not need controlling.

Even under the most optimistic biodegradation time horizons, compostable plastics will pose the same risks to the natural environment if they escape collection as conventional plastics. This is particularly true for industrially compostable plastics, as clearly the conditions required for these to fully break down are never found in the natural environment. Therefore, the concerns we raise in response to question 8 regarding microplastic pollution and toxicity are also relevant here.

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?

As previously noted, biodegradable plastics can be sourced from both fossil fuel feedstocks and bio-based sources. Our answer to question 5 fully explains our concerns about unintended consequences of growth in the use of bio-based plastics, which are equally applicable to biodegradable plastics sourced this way.

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.

In their working paper on biodegradable plastics, the Environmental Protection Agency network cited the following disadvantages for the wider use of biodegradable plastics in Europe:[71]

- Consumer confusion
- Need for correct labelling
- Not readily degradable
- Disturb established waste streams
- Increased littering
- Lack of clear definitions
- Not recyclable
- Costly

A range of other challenges including access to composting companies to utilise the waste, questions around carbon footprint in production, no documented advantages, limited application in closed-loop applications and the impact of incorrect disposal on waterways and wildlife.

It is clear that there are a host of environmental, economical and social unintended consequences that need to be carefully considered in the context of a growing biodegradable plastics market. An overall focus should be on avoiding these unintended consequences through promotion of prevention, reduction, re-use and refillable alternatives.

Compostable plastics

14. What evidence, if any, is available regarding the suitability of the existing industrial and home composting[72] standards? We welcome any suggestions on how these standards could be adapted to current and future needs, if necessary.

Fundamentally, we do not believe that a revision to existing standards will be sufficient in making compostable materials sustainable to be scaled up in the UK.

We also note that there is no international or European standard for marine biodegradability, and therefore these are not included in composting standards. A conformity mark has been developed for products described as biodegradable in seawater by Vinçotte, known as 'OK Biodegradable MARINE'. The biodegradability component of this certificate is based on the now-withdrawn international standard ASTM D7081-05 and such products should therefore not be considered as safe for the marine environment. The test procedures involved do not address the impacts on multispecies communities and biogeochemical processes, and the toxicity assays required by the OK Biodegradable MARINE label do not account for the ability of microplastic particles to adversely affect aquatic organisms.[73]

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?

[71] Maier, N., 2018 European Network of the Heads of Environment Protection Agencies (EPA Network) - Interest group on Plastics – Working paper

[72] Existing home composting standards are international, rather than UK-specific

[73] Harrison, J.P., Boardman, C., O'Callaghan, K., Delort, A.M. and Song, J., 2018. Biodegradability standards for carrier bags and plastic films in aquatic environments: a critical review. Royal Society open science, 5(5), p.171792

Since not all households have access to home composting - and those that do, do not necessarily have the expertise and time-requirements to achieve the conditions required for plastic alternatives classed as 'home compostable' to fully break down - we do not support the scaling up of these materials. Any standard should assume the least optimal home composting conditions which would be achieved by all citizens without specialist expertise in composting. We are concerned that the introduction of home compostable plastics in neighbourhoods and regions where very few people have access to facilities to properly dispose of these will lead to increased landfill and contamination of existing recycling streams.

With regards to the current status in the UK, not all households have composting facilities or access to curbside compostable waste collections; even when they do, it is possible that home-based composting will fail to achieve the heat or moisture levels required to trigger biodegradation. Accurate and up-to-date statistics on home composting are hard to find. According to a 2009 study for Defra's Waste and Resources Evidence Programme,[74] "just over 1 in 3 households with access to a garden currently compost". According to a 2014 survey by BusinessWaste.co.uk[75] only 3% of households have a compost heap or compost bin in their gardens. Use of compostable plastics in packaging formats that have established recycling systems (e.g. bottles) could result in cross-contamination, particularly if consumers cannot readily tell the difference between compostable and non-compostable plastics.[76]

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?

As with biodegradable plastics, compostable plastics can be produced from fossil fuels or bio-based sources. Our concerns about bio-based plastics are described in answer to question 5. Since compostable plastics are a subset of biodegradable plastics, our response to question 13 is also applicable.

Growth in the use of compostable plastics could incentivize an increase in the use of incineration as a method of waste disposal. A recent investigation by Foodservice Footprint[77], also referenced in response to question 1d, into the use of compostable plastic in Parliament is a useful case study. The investigation found that even within Parliament, a relatively controlled environment, large volumes of compostable packaging being sent for incineration due largely to contamination and a lack of industrial composting infrastructure. The findings were:

- Parliament's waste contractor Bywaters has been unable to send the waste generated during the first seven months of the switch to compostable packaging to an IVC facility for composting
- All of the compostable waste collected between October 2018 and May 2019 was sent to an energy from waste plant for incineration

[74] WR1204 Household Waste Prevention Evidence Review:L3 m3-5 (T) - Attitudes and Behaviours Home Composting: A report for Defra's Waste and Resources Evidence Programmes. October 2009
[75] https://www.businesswaste.co.uk/97-of-uk-households-dont-compost-britain-forgets-the-art-of-composting/
[76] North, E. and Halden, R., 2014. Plastics and Environmental Health: The Road Ahead, Rev. Environ. Health, 28:1, pp:1-8
[77] https://www.foodservicefootprint.com/footprint-investigation-parliament-burnt-by-compostable-pledge/

- Parliament has been forced to invest almost £70,000 a year to develop its own bespoke waste stream for compostables
- Compostable waste from Bywaters' other London-based clients is not currently being composted due in part to a lack of London-based IVC facilities

Existing and potential biodegradability standards

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'[78]. Are there other relevant standards or test methods for those circumstances that you are aware of that do not appear on this list?

N/A

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?

As per our answer to question 7, the concept of biodegradable plastics poses a paradox. In order to ensure they do not cause harm if they leak into the natural environment, it is necessary for them to be designed to fully decompose as quickly as possible. However, by enforcing requirements for faster biodegradation as required to protect the natural environment, the Government would be falling into contradiction of its stated desire to create 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." We're unsure how the development of new standards for biodegradable plastics could both ensure effective environmental protection should the material escape collection, while also playing a meaningful role in a truly circular economy.

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:

N/A

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

The main standards used to demonstrate plastic biodegradability under industrial conditions are EN 13432:2000 and ASTM 6400-12. Both require the test material to yield 90 per cent of its organic fraction within 180 days. Other criteria cover the material's disintegration under test conditions and its potential toxicity. Currently, there is no standard providing pass/ fail criteria for marine bio-degradation. US legislation ASTM D7081 defined marine degradable plastics as materials that,

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

besides full biodegradation in a composting test, reach 20 per cent biodegradation in a marine test within six months, and at least 70 per cent disintegration within three months. This was withdrawn without replacement.

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)?

We would strongly oppose the simple substitution of conventional single use carrier bags for compostable carrier bags, since these should be phased out in favour of reusable alternatives. However, it could be explored in certain instances where there is a high chance of contamination with food waste - i.e. for tea bags, labels on loose fruit/veg - in vicinities where there are widely available end-of-life treatment, such as food waste collection.

Specific standards for bags designed to be used to collect food waste would also be beneficial. Not all Local Authorities that have food waste collections currently have facilities that can process these: for example, a Q&A from Monmouthshire Government website states that "Compostable bags require air and light to help break them down. The anaerobic digester operates in the dark and in the absence of air so cannot process compostable bags. All bags are separated from the food and burnt to produce electricity. So, ideally we would like to see all those old plastic bags being re-used rather than expensive compostable bags. Compostable bags are also more difficult for the plant to separate as they become sticky when warm."[79]

Certification and labelling

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

Bio-based plastics are derived (at least partially) from organic materials such as starch, cellulose, oils (e.g. rapeseed oil), wood and proteins.[80] They often also use fossil fuel derived feedstocks. Most European bio-based plastics (~80%) are starch-based, from maize, potatoes and cassava.[81] Bio-based plastics can also be derived from waste feedstock materials, and from microalgae.[82] Bio-plastics can indicate 'bio-based carbon content', measured by EU standard CEN/ TS 16137 and US standard ASTM 6866.17. The European Committee for Standardisation is currently developing measures for the indication of bio-based content.

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

As noted in question 1, point d, labelling of all packaging regardless of the material should have clear consumer calls to action with regards to end-of-life disposal and environmental impact. This will

[79] *https://www.monmouthshire.gov.uk/app/uploads/2019/01/Food-Waste-FAQs-ENG.pdf*
[80] . British Plastics Federation, 2018. Bio-based plastics: Feedstocks, Production and the UK Market
[81] British Plastics Federation, 2018. Ibid.
[82] Lambert, S. and Wagner, M., 2017. Environmental performance of bio-based and biodegradable plastics: the road ahead, Chem. Soc. Rev, 46, pp: 6855-6871.

prevent incorrect disposal, misguided behaviours e.g. littering of biodegradable materials and misleading information on the environmental credentials of a material - just because it is made from a 'renewable source' does not mean it is "biodegradable". For instance wood pulp-derived cellulose or sugarcane-derived polyethylene are not biodegradable. It is critical that policy and legislation is introduced to require manufacturers, brands and retailers to clearly communicate the source and end-of-life outcomes for all materials to ensure citizens are not greenwashed.

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?

Clarifying and simplifying information about waste disposal for consumers will mitigate the risk of incorrect disposal, including littering. Therefore, clear and accurate information about the disposal routes should be in place to inform consumers at point of purchase to inform their decision making.

Given the risks that surround the sourcing of bio-based plastics (i.e. deforestation, land use change, competition with agricultural land etc. - see early answers) we urge that should the Government choose not to ban bio-based plastics, they must ensure the very highest environmental and social criteria are met for these materials to gain market access. Reassurance these have been met must be considered in the creation of any labelling or certification.

So far no comprehensive certification for precautionary, ecological agriculture compatible, bioplastic feedstocks exist[83] and while using Forest Stewardship Council (FSC) certified materials for sourcing feedstocks from responsible forestry can be a useful tool, additional due diligence is often required.[84]

Such labelling should be re-enforced and operated alongside better control of claims made by brands and retailers around bio-based, biodegradable and compostable packaging and the benefits of these versus other materials, which can otherwise amount to greenwash. These claims must be transparent, credible and must not mislead the consumer.

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?

As previously noted in other answers, there is a risk that consumers may be more relaxed about discarding plastics products labelled 'biodegradable', rather than reusing or recycling.[85] Therefore

[83] The Bioplastics Feedstock Alliance criteria, which is not a certification but a set of criteria for comparing different feedstocks, while covering some of the key principles of ecological agriculture, does not address some of them comprehensively enough e.g. on food sovereignty, local needs versus global commodification and local nutrient cycles

[84] GPI (2018) Statement on Forest Certification and Guidance for Companies and Consumers, Greenpeace International, March 2018 https://storage.googleapis.com/planet4-internationalstateless/2018/03/6b3d1c70-greenpeace-statement-on-forest-certification-and-guidance-for-companies-andconsumers_final.pdf

[85] O'Brine, T and Thompson, R.C. 2010. Degradation of plastic carrier bags in the marine environment. Marine Pollution Bulletin. Volume 60, Issue 12, December 2010, Pages 2279-2283. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0025326X10003553

we urge for the correct disposal route to be clearly labelled on all bio-based, biodegradable and compostable products.

Impacts on waste processing

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?

While some biodegradable plastics can be recycled, they need separating from other polymers, requiring investment in sorting technologies. According to UNEP, their promotion as a greener alternative is unjustified in the absence of effective provision of industrial composting or anaerobic digestion facilities.[86] There are also concerns that novel additives used to promote biodegradation may pose a challenge to the recycling sector. [87]

Use of compostable plastics in packaging formats that have established recycling systems (e.g. bottles) could result in contamination of recovered plastics, particularly if consumers cannot readily tell the difference between compostable and non-compostable plastics.[88] Scientists report a "serve incompatibility" of PLA with high-value PET recycling streams given the different behaviour of PLA at higher temperatures – with contamination occurring at levels of two per cent PLA.

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?

Bio-based plastics generally require recycling in separate streams to fossil-based plastics and failure to separate them from other polymers could cause contamination.[89] There are technological challenges associated with separation.[90] If sorting and processing cannot be done economically because of low volumes, bio-based plastics will most likely be incinerated or sent to landfill.[91]

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

The Government's consultation on "Consistency in household and business recycling collections in England" is proposing a mandatory weekly food collection. This could be an avenue for collecting

[86] UNEP, 2018. Exploring the potential for adopting alternative materials to reduce marine plastic litter. Available at: https://www.unenvironment.org/resources/report/exploring-potential-adopting-alternative-materials-reduce-marine-plastic-litter
[87] Lambert, S. and Wagner, M., 2017. Environmental performance of bio-based and biodegradable plastics: the road ahead, Chem. Soc. Rev, 46, pp: 6855-6871
[88] North, E. and Halden, R., 2014. Plastics and Environmental Health: The Road Ahead, Rev. Environ. Health, 28:1, pp:1-8.
[89] WRAP (2010). Biopolymer packaging in UK grocery market available at: http://www.wrap.org.uk/sites/files/wrap/Biopolymer%20briefing%20dec%202010%20final1.pdf
[90] Green Alliance, 2017. Getting it right from the start: Developing a circular economy for novel materials. Available at: https://www.green-alliance.org.uk/resources/Novel_Materials.pdf
[91] AllThings.Bio, 2017. How to dispose of bio-based plastics http://www.allthings.bio/dispose-bio-based-plastics/

niche applications of biodegradable and compostable plastics as long as they meet required standards for inclusion in this process with demonstrated environmental benefits. This must be accompanied by clear customer labelling and education of end-of-life disposal.

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

We strongly oppose the mass introduction of biodegradable plastic. Waste collection systems are already struggling to deal with current levels of plastic waste, with currently only a third of UK consumer plastic packaging classed as 'recycled' - and this figure depends on exporting waste overseas. Focusing on addressing this existing problem must be the primary concern of the Government, rather than further complicating the situation by supporting the growth of existing biodegradable plastics and allowing the introduction of new ones.

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?

As previously stated in question 15, "Compostable" packaging and plastic wastes are a permitted input …"only if the product is independently certified as conforming to all composting-relevant parts of a standard accepted by the Environment Agency or Northern Ireland Environment Agency." There were four standards accepted at the time of publishing the protocol - BS EN 13432, BS EN 14995, ASTM D6400 and AIB-Vinçotte International S.A.'s 'Program OK 2' criteria for 'home compostable' packaging and plastics. If the food waste bags/liners adhere to one of these standards they should be suitable for the composting process. However composters will not be able to discern from bag to bag and therefore it is more sensible to remove all bag and potentially plastic products from the input than risk contamination of their output - as demonstrated with the Monmouthshire example included in answer to question 21.

Other related issues

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

The EU Directive 904/2019 - o*n the reduction of the impact of certain plastic products on the environment* covers certain plastic items regardless of whether the plastic they are made of is compostable or not or whether they were produced from fossil fuels or bio-based materials. If the UK does not want to create further regulatory barriers that hinder trade with the EU, it should be careful not to induce the domestic industry to invest in the use of a type of material that will be subject to bans, high Extended Producer Responsibility costs, reduction targets, etc.