# Examining sustainability claims of bioplastics

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# Executive Summary

## Introduction

The increasing production and use of plastics globally presents a considerable problem for nature and humanity. In Australia the vast majority of plastic ends up in landfill, where it can contaminate nearby soil and groundwater. A smaller percentage ends up in nature and causes harm to wildlife and ecosystems. Given these adverse effects, it is essential that methods of minimising the environmental impacts of plastic and plastic waste and avoiding the presence of plastics in the environment are developed.

Bioplastics (a term referring to bio-based and biodegradable plastics) are often considered a more sustainable alternative to conventional plastics. However, their environmental outcomes are currently not well understood and need to be critically examined. In light of this, this report had the primary objective of examining the sustainability of bioplastics in Australia, in order to understand how the future use of bioplastics in Australia can contribute to sustainability. The research is structured around four key research questions:

- What are the sustainability benefits and risks of bioplastics across the lifecycle?
- What has been the approach to bioplastics in Australia and the sustainability outcomes?
- Are there potentially misleading claims being made about the sustainability of bioplastic products sold in Australia?
- What will ensure the sustainable use of bioplastics in Australia?

For this study we undertook a review of academic and grey literature, interviews with eleven Australian experts involved in the production, use, composting and research of bioplastics and an assessment of sustainability claims of bioplastic products sold in Australia.

Bioplastics is a broad term that includes both bio-based and biodegradable plastics. **Bio-based** plastics are derived from plant-based feedstocks or other biomass, such as corn, sugarcane and algae. **Biodegradable** refers to the ability of a plastic to break down by micro-organisms into elements found purely in nature, but does not specify the timeframe. **Compostable** plastics are a subset of biodegradable plastics that break down in a composting system within a relatively short timeframe. Plastics that are **certified compostable** in Australia adhere to Australian Standards which outline the timeframe, quality and ecotoxicity criteria for their biodegradation in either industrial (AS4736) or home (AS5810) compost systems.

Some bio-based plastics are biodegradable or compostable and some are chemically identical to recyclable conventional plastics. Biodegradable and compostable plastics can be either bio-based or fossil-based, or a mix.

## Lifecycle sustainability of bioplastics

As bioplastics are a relatively new form of plastic and still make up a small share of the plastics produced, there is limited data and uncertainties regarding their environmental impacts. Bioplastics are often assumed to be better for the environment than conventional plastics, which are made from fossil fuels and contribute to climate change and environmental pollution throughout their lifecycle.

From our review of the sustainability impacts of bioplastics across the lifecycle, we determined that bioplastics can play a role in reducing the environmental impacts of plastics and contribute to a circular economy, but are not a solution to the problems of plastic waste generation and plastic pollution.

Whilst bio-based plastics most likely have lower environmental impacts than conventional plastics across the lifecycle, they use more land and water in production, and could impact on food security and biodiversity (depending on the type of feedstock and location in which it is grown). Careful decision-making and responsible practices are necessary for sourcing bioplastic feedstocks to ensure they contribute to sustainability.

Bioplastics can lead to environmental harm in the same way as conventional plastics, such as contamination of soil and water, and harming of wildlife, if they are not managed appropriately and end up in the environment. Even though biodegradable plastics may break down in the environment quicker than conventional plastics, they still have risk of causing environmental harm as they will likely take years or decades to biodegrade.

Bioplastics that are either recyclable or compostable can contribute to a circular economy, but there are challenges for their collection and processing. There is no benefit of plastic to be compostable if it does not end up in a composting system, as it may emit methane (a greenhouse gas) in other environments, may not break down in a quicker timeframe and may contaminate compost or recycling streams. The appropriate end-of-life management of bioplastics is essential for ensuring that their potential benefits are met and any potential harm is minimised.

## Sustainability outcomes and future applications of bioplastics in Australia

It is estimated that less than 1% of the nearly 3.5 million tonnes of plastic used each year in Australia are bioplastics, and they are mostly used in single-use plastic products. The majority (90%) of bioplastics in Australia are compostable and are used in applications such as kitchen caddy liners for food waste collection, takeaway coffee cups and lids, food serviceware, postage satchels and retail bags. Single-use plastic items including plastic bags and serviceware are being banned in many states in Australia, and in some cases, these bans also apply to bioplastic alternatives, including compostable plastics. Careful consideration of the types of bioplastics brought on to the market and appropriate applications is essential to ensure sustainability for future bioplastics use in Australia.

Although bio-based and compostable plastics have the potential for environmental benefits, these benefits are generally not currently being realised in Australia because of the way these plastics are managed at end-of-life. The best options for management of bioplastics at end of life are recycling (for conventional plastics manufactured with bio-based feedstocks such as bioPET) or composting (for compostable plastics certified to the Australian Standards).

Compostable plastics need to be processed in commercial or home compost systems to ensure they biodegrade as designed. Compostable plastics can have a positive environmental benefit when they are accepted in compost systems and used to increase the collection and recovery of food waste and food contaminated packaging. There have been some positive examples in Australia of where compostable plastics are successfully collected and processed in municipal food and garden organics collection systems and where food waste bin liners have increased the rates of food waste collection. However composting facilities are limited across most of Australia, and most do not accept compostable plastics, so the majority of compostable plastic products are currently ending up in landfill. In addition, there are many compostable products which are used in applications where they are likely to end up in landfill and it is unclear if they will have an environmental benefit.

Bio-based plastics may provide an environmental benefit if they have evidence of lower environmental impacts over the lifecycle compared to alternatives and can either be recycled or composted, or are used in an application which requires virgin plastics and recycling or composting is not possible. There are some problematic products on the market which need to be sent to landfill as they are not suitable for either composting or recycling.

Biodegradable plastics that are not certified compostable to Australian Standards should be avoided due to the risk of contaminating compost, as well as bio-based plastics that cannot be recycled or composted (except in niche applications), as they cannot be recovered at end-of-life.

## Sustainability claims of bioplastic products in Australia

We undertook an assessment of sustainability claims made by companies selling bioplastics products to evaluate if there were examples of claims being made that may be potentially misleading to consumers. 26 bioplastic products from 14 companies were evaluated, including plastic bags, serviceware, coffee pods, postage bags, loose packing fill and balloons.

Under Australian law, environmental claims should be accurate, able to be substantiated, specific, use plain language, be made for a real benefit, and not overstate a benefit. **The review found that nearly one third of sustainability claims about bioplastic products were potentially misleading and nearly one quarter were unable to be verified**.

The majority of claims that were potentially misleading related to use of vague terminology or statements that may mislead consumers on correct end-of-life disposal of the product.

- Half of the companies made statements that may mislead or confuse consumers on how to dispose of products at end-of-life, and only a small number provided clear information on how to dispose of the products.
- Some products use the term biodegradable for products which are not compostable. This is problematic because the term 'biodegradable' does not have a timeframe under which the product will break down, which may mislead consumers to think that the product will biodegrade in a short timeframe, when it will likely remain in landfill (or the environment) for many years.
- More than half of the companies used vague terminology about the environmental benefits of the product such as "green", "eco-friendly", "environmentally friendly", "earth friendly", "earth loving", "sustainable" and "safe" which may mislead consumers into thinking that the product causes no environmental harm.
- Some companies claim that their products are not a plastic or will not contribute to the plastic waste problem by using terms such as "plastic-free", which is potentially misleading to consumers as these products are still plastic and may have similar environmental impacts to conventional plastics if not managed appropriately.
- Some companies made claims about environmental benefits of the product which are unsubstantiated, including claims about their feedstocks and carbon footprint.
- Not all products that claim to be compostable are certified to the Australian Standards, which is a requirement for them to be suitable for composting in commercial or home compost systems in Australia.

In our interviews with experts, it was noted there was high levels of greenwashing around bioplastic products, particularly bio-based products that are not compostable or recyclable or "biodegradable" products that are not compostable. Fragmentable plastics such as oxo-degredable plastics were not included in our review (as they are not bioplastics but conventional plastics that contain additives to break down into microplastics), but they were considered highly problematic by interviewees and to be frequently greenwashing consumers.

## Ensuring sustainable outcomes of bioplastics in Australia

To ensure sustainable outcomes in the use of bioplastics there is a need to ensure responsible sourcing of feedstocks, determine what applications they are most suitable to be used in and ensure the appropriate end-of-life management. Potential strategies that could help ensure sustainable outcomes of future bioplastics use in Australia include avoiding the sale of problematic products (particularly those that do not have viable pathway for composting or recycling at end-of-life), improving labelling, reducing potentially misleading claims and greenwashing, increasing business and consumer awareness, increasing harmonisation of organics recycling services and further research to compare the sustainability of bioplastics and other plastic alternatives. Any increase in the use of bioplastics needs to be considered alongside broader system changes to improve the environmental impacts of plastics, such as strategies to reduce the use of single-use plastics.

# Contents

# 1. Introduction

## 1.1 Why is this research needed?

In 2018-19, Australians used approximately 3.5 million tonnes of plastic, a total which is steadily increasing year on year.[1] Of this plastic, the vast majority (over 80%) is sent to landfill, while around 4% leaks into marine environments.[2] The presence of plastic in landfill is problematic, as upon degradation, harmful chemicals can be released into nearby soil and groundwater and methane can be emitted into the atmosphere, and valuable resources are not recovered.[3] If plastics enter the environment, particularly marine environments, they can harm wildlife and ecosystems and break into micro-plastics, causing further harm.[4]

Bioplastics (a term that includes bio-based and biodegradable plastics) are increasingly being used as a replacement for conventional plastics, and considered as a potential solution to the environmental problems associated with conventional plastic production and pollution. For instance, it has been suggested that bio-based plastics could emit less greenhouse gas emissions than fossil-based plastics, that biodegradable plastics that break down more quickly in the environment could reduce the impact on land and marine life, and that compostable plastics could reduce the amount of plastic going to landfills.

However, the sustainability outcomes of bioplastics are not well understood, and there is the potential of unintended negative environmental impacts from their production, use and disposal at end-of-life.[5] Sustainable plastics are defined as those that are managed within a circular economy that avoids the creation of waste, toxics and pollution throughout the lifecycle, and where plastics are used in appropriate products and sustainable value from the plastics is recaptured after use.[6]

There is a need to critically examine bioplastics to understand their sustainability benefits and risks and to understand if the claims being made about the sustainability benefits of bioplastics are potentially misleading to consumers. This is particularly important in the Australian context where the bioplastics market is growing, partly influenced by single-use plastics bans across states and territories and consumer demand for more sustainable alternatives to conventional plastics.

## 1.2 Objectives of this report

This report had the primary objective of examining the sustainability of bioplastics Australia, in order to understand how the future use of bioplastics in Australia can contribute to sustainability. The research is structured around four key research questions:

- What are the sustainability benefits and risks of bioplastics across the lifecycle? (Chapter 2)
- What has been the approach to bioplastics in Australia and the sustainability outcomes? (Chapter 3)
- Are there potentially misleading claims being made about the sustainability of bioplastic products sold in Australia? (Chapter 4)
- What will ensure the sustainable use of bioplastics in Australia? (Chapter 5)

This research was commissioned and funded by WWF-Australia.

[1] DAWE (2021). National Plastics Plan 2021. Department of Agriculture, Water and the Environment, Canberra, December.
[2] O'Farrell, K., Harney, F., & Chakma, P. (2021). Australian plastics flows and fates study 2019-20: National Report, Envisage Works
[3] Ilyas, M., Ahmad, W., Khan, H., Yousaf, S., Khan, K., & Nazir, S. (2018). Plastic waste as a significant threat to environment–a systematic literature review. *Reviews on environmental health*, *33*(4), 383-406.
[4] Ibid.
[5] Nandakumar, A., Chuah, J. A., & Sudesh, K. (2021). Bioplastics: A boon or bane? *Renewable and Sustainable Energy Reviews*, 147, 111237.
[6] OECD (2018). Considerations and Criteria for Sustainable Plastics from a Chemicals Perspective. Available online: https://www.oecd.org/environment/waste/background-paper-sustainable-plastics-from-a-chemicals-perspective-considerations-and-criteria.pdf

## 1.3 Approach to this research

To address these objectives, a range of methods were implemented. A **literature review** was undertaken of academic and grey literature to synthesise current information on the sustainability of bioplastics including in the Australian context.

Secondly, **interviews** were carried out with eleven bioplastics experts in Australia, including researchers, policy makers and representatives from industry. Interviewees were asked questions on the real-world impacts of bioplastics use in Australia, occurrences of potentially misleading claims, and their views on future bioplastics use and sustainability.

Interviews were conducted with representatives of the following organisations (note: some individuals/organisations participated on the condition of anonymity, and are therefore not included in this list):

- Australasian Bioplastics Association (ABA)
- Australian Packaging Covenant Organisation (APCO)
- Australian Organics Recycling Association (AORA)
- Green Industries South Australia (GISA)
- Peats Soil & Garden Supplies
- Queensland Department of Environment and Science (QLD DES)
- South Australia Environment Protection Authority (SA EPA)
- The University of Queensland (UQ)

An **assessment of sustainability claims** made by companies selling bioplastics products in Australia was undertaken to identify examples of potentially misleading claims (further details on this method are provided in Chapter 4).

## 1.4 What are bioplastics?

**Bioplastics** is a broad term for plastics that are either **bio-based**, **biodegradable**, or both.[7] A plastic is considered a bioplastic based on either the raw materials used to produce the plastics coming from biological sources (bio-based feedstocks) or because the plastic biodegrades at end-of-life.

The terminology relating to bioplastics is complex and often misunderstood. Key definitions are explained in further detail below:

- **Bio-based plastics:** Bio-based plastics are either fully or partly derived from plant-based feedstocks or other biomass. Various types of plants can be used to produce bio-based plastics, including corn, sugarcane, cellulose and algae. Many common plastics that are typically produced from fossil-based feedstocks can be instead produced from bio-based feedstocks, and they are chemically identical to the fossil-based equivalent.[8]
- **Biodegradable plastics:** The term biodegradable refers to the ability of a plastic to break down by micro-organisms, such as bacteria and fungi, into elements found purely in nature (water, carbon dioxide and biomass).[9] Biodegradable is a generic term that does not specify a timeframe of biodegradation, as the timeframe changes depending on the environmental conditions in which the plastic ends up.[10] Biodegradability is an inherent property of a plastic determined by the chemical composition of the plastic. There are both bio-based and fossil-based plastics that are biodegradable.
- **Compostable plastics:** Compostable plastics are a subset of biodegradable plastics that will break down if processed in a composting system, either in industrial facilities or in the home.[11] In many countries there are standards which outline the timeframe and quality criteria for the biodegradation of compostable plastics. In Australia there are two standards for compostable plastics:
  - **Industrial compostable:** Australian Standard AS 4736:2006 – Biodegradable plastics suitable for composting and other microbial treatment (Australian Industrial Composting Standard)
  - **Home compostable:** Australian Standard AS 5810:2010 – Biodegradable plastics suitable for home composting (Australian Home Composting Standard).

  The Australian Industrial Composting Standard defines compostable plastics as those that disintegrate within 12 weeks and fully biodegrade within 180 days in a compost system, and have no contamination or toxic effects on the compost.[12] Composting in a home compost system takes a longer time period and certified home compostable plastics are required to disintegrate within 180 days.[13] Plastics that are certified to the standard for industrial composting need to be processed in an industrial or commercial composting facility (also known as organics recycling), as they do not necessarily compost in home conditions, but most plastics certified to the standard for home composting will also meet the standard for industrial composting.

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[7] Australian Packaging Covenant Organisation (APCO) (2020). *Considerations for Compostable Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Considerations%20for%20Compostable%20Packaging

[8] Australian Packaging Covenant Organisation (APCO) (2020). *Considerations for Compostable Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Considerations%20for%20Compostable%20Packaging

[9] Australasian Bioplastics Association (n.d.). *Bioplastics explained.* Available online: https://bioplastics.org.au/bioplastics/bioplastics-explained/

[10] Coppola, G., Gaudio, M. T., Lopresto, C. G., Calabro, V., Curcio, S., & Chakraborty, S. (2021). Bioplastic from renewable biomass: a facile solution for a greener environment. *Earth Systems and Environment*, 5(2), 231-251.

[11] Australasian Bioplastics Association (n.d.). *Bioplastics explained.* Available online: https://bioplastics.org.au/bioplastics/bioplastics-explained/

[12] AS – Standards Australia (2006). *Australian Standard AS 4736:2006 – Biodegradable plastics suitable for composting and other microbial treatment (Australian Industrial Composting Standard)*

[13] AS – Standards Australia (2010). *Australian Standard AS 5810:2010 – Biodegradable plastics suitable for home composting (Australian Home Composting Standard)*

The Australasian Bioplastics Association (ABA) administers a voluntary verification scheme to certify compostable plastics to the Australian standards.[14] Plastics that are certified to these standards are referred to as **certified compostable plastics**. Certification provides assurance these plastics will successfully break down in a correctly managed compost system without harming the quality of finished compost.


*Figure 1 – Labels for products certified to the Australian Standards for compostable plastics*

The Australian industrial standard is similar to other international standards, such as the European Standard EN 13432. However, the Australian Industrial Composting Standard contains an important ecotoxicity test for earthworm survival, which has been included to assure users of the recycled organics that there are no toxic residues in the organic output.[15] Certification also requires that fluorinated chemicals, such as per- and poly- polyfluorinated alkyl substance (PFAS), are not intentionally added to products.[16]

There are a range of different plastics that are considered bioplastics, as shown in Table 1.

*Table 1: Overview of plastics that are considered bioplastics (highlighted in green cells)*[17]

| | Fossil-based | Bio-based |
|---|---|---|
| **Commonly used in compostable products (biodegradable)** | some PBAT | some PLA, PHA, starch-based |
| **Biodegradable** | PBAT, PCL, PVA, PBS | PLA, PHA, bioPBS, starch-based, cellulose |
| **Non-biodegradable** | PS, PET, PVC, PE, PP (conventional plastics) | bioPE, bioPP, bioPCs, bioPUs, bioPET, PEF |

In addition, there are several other important definitions which are helpful to understanding bioplastics:

- **Conventional plastics:** Conventional plastics are typically derived from fossil fuels, such as petroleum and natural gas, and some these plastics can be mechanically recycled. Common recyclable plastics include polyethylene terephthalate (PET), high density polyethylene (HDPE), low density polyethylene (LDPE) and polypropylene (PP). Polyvinyl chloride (PVC) and polystyrene (PS), and a range of other plastics including composite plastics, are challenging to recycle.[18]

[14] Australasian Bioplastics Association (n.d.). *Certification.* Available online: https://bioplastics.org.au/certification/
[15] Australasian Bioplastics Association (n.d.). *Composting.* Available online: https://bioplastics.org.au/composting/
[16] Australasian Bioplastics Association (n.d.). *ABA verification to address PFAS concerns.* Available online: https://bioplastics.org.au/aba-certification-to-address-pfas-concerns/
[17] Sources: Australian Packaging Covenant Organisation (APCO) (2020). *Considerations for Compostable Plastic Packaging.* O'Farrell, K., Harney, F., & Chakma, P. (2021). Australian plastics flows and fates study 2019-20: National report, Envisage Works; Rosenboom, J. G., Langer, R., & Traverso, G. (2022). Bioplastics for a circular economy. *Nature Reviews Materials*, 7, 117-137.
[18] Dominish, E., Retamal, M., Wakefield-Rann, R., Florin, N., 2020, *Environmentally responsible trade in waste plastics Report 1: Investigating the links between trade and marine plastic pollution*, Prepared for the Department of Agriculture, Water and the Environment, June 2020. Available online: https://www.dcceew.gov.au/sites/default/files/documents/ert-waste-plastics-report-1.pdf

Some conventional plastics can also be manufactured using fully or partly bio-based feedstocks, such as PET (known as bioPET). These bio-based plastics are recyclable in the same way as their fossil-based equivalents and are not compostable.

- **Mechanical recycling:** The processing of scrap plastics into an input for the manufacture of new products, through physical processes such as sorting, chipping, grinding, washing and extruding.[19]
- **Fragmentable plastics:** Fragmentable plastics are conventional plastics that contain additives to accelerate the fragmentation of the material into smaller pieces (microplastics) after exposure to ultraviolet radiation or heat.[20] These plastics are not biodegradable, although they are sometimes misleadingly labelled as biodegradable. Fragmentable plastics include **oxo-degradable** plastics. These plastics break up into microplastics, but the microplastics do not readily biodegrade in the same way a biodegradable plastic does. Because these plastics contribute to microplastic pollution if they enter the environment they are banned or being phased out in many jurisdictions, including Australia. There are also some plastics labelled as oxo-biodegradable which claim to break down into fragments and then biodegrade. However, they differ from biodegradable plastics as they contain additives to facilitate the biodegradation process.

**Clarifying common misconceptions**

Whether or not a plastic is bio-based or fossil-based does not directly relate to how it behaves at end-of-life. It is important to note that not all bio-based plastics are biodegradable or compostable and not all biodegradable or compostable plastics are bio-based.[21] For example, many compostable plastics are fossil-based.[22]

The term biodegradable is often used in a way that could be misleading for products which are not compostable as it implies that products will biodegrade in reasonable timeframe. Many fragmentable plastics are misleadingly labelled as biodegradable.

The Australian Packaging Covenant Organisation (APCO) states that to provide clarity to industry and consumers plastics should be referred to as 'certified compostable plastics' or 'conventional plastics' and the term 'biodegradable' should be avoided.[23] APCO also states that for an item to be called 'compostable' it needs to be certified to the Australian standards.

Throughout this report we use the term bioplastics when discussing the broad group of plastics that fall under this term, and distinguish between bio-based, biodegradable, compostable and certified compostable plastics where relevant.

[19] Australian Packaging Covenant Organisation (APCO) (2020). *Action Plan for Problematic and Unnecessary Single-Use Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Action%20Plan%20for%20Problematic%20and%20Unnecessary%20Single-Use%20Plastic%20Packaging
[20] Australian Packaging Covenant Organisation (APCO) (2020). *Action Plan for Problematic and Unnecessary Single-Use Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Action%20Plan%20for%20Problematic%20and%20Unnecessary%20Single-Use%20Plastic%20Packaging
[21] Australian Packaging Covenant Organisation (APCO) (2020). *Considerations for Compostable Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Considerations%20for%20Compostable%20Packaging
[22] Kubowicz, S., & Booth, A. M. (2017). Biodegradability of plastics: challenges and misconceptions. *Environmental Science and Technology*, 51, 12058-12060.
[23] Australian Packaging Covenant Organisation (APCO) (2020). *Considerations for Compostable Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Considerations%20for%20Compostable%20Packaging

## 1.5 Bioplastics market

### Bioplastics market

In 2021, bioplastics represented less than 1% of the 367 million tonnes of global plastics production (not including the production of recycled plastics).[24] However, the bioplastics market is expected to grow at a rate higher than that of fossil-based plastics in the coming years. Production capacities are expected to grow from about 2.26 million tonnes in 2021 to about 6.15 million tonnes in 2026.[25]

The market growth is driven by a range of factors including a growing number of regulations and laws aimed at reducing conventional single-use plastics (which could drive increased uptake of bioplastics), increasing consumer demand related to perceived social and environmental benefits, advances in bioplastic properties, broader ranges of applications and the high potential for innovation. However, the higher production cost compared to conventional plastics remains a barrier to market growth.[26]

### Bioplastics applications

Compared to fossil-based plastics, bio-based plastics can be manufactured to perform in a similar way, with few caveats. It is estimated that 85% of fossil-based plastics could be replaced by bioplastics.[27]

By comparison, compostable plastics, due to needing to be broken down in composting conditions, are often more vulnerable to oxygen and water vapour, rendering them less viable for certain kinds of uses, such as packaging for fresh meat or liquids.[28] On the other hand some compostable plastics, such as PLA, have barrier properties which can extend the life of fresh food, much of which is currently wrapped in fossil-based plastic that is used only once (single-use plastic) and not typically recycled, resulting in large amounts of plastic waste.[29]

Packaging remains by far the largest market segment for bioplastics, accounting for more than half of the total bioplastics market.[30] Bioplastics are also used in textiles, consumer goods, agriculture and horticulture, automotive and electronic equipment, construction, coatings/adhesives and the medical sector.[31]

Specific applications of bioplastic polymers include:

- Compostable, fossil-based PBATs have been used for agricultural mulch film, and for plastic bags
- Compostable PLAs and PHAs have been used for plastic bags and single-use food service ware, such as cutlery, plates and cups, and PLA can be used to line coffee cups to replace polyethylene
- Compostable starch-based plastics are used for bags to collect food waste for composting or food and organic waste collection services
- Fossil-based PCL that is biodegradable has been used for surgical equipment and implants
- Non-biodegradable bio-based plastics, such as bioPET, has most commonly been used for single-use plastics, such as plastic bags and plastic water bottles.

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[24] European Bioplastics (n.d.) Bioplastics Market Data. Available online at: https://www.european-bioplastics.org/market/
[25] Institute for Bioplastics and Biocomposites (2022). Available online at https://biopolydat.ifbb-hannover.de/market-data
[26] Institute for Bioplastics and Biocomposites (2022). Available online at https://biopolydat.ifbb-hannover.de/market-data
[27] Shen, L., Haufe, J., & Patel, M. K. (2009). *Product overview and market projection of emerging bio-based plastics* PRO-BIP 2009.Report for European polysaccharide network of excellence (EPNOE) and European bioplastics, *243*, 1-245.
[28] Interview data
[29] Van den Oever, M., Molenveld, K., van der Zee, M., & Bos, H. (2017).*Bio-based and biodegradable plastics: facts and figures: focus on food packaging in the Netherlands* (No. 1722). Wageningen Food & Biobased Research. Available online at: https://edepot.wur.nl/408350
[30] Institute for Bioplastics and Biocomposites (2022). Available online at https://biopolydat.ifbb-hannover.de/market-data
[31] Institute for Bioplastics and Biocomposites (2022). Available online at https://biopolydat.ifbb-hannover.de/market-data

## 2. Lifecycle sustainability of bioplastics

- Bioplastics can play a role in reducing the environmental impacts of plastics and contribute to a circular economy, but are not a solution to the problems of plastic waste generation and plastic pollution.
- Bioplastics can lead to environmental harm in the same way as conventional plastics, such as contamination of soil and water, and harm to wildlife, if they are not managed appropriately and end up in the environment. Even though biodegradable plastics may break down in the environment quicker than conventional plastics, they still risk causing environmental harm as they will likely take years or decades to biodegrade.
- Bio-based plastics generally – but not always – have lower environmental impacts in their production compared to fossil-based plastics. Careful decision-making and responsible practices are necessary for sourcing bioplastic feedstocks to ensure they contribute to sustainability, and avoid potential impacts on food security, biodiversity, air, soil and water.
- Bioplastics that are either recyclable or compostable can contribute to a circular economy, but there are challenges for their collection and processing. The appropriate end-of-life management of bioplastics is essential for ensuring that their potential benefits are met and any potential harm is minimised, such as leakage into the environment and contamination of compost and recycling streams.

## 2.1 Sustainability benefits and risks of bioplastics

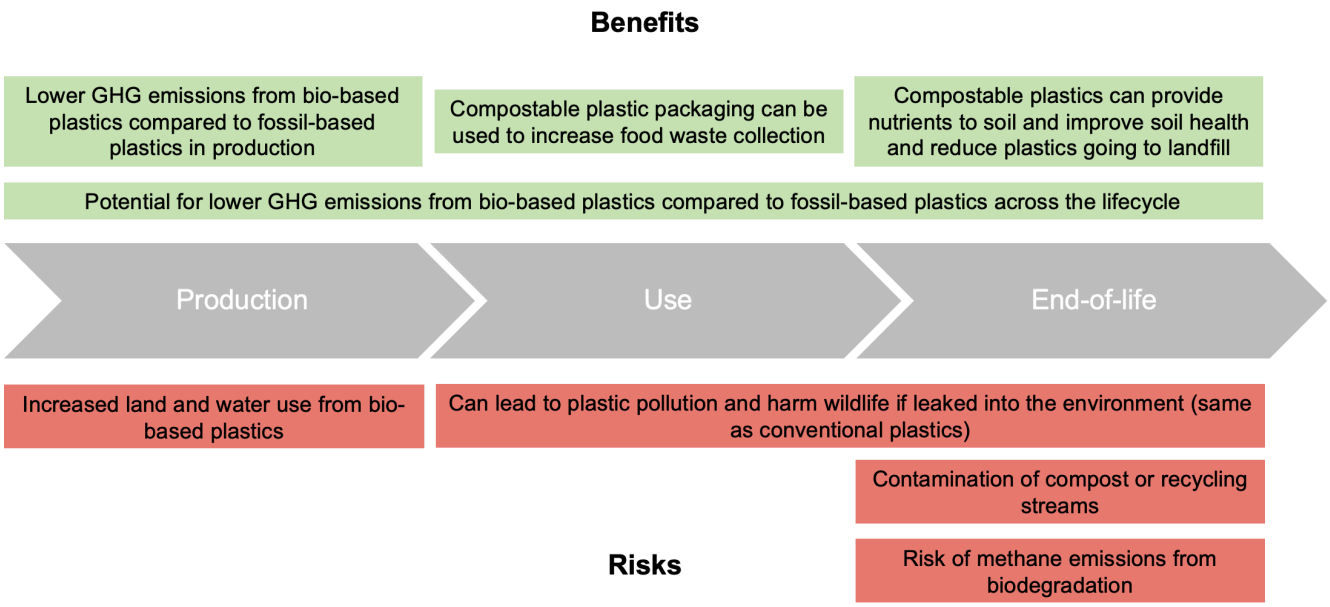
Conventional plastics contribute to climate change and environmental impacts throughout their lifecycle. Plastic waste is a significant environmental challenge, particularly when it enters the environment as plastic pollution and threatens ecosystems and wildlife.[32]

Bioplastics are not a solution to the problems of plastic waste generation and plastic pollution. The use of bioplastics needs to be considered alongside broader systemic change in the use and management of plastics, such as reducing single-use plastic consumption, increasing reuse and repair rates, and improving waste management. Bioplastics have a role to play in a circular economy which leads to efficient use of resources, the recovery of resources at end-of-life and minimises waste and emissions.

To realise the potential benefits of bioplastics, which includes a wide range of different bio-based and/or biodegradable plastics, it needs to be determined what applications they are most appropriate to be used in, and then ensure responsible sourcing and end-of-life management.

The sustainability of bioplastics is determined by their impacts across the whole lifecycle, in particular their production and feedstocks (the raw materials that are used to produce plastics) and management at end-of-life (how they biodegrade and if they can be recycled or composted). Figure 2 provides a summary of the key benefits and risks for bioplastics across the lifecycle, which are described in further detail in the following sections.

*Figure 2: Benefits and risks of bioplastics across the lifecycle*




[32] Ilyas, M., Ahmad, W., Khan, H., Yousaf, S., Khan, K., & Nazir, S. (2018). Plastic waste as a significant threat to environment–a systematic literature review. *Reviews on environmental health*, *33*(4), 383-406.

## 2.2 Environmental impacts in plastic production

Although bio-based plastics avoid the use of fossil fuels for their production, their production has local environmental and social impacts. Bio-based plastics are made from biomass feedstocks, the majority of which require agricultural land for plants to be grown and water for irrigation.[33] Increased chemical use in the growing of crops to be used for bio-based plastics can lead to potential pollution or contamination of the environment, with impacts on biodiversity, soil, air and water.[34]

As demand for bio-based plastics increases, there is the potential for demand for agricultural land for biomass to lead to further land clearing, leading to biodiversity loss and climate change impacts.[35] There is also the potential for competition for agricultural land between feedstocks for bioplastics and for crops food production, therefore ensuring food security needs to be the first priority of biomass usage.[36]

A wide range of renewable bio-based feedstocks are used in bioplastic production, which have been classified into three "generations". 1st generation feedstocks are the most common and efficiently produced (highest yield, least amount of area) and are mostly made from carbohydrate-rich plants that are also food crops or animal feed, such as corn, sugar cane, potatoes and cassava.[37] 2nd generation feedstocks are non-food or animal feed crops such as cellulose or waste materials from 1st generation feedstocks.[38] 3rd generation feedstocks are the least common and in the development phase such as biomass from algae and waste streams such as $CO_2$ or methane.[39]

Feedstock generations are a broad classification that do not give a direct prediction of sustainability, and there is no feedstock that can be considered the "most sustainable", as where and how it is grown can lead to considerable variation in the environmental impacts of a feedstock. The sustainability of a feedstock needs to be determined based on how sustainably and efficiently it can be produced in the local context. This is dependent on the crop used, the conditions in the region it is grown in and local production practices. First generation food crops are not necessarily a less sustainable option than non-food crops, as they are often more efficiently produced than other feedstock alternatives, requiring less agricultural land.[40]

One study estimates that if all plastics were replaced with bio-based plastics the demand for feedstock would be approximately 5% of the world's total biomass produced and harvested each year.[41] However, it also suggests that bioplastic feedstocks are unlikely to reach such a large share of biomass as the industry will continue to develop technologies that use second generation feedstocks from waste from agriculture and food production and third generation feedstocks such as algae.[42]

Careful decision-making and responsible sourcing are necessary for bio-based feedstocks, considering the increasingly important issues related to food security, competition for agricultural land, water, climate change, biodiversity loss, safe labour practices, and overall environmental and social impacts. The responsible production of feedstocks for bioplastics has the potential to support local economies and drive environmental stewardship.[43]

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[33] Di Bartolo, A., Infurna, G., & Dintcheva, N. T. (2021). A review of bioplastics and their adoption in the circular economy. *Polymers*, 13(8), 1229.
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[37] Australian Packaging Covenant Organisation (APCO) (2020a). *Considerations for Compostable Plastic Packaging.*
[38] European Bioplastics (2022). Accessed online at: https://www.european-bioplastics.org/bioplastics/feedstock/
[39] Bioplastics Magazine (2020) Glossary. Bioplastics Magazine, 06/20, Vol 15 pp 54-57.
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[41] Van den Oever, M., Molenveld, K., van der Zee, M., & Bos, H. (2017).*Bio-based and biodegradable plastics: facts and figures: focus on food packaging in the Netherlands* (No. 1722). Wageningen Food & Biobased Research. Available online at: https://edepot.wur.nl/408350
[42] IFBB (2022). Accessed online at https://biopolydat.ifbb-hannover.de/lca
[43] Bioplastic Feedstock Alliance (2022) Methodology for the Assessment of Bioplastic Feedstocks. World Wildlife Fund.

## 2.3 Pollution

Bioplastics can lead to plastic pollution in the same way as conventional plastics if they are not managed appropriately,[44] leading to environmental harm such as contamination of soil and water, and injury, disease and mortality in wildlife. Bioplastics, as with regular plastics, can leak into the environment through several means, including littering or in the waste management process.[45]

Biodegradable plastics can still lead to harm if they enter the environment. While they may degrade in the environment quicker than conventional plastics, this process takes years or even decades.[46] A study of plastic bags left in natural environments found that biodegradable, oxo-biodegradable and conventional HDPE bags were still functional as plastic bags after three years in marine or soil environments.[47] Compostable plastics can also pose a risk if they enter the environment and need to be processed in composting systems to ensure they break down in a short timeframe.

Shifting from conventional plastics to bioplastics is not a solution to reducing environmental impacts if plastics end up in the environment.[48] The only exception to this may be some niche applications where plastics are used in applications where they are frequently left in the environment, such as agricultural mulch films, that meet a specific standard for biodegrading in soils (different to composting standards).[49]

There is a risk that bioplastics could lead to increased littering. A survey of the Australian public's attitude towards bioplastics found that the public are more likely to litter bioplastics than conventional plastics, because they believe that they will break down in the environment, or are unaware of how to dispose of bioplastics appropriately (whether they should be recycled, composted or sent to landfill).[50]

*Figure 3: Oxo-biodegradable bags which had either been submerged in the marine environment (left) or buried in soil (right) for over three years. Reprinted with permission from Napper, I. E., & Thompson, R. C. Copyright (2019) American Chemical Society.[51]*

[44] Coppola, G., Gaudio, M. T., Lopresto, C. G., Calabro, V., Curcio, S., & Chakraborty, S. (2021). Bioplastic from renewable biomass: a facile solution for a greener environment. *Earth Systems and Environment*, 5(2), 231-251. And
[45] Cucina, M., de Nisi, P., Tambone, F., & Adani, F. (2021). The role of waste management in reducing bioplastics' leakage into the environment: a review. *Bioresource Technology*, 337, 125459.
[46] Lambert, S., & Wagner, M. (2017). Environmental performance of bio-based and biodegradable plastics: the road ahead. *Chemical Society Reviews*, *46*(22), 6855-6871.
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[48] Australian Packaging Covenant Organisation (APCO) (2020). *Considerations for Compostable Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Considerations%20for%20Compostable%20Packaging
[49] Australian Bioplastics Association, (n.d.) Soil biodegradable verification program. Available online: https://bioplastics.org.au/certification/soil-biodegradable-verification-programme/
[50] Dilkes-Hoffman, L., Ashworth, P., Laycock, B., Pratt, S., & Lant, P. (2019). Public attitudes towards bioplastics–knowledge, perception and end-of-life management. *Resources, Conservation and Recycling*, 151, 104479.
[51] Napper, I. E., & Thompson, R. C. (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. *Environmental science & technology*, *53*(9), 4775-4783.

## 2.4 Recovery at end-of-life

Depending on the type of bioplastic, it can either be recycled, composted, or disposed of in landfill at end-of-life. It is often not clear to consumers how a bioplastic should be disposed of, and this can result in contamination of recycling or compost waste streams when disposed of incorrectly.[52] If plastics which are not certified compostable end up in composting systems and are not removed in the composting process, this could lead to plastics entering the environment when compost is applied to land.

When plastics are mechanically recycled, recovered materials can be used as an input for new plastic production. Some research has found that bio-based plastics that can be recycled mechanically have better environmental outcomes than those that can be composted, when considering greenhouse gas emissions and potential contamination.[53] However there are applications where compostable plastics may be more suitable than recyclable plastics, such as packaging that is likely to be contaminated with food, or when compostable plastics are used to increase the collection and processing of food waste.[54]

### *Bio-based plastics (not biodegradable)*

Some bio-based plastics are recyclable in conventional recycling streams, such as bioPET which can be recycled alongside conventional fossil-based PET (these plastics are not designed to be biodegradable).[55] There are some bio-based plastics which are not suitable for either recycling or composting and need to be sent to landfill. If bio-based products are not clearly labelled with details of how they need to be managed at end-of-life, there is a risk that consumers may assume these plastics can be composted, which can contaminate compost.

### *Compostable plastics*

Compostable plastics have potential sustainability benefits – if composted they break down into elements that can provide nutrients to soil and improve soil health.[56] In addition they could result in less plastics ending up in landfill and polluting the environment, where they are used in place of plastics that are currently challenging to recycle. However, compostable plastics need to end up in a compost system for these benefits to be realised. Most compostable plastics are only suitable for industrial scale composting (rather than home composting), and in many places there are limited collection systems and composting facilities, and even when they do exist, many do not accept bioplastics because of the risk of contamination.[57] Plastics that are suitable for home composting may not always break down as expected, as they are tested in lab conditions which are not necessarily replicated in actual backyard compost systems.[58]

### *Biodegradable plastics (not compostable)*

Biodegradable plastics which are not certified compostable cannot be recovered and need to go to a landfill at end-of-life (unless they are suitable for recycling). Even though these plastics are biodegradable they will still contaminate compost if incorrectly disposed of in compost systems, as they will not break down in a suitable timeframe.

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[52] Dilkes-Hoffman, L., Ashworth, P., Laycock, B., Pratt, S., & Lant, P. (2019). Public attitudes towards bioplastics–knowledge, perception and end-of-life management. *Resources, Conservation and Recycling*, 151, 104479.
[53] Di Bartolo, A., Infurna, G., & Dintcheva, N. T. (2021). A review of bioplastics and their adoption in the circular economy. *Polymers*, 13(8), 1229.
[54] Australian Packaging Covenant Organisation (APCO) (2020). *Considerations for Compostable Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Considerations%20for%20Compostable%20Packaging
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[56] Colwill, J. A., Wright, E. I., Rahimifard, S., & Clegg, A. J. (2012). Bio-plastics in the context of competing demands on agricultural land in 2050. *International Journal of Sustainable Engineering*, 5(1), 3-16.
[57] O'Farrell, K., Harney, F., & Chakma, P. (2021). Australian plastics flows and fates study 2019-20: National report, Envisage Works
[58] Purkiss, D., Allison, A. L., Lorencatto, F., Michie, S., & Miodownik, M. (2022). The Big Compost Experiment: Using citizen science to assess the impact and effectiveness of biodegradable and compostable plastics in UK home composting. *Frontiers in Sustainability*, 132.

## 2.5 Lifecycle greenhouse gas emissions

Bioplastics can lead to a reduction in greenhouse gas emissions over their lifecycle compared to conventional plastics, but it is not possible to draw generalised conclusion across all bioplastics. While there are many studies on lifecycle greenhouse gas emissions, they usually relate to a specific bioplastic and results are influenced by location-specific assumptions around production and end-of-life management, and do not give a full picture for bioplastics overall.

### *Bio-based plastics*

Fossil-based plastics are produced through the extraction and distillation of oil, leading to the release of large amounts of greenhouse gas emissions (GHG). Over the last four decades, global plastics production has quadrupled and if this trend were to continue, the greenhouse gas emissions from plastics would reach 15% of the global carbon budget by 2050.[59]

The production of bio-based plastics is less energy intensive and does not rely on the extraction of fossil fuels, so emits less greenhouse gas pollution in the production stage.[60] Studies have also found that bio-based plastics result in a reduction in greenhouse gas emissions throughout the lifecycle compared to fossil-based plastics, regardless of whether or not they are compostable.[61] However, studies have also found that the emissions of greenhouse gases are comparable to fossil-based plastics when emissions from land use change associated with feedstocks is considered. Responsible sourcing practices that take into account localised data on greenhouse gas emissions are necessary to ensure bio-based plastics have a positive climate impact.[62]

### *Compostable plastics*

If plastics are designed to break down within a short time frame, such as compostable plastics, the emissions from the plastic are determined by the environment it ends up in at end of life.[63] If compostable plastics are composted at end-of-life as intended, they will break down in the presence of oxygen (an aerobic environment). However, if they end up in landfill (which is an environment without oxygen, known as anaerobic) they produce methane (a greenhouse gas) while they break down, although in most landfills this will happen very slowly.[64]

Compostable plastics can have a positive benefit for greenhouse gas emissions if they are used in applications which help to increase the collection and processing of food waste, such as kitchen caddy liners for FOGO collection, avoiding emissions from sending food waste to landfill.[65]

### *Biodegradable plastics (not compostable)*

Biodegradable plastics (that are not certified compostable) will need to go to a landfill at end-of-life where they produce methane as they break down (unless they are suitable for recycling).

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[59] Zheng, J., & Suh, S. (2019). Strategies to reduce the global carbon footprint of plastics. *Nature Climate Change*, *9*(5), 374-378. Available online at: https://escholarship.org/uc/item/8pp2t7v8

[60] Coppola, G., Gaudio, M. T., Lopresto, C. G., Calabro, V., Curcio, S., & Chakraborty, S. (2021). Bioplastic from renewable biomass: a facile solution for a greener environment. *Earth Systems and Environment*, 5(2), 231-251.

[61] Brizga, J., Hubacek, K., & Feng, K. (2020). The unintended side effects of bioplastics: carbon, land, and water footprints. *One Earth*, 3(1), 45-53.

[62] Bioplastic Feedstock Alliance (2022) Methodology for the Assessment of Bioplastic Feedstocks. World Wildlife Fund. Available online at: https://www.worldwildlife.org/publications/report-methodology-for-the-assessment-of-bioplastic-feedstocks

[63] Coppola, G., Gaudio, M. T., Lopresto, C. G., Calabro, V., Curcio, S., & Chakraborty, S. (2021). Bioplastic from renewable biomass: a facile solution for a greener environment. *Earth Systems and Environment*, 5(2), 231-251.

[64] Rosenboom, J. G., Langer, R., & Traverso, G. (2022). Bioplastics for a circular economy. *Nature Reviews Materials*, 7, 117-137.

[65] City of Holdfast Bay and Green Industries SA (2019). Compostable bag supply via supermarkets pilot. Available online: https://www.greenindustries.sa.gov.au/documents/Holdfast%20Bay%20Compostable%20Bag%20Trial_Project%20Report_Public_2%20June2020.pdf?downloadable=1

# 3. Sustainability outcomes and future applications of bioplastics in Australia

- Careful consideration of the types of bioplastics brought on to the market and appropriate applications is essential to ensure sustainability for future bioplastics use in Australia.
- Although bio-based and compostable plastics have the potential for environmental benefits, these benefits are generally not being realised in Australia because of the way these plastics are managed at end-of-life. Bioplastics need to have a viable pathway for recycling (for conventional plastics manufactured with bio-based feedstocks such as bioPET) or composting (for certified compostable plastics). Challenges for this included limited consumer awareness of appropriate end-of-life management of bioplastics and compost certifications, a lack of clear and consistent labelling and limited access to convenient collection.
- Compostable plastics need to be certified to Australian Standards and processed in commercial or home compost systems to ensure they biodegrade as designed. Compostable plastics can have a positive environmental benefit when they are accepted in compost systems and used to increase the collection and recovery of food waste and food contaminated packaging, and there have been some positive examples. However composting facilities are limited across most of Australia, and many facilities do not accept compostable plastics, so the majority of compostable plastic products are ending up in landfill.
- Bio-based plastics may provide an environmental benefit if they have evidence of lower environmental impacts over the lifecycle compared to alternatives and can either be recycled or composted, or are used in an application which requires virgin plastics and recycling or composting is not possible.
- There are some problematic bioplastic products on the market which need to be sent to landfill as they are not suitable for either composting or recycling. Biodegradable plastics that are not certified compostable should be avoided, as well as bio-based plastics that cannot be recycled or composted (except in niche applications), as they cannot be recovered at end-of-life and risk contaminating compost.

## 3.1 Current applications of bioplastics in Australia

It is difficult to evaluate the sustainability outcomes of bioplastics use in Australia given that bioplastics make up only a minor share of total plastic consumption. Of the nearly 3.5 million tonnes of plastic consumed in 2019-20, it is estimated that less than 10,000 tonnes (<1%) were bioplastics.[66] Bioplastics are predominantly used in single-use packaging and serviceware applications in Australia (more than 95%), with a small amount used in agriculture.[67]

It is estimated that approximately **90% of the bioplastics market in Australia is certified compostable plastics** and 10% is other bioplastics (such as bio-based and not compostable plastics, or "biodegradable" plastics).[68] Compostable plastics are mainly seen in applications such as food waste bin or caddy liners, takeaway coffee cups and lids, food serviceware, postage satchels and retail bags.[69]

[66] O'Farrell, K., Harney, F., & Chakma, P. (2021). Australian plastics flows and fates study 2019-20: National report, Envisage Works
[67] O'Farrell, K., Harney, F., & Chakma, P. (2021). Australian plastics flows and fates study 2019-20: National report, Envisage Works
[68] O'Farrell, K., Harney, F., & Chakma, P. (2021). Australian plastics flows and fates study 2019-20: National report, Envisage Works
[69] Australian Packaging Covenant Organisation (APCO) (2020). *Considerations for Compostable Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Considerations%20for%20Compostable%20Packaging

## 3.2 Policy approaches to managing bioplastics in Australia

The approach to managing bioplastics varies across Australia. At a national level bioplastics are covered in several key policies:

- The National Waste Policy Action Plan (2019) has a target to phase out problematic and unnecessary plastics by 2025.[70]
  - At a meeting of National Environment Ministers in 2021, federal, state and territory leaders agreed on what the term would cover, and identified *"eight 'problematic and unnecessary' plastic product types for industry to phase out nationally by 2025 (or sooner in some cases). These are lightweight plastic bags; plastic products misleadingly termed as 'degradable'; plastic straws; plastic utensils and stirrers; expanded polystyrene (EPS) consumer food containers (e.g. cups and clamshells); EPS consumer goods packaging (loose fill and moulded); and microbeads in personal health care products."*[71]
  - Ministers also agreed *"in principle to support a roll out of Food Organics and Garden Organics (FOGO) waste collection services in partnership with the Commonwealth to address current gaps in waste collection streams",* to *"work collaboratively to improve the harmonisation of municipal waste collection"* and *'to work with the private sector to design out waste and pollution, keep materials in use and foster markets to achieve a circular economy by 2030'.*
- The National Plastics Plan (2021) includes:[72]
  - Phase out non compostable plastic packaging products containing additive fragmentable technology that do not meet relevant compostable standards (AS4736-2006, AS5810-2010 and EN13432) (July 2022)
  - Phase out expanded polystyrene (EPS) in loose fill and moulded consumer packaging (July 2022), and food and beverage containers (December 2022)
- The 2025 National Packaging Targets (established in 2018 and updated 2020) facilitated by APCO have a target for 100% of packaging being reusable, recyclable or compostable and for 70% of plastic packaging to be recycled or composted.

Single-use plastic items including plastic bags and serviceware are being banned in many states in Australia, which may lead to an increase in bioplastic alternatives. However, in many cases these bans also apply to bioplastic alternatives, including compostable plastics, as these items can cause the same environmental impacts if littered and can be challenging to manage at end-of-life.[73]

All states and territories have legislated bans on the supply of lightweight plastic shopping bags (less than 35 microns thick). In New South Wales, Queensland and Victoria this ban also applies to compostable bags, but they are allowed in other states and territories.[74]

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[70] Australian Department of Environment and Energy (2019) National Waste Policy Action Plan 2019. Available online: https://www.dcceew.gov.au/sites/default/files/documents/national-waste-policy-action-plan-2019.pdf

[71] Australian Department of Climate Change, Energy, Environment and Water (2021) Environment Minister Meeting 1 – Agreed Communique April 15 2021. Available online: https://www.dcceew.gov.au/sites/default/files/documents/emm-1-agreed-communique.pdf and Australian Department of Climate Change, Energy, Environment and Water (2021) Environment Minister Meeting 1 – Agreed Communique October 21 2022. Available online: https://www.dcceew.gov.au/sites/default/files/documents/emm-communique-21-oct-2022.pdf

[72] DAWE (2021) *National Plastics Plan 2021*. Department of Agriculture, Water and the Environment, Canberra, December. CC BY 4.0. Available online: https://www.dcceew.gov.au/sites/default/files/documents/national-plastics-plan-2021.pdf

[73] Victorian Government (n.d) Reducing plastic pollution starts with us: Get ready for the single-use plastics ban. Accessed online at: https://www.vic.gov.au/single-use-plastics

[74] Berry, F., Retamal, M., Kuzhiumparambil, U. and Ralph, P. (2022) *Market and sustainability potential for algal bioplastics in Australia.* UTS Institute for Sustainable Futures and UTS Climate Change Cluster.

Several states and territories have also banned single-use plastic items, including compostable versions. This includes cutlery, straws and stirrers in South Australia from March 2021, Australian Capital Territory from July 2021/22, Western Australia from July 2022, New South Wales from November 2022 and proposed in Victoria from February 2023. In addition, in New South Wales and Western Australia this ban also extends to plates and bowls without lids and in Victoria to plates. Queensland has banned single-use plastic items such as cutlery, straws, stirrers, bowls and plates but allows compostable plastic alternatives if they meet the Australian Standards. South Australia has announced bans on various other single-use plastic items from 2023-25 and has noted that exemptions for compostable plastic alternatives may be required for some of these items.[75] Some Australian Standard certified compostable food ware, such as cups and coffee cups, may be considered for exemptions from these bans due to established organics recycling pathways in South Australia.

**Fragmentable plastics**

Fragmentable plastics (in particular oxo-degradable plastics) are not technically bioplastics but are important to mention as they create confusion for consumers because of the term 'degradable', and as they are sometimes misleadingly labelled as 'biodegradable'. Oxo-degradable plastics contain additives that mean they break down into microplastics and contribute to microplastic pollution if they enter the environment.

These types of plastics are listed to be phased out under the National Waste Policy Action Plan and National Plastic Plan. Oxo-degradable plastics are currently banned in South Australia, Australian Capital Territory and Victoria, in Western Australia from 2023 and Tasmania from 2025 and will be reviewed in New South Wales in 2024. Interviewees noted that it is up to states to define what is covered in their definition of a fragmentable plastic.

[75] Government of South Australia (n.d.). Replace the Waste. Available online: https://www.replacethewaste.sa.gov.au/

## 3.3 Waste management landscape for bioplastics

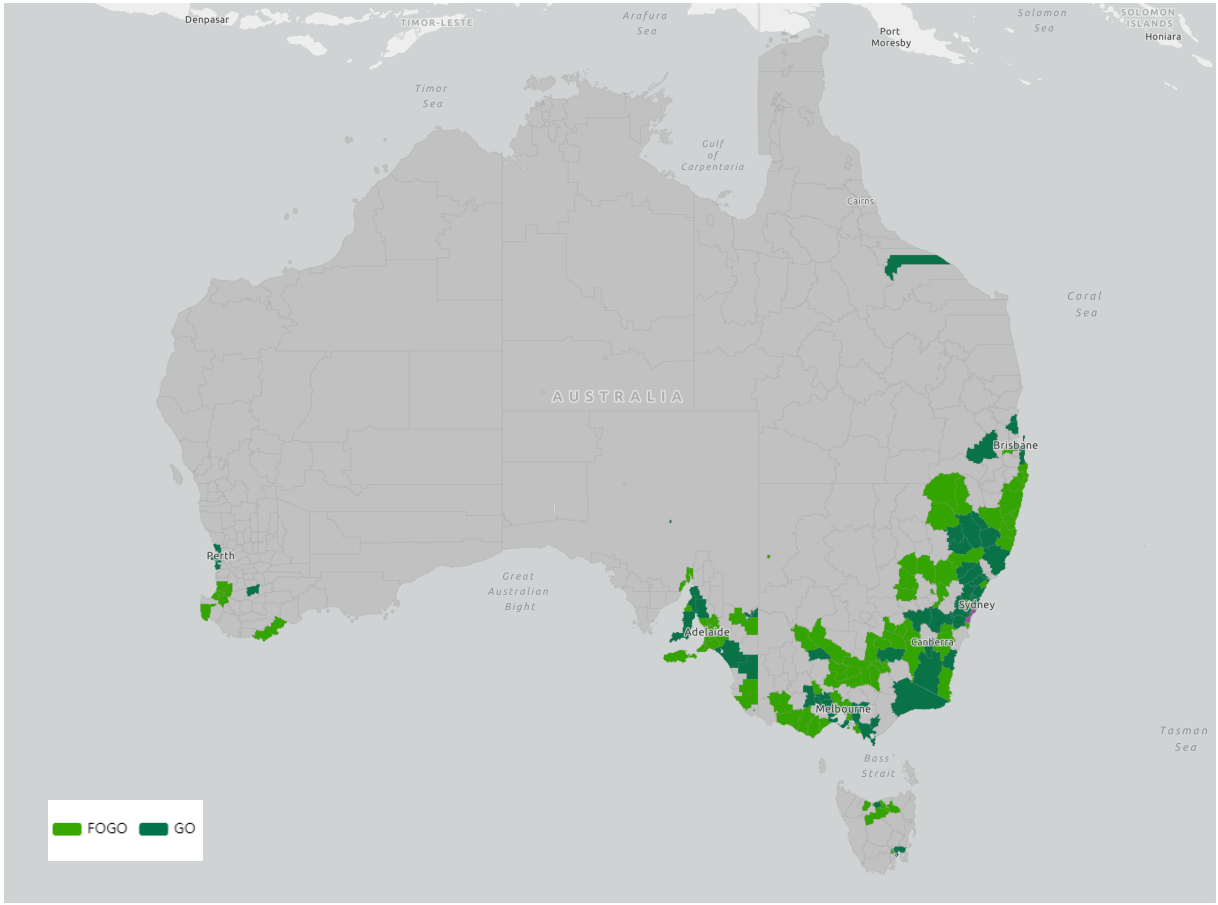
According to the waste hierarchy, the best options for management of bioplastics at end of life are recycling or composting. However, there are some problematic bioplastic products on the market which need to be sent to landfill as they are not suitable for either of these end-of-life pathways. This includes biodegradable and bio-based plastics that are not certified compostable or recyclable.

### Composting of bioplastics

While it is estimated 90% or more of the bioplastics market in Australia are compostable plastics, there is no data available on the rates of composting of compostable plastics in Australia.

Certified compostable plastics need to be processed in suitable composting facilities either at home or in a commercial composting facility to ensure they biodegrade as designed. Most certified compostable plastics are only suitable for industrial scale composting (rather than home composting). Composting of these plastics is only possible if the local waste management service (e.g. local council) has compost processing facilities and provides a separate Food Organics and Garden Organics (FOGO) bin and collection service which accepts compostable plastics.

*Figure 4: Provision of Food and Garden Organics (FOGO) and Garden Organics (GO) services in by local council*[76]




[76] Australian Department Climate Change, Energy, the Environment and Water (n.d.) Food Organics and Garden Organics Interactive Map. Accessed online at: https://experience.arcgis.com/experience/e6b5c78e1dac47f88e7e475ffacfc49b

Only 30% of Australians currently have access to a full FOGO collection service, which is available predominantly in metropolitan areas of New South Wales, Victoria, South Australia, Western Australia and Tasmania.[77] Of those councils which have a FOGO service, some accept certified compostable plastics, but the vast majority do not, except in South Australia. Some councils accept compostable kitchen caddy liners for collection of food waste, but do not accept other types of compostable plastics, even if certified. This is because of the risk of cross-contamination and misidentification[78] and because many compost facilities do not have the capability to properly process compostable plastics.[79] Of the 350 national active compost processing facilities, only around 10-20 accept compostable bioplastics.[80]

In NSW the Environment Protection Authority (EPA) regulations state that only compostable plastic kitchen caddy liners that comply with Australian Standard AS 4736-2006 can be collected in FOGO bins, and other compostable plastics (as well as fibre-based packaging) are prohibited.[81]

Interviewees noted the following challenges to managing compostable plastics through FOGO:

- Many composting facilities (such as in-vessel composting) have shorter durations for processing organic waste than those specified in the compost standard, which means plastics may not adequately biodegrade in these facilities.
- The inclusion of compostable plastics in FOGO can lead to contamination with conventional or fragmentable plastics. This is because of low consumer awareness of compostable plastic certification and logos and confusion about appropriate end-of-life pathways for various bioplastic products. This is partly due to misleading labelling of products, for example products labelled as “biodegradable” which are not compostable.

### Recycling of bioplastics

Mechanical recycling is only suitable for a small share of bioplastics on the market which replicate plastics that are already capable of being recycled (such as bio-PET). Given this, only a small fraction of bioplastics are collected and recycled through either municipal solid waste collection, commercial and industrial waste, or container deposit scheme collection services.[82] In 2019-20, it was estimated only 1.6% of bioplastics were recovered through recycling.[83]

[77] APCO (2021) National Compostable Packaging Strategy. Available online: https://documents.packagingcovenant.org.au/public-documents/National%20Compostable%20Packaging%20Strategy
[78] City of Vincent (2022). FOGO – Frequency asked questions. Available online: https://www.vincent.wa.gov.au/residents/waste-recycling/what-the-fogo/faqs.aspx
[79] MRA (2022) National Recovered Material Specifications for Sorting and Processing Facilities - A Submission to the Department of Agriculture, Water and the Environment. On behalf of National Waste and Recycling Industry Council (NWRIC)
[80] O’Farrell, K., Harney, F., & Chakma, P. (2021). Australian plastics flows and fates study 2019-20: National report, Envisage Works
[81] NSW Environment Protection Agency (n.d.) FOGO information for households. Available online: https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/household-recycling-overview/fogo-information-for-households
[82] Australian Packaging Covenant Organisation (APCO) (2021). Australian Packaging Consumption Recycling Data 2018-19. Available online: https://documents.packagingcovenant.org.au/public-documents/Australian%20Packaging%20Consumption%20And%20Recycling%20Data%202018-19
[83] O’Farrell, K., Harney, F., & Chakma, P. (2021). Australian plastics flows and fates study 2019-20: National report, Envisage Works

## 3.4 Sustainability outcomes of bioplastics in Australia

It is difficult to draw a broad conclusion about the sustainability outcomes of bioplastics use in Australia, owing to the lack of data and as the industry is still comparatively small. In this section we draw on the views of experts from across research, policy making, and industry who were interviewed as part of this project.

Overall interviewees felt that bioplastics had an important role to improve the sustainability of plastics in Australia, but they are only having a positive environmental benefit in specific applications when managed appropriately at end-of-life.

Given the high percentage of bioplastics that take the form of single-use plastics, and that the majority of such plastics end up in landfill, it is likely that the majority of bioplastics used in Australia go to landfill.[84] This also includes compostable plastics, as in most states and territories the waste management systems do not have the capability to collect or process them. Biodegradable and compostable plastics may emit methane if they biodegrade in landfill that is not always captured by landfill gas capture systems and will not be able to be recovered as compost to provide nutrients to soil and improve soil health.

Interviewees also noted that many businesses and consumers want to make sustainable choices but had low awareness and confusion around the performance, environmental impacts and appropriate end-of-life management of bioplastics on the market, including bio-based, biodegradable and compostable plastics (as well as fragmentable plastics).

**Bio-based plastics**

Whilst some estimates suggest that the replacement of fossil-based plastics with bio-based plastics will lower the amount of greenhouse gas emissions during production,[85] the current impact of bio-based plastics on emissions reductions in Australia is unknown and likely to be minor.

Some interviewees felt that the use of bio-based plastics was environmentally preferable to fossil-based alternatives, regardless of how they were managed at end-of-life. However, other interviewees felt that the end-of-life pathways for recovery was the most important sustainability consideration, and whether plastics are bio- or fossil-based was of less importance.

Several interviewees mentioned there were various problematic products on the market which could cause environmental harm, including the risk of contaminating compost. This includes bio-based plastic bags that are not recyclable or compostable, and plastic bags marketed as “biodegradable” which are not compostable.

[84] O’Farrell, K., Harney, F., & Chakma, P. (2021). Australian plastics flows and fates study 2019-20: National report, Envisage Works

[85] Coppola, G., Gaudio, M. T., Lopresto, C. G., Calabro, V., Curcio, S., & Chakraborty, S. (2021). Bioplastic from renewable biomass: a facile solution for a greener environment. *Earth Systems and Environment*, 5(2), 231-251.

**Compostable plastics**

Overall interviewees felt that certified compostable plastics had led to a positive sustainability outcome in Australia. Despite the fact that most compostable plastics are ending up in landfill, interviewees still felt they had an overall environmental benefit when used to aid in food waste recovery, particularly when used as kitchen caddy liners for collection of food waste for FOGO services.

Some interviewees mentioned that compostable plastics that looked similar to conventional plastics had caused issues in recycling facilities of conventional plastics (such as PLA cups which look similar to PET).

For applications such as compostable plastic bags and postage satchels, which are being marketed as an alternative to conventional soft plastics with low recycling rates, there was no consensus if this was an appropriate application, and several interviewees felt that that improving the collection and recycling rates of soft plastics would be more beneficial.

For applications such as garbage bin bags and dog poo bags which would most likely be sent to landfill because of their application and not end up composted, interviewees generally did not feel they had an environmental benefit over conventional plastic alternatives. Interviewees noted there were compostable plastic products on the market that would not lead to a positive sustainability outcome, such as where they replace plastics in applications where established recycling systems exist (such as PET drink bottles).

**South Australia's approach to compostable plastics**

South Australia is the only state or territory in Australia where compostable plastics are widely collected and processed in FOGO services. 100% of Adelaide metro councils (19 councils) and nearly 30% of regional councils (14 councils) have a FOGO service. Australian Standard certified compostable plastics (including packaging and food serviceware) is accepted for collection in all metropolitan FOGO systems and in some regional areas.

The use of compostable plastic kitchen caddy liners has been successful in increasing the rate of food waste collection in South Australia. A 2010 pilot study of residential food waste in South Australia found a 54.5 per cent food waste diversion for kitchen caddy's lined with corn-starch bags compared to 9.31 percent for the unlined caddy.[86] A separate trial was undertaken in 2018 of replacing plastic produce bags in supermarkets with compostable bags, which allowed customers to use the compostable bag to purchase fruit and vegetables and reuse to dispose of food waste for FOGO collection. This led to an increase of food waste collection from households from 0.20 kg of food waste per household per week to 0.60 kilograms per household per week.[87] As of April 2022, Woolworths has introduced these compostable fruit and vegetable bags in all stores across the state.[88]

Interviewees noted that South Australia has had success in composting Australian Standard compostable plastics for several reasons, including a well-established organics recycling industry, and the use of open air windrow composting which has long processing times of approximately 12 weeks that are suitable for compostable plastics. Compost produced in these facilities meets the Australian standards for compost quality (AS 4454 2012 – Australian Standard for composts, soil conditioners and mulches).

Unlike in other states and territories, the rules about what products are allowed in FOGO bins is harmonised across all metropolitan councils.

[86] Zero Waste SA (2010). Valuing our food waste South Australia's Household Food Waste Recycling Pilot Summary Report – 2010. Available online: https://www.greenindustries.sa.gov.au/resources/valuing-our-food-waste-sa-s-household-food-waste-recycling-pilot-2010

[87] City of Holdfast Bay and Green Industries SA (2019). Compostable bag supply via supermarkets pilot. Available online: https://www.greenindustries.sa.gov.au/documents/Holdfast%20Bay%20Compostable%20Bag%20Trial_Project%20Report_Public_2%20June2020.pdf?downloadable=1

[88] Woolworths Group (n.d.) Fruit & Veg Shopping gets even greener as Woolworths rolls out compostable bags in S.A. Accessed online at: https://www.woolworthsgroup.com.au/au/en/media/latest-news/2022/fruit-and-veg-shopping-gets-even-greener-as-woolworths-rolls-out-compostable-bags-in-sa.html

## 3.5 Future applications of bioplastics in Australia

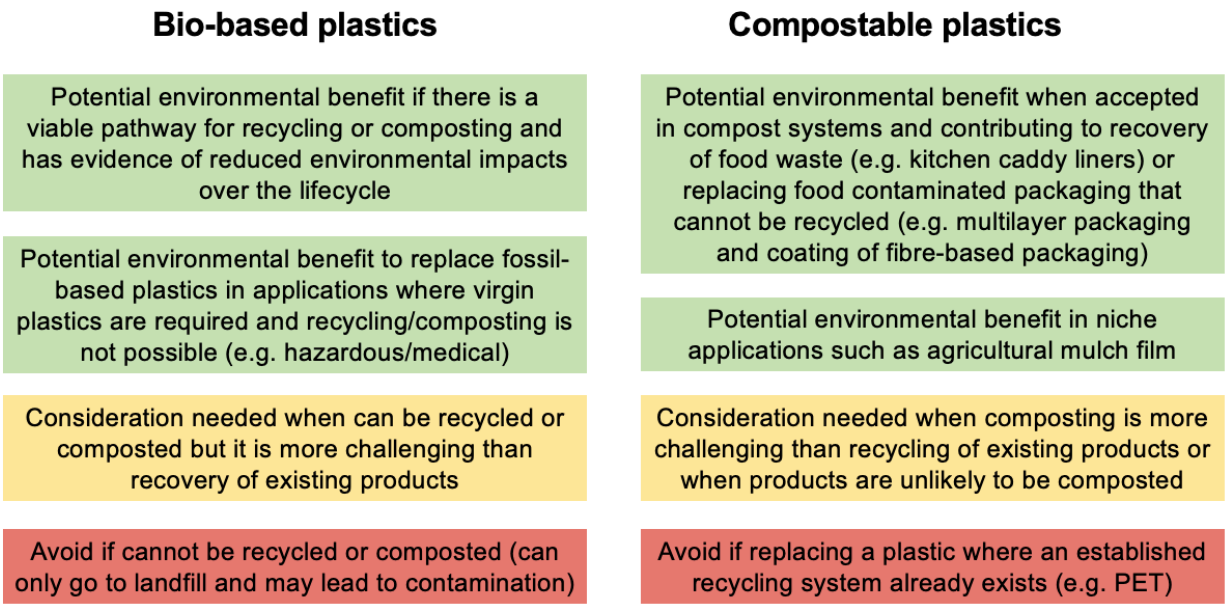
Bioplastics have potential environmental benefits but are not a cure-all for the plastic waste problem. If used in inappropriate applications can have unintended negative consequences. To ensure that any growth in the use of bioplastics in Australia leads to the most sustainable outcomes, interviewees noted that there is a need for careful consideration of the types of bioplastics brought on to the market and appropriate applications.

Interviewees noted the following key principles for the future use of bioplastics:

- Bioplastics need to have a viable pathway for recycling or composting at end-of-life to ensure they contribute to a circular economy. For compostable plastics, this means they need to be certified commercially compostable and be accepted in a local organic waste collection systems or be home compostable.
- Biodegradable products that are not certified compostable do not have a pathway for management at end-of-life and should be avoided.
- Bio-based plastics that cannot be recycled or composted should be avoided (except in niche applications detailed below).
- Careful consideration and specific data are needed to determine the most sustainable option in an application by comparing bioplastic products to other options such as reusable or fibre-based alternatives or conventional plastics from recycled content.

There are applications where bio-based and compostable plastics have a clear rationale for their use and can create positive environmental benefit and others where they should be avoided, summarised in Figure 5. There are many applications where it is unclear if a bio-based or compostable plastic will have an environmental benefit compared to alternatives and further research is required.

*Figure 5: Principles for future applications of bioplastics in Australia*



**Applications for bio-based plastics:**

Bio-based plastics may provide an environmental benefit compared to fossil-based plastics if they have a viable pathway for recycling or composting at end-of-life and if they have evidence of lower environmental impacts over the lifecycle compared to alternatives, which will be determined by the specific feedstock and plastic used.

They can also have a positive benefit in niche applications that need to use virgin plastics (as using recycled content is not possible) in applications where recycling or composting is not possible (such as medical or hazardous waste). Responsibly sourced bioplastics could improve the environmental lifecycle impacts for these types of products compared to fossil-based plastics.

Aside from these applications, bio-based plastics should be avoided if they cannot be recycled or composted as they can only go to landfill and may lead to contamination in the waste management system. Careful consideration is needed to determine the most suitable product if the end-of-life pathway is more challenging than for existing products.

**Applications for compostable plastics:**

The most beneficial future applications of compostable plastics are likely to be when they are used to increase the collection and processing of food waste (such as kitchen caddy liners) and for increasing recovery of food contaminated packaging (such as multilayer packaging and coating of fibre-based packaging). They will also likely have a role in other niche markets such as agricultural mulch film.

Compostable plastics should be avoided if they are replacing a plastic that has an established recycling system, such as PET bottles.

For many applications careful consideration is needed to determine if compostable plastics will have any environmental benefit. For example, if replacing a product that could be recycled (such as soft plastics) or when used in applications where composting is not likely (such as when used as a garbage bag).

### Future capacity to manage compostable plastics through FOGO

- There was a lack of consensus across the interviewees about how likely it would be that there would be widespread collection and composting of compostable plastics through municipal FOGO systems.
- Several interviewees mentioned that improving the recycling rates of soft plastics was more realistic than creating a pathway for composting.
- Many interviewees felt that compostable serviceware (such as cutlery, plates and bowls) would not likely be managed through FOGO systems because of the risk of contamination with non-compostable plastics (unless in closed environments).
- Several interviewees highlighted that a sensible approach would be to agree nationally on a list of plastic items that would make sense to be recovered through composting. The packaging industry can make this shift before expecting commercial composters to begin processing these, to give them assurance. At the same time other interviewees highlighted that some composters are working towards the bigger picture and are happy to manage contamination within the current system in the interim.

# 4. Sustainability claims of bioplastic products in Australia

- Under Australian law, environmental claims should be accurate, able to be substantiated, specific, use plain language, be made for a real benefit and not overstate a benefit.
- A review of 26 single-use bioplastic products from 14 companies found that nearly one third of sustainability claims about bioplastic products were potentially misleading.
- The majority of claims that were potentially misleading related use of vague terminology (such as "eco-friendly") or statements that may mislead consumers on how to dispose of the product at end-of-life (for example not explaining that it needs to be processed in a commercial composting facility).
- Other potentially misleading claims included using the term biodegradable for products which are not compostable, claiming that bioplastic products are not a plastic or will not contribute to the plastic waste problem and claiming to be compostable when not certified to the Australian standards.
- Interviewees noted there are high levels of greenwashing around bioplastic products, particularly bio-based non-compostable products or "biodegradable" products.
- Fragmentable plastics such as oxo-degradable plastics were not a focus on this assessment but were considered highly problematic by interviewees and to be frequently greenwashing consumers.

## 4.1 What is a potentially misleading or false claim about sustainability?

Consumers are becoming more informed about the environmental impacts of their purchasing decisions, but generally rely on product information from companies to make decisions. We undertook a review of sustainability claims made by companies selling bioplastics products to evaluate if there were examples of claims being made that may be potentially misleading to consumers, and to determine if there were cases of greenwashing. Greenwashing refers to the *"act of disseminating disinformation to consumers regarding the environmental practices of a company or the environmental benefits of a product or service."*[89]

### What is the law in Australia?

The Australian Consumer Law (ACL), which is a schedule to the Competition and Consumer Act 2010, applies nationally and states that *"businesses must not mislead or deceive consumers in any way"*. The ACL applies to all forms of marketing, including claims on packaging, labelling and in all mediums of advertising, and it carries serious penalties for businesses that fail to meet these requirements.[90]

The Australian Competition and Consumer Commission (ACCC) produced guidelines for specifically for environmental claims in *2011 – Green marketing and the Australian Consumer Law*.[91] These state that under the law claims should be accurate, able to be substantiated, specific (not unqualified and/or general statements), use plain language, be made for a real benefit and must not overstate a benefit. In addition, they should consider the whole life cycle of a product.

The ACCC produced a factsheet on *Biodegradable, degradable and recyclable claims on plastic bags* in 2010.[92] This states that advertising should be specific to reduce the risk of inadvertently misleading

[89] Baum, L. M. (2012). It's not easy being green… or is it? A content analysis of environmental claims in magazine advertisements from the United States and United Kingdom. *Environmental Communication: A Journal of Nature and Culture*, 6(4), 423-440. https://www.tandfonline.com/doi/full/10.1080/17524032.2012.724022
[90] ACCC (2011). Green marketing and the Australian Consumer Law. Available online: https://www.accc.gov.au/system/files/Green%20marketing%20and%20the%20ACL.pdf
[91] ACCC (2011). Green marketing and the Australian Consumer Law. Available online: https://www.accc.gov.au/system/files/Green%20marketing%20and%20the%20ACL.pdf
[92] ACCC (2010). Biodegradable, degradable and recyclable claims on plastic bags. Available online: https://www.accc.gov.au/system/files/Biodegradable%2C%20degradable%20and%20recyclable%20claims%20on%20plastic%20bags.pdf

consumers and that *"using broad or unqualified statements or vague or ambiguous wording is risky because they may not adequately explain the environmental benefits of your product to your target audience."* It also notes it is important to be able to substantiate claims such as how a plastic will biodegrade.

The ACL has been used specifically in relation to sustainability claims related to bioplastics. These include:

- In 2004 the Federal Court found that Lloyd Brooks Pty Ltd has engaged in false or misleading conduct by misrepresenting the environmental benefits of "Earthstrength" biodegradable plastic bags, following proceedings brought by the ACCC. Problematic claims made on packaging included "even if this bag isn't thrown in the bin it won't end up as litter", "this bag won't contribute to the landfill problem. It will make it disappear". On the company website it was claimed that Earthstrength bags would "compost just like kraft paper bags, sticks and twigs, yard trimmings and food scraps which are quickly broken down" and that they would biodegrade within 28 days.[93]
- In 2018, the ACCC commenced legal action in the Federal Court, alleging that the environmental representations Woolworths made about its "biodegradable and compostable" 'W Select eco' picnic products were false, misleading or deceptive, as consumers would expect the products to biodegrade in a reasonable timeframe. The Federal Court dismissed the ACCC's case in 2019.[94]
- In 2019 the ACCC rejected an application for four certification trademarks for certain biodegradable plastics by OxoPak Pty Ltd.

## What is best practice?

Bioplastic manufacturers, product developers and retailers can provide information on the sustainability of their products, including the feedstocks and their origins, the country of manufacture and options for disposal at end-of-life (e.g. recyclable, industrial or home compostable, or neither).

There is currently no widely recognised or consistent labelling or certification system for the whole bioplastic product lifecycle. The Australasian Bioplastics Association (ABA) provides verification to the standards for compostable plastics, however it is not mandatory or consistently applied across all compostable products.

APCO states that if a product is labelled as compostable, it is vital that it is certified to the Australian standards. APCO recommends that compostable packaging products have clear statements on the end-of-life options so as not to mislead consumers, and clearly state whether packaging is certified for industrial or home composting. APCO states that *"it is vital if using compostable plastics to provide information about disposal, account for waste collection variations at a local level and explain where consumers can find further information."*[95] If not certified compostable, bioplastic products should clearly state whether collection systems are suitable (such as recycling) or unsuitable (such as littering to the environment).

International standard AS/NZS ISO 14021:2016 *Environmental labels and declarations—self-declared environmental claims (type II environmental labelling)* specifies requirements for environmental claims, including statements, symbols and graphics. It further describes selected terms commonly used in environmental claims and gives qualifications for their use.[96] ISO 14067 provides general guidelines on how to use carbon footprint claims correctly.[97] While recommended by APCO, the ISO 14000 standards are not easy to comprehend and require expert interpretation to use them proficiently.[98]

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[93] ACCC (2004). Environmental bag claims 'Misleading'. Available online: https://www.accc.gov.au/media-release/environmental-bag-claims-misleading
[94] ACCC (2019). Court dismisses ACCC's case against Woolworths over disposable picnic products. Available online: https://www.accc.gov.au/media-release/court-dismisses-acccs-case-against-woolworths-over-disposable-picnic-products
[95] APCO (2020). *Considerations for Compostable Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Considerations%20for%20Compostable%20Packaging
[96] ISO (2016). ISO 14021: 2016, Environmental labels and declarations—Self-declared environmental claims (Type II environmental labelling). Available online at: https://www.iso.org/standard/66652.html
[97] European Bioplastics (2019) Bioplastics - Industry standards & labels Fact Sheet. Available online: https://docs.european-bioplastics.org/publications/fs/EUBP_FS_Standards.pdf
[98] APEC Committee on Trade and Investment (2003) Best Practices of ISO 14021. Available online: https://www.apec.org/Publications/2003/02/Best-Practices-of-International-Organization-for-Standardization-ISO-14021-Self-Declared-Environment

## 4.1 Review of sustainability claims of bioplastic products

### Method

To understand the extent to which claims about bioplastics are potentially misleading to consumers, a review was undertaken sustainability claims by companies selling bioplastic products in Australia.

We reviewed sustainability claims for 11 types of products. The products were first narrowed down to **single-use plastic products**, as these are the most relevant to the general public. The product types were selected based on the most widely available bioplastic products in Australia (bin liners, retail bags, takeaway coffee cups and lids, food serviceware)[99] and bioplastic products which may replace the conventional plastic version of products targeted in regulations as problematic (e.g. EPS loose fill). In addition, coffee pods and balloons were included because of public media attention on the sustainability of these products.

We reviewed a total of 26 products from 14 companies (a combination of large and small national and international). Most companies did not disclose where their products were made, except for small number that stated they were manufactured in Australia.

Individual products were selected for review as they either claimed to be bio-based, or to be biodegradable or compostable, or both. The majority of the products were bio-based (23 of 26 products, with 2 not providing this information and one product made from conventional plastics). The majority of products claimed to be compostable and/or biodegradable (24 out of 26 products). Note that as this review was focused on bioplastics, we did not include fragmentable or degradable products.

*Table 2: Product types*

| Product type | Number of products |
|---|---|
| **Plastic bag - Bin liner** | 5 |
| **Plastic bag - Food waste bin liner** | 3 |
| **Plastic bag - Retail bag** | 3 |
| **Serviceware - Coffee cups** | 2 |
| **Serviceware - Coffee cup lids** | 1 |
| **Serviceware - Containers** | 2 |
| **Serviceware - Cutlery** | 1 |
| **Coffee pods** | 2 |
| **Postage bags** | 3 |
| **Loose packing fill** | 2 |
| **Balloons** | 2 |

The publicly available information for each of the products sold by these companies was then reviewed to identify sustainability ***claims*** (a statement relating to the sustainability impact of the product). This included the product packaging, the product page on the company website and any sustainability or FAQ pages. Very few of the companies had a clear sustainability page on the website or corporate sustainability report providing further evidence to substantiate claims. If required the ABA website was also searched to check for certification to the Australian compostable plastics standards. 158 individual sustainability claims were identified. Each claim was analysed and categorised as acceptable, potentially misleading or unable to be verified.

[99] Australian Packaging Covenant Organisation (APCO) (2020). *Considerations for Compostable Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Considerations%20for%20Compostable%20Packaging

## Results

### Nearly 1/3 of sustainability claims about bioplastic products were potentially misleading

Of the 158 sustainability claims identified, nearly 1/3 (29%) of claims were potentially misleading, and nearly 1/4 (24%) were unable to be verified. Less than half (47%) were categorised as acceptable (not likely to mislead consumers). The majority of claims that were potentially misleading related use of vague terminology or statements that may mislead consumers on correct end-of-life disposal of the product.

Claims that were considered potentially misleading included:

- Statements that may mislead or confuse consumers on how to dispose of products at end-of-life (9 products from 7 companies)
- Claiming to be biodegradable (products that are not compostable) (3 products from 3 companies)
- Use of vague terminology about the environmental benefits of the product (17 products from 9 companies)
- Use of language that implies the product is not a plastic and won't create waste (8 products from 4 companies)
- Claims about environmental benefits of the product which are unsubstantiated (6 products from 3 companies)
- Claiming to be compostable but no statement about meeting the standards (3 products from 3 companies)
- Claiming to be home compostable when the product is only certified to the commercial compost standards (3 products from 2 companies)

These are explained in further detail below:

### Half of the companies made statements that may mislead or confuse consumers on how to dispose of products at end-of-life

If a product is incorrectly disposed of, this could negate any potential benefit of the product or cause environmental harm, such as the contamination of food waste for organics recycling. Several of the products implied that their products would be accepted in all FOGO systems, when many composters do not accept compostable plastics. Some products used language which implied that they would break down in a home compost or garden when they are not certified for this.

Two plastic bags which are not compostable are a green colour, which may confuse the consumer that they are compostable, as they look similar to green coloured certified compostable plastic bags. During the interviews this was mentioned as a problem currently causing contamination in FOGO systems. One of these products is neither compostable or recyclable which is highly problematic as there is no end-of-life pathway for the product.

Several companies used symbols for "biodegradable" or "compostable" that are not the labels of the Australian standards. This could mislead consumers that these products are certified to a standard that does not exist, and creates confusion with the official compost standard logos within the public.

Several companies had clear communication about how to dispose of their products. APCO states that *"it is vital if using compostable plastics to provide information about disposal, account for waste collection variations at a local level and explain where consumers can find further information."*[100] Three of the companies with certified commercially compostable products provided detailed information to consumers about the correct disposal method for their products, recommending they be disposed of to an industrial composting facility and reminding customers to check their local council waste service provided a FOGO

[100] Australian Packaging Covenant Organisation (APCO) (2020). *Considerations for Compostable Plastic Packaging.* Available online: https://documents.packagingcovenant.org.au/public-documents/Considerations%20for%20Compostable%20Packaging

(food and garden organics) collection service that accepts compostable plastics. Two companies provided a service to take back the bioplastic products for the company to compost.

**Some products use the term biodegradable for products which are not compostable**

Three products (a plastic bag and two balloons) from three companies claim that their products are biodegradable but not compostable. This is problematic because the term 'biodegradable' does not have a timeframe under which the product will break down, which may mislead consumers to think that the product will biodegrade in a short timeframe, when it will likely remain in landfill or the environment for many years. An Australian study which composted 'biodegradable' latex balloons found that they didn't meaningfully degrade in 16 weeks and will continue to pose a threat to wildlife.[101]

**More than half of the companies used vague terminology about the environmental benefits of the product**

The ACCC suggests that under Australian Consumer Law, broad or unqualified claims can be risky as they are ambiguous and do not explain any specific environmental benefit. Vague terminology such as this can potentially mislead consumers into thinking that the product causes no harm to the environment in its production, usage and disposal.[102]

Terms used by the companies include "green", "eco-friendly", "environmentally friendly", "earth friendly", "earth loving", "sustainable" and "safe".

**Some companies claim that their products are not a plastic or will not contribute to the plastic waste problem**

Companies used terms such as "plastic-free", "designed to replace plastic", "alternative to plastic", "continue to experience the same benefits of plastic" and "behave just like plastic". This is potentially misleading to consumers as these products are still a plastic and may have similar environmental impacts to conventional plastics if not managed appropriately. Some companies used wording that implies to consumers that their compostable products will not create waste or will not have an environmental impact if they enter the environment.

**Some companies made claims about environmental benefits of the product which are unsubstantiated**

Three companies made claims that their products were either carbon neutral and/or had a lower carbon footprint than conventional plastic alternatives, but did not provide any evidence.

The companies disclosed very limited information about the feedstocks of their products. 23 of the 26 products claimed to be bio-based, but only half of the companies disclosed the polymer name (e.g. PLA, PBAT) or the feedstock crop (e.g. corn). Many of the companies used general terms such as "plant-based", "renewable" or "sustainable" materials. No company clearly explained the type of feedstock, where it was grown or produced and where and how the product was manufactured.

[101] Gilmour, M. & Lavers, J. (2020). We composted 'biodegradable' balloons. Here's what we found after 16 weeks. The Conversation. Available online: https://theconversation.com/we-composted-biodegradable-balloons-heres-what-we-found-after-16-weeks-138731

[102] ACCC (2011). Green marketing and the Australian Consumer Law. Available online: https://www.accc.gov.au/system/files/Green%20marketing%20and%20the%20ACL.pdf

**Not all products that claim to be compostable are certified to the standards**

APCO states that if a product is labelled as compostable, it should be certified to the Australian standards.

Of the 21 products which claimed to be compostable, 18 of the products claimed certification to the commercial compost standard (AS 4736) and 7 to the home compost standard (AS 5810).[103]

There were three products from three companies that claimed to be compostable but did not state that they met any Australian standard (one stated that they met a European standards). This means that they may not be suitable for composting in commercial or home compost systems in Australia as they may not pass the standards for biodegradation, ecotoxicity and the worm test.

There were also three products from two companies that claimed that their product could be home composted when the product is only certified to the commercial compost standards, which creates a risk they could contaminate home composts or gardens as they may not break down in the required timeframe.

Some of the products clearly displayed the seedling logo on their product or website, however many did not. Displaying this logo on compostable products may help to increase consumer awareness to look for products that are certified to the compost standards if they are seeking a compostable product.

**Interviewee perspectives on potentially misleading claims**

The majority of stakeholders interviewed for this study felt that there were high levels of greenwashing surrounding bioplastics and conventional plastic alternatives in Australia. Key issues that were mentioned by interviewees were:

- Fragmentable plastics such as oxo-degradable plastics (although not technically bioplastics) were mentioned as highly problematic and frequently greenwashing consumers by claiming to be environmentally friendly.
- Bio-based plastics that are not suitable for either composting or recycling were considered problematic and likely to mislead consumers that they could be composted, leading to a high risk for contamination of FOGO.
- Biodegradable plastics that are not certified compostable are also likely to mislead consumers that they could be composted or that they will break down within a short time however they are disposed of.
- In many cases consumers feel that they are making the right environmental choice, but can be easily mislead because of confusion about terminology such as bio-based, biodegradable and compostable, and low awareness of compost systems and standards.

[103] Note that we checked the list of certificates for products verified to the compost standards on the ABA website (see https://bioplastics.org.au/certification/who-is-certified-in-aus-nz/) but not every product could be confirmed because in some cases the trade name of the bioplastic polymer is certified, which is not always provided by the company we reviewed. We assumed companies were verified to the standards if they stated this, but this may not always be the case.

# 5. Ensuring sustainable outcomes of bioplastics in Australia

Any increase in the use of bioplastics needs to be considered alongside broader system changes to improve the environmental impacts of plastics as part of a broader transition to a circular economy, and specifically strategies to reduce the use of single-use plastics.

To ensure sustainable outcomes in the use of bioplastics, strategies are required at all stages of the lifecycle, including in how bioplastics are produced, sold, used and disposed of at end-of-life. There is a need to ensure responsible sourcing of feedstocks, determine what applications they are most suitable to be used in and ensure the appropriate end-of-life management – to avoid pollution, increase recovery rates and reduce contamination in organics and mechanical recycling steams.

The following section outlines a range of strategies that could help ensure that any growth in the use of bioplastics in Australia leads to sustainable outcomes. These are drawn from the literature reviewed in previous chapters, the perspectives of interviewees and the findings from the review of sustainability claims. Further work is required to assess the most effective and suitable mechanisms to support these strategies, and there is a need to assess viable policy responses and regulatory action.

Potential strategies include:

- Industry or regulatory action to **phase out the sale of problematic bioplastic products** that do not have a viable pathway for composting or recycling at end-of-life (except in niche applications).
- **Improving labelling to reduce confusion** for businesses, consumers and recyclers, such as:
  - Ensuring that products only use the term compostable if they are certified to the Australian Standards, and avoiding the use of the term biodegradable for products that are not certified compostable. This could include mandating certification for products labelled as compostable (see box section on following page).
  - Consistent and standardised labelling of certified compostable products through increasing the use of the official seedling logos for the Australian Standards, and avoiding the use of other symbols or logos for compostability. To help achieve this, more detailed guidance on labelling of compostable products could be developed with industry.
  - Providing clear information to consumers on the appropriate way to dispose of a plastic. The Australasian Recycling Label provides consumers with clear information on whether packaging is recyclable, conditionally recyclable or not recyclable (needs to go to landfill). This label can be more broadly applied including on bioplastic products that are not compostable.
  - The development or adoption of one (or more) reputable standards for the lifecycle environmental impacts and responsible sourcing of bio-based plastics (see box section on following page).
- **Reducing potentially misleading claims and greenwashing** around bioplastics and plastics more broadly, through stronger enforcement of the Australian Consumer Law. The ACCC's new program of work on greenwashing may support this; other opportunities could be explored.
- **Increasing business and consumer awareness** about the performance, environmental impacts, standards, labelling and appropriate end-of-life management of bioplastics on the market. The introduction of laws to phase out the most problematic and unnecessary single use plastics by all states and territories provides an opportunity and a need to engage businesses and consumers about bioplastics.
- **Improving end-of-life management** options for compostable plastics through increasing harmonisation within and/or across jurisdictions on which compostable plastics are accepted in organics recycling services. The Environment Ministers' agreement on a shared agenda to *"design out waste and pollution, keep materials in use and foster markets to achieve a circular economy by 2030"* should include a specific focus on bioplastics and organics recycling.
- **Further research** to compare and determine the sustainability of bioplastics and other alternatives to conventional plastics.

### International examples of policies for clear labelling of bioplastics

- In France products and plastics that can only be industrially composted cannot be labelled as "compostable" (they can only be labelled this if home compostable). Home and industrial compostable products need to be labelled with the words "do not throw into the environment". Terms such as "biodegradable" and "environmentally friendly" are not permitted on products or packaging.[104]
- In Belgium the term "biodegradable" is not permitted.[105]
- In California the terms "compostable" or "home compostable" can only be used on products if they meet one the relevant standards for composting.[106]

### Standards for the bioplastic lifecycle

There is a lack of information provided by producers and retailers of bioplastic products in Australia about the feedstocks of their products and any associated impacts. There are a range of sustainability standards or certification schemes specifically for bio-based plastic feedstocks. The use of these standards could provide substantiate the claims of bio-based plastic products, provide transparency to consumers and combat greenwashing.

- **Roundtable on Sustainable Biomaterials (RSB) Global Advanced Products Certification** enables the certification of non-energy bio-based feedstocks products, including plastics and packaging. RSB certifies materials made from primary biomass and wastes/residues and the end products.[107]
- **Bioplastic Feedstock Alliance Methodology for Assessment of Bioplastic Feedstocks** enables brands and producers to rate potential bioplastic feedstock solutions based on sustainability criteria. This allows the user to (i) compare different bioplastic feedstocks and different production systems across key criteria in terms of environmental and social sustainability; (ii) understand what kinds of changes to production systems would result in more sustainable production; and (iii) identify opportunities for management programs that would track progress and improve sustainability over time.[108]
- **European standard on bio-based products** *(EN 16935:2017 Bio-based products - Requirements for Business-to-Consumer communication and claims)* requires claims about bio-based products to provide the minimum bio-based content, recommended end of life of the product and suggests to avoid the use of the prefix 'bio-' without additional information. It also suggests additional information such the sustainability of biomass could be provided.[109]
- There are also various standards for production and sourcing of specific crops, including sugarcane, soy, tree-based products and palm oil which could be relevant for bio-based plastics.[110]

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[104] Rethink Plastic Alliance (2021). Assessment of European countries' transposition of the Single Use Plastics Directive. Available online: https://rethinkplasticalliance.eu/wp-content/uploads/2021/06/SUP-Assessment-Design-final.pdf
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