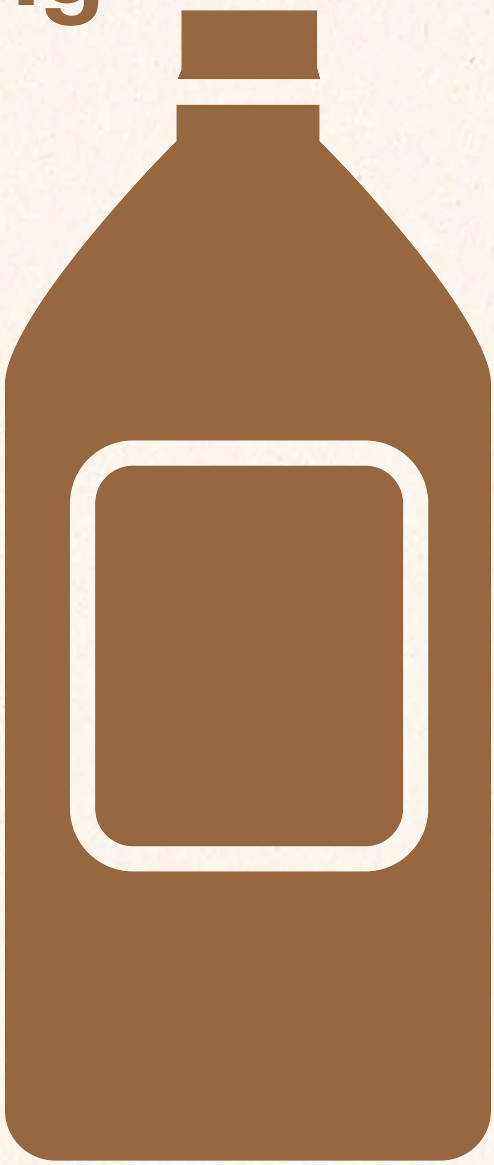
Design Smart Material Guide No.9

Australian Packaging Covenant

# Compostable Plastic Packaging



Australian Packaging Covenant

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# Purpose of this Guide

**This Design Smart Material Guide for compostable plastic packaging is the ninth in a series of ten guides published by the Australian Packaging Covenant (APC).**

It considers the use of compostable plastic packaging intended for disposal to either commercial or home composting, and manufactured from either renewable feedstocks (e.g. sugar from corn) or fossil hydrocarbon-based chemicals.

The purpose of this guide is to help you improve the environmental performance of your packaging system, without compromising on cost or functionality. It provides a 'checklist' of sustainability issues to keep in mind when designing and/or specifying your next compostable plastic-based package. The Guide will also support your packaging reviews against the Sustainable Packaging Guidelines (SPG), as required by the APC. To facilitate this, the design considerations are grouped under the four principles of the guidelines.

There are many different types of compostable polymer materials now available on the market. These polymers have a diverse range of raw material inputs (from 100% renewable plant-based, to 100% non-renewable fossil hydrocarbon-based) and related manufacturing processes. They also have different degradation characteristics in potential end-of-life environments. Because of their diversity this guide aims to provide you with the questions you need to ask, often of your potential suppliers, rather than detailed answers on polymer selection for a specific application.

Non-compostable polymers, such as polyethylene terephthalate (PET) and polyethylene (PE), can now be made from renewable resources. If you are considering using a conventional polymer that is made from plant-based raw materials, then please refer to the Rigid Plastic and Flexible Plastic guides in this series for more on the design considerations relating to non-compostable plastic polymers.

# Purpose of this Guide

The information contained in this guide is broadly based on 'life cycle thinking', which considers the sustainability impacts of packaging throughout its supply chain, during use, and at end-of-life. It considers the impacts of the whole packaging system, including primary, secondary and tertiary packaging[1], as well as its performance in delivering the product to the consumer.

The primary environmental design objective for packaging is to protect the product inside it, in order to minimise product waste. Packaging formats and materials need to be selected to best achieve this objective, while reducing the environmental impact of the packaging itself across its entire life cycle, including raw material sourcing, manufacture and conversion, use, and end-of-life impacts.

You are probably designing your packaging to fulfil a particular function, rather than an intrinsic need to use a compostable plastic as the primary packaging material. If this is the case, then we encourage you to read the first of the guides, which provides information on the comparative environmental and functional performance of the many different packaging material types that are available. Maybe there is another packaging format that will better fulfil your need to optimise cost, function, and environmental performance. Before specifying a compostable plastic material confirm that degradability is a desirable characteristic for your particular application, either because it will add to the functionality of the packaging or assist in its end-of-life outcome.

[1]See the Introductory Guide in this series for more detail and definitions on packaging system terminology.

Disclaimer

This document is provided as a general guide only. Aspects relating to material extraction, material processing, transport systems and consumption patterns will impact the environmental, financial and functional performance of packaging systems. Appropriately detailed analyses of specific packaging systems are necessary to confirm the benefits of any of the design considerations outlined in this guide.

The development of this guide has largely relied on the sources listed in the Useful Further Reading section, as well as targeted consultation to confirm design aspects for the Australian context. The APC will endeavour to review the content of these guides on a regular basis to ensure currency and alignment to industry developments.

If you have any questions about theses guides, would like to make comments regarding the guidance provided, or just like to better understand sustainable packaging assessments in general, please contact the APC at apc@packagingcovenant.org.au.

# Terms Used in this Guide

The key terms used in this guide are:

### Compostable

This is a specific term which describes a polymer that meets the requirements of the Australian Standards AS 4736–2006 (the similar European standard is EN 13432) or AS 5810–2010, and is also independently certified as meeting the respective performance standards. For packaging to be called compostable it has to biologically decompose and disintegrate in a composting system (under either commercial or home composting conditions) to set levels within a defined period of time. The compost must also meet specific quality criteria relating to eco-toxicity and other characteristics. It is recommended that you review the Australian Standards if you are considering using a compostable plastic.

### Biodegradable

This is a fairly generic term which indicates that the polymer is biologically available for microbial decomposition. This term is often used in a way that is non-specific in terms of breakdown products, degradation time/extent, and end environments. In this guide the term ‘compostable’ (with reference to the Australian Standards) has been used in preference to ‘biodegradable’, as it provides specific and verifiable information on the biodegradability of a given polymer, in a specified end environment.

### Degradable

This is a term used in this guide for polymers which are designed to degrade to an unspecified extent, usually in an unspecified time and in an unspecified end environment.

Associated with the word degradable are terms such as ‘oxo-degradable’ or ‘oxo-biodegradable’. These terms are used to describe conventional polymers (usually polyethylene or polypropylene) that have additives incorporated into the polymer at low rates (2-3%) to provide highly accelerated degradation of the plastic. This term is often used in a non-specific way in terms of breakdown products, degradation time/extent, and appropriate end environments.

# The Life Cycle of Compostable Plastic Packaging

**While you are probably aiming to reduce the overall life cycle impacts of your packaging, you are likely to be choosing a compostable polymer because you want to reduce its environmental impacts at end-of-life.**

It is critical to ensure that the packaging is designed to be compatible with the intended disposal or recovery system. Consumers also need to understand how to correctly dispose of the compostable plastic packaging at end-of-life.

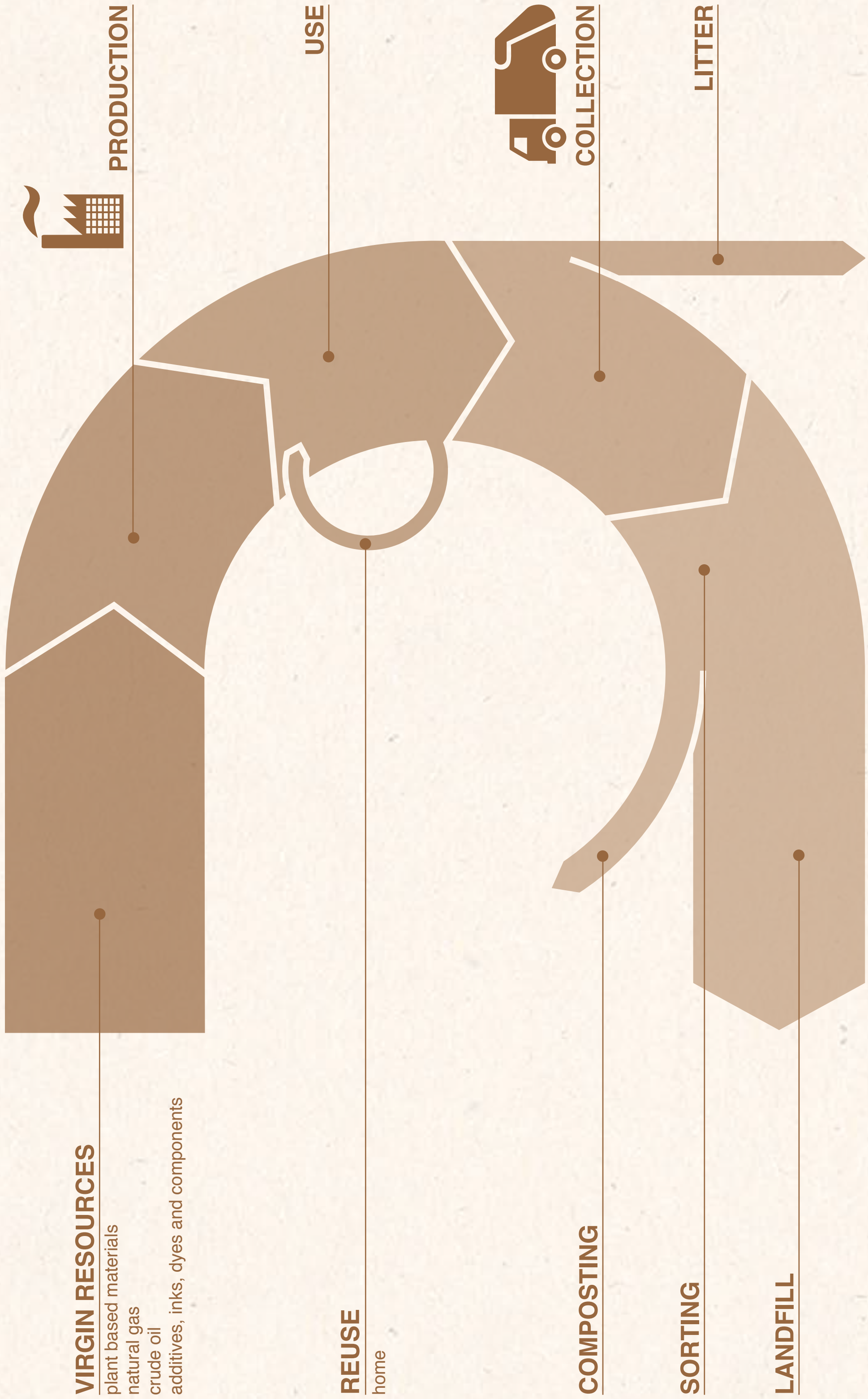
Of course, the environmental impacts of compostable polymers do need to be considered over the entire life cycle, as they do for any other packaging material or format. Design aspects across the full life cycle of compostable polymers are considered in this guide.

# The Life Cycle of Compostable Plastic Packaging

Figure 1

## Life cycle of compostable plastic packaging

Adapted from diagrams developed by GreenBlue (2009)



# The Life Cycle of Compostable Plastic Packaging

## Manufacturing compostable plastics

Compostable plastics are manufactured from either renewable (plant-based) raw materials or fossil hydrocarbons.

Table 1

### Types of compostable polymers (current at May 2013

| Type of Polymer | Trade Names and Manufacturer (examples only) | Raw Materials |
|---|---|---|
| **Biodegradable starch-based polymers** | Mater-Bi™ (Novamont) | Starch from corn, potato or wheat, blended with biodegradable polyesters (see below). |
| | Cardia Compostable B-F™ (Cardia Bioplastics) | Starch from corn, blended with biodegradable polyesters (see below). |
| **Biodegradable and water soluble starch-based polymers** | Plantic (Plantic Technologies) | Starch from corn. |
| **Biodegradable cellulose-based polymers** | NatureFlex™ (Innovia Films) | Wood fibre from managed plantations. |
| **Biodegradable polyes ters** | Polylactic acid (PLA) - Ingeo® (Nature Works LLC) | Lactic acid produced from corn. |
| | Aliphatic aromatic copolyester (AAC) – ecoflex™, ecovio™ (BASF) | Crude oil or natural gas. |

Source: Adapted from PACIA (2008) – Degradable polymers in product design

## Recovery of compostable plastics

Depending on the polymer used, compostable packaging could be recovered through a home composting system or a commercial or municipal composting system. The only polymers that are likely to biodegrade completely and safely in one of these recovery systems are those that have been certified against a recognised composting standard.

## Compostable plastics in landfill

As the likely end-of-life fate of most compostable plastics at present is landfill, it is worth discussing the landfill-related impacts of compostable plastics in more detail. This is particularly important as the anaerobic decomposition (under oxygen-free conditions) of organic materials in landfill results in the generation of methane, which is a strong greenhouse gas if released to the atmosphere.

The level of decomposition of compostable plastics in landfill (under oxygen-free/ anaerobic conditions) will be determined by the level of moisture in each landfill. A number of larger metropolitan landfills in Australia are now operated as 'bio-reactors', where water is circulated through the landfill to maintain moisture levels high enough to support anaerobic processes, so breakdown of compostable plastics is more likely. Many other landfills do not manage moisture levels, so levels are likely to be too low to support significant anaerobic breakdown of the plastics. In these cases longer term sequestration of compostable plastics, without biodegradation, is more likely.

# The Life Cycle of Compostable Plastic Packaging

A proportion of compostable packaging will decompose in landfill to form methane, however this will generally occur in larger landfills, which also tend to have much more comprehensive and sophisticated landfill biogas (i.e. methane) capture and combustion systems in place. In addition, relative to all the other organics disposed to landfill, the climate change implications of compostable plastics in landfill are not significant. It is still worth noting that the disposal of compostable plastics to landfill can have this unintended environmental consequence.

## In favour

**Life Cycle Related Considerations in Favour of Compostable Plastic Packaging**

- Plastics made using renewable resources consume less non-renewable natural gas and crude oil resources than conventional plastics.
- In general, life cycle studies of the use of plastics manufactured from renewable resources find they reduce the consumption of non-renewable energy compared with conventional polymers. This is on a mass basis, and must be adjusted for the relative quantities of a polymer required in any specific packaging application.
- In general, life cycle studies comparing the use of plastics manufactured from renewable resources find they have lower greenhouse gas emissions than conventional polymers. However, this is dependent on the specific source of the plant material, and is on a mass basis, so must be adjusted for the relative quantities of the polymer required in any specific packaging application.
- ‘Compostable’ packaging is considered compostable if certified to AS 4736–2006 or AS 5810–2010, and this is independently verified. From a life cycle perspective, this is down-cycling the material, however composting does enable the recovery of a proportion of the biological nutrient value embodied in the material. Composting is an approach that should be considered when other forms of recycling are not available for the given application and market. For example for rigid containers that could be made from PET, in a market where PET recycling is well established, recycling may be the preferred option. However, for flexible packaging not collected for recycling, composting may be the preferred option.
- The litter-related impacts of compostable packaging are likely to be lower than for functionally equivalent non-compostable polymers; however the packaging fragments that result from partial degradation may also have environmental impacts and these impacts need to be considered. Great care should be taken to avoid the perception that degradability provides consumers with a license to litter.
- Compostable plastic bags can be used to facilitate the source segregation and recovery of food organics from residential and commercial sectors.
- Plastic packaging (in general) has high strength-to-weight ratios, and can provide excellent packaging-to-product weight ratios.

# The Life Cycle of Compostable Plastic Packaging

## Against

**Life Cycle Related Considerations Against Compostable Plastic Packaging**

- The use of compostable polymers in packaging formats that have established recycling systems (e.g. bottles) are likely to result in contamination of the recovered plastics, particularly if consumers cannot readily tell the difference between the compostable and non-compostable polymer types.
- In general, life cycle studies of plastics manufactured from renewable resources find they may have higher impacts than conventional polymers on water systems and ozone depletion (mostly related to the plant cultivation). This is on a mass basis, and must be adjusted for the relative quantities of a polymer required in any specific packaging application.
- Packaging certified as compostable to AS 4736–2006 will not necessarily compost at every commercial composting facility, as not all facilities operate at an appropriate level to cope with these materials. Loose packaging, even if certified to AS 4736–2006, will not be accepted by commercial composters. Composting of compostable packaging is a viable end-of-life option only in situations where the householder is involved in source separation and collects clearly identified certified compostable packaging into composter-endorsed and easily identifiable collection bags, which are also compostable. This is a council-by-council proposition, depending on the availability of suitable composting facilities to each local government area.
- Less than half of Australian households are able to or interested in actively composting at home. For the households that do compost organics, plastics certified to the home composting standard will probably decompose in a reasonable length of time. However, the maintenance of the required conditions is a necessary assumption, as the compost heap may not be in the right climate or of sufficient volume to maintain the required temperature of 20–30 °C, and the moisture content of the compost may not be sufficient to support microbial activity. It is possible that home-based composting will often fail to achieve the heat or moisture levels to trigger biodegradation.
- Compostable plastics, if disposed to landfill with sufficient moisture levels, will probably decompose anaerobically. This will result in the generation of methane, which is a strong greenhouse gas if released to the atmosphere.
- Compostable plastic packaging is not collected in most kerbside organics collection systems, or other recycling systems, in Australia.
- Compostable plastics are more likely to be susceptible to degradation by light, and may not be as water resistant as conventional polymers.
- Compostable plastics can be prone to microbial attack if the conditions are suitable. The physical properties, strength and densities of compostable plastics are different to that of conventional plastics; therefore their suitability for a given application must be assessed against the specified packaging performance requirements to determine their feasibility.
- Some compostable plastics have a higher density and/or lower material strength, than comparable conventional polymers. For this reason, some compostable plastics tend to use more material to fulfil the same packaging application.
- Plastics manufactured from renewable resources generate impacts associated with agriculture, e.g. land clearing, fertiliser and pesticide use.

# Design Considerations for Compostable Plastic Packaging

Packaging design should be guided by the resource efficiency design hierarchy[1].

## The hierarchy of preferred packaging design changes is: avoid, minimise, reuse, recycle, recover (energy) and dispose.

The robustness of this general hierarchy is backed by a very significant body of evidence, based on packaging life cycle assessments (LCAs).

It should be noted that compostable plastics are generally designed for a single use, material which runs counter to the goal of keeping materials in the system for use in subsequent applications.

Embedded across the resource efficiency design hierarchy are the requirements to maintain or improve the packaging system functionality (fitness for purpose), and to minimise product losses. The environmental impacts associated with the packaged product are usually much greater than the packaging itself. Don't compromise functional performance (e.g. through down-gauging) to reduce the environmental impacts of the packaging, if it could lead to greater overall environmental impacts due to product loss and wastage.

## Why use compostable packaging?

Compostable packaging has fairly specific reasons for selection in particular applications:

- Packaging that is more likely (or intended) to end up in organics recovery/composting systems, and would contaminate the recovered organics, if the polymer is not compostable. Examples may include fast food packaging and plastic wrap on fresh produce. This type of packaging (typically films) is also more likely to be contaminated with food residue, and therefore less likely to be recovered for recycling. Clear labelling to consumers is particularly important in these types of applications.
- Plastic bags that can be used as bin liners to assist householders to divert food organics into organics recovery/composting systems. Kerbside food organics recovery systems aren't common in Australia at present but this is expected to change significantly in the next 3–5 years.

[1]The resource efficiency design hierarchy is also often referred to as the waste hierarchy.

# Design Considerations for Compostable Plastic Packaging

## Compostable polymer design and material selection considerations

So what are the key design and material selection criteria you should have in mind for your packaging? The key aspects (not necessarily in order of importance) are:

- Do you need to use a compostable polymer? If your packaging is unlikely to be recovered through a composting system (either commercial or home-based), then selecting a compostable polymer may be of little benefit. Most packaging film in Australia is currently disposed to landfill, with a small (but growing) amount recycled. Compostable polymers provide no benefit for either of these end-of-life fates.
- Ensure that the functional performance of the packaging is maintained with any switch to a compostable polymer.
- Light-weight the packaging as much as possible. Some compostable polymers require more material than conventional polymers to achieve the same level of functional performance. If in doubt about the benefits of a compostable material for your particular application then the preferred approach is to minimise material use. This may require the selection of a conventional polymer instead of a compostable polymer.
- Clearly label the packaging as compostable (if it is certified as compostable) to assist in proper disposal, and give consumers clear instructions on how to recover the packaging.
- If you are using compostable packaging to reduce the impact if the packaging is littered, then it is highly recommended that you speak to potential suppliers about the degradation characteristics and breakdown products (residues), in the 'open environment' conditions to which you anticipate your packaging will be disposed. Keep in mind that the physical dimensions of your packaging (primarily film/wall thickness) will be a factor in determining its compostability in a given end environment.
- If the packaging is intended to be recovered through commercial or home composting then select polymers that are certified to the Australian Standards AS 4736–2006 (commercial composting) and/or AS 5810–2010 (home composting) – more information about these can be found in Design Considerations Table. Keep in mind that the physical dimensions of your packaging (primarily film/wall thickness) will be a factor in determining its breakdown in composting systems. Strong communication with consumers on the need to divert compostable plastics from kerbside recycling systems is highly recommended.
- If your packaging is likely to be diverted into current plastics recycling systems, then the use of compostables should be avoided. If you still want to use a compostable polymer, then choose a compostable polymer that is compatible with the recycling system. Discuss this with recyclers early in the design or procurement process.
- Consider sourcing compostable polymers that are made from agricultural co-products (e.g. sugar production wastes), rather than primary agricultural products, as these wastes may be more likely to have generally lower life cycle-related material production impacts.

As with all other packaging materials, compostable plastic packaging systems have specific design constraints, which may limit the application of the resource efficiency design hierarchy. With this in mind, outlined in Figure 1 are the general design considerations for compostable plastic packaging. During material selection and packaging system design all of the aspects in Figure 1 should be considered.

Each of these design considerations is then discussed in more detail in Table 2.

# Design Considerations for Compostable Plastic Packaging

Figure 1

## Summary of design considerations for compostable plastic packaging

**Design to be fit-for-purpose**
SPG principle 1

**Design for resource efficiency**
SPG principle 2

**Design with low-impact materials**
SPG principle 3

**Design for resource recovery**
SPG principle 4

**Design to:**

- Improve accessibility
- Minimise product waste by consumers
- Manage the trade-offs between primary, secondary and tertiary packaging

**Design to:**

- Minimise the primary packaging
- Minimise the secondary packaging
- Minimise the manufacturing inputs of production processes
- Use reusable/ returnable secondary packaging
- Reduce consumption-related impacts
- Recover filling line packaging losses
- Maximise product-to-packaging weight/ volume ratios
- Maximise transport efficiencies

**Design to:**

- Minimise impacts of virgin material sourcing
- Minimise impacts of littering
- Maximise recycled content in secondary packaging
- Minimise the use of problematic chemicals during packaging manufacture

**Design to/for:**

- Facilitate compostability
- Avoid contamination by minor packaging components
- Avoid contamination of plastics recycling systems
- Provide clear consumer information

# Design Considerations for Compostable Plastic Packaging

Table 2

| SPG Principle | Design to | Design Considerations | Life Cycle Importance |
|---|---|---|---|
| 1 - Design to be Fit-for-Purpose | Improve accessibility | If using closures or seals with compostable plastic packaging, check the required removal force. The force required to tear the packaging, or pull/puncture a seal should not exceed 22 newtons. Avoid seals that require a tool to puncture.<br><br>When using a pull tab, increase the coefficient of friction by coating the tab so that extensive pinching is not required, and increase the size of the tab to accommodate a pinch. Place directions for opening the packaging directly on the packaging in a clear, easy-to-comprehend format.<br><br>Zip tracks on resealable packaging can be difficult re-seal properly. These can be improved by using the right zip for the right package, and using a plastic nubbin (zip fastener) that is big enough to grip.<br><br>Make heat-sealed strips, and press-and-seal strips, easier to pull apart by leaving enough room for fingers to grip the two edges, both for opening and closing.<br><br>Check Arthritis Australia's Food Packaging Design Accessibility Guidelines (see Useful Further Reading list) for more suggestions to improve the accessibility of your packaging. | HIGH |
| | Minimise product waste by consumers | Ensure that the contents can be fully dispensed, e.g. by avoiding square shoulders and grooves that make it very difficult for consumers to remove the last bit of product. The loss of your product as waste is the loss of a valuable resource with a potentially significant environmental impact.<br><br>Another approach to consider is modifying the flow characteristics of your product, so it is more easily dispensed. Obviously, there is a trade-off here, as concentrating a product (and potentially reducing its flowability) leads to a reduction in the packaging requirement. Speak to your suppliers about balancing flowability and product concentration. | MEDIUM |
| | Manage the trade-offs between primary, secondary and tertiary packaging | Consider possibilities for minimising the tertiary packaging components that are required to secure loaded pallets, which include the use of: strapping, down-gauged and perforated stretch films, sleeves, 'lock-'n-pop' low residue adhesives, returnable plastic crates that lock into place on pallets with minimal strapping, or pallet boxes. | MEDIUM |

# Design Considerations for Compostable Plastic Packaging

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|---|---|---|---|
| 2 - Design for Resource Efficiency | Minimise the primary packaging | Computerised design techniques, such as Finite Element Analysis, can help minimise plastic use. In addition, technologies are always improving. Speak to your suppliers about different design and manufacturing techniques that can reduce material usage.<br><br>The movement towards concentrating products (e.g. double or triple concentrated laundry detergents) is now well established in Australia. Concentrated products require less primary, secondary and tertiary packaging, and are also more efficient to transport. Is reformulating your product to reduce its water content (or volume in general) a viable possibility?<br><br>Consider using in-store shelf-ready packaging more effectively for product communication rather than relying on additional primary packaging components. For example, consider whether it is possible to reduce the label size by providing more promotional material on the shelf-ready packaging. Explore the options for novel display shippers or other shelf communication approaches that minimise the primary packaging.<br><br>Finally, more packaging is often used to signal a premium product. Consider alternative approaches to signal product quality to consumers through reduced printing and primary packaging. For example consider the use of shelf-ready secondary packaging that allows the reduction or elimination of primary packaging. Potentially these types of changes can also lead to less in-store labour as well. The secondary packaging can incorporate elements such as shelf communication tools (e.g. external and internal printing) to aid brand recognition, while controlling and presenting products consistently. | HIGH |
| | Minimise the secondary packaging | Optimise your use of corrugated board in secondary packaging by minimising flap overlaps (even to the point that the box contents are visible). Also consider moving the flaps to the smallest end of the box (so there is less overlapping flap material). Discuss the possible options with your supplier and/or converter.<br><br>You might be using a double-walled corrugated container (with two corrugated medium layers) to fulfil a structural strength requirement. Consider if adequate strength can be achieved with a single-walled corrugated container through the use of thicker gauge liners, but while still achieving a reduction in overall weight. Ask your supplier to assist with identifying the lightest weight corrugated board that will fulfil your functional requirement.<br><br>Shelf-ready packaging is becoming an important supply chain value-add for many food and grocery items, and this shift may increase the packaging-to-product ratio. When moving to shelf-ready packaging, look for opportunities to minimise material use.<br><br>Down-gauge secondary packaging as much as possible, while ensuring that the integrity of the primary pack is not compromised. The exception to this is if you are considering moving to a higher level of recycled content in the fibre-based secondary packaging, in which case a degree of 'up-gauging' could well be justified. See the second guide in this series (Fibre-based packaging), for more details on optim ising the environmental performance of corrugated board-based secondary packaging. | HIGH |

# Design Considerations for Compostable Plastic Packaging

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|---|---|---|---|
| 2 - Design for Resource Efficiency | Minimise the manufacturing inputs of production processes | Electricity is usually the primary energy input during the manufacture of compostable plastic packaging formats, used both for powering equipment and for generating the heat used in forming the packaging. Ask your suppliers about their energy procurement practices, in particular for electricity. Do they source a proportion of their electricity from GreenPower™ accredited sources? What are the measures they have in place to improve energy efficiency? Do they purchase any greenhouse gas offsets?<br><br>Source your compostable polymers from suppliers with a documented environmental management system and a strong commitment to best practice, e.g. as a signatory to PACIA's Sustainability Leadership Framework. | MEDIUM |
| | Use reusable/ returnable secondary packaging | Returnable plastic crates/trays (RPCs) that are collapsible or nesting are now seeing much broader use in the market, particularly by the major supermarket chains. The life cycle environmental and cost benefits of using returnable plastic crate systems, instead of corrugated boxes, are significant. Supply chain product losses are also reported to be significantly lower when using returnable plastic crate systems. However this currently relates more to fresh foods, such as fruit and vegetables, than more robust products commonly found in compostable (usually flexible) plastic packaging. The market is moving in this direction, so consider if your product could be supplied in RPCs.<br><br>Reusable packaging can be particularly suitable for short distribution chains, loose or manually packed products, easily damaged high value products, and large volume fast moving products. | MEDIUM |
| | Reduce consumption-related impacts | If your product doesn't require refrigeration, make sure that this is prominently communicated on the label, to avoid consumers unnecessarily refrigerating the product. | MEDIUM |
| | Recover filling line packaging losses | While plastic packaging losses in the filling line will be low, confirm with line operators that they have an appropriate plastics recycling collection system in place. If your packaging is compostable then it can be recovered in an organics recycling facility. | LOW |
| | Maximise product-to-packaging weight/volume ratios | Many products packaged in compostable plastic packaging already have close to ideal product-to-packaging weight and volumetric ratios. However, consider doing some 'back of the envelope' calculations on these ratios as part of your packaging system design process.<br><br>Pre-settling or vacuum packing loose fill product is not feasible for many less dense products. However, consider if one of these techniques is viable for your product. Reducing the product volume reduces the primary, secondary and tertiary packaging requirement, and also reduces the transport requirements. | LOW |
| | Maximise transport efficiencies | Have a look at your palletisation (volumetric) efficiencies; improving these can significantly reduce the costs associated with product storage and distribution. | HIGH |

# Design Considerations for Compostable Plastic Packaging

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|---|---|---|---|
| 3 - Design with Low-Impact Materials | Minimise impacts of virgin material sourcing | Nearly all plastics based on renewable resources are manufactured from either carbohydrate-rich crops such as grains, maize and sugar cane/ beets, or from plantation timbers. These crops are processed to provide purified starches or sugars (e.g. starch and cellulose), which can then be used without any further (significant) transformation, or chemically or biologically converted (e.g. via fermentation) to produce chemical building block monomers (such as ethanol, lactic acid and succinic acid). These monomers are then transformed into polymers suitable for making a range of plastic products.<br><br>The use of alternative plant-based feedstocks (e.g. cellulosic farm wastes) to manufacture polymers, while growing, is still small scale or at the research level.<br><br>Ask suppliers about the specific raw materials used to manufacture their compostable polymer. Request independently verified life cycle data on the environmental impacts of the production of the virgin polymer. This information should be provided to you, by your suppliers, in line with the AS/ NZS 14040 series of LCA standards, or, if for greenhouse gas emissions only, the carbon footprinting standards. These standards are PAS 2050 (a UK standard) or the international ISO 14067 carbon footprinting standard. Compare the responses you get, and remember to adjust the life cycle data for any changes in the weight of your packaging, when using polymers with different functional specifications.<br><br>There are concerns the impacts of renewable resource-based materials on global food supplies. However, this issue is dominated by renewable fuel production, rather than the production of plastics from renewable resources, and is not a focus of this guide. Data on land use is available from the Australasian Bioplastics Association and similar organisations in Europe and North America. Check with your suppliers that their raw materials are sourced from certified suppliers operating to appropriate environmental, social and economic standards. These include the International Sustainability and Carbon Certification (ISCC) system for annually renewable crops, and the Forest Stewardship Council (FSC) or the Programme for the Endorsement of Forest Certification (PEFC) for wood fibre-based materials. | HIGH |
| | Minimise impacts of littering | Littering is best understood as an issue related to consumer behaviour and the adequacy of waste management systems in public places. There is a risk that designing packaging using compostable polymers of any type, and also communicating with consumers that the packaging will have a lower environmental impact if littered, may encourage littering behaviour.<br><br>From a technical life cycle assessment perspective, there are no commonly agreed LCA environmental impact categories quantifying the 'environmental impact' of packaging litter. Any attempt to communicate with consumers about the 'lower litter-related environmental impacts' of your packaging will be difficult, and perhaps impossible to substantiate. Under the Australian Consumer Law, which is a schedule to the Australian Competition and Consumer Act 2010, it is a legal requirement that you are able to substantiate, and appropriately qualify, any environmental claims about your product and packaging.<br><br>The Australian composting standard AS 4736–2006 applies to the processing conditions found in commercial composting facilities, and compliance with the standard cannot be used to support to any claims on the biodegradability of plastics in the open environment.<br><br>While you might consider choosing a compostable material and designing your packaging to break down quickly should it be littered in the open environment, it is recommended that you consider very carefully how to communicate this to consumers. | HIGH |

# Design Considerations for Compostable Plastic Packaging

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|---|---|---|---|
| 3 - Design with Low-Impact Materials | Maximise recycled content in secondary packaging | Specify the highest possible level of post-consumer content in corrugated broad or polyethylene overwraps and shelf-ready packaging, while maintaining the required functional and strength performance of the secondary packaging. | MEDIUM |
| | Minimise the use of problematic chemicals during packaging manufacture | Printing processes for plastics packaging often involve the use of high VOC (volatile organic compounds) chemicals, particularly in the solvents. These chemicals can be locally toxic to human health (e.g. the shop-floor workers) and the environment, and their use requires the operation of significant (and expensive) pollution control measures, such as gas-fired after-burners. They are also a contaminant in the recycling process. Discuss with your packaging material supplier whether alternative low-VOC inks and lacquers are available that will fulfil your requirement. This type of change may reduce emission management-related costs, improve the health of the local environment, and will assist your supplier in maintaining a healthy work environment. If your packaging is compostable, ensure that any printing chemicals that will remain with the packaging are compatible with composting. | MEDIUM |
| 4 - Design for Resource Recovery | Facilitate compostability | There are two Australian Standards for testing if plastic packaging is suitable for composting under either commercial or home composting conditions:<br>• **AS 4736—2006 Biodegradable plastics—Biodegradable plastics suitable for composting and other microbial treatment.** Note that the similar European standard to AS 4736 is EN 13432.<br>• **AS 5810—2010 Biodegradable plastics—Biodegradable plastics suitable for home composting.**<br><br>There are two significant differences between the two standards. The test conditions for the home composting standard requires lower composting temperatures (in the range of 20–30 °C), reflecting the typically lower temperatures reached in home composting, compared to commercial composting (typically >60 °C). The time period over which complete degradation must take place also varies (disintegration in six months for home conditions, versus three months for commercial conditions).<br><br>If you are designing a package for recovery through a commercial or home composting system, particularly if you intend to make a compostability claim, consider downloading a copy of the appropriate standard. Read the standard fully and complete either Appendix B (AS 4736–2006) or Appendix A (AS 5810–2010) in consultation with your suppliers. By completing this checklist, you will be ensuring, as much as possible, that your packaging is compostable under typical composting conditions.<br>Both these standards have similar and very specific performance requirements (criteria) on how a plastic must decompose under composting conditions, if it is to be considered compatible with composting processes. These criteria are:<br><br>**Characterisation**<br>The physical and chemical characteristics of the plastic must be identified, to a level defined by the standards.<br><br>**Biodegradability**<br>The biological breakdown characteristics of the packaging must be determined. | HIGH |

# Design Considerations for Compostable Plastic Packaging

**4 - Design for Resource Recovery**

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| Facilitate compostability | **Disintegration**<br>The particle size breakdown characteristics of the packaging must be determined.<br><br>**Compost quality**<br>Key aspects of the physical, chemical and toxicity-related aspects of the compost product must be determined.<br><br>**Recognisability**<br>The plastic packaging product (as intended for sale) must be easily recognised by consumers as compostable.<br><br>The standards stipulate 'pass/fail' conditions against the criteria outlined above. Another important aspect that should be considered, but which isn't a criterion under the Australian standards, is the impact of compostable plastics (e.g. compostable films) on the composting processes undertaken by organics reprocessors. This aspect is significant, and is discussed in more detail elsewhere in this guide.<br><br>**AS 4736–2006** requires the composting of products, rather than materials. That is, your packaging product must be shown to fulfil the compostability criteria of the standard, not just a sample of the compostable plastic from which your packaging is made. This means it is important to consider the impact of packaging size and shape, and particularly the wall thickness, on the rate of composting. Also consider the impact of pigments and coatings on composting rates, and compost eco-toxicity and quality. Before making any claim of compostability (i.e. compliance with AS 4736–2006 or AS 5810–2010) it is important to check with your supplier that your packaging design will meet the requirements of the relevant standard. If there is any doubt, and you wish to make a compostability claim, then you may have to get your packaging tested and certified against the standard by an independent agency. Contact the Australasian Bioplastics Association (www.bioplastics.org.au) for information on certification. | HIGH |
| Avoid contamination by minor packaging components | Compostable packaging should be designed so that coatings and pigments do not interfere with composting systems, and pigments and inks do not contain chemicals, such as metals (e.g. lead, cadmium or mercury) that will impact on the quality or eco-toxicity of the processed compost.<br><br>If the packaging is not printed but uses a label instead, then the label, the adhesive used to secure the label, and the printing on the label all need to satisfy the requirements for composting. | HIGH |
| Avoid contamination of plastics recycling systems | Recovery and reprocessing systems are not commercially available to recycle compostable plastics into new products (except compost). Compostable materials are designed for a single life, and their key purpose is to reduce the single use life cycle impacts of the product. The primary exceptions to this are the reuse of compostable bags as bin liners for general waste, and compostable bags as bin liners for organics collection.<br><br>It is important to ensure that compostable packaging does not inadvertently end up in the plastics recycling stream. Depending on the polymer, contamination rates as low as 1% can impact on conventional plastics reprocessing. Wherever possible avoid using compostable plastics in product applications where recycling is likely to occur e.g. household rigid packaging. Take great care to ensure that your packaging is clearly identified to consumers as compostable, particularly if it looks similar to a commonly recycled product. | HIGH |

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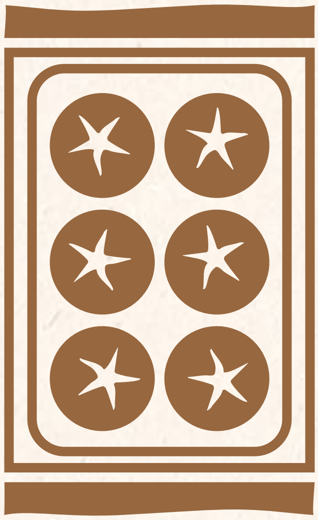
| Provide clear consumer information | It is important to provide consumers with clear guidance on how to dispose of the packaging, whether this is in their general waste, home composting system or kerbside organics bin.<br><br>Related to this is the importance of communicating the basis of any claim of degradability or compostability. Generic and unsubstantiated claims of degradability, biodegradability or compostability have potential to mislead consumers and should be avoided. Under the Australian Consumer Law it is a legal requirement that you are able to substantiate, and appropriately qualify, any environmental claims about your product and packaging.<br><br>Currently, the best way to substantiate claims about compostability is for your packaging to fulfil the test criteria of AS 4736–2006 or AS 5810–2010. Products that have been certified to AS 4736 can apply to the Australasian Bioplastics Association to use the 'seedling logo' (www.bioplastics.org.au). The Association has also developed a new logo for products that have been certified to AS 5810.<br><br>If you intend to make any general claims about degradability, biodegradability or compostability, then speak to your supplier about the standards they have used to support their claims of degradability. It is also highly recommended that you download and read a copy the of ACCC publication Biodegradable, degradable and recyclable claims on plastic bags from the ACCC website (www.accc.gov.au). The ACCC publication states that 'being able to substantiate claims is particularly important if those claims predict future outcomes, such as whether plastics will biodegrade or degrade within a certain time frame and under certain conditions'. So in summary, any claims need to be both specific and able to be backed up.<br><br>See the Introductory Guide for more on labelling in general. | HIGH |

# Design Example

This hypothetical design example illustrates some of the sustainability design aspects that could be considered during a packaging development or review. The brief is for a plastic tray and sealed plastic overwrap for fresh tomatoes. The aim is to extend the shelf life of the product while enabling back-of-store waste (if any) to be composted with other food waste. The conventional packaging is a PET, PVC or polystyrene tray, with a biaxially oriented polypropylene (BOPP) or PVC film overwrap.



## Sustainable design considerations

### Selecting materials

Specify materials that have been certified to a recognised standard for commercial composting facilities, i.e. AS 4736–2006. For example:

- Trays can be thermoformed from certified compostable poly-lactic acid (PLA)[1]
- There are many compostable plastics suitable for film, including: starch-based polymers, cellulose-based polymers or biodegradable polyesters – the film must be transparent and heat sealable, with an appropriate gas and moisture barrier.[2]

It is also important to understand how the polymer is made and whether it has any significant impacts during production of raw materials (e.g. growing crops) or in manufacturing.

### Design for composting

The label, inks and adhesives all need to be compostable or approved ingredients, used within the limits set out in the relevant standard.

### Consumer labelling

If the packaging meets the requirements of a recognised home composting standard, e.g. AS 5810–2010, provide prominent advice to consumers on how to compost the pack after use. They should be clearly instructed to not put it in their recycling bin. Consider using the Australian Bioplastics Association's home composting logo.

## More innovative ideas that could be explored

A compostable cardboard tray with a film overwrap. In 2010 Filogea launched new packaging for its ready-to-eat salads – a folded tray, manufactured from paperboard coated with Novamont's Mater-Bi starch-based compostable polymer, and enclosed in a Mater-Bi film. See www.europeanplasticsnews.com/subscriber/featured2.html?cat=1&featuredid=1284126917.

[1]Walmart uses Ingeo™ PLA for fresh salads, salsa and bagged spinach – see www.natureworksllc.com/~/media/Ingeo%20Earth%20Month/2011/2011_Ingeo_Earth_Month_LookBook_pdf.

[2]For example, Innovia's NatureFlex™ films are manufactured from renewable wood pulp, are certified compostable and offer good gas barrier properties – see www.innoviafilms.com.

# Useful Further Reading

| Reference | What is it? |
| --- | --- |
| **APC, 2010. Sustainable Packaging Guidelines, Australian Packaging Covenant. 30 pages.** | The SPG is the key document for APC signatories and others to use in framing APC-compliant packaging reviews. The objectives of these reviews are to optimise resources and reduce environmental impact, without compromising product quality and safety. Free download from: www.packagingcovenant.org.au |
| **Arthritis Australia, 2012. Food packaging design accessibility guidelines. 31 pages.** | This document provides more detailed guidance on accessibility principles and strategies to improve accessibility of food packaging; prepared in conjunction with NSW Health. For a complimentary copy of the Food Packaging Accessibility Guidelines and several other packaging design reports contact Arthritis Australia at: design@arthritisaustralia.com.au |
| **European Bioplastics, 2011. Fact sheet – Better packaging with bioplastics. 4 pages.** | This European Bioplastics industry fact sheet provides a useful overview of 'bioplastics', in both current and prospective packaging applications. Page 4 of the fact sheet provides a detailed table describing the typical applications for bioplastics in packaging. Free download from: en.european-bioplastics.org/multimedia/ |
| **European Bioplastics, 2012. Accountability is key: Environmental communications guide for Bioplastics. 32 pages.** | This publication goes into greater detail on communicating the benefits of biodegradable and compostable plastic packaging, with good and bad examples. Free download from: en.european-bioplastics.org/wp-content/uploads/2012/publications/BP_ECG-Summary_eng.pdf |
| **Plastics and Chemicals Industries Association, 2007. Using Degradable Plastics in Australia – A Product Stewardship Guide and Commitment. 28 pages.** | This PACIA guide was developed to assist suppliers and users of degradable plastic polymers in introducing products into the market that include a full consideration of the life cycle implications of using degradable plastics, and promote sound communication with consumers. A must read if you are considering using a degradable polymer for your packaging. Free download from: www.pacia.org.au/learningcentre/degradables |

# Useful Further Reading

**Plastics and Chemicals Industries Association, 2008–2009. Quickstart Issues 1, 4 and 11. 6–7 pages.**

The PACIA Quickstart documents provide lots of great information on sustainable packaging design, using recycled plastics and potential applications. Of particular note, Quickstart Issue 4 focuses on degradable polymers, and Quickstart Issue 11 is aligned with the four principles of the APC's Sustainable Packaging Guidelines (fitness for purpose, resource efficiency, low-impact materials and resource recovery). These documents are valuable resources for plastic packaging designers. Free download from: www.pacia.org.au/programs/quickstartpublications

**Verghese, K., Lewis, H. & Fitzpatrick, L., 2012. Packaging for Sustainability. 1st ed. Boston: Springer. 384 pages.**

This life cycle thinking-based reference book provides extensive detail on just about every aspect of sustainable packaging design. Beyond design, it also contains detailed information on marketing, regulatory and labelling aspects. Order from: www.springer.com/engineering/production+engineering/book/978-0-85729-987-1

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