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1. Why should we recycle batteries?

There are a number of reasons.

Batteries contain heavy metals that are toxic to human health and/or have eco-toxicity impacts if they exceed certain minimum concentrations in the natural environment. Lead, mercury and cadmium are particularly toxic, but other metals such as nickel can also be a concern if they leach into surface or ground water.

Recycling will help to conserve valuable non-renewable resources. A report by CSIRO [1] noted that ore grades are in terminal decline for a range of metals including nickel and lead–zinc–silver ores. Recycling has the ability to generate a substantial and growing resource and will become more economically viable as virgin resources are depleted and become more expensive.

The recovery and recycling of batteries will reduce pollution from landfills. As batteries start to break down in landfill, particularly in an acidic environment, heavy metals can leach into surface and groundwater. This is a concern because 15% of large landfills and 65% of medium sized landfills in Australia are unlined [2].

Removal of batteries and other electronic products from household waste will help to support the production of high quality organic products from alternative waste facilities. These facilities process mixed household waste and/or source-separated organic wastes to generate energy and organic

products such as soil conditioners and mulch. Batteries and other hazardous products make it difficult for operators to meet stringent quality requirements.

There is strong and growing support in the Australian community for battery recycling. When Planet Ark surveyed consumers about batteries in 2010, they found strong support for recycling:

- 80% said that end of life batteries should be recycled
- 75% said they would ‘definitely’ recycle batteries if there was an easy way to do it.

When asked who should be responsible for bearing the cost of battery recycling, the most commonly nominated group was battery manufacturers (nominated by 36% of respondents).

The RecyclingNearYou website allows visitors to search for recycling options for a wide range of products and materials. Between May 2009 and April 2010, there were 112,000 queries about battery recycling, second only to computers (220,000 queries).

2. What is the current recycling rate?

Approximately 264 million handheld batteries reach the end of their useful life in Australia each year – equivalent to around 12,000 tonnes of material – and less than 5% of these are recycled [3].

Around 183 million batteries (8,000 tonnes) are disposed to landfill each year, and this represents a loss of valuable, non-renewable resources. Approximately 3,000 tonne are ‘informally stockpiled’, for example embedded in broken or unwanted products such as old mobile phones or left to accumulate in the house, garage or office (Table 1).

Table 1: Fate of batteries at end of life, 2010

Fate of arisings – handheld batteries	Tonnes	Total Proportion
Reprocessed in Australia	350	2.9%
Legal Export	150	1.3%
Landfill	8,024	67.4%
Stockpiled Formal	250	2.1%
Stockpiled Informal	3,070	25.8%
Rebirth	10	0.1%
Illegal Export	50	0.4%
Totals	11,904	100%

Source: Warnken ISE (2010) Analysis of battery consumption, recovery and disposal in Australia, report to ABRI

3. What happens to batteries collected for recycling in Australia?

Batteries are sorted by chemistry and then transported to recyclers here and overseas. At present only lead acid, mercury and silver batteries are recycled in Australia. Local reprocessing of alkaline and lithium batteries may become more viable as collection volumes increase.

4. Why are alkaline batteries no longer recycled in Australia?

A pilot facility was established by AusZinc at Port Kembla in 2007. The pilot was discontinued at the end of 2012 after a strategic review by the business’s new owners.

5. If batteries are exported, do the transport impacts cancel out any environmental benefit?

We would need to do a full life cycle assessment (LCA) to know for sure, but LCAs of other products generally show that sea transport contributes a very small percentage of total energy costs.

Batteries are transported in large diesel-powered ships, which are very efficient.

6. Are batteries hazardous in landfill?

Yes, they are potentially hazardous.

Heavy metals leach out of batteries and other electronic products in landfill, although the timeframe may be anywhere from decades to thousands of years [4-7]. The reason for the slow rate of degradation is that metals corrode in landfill but are immobilised as solid compounds or ions, which stops them becoming biologically active [8]. While the migration of heavy metals is low during the first decades after disposal relative to the amount available, it will continue for a long time after closure of the landfill. Changing environmental conditions in the landfill can cause a sudden release of heavy metals [9].

The use of cadmium and mercury to produce new batteries is gradually being phased out. However, long delays between the production of many rechargeable batteries and their ultimate disposal by the consumer means that these materials will continue to enter the waste stream for the next two decades at least. Research in Japan calculated the time between the production date and the return date for common rechargeable batteries (called the 'disposal term'). This includes the time in the retail supply chain, time in use, and time that the product is hoarded (stored) before disposal. The estimated disposal term for common products is shown in Table 2.

Table 2: Disposal term for rechargeable batteries in Japan (years), average 2008-2012

Type of battery	Ni-Cd	Ni-MH	Li-Ion
Mobile phone	10	4.8	
Power tool	9.4	6.4	3.4
Single cells for retail	12.1	7.5	
Notebook PC		8	7.8
VCR	16.2		8.2

Source: Mike Takao (Panasonic), Presentation to International Congress for Battery Recycling, Croatia, 2013

7. Are primary (alkaline) batteries hazardous?

They are potentially hazardous.

The Australian Government classifies alkaline batteries as hazardous under the *Hazardous Waste Act* because the electrolyte (potassium hydroxide) is a corrosive chemical and manganese is a neurotoxin.

Mercury is no longer used to manufacture common household batteries (alkaline and carbon zinc) in Europe and the United States. However, a study by UK authorities in 2007 found some batteries on the market that still contain high levels of mercury (up to 0.0155%) [10, p. 22].

Mercury continues to be used to manufacture alkaline button cells (as well as other button cells). Its purpose is to suppress zinc corrosion, which can cause the generation of hydrogen gas in the canister. This can cause the battery to leak, limiting its ability to function. These types of button cells can contain up to 0.005 grams of mercury. Mercury free alternatives are available but they are more expensive and not commercially available everywhere [11].

Batteries collected for disposal or recycling are likely to include button cells as well as older alkaline and carbon zinc batteries containing mercury. This makes them more hazardous than new batteries.

8. Is it beneficial to recycle alkaline batteries?

Yes it is, but recycling programs need to be designed carefully to optimise recovery of metals and minimise transport impacts.

There have been a number of life cycle assessment (LCA) studies that considered the recovery of alkaline or mixed household batteries. They all show that mining and refining processes dominate the environmental footprint.

An LCA funded by the UK Department for Environment Food and Rural Affairs investigated the environmental impacts and financial costs of implementing the *EU Directive on Batteries and Accumulators*. The environmental and financial implications were estimated for the collection and recycling of mixed household batteries (primary and rechargeable). The overall conclusion of the study was that [12, p. 3]:

'... increasing recycling of batteries is beneficial for the environment, due to the recovery of metals and avoidance of virgin metal production.'

An LCA conducted for the National Electrical Manufacturers Association (NEMA) in the US [13] considered the recovery of alkaline batteries only. This concluded that recycling may generate a net environmental benefit if designed correctly, for example by minimising road transport and by recovering other metals (e.g. steel and/or manganese) for their metal value in addition to zinc. For collection, the greatest environmental burden was associated with individual consumers dropping their batteries off at a municipal waste location, such as a transfer station. Retail drop-off programs were found to have a lower impact than municipal drop-offs.

On the basis of this LCA, The Corporation for Battery Recycling (CBR), whose members included Duracell, Energizer, Panasonic and Spectrum Brands, decided to establish a voluntary national recycling program for primary batteries in the US [14, p. 3]:

'The Dry Battery Section of... [NEMA] is engaged in developing an industry led voluntary primary battery collection and recycling program covering the whole of the US. This objective is based on a Life Cycle Analysis (LCA) report which showed that it may be possible for a carefully designed program to be a net positive for the environment compared to disposal to landfill with other domestic garbage.'

9. Do we need to recycle ALL types of batteries, or just rechargeable batteries?

All used batteries should be recovered to conserve valuable metals and to reduce environmental impacts in landfill.

Some batteries are more hazardous than others, but most consumers will not be able or willing to sort batteries into the different chemistries.

Programs that allow consumers to recycle both their primary (single use) and rechargeable batteries are easier to understand and more convenient than those that collect rechargeable batteries only. They are therefore likely to increase recovery of all batteries, including those that are most toxic (e.g. mercuric oxide, nickel cadmium and sealed lead acid batteries).

10. Who should be responsible for recycling batteries?

Battery recycling is a shared responsibility between consumers, battery manufacturers, retailers, governments and recyclers.

Consumers are responsible for taking their used or unwanted batteries to a collection point for recycling (see www.batteryrecycling.org.au/recycling/handheld-batteries for more information).

Consumer electronics and battery manufacturers have a social responsibility to minimise the environmental impacts of their products throughout their life cycle, including at end of life. This is called 'product stewardship'. In many countries around the world manufacturers offer take back and recycling programs for their own products or support collective industry initiatives. In Australia the MobileMuster program for recycling mobile phones and mobile phone batteries is an excellent example of voluntary industry stewardship.

Retailers that sell batteries or battery-powered devices are starting to offer recycling services to their customers. This is convenient for consumers, builds the retailer's reputation for service and environmental responsibility, and makes good business sense.

State governments and local councils have a responsibility to manage the risks associated with hazardous products in landfill, including batteries, by supporting recycling programs.

Recyclers have a responsibility to comply with all legal requirements and to operate according to best practice standards.

11. Does battery recycling need to be regulated?

No, but the most successful battery recycling programs overseas are those that are supported by regulation. Battery recycling is mandatory in the European Union and recycling rates of over 50% have been achieved in some countries.

Call2Recycle, a voluntary recovery program for handheld batteries in North America, is calling for battery recycling to be regulated to eliminate the 'free rider' problem [15, p. 15]:

'A recent audit showed that as much as 40% of the Call2Recycle battery waste stream comes from companies not participating in the Call2Recycle program. As more products entering the US are from non-participating companies, Call2Recycle member companies are carrying the financial burden of recycling for them.'

Call2Recycle is now advocating that any manufacturer that puts rechargeable batteries into the market be held accountable for financing the recycling of the waste. Several bills that would require manufacturers to participate in a qualified program, such as Call2Recycle, and submit their recycling plans to the state are under consideration in Washington, Oregon, California and Minnesota.... Our goal is to support legislation that will empower the industry to self-regulate participation and compliance.'

The Corporation for Battery Recycling (CBR) in the US, representing manufacturers of alkaline primary batteries, have also shifted their focus from voluntary stewardship to regulation [16, p. 3]:

'CBR's three founding companies – Duracell, Energizer and Panasonic – remain committed to their vision of leading and shaping a national household battery-recycling program. CBR is also exploring appropriate legislative solutions during

2013 as a means to best level the playing field and create fair participation by key players.’

12. Where can I recycle my batteries?

Find out how to recycle handheld batteries at ABRI’s website - www.batteryrecycling.org.au/recycling/handheld-batteries.

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