Design Smart Material Guide No.5

Australian Packaging Covenant

Aluminium Packaging

Australian Packaging Covenant

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Purpose of this Guide

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

Its purpose 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 aluminium-containing 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 aluminium 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?

[1]Primary packaging contains the sales unit product (e.g. an aluminium can containing soft drink), secondary packaging contains a number of the sales units (e.g. a cartonboard box of 24 cans), and tertiary packaging is the freight/distribution-related packaging (e.g. a pallet, with pallet wrap and a cardboard 'slip').

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.

The Life Cycle of Aluminium Packaging

In packaging applications there are three types of aluminium alloys that are most commonly used: the 1000-series, 3000-series and 5000-series alloys. The 3000-series alloy, of which aluminium beverage can bodies are made, contains the most recycled aluminium packaging. Manganese is the primary alloying element in the 3000-series alloy. The second most common alloy in packaging, the 5000-series alloy, contains magnesium for hardness and is used to make beverage can lids, pull tabs, and other rigid containers. The 1000-series alloy is almost pure aluminium containing less than 1% alloying elements. It is more pliable than the other alloy series, and is often used in aluminium foil applications.

All these alloys are compatible with current Australian aluminium recycling systems. It is common for all recovered aluminium packaging to be reprocessed into new ingots of 3000-series alloy, even if some of the recovered aluminium is made from a different alloy.

Aluminium foil is defined in this guide as any aluminium layer that is less than 0.2 mm (200 micrometres or μm) in thickness. As a general rule of thumb, any aluminium layer less than 0.2 mm in thickness is probably not recoverable at end-of-life (for comparison, the body and lid of an aluminium beverage can are typically around 0.25 mm in thickness). Rigid and semi-rigid aluminium trays (e.g. for human or pet food applications) can have a thickness in the range 70–300 μm, so might be 'technically' recoverable depending on the actual thickness.

Aerosol cans account for a significant proportion of non-beverage aluminium packaging. Other significant applications of aluminium packaging include: pet food and sea food (e.g. sardines) rigid packaging, semi-rigid foil trays, closures (e.g. twist caps on wine bottles) and foils.

Virgin aluminium production is highly resource-intensive – see the Introductory Guide for a comparison of the greenhouse gas emissions and water inputs for aluminium production, versus other packaging material types. However, the recovery of recycled aluminium back into packaging is much less resource- and greenhouse gas emission-intensive.

Consumption of aluminium beverage packaging grew from 45,700 tonnes in 2003 to 57,200 tonnes in 2010–11, an increase of 25%. The recycling rate for used beverage cans (UBCs) increased only slightly over the same period, from 63% to 64%. The recycling rate for non-beverage aluminium packaging was 41% in 2010–11. A relatively high proportion of aluminium packaging, even though it is generally recoverable, is still finding its way into landfill.

Beverage cans are by far the largest aluminium packaging application by weight, accounting for nearly 90% of all aluminium use in packaging.

The Life Cycle of Aluminium Packaging

Figure 1

Life cycle of aluminium packaging

Adapted from diagrams developed by GreenBlue (2011)

The Life Cycle of Aluminium Packaging

In favour

Life Cycle Related Considerations in Favour of Aluminium Packaging

- High diversion of aluminium used beverage containers (UBCs) into recycling at end-of-life.
- Recycled aluminium smelting and production requires relatively low energy inputs and produces relatively small amounts of greenhouse gas emissions.
- UBCs and aluminium aerosols are relatively easy to separate from other packaging materials at Materials Recovery Facilities (MRFs). This is because aluminium is electrically conductive, and can therefore be sorted using electrically induced magnetic fields generated by “eddy current” sorting equipment.
- There is strong demand for aluminium UBCs, as they have the highest value per tonne of all packaging materials. UBCs can be readily reprocessed back into new aluminium sheet.
- Established and large-scale reprocessing facilities.
- Rigid aluminium packaging of sufficient thickness is virtually 100% recyclable. The production of aluminium using recyclate uses about 5% of the energy used by production from aluminium ore (bauxite).
- A recycled content of >90% is feasible, however in practice the post-consumer recycled packaging content of aluminium sheet utilised in Australia is much lower than this.
- Provides excellent product protection – strong and durable, and so may require less secondary packaging than other packaging types.
- The product is shelf-stable, lowering wastage and refrigeration requirements.
- Very thin layers of aluminium foil may be sufficient to achieve the required packaging functionality. However, any aluminium layer less than 0.2 mm (200 μm) in thickness is probably not recoverable at end-of-life (see below under ‘considerations against’). Aluminium beverage can walls and lids are typically around 0.25 mm thick.
- Aluminium layers manufactured using vapour deposition on a substrate (often a plastic film) are ultra-thin (40–100 nanometres). This type of aluminium layer provides the required barrier properties, and although not recoverable, it is so thin as to contain a trivial amount of aluminium.

A square kilometre of 70 nm-thick aluminium would weigh 190 kg.

- Aluminium has a similar density to glass (2.7 g/cm^3), and about a third the density of steel. However aluminium can substitute for both of these materials in containers, while achieving significant weight reductions.
- Aluminium can have similar (or better) life cycle environmental performance, when adjusted for functional performance, than many substitute packaging materials. This is due to its light weight and its potential to be recycled in a closed loop (i.e. back into its original packaging application). However, due to the significant inputs required to manufacture virgin aluminium, the recovery of aluminium packaging at end-of-life is particularly important, as this recovery and reuse is one of the most significant factors in off-setting the up-front impact. Putting this in another way, the landfilling of aluminium packaging has a particularly large impact on the environmental performance of aluminium packaging, when compared with other packaging materials.

The Life Cycle of Aluminium Packaging

Against

Life Cycle Related Considerations Against Aluminium Packaging

- Virgin aluminium production is very resource- and energy intensive.
- Virgin aluminium production is very emissions-intensive, including greenhouse gases.
- The significant impacts of bauxite refining, including the impacts of waste products such as caustic effluents and 'red-mud', which is the iron-rich component of bauxite.
- The current low recycling rate for aluminium non-beverage packaging at end-of-life.
- Bauxite (aluminium ore) is a non-renewable (if abundant) resource. The land use impacts associated with mining, which include habitat destruction (potentially threatening biodiversity) and water system impacts, are significant.
- Aluminium packaging is not typically suitable for reuse.
- Unless highly compacted, aluminium foil (<0.2 mm) is unrecoverable, as it will generally combust (oxidise) in the melt furnace during reprocessing.
- From a consumer perspective: the product inside aluminium packaging is not visible, and the packaging cannot generally be resealed after opening.
- There are some scientific and consumer concerns about Bisphenol A (BPA) migrating from internal beverage can lacquers into the product, although Food Standards Australia New Zealand (FSANZ) reports no health or safety issues at typical exposure levels, including those for small children.
- Composite packaging materials (multi-layer laminates), incorporating an aluminium layer (e.g. aseptic liquid paperboard), are not recyclable with existing processes. Some of this aluminium might be recycled if the pack is exported, however the level of this recovery is unknown and probably very low.

Design Considerations for Aluminium 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, aluminium 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 aluminium 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 Aluminium Packaging

Figure 2

Summary of design considerations for aluminium packaging

Design to be fit-for-purpose
SPG principle 1

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

Design for resource efficiency
SPG principle 2

Design to:
- Minimise the thickness of aluminium foils or move to vapour deposition based composites
- Minimise the secondary packaging
- Minimise the primary packaging
- Use reusable/ returnable secondary packaging
- Recover filling line packaging losses
- Maximise product to packaging weight/ volume ratios
- Maximise transport efficiencies

Design with low-impact materials
SPG principle 3

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 for resource recovery
SPG principle 4

Design to/for:
- Ensure compatibility of minor components with recycling systems
- Provide clear consumer information
- Eliminate or minimise the use of aluminium layers or components
- Ensure compatibility of minor components with recycling systems
- Maximise the value of recovered recyclate
- Print directly onto the aluminium packaging

Design Considerations for Aluminium Packaging

Table 1

SPG Principle	Design to	Design Considerations	Life Cycle Importance
1 - Design to be Fit-for-Purpose	Improve accessibility	Consider alternatives to the conventional ring-pull tab. If using a ring pull, make it easier for the consumer to access, either by raising the ring or providing a depression under the ring. Ensure there are no sharp edges on the lid or ring pull. Peelable aluminium foil ends can assist in improving accessibility, if they are easy to open. Ensure that the force required to pull the seal does not exceed 22 newtons, and avoid seals that require a tool to puncture. Minimise the rotational force requirements for breaking the initial seal on screw-top containers. Rotational forces greater than 1.1 Nm (newton metre) often exceed the functional capabilities of the frail, elderly and those living with arthritis. 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 use of a down-gauged aluminium sheet (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.	HIGH
	Minimise product waste by consumers	For aerosol cans, choose a propellant that maximises the proportion of product in the can.	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 aluminium packaging formats are weight-bearing, so secondary packaging is required to provide little, if any, 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 Aluminium Packaging

2 - Design for Resource Efficiency			
	Minimise the thickness of aluminium foils or move to vapour deposition-based composites	Thin aluminium foil is generally not recyclable, so if your packaging application incorporates an aluminium foil element of less than 0.2 mm in thickness, then the best approach is probably to down-gauge the foil thickness as much as possible (while maintaining functional performance), so as to minimise the loss of aluminium to landfill or during smelting. Alternatively, if your foil is around 0.2 mm in thickness, and down-gauging is not feasible, then redesign of the packaging to facilitate the recovery of the foil layer is possibly the best approach. This could even involve "up-gauging" the thickness of the aluminium layer, although this would have to be considered very carefully. As a general rule of thumb, rigid and semi-rigid aluminium trays for food applications are based on aluminium foil with a thickness in the range 70–300 μm. Another option is to shift from aluminium foil to a metallised film. These have an aluminium layer manufactured using vapour deposition of aluminium onto another substrate (often a plastic film), where the aluminium layer is ultra-thin (40–100 nm) but can be functionally equivalent to much thicker aluminium foil. While the aluminium is not recoverable from these types of packaging materials, it is so thin as to contain a trivial amount of aluminium, so consider shifting from the use of an aluminium foil to the use of a metallised film. As neither aluminium foil (under 0.2 mm), or aluminium metallised films, are recoverable with current systems, from an overall life cycle perspective, the use of the metallised plastic films is probably going to result in a lower life cycle impact.	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. Consider using cut-away windows in multi-pack cartons. Down-gauge secondary packaging as much as possible, while ensuring that the integrity of the primary pack is not compromised.	HIGH
	Minimise the primary packaging	Consider using in-store shelf-ready packaging for product communication rather than relying on additional primary packaging components. For example, avoid using cartonboard wraps around products in aluminium trays. Consider whether it is possible to reduce the amount of printing on the primary packaging 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. Rigid plastic components are problematic in the aluminium recycling process. They can cause quality and safety issues during the delacquering of aluminium recyclate. Aluminium reprocessors may reject bales of recovered aluminium if the levels of contaminates, such as plastics, are too high. As much as possible, plastic components should be omitted or minimised from packaging designs to improve the recyclability and value of the recyclate. Plastic film labels (e.g. shrink fit) on aluminium packaging are not excessively problematic to either the recovery of packaging at the MRF, or subsequent reprocessing, but should be avoided or minimised as much as possible. PVC films should be avoided due to their high chlorine content, which is a contaminate during aluminium reprocessing. Preferably use direct printing on the aluminium container.	HIGH

Design Considerations for Aluminium Packaging

2 - Design for Resource Efficiency		Composite multi-layer cartonboard (liquid packaging) laminates, which incorporate a layer of aluminium foil, are not practically recyclable in Australia, and the aluminium layer will definitely not be recovered. Packages made from this material are used to hold products such as long-life milk, stocks and fruit juices, and it is an excellent material in terms of barrier properties, shelf stability, strength and low weight. A typical composition of this laminated material is 70–75% wood fibre, 20% LDPE film(s) and 4% aluminium foil. Consider if the barrier/product protection functionality provided by the aluminium layer is necessary for your product, as multi-layer (liquid packaging) laminates without the aluminium layer are available. Consider if a recoverable mono material primary packaging material type is available to fulfil your application.	
	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 and cost benefits of using returnable plastic crate systems, instead of cardboard boxes, are potentially 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 more robust shelf-stable products in aluminium 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 aluminium packaging losses will be very low, confirm with filling line operators that they have aluminium recycling systems in place.	LOW
	Maximise product-to-packaging weight/volume ratios	Many products packaged in aluminium 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 suppliers for information on the proportion of recycled content in your packaging. Enquire about the availability of aluminium packaging that has the highest possible proportion of recycled content. Specify the highest possible level of post-consumer content in labels and any other primary packaging components.	MEDIUM
	Maximise recycled content in secondary packaging	Specify the highest possible level of post-consumer content in cardboard or polyethylene over-wraps and shelf-ready packaging, while maintaining the required functional and strength performance of the secondary packaging. Keep in mind that many aluminium packaging options are self-supporting and may require less structural integrity in secondary packaging.	MEDIUM

Design Considerations for Aluminium Packaging

3 - Design with Low-Impact Materials	Minimise the use of problematic chemicals in coatings and lacquers	Inks and lacquers are applied by spraying to both the interior and exterior of nearly all aluminium containers (including beverage cans), and are then baked on. These coatings need to be removed, but are generally not problematic during aluminium reprocessing; however they can have other environmental issues associated with them. Often these coatings 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. to 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. Discuss with your packaging material supplier whether alternative low-VOC or water-based inks and lacquers are available that will fulfil your requirement. This type of change may reduce emission management-related costs and improve the health of the local environment, and will assist your supplier in maintaining a healthy work environment. Rigid aluminium packaging for food and beverages almost always has a thin layer of plastic (e.g. an epoxy-acrylic) lacquered onto the inside of the container to provide protection from acid corrosion and oxidation. This layer may contain Bisphenol A (BPA), which is a weak endocrine disruptor that appears to interfere with normal hormone function, and does measurably migrate into products contained by aluminium packaging, particularly those high in fat. Heavier film weights are used for soft drinks due to their high acidity. FSANZ advises that BPA is not a health or safety risk at the levels to which most people are exposed. This is a developing (and contested) area, so consider undertaking a risk assessment of potential BPA migration into your product, particularly if it is intended for consumption by small children.	MEDIUM

4 - Design for Resource Recovery	Ensure compatibility of minor components with recycling systems	Consider using a ‘skeletal’ carton-board wrap for multi-packs, rather than a polyethylene film. Residential collection of plastic film for recycling is currently very low, and is unlikely to improve markedly for at least 3–5 years. Rigid plastic components are problematic in the aluminium recycling process. They can cause quality and safety issues during the delacquering of aluminium recyclate. Aluminium reprocessors may reject bales of recovered aluminium if the levels of contaminates, such as plastics, are too high. As much as possible, plastic components should be omitted or minimised from packaging designs to improve the recyclability and value of the recyclate. Plastic film labels (e.g. shrink fit) on aluminium packaging are not excessively problematic to either the recovery of packaging at the MRF, or subsequent reprocessing, but should be avoided or minimised as much as possible. PVC films should be avoided due to their high chlorine content. Preferably use direct printing on the aluminium container.	HIGH

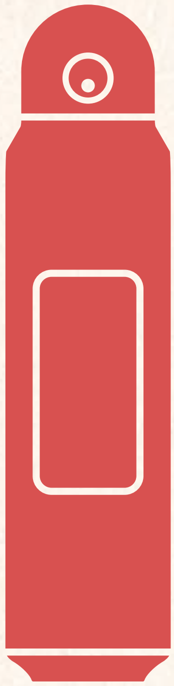
Design Considerations for Aluminium Packaging

4 - Design for Resource Recovery			
	Provide clear consumer information	End-of-life aluminium UBCs have enjoyed high, but unchanging recycling rates (60–70%) for many years. However other forms of aluminium packaging have lower recycling rates, so ensure 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 or (for aerosols), ‘recycle when the can is completely empty’. 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 in general.	HIGH
	Eliminate or minimise the use of aluminium layers or components	As neither aluminium foil (under 0.2 mm), or aluminium metallised films, are recoverable with current systems, from an overall life cycle perspective, the use of metallised plastic films is probably going to result in the lowest life cycle impact. Aluminium screw-tops (e.g. used as wine closures and on some other glass bottles) are typically made from 5000-series aluminium, and will not cause any problems in aluminium reprocessing. However, due to their small size they may be unlikely to be recovered into the aluminium (mostly UBCs) stream at MRFs. The tamper-evident ring usually associated with aluminium screw tops will remain with the glass bottle, and are unlikely to be recovered by glass reprocessors. Investigate options to minimise the aluminium used in such closures as much as is feasible. Alternatively, consider shifting to a plastic closure, which is unlikely to be recovered either, but may be less resource-intensive to manufacture. Avoid the use of composite bi-metal beverage cans which have steel bodies with aluminium ends (which are currently rare in Australia). Electro-magnets at Materials Recovery Facilities (MRFs) will generally divert these types of composite metal packaging into the steel can stream early in the sorting process and the aluminium components will be lost during steel smelting.	MEDIUM
	Maximise the value of recovered recyclate	Most aluminium aerosols are manufactured from 1000-series aluminium, which is recyclable; however consumers do not always understand that aerosols are recyclable. Consider providing clear recycling instructions on aerosol cans, and as suggested earlier, minimise the use of components made from other materials (e.g. plastics). Propellants in aerosols can be either hydrocarbon-based (e.g. propane), or non-hydrocarbon-based (e.g. carbon dioxide or nitrous oxide). The hydrocarbon-based propellants in particular can cause safety issues when the container is ruptured, which is most likely to occur during compaction and baling at a material recovery facility (MRF). For this reason, and due to the non-aluminium components used in aerosol packaging, such as plastic and steel components (e.g. the cap and valve), aluminium aerosols are often not labelled as recyclable. While the potential safety risks associated with hydrocarbons can generally be managed by MRF operators, consider whether it is feasible to use a non-hydrocarbon based propellant to improve the safety of aluminium aerosols recovery.	MEDIUM
	Print directly onto the aluminium packaging	Paper and plastic film labels (e.g. shrink fit) on aluminium packaging are not excessively problematic to either the recovery of packaging at the MRF, or subsequent reprocessing, but should be avoided or minimised as much as possible, as they will not be recovered. PVC films should be avoided due to the high chlorine content. Preferably print directly on the aluminium container.	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 an aerosol can for deodorant. The industry standard pack is aluminium with an integrated valve.

Sustainable design considerations



Design for efficiency

- Specify aluminium with a percentage of recycled material[1]
- Lightweight as much as possible

Design for accessibility

- Make sure the cap can be easily removed (where fitted)
- Increase the size of the actuator (button) so that it's ergonomic and easy to press

Design for recycling

Aerosol cans are recyclable. Ideally the plastic components should be removed first because they reduce the value of the baled aluminium to a recycler. Hydrocarbon propellants are a potential safety risk during the baling process at a MRF, but one that can generally be managed by the operator.

To maximise recyclability:

- Design the nozzle so that it can be easily removed from the can
- Ensure that 100% of the contents can be dispensed during use, e.g. by optimising the curvature of the base
- Provide clear instructions for consumers (see below)

Lower impact propellant

- Choose a non-flammable propellant with minimal environmental impact[2].
- Investigate technologies that could reduce the amount of propellant required to deliver the product[3]

Consumer labelling

Many consumers don't know that aerosol cans are recyclable. Provide information on the can in a prominent location, including:

- The Mobius loop recycling symbol
- A consumer message like 'Ensure that the can is completely empty. Please remove the cap and nozzle before recycling. If all plastics are included in your kerbside recycling service, add these to the recycling bin as well as the aluminium can'

More innovative ideas that could be explored

Use a manual pump spray rather than an aerosol. Hydrocarbons that are commonly used as propellants do not damage the ozone layer, but they are a greenhouse gas.

[1]Ball Corporation has developed a new technology that allows the use of recycled material in aluminium aerosol cans. It can also be up to 10% lighter without affecting packaging integrity - see: www.prnewswire.com/news-releases/ball-introduces-sustainability-breakthrough-in-aluminum-aerosol-packaging-147752425.html

[2]A new aerosol system developed in the UK uses 'dead air' rather than hydrocarbon propellants – see: www.cosmeticsdesign.com/content/view/print/308049

[3]Unilever's new deodorant has been downsized from 150ml to 75ml, but it delivers the same amount of product with less propellant – see: www.dailymail.co.uk/news/article-2273076/Your-deodorant-shrinks--price-doesnt-Firm-reduces-size-cans-bid-green.html

Useful Further Reading

Reference	What is it?
ACOR, 2012. Recycling Guide for Beverage and Food Manufacturers Marketing in Aluminium, Australian Council of Recycling. 10 pages.	This Australian Council of Recycling (ACOR) document provides an overview of aluminium recycling in Australia, along with details on markets for recyclate and contaminates to the aluminium recycling process. 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: Aluminium Packaging, California: GreenBlue. 39 pages.	Lots of great information discussing the different packaging applications of aluminium, the manufacturing processes, and the possible end-of-life outcomes for the packaging. Free download from: www.greenblue.org/publications/
ILSI Europe, 2007. Packaging Materials 7: Metal Packaging for Foodstuffs, Brussels: International Life Sciences Institute (ILSI). 44 pages.	This is a fairly technical report that provides an excellent overview of the numerous chemicals used in steel and aluminium packaging, and provides detail on the food safety and toxicology aspects that relate to the use of these chemicals. Free download from: www.ilsi.org

Useful Further Reading

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 aluminium packaging. Free download from: www.wrap.org.uk

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

This SPC report provides life cycle-based information and data intended to assist packaging designers with understanding the environmental and human health impacts of using steel and aluminium in packaging. Lots of great information. 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

Developed by SRU Sustainable Resource Use; Helen Lewis Research

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