

# AN EXTENDED PRODUCER RESPONSIBILITY RATIONALE FOR USED LEAD ACID BATTERIES



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# AN EXTENDED PRODUCER RESPONSIBILITY RATIONALE FOR USED LEAD ACID BATTERIES

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IN ASSOCIATION WITH  
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## Front Cover Pictures

Top: Used Lead Acid Batteries (ULABs) separated at Brisbane waste transfer station.

Middle: Split battery case at resource recovery facility in Sydney. Split battery cases can cause lead contamination of surrounding waste materials, limiting opportunities for resource recovery (source Global Renewables).

Recycled Organic Media (OGM) – Municipal waste can be processed to produce a useful compost product. The presence of ULABs in the waste stream is a serious quality issue for this type of resource recovery (source: Global Renewables).

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## EXECUTIVE SUMMARY

Extended Producer Responsibility (EPR) proposals are a response to progressive societal demands that companies extend their spheres of concern to take responsibility for impacts over and above their financial bottom line, whether they be social in terms of how companies interact with staff, shareholders and community, or environmental impacts arising from the manufacture, use and end-of-life of their products. The rationale for EPR is that choices made by the producer in materials of manufacture determine whether the product can be recovered for resource value or whether it must be wasted to landfill. Furthermore, producer choices can 'toxify' an entire potential resource stream, further compounding the impact of their products.

Used lead acid batteries (ULABs) such as car batteries at the end of their service life, are one case where a small percentage in the domestic waste stream (municipal solid waste) can 'toxify' an entire potential resource stream. Lead acid batteries are used to store electricity for a number of applications, ranging from starting cars to providing motive power to golf carts. However, lead is a heavy metal that is toxic to humans, animals, plants and micro-organisms at low exposure levels due to its bio-accumulating properties. Recycling of ULABs prevents the emission of lead into the environment and also avoids the energy usage associated with manufacturing lead from virgin resources. Recycling only requires 40 per cent of the energy associated with primary smelting, and thus each tonne of recycling avoids 1.3 tonnes of carbon dioxide equivalent (CO<sub>2</sub>e) in greenhouse gas emissions. Furthermore, recycling avoids the solid waste burden associated with mining and concentrating ore deposits.

The Australian Battery Industry Association (ABIA) estimates that nearly 96 per cent of car batteries are recovered for recycling either in Australia or overseas, while the Battery Council International estimated that in the United States 99.2 per cent of all lead acid batteries generated were recycled between 1999 and 2003. However, no comprehensive data were identified regarding the materials stocks and flows of lead and lead based products in Australia, making estimates of automotive battery production and consumption, in addition to recycling rates difficult to verify. Furthermore, the high recycling rates of car batteries are challenged by a recent US Geological Survey. This study concluded that lead consumption data are under-estimated in the United States by 24 per cent. This under reporting of consumption potentially reduces US estimated ULAB recovery rates to 80 per cent. While there are differences between the Australian and United States markets, a similar under-reporting error in lead acid battery consumption would decrease the current estimated recycling rate from 96 per cent to 77 per cent. This means that the average lead concentration in waste would be above 700 milligrams per kilogram.

Irrespective of how close the real recycling rate is to the Australian industry estimate of 96 per cent, the hazardous nature of used lead acid batteries means that even a small amount of 'leakage' into household garbage collections can contaminate resource recovery operations. When disposed of through kerbside collection of household waste, the presence of ULABs can disrupt the recycling of the organic fraction through processing with alternative waste technologies. The organic fraction includes food, paper, garden and wood wastes with degradable organic carbon. Using site specific information from UR-3R, a resource recovery facility operated at Eastern Creek, Sydney, by Global Renewables Ltd, it is estimated that the lead concentration in Municipal Solid Waste is at least 1,050 mg/kg on a dry weight basis. If no action was taken to remove ULABs then it would be impossible to produce usable compost as lead concentration levels would breach regulatory thresholds.

One ULAB disposed of incorrectly into a municipal solid waste collection system, and not removed prior to entering a resource recovery facility for mixed MSW, could contaminate 25 tonnes of MSW and prevent the recovery of the organic resources within this waste (estimated at 25 per cent of the waste inputs, or 6.5 tonnes) because of lead levels in excess of 500 mg/kg. The contaminated product would have to be landfilled because of elevated lead content, contributing to an associated greenhouse gas liability from the decomposition of degradable organic carbon into landfill gas.

The Australian Greenhouse Office estimates that the landfilling of one tonne of MSW has a greenhouse gas liability of 1.14 tonnes of carbon dioxide equivalent (CO<sub>2</sub>e) from the landfill gas that is generated by the organic fraction in MSW.<sup>1</sup> This arguably translates to a greenhouse impact of 7.4 tonnes of CO<sub>2</sub>e arising from one used lead acid battery that prevents recycling of 6.5 tonnes organic material through elevated lead levels.

While this is not necessarily a direct causal link, it serves to highlight that although the recycling of 100 batteries (nearly one tonne of lead) will avoid 1.3 tonnes of CO<sub>2</sub>e, the presence of one battery in household garbage collections could cause up to of 7.4 tonnes of CO<sub>2</sub>e emissions from landfill gas by making the organic fraction of MSW un-recyclable. Given the Stern Review estimate of \$110 for the 'per tonne' social cost of greenhouse gas emissions, a social cost of \$814 could be attributed to a single ULAB in MSW.

When the direct financial impacts to alternative waste technologies of \$62.50 per ULAB present in MSW inputs are also considered, and the fact that lead levels from split ULAB casings (spillage of paste and acid) will reduce final compost quality, it is clear that greater efforts aimed at eliminating ULABs from household waste collections are needed.

The main role of Extended Producer Responsibility (EPR) is aimed at reducing the end-of-life environmental impacts associated with products entering the market place. EPR thus serves dual operational roles in resource recovery (products) and 'detoxification' of a residual waste stream to aid in residuals processing and recovery. Several countries and individual jurisdictions around the world operate EPR schemes aimed at reducing the number of ULABs which ultimately end up in landfill or incinerators. For example, the European Union has a directive specifically addressing batteries and waste batteries. Other case studies from Germany, the United States, and Canada provide details of EPR schemes that are designed to maximise the return of used lead acid batteries for recycling, usually through the point of retail. For example, many schemes charge a deposit on the sale of a new battery if the old battery is not returned at the time of sale.

The need to recycle lead acid batteries is well recognised in Australia, with several initiatives established and systems in place for the collection and transport of ULABs. However, in spite of these initiatives, it is clear that ULABs are being disposed of inappropriately through kerbside collections of household waste. Even at high recycling rates, the potential negative impact of ULABs to disrupt and contaminate resource recovery streams provides a compelling case for policy intervention in the form of an EPR scheme for ULABs.

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<sup>1</sup> Note that the AGO estimate uses a global warming potential for methane of 21 times that of carbon dioxide.

The following actions are recommended as part of a campaign to eliminate used lead acid batteries from household waste:

- fast track the introduction of an EPR scheme for ULABs where a significant deposit is charged per battery that is sold without the return of the old battery. Such a scheme should preferably be national in operation, requiring federal government involvement. However, if action on a national level is not forthcoming, then progressive jurisdictions should introduce state based schemes
- explore mechanisms to bring all lead acid batteries into the EPR scheme, including sealed lead acid batteries
- conduct five yearly reviews, including annual collection of data on material flows and occurrence of ULABs in municipal and C & I waste collections; and if ULABs are still presenting in household or commercial waste, increase the coverage of the deposit to all automotive batteries. This is likely to be a shared government and industry responsibility.

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# 1 INTRODUCTION

There are many high-profile examples of companies gaining commercial advantage by internalising profit and socialising cost. However, society is progressively demanding that companies extend their spheres of concern to take responsibility for impacts over and above the financial bottom line. This increased sphere of responsibility has resulted in improving occupational health and safety; capturing and treating discharges of solid, liquid and gaseous wastes; and ensuring the safe operation of products according to advertised specifications.

'Extended Producer Responsibility' (EPR) is evidence of the logical progression of this trend, making companies responsible for the fate of their products when they have reached the end of their service life. The rationale for EPR is that choices made by the producer in materials of manufacture, determine whether the product can be recovered for resource value or whether it must be wasted to landfill. Furthermore, with the emergence of innovative technologies to recover resource value from mixed 'wastes' such as municipal solid waste, producer choices can 'toxify' an entire potential resource stream, further compounding the impact of their products.

This potential to disrupt other forms of recycling, especially those resource recovery technologies that focus on the recovery of food, paper, garden and wood wastes, takes on even greater importance within the context of global warming. Food, paper, garden and wood wastes contain degradable organic carbon, which decomposes to form methane in landfill conditions. Methane is a greenhouse gas with a global warming impact 23 times the impact of carbon dioxide.<sup>2</sup> The broader environmental impacts arising from products that prevent recycling should be directly attributed under the responsibility umbrella of the 'offending' product.

Used Lead Acid Batteries (ULABs) (car batteries at their end-of-life) are one such product category that has a significant potential to disrupt recycling of materials, especially those food, paper, garden and wood wastes with degradable organic carbon sourced from Municipal Solid Waste (MSW).

Total Environment Centre (TEC), a Sydney based environment NGO,<sup>3</sup> is active in campaigning for increased uptake of EPR as a policy to improve resource recovery rates, detoxify the waste stream and focus producer attention on design for environment. TEC, with funding from the Australian Council of Recyclers (ACOR),<sup>4</sup> has commissioned this report from Warnken ISE.

## 1.1 Overview of Report

This paper examines the rationale for Extended Producer Responsibility of Used Lead Acid Batteries, and focuses in particular on the negative potential of ULABs to disrupt resource recovery from Municipal Solid Waste. The structure of the study is presented in Figure 1 below. Following this introduction, an overview of Extended Producer Responsibility (EPR) is provided, with selected EPR case studies presented to

<sup>2</sup> IPCC 2001, 'IPCC Third Assessment Report – Technical Summary of the Working Group I Report', Intergovernmental Panel on Climate Change, Geneva, accessed at [http://www.grida.no/climate/ipcc\\_tar/vol4/english/pdf/wg1ts.pdf](http://www.grida.no/climate/ipcc_tar/vol4/english/pdf/wg1ts.pdf), May 2007.

<sup>3</sup> See <http://www.tec.org.au> for more information.

<sup>4</sup> See [www.acor.org.au](http://www.acor.org.au) for more information.

highlight the operational application of EPR, in addition to the role of EPR in detoxifying the residual waste stream and increasing resource recovery.

Section 3 presents information on used lead acid batteries (ULABs) in Australia, including the production and consumption of lead acid batteries, the negative impacts on ULABs on resource recovery, the environmental benefits of recycling lead, and current initiatives in Australia around ULAB recovery. Section 4 then examines the international experience with regard to ULABs, drawing on information from the European Union, Germany, United States and Canada. The information from Australia and international sources is brought together in Section 5 to build the case for implementing an EPR scheme for ULABs in Australia.

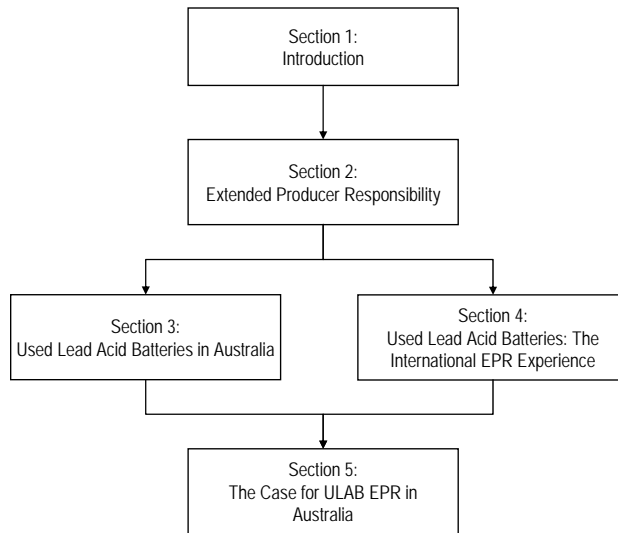


Figure 1 –Structure of report

## 2 EXTENDED PRODUCER RESPONSIBILITY

The main role of Extended Producer Responsibility (EPR) is to reduce the end-of-life environmental impacts associated with consumer products. An overview of EPR is provided in the section below, in addition to some significant examples of EPR in action from around the world and an examination of the potential operational roles for EPR in resource recovery (products) and ‘detoxification’ of a residual waste stream to aid in residuals processing and recovery.

### 2.1 Overview of Extended Producer Responsibility

Traditionally, the environmental responsibility of producers focused on managing the environmental impacts of the production process. Extended Producer Responsibility (EPR) is a policy approach in which a producer or manufacturer takes responsibility for the environmental impacts of their products throughout the entire product life cycle, thus including impacts of the product in its use and ultimately its end of life management. In this way the cost of the environmentally significant post-consumer characteristics of products, such as waste volume, toxicity and recyclability, is transferred from local authorities to the producers. This transfer of costs is designed to provide economic incentives for producers to prevent/reduce the amount of waste generated, reduce the usage of toxic materials, increase recycling and enhance markets for secondary materials<sup>5</sup>.

The four principal goals of EPR are:

- source reduction (natural resource conservation and materials conservation)
- waste prevention
- design of more environmentally compatible products
- closure of material loops to promote sustainable development.

Four generic approaches to implementing extended producer responsibility are identified. The first of these is where the producer is *liable* for proven environmental damages caused by their products at all stages of the product life cycle, including usage and final disposal. *Economic responsibility* models require the producer to cover all or part of the costs for example the collection, recycling or final disposal of the products it is manufacturing. The manufacturer may take part in *physical management* of products at the end of their life cycles, or the impacts of products. The manufacturer may retain the *ownership* of their products throughout their life cycle, and consequently may be linked to the environmental problems of the product. Some generic examples of programs which are used to implement EPR are presented in Appendix 1.

The approaches which are used to achieve EPR in practice vary widely between jurisdictions, focus products and the aim of the EPR program. Selected examples of EPR programs from around the world are identified in the section below.

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<sup>5</sup> Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility*, accessed online at [http://www.oecd.org/document/19/0,3343,en\\_2649\\_201185\\_35158227\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/19/0,3343,en_2649_201185_35158227_1_1_1_1,00.html), June 2006.

## 2.2 Selected Examples of EPR Schemes from Around the World

EPR schemes and approaches address a wide variety of product types including general packaging, plastic bags, end-of-life vehicles, mobile phones, paint, electrical and electronic equipment, tyres, paper, rechargeable batteries, hazardous materials, oil and pesticides. For an EPR scheme to be effective, the focus of the scheme needs to be identifiable as a distinct product or material type, in addition to having a well defined and identifiable industry.

### 2.2.1 Used Tyres in Canada

Used tyres are the subject of a number of EPR programs around the world. In Canada, each state has its own mechanisms set up for this purpose. In Manitoba for example, a pre-disposal levy of C\$2.80 per tyre is collected on the sale of new tyres and is transferred to the Tyre Stewardship Board. Retailers must accept used tyres back from consumers, and tyres are collected from both landfills and retailers. The municipalities are paid C\$0.50 per tyre by the Tyre Stewardship Board, to accept and stockpile tyres that are going to be picked up by processors at landfills. Used tyre processors shred, mould or die-cut the tyres to produce blast mats, traffic cone weights, mats, mud flaps, truck box liners, feeders and scraper mats. The Tyre Stewardship Board pays the processor a fee for recovering the tyres on proof-of-sale of a new product from recycled tyres. Other provinces in Canada have slightly different mechanisms. In British Columbia the levy is C\$3, and the Program pays a financial incentive for the transport of scrap tyres from the generating site to the nearest eligible processor. In Alberta the fee is C\$4, and financial incentives are provided to processors for the first phase of processing, which is shredding. The fee includes funding for the collection of whole tyres and it amounts to C\$175 per tonne of shredded material produced or C\$110 per tonne of crumb that is produced. The program also pays predetermined credits to a processor on the proof-of-sale of new recycled products. Manufacturers receive \$100 per tonne of the product that is sold.<sup>6</sup>

### 2.2.2 End of Life Vehicles in Europe

The European Commission has adopted a Directive which aims at making vehicle dismantling and recycling more environmentally friendly, sets clear quantified targets for reuse, recycling and recovery of vehicles and their components and encourages producers to design and manufacture new vehicles towards improved recyclability at the end of their useful lives. Under the directive, Member States are required to take measures to ensure that processors set up systems for the collection, treatment and recovery of end-of life vehicles so that the owner can deliver the end-of life vehicle to a treatment facility at no cost. In addition, it is a requirement to ensure that car manufacturers meet all, or a significant part of, the costs of the implementation of these measures.<sup>7</sup>

It is noted that each European Union country is responsible for setting up the infrastructure required to meet the requirements of the directive in their own way.

EPR legislation which covers end of life vehicles is also in place in Maine in the United States and Japan.

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<sup>6</sup> Environment Canada, 2002, *An Inventory of Waste Diversion Programs in Canada*, accessed at <http://www.ec.gc.ca/epr/inventory/en/SearchResults.cfm?intProgram=11&newQuery=1>, June 2007.

<sup>7</sup> European Union, 2000, *Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles*, accessed at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0053:EN:HTML>, June 2007.

### 2.2.3 Waste Oil in Australia

Under the Product Stewardship Arrangements for Waste Oil,<sup>8</sup> oil producers and importers pay a levy on lubricants to support environmentally sustainable management and refining of waste oil. The program aims provide economic incentives to increase the uptake and appropriate recycling and use of waste oil, to encourage the environmentally sustainable management and re-refining of waste oil and its reuse, and to support economic recycling options for waste oil.

These product stewardship arrangements include three mechanisms (or 'sub-programs') for overcoming barriers to the uptake of waste oil. These are:

- a product stewardship levy which is placed on producers and importers of oils and lubricants
- product stewardship benefits which are payable to oil recyclers as an incentive to undertake increased recycling of waste oil. These benefits are offset by the product stewardship levy. The amount of benefit paid will be dependant on the type of oil recycled
- transitional assistance funds to engender change that will underpin the long-term viability of the oil recycling industry.

### 2.2.4 Food and Beverage Containers in South Australia

Container Deposit Legislation (CDL) is one of the older EPR mechanisms which has been successfully used around the world for promoting the return of beverage and food containers for reuse or recycling. South Australia is currently the only Australian state with a container deposit scheme in place. The system originally applied to all beverage containers except wine and milk, with a 10c deposit applying to refillable containers (returned for refund at the point of sale) and a 5c deposit for non-refillable containers (returned to designated collection centres). In 2000 the scheme was reviewed, with one outcome of the review being an amendment to the regulations to increase the variety of containers to which a deposit is applied.

The scheme works as follows. The container manufacturer supplies containers to beverage fillers/distributors and does not engage in the refund system. The beverage filler/distributor theoretically includes the 5 cent refund and agreed handling fee in the wholesale price to retailers (pricing strategies vary between companies and are not necessarily based entirely on cost structures). If the refund and handling fee are not included in the wholesale price, they may be partially or fully absorbed by the beverage filler/distributor. The retailer then sells to consumers at prices incorporating the 5 cent refund and handling fee (when passed on by the beverage filler/distributor). The consumer returns the empty container to a collection depot or point of sale. The collection depot or point of sale vendor reimburses the consumer (or person returning the container) and sorts the containers. A so-called 'supercollector' collects the containers from the various collection depots for auditing and recycling and pays the collection depots the refund and agreed handling fee. The supercollectors are paid the refund and agreed handling fee by the beverage fillers/distributors on the basis of documented container returns.<sup>9</sup>

<sup>8</sup> Environment Australia, 2007, Oil Recycling, online at <http://www.oilrecycling.gov.au/program/index.html>, accessed June 2007.

<sup>9</sup> South Australia Environment Protection Agency, 2005, Collection Industry Arrangements for Used Beverage Containers Under Container Deposit Legislation, accessed at [http://www.epa.sa.gov.au/pdfs/cdl\\_collection.pdf](http://www.epa.sa.gov.au/pdfs/cdl_collection.pdf), June 2007.

## 2.3 Operational Role for EPR – Resource Recovery and ‘Detoxification’

The discussion above presents examples of how various types of EPR schemes can be used to limit the volumes of specific end-of-life products that are disposed of to landfill. The key drivers behind such schemes include natural resource conservation and materials conservation, waste prevention, and closure of material loops to promote sustainable development. In this regard EPR can be used as a very effective tool to increase the recovery of resources that otherwise would have been wasted in landfill.

The other role for EPR is to detoxify the residual waste stream so as to achieve higher levels of resource recovery through the processing of waste materials. For example, Municipal Solid Waste (MSW) contains (by weight) more than 50 per cent ‘organic’ materials such as food and garden waste.<sup>10</sup> These materials can be processed through an alternative waste technology such as mechanical biological treatment to produce a usable compost product. However, contaminants in MSW can limit this resource recovery option. EPR can be used to remove hazardous materials from the waste stream, thus preventing the contamination of other recoverable resources.

The importance of this form of resource recovery from mixed residual waste streams like MSW is highlighted by the current debate on greenhouse gas emissions. Landfill gas is generated by the decomposition (dissimilation) of degradable organic carbon in waste materials such as food, garden, paper and wood wastes. Landfill gas contains methane which has a global warming potential 25 times that of carbon dioxide.<sup>11</sup> Each tonne of MSW landfilled will generate landfill gas, which if emitted will have a warming impact of 1.36 tonnes of carbon dioxide equivalent (CO<sub>2</sub>e).<sup>12</sup> If the residual waste stream is contaminated by toxic materials then the residual will have to be landfilled, which will add to greenhouse gas emissions. If it is accepted that the toxic products prevent the recovery of other resources, then it can be argued that the associated increase in greenhouse gas emissions are the responsibility of the producer of the toxic product.

Used lead acid batteries (ULABs) are one case where a small percentage in the waste stream can ‘toxify’ an entire resource stream. The following section presents more information on used lead acid batteries in Australia.

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<sup>10</sup> Hyder Consulting 2006, ‘Waste and Recycling in Australia’, Department of Environment and Heritage, accessed at <http://www.pc.gov.au/inquiry/waste/subs/sub103attachmenta.pdf>, June 2007. The state based break down of waste disposal to landfill from MSW materials shows that food, garden and other organics are more than 50% of the total.

<sup>11</sup> IPCC 2007, ‘IPCC Fourth Assessment Report – Technical Summary of the Working Group I Report’, Intergovernmental Panel on Climate Change, Geneva, accessed at <http://ipcc-wg1.ucar.edu/wg1/wg1-report.html>, July 2007. Note that in this report the IPCC revised their estimate of the Global Warming Potential (GWP) of methane to 25 times that of carbon dioxide, up from 21 in the second assessment report and 23 in the third assessment report.

<sup>12</sup> AGO, 2006, ‘AGO Factors and Methods Workbook - For use in Australian greenhouse emissions reporting’, Australian Greenhouse Office, Canberra, accessed at <http://www.greenhouse.gov.au/workbook/pubs/workbook2006.pdf>, June 2007. Note that carbon dioxide equivalent is the basic unit of measurement for greenhouse gases. Also the AGO used a global warming impact for methane of 21, instead of the revised estimate of 25. The default emission factor for MSW is 1.14, which has been adjusted here to 1.236 to account for methane at 25 times the global warming potential of carbon dioxide.

### 3 USED LEAD ACID BATTERIES IN AUSTRALIA

Lead acid batteries are used to store electricity for a number of applications, ranging from starting cars to providing motive power to golf carts. No comprehensive data were identified regarding the materials stocks and flows of lead and lead based products in Australia, making estimates of automotive battery production and consumption, in addition to recycling rates difficult to verify. A US Geological Survey highlighted the fact that lead consumption data are under estimated in the United States, reducing estimated ULAB recovery rates. The potential for ULABs to disrupt recycling increases the impact of higher than anticipated volumes of ULABs collected through kerbside household waste. Conversely, the benefits of improved lead recycling provide a proactive motivation to maximise recycling rates. These issues are explored in greater detail below.

#### 3.1 Operation of Lead Acid Batteries

Lead acid batteries (LABS) are rechargeable electrochemical devices with the ability to store electricity until required. LABS contain one or more cells, comprising two plates of lead 'mesh', each of which is covered in lead oxide paste. Both plates are submerged in a fairly concentrated sulphuric acid. The battery is encased in a robust plastic casing, usually polypropylene or polyethylene.

In very simple terms the battery discharges a current when a chemical reaction converts lead oxide into lead sulphate and water. The process of recharging reverses the chemical reaction, changing lead sulphate and water back into lead oxide and sulphuric acid.

LABS are used in a variety of applications, most common perhaps being for automotive use in cars, trucks and motorcycles. They are also used for industrial uninterrupted power supply (UPS) units, for example in hospitals, and to provide power in electric vehicles such as forklifts and golf buggies. Other uses for small sealed lead acid batteries are more widespread, for example in domestic alarms, emergency lights, power tools, videos and small UPSs.<sup>13</sup>

The main issue with LABS is their hazardous nature at end-of-life. Used lead acid batteries contain lead, lead compounds and sulphuric acid. While the acid is corrosive, lead is the major concern. Compounds of lead are highly toxic to humans, plants and other animals when ingested or inhaled. In order to prevent emissions of lead into the environment, used LABS are classified as hazardous waste under the federal Hazardous Waste (Regulation of Exports and Imports) Act 1989 and need a permit for export or import.<sup>14</sup>

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<sup>13</sup> These sealed LABS are of significant concern as there is little information regarding consumption and use, in addition to being 'orphans' in that they are not covered by any industry association or body.

<sup>14</sup> For more information on used lead acid batteries visit <http://www.deh.gov.au/settlements/publications/chemicals/hazardous-waste/lead-acid-fs.html>.

### 3.2 Production and Consumption of Automotive Lead Acid Batteries in Australia

A recent scientific investigation published by a US Geological Survey identified 10 different classifications of lead acid batteries. These are reproduced in Table 1 below.

Table 1 – Classification, types, weight and average life of lead acid batteries<sup>15</sup>

<i>Classification</i>	<i>Lead Acid Battery Types</i>	<i>Weight of lead (kilograms)</i>	<i>Average Battery Life<sup>16</sup></i>
Golf cart	Golf carts or similar vehicles	18.6	3
Marine	Speed boats, trolling craft	14.0	3
Military vehicle	Motorised fighting vehicles, tanks	20.0	6
Large stationary	Uninterruptible power supply equipment	816	10
Small motive	Airline ground equipment or similar motive equipment	17.2	6
Passenger car/light truck	Passenger cars, light trucks	9.7	4
Speciality vehicle	Industrial forklifts, mining equipment, or similar equipment	11.3	3
Tractor	Tractors	15.0	3
Truck and heavy duty	Trucks, heavy duty vehicles	17.5	3
Utility	Special purpose motor vehicles	4.1	2

A breakdown of production and consumption of these lead acid battery types for Australia in the public domain was not found, however the replacement market for automotive type batteries in Australia is estimated to be some 4.5 million units per year.<sup>17</sup> Each battery passenger car battery contains on average 9.7 kilograms of lead, which means that approximately 43,650 tonnes of lead are used in replacement car batteries. Most replacement batteries are sold through service outlets, however the DIY sector is estimated to comprise at least one third of the national market. Sixty per cent of batteries are manufactured by Exide in Adelaide and Century Yuasa in Brisbane, the balance are imported through some 50 to 100 importers ranging in size from large operations like the Lion Group<sup>18</sup> to 'micro' operators, many of which open and close within the same year of operation.

Automotive lead acid batteries are homogenous in that lead and sulphuric acid technology is used in manufacture regardless of brand. This makes the recycling process easier to standardise, as lead acid battery material composition remains constant.

<sup>15</sup> Wilburn, D.R., and Buckingham, D.A., 2006, *Apparent Consumption vs. Total Consumption - A Lead-Acid Battery Case Study*: U.S. Geological Survey, Reston, accessed at <http://pubs.usgs.gov/sir/2006/5155/sir20065155.pdf>, June 2007.

<sup>16</sup> SmithBucklin Corporation, 2005, *'National Recycling Rate Study'*, Battery Council International, Chicago, accessed at <http://www.batterycouncil.org/BCIRecyclingRateStudyReport.pdf>, June 2003.

<sup>17</sup> Industry information supplied by Alan Hyde, Executive Officer of Australian Battery Industry Association (ABIA) November 2005. Note that these numbers should be viewed as indicative only.

<sup>18</sup> See <http://www.apollobatteries.com.au> for more information.

### 3.3 Recycling Rates of Used Lead Acid Batteries

No published data on the material flows of lead through the Australian economy were identified as part of this study. This data is important to estimating recycling rates for used lead acid batteries, as estimates for waste generation are dependant on consumption estimates and average life span of batteries.

More than 95 per cent of the battery can be recycled, including the plastic casings. The Australian Battery Industry Association (ABIA) estimates that nearly 96 per cent of car batteries are recovered for recycling either here or overseas.<sup>19</sup> This estimate would translate to a very high recycling rate of approximately 4.3 out of 4.5 million decommissioned batteries, especially when compared against other material types, but is similar to claimed recycling rates for ULABs in other countries. For example, the Battery Council International estimated that in the United States 99.2 per cent of all lead acid batteries generated were recycled between 1999 and 2003.<sup>20</sup> It is important to note that these recycling rates are contingent on estimated consumption estimates of lead acid batteries, and that recent research indicates that consumption estimates could be understating the actual rate of consumption.

One such piece of research was a US Geological Survey study which identified that lead acid battery consumption was under-reported by 24 per cent. The under reporting was caused by excluding lead contained in imported batteries, vehicles containing batteries and other manufactured products.<sup>21</sup> Adjusting for this increase in battery consumption would increase estimates of waste generation, thereby decreasing the recycling rate of lead acid batteries in the United States to approximately 80 per cent. While there are differences between the Australian and United States markets, a similar under-reporting error in lead acid battery consumption would decrease the current estimated recycling rate from 96 per cent to 77 per cent. This lower estimate suggests that if 4.3 million car batteries are recycled, there would be 1.26 million landfilled (increase in total consumption to 5.56 million car batteries).

To place this into a waste disposal context, in 2002/2003 Australia landfilled approximately 17.5 million tonnes of waste from municipal solid waste (MSW), commercial and industrial (C&I), and construction and demolition (C&D) waste streams.<sup>22</sup> The lead concentration in landfilled waste can be calculated according to the estimated amount of lead in a ULAB and the amount of ULAB disposal into landfill (assuming ULAB landfilling is spread evenly throughout all MSW, C&I and C&D waste streams). If the consumption of lead data in Australia has been under-estimated to the same extent reported in the United States, then seven times the amount of ULABs are being landfilled each year than was previously thought. This means that the average lead concentration in waste is above 700 milligrams per kilogram.

Other evidence supports the case for a lower recovery rate than is currently claimed by the Australian Battery Industry Association, is illustrated by the following case study. Global Renewables Limited (GRL) is a company that operates a resource recovery facility built under contract to WSN Environmental Solutions at Eastern Creek, near Sydney NSW.<sup>23</sup> The UR-3R facility processes some 175,000 tonnes per year of municipal solid waste (MSW) to produce a range of recyclables, including organic growth media

<sup>19</sup> ABIA, undated, 'Home Page', Australian Batter Industry Association, Eltham, accessed at <http://www.abia.org.au/home.html>, June 2007.

<sup>20</sup> *Ibid*, 2005.

<sup>21</sup> Wilburn, D.R., and Buckingham, D.A., 2006. Apparent Consumption vs. Total Consumption - A Lead-Acid Battery Case Study: U.S. Geological Survey, Reston, accessed at <http://pubs.usgs.gov/sir/2006/5155/sir20065155.pdf>, June 2007.

<sup>22</sup> Derived from Hyder Consulting 2006, 'Waste and Recycling in Australia', Department of Environment and Heritage, found at <http://www.pc.gov.au/inquiry/waste/subs/sub103attachmenta.pdf>, July 2007.

<sup>23</sup> See [www.globalrenewables.com.au](http://www.globalrenewables.com.au) for more information.

(OGM), a compost product. Global Renewables estimate that up to 80 lead acid batteries enter their facility each day, which is equivalent to an average of one battery every 12.5 tonnes of MSW input material, or 0.08 batteries per tonne. Based on an annual throughput of 175,000 tonnes, it is estimated that some 15,000 batteries are being thrown into household waste within from the local government areas that send their waste for processing at the UR3R facility. This amount of batteries contains 145,500 kilograms of lead as a potential contaminant to the process, requiring a strict pre-sorting system to remove the ULABs before they enter the UR-3R process.<sup>24</sup>

The UR-3R experience highlights the significant challenge of lead contamination in resource recovery from MSW in Australia. It is estimated that 6.2 million tonnes of MSW is disposed of to landfill in Australia.<sup>25</sup> Using the UR-3R concentration rate of 0.08 batteries per tonne of MSW gives an estimate of 496,000 ULABs (4,800 tonnes of lead) that are disposed of to landfill through kerbside waste collection.

If the revised increase in lead acid battery consumption and lower recovery rate of 77 per cent is accurate, this suggests that forty per cent of the ULABs landfilled in Australia are disposed of through kerbside collection. (The remainder would come through C&I and C&D channels). Alternatively, if all landfilled ULABs are disposed of through MSW kerbside collection, then it is likely that the increase in lead acid batteries is lower than suggested by a straight comparison with the US study, with consumption increasing to 4.82 million batteries and the recovery rate in Australia closer to 90 per cent (assuming the 4.3 million automotive battery recycling estimate is correct. It is noted that another interpretation would be to reduce the recycling rate to 4 million batteries, which gives a similar recovery rate of 89 per cent. The main point here is not the market for replacement batteries, but the amount of used lead acid batteries entering landfill).

It is suggested that in the absence of better data on the total consumption of lead in Australia, a mid point between the lower estimate of lead acid battery recovery (77 per cent) and the Global Renewables extrapolation (90 per cent) should be adopted as a starting point for estimating the recovery rates of used lead acid batteries across MSW, C&I and C&D streams. This estimate of 84 per cent recovery would then be updated when more robust and verifiable data can be produced. Figure 2 overleaf presents the differences between the recovery estimates of ULABs. This information is then summarised in Table 2 overleaf, including the relative estimates of lead concentration in the landfilled waste.

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<sup>24</sup> Lawson, J., Unpublished, 'Presentation to Battery Stewardship: Removal of lead acid batteries from MSW Workshop 9/11/05 held UR3R – Eastern Creek'.

<sup>25</sup> Hyder Consulting 2006, 'Waste and Recycling in Australia', Department of Environment and Heritage, found at <http://www.pc.gov.au/inquiry/waste/subs/sub103attachment1a.pdf>, June 2007.

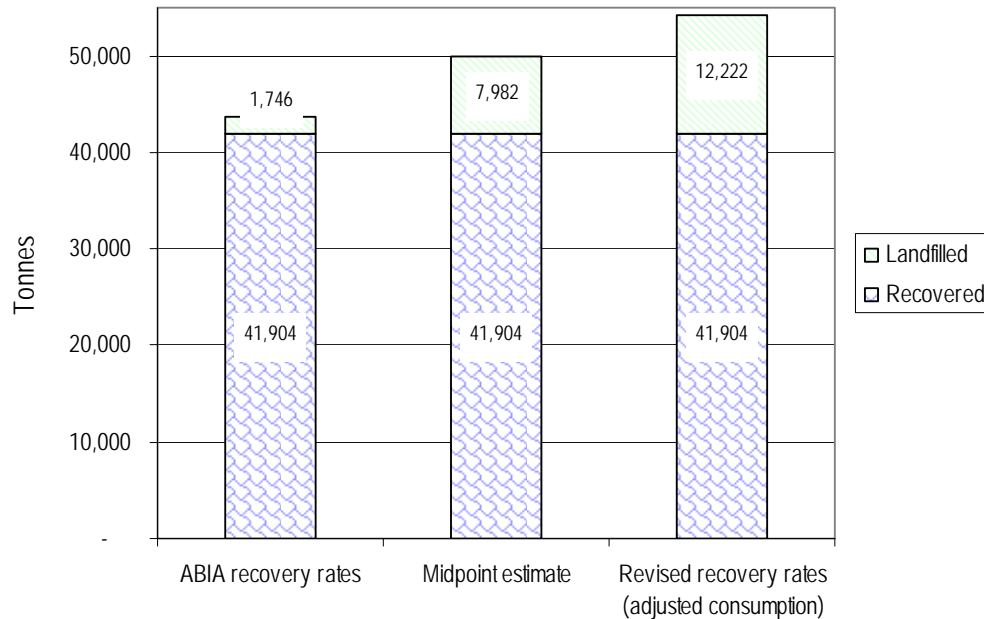


Figure 2 – Differing estimates of ULAB recovery rates

Industry estimate of replacement market for car batteries (ULAB)	4,500,000 units per annum
Lead content in a ULAB	9.7 kg
ABIA recovery rate of ULABs	4.3 million = 96%
Estimated tonnes of ULAB lead in waste (ABIA recovery rates)	1,746 tonnes
Estimated lead concentration in landfilled waste (ABIA recovery rates)	100 mg/kg
Lead from ULABs as a proportion of the total waste stream	0.01%
Revised estimate of replacement market for car batteries (ULAB) (increased lead consumption)	5,580,000 units per annum
Revised recovery rate of ULABs	4.3 million = 77%
Estimated tonnes of ULAB lead in waste (revised recovery rates)	12,222 tonnes
Estimated lead concentration in landfilled waste	700 mg/kg
Lead from ULABs as a proportion of the total waste stream	0.06%
Mid-point estimate of replacement market for car batteries (ULAB)	5,140,000 units per annum
Mid-point estimate recovery rate	4.3 million = 84%
Estimated tonnes of ULAB lead in waste (midpoint estimate)	7,982 tonnes
Estimated lead concentration in landfilled waste (midpoint estimate)	458 mg/kg
Lead from ULABs as a proportion of the total waste stream	0.05%

Table 2 above shows the differing estimates of recycling and the impact this has on the lead concentration. Importantly it highlights that the revised estimates and 'mid-point' estimates of waste in landfill are above 450 mg/kg. (Note that no adjustment has been made here for moisture content, thus the concentrations are on an 'as received' basis). However, as was identified above, it is more likely that certain parts of the waste stream will have higher concentrations, in particular MSW and C&I. Using the GRL extrapolations to estimate the lead concentration in MSW indicates that although the mass of lead in MSW is less than 0.08 per cent, this corresponds to a high lead concentration rate of 775 mg/kg on an as received basis. (Note that as MSW comprises more than 50 per cent food and garden organics (see Section 2.3), and that as these materials have a moisture content greater than 50 per cent, then the overall moisture content of MSW is at least 25 per cent. This means that the lead concentration on a dry weight basis is at least 1,050 mg/kg.)

Regardless of how close the real recycling rate is to the industry estimate of 96 per cent, the hazardous nature of used lead acid batteries means that even a small amount of 'leakage' into household waste collections can contaminate resource recovery operations. The impacts of lead levels in MSW on resource recovery are examined below.

### 3.4 Negative Impacts on Municipal Solid Waste Resource Recovery

Many alternative waste technologies, such as the UR-3R mentioned previously, focus on recovering the organic component with Municipal Solid Waste (MSW) in the form of value-added manufactured compost. The Australian Compost Standard AS4454 2003 gives guidance on the process for making quality assured compost, but does not define limits for heavy metals such as lead. The closest regulatory guidelines to allowable heavy metal thresholds in compost products is given in the 'Use and Disposal of Biosolids Products' produced by the former New South Wales Environment Protection Authority.<sup>26</sup> (Biosolids refer to the residual sludge left after the processing and treatment of sewage). Table 3 below presents the threshold limits on biosolids as they apply to lead.

Table 3 – Lead contamination acceptance concentration thresholds for grades of biosolids<sup>27</sup>

<i>Biosolids Grade</i>	<i>Concentration threshold (mg/kg)<sup>28</sup></i>
Grade A – unrestricted use	150
Grade B – restricted use 1	150 <sup>29</sup>
Grade C – restricted use 2	420
Grade D – restricted use 3	500
Not suitable for use	>500

Using the Biosolids Guidelines as an indicator of likely regulatory standards for compost products across Australia, it is evident that a small number of used automotive lead acid batteries (ULABs) remaining in the waste stream have the potential to disrupt the quality of the composted products made from the organic fraction of MSW (food, paper, garden and wood materials). For example, if the testing of compost identifies a threshold concentration of lead greater than 150 milligrams per kilogram (mg/kg) on a dry weight basis, then the compost drops from an unrestricted use category (including home lawns and gardens) to Grade C, which restricts use to agriculture and forestry applications.

If the lead in MSW is not removed, then 72,000 ULABs would downgrade compost from Grade A to Grade C (1.6 per cent of ULAB generation rate). The goal of 'zero' or greater than 99 per cent diversion from MSW collection is required to eliminate lead as a risk to compost. However the current situation with an estimated lead concentration level of 1,050 mg/kg (dry weight basis) means that if ULABs are not removed from processing, then any compost produced from mixed MSW will not be suitable for use (greater than 500 mg/kg of lead on a dry weight basis).

<sup>26</sup> NSW EPA, 1997, 'Environmental Guidelines: Use and Disposal of Biosolids Products', New South Wales Environment Protection Authority, Sydney. NSW EPA is now the Department of Environment and Climate Change.

<sup>27</sup> *ibid* 1997.

<sup>28</sup> Measured on a dry weight basis. Note that these thresholds do not refer to average concentrations, rather to a threshold that is estimated using a statistical sampling regime and adjusted for the amount of samples taken from a given batch. For example, in a batch of 500 dry solid tonnes, a minimum of five samples would need to be taken and the concentration reported as the mean plus 1.85 times the standard deviation. In other words, the average concentration of lead would need to be much lower than 150 mg/kg in order to meet the Grade A classification.

<sup>29</sup> There are other factors that influence the biosolids classification, so that meeting the lead requirement may not be enough to meet Grade A overall. Some other factors include other contaminants and also stabilisation and maturation of the final product.

MSW processing facilities can include mitigation options such as manual pre-sorting to remove and recover the ULABs. However, this does not address the contamination from those batteries crushed in household waste collection trucks, in that casings can be split in garbage collection trucks and contaminate the MSW before any pre-sorting is carried out.

The preliminary evidence is that approximately half of the ULABs collected through household garbage compactor trucks will have their casings split. The impact of the lead contamination is to downgrade the resulting compost production from Grade A unrestricted, to Grade C – restricted use 2 (agriculture and forestry).<sup>30</sup> The potential for split batteries to toxify residual MSW and prevent resource recovery of the organic fraction is therefore high, and unless batteries are prevented from entering MSW collections, it is unlikely that Grade A compost will be produced.

### 3.5 Potential Financial Impacts of ULAB Contamination in MSW

The financial impacts of ULABs in household garbage collections (MSW) are primarily twofold. Firstly there is the cost of rigorous sorting of MSW prior to processing; and secondly there is the cost of residual lead contamination from split casings and its deleterious impact on opportunities to use compost.

These costs are difficult to quantify, as they are dependent on the resource recovery process, the amount of manual labour required for sorting, and market prices for composted products. As a preliminary guide it is estimated that additional cost for equipment and maintenance is approximately \$5 per tonne of composted output, with additional labour costs a similar amount (\$5 per tonne).<sup>31</sup> Industry estimates suggest that the lost opportunity cost of selling a Grade C compost product instead of a Grade A (unrestricted use) compost product is in the order of \$10 per tonne (although it is noted that compost market prices are variable and often subjected to gluts of oversupply). The combined financial impact of ULABs in MSW is therefore potentially \$20 per tonne of compost. Assuming that compost outputs account for 25 per cent of the MSW inputs into a resource recovery technology, then the additional cost is \$5 per tonne of MSW input, or a potential \$31 million additional barrier to MSW resource recovery across Australia. This translates to a financial impact of \$62.50 per used lead acid battery in the municipal solid waste stream.

Removing ULABs from MSW would not only avoid these additional costs, it would also 'detoxify' the MSW stream and provide many other environmental benefits over and above increased diversion of organic materials from landfill. Part of this additional environmental upside is explored below.

### 3.6 Environmental Benefits from ULAB Recycling

The main environmental benefits from recycling used lead acid batteries come from avoiding the manufacture of lead from primary raw materials. Lead ores are often mixed with zinc ores, and both lead and zinc can be manufactured concurrently using the process of Imperial Smelting. However, this joint processing only accounts for 10 per cent of global lead production, with the remainder manufactured from

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<sup>30</sup> Lawson, J., *Global Renewables Limited, 2007, Personal Communication.*

<sup>31</sup> *This assumes a facility with a compost output of 40,000 tonnes of compost, and additional labour of four full time equivalent employees.*

blast furnace technology. Here lead ores are mined and then concentrated before being roasted (sintering) and then processed into lead metal in a blast furnace. Further refining then occurs to improve the purity of the lead metal.<sup>32</sup>

Each tonne of lead manufactured through a blast furnace from virgin resources uses 20 gigajoules (GJ) of energy<sup>33</sup> and emits 2.1 tonnes of carbon dioxide equivalent (CO<sub>2</sub>e) in greenhouse gases. Furthermore, for each tonne of production there is a solid waste burden of 14.8 tonnes.<sup>34</sup> In comparison, each tonne of lead recycled that avoids the production of lead from virgin resources uses only 8 GJ of energy,<sup>35</sup> and avoids the emission of 1.3 tonnes of CO<sub>2</sub>e in greenhouse gas emissions. Also, because no mining is required for lead recycling, the solid waste burden is virtually eliminated.

Moving from a recovery rate of 82 per cent to a genuine 99 per cent recovery rate would recycle an additional 7,850 tonnes of lead, and prevent the emission of 10,200 tonnes of CO<sub>2</sub>e. In addition to not disrupting the recovery of organic resources from MSW, the other main advantage from achieving a high recovery rate with lead recycling processes that meet best practice standards for process and emission controls is that lead is prevented from entering the environment.

Lead is a heavy metal that is toxic to humans, animals, plants and micro-organisms at low exposure levels due to its bio-accumulating properties. Although there are natural releases of lead into the environment, including volcanos, erosion of certain rocks and bush fires, human releases are more problematic.

Lead from human activity can enter the environment through combustion of products containing lead (for example leaded petrol), metal processing, 'weathering' of products with lead (such as ammunition, lead based paint and lead sheathing of cables) and through emissions from waste incineration and landfill leachate. With regard to the last two releases of lead, the United Nations Environment Programme recognises that prevention of lead based products from entering the waste stream is 'one of the only really long-term measures' that provides a solution for lead pollution. Once it has entered the waste stream, the presence of lead means that residual waste requires special emissions controls, such as the treatment of landfill leachate.<sup>36</sup> The potential for environmental damage arising from lead in the waste stream highlights the need to maximise levels of recycling.

There are also financial benefits from recycling lead. The price of lead on international commodity markets points to the recycling of lead as a commercially viable operation. For example, Figure 3 below shows that the price of lead rose from around US\$500 per tonne in 2000 to US\$2,000 per tonne in 2007. This means that the barrier to increased levels of recycling is the collection of ULABs that are currently in the waste stream, as opposed to overcoming technical or financial barriers.

<sup>32</sup> Norgate, T.E. and Rankin, W.J., undated, 'An Environmental Assessment of Lead and Zinc Production Processes', CSIRO Minerals, Melbourne, accessed at [http://www.minerals.csiro.au/sd/CSIRO\\_Paper\\_LCA\\_PbZn.pdf](http://www.minerals.csiro.au/sd/CSIRO_Paper_LCA_PbZn.pdf), June 2007.

<sup>33</sup> By way of comparison, one tonne of black coal has approximately 27 GJ of energy, thus the energy requirements to make one tonne of lead are equivalent to the energy contained in 741 kilograms of coal.

<sup>34</sup> Norgate, T.E., Jahanshahi, S. and Rankin, W.J., 2006, 'Assessing the Environmental Impact of Metal Production Processes', *Journal of Cleaner Production* 15 (2007) 838e848, accessed at <http://linkinghub.elsevier.com/retrieve/pii/S0959652606002320>, June 2007.

<sup>35</sup> Rydh, C.J., 2003, *Doctoral Dissertation entitled 'Environmental Assessment of Battery Systems: Critical Issues for Established and Emerging Technologies'*, Chalmers University of Technology, Goeteborg, Sweden, accessed at [http://homepage.le.hik.se/personal/ryca/battery/Rydh\\_2003\\_Thesis\\_Env\\_Assess\\_Batteries.pdf](http://homepage.le.hik.se/personal/ryca/battery/Rydh_2003_Thesis_Env_Assess_Batteries.pdf), June 2007.

<sup>36</sup> UNEP, 2006, *Interim Review of Scientific Information on Lead - Version of October 2006*, United Nations Environment Programme DTIE/Chemicals, Geneva, accessed at [http://www.chem.unep.ch/Pb\\_and\\_Cd/SR/Files/Interim\\_reviews/UNEP\\_Lead\\_review\\_Interim-Oct2006.pdf](http://www.chem.unep.ch/Pb_and_Cd/SR/Files/Interim_reviews/UNEP_Lead_review_Interim-Oct2006.pdf), June 2007.

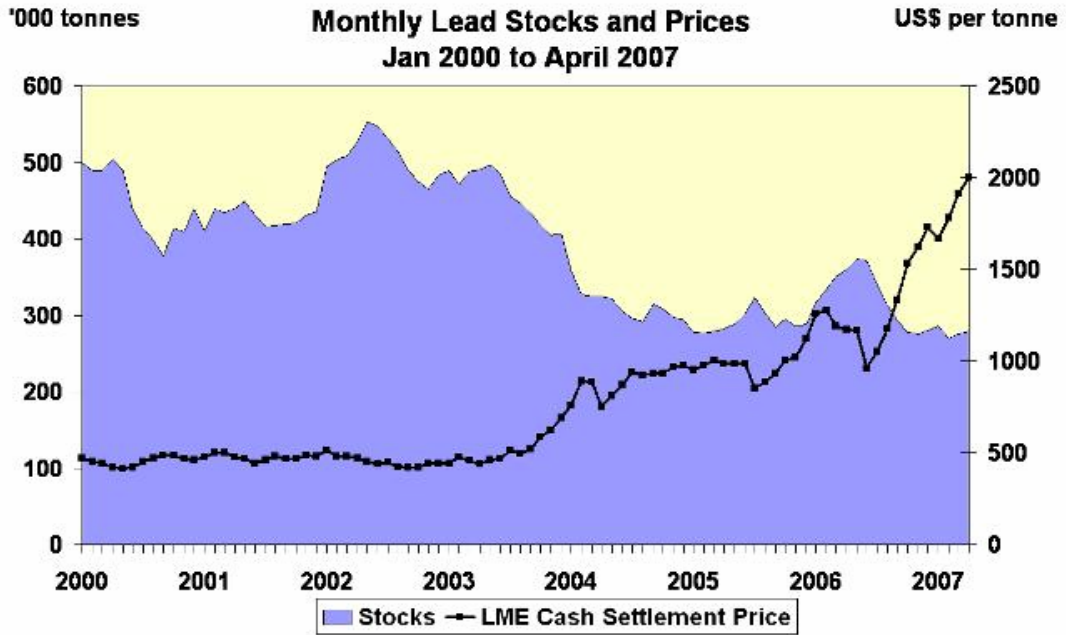


Figure 3 –Historical price of lead on the London Metal Exchange (LME)<sup>37</sup>

The following section presents a summary of international efforts to improve recycling of used lead acid batteries.

<sup>37</sup> Source: International Lead and Zinc Group, accessed at <http://www.ilzsg.org/>, July 2007.

## 4 USED LEAD ACID BATTERIES: THE INTERNATIONAL EPR EXPERIENCE

Several countries and individual jurisdictions around the world operate EPR schemes aimed at reducing the number of ULABs which ultimately end up in landfill. For example, the European Union has a directive specifically addressing batteries and waste batteries. Further detail on this directive, in addition to case studies from Germany, the United States, and Canada are presented below.

### 4.1 European Union

Under EU directive 2006/66/EC,<sup>38</sup> Member States are required to ensure that producers of car batteries, or third parties, set up schemes to collect waste automotive batteries and accumulators from end-users or from an accessible collection point in their vicinity, where collection is not carried out as part of an end of life vehicle program. Furthermore, where the batteries have originated from private, non-commercial vehicles, the schemes may not involve any charge to end-users when discarding waste batteries, nor any obligation to buy a new battery.

Under this Directive it is also required that member states prohibit the landfilling or incineration of automotive batteries. This effectively sets the goal of zero disposal of ULABs and a 100 per cent recovery rate. This differs slightly from the stated recycling target of 65 per cent by average weight of lead-acid batteries, in that this lower target refers to recycling efficiency. The lead content is required to be recycled to the highest degree that is technically feasible while avoiding excessive costs, however other elements in the battery such as the plastic casings and acid solution, do not have the same expectations.

Member States are required to report on the levels of recycling achieved in each calendar year and whether the recycling efficiencies have been met. Disposal to landfill is banned. It is noted that the design of schemes to achieve the requirements of the EU directive is left up to individual countries.

### 4.2 Germany

Under the German Battery Ordinance of 2001,<sup>39</sup> battery distributors are required to accept any used batteries from customers at the end of their serviceable life. Battery manufacturers are in turn required to accept returned batteries for recovery, and are responsible for suitable disposal of batteries which cannot be recovered.

Furthermore, any distributor who sells LABs is obliged to levy a deposit of 7.50 Euros, including VAT, if the purchaser fails to return a used battery at the time of purchasing the new battery. The deposit is refunded upon return of a battery.

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<sup>38</sup>European Union Parliament, 2006, Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators, accessed online at <http://ec.europa.eu/environment/waste/batteries/index.htm>, June 2007.

<sup>39</sup>Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany, 2001, Ordinance on the Return and Disposal of Used Batteries and Accumulators, accessed online at [http://www.bmu.de/files/pdfs/allgemein/application/pdf/battv\\_engl.pdf](http://www.bmu.de/files/pdfs/allgemein/application/pdf/battv_engl.pdf), June 2007.

In terms of monitoring, manufacturers need to submit verifiable documentation with information on the weight of the batteries placed on the market in the preceding year, classified into systems and type categories, the weight of the batteries accepted for return in the preceding year, classified into systems and type categories, the qualitative and quantitative results of recovery and disposal, and total prices paid for sorting, recovery and disposal.

### 4.3 United States

A number of states in the US have legislation surrounding the return of car batteries. Some examples include:<sup>40</sup>

- Arizona, Arkansas, Connecticut, Idaho, Maine, Minnesota, New York, South Carolina and Washington all require a deposit of between US\$5 and US\$10 to be paid by consumers who purchase a new battery without returning a used battery at the same time. Wisconsin law allows retailers to charge a US\$5 deposit in lieu of a trade-in, and to charge US\$3 for taking a battery.
- Florida, Maine, South Carolina and Texas also charge a non-refundable fee of US\$1 to US\$3 on each battery to cover scheme administration costs and/or waste management costs in the state.
- In Rhode Island, distributors are required by law to accept used batteries in reasonable condition from consumers. Distributors in turn may not refuse to accept batteries back from retailers. Here retailers may also voluntarily add an unspecified charge to the price of a new vehicle battery which must be refunded if a used battery is returned within 7 days of purchase.
- Some of the states, including Connecticut, Minnesota, have legislation that requires retailers to accept one or more used batteries at the time of sale of a new battery.
- Many states have placed a ban on landfilling and/or incineration of lead acid batteries (for example, New Hampshire, New Mexico, and Massachusetts).

### 4.4 Prince Edward Island, Canada

In the province of Prince Edward Island in Canada, a mandatory take back scheme was introduced in 1993 to reduce the number of LABs which end up in landfill.<sup>41</sup> Retailers of new LABs are required by law to accept used batteries at the time of the sale of new batteries and are responsible for sending old batteries to appropriate recycling facilities. In addition, if a used battery is not presented at the time of purchasing a new battery or within 30 days of purchase, a C\$5 levy is charged to the purchaser which acts as a return incentive to the consumer. For the rest, the initiative is self-funded, due to the inherent value of the lead. The government does have some enforcement costs although this is offset to some degree by avoided costs associated with disposal and waste management.

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<sup>40</sup> Battery Council International, 2006, *Summary of US State Lead Acid Battery Laws*, accessed online at <http://www.batterycouncil.org/states.html>, June 2007.

<sup>41</sup> Environment Canada, 2002, *PE Lead Acid Battery Take Back Programme*, accessed at <http://www.ec.gc.ca/epr/inventory/en/DetailView.cfm?mInitiative=72>, June 2007.

Monitoring of the scheme is carried out as follows: Battery retailers are required to report the number of lead acid batteries that are imported into the province annually. The province also calculates the number of batteries that leave the province for recycling purposes. The scheme has grown in terms of recovery rates. In 1998, there was a reported 65 per cent recovery rate of batteries and battery-related materials, followed by a 70-75 per cent capture rate in 1999, and a 107 per cent rate in 2000. (Note that recovery rates greater than 100 per cent can be reported where the amount of recovery in a given year is greater than the number of units sold, either through a dip in sales for a given year, or recovery of historical stock).

The EPR schemes in place around the world are designed to maximise the return of used lead acid batteries for recycling, usually through the point of retail. For example, many schemes charge a deposit on the sale of a new battery if the old battery is not returned at the time of sale. The case for introducing an EPR scheme for ULABs in Australia is examined in the following section.

## 5 THE CASE FOR ULAB EPR IN AUSTRALIA

The need to recycle lead acid batteries is well recognised in Australia, with several initiatives established and systems in place for the collection and transport of ULABs. However, given the uncertainty around the actual recycling rate of ULABs, with the likelihood of an overestimation from the battery industry, and the negative impact of split battery casings in disrupting the recycling of the organic fraction in MSW, there is a need for greater policy intervention aimed at eliminating lead from residual waste streams.

### 5.1 Current Initiatives in Australia for ULAB Recycling

In Australia, many automotive service stations and battery retailers will accept batteries for recycling. Furthermore, in New South Wales, WSN Environmental Solutions will accept ULABs to be dropped off at any of their waste recovery centres for recycling. A similar situation exists in Queensland where Brisbane City Council will accept ULABs at their waste transfer stations. In Victoria the RACV offers an annual collection of used car batteries. As an incentive, for every car battery collected, the RACV donates \$1 to The Royal Children's Hospital. Batteries can also be taken to many transfer stations in that State.

NSW batteries, including lead acid batteries, have been identified as a specific priority waste rather than being treated as part of a broad 'household chemicals' category in the NSW Extended Producer Responsibility Priority Statement for 2005/06.<sup>42</sup> The Minister for the Environment has requested the Australia Battery Industry Association to prepare an outline of proposed actions or details of current actions to engage suppliers of the DIY consumer markets and householders to divert lead acid batteries away from the municipal waste stream and the NSW Chemical Cleanout program towards more appropriate systems such as point of sale take-back. In addition, the current ULAB mechanisms for battery take back will be assessed against the evaluation criteria set out in the Priority Statement.

(It is noted that under the Australian Hazardous Waste (Regulation of Exports and Imports) Act 1989, ULABs are defined as a hazardous waste, and exports to other countries for recycling can only occur after the exporter has been granted an export permit.<sup>43</sup>)

However, in spite of these initiatives, it is clear that ULABs are still being disposed of inappropriately through kerbside collections of household waste. Even at high recycling rates, the potential negative impact of ULABs to disrupt and contaminate resource recovery streams provides a compelling case for policy intervention in the form of an EPR scheme for ULABs.

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<sup>42</sup> NSW Department of Environment and Conservation, 2006, NSW Extended Producer Responsibility Priority Statement for 2005/06, accessed online at [http://www.environment.nsw.gov.au/resources/2005624\\_prioritystatement2005\\_06.pdf](http://www.environment.nsw.gov.au/resources/2005624_prioritystatement2005_06.pdf), June 2007.

<sup>43</sup> Department of the Environment and Heritage, 2005, Used Lead Acid Batteries Fact Sheet, accessed online at <http://www.environment.gov.au/settlements/publications/chemicals/hazardous-waste/lead-acid-fs.html>, June 2007.

## 5.2 The Need to Eliminate ULABs from Household Waste

The impact of used lead acid batteries was highlighted by the fact that estimated concentration of lead in MSW is 1,050 mg/kg (dry weight basis) and that unless removed the lead concentrations alone would prevent the production of any usable composted products. One ULAB disposed of incorrectly into a municipal solid waste collection system, and not removed prior to entering a resource recovery facility for mixed MSW, could contaminate 25 tonnes of MSW and prevent the recovery of the organic resources within this waste (estimated at 25 per cent of the waste inputs, or 6.5 tonnes) because of lead levels in excess of 500 mg/kg.<sup>44</sup> The contaminated product would have to be landfilled because of its elevated lead content, contributing to an associated greenhouse gas liability from the decomposition of degradable organic carbon into landfill gas.

The Australian Greenhouse Office estimates that the landfilling of one tonne of MSW has a greenhouse gas liability of 1.14 tonnes of carbon dioxide equivalent (CO<sub>2</sub>e) from the landfill gas that is generated by the organic fraction in MSW.<sup>45</sup> This arguably translates to a greenhouse impact of 7.4 tonnes of CO<sub>2</sub>e arising from one used lead acid battery that prevents recycling of 6.5 tonnes organic material through elevated lead levels.

While this is not necessarily a direct causal link, it serves to highlight that although the recycling of 100 batteries (nearly one tonne of lead) will avoid 1.3 tonnes of CO<sub>2</sub>e, the presence of one battery in household garbage collections could cause up to of 7.4 tonnes of CO<sub>2</sub>e emissions from landfill gas by making the organic fraction of MSW un-recyclable. By 2010 if the amount of used lead acid batteries in MSW remains constant, they could represent a barrier to reducing waste to landfill in Australia with a potential greenhouse impact of 3.7 million tonnes of CO<sub>2</sub>e. On a per battery basis, and given the Stern Review estimate of \$110 for the 'per tonne' social cost of greenhouse gas emissions,<sup>46</sup> a social cost of \$814 could be attributed to a single ULAB in MSW for its potential to disrupt resource recovery.

When the direct financial impacts to alternative waste technologies of \$62.50 per ULAB present in MSW inputs are also considered, and the fact that lead levels from split ULAB casings (spillage of paste and acid) will reduce final compost quality, it is clear that greater efforts aimed at eliminating ULABs from household waste collections are needed. While consumer education is a worthwhile activity, education alone will be unable to provide the needed elimination of ULABs from MSW. A stronger mechanism is required.

From this perspective the introduction of a deposit on all lead acid batteries sold where there is no trade-in of a ULAB has strong appeal, especially with a high deposit. This would directly target the section of the lead acid battery market where leakage is likely, without the need for implementing a deposit on all lead acid batteries. However, additional funds would be needed as an incentive for 'orphan' ULABs, so that a bounty would be paid on the return of any ULAB at any point of sale in Australia.

<sup>44</sup> One ULAB contains 9,700,000 milligrams of lead (9.7 kg), which would raise the lead concentration level of 19,000 kg of MSW on an as received basis to over 500 mg/kg (9,700,000/500). This has a moisture content of at least 25%, so to adjust to a dry weight basis multiply by 1.33 = 25

<sup>45</sup> GO, 2006, 'AGO Factors and Methods Workbook - For use in Australian greenhouse emissions reporting', Australian Greenhouse Office, Canberra, found at <http://www.greenhouse.gov.au/workbook/pubs/workbook2006.pdf>, June 2007.

<sup>46</sup> Stern Review, 2006, 'The Economics of Climate Change', HM Treasury, London, accessed at [http://www.hm-treasury.gov.uk/independent\\_reviews/stern\\_review\\_economics\\_climate\\_change/stern\\_review\\_report.cfm](http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm), June 2007. US\$85 = A\$110.

### 5.3 Recommendations

For action on the elimination of ULABs to be successful, greater efforts are required by industry, government and the consumer. The following actions are recommended as part of a campaign to eliminate used lead acid batteries from household waste:

- fast track the introduction of an EPR scheme for ULABs where a significant deposit is charged per battery that is sold without the return of the old battery. Such a scheme would need to be national in operation, requiring federal government involvement. However, if action on a national level is not forthcoming, then progressive jurisdictions should introduce state based schemes
- explore mechanisms to bring all lead acid batteries into the EPR scheme, including sealed lead acid batteries
- conduct five yearly reviews, including annual collection of data on material flows and occurrence of ULABs in municipal and C & I waste collections; and if ULABs are still presenting in household or commercial waste, increase the coverage of the deposit to all automotive batteries. This is likely to be a shared government and industry responsibility.

## 6 APPENDICES

### 6.1 Appendix 1 – Example of Extended Producer Responsibility Programs

Table 4 – Examples of EPR programs<sup>47</sup>

<i>Type of EPR Approach</i>	<i>Examples</i>
Product take-back programs	<ul style="list-style-type: none"> <li>– Mandatory take-back</li> <li>– Voluntary or negotiated take-back programs</li> </ul>
Procurement/consumer programs	<ul style="list-style-type: none"> <li>– Procurement guidelines and policies</li> <li>– Information disclosure programs</li> </ul>
Regulatory approaches	<ul style="list-style-type: none"> <li>– Prohibitions of certain hazardous materials or products.</li> <li>– Disposal bans</li> <li>– Mandated recycling</li> </ul>
Voluntary industry practices	<ul style="list-style-type: none"> <li>– Voluntary codes of practice</li> <li>– Public/private partnerships</li> <li>– Leasing and "servicising" (in which companies which range from as photocopy manufacturers to carpet manufacturers lease their products or provide services, thereby retaining ownership of the product, including responsibility for its end-of-life disposal)</li> </ul>
Economic instruments	<ul style="list-style-type: none"> <li>– Special taxes</li> <li>– Product charges</li> <li>– Advance disposal fees</li> <li>– Deposit/refund schemes</li> <li>– Subsidies and tax credits for the production and use of environmentally preferable products</li> </ul>

<sup>47</sup> Environment Canada, 2002, *Approaches to Extended Producer Responsibility and Stewardship*, accessed at <http://www.ec.gc.ca/epr/en/approaches.cfm>, June 2007.