# Packaging Material Guide

Extended version of Packaging Material Selector table

2019

Australian Fresh Produce Alliance

Growing a healthier Australia

## About this Guide

This guide is extended version of the Australian Fresh Produce Alliance's *Packaging Materials Selector*.

It provides greater information on the materials and details key areas of focus in sustainable packaging design.

## About the Australian Fresh Produce Alliance

The Australian Fresh Produce Alliance (AFPA) is made up of Australia's major fresh produce growers and suppliers. AFPA members represent:

- Half the turnover of the Australian fresh produce (fruit and vegetables) industry - $4.5 billion of the $9.1 billion total.
- More than a third of Australian fresh produce exports - $410 million of the $1.2 billion total.
- More than 20,000 direct employees.
- Grower supplier network of more than 1,000 growers

The key issues AFPA is focusing on include:

- Packaging and the role it plays in product shelf life and reducing food waste
- Labour and the need for both a permanent and temporary supply of workers
- Market access to key export markets for Australian produce
- Product integrity both within and outside the supply chain
- Pollination and research into alternative pollination sources
- Water security including the efficient and productive management of water

### AFPA Members

The members of the Australian Fresh Produce Alliance are:

Costa Group, Perfection Fresh, LaManna Premier Group, One Harvest, Fresh Select, Mackay's Banana Marketing, Montague, Freshmax, Driscoll's, Rugby Farm, Pinata Farms, Mitolo Group, 2PH Farms, Fresh Produce Group.

## Acknowledgements

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## Terms of use



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# Polyethylene Terephthalate (PET)


## Material Characteristics [1]

Clear, tough, solvent resistant. Used for rigids, film, sheets and fibres.
Softens: 55° C. Specific Gravity = 1.38.

## Applications [1]

Beverage & household products, bottles, food trays, laminated sheets, clear and printed packaging film.

## Raw Material

Fossil Fuel (Non-renewable resource).
There is currently a limited availability of PET partially made from renewable resources, which is compatible with PET recycling.
Example: Coke Plant Bottle™ – the PET is partially made from sugarcane and waste from the sugarcane manufacturing process.

## Barrier Characteristics (Moisture, Gas barriers) [2]

Rigids: The barrier performance is dependent on the gauge of the materials. PET has a 'good barrier to oxygen' and a 'medium barrier to moisture' (MVTR).

Flexibles: The barrier performance is dependent on the gauge of the materials, however there are a range of coatings or metallisation available that can enhance the barrier of the PET film.

## End of Life (EoL) [3]

Clear Rigid PET is widely accepted at kerbside and is technically recyclable. The additions of colours, seal coating or barrier layers along with the type and style of labelling may affect recyclability. APCO Members should use the PREP tool for assessing recyclability.

PET flexible packaging is not recyclable through REDcycle program*.

## Green House Gas Emissions (GHG) – Carbon Footprint

2.99 kg CO2e per kg of basic material.

## Comments

Metallised PET films are excellent barriers to oxygen and often used to replace aluminium foil however please note the recyclability concerns.
Trays made of Crystalline PET (cPET) can be used in conventional ovens at up 220°C and are technically recyclable

## High Density Polyethylene (HDPE)


### Material Characteristics [1]
Hard to semi-flexible, waxy surface, opaque appearance.
Softens: 60° C.  Specific Gravity = 0.96.

### Applications [1]
Films, blow moulded containers and closures, crinkly shopping bags, freezer bags, milk bottles, buckets, rigid agricultural pipe and milk crates.

### Raw Material
Fossil Fuel (Non-renewable resource).
There is currently a limited availability of sources of HDPE partially made from renewable resources (sugar cane/alcohol) are available and are compatible with HDPE for recycling.

### Barrier Characteristics (Moisture, Gas barriers) [2]
The barrier performance is dependent on the gauge of the materials.  HDPE has a 'poor oxygen barrier' and a 'good moisture barrier' (MVTR).

### End of Life (EoL) [3]
Rigid HDPE is widely accepted at kerbside and is technically recyclable. The additions of colours or barrier layers along with the type and style of labelling may affect recyclability.  APCO Members should use the PREP tool for assessing recyclability.

Flexible HDPE can be recycled via the REDcycle program*.

### Green House Gas Emissions (GHG) – Carbon Footprint
2.17 kg CO2e per kg of basic material.

### Comments
Flexibles: HDPE can be used in multilayer co-extrusions to improve moisture barrier or rigidity; however this may affect the recyclability.

## Polyvinyl Chloride (V)

Unplasticised Polyvinyl Chloride (UPVC)


### Material Characteristics [1]

Hard rigid, can be clear appearance and can be solvent welded.
Softens: 70°C. Specific Gravity = 1.40.

### Applications [1]

Clear food trays, clear cordial/fruit juice handled bottles, blister packs, plumbing pipes and fittings.

### Raw Material

PVC is largely derived from salt — an abundant and inexpensive resource – and ethylene, which is derived from natural gas (Non-renewable resource).

### Barrier Characteristics (Moisture, Gas barriers) [2]

The barrier performance is dependent on the gauge of the materials. PVC is a 'good oxygen barrier' and a 'medium moisture barrier' (MVTR).

### End of Life (EoL) [3]

PVC is currently accepted at kerbside and can be recycled, however because of the negative impact this clear material has on the current plastic recycling stream, it's future at kerbside collection is in doubt. APCO Members should use the PREP tool for assessing recyclability.

### Green House Gas Emissions (GHG) – Carbon Footprint

2.20 kg CO2e per kg of basic material.

### Comments

Needs additives for processing and avoiding degradation. PVC produces HCl upon combustion almost quantitatively related to its chlorine content.

## Polyvinyl Chloride (V)

Plasticised Polyvinyl Chloride (PPVC)


### Material Characteristics [1]

Flexible, clear, elastic, can be solvent welded. Cling qualities, good vapour barrier, excellent clarity and puncture resistant.
Can be sterilized by irradiation.
Softens: 70° C. Specific Gravity = 1.35.

### Applications [1]

Meat and fresh produce wrap, Commercial stretch wrap, house-hold catering films and medical products.

### Raw Material

PVC is largely derived from salt — an abundant and inexpensive resource – and ethylene, which is derived from natural gas (Non-renewable resource).

### Barrier Characteristics (Moisture, Gas barriers) [2]

The barrier performance is dependent on the gauge of the materials. PVC is a 'good oxygen barrier' and a 'medium moisture barrier' (MVTR).

### End of Life (EoL) [3]

PVC is Not Recyclable - Soft plastic is not recyclable at a Material Recovery Facilities (MRF's) and is not widely collected at kerbside. The soft plastic film is also a contaminant in REDCycle soft plastic collection and processing*. APCO Members should use the PREP tool for assessing recyclability.

### Green House Gas Emissions (GHG) – Carbon Footprint

2.20 kg CO2e per kg of basic material.

### Comments

PVC flexible properties make it suitable for food packaging to keep meat and other perishable produce fresh. The PVC film contains high level of plasticising compound. Incineration can generate hydrogen chloride gas and dioxins on burning.

## Low Density Polyethylene (LDPE)


### Material Characteristics [1]
Soft, flexible, waxy surface translucent, withstands solvents.
Softens: 40°C. Specific Gravity = 0.92.

### Applications [1]
Plastic Bags, packaging film (clear, coloured or printed), agricultural pipe, garbage bags, stretch and shrink films, silage and mulch films, garbage bins liners. Also used in nursery & other films, squeeze bottles, labels, extrusion coating paper board, irrigation tube and many other applications.

### Raw Material
Fossil Fuel (Non-renewable resource).
There is currently a limited availability of sources of LDPE made from renewable resources (sugarcane/alcohol).

### Barrier Characteristics (Moisture, Gas barriers) [2]
The barrier performance is dependent on the gauge of the materials. LDPE is a "poor oxygen barrier" and a "good barrier to moisture" (MVTR). [5]

### End of Life (EoL) [3]
Rigid LDPE will be 'Recyclable with Lost Value' and will be recycled with the 'Mixed Plastics" stream and some value will be lost. APCO Members should use the PREP tool for assessing recyclability.

Soft LDPE film is only recyclable via REDcycle program*

Soft LDPE film is not recyclable in kerbside or Material Recovery Facilities (MRF's) as it causes equipment issues. However it is technically recyclable, with pallet shrink and some other agricultural films being widely recycled.

### Green House Gas Emissions (GHG) – Carbon Footprint
2.35 kg CO2e per kg of basic material.

### Comments
Sub families include LLDPE, ULDPE, metallocene LDPE. These can provide superior properties enhancing clarity, sealability, strength, etc. LDPE's are often used as sealing layers in laminates and co-extrusion. Typical laminates (flexibles) include BOPP//LDPE, PET//LDPE, LDPE//LDPE. Recyclability may be affected with these additional layers.

## Polypropylene (PP)


### Material Characteristics [1]

Semi-crystalline, wide property and application range. Translucent (injection moulded), exceptionally clear (cast film and BOPP films), hard, flexible, good chemical resistance, low Specific Gravity.
Softens: 80° C  Specific Gravity = 0.90.

### Applications [1]

Films (confectionery & chip wrap), pails, clear punnets/trays, bottles, hinged caps and closures, microwave ware packaging, plant pots.

### Raw Material

Fossil Fuel (Non-renewable resource).

### Barrier Characteristics (Moisture, Gas barriers) [2]

The barrier performance is dependent on the gauge of the materials.
PP rigid containers have a 'poor oxygen barrier' and a 'good moisture barrier'.
BOPP film has a 'poor oxygen barrier' and a 'good moisture barrier'.
Metallised BOPP film has a 'good oxygen barrier' and an 'excellent moisture barrier'.

### End of Life (EoL) [3]

Rigid PP containers can be recycled at kerbside, however the large variations of physical properties mean it will be recycled with the 'Mixed Plastics' stream and some value will be lost.  The addition of colour or seal coating or barrier layers will also affect the recyclability. APCO Members should use the PREP tool for assessing recyclability.
Thin films / flexible packaging can also be recycled via the REDcycle* supermarket drop off scheme but are not recyclable in kerbside or Material Recovery Facilities (MRF's) as they cause equipment issues.

### Green House Gas Emissions (GHG) – Carbon Footprint

2.20 kg CO2e per kg of basic material

### Comments

BOPP film is extensively used in flexible packaging (eg in lettuce bags).  Permeability to moisture can be enhanced by laser micro perforation of by mechanically placed holes in the film.

## Polystyrene (PS)


### Material Characteristics [1]

Clear, glassy appearance, rigid, brittle, semi-tough, melts at 95°C.
Softens: 85°C. Specific Gravity = 1.06.

### Applications [2]

Meat & poultry trays, yoghurt & dairy containers, vending cups. Refrigerator bins & crispers, air conditioner, coat hangers. Expanded Polystyrene (EPS)

### Raw Material

Fossil Fuel (Non-renewable resource).

### Barrier Characteristics (Moisture, Gas barriers) [2]

Polystyrene has a 'medium barrier' to oxygen and moisture (MVTR).
It should be noted that PS is vulnerable to stress cracking in the presence of fats and oils.

### End of Life (EoL) [3]

Polystyrene is currently recycled at kerbside and will be recycled with the 'Mixed Plastics' stream and some value will be lost.
Note: The future of Polystyrene is as a recyclable material is currently under review.

### Green House Gas Emissions (GHG) – Carbon Footprint

3.96 kg CO2e per kg of basic material.

### Comments

Properties can be modified to meet requirements for both clarity, temperature performance and breakability.

Expanded Polystyrene (EPS) is extensively used in produce export boxes; although there are facilities around Australia for collecting industrial quantities, the processing is undertaken overseas. EPS is classified as not recyclable through Australian Kerbside collection.

# Paper / Cardboard

## Material Characteristics
Versatile material, light and strong, rigid or flexible, moisture sensitive, limited gas barrier, product invisibility (opaque).

## Applications
Bags, sacks, sheets, cartons, boxes, trays, labels, inserts, cushions, laminates / coated paper.

## Raw Material
Renewable resource – Timber (assuming it is sourced from certified forest stewardship programs such as FSC or PEFC)
**FSC** – Forestry Stewardship Council
**PEFC** – Program for the Endorsement of Forest Certification)

## Barrier Characteristics (Moisture, Gas barriers)
Paper & board products have a 'very oxygen barrier' and a 'poor moisture' in their uncoated forms.

## End of Life (EoL) [3]
Most paper products are recyclable, although addition of coatings to improve presentation (typically PET or PP laminates) or moisture resistance (PE extrusion coating or chemical treatments) may affect recyclability. More rigid cardboard packaging formats need to be flattened (i.e. so the shortest dimension is <10% of the longest dimension, then the object will be considered two dimensional and will not be separated as plastic).

## Green House Gas Emissions (GHG) – Carbon Footprint
1 - 1.5 kg CO2e per kg of basic material.

## Comments
Reduction in physical properties due to recycling; usually additives and/or more material needed to compensate loss of performance. To aid recycling, more rigid cardboard packaging needs to be flat (i.e. If the shortest dimension is <10% of the longest dimension, then the object will be considered two dimensional and will not be separated as plastic).

# Compostable Polymers

## Material Characteristics

A vast range of very different material families. Compostable certification required under the Australian Standards AS4736 for industrially compostable materials or AS5810 for home compostable materials.

## Applications

Bags, sacks, sheets, cartons, boxes, trays, labels, inserts, cushions, laminates.

## Raw Material

Some are from 'Renewable Resources' such as wood pulp, corn, bagasse , wheat straw, etc).
Some are from 'Non-Renewable' fossil fuel sources such as aliphatic polyesters.
Some are hybrids of the above.

## Barrier Characteristics (Moisture, Gas barriers)

Material and structure dependent. Laminates can be formulated to improve moisture and oxygen barriers.

## End of Life (EoL) [3]

Currently consumers don't have access to facilities for the collection and composting of compostable packaging with organic waste. Home composting is an option, but these materials are not recyclable and may result in contaminating the recycling system. Note that these materials will not compost in land fill, as is the case for paper and organics.

## Green House Gas Emissions (GHG) – Carbon Footprint

There is a broad range, which is material dependent. Eg: 3.39 kg CO2e per kg of Polylactic Acid (PLA).

## Comments

Please Note that Biodegradable doesn't mean it's Compostable**.** Compostable polymers are those biodegradable polymers that have been tested and verified to actually compost within the times and conditions specified and also meets specific quality and ecotoxicity criteria. Compostable certification to the Australian Standards is available from the Australasian Bioplastics Association (ABA). Certified composters can be identified via the Australian Organic Recycling Association (AORA).

# Renewable Polymers

## Material Characteristics

Made from renewable resources, obtained through chemical modification of natural polymers, such as starch, cellulose, or chitin. A vast range of materials that cannot be simply grouped under one class. **Note that renewable materials are <u>not necessarily</u> compostable.**

## Applications

Rigid containers, packaging films, trays.

## Raw Material

Renewable resources include:
**Sugarcane**: renewable PE, partially renewable PET.
**Wood pulp**: paper, paperboard, cellulosic materials
**Sugarcane, cassava and corn**: renewable PBS
**Corn starch:** Polylactides (eg: PLA)

## Barrier Characteristics (Moisture, Gas barriers)

Material and gauge dependent. Generally 'good oxygen barriers' and generally 'poor moisture barriers', unless metallised.

## End of Life (EoL) [3]

Certified compostable materials – refer above.
Some renewable resource-based materials will be compatible with the recycling system. Others are likely to end in landfill or be a contaminant to the recycling system. EoL option must be verified via APCO's PREP tool.

## Green House Gas Emissions (GHG) – Carbon Footprint

There is a broad range, which is material dependent. Eg: 3.39 kg CO2e per kg of Polylactic Acid (PLA).

## Comments

Suitability for the intended application needs to be assessed case by case, particularly to ensure an acceptable EoL options.

# Reference Information

## Material Characteristics

This provides a description of the characteristics of the primary packaging material, including chemical aspects and properties. Plastics information is available from Chemistry Australia's website, the pre-eminent national body representing Australia's chemicals and plastics industries.
Specific Gravity (SG) refers to material density, in gm/cm3.

## Applications

Information for plastics was sourced from Chemistry Australia[1], providing a list of the applications that primary packaging material can be used.

## Raw Materials

Identifies the main raw materials used in the production of the material and if the material is a renewable or non-renewable.

## End of Life End of Life (EoL) [3]

This is a term used to describe the expected disposal option of packaging when the customer/consumer has removed the product, i.e. Reuse, Recycle, Compost or Landfill.

In 2018 the Australian Packaging Covenant Organisation (APCO) made available to its members the Packaging Recyclability Evaluation Portal (PREP). This online tool uses recyclability information gathered from across Australia and New Zealand to enable users to conduct a PREP assessment, generating reports. These reports are used to inform the application of the Australasian Recycling Label (ARL). The aim to increase recycling and recovery rates and contribute to cleaner recycling streams.

The Australasia Recycling Label (ARL) is an evidence-based, standardised labelling system that provides clear and consistent on-pack recycling information to inform consumers of the correct disposal method. The ARL is designed to be used in conjunction with PREP, which informs the user of the correct on-pack ARL artwork for each 'separable component' of packaging. It is a simple and effective method to improve consumer recycling behaviours.

## REDcycle Program

REDcycle was launched in 2011 and is a recovery initiative for post-consumer soft plastic. This product stewardship model is supported by leading brand owners, Supermarkets, Industry Groups and Governments. Over 90% of the Australian population have access to a REDcycle bin via the REDcycle supermarket drop off.

The recovered material is used as raw material for useful products such as benches, bollards, manufactured by REDcycle's partner, Replas. REDcycle also partners with Close the Loop and Downer Group for Australian municipal road infrastructure. For more information on REDcycle, please refer to their website, www.redcycle.net.au

## Green House Gas Emissions (GHG) – Carbon Footprint

Conversion processes required to transform the material into its final packaging format will add to the carbon footprint.

## Compostable and Renewable Polymers [4, 5]

- **Degradable polymers** (including Oxo-biodegradable polymers and Photodegradable polymers) are those made with plastics, but with additives to help them disintegrate faster. It is still plastic which will end up in smaller pieces and be a bigger hazard to wildlife than plastic that take a long time to degrade. These materials are progressively being banned in advanced jurisdictions as they do not compost under home or industrial composting conditions.
- **Water-soluble polymers** are those that dissolve in water within a designated temperature range and then biodegrade in contact with micro-organisms. An example is PLANTIC, a high barrier biobased recyclable made from recycled PET, with a thin layer of Plantic R material. During the recycling process, the thin Plantic plant starch layer uniquely washes away, enabling the PET to be recycled.
- **Biodegradable polymers.** Biodegradable refers to a natural process during which micro-organisms that are available in the environment convert materials into natural substances such as water, carbon dioxide and biomass (artificial additives are not required). The process of biodegradation depends on the surrounding environmental conditions e.g. location or temperature, on the material itself, and on the application. Biodegradability is an inherent property of certain bioplastic materials that can benefit specific applications. e.g. food/organic waste bags, food service ware, agricultural films and wraps. However, the term biodegradable, by itself, does not imply any timeline to achieve full biodegradation, nor does it infer the usability or quality of the resulting by-products [4, 5]. For EoL purposes, compostability is the target, not biodegradability.
- **Compostable polymers** are those biodegradable polymers (or goods made from them) that have been tested and verified to actually compost within the times and conditions specified. Additionally, the resultant compost meets specific quality and ecotoxicity criteria detailed in Australian Standards AS 4736-2006 (biodegradable materials suitable for commercial composting) or Australian Standard AS 5810-2010 (biodegradable plastics suitable for home composting). Verification of conformance to these Australian Standards is available via the Australasian Bioplastics Association.
- **Starch** – (aliphatic) polyester blends that mix thermoplastic starch with polyesters made from hydrocarbons. Examples, Bagasse & Wheat Straw.

## Sustainable Packaging Design Guidelines[6]

1. Food packaging must ensure the safe delivery of food to the consumer, providing barrier from external element. Accordingly, the packaging must contain and protect the product from physical and temperature damage, including protection from chemical and microorganism deterioration.
2. The packaging must minimise the cost of materials and delivery.
3. The packaging needs provide safety features like tampering resistance and child proof closures.
4. The packaging provides the consumer with product information, allergens and nutritional data. For the manufacturer, it provides the key point of sale for the product to the consumer - product presentation, brand identification, information and convenience for the product from the moment of production through until it is ultimately consumed.
5. The packaging must be easy to carry, open, use and perhaps reseal. Consumers require convenience from the product they purchase and seek information of correct environmental recycling or repurposing.
6. Packaging plays an important role in protecting food from damage and contamination, it extends the useful life of food items on the retail shelf and at home, thus potentially reducing food waste and its significant environmental impacts. Today, there is a strong focus on the environmental aspects of food packaging to ensure that at the end of its life (after use of the product contained) that it can be reused, recycled or composted.

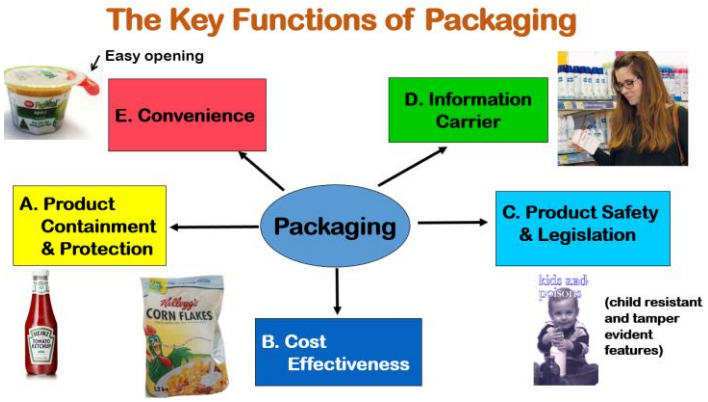
## Considerations before commencing packaging design

1. As early as possible, in the initiation stage of a packaging design project, it is suggested to have the Marketing & Product development groups document the following information:
   - Pack size (volume or weight),
   - Design or style of pack,
   - Shelf life of the product (barrier),
   - Process (temperature, pressure),
   - Sealing or lidding,
   - Usage of the product (dosage & handling),
   - Labelling and Branding,
   - Launch timing, and
   - Volumes.

2. Document with the Product Development groups assistance and agreement with the Manufacturing group the following production and process requirements:
   - Production line options,
   - Production line dimensional limitation – (packaging infeed, filler, sealer, packer, palletiser),
   - Capacity restraints, and
   - Change parts.

3. The Retail or Wholesale customers requirements provide the final details and dimensional data required to allow the finalising of the package design. The Australian Food and Grocery Council (AFGC) has available on the ECR Australasia website and number of Toolkits to assist companies understand the Retailers requirements: www.tradingpartnerforum.com.au/toolkits/

   Customer requirements (retailer/wholesaler) include:
   - Case size (number per outer),
   - Shelf Ready & Shelving dimensions,
   - Case weight,
   - Maximise Shelf & Palletisation,
   - Barcoding, and
   - Case branding & information.



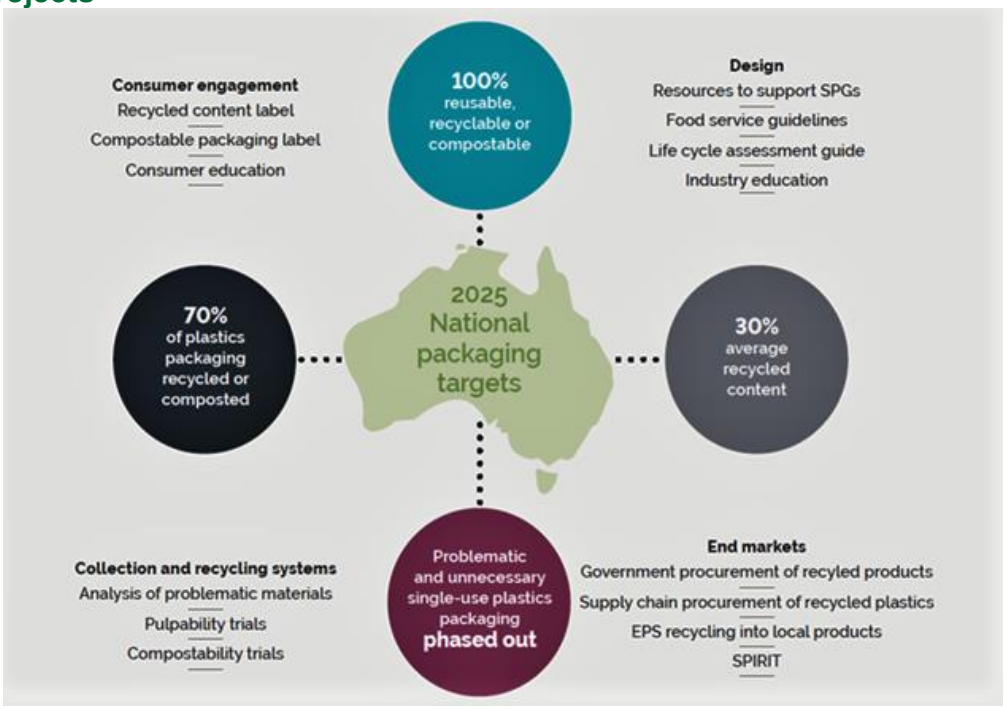
## Designing sustainable packaging

1. Start with commodity materials that are commonly recycled at major municipalities: #1 PET, #2 HDPE, aluminium, glass, paper, paperboard.
2. Design the package from a single material. Single-material packages are easier to identify and separate during recycling.
3. Undertake a PREP analysis to understand recyclability issues.
4. Review the product-to-package ratio. The package should be as small as possible while still protecting the product and providing adequate branding real estate.
5. Design for assembly at the point of manufacture. Think through the assembly steps, as well as the use of hand labour versus automation; the more efficient the better.
6. Avoid gluing and laminations. Laminations and glue make it difficult to separate materials for recycling and can negatively impact what would be an environmentally friendly package.
7. Design for distribution. Design the primary, secondary and tertiary package from the beginning, looking to optimise all package dimensions for pallet efficiency.
8. Eliminate secondary and tertiary packaging when possible. Look for opportunities to make the primary package more robust, as well as combining functions of shipper and point-of-purchase (POP) displays.
9. Design for disassembly. The end user will ultimately be responsible for cleaning and separating the packaging components for end of life disposal. Apply the Australasian Recycle label (ARL) so that the end user knows what needs to be done in disposing of the packaging.
10. Use Lifecycle Assessment (LCA). It is important to understand the entire supply chain in order to achieve sustainable savings and address environmental issues. Improvements in distribution could greatly offset a more premium material selection or increase in manufacturing complexity.

## Australian 2025 National Waste Targets

The Australian Packaging Covenant Organisation (APCO) was endorsed to lead the government's response to the China Ban issue, setting targets to achieve 100% recyclable, reusable or compostable packaging in Australia by 2025. The 2025 targets, are listed below:


### 2019 APCO Projects



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2. Moisture & Oxygen Barrier Chart: Best of plastics: Barrier packaging by Don Rosato, 2016.

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4. Australian Bioplastics Association. The peak body for bioplastics, who operate the verification program for compostable materials for AS4736 Industrially Compostable Materials and AS5810 Home Compostable Materials.

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