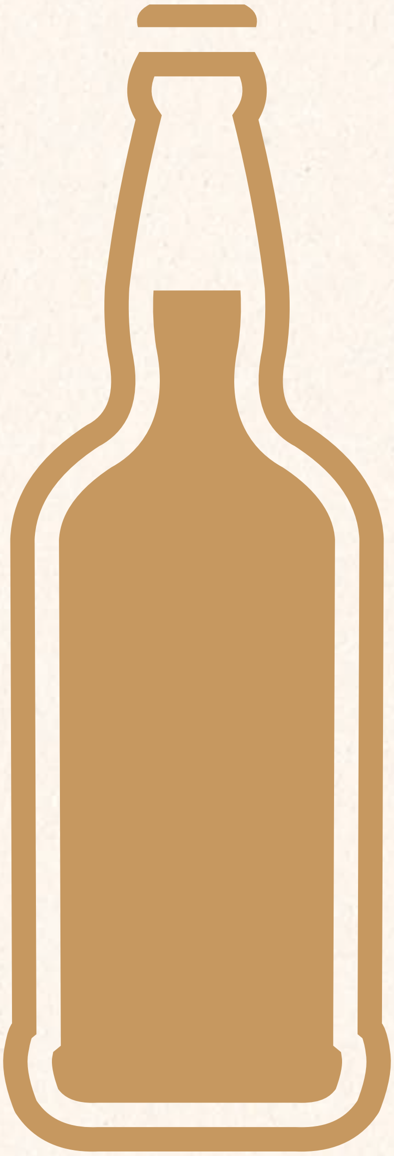
Design Smart Material Guide No.7

Australian Packaging Covenant

Glass Packaging



Australian Packaging Covenant

Contents

Purpose of this Guide

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

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 glass 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.

The information contained in this guide is 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.

You are probably designing your packaging to fulfil a particular function, rather than an intrinsic need to use glass 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. Maybe now is the time to consider a bigger change?

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 analysis of specific packaging systems is necessary to confirm the benefit 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.

If you or your organisation have any questions or comments about these guides, or would like to better understand packaging assessments, please contact the Australian Packaging Covenant at apc@packagingcovenant.org.au. The APC will endeavour to review the content of these guides on a regular basis to ensure currency and alignment to industry developments.

[1]Primary packaging contains the sales unit product (e.g. a glass bottle containing beer), secondary packaging contains a number of the sales units (e.g. six-packs in carrier board wraps, and a cartonboard box of 24 bottles), and tertiary packaging is the freight/distribution related packaging (e.g. a pallet, with pallet wrap and a cardboard 'slip').

The Life Cycle of Glass Packaging

By weight, glass-based packaging is the second most common form of packaging used in Australia after paper- and cardboard-based packaging. Most locally manufactured packaging glass sold in Australia contains at least 30% recycled content.

As a packaging material, glass has numerous positive functional characteristics; it is potentially reusable, highly recyclable, strong, transparent, can be formed into a wide variety of shapes, and is chemically resistant and inert.

There are a variety of different types of glass, however the main one used for packaging is 'soda-lime' glass. All references in this guide to 'glass' relate to soda-lime glass, unless otherwise indicated.

The general composition of glass, if manufactured from 100% virgin materials, is:

- **Silica sand (SiO^2) 68–73%**
- **Soda ash (Na^2CO^3) 12–15%**
- **Limestone ($CaCO^3$) 10–13%**
- **Alumina (Al^2O^3) 1.5–2.0%**
- **Other metal oxides ~1% (e.g. for colouring).**

However, virtually all glass packaging is manufactured with the inclusion of 'cullet', which is another name for crushed post-consumer glass containers. The inclusion of cullet significantly reduces the environmental impacts of glass manufacturing, and reduces waste going to landfill. Cullet allows the glass melting furnace to operate at a lower temperature, and eliminates the energy and other impacts that would have been required to mine and process an equivalent amount of virgin material inputs.

Smelting virgin materials to manufacture glass packaging also results in the direct emission of carbon dioxide (CO_2) due to the chemical reactions taking place. These direct greenhouse gas emissions are also reduced when cullet is used. See the Introductory Guide for a comparison of the greenhouse gas emissions and water inputs for glass production, versus other packaging material types.

The use of 50% post-consumer cullet reduces glass manufacturing energy consumption by approximately 10–15%, and greenhouse gas emissions by 20–30%.

While the use of cullet increases the energy efficiency and lowers greenhouse gas emissions from glass production, it is also a potential source of contamination. Glass manufacturing is sensitive to impurities such as: ceramics, metals (e.g. aluminium tamper-evident rings or steel jar lids), non-packaging glass types, plastics, cobalt blue glass, and some metal-based inks (which may be used for on-glass printing, although uncommon).

The Life Cycle of Glass Packaging

Prior to the addition of colourants (known as 'fluxes'), the colour of the glass is greenish yellow, due to the iron oxides that are present in the virgin materials. Therefore, to create 'colourless' glass, colourants such as magnesium (which imparts purple) are added until the glass is grey and appears colourless. Iron and sulphur are added to create amber (brown) glass, chromium to obtain green glass, and cobalt to produce blue glass.

If the cullet is of sufficient quality then glass can contain up to 90% recycled content; the approximate tolerances of the different glass colours for the inclusion of cullet are:

- **Flint: 50–60% cullet**
- **Amber: up to 90% cullet**
- **Green: up to 90% cullet**

While no longer economically feasible in Australia on a commercial scale, the reuse of glass packaging is the most environmentally beneficial outcome, if high return rates can be achieved. The next best options are to recycle glass packaging back into new soda-lime glass ('closed-loop' recycling) or into fibreglass applications.

This guide focuses on design considerations to improve the recovery of glass in closed-loop recycling, as well as ideas for reducing the environmental impacts of glass packaging during each phase of its life cycle.

In 2011, glass packaging represented nearly a quarter of all packaging sold (by weight) in Australia. 1,054,000 tonnes was consumed, of which 520,000 tonnes was recycled (49%).

APC data shows that the consumption of glass packaging grew from 850,000 tonnes in 2003 to 1,054,000 tonnes in 2010–11, an increase of 24%. The recycling rate for glass containers increased significantly over the same period, from 28% to 49%. Over half of the recovered container glass (55% of the 49%) is recycled back into packaging, giving an estimated average post-consumer recycled content of glass manufactured in Australia of somewhere in the order of 30%.

Even though it is highly recyclable, approximately half of the glass packaging sold in Australia is still finding its way into landfill.

The Life Cycle of Glass Packaging

Figure 1

Life cycle of glass packaging

Adapted from diagrams developed by GreenBlue (2011)

The Life Cycle of Glass Packaging

In favour

Life Cycle Related Considerations in Favour of Glass Packaging

- Relatively high diversion of glass packaging into recycling at end-of-life.
- While glass recyclate is not a high value material (compared to aluminium, PET or HDPE recyclate), demand for glass container recyclate is strong.
- Established and large-scale reprocessing facilities.
- Glass is well understood by the community to be a recyclable material.
- Glass packaging is theoretically 100% recyclable. The production of glass using cullet produces less greenhouse gas emissions, and requires less energy and virgin materials than using 100% virgin materials.
- A recycled content of up to 90% is feasible and sometimes achieved. However in practice the post-consumer recycled content of glass in Australia is usually significantly lower than this due to supply constraints. High recycled-content glass has no effect on functional performance.
- Glass provides excellent product protection – it is strong and durable and may require less secondary packaging than other packaging types.
- Products contained in glass are often shelf-stable, lowering wastage and refrigeration requirements. Glass is impermeable to oxygen and moisture, so product degradation can be slower than for some other packaging types.
- Glass is transparent, durable, and can be formed into a wide variety of shapes. It also provides an excellent moisture and gas barrier.
- Glass is chemically inert, which means there is no risk of food contamination from the packaging.
- If recovered glass is of insufficient quality for reprocessing back into packaging, or used in fibreglass manufacture, it can be reused in numerous other applications (e.g. as sand and aggregate substitutes).
- Dedicated collections of glass from commercial sites can produce large quantities of glass with low contamination rates.

The Life Cycle of Glass Packaging

Against

Life Cycle Related Considerations Against Glass Packaging

- Glass production is resource- and energy-intensive, particularly glass from virgin feedstocks.
- Glass is made from non-renewable (if abundant) resources. The land use impacts associated with mining, which include habitat destruction (potentially threatening biodiversity) and water system impacts, are significant.
- Glass is breakable, and broken glass is challenging to sort from commingled kerbside recycling streams at Materials Recovery Facilities (MRFs). In particular, glass fragments are a problematic contaminant during the downstream reprocessing of paper and cardboard and plastics.
- Broken glass is a safety hazard if it ends up in the litter stream.
- System losses of glass, between disposal at the kerbside and the production of a new glass container, can be high.
- Glass containers have thicker walls compared to the alternatives, which results in higher material use impacts and transport impacts.
- Glass reprocessing is very sensitive to some forms of contamination, particularly ceramics and metals.
- The closed-loop recycling of glass back into packaging reduces greenhouse gas emissions and the need for additional energy inputs. However, the recycling of glass back into secondary applications such as aggregates and sand substitutes does not generate the same level of environmental benefit.

Design Considerations for Glass 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).

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.

As with all other packaging materials, glass packaging systems have specific design constraints, which may limit the application of the resource efficiency design hierarchy. With this in mind, we have outlined the general design considerations for glass packaging in Figure 2. During material selection and packaging system design all of the aspects in Figure 2 should be considered.

Each of these design considerations is then discussed in more detail in Table 1.

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

Design Considerations for Glass Packaging

Figure 2

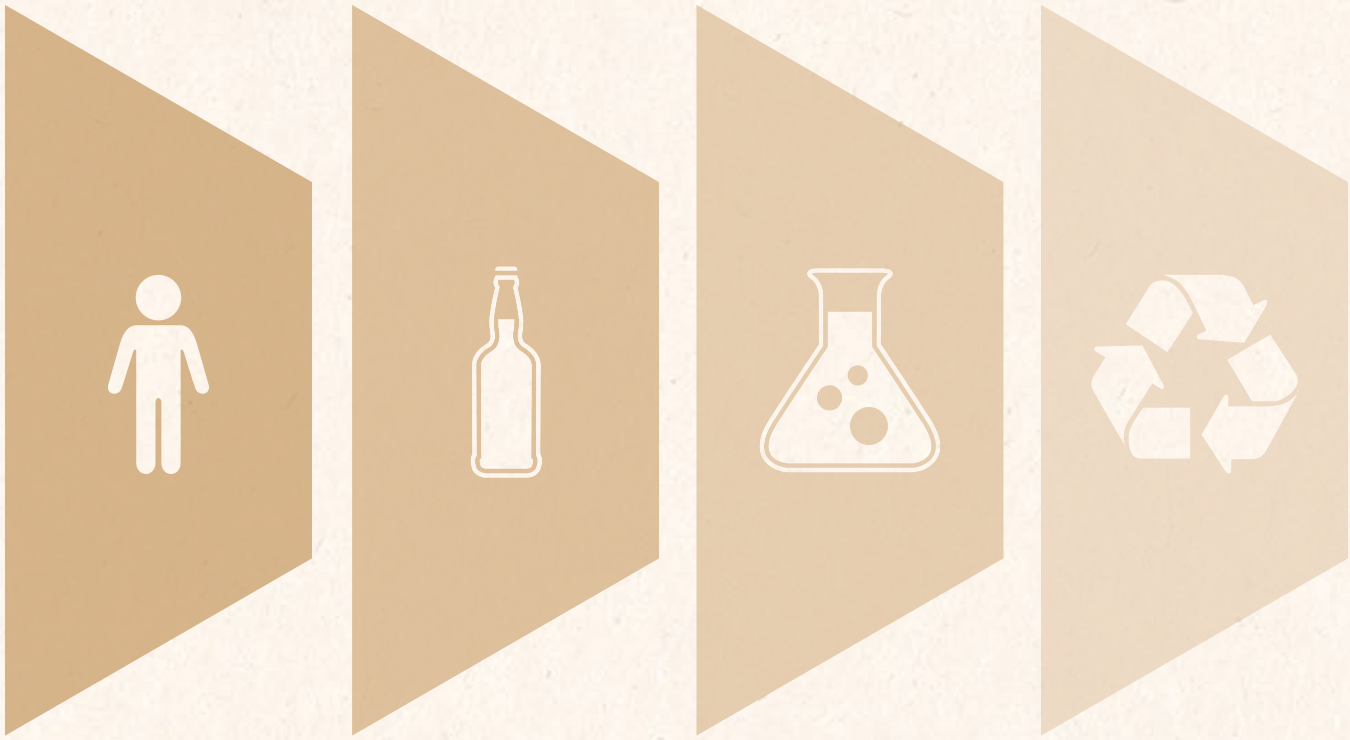
Summary of design considerations for glass packaging

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
- Withstand loads from stacking
- Minimise product waste by consumers
- Manage the trade-offs between primary, secondary and teriary packaging

Design to:

- Minimise the primary packaging
- Minimise the secondary packaging
- Use reusable/ returnable secondary packaging
- Recover filling line packaging losses
- Maximise product to packaging weight/ voulme ratios
- Maximise transport efficiences

Design to:

- Maximise recycled content in primary packaging
- Maximise recycled content in secondary packaging
- Minimise the use of problematic chemicals in coatings and lacquers

Design to/for:

- Avoid colours that are not accommodated by the three colour recycling split (flint, amber and green)
- Ensure compatibility of minor components with recycling systems
- Provide clear consumer information
- Maximise the value of recovered recyclate
- Minimise the impact of external coatings

Design Considerations for Glass Packaging

Table 1

SPG Principle	Design to	Design Considerations	Life Cycle Importance
1 - Design to be Fit-for-Purpose	Improve accessibility	Minimise the rotational force requirement for breaking the initial seal on screw-top containers. Find the right balance between how much vacuum suction is needed against how easy the container is to open. Rotational forces greater than 1.1 Nm (newton metre) often exceed the functional capabilities of the frail, elderly and those living with arthritis. Ensure that screw-top caps fit in the hand. Their removal should require no more than ¼ turn for each angular movement, and no more than two angular movements should be required. Use steep rather than gradual threading to prevent over-tightening of the cap. Stipulate a grip span of no more than 71 mm for products required to be gripped in one hand, and incorporate serrations in plastic caps to make them easier to grip. 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
	Withstand loads from stacking	If considering the down-gauging of your glass packaging (as discussed elsewhere in this guide), confirm with suppliers that the finished packaging will be sufficiently robust to tolerate the required stacking loads for your product. Transit test thinner/lighter weight glass to prevent product loss through damaged 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.	MEDIUM
	Manage the trade-offs between primary, secondary and tertiary packaging	Consider primary, secondary and tertiary packaging as a total system. In particular avoid functional overlap between the primary and secondary packaging levels. For example, most glass packaging formats are weight-bearing, so secondary packaging can provide less load-bearing functionality. 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 Glass Packaging

2 - Design for Resource Efficiency			
	Minimise the primary packaging	Avoid long necks, flat shoulders, sudden transitions in shape, square shoulders/heels and deep dimples (punts) at the bottom of glass bottles and containers, which usually add extra glass into the design to maintain container structural strength and internal volume. Consider shifting excess glass from wherever thickness is not critical to the areas where it is needed most. Glass is usually heavier than the alternatives, requiring more energy for manufacturing, transportation and reprocessing. Down-gauging glass packaging so that the minimum amount of material is used, without compromising the safety of the contents, is a particularly important design consideration. Less glass can also mean cheaper packaging. It is also important to keep in mind that thinner glass packaging is more likely to be broken into smaller pieces during kerbside collection or initial sorting at the MRF. Glass colour sorting equipment at glass reprocessing plants is improving all the time, and is typically able to accurately colour sort glass fragments of 10 mm or less in diameter. However, if these fragments are too small to be accurately colour sorted, then they are less likely to be recycled back into new glass packaging. Consider speaking to your glass suppliers and recyclers about this issue as they can help you to find the appropriate balance between down-gauging and recyclability. There are two common process for forming glass containers, which are 'blow-and-blow' moulding (usually for long neck bottles), and 'press-and-blow' moulding (usually for jars and increasingly for long neck bottles). Press-and-blow manufacturing might allow reduced wall thickness for your packaging. Check with your suppliers to find out if an alternative forming process will allow you to down-gauge. 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. Would direct printing of the label be a viable option for your product? Shrink fit plastic labels on glass packaging are not excessively problematic to either the separation of glass packaging at the MRF, or subsequent reprocessing, however they can retain glass fragments during crushing. Consider designing these labels so that they are removable by consumers, and provide consumers with clear instructions on the need to remove the label, and how to do it.	HIGH
	Minimise the secondary packaging	Minimise secondary packaging wherever possible. Shelf-ready packaging is becoming mandatory for many food and grocery items, and this may increase the packaging-to-product ratio. Look for opportunities to reduce costs and environmental impacts during the design process. Minimise the size of the front face on shelf-ready packs to ensure that the product is highly visible to consumers. Down-gauge secondary packaging as much as possible, while ensuring that the integrity of the primary pack is not compromised.	HIGH

Design Considerations for Glass Packaging

2 - Design for Resource Efficiency	Use reusable/ returnable secondary packaging	Returnable plastic crates/trays (RPCs) that are collapsible or nestable are increasingly being used by the major supermarket chains. The life cycle and cost benefits of using RPCs instead of cardboard boxes are significant. Supply chain product losses are also reported as significantly lower when using returnable plastic crate systems, however this relates more to fresh foods such as fruit and vegetables than robust shelf-stable products in glass packaging. The market is moving in this direction, so consider if your product could be supplied in RPCs.	MEDIUM
	Recover filling line packaging losses	While filling line glass packaging losses are generally very low, confirm with filling line operators that they have glass recycling systems in place.	LOW
	Maximise product to packaging weight/volume ratios	Many products packaged in glass 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.	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.	LOW

3 - Design with Low-Impact Materials	Maximise recycled content in primary packaging	Ask your glass packaging supplier for information on the post-consumer recycled content percentage of your packaging. Find out if this can be increased. Provide recycled content information on the label to let consumers know the level of recycled content, and if appropriate, that you are working on increasing it. To increase the recycled content, review your clarity specifications to see if it's possible to allow a subtle green tint in white flint where this won't affect the product appearance. Or similarly, review your amber specifications to allow a greater amount of recycled glass to be used, perhaps resulting in a slightly lower level of redness. Consider moving from flint to a high-recycled content green or amber glass if this is compatible with your product. Green and amber glasses allow the highest recycled content of the main glass colours.	HIGH
	Maximise recycled content in secondary packaging	Specify the highest possible level of post-consumer content in cardboard or polyethylene over-wraps and other forms of secondary packaging (e.g. shelf-ready packaging), while maintaining the required functional performance of the secondary packaging.	MEDIUM

Design Considerations for Glass Packaging

3 - Design with Low-Impact Materials	Minimise the use of problematic chemicals in the packaging	A softened form of polyvinyl chloride (PVC) plastic is often applied to the inside of the metal lids on glass containers to provide an air-tight seal. Pure PVC is a hard material, so where necessary it is softened using additives called ‘plasticisers’. These are often from a group of chemicals called phthalates, some of which have been identified as reproductive toxicants and endocrine disruptors. Phthalates leach from the seals, and often end up in very low concentrations in food. They are somewhat volatile (become a gas at room temperature), so even if the food contents of the container don’t come into contact with the seal, the phthalates may still transfer to a degree. This is a complex and developing area, so we recommend you do some further reading on this issue and ask your suppliers what type of plasticiser they use. As a precautionary measure, consider shifting away from the use of phthalate-based plasticisers, but make sure that the alternative is safe and effective. There are no known health issues associated with the use of the internal and external coatings used on glass packaging. These include external coatings based on tin oxide and fatty acids/waxes (which lubricate the outside surface of the glass), and an internal dealkalisation ‘treatment’ using a sulphur- or fluorine-based salt.	MEDIUM
4 - Design for Resource Recovery	Avoid colours that are not accommodated by the three-colour recycling split (flint, amber and green)	Avoid the use of dark green, dark or arctic (pale) blue, and black glass, as these coloured glass types are contaminates in the three specifications for closed-loop recycling: flint (clear), amber and green. These types of coloured glass will either be contaminates in closed-loop glass container reprocessing, down-cycled into lower value secondary applications (e.g. road base), or disposed to landfill. If you are considering using a glass colour other than flint, green or amber, then check with your glass supplier or recyclers to ensure that it will be compatible with current glass reprocessing systems.	HIGH
	Ensure compatibility of minor components with recycling systems	The glassmaking process is significantly impacted by metals contamination. Metals can damage furnaces during batch melting, discolour the melt, or cause structural defects in glass containers. Avoid or minimise the use of very small metal components in your packaging design (e.g. tamper-evident rings and RFID tags). Steel components (e.g. closures) are very commonly associated with glass containers. While steel is a serious contaminate in the glass melting furnace, it is easily separated from glass using magnets. This is done both at the MRF, and then after glass colour sorting and crushing (beneficiation) at the glass reprocessing facility. Both plastics and aluminium are more difficult to separate from crushed glass than steel, so steel closures are usually the best option. If the use of metal or rigid plastic components can’t be avoided, design these components so they are easily separable from the glass, to improve the recyclability and value of the glass recyclate. Consider providing consumers with clear instructions on the need to do this, and how to do it. Plastics are problematic in the glass smelting process; small pieces of plastic are destroyed in glass furnaces, however they tend to create bubbles in the melt which must be removed by the addition of ‘fining agents’ such as sodium sulphate, arsenic oxide and antimony oxide. Avoid the use of metal-based inks for on-glass printing. Consider using organic coatings or overprinting to provide packaging colour and labelling, as these will burn off easily during the melting process.	HIGH

Design Considerations for Glass Packaging

	In general, paper labels and plastic labels (e.g. pressure-sensitive labels) present minimal issues to glass recycling, although paper is preferable. Full body shrink labels made from plastic are more problematic, as they may trap pieces of broken glass after crushing. This can result in glass being lost when the label is removed, or the label being too heavy to be removed and ending up in the glass furnace. Either way, the label can interfere with the optical sorting of the glass. If full body shrink labels need to be used then ensure that the label is removable by consumers, and that clear instructions are provided on the label on how to do this. 'Lightning style' or 'swing-top' closures, which consist of a metal cage, plug and rubber gasket (sometimes seen on premium beers, and speciality food and wine bottles), can be problematic in glass reprocessing, and should be avoided. If their use is required, then consider using a plastic plug, which is less problematic than ceramic in glass reprocessing. Can the closure be designed to be removed by the consumer? If so, then provide clear instructions on the packaging on how to do this. Capsules are protective sleeves used to cover the top of bottles, and are usually made from aluminium foil or plastic film. Avoid or minimise the size of capsules where possible. If a capsule is required (e.g. as a tamper-evident feature), then try to avoid the use of aluminium, as plastic capsules are less problematic in glass furnaces.	
Provide clear consumer information	Ensure that recycling messages are visible and provide clear guidance to consumers. The Mobius loop recycling symbol is recommended, plus the words 'rinse and recycle' where relevant. Provide a clear anti-littering message for products that are more likely to be consumed away from home. See the Introductory Guide for more on labelling.	HIGH
Maximise the value of recovered recyclate	You can maximise the value of recovered recyclate by avoiding the use of coloured glass that is not compatible with the current three-colour recycling split. Preferably specify the use of flint glass for your product, as this is the most easily reused form of cullet.	MEDIUM
Minimise the impact of external coatings	Glass containers usually receive two exterior coatings during the manufacturing process. The first coating, termed the 'hot end' coating, is applied after the container is formed and before annealing. This coating is usually a thin layer of oxidised tin or titanium tetrachloride. The second coating, termed the 'cold end' coating, is applied after annealing, and consists of a lubricant such as oleic acid (which is a fatty acid that occurs naturally in many plants and animals) or polyethylene wax (a synthetic product). In combination the two layers provide important protection against surface scratches, helping to avoid fractures and failure of the container. The external coatings that are applied to glass containers are not problematic in the recycling process, and are beneficial in protecting glass containers during use and recovery. However, there are a number of functionally equivalent "cold-end" coatings available. Ask your supplier about the different coating options that are compatible with your product, to see if it is possible to select coatings with a lower environmental impact.	LOW

Design Example

This design example illustrates some of the sustainability design aspects that could be considered during a packaging development or review. The brief is for a glass pack for jam that will stand out on the shelf and differentiate the product in a busy category. The industry standard is a glass jar with a metal screw top lid and a paper label.

Sustainable design considerations

Design for efficiency

Cylindrical shapes with straight vertical sides are stronger and use less material than those with square sides or sudden transitions in shape.

Container glass manufactured in Australia contains an average of 30% recycled cullet. This could be increased for off-spec colours, so discuss this with suppliers.

For an efficient label:

- Choose a lightweight material, as the label is unlikely to be recovered
- Optimise label size (minimise waste but ensure that all text is readable)

Design for accessibility

Many people with limited strength or dexterity have difficulty opening conventional round metal lids. Consider alternatives[1]:

- A lid which has rounded edges, and a high friction surface that is easier to grip and control e.g. a textured surface is one approach
- A jar profile with grip indentations or a high friction surface
- A lid that is not perfectly circular, because it accommodates a variety of grip sizes
- A screw top cap that fits in the user's hand and requires no more than two ¼ turns to open. A steep thread is recommended

Design for recycling

Clear glass is preferred for jam because it displays the product. It is also highly recyclable.

Use a paper label instead of plastic. Plastic labels can cause glass pieces to clump together after crushing and these may get rejected at the colour sorting stage.

[1]In 2011 Nestle redesigned its Nescafe Gold coffee jar with an easy-to-hold jar, 'click and lock' screw cap and easy-peelable foil membrane. www.nestle.com/Media/NewsAndFeatures/Pages/packaging_design_easier.aspx?Category=Investors,Brands,Coffee,HealthcareNutrition,RandD

Design Example

Minise food waste

Some shapes make it difficult to remove the last of the product, e.g. if they have grooves at the bottom of the jar. Make it easy to dispense the product:

- Provide a large opening, e.g. with a low, wide jar rather than a tall, narrow jar
- Avoid grooves, flat shoulders and square heels

GROOVES AND RECESSES
in the jar increase product waste

Consumer labelling

Encourage the consumer to recycle:

- Print the Mobius loop on the jar and a brief message, e.g. ‘please recycle’
- Mould the Plastics Identification Code for onto the cap if made from plastic, and provide consumers with instructions to dispose of the jar and lid separately

More innovative ideas that could be explored

Use a wrap-around paper label, with minimal adhesive, to allow consumers to remove the label for recovery into paper recycling. Provide consumers with label instructions to do this.

Useful Further Reading

Reference	What is it?
ACOR, 2012. Beneficiated Cullet Specification (Glass), Australian Council of Recycling. 7 pages.	This ACOR document provides crushed glass cullet colour and contamination specifications. The very low levels of acceptable metals and ceramic contamination are worth noting. Free download from: www.acor.org.au
APC, 2010. Sustainable Packaging Guidelines, Australian Packaging Covenant. 30 pages.	The SPG is the key document for APC signatories and others to use in undertaking 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
GreenBlue, 2011. Design for Recovery Guidelines: Glass Packaging, California: GreenBlue. 34 pages.	This US packaging guide provides lots of great information on the effects of different physical aspects of glass packaging on the practical recyclability of glass packaging. The document also provides an overview of glass packaging manufacturing processes and glass packaging collection, sorting, and reprocessing operations. Free download from: www.greenblue.org/publications
PRAG, 2009. An introduction to Packaging and Recyclability, United Kingdom: Packaging Resources Action Group. 23 pages.	A comprehensive overview of packaging design aspects, particularly with respect to the impact upon end-of-life recyclability. Some information specifically on glass packaging. Free download from: www.wrap.org.uk

Useful Further Reading

Sustainable Packaging Coalition, 2009. Environmental Technical Briefs of Common Packaging Materials: Metals and Glass in Packaging, Virginia: Green Blue Institute. 32 pages.

Life cycle-based information and data intended to assist packaging designers with understanding the environmental and human health impacts of using steel and glass in packaging. Order from: www.sustainablepackaging.org

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

WRAP, 2009. Efficient use of resources in hot drinks packaging design, United Kingdom. 75 pages.

This report looks in detail at glass-based packaging systems. It provides a lot of design examples, as well as extensive detail on UK "best-in-class" glass packaging design, with a strong focus on light-weighting. Free download from: www.wrap.org.uk/content/report-efficient-use-resources-hot-drinks-packaging-design

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