Environment Australia

Department of the Environment and Heritage

Environmental Impact of End-of-Life Vehicles: An Information Paper

DISCLAIMER

The views and opinions in this Information Paper do not necessarily reflect those of the Commonwealth Government or the Minister for the Environment and Heritage.

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- Motor Trades Association of Australia (MTAA)
- Automobile Parts Recyclers Association of Australia (APRAA)
- Federation of Automotive Product Manufacturers (FAPM)
- Environment Protection Agency (EPA) - South Australia
- Environment Protection Authority – New South Wales
- Environment Protection Agency – Queensland
- Environment Protection Authority – Victoria
- Environment Protection Authority – Western Australia
- Environment ACT
- ACT Urban Services
- Environment Australia
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- Simsmetal
- Metalcorp
- Sell and Parker Pty Ltd
- Ford Australia
- Mitsubishi Motors Australia Ltd
- General Motors Holden
- ABSAN (Plastics Recycling)
- Western Sydney Waste Board
- Australian Bureau of Statistics

Contents

1. Preamble – Purpose and Scope

The purpose of this information paper is to help inform discussion by presenting facts and pertinent observations about the environmental impacts of end-of-life vehicles (ELVs).

The information in this paper is based on earlier work undertaken for Environment Australia by A.D.Edwards Consulting Pty Ltd, which was limited to a review of existing literature and discussions with stakeholders. Accordingly, the paper reports on factors associated with ELVs which have been considered by others to pose potential environmental threats. No independent scientific assessment of the extent of any such impacts in Australia has been undertaken.

Finally, it is recognised that some of the potentially harmful materials within ELVs – such as air-conditioning gases, oils etc – are already addressed to varying degrees by regulations in some jurisdictions. Moreover, this information paper does not attempt to measure the extent of compliance with existing regulations, but simply notes the ELV materials as having potentially negative environmental impacts if improperly managed.

2. Executive Summary

The purpose of this paper is to make information available to help generate discussion about the nature and extent of any environmental impacts resulting from end of life vehicles (ELVs).

Based on Australian Bureau of Statistics (ABS) estimates, over 500,000 of the 12.5 million vehicles on Australian roads reach the end of their life each year. The number of these "ELVs" is increasing each year.

ELVs are already one of the most highly recycled consumer products. Components having an economic value are removed by auto dismantlers for refurbishing and reuse although, this may be a declining industry due to the continuing trend towards newer, more reliable vehicles with long warranty periods. The balance of the ELV is "shredded" by metal recyclers. The metal fraction, accounting for approximately 70% of materials by weight, is recycled. The remainder of the ELV, primarily plastics, seat foam, glass and rubber, is sent to landfill as waste and is known as shredder "flock" (or "fluff" or "residue").

It is important to ensure that any measures to further improve ELV environmental outcomes do not adversely impact on the market dynamics responsible for current recycling levels. In particular, it may be inequitable and counterproductive for responsibility to be attributed solely or largely to last receiver of the ELV (usually metal recyclers).

Present recycling levels produce positive environmental outcomes, which partly offset the substantial impacts that occur in the "production" and "in-service" life cycle phases of vehicles. The environmental impacts of ELVs must not be considered in isolation from total life cycle impacts. For instance, the increased use of plastics in cars may produce detrimental end of life consequences (increased waste), but probably produces net environmental gains given reductions in energy use and emissions during the vehicles operational life.

Nevertheless, there are several environmental issues associated with ELVs that have been the focus of much attention internationally. Most significant are the comprehensive new ELV management requirements recently agreed by the European Parliament. Shredder flock is classified as "hazardous" waste in some international jurisdictions. However, there is a paucity of empirical evidence in Australia about the composition of shredder flock and its environmental impact. More independent analysis is needed in this area.

Potential ELV environmental impacts fall into two main categories – pollution and resource loss.

The possible sources of environmental impacts within these categories are: (1) landfilling waste or "flock" from metal shredders; (2) poor environmental practices at some auto dismantlers and other ELV treatment facilities; and (3) vehicles abandoned in the environment. Materials with potential negative environmental consequences in ELVs include: oil, coolant, fuel, brake and other fluids; air-conditioning gases; and heavy metals including lead, hexavalent chromium, cadmium and mercury. Existing regulatory requirements in relation to some of these materials in some jurisdictions may already be reducing the level of environmental exposure.

The second category of potential environmental impacts relates to waste and resource loss, through not maximising ELV reuse and material recycling. The non-metal portion of ELVs accounts for approximately 30% by weight and is generally not recycled. Based on ABS estimates of the number of de-registered vehicles annually, and the non-metal proportion of vehicles, an approximate calculation suggests that some 195,000 tonnes of waste from ELVs may be being produced each year. However, one metal recycler estimated that an industry maximum figure of 70,000 tonnes was more realistic.

The Table at (i) below summarises the ELV impacts. Table (ii) summarises the main findings.

Setting the scene for this study, as with similar policy investigations by governments around the world, is the European Parliament directive on end of life vehicles. The directive is perhaps the most significant example of "extended producer responsibility" models to be enacted anywhere, and had its genesis in landfill shortages and other environmental concerns, which have been mounting in Europe over the last 10 years. Essentially, vehicle manufacturers are responsible for ensuring recycling targets (95% by weight by 2015) are met for ELVs which they originally manufactured. Formal ELV deregistration requirements, requiring a "certificate of disposal" from a certified treatment facility, are amongst associated measures.

A key prerequisite for improving environmental outcomes is better management of the process by which ELVs enter the waste stream. Accordingly, aspects of the European style ELV deregistration requirements are discussed in this paper, including the setting of environmental standards for recycling facilities. This could allow environmentally sound management of ELV disposal (including de-pollution) and set minimum standards for ELV dismantling/recycling firms. Added benefits might include reductions in the number of abandoned vehicles, and in criminality associated with "re-birthing" of vehicles. Discussions with industry associations and state and territory governments suggest there are widespread concerns in these areas.

There appears substantial opposition from the manufacturers and the Federal Chamber of Automobile Industries (FCAI) to any moves to mandate recycling levels through a European style "extended producer responsibility" (EPR) approach. While an EPR approach may produce the greatest environmental outcomes, it could have a significant detrimental impact on the viability of the local car industry. Other relevant considerations include the low investment/low volume nature of the local industry, landfill pressures/costs are currently relatively low, infrastructure and markets for recycled ELV materials are limited, and the cost of many of the recycling technologies mean they are not currently viable given the local market size.

It should also be noted that EPR for ELVs has not been adopted outside of Europe, and its effectiveness in Europe has yet to be tested. It remains to be seen whether the approach will be sufficient to overcome the current failure of markets to produce higher levels of recycling.

While the European experience should continue to be monitored, co-operative approaches with industry may be a better starting point for discussion of the issues in Australia.

Initial discussions suggest there may be merit in co-operative approaches aimed at: phasing out the use of certain materials with potentially negative environmental impacts; setting targets for vehicle "recyclability"; instituting certain "design for disassembly" and "design for recycling" measures; and establishing a forum for the manufacturing and recycling industries to work towards higher levels of ELV recycling. Most manufacturers are already instituting improvements in these areas in response to head office directives and developments in the global market. There may be scope for further consideration by stakeholders of what agreements in these areas could be reached, recognising existing industry planning and timing, the realities of lead times in vehicle design, and the need for broader industry sustainability objectives to also be met. There might also be resultant industry benefits by projecting the Australian industry as meeting or exceeding international standards.

Supply side measures, such as improvements in vehicle design and better waste stream management, are likely to improve the commercial viability of ELV recycling over time. However, further investigation and discussion amongst stakeholders may be desirable to better understand the technical and economic impediments to the development of markets for non-metal ELV materials – particularly plastics, foam, glass and rubber. All sources of those waste materials could be considered, rather than examining ELVs in isolation (ELVs account for only about 7% of waste plastics, for instance). Until the nature of these markets is better understood, it would be premature to consider any form of direct financial intervention to compensate for the limited commercial viability of non-metal, ELV materials recycling.

The intention of the paper is to inform discussion on possible policy responses to the environmental impacts from ELVs, which should be pragmatic and achievable.

(i) Summary Table – ELV impacts

Key Issue	Releases to Environment	Resource Loss/Waste
Dumped vehicles	Releases of fluids etc, disturbed water flows, pollution, vermin habitat etc	ELVs not entering the recycling stream
Poor practices at ELV recyclers	Releases to ground, air and water of ELV fluids, air-conditioning gasses etc	ELV fluids etc not recycled
Landfill contamination – fluids etc	Leaching of potentially polluting fluids etc in shredder flock at landfill sites	ELV fluids etc not recycled
Landfill contamination – heavy metals etc	Potential leaching of heavy metals, PCBs, PVC etc which may be contained in landfilled shredder flock	A small proportion of metals are not recycled through the shredders
Recycling of components		Limited reuse of ELV components
Waste volume and lack of material recycling	Release of potentially polluting substances Use of land for waste disposal	Waste volumes generated by shredder flock Limited recycling of non-metal portion of ELV materials

(ii) Summary of Key Findings

- Over 500,000 vehicles enter the waste stream each year in Australia.(p.3:12)
- The volume of ELVs is likely to increase at an escalating rate as the result of the continuing upward trend in the rate of vehicle ownership, the decreasing average age of vehicles, and the declining cost effectiveness of owning older vehicles. (p.3:14)
- Given these trends, it is conceivable that the number of ELVs might exceed 750,000 per year by 2010. (p.3:14)
- Current levels of ELV recycling are high relative to most other consumer products due to the demand for the metal content. Care must be taken to ensure that any changes to policy or regulatory settings do not adversely impact on current levels of recycling - for instance, it would be inequitable and potentially counter productive for the burden to fall mostly on the last receiver of an ELV (generally metal shredders).(p.4:17)
- No legislative or regulatory requirements in Australia require the last owner to ensure the end of life vehicle enters the existing recycling infrastructure.(p. 5:19)
- It seems likely that the proportion of ELVs reaching recycling facilities is probably over 90%. (p 5:23)
- While ELVs are frequently removed from even remote parts of the country, potentially greater outcomes and reduced costs to local councils could be achieved through facilitating formal ELV collection points. (p.5:23)
- The current lack of any formal ELV deregistration requirements is likely to be contributing to the costs and inefficiencies of collecting and treating ELVs.(p.5:24)
- There may be merit in considering measures to further increase the substitution of recycled components for new components in both new and existing vehicles (p.6:28)
- Between 65% and 75% of ELVs by weight are currently being recycled, which represents the metal fraction of an ELV.(p.7:31)

- It is likely that some 455,000 tonnes of metal is recycled annually from ELVs, producing substantial environmental benefits from reduced environmental releases and resource reuse. The balance of the ELV is reduced in volume by 90% - producing benefits in terms of landfill space savings. (p7:33)

- ELVs are one of the most highly recycled consumer products, due to strong markets for recycled metals.(p.7:34)

- Current ELV recovery and recycling levels could be jeopardised by measures which placed an additional ELV processing cost burden on metal recyclers.(p.7:34)

- Plastics and foams may account for approximately 50% of the waste from ELVs.(p.8:36)

- Initial estimations suggest that as much as 195,000 tonnes of waste could be produced from ELVs per annum, and may constitute around 1 % of total annual waste. However, these figures are not supported by at least one industry stakeholder which estimates the figure as being less than 70,000 tonnes.(p.8:37).

- As a single product waste stream, ELVs constitute a significant source of waste.(p.8:37)

- Negative environmental impacts may be occurring through the landfilling of heavy metals, hazardous fluids and other materials contained in shredder flock.(p.8:41)

- There is a lack of information on the composition of shredder flock and the extent of any environmental releases occurring through current disposal arrangements in Australia.(p.8:41)

- With the increased use of plastics in new vehicles, the metal content will continue to decline leading to increased levels of shredder flock.(p.8:44)

- Significant energy and emission savings might be possible by increasing the level of recycling of plastics from ELVs, including for use in new vehicles.(p.8:44)

- Simply increasing the costs of flock disposal may increase the financial burden on metal recyclers and decrease the extent of ELV collection and recycling.(p.8:44)

- Australian vehicle manufacturers are taking action to reduce or eliminate the use of heavy metals in the manufacture of vehicles. (p.9:47)

- Pollution to air, land and water is likely to be occurring at many auto-recycling facilities due to inadequate premises and practices. Most States and Territories consulted agreed this was a significant issue.(p.10:51)

- The lack of clear requirements to remove operating fluids, batteries and other potentially polluting materials from ELVs prior to shredding may be a source of negative environmental impacts. (p.10:52)

- De-polluting ELVs ought not impact on the viability of current recycling levels given the economic value of ELVs and the views of APRAA and the shredder operators that good practice is already being (or should be) followed.(p.10:52)

- There appears to be strong support from many stakeholders for some form of national vehicle de-registration process. (p.10:53)

- It is likely that economic markets probably cannot exist at present for recycled plastics (and most other) ELV materials due to the mix of plastic types in components, contamination from other materials, the costs of disassembly, and the price for the recycled materials.(p.11:59)

- Given the lack of economic markets, increasing the level of disassembly and recycling of ELV materials would entail significant additional costs – European experience suggests around $200 million (US$200 per ELV).(p.11:59)

3. Number of ELVs and trends

Number of end of life vehicles

Australian Bureau of Statistics' Motor Vehicle Census figures show a steady increase in the "attrition" rate (vehicles removed from national vehicle registration databases). The attrition rate was 4.6% of the total vehicle fleet, or **572,530** vehicles in the 12 months to October 1999.[1] In the following 17 months to March 2001, a further **908,106** vehicles ceased to be registered, accounting for 5% of the vehicle fleet.

ABS figures include all motor vehicles, of which about 80% are passenger vehicles and about 14% are light commercial vehicles.

ESTIMATED VEHICLE ATTRITION RATE

1996 - 1997		1997 - 1998		1998 - 1999		1999 - 2001(a)	
No.	*% fleet*	*No.*	*% fleet*	*No.*	*% fleet*	*No.*	*% fleet*
442,467	3.8	404,430	3.3	572,530	4.6	908,106 (641,016 p.a.)	5.0

Source: ABS (*Motor Vehicle Census, Australia*, various years)

(a) *"No."* figures are for 17 months since the October 1999 survey (Previous year figures are for 12 months periods to October each year). The figure in brackets is the annualised equivalent derived by the consultant. *"% fleet"* figure is annualised by ABS.

It can be expected that there would be a high level of correlation between the year on year attrition statistics and ELV numbers. There may not be exact correlation for a particular year, as a small number of vehicles that had previously been de-registered may be re-registered in a following year. However, this possible anomaly would tend to average out over time.

Discussions with the author of the ABS reports indicated that minor statistical anomalies may arise due to some States occasionally clearing a backlog of registration paperwork, although this was considered relatively insignificant over time and when looking at national results. For this reason, some caution should be exercised in examining the relative rate of attrition for each state. New South Wales, Victoria and the Northern Territory had the largest proportions of their vehicle fleets retired in the most recent survey (5.7%, 5.2% and 7.0% respectively).

The ABS statistics were discussed with the statistician and author responsible for the ABS Motor Vehicle Census report. Other than the caveats above, there appear to be no

[1] ABS statistics quoted in this Chapter are from Refs 60, 61, 62, 63, 64 and 66).

methodological or other grounds to doubt the accuracy of the ABS estimates of vehicles being "retired".

It should also be noted that APRAA estimates that approximately 500,000 ELVs are received annually by auto dismantlers, with a roughly equivalent number exiting each year for metal salvaging. Of those, the recognised auto dismantling industry handles approximately 80%. The methodology for calculating the APRAA figures was not tested in this review and APRAA recommends caution in their use. However, as these figures broadly correlate with the ABS attrition statistics, the ABS figures are considered a reasonably strong proxy for ELV numbers.

It is the case, however, that the ABS figures do not provide any guidance on the subsequent question of what happens to deregistered vehicles (this is discussed in Chapter 5).

Key Finding:

- *Over 500,000 vehicles enter the waste stream each year in Australia.*

Trends in the volume of ELVs

As can be seen from the figures above, the number of ELVs has been increasing in each of the last few years. Of particular note is the 12% increase in the average number of vehicles deregistered each month between the 1998-99 and the 1999-2001 censuses (53,418 compared with 47,711 per month).

- In addition, the size of the total vehicle fleet continues to increase. There are approximately **12.5 million vehicles** currently registered in Australia (March 2001), equivalent to about 0.65 vehicles per person. There are 50% more vehicles on the road today than in 1982, and 145% more than in 1972.

- Between 1991 and 2001 the vehicle fleet increased by 24%, which was double the growth in Australia's resident population.

There is a continuing upward trend in the number of registered vehicles in Australia – the October 1999 figure represented a 1.7% increase over October 1998, which in turn was up 3.4 % over October 1997. The <u>rate</u> of growth of total motor vehicle numbers has also been higher in recent years.

On a pro rata basis, Western Australia has the highest number of vehicles (0.72 per person), and the Northern Territory the lowest (0.54 per person) along with New South Wales (0.57).

Along with the continuing increase in the number of vehicles, so to the average age of vehicles on Australian roads continues to decline, dropping from 10.7 years in 1998 to **10.6 years** in 1999 (Ref 60) to 10.1 years in 2001 (ref. 66). This decline reverses the previous historical trend – the average age of vehicles was just 6.1 years in 1971. In contrast to passenger vehicles, there was an increase in the average age of campervans, trucks heavier than 4.5 tonnes and non-freight carrying trucks.

Over 780,000 new vehicles were sold in Australia in year 2000 (Ref 59).

The States with the oldest vehicles are Tasmania (12.4 years) and South Australia (12.0 years) while the Northern Territory has the newest vehicles (9.2 years) followed by New South Wales (9.4 years).

Over half of all passenger vehicles (56%) were manufactured in the last 10 years, with only 9.2% manufactured before 1982. 23% of all vehicles currently on the road were manufactured to operate on leaded petrol (down from 64% in 1991).

No reliable figures on the life expectancy of Australian vehicles were found (although there were some clearly inaccurate statistics found in some papers, which confused average age with life span, eg. Ref. 27). In the UK, the life span of vehicles is estimated at about 14 years. By deduction from the statistics given above, it is likely that vehicles on Australian roads have a life span slightly greater – probably at least 15 years.

The ABS figures show that the most common vehicles on Australian roads are Fords (21.4% of all registered vehicles) and Holdens (19.7%). They are also amongst the oldest, with 36% of all Ford vehicles and 40% of all Holden vehicles more than 13 years old. Assuming no significant changes to economic or regulatory variables affecting vehicle-purchasing decisions, it can be expected that the trend of the last five years towards more, and newer, vehicles will continue unabated.

Discussions with stakeholders indicated that a key reason for the trend is probably the ongoing increase in affordability of new vehicles. The lower cost of new vehicles may be due to several factors including rationalisation of the number of vehicle producers, partly as a result of the trend towards global rather than domestic markets. Additionally worldwide demand, including from developing economies, and hence increased production volumes, and more efficient production techniques and use of materials may play a role. Most recently in Australia new vehicle costs have also fallen as a result of the changed taxation arrangements resulting from the introduction of the Goods and Services Tax and low interest rates.

Along with the lower initial purchase costs of new vehicles, the cost effectiveness of owning older vehicles also continues to decline due to the greater operational efficiency of new vehicles, and the benefits of increased reliability and lengthy warranty periods. Three year and even five-year warranty periods are now common on new vehicles. The Auto Parts Recyclers Association of Australia (APRAA), amongst others, nominated lengthy warranty periods as a significant factor in the declining market for used vehicle components.

Key Findings

- *The volume of ELVs is likely to increase at an escalating rate as the result of the continuing upward trend in the rate of vehicle ownership, the decreasing average age of vehicles, and the declining cost effectiveness of owning older vehicles.*

- *Given these trends, it is conceivable that the number of ELVs might exceed 750,000 per year by 2010.*

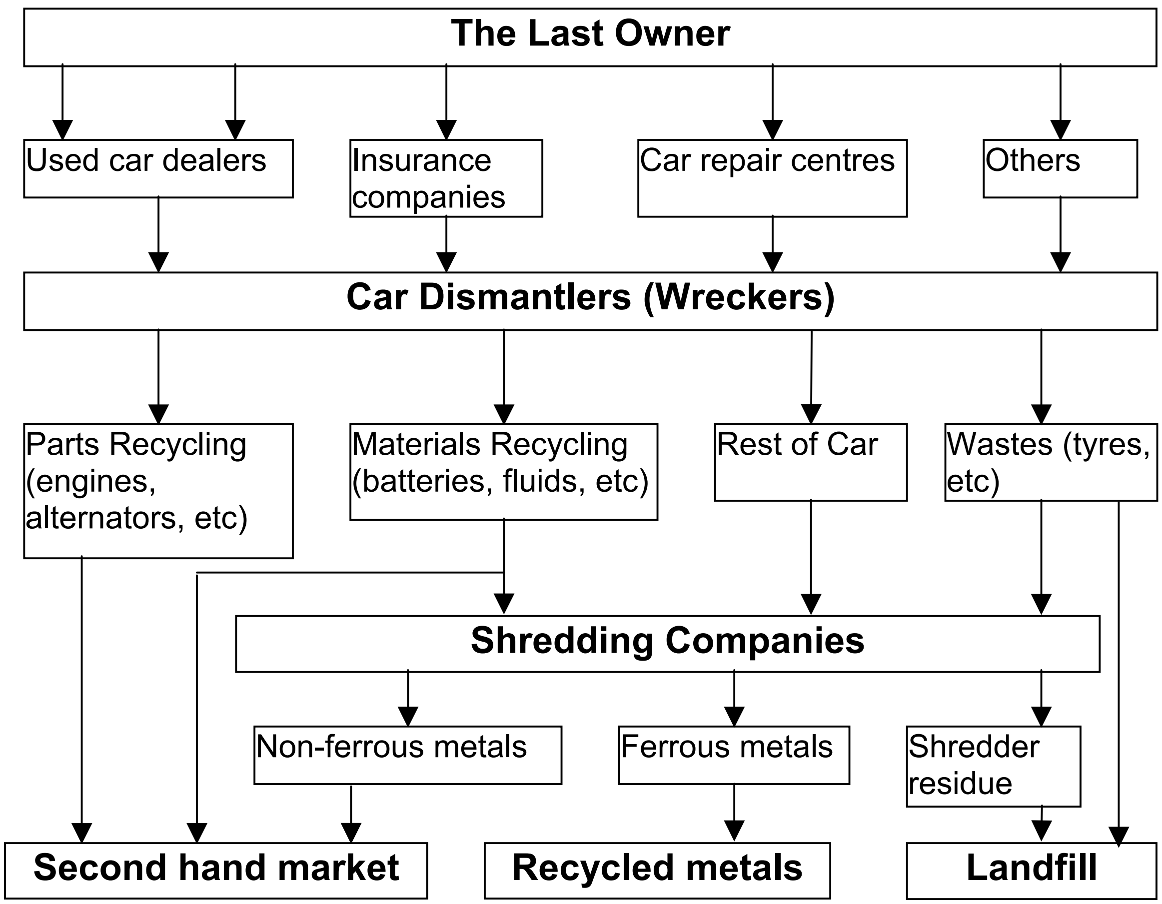
4. Introduction to current ELV recycling practices and ELV material composition

Current Recycling Practices

The diagram below illustrates the current ELV processing arrangements.

The ELV passes from the last owner to an automobile "wrecker" (the terms "parts recycler" or "dismantler" are now preferred by the industry) either directly or via third parties such as insurance companies (eg. in the case of insurance "write offs"), used car dealers, and car repairers.

The parts recyclers remove parts that have a commercial value on the second hand market – which may include many mechanical, body and trim components.



An efficient market operates for the removal of those ELV parts which have an economic value for reuse, with approximately 1000 – 1200 firms in existence whose primary business is parts recycling (source: APRAA). Of those, APRAA estimates approximately 800-900 are "competent" or "legitimate" operators (see Chapter 6).

In a minority of cases, particularly for older model vehicles or those with parts that for other reasons little economic value, the vehicle is taken directly to metal "shredders" or intermediary scrap metal merchants. A number of companies provide a car body removal service for a fee and metal recyclers sometimes operate drop off centres at landfill sites.

Once parts are removed, the metal "shredder" operators generally process the balance of the ELV.

Other than reuse of parts, recycling of materials in ELVs is largely limited to the metal components, for which a competitive market exists. Shredded metal is either smelted and re-processed in Australia, or more commonly exported including to Asian countries, such as Korea. These recyclable ferrous and non-ferrous metal materials in ELVs account for approximately 65%-75% of the ELV by weight.

It is therefore important to note that ELVs are therefore already one of the most highly recycled consumer products with the current metal recycling industry providing substantial environmental benefits (discussed further in Chapter 7). It is estimated in the USA that recycling the metals in ELVs produces annual energy savings equivalent to 3 days of national energy consumption (Ref: 68, p.276).

The non-metal remainder of the ELV exits the shredder as waste residue, known as shredder "fluff" or "flock", which in Australia is mostly disposed of in landfill. Issues associated with shredder flock are discussed in Chapter 8.

Vehicle composition

The nature and extent of materials recycling (and, conversely, waste), is a factor of materials used in vehicle manufacture and the value of those materials in secondary markets.

The average motor vehicle is comprised of approximately 15,000 parts (ref.26p.1). The primary materials used are metals (particularly steel) and plastics. Currently, these account for over 80% of the materials in a vehicle.

Material	Proportion by weight (%)
Steel	66
Zinc, copper, lead	2
Aluminium	6
Plastics	9
Rubber (tyres)	4
Adhesive, paints	3
Glass	3
Textiles	1
Fluids	1
Other	3

(Source: 1, p.3)

The figures in the preceding table are indicative only, as various papers estimate slightly different proportions of each material. The metal content in vehicles is variously stated to be between 65% and 75% of modern vehicles, and plastics content at between 7% and 10%. An Australian research article from the mid 1990s quoted statistics for steel and iron content at 63% and aluminium alloys at 10% of total car weight, giving a total metal content of 73% (Ref: 27, p.3).

There may not be a direct correlation between the composition of vehicle materials and shredder flock composition. Factors to consider include the extent and nature of parts removal prior to shredding, and the fact that ELVs sometimes contain non- ELV related waste dumped in the vehicle. One item of particular concern to the shredder operators is the dumping of gas cylinders in ELVs that can cause loud explosions and significant damage to the shredding machinery.

Key Findings

- *Current levels of ELV recycling are high relative to most other consumer products due to the demand for the metal content. Care must be taken to ensure that any changes to policy or regulatory settings do not adversely impact on current levels of recycling - for instance, it would be inequitable and potentially counter productive for the burden to fall mostly on the last receiver of an ELV (generally metal shredders).*

5. Getting ELVs into the recycling stream

Introduction

The environmental impacts resulting from current ELV treatment practices are discussed in the following chapters.

However, a key first issue is the extent to which ELVs enter the recycling stream at all – whether by regulation or market forces. It seems desirable to maximise the number of ELVs which reach recycling facilities, thereby reducing the number which are being inappropriately stored or disposed of.

While the majority of the 500,000 or more vehicles taken off the road each year in Australia are managed through the existing ELV recycling processes, it appears that a significant number are not.

Abandoned vs. Not Recycled

It is important to note that ELVs which do not reach recycling facilities are not necessarily vehicles which are "abandoned" in the environment. Most abandoned vehicles seem to eventually find their way to recyclers anyway, albeit often at a cost to local authorities (more on this below).

In reality, it is likely that the majority of vehicles which are not recycled remain with individual car owners or are stored elsewhere with the agreement of third parties.

Regulatory requirements governing ELV disposal

There appear to be no requirements specifically dealing with the manner in which end of life vehicles are disposed of, nor any regulatory requirements for ELVs to be disposed of through recycling facilities. However, new requirements for the treatment of "written off" vehicles are being progressively introduced in all States and Territories. In effect, this will constitute a type of formal "de-registration" requirement for this category of ELV.

Other than this, the last owner of a vehicle does not currently need to formally deregister a vehicle – in practice the owner either does not renew the registration, which then lapses, or cancels the registration to obtain a refund for the unused portion. It is not generally considered to be an offence for the owner to keep their own unregistered vehicles on their property. Councils may be able to invoke regulations if it is established that unregistered vehicles are being stored on private property in a manner which is causing a health or fire hazard, for instance, or a loss of amenity to other residents.

States and Territories generally can pursue last owners who improperly dispose of ELVs under anti-pollution or anti-littering legislation. However, this does not usually provide a solution where ELVs are dumped on private property with the landowners' consent.

A number of organisations consulted during the course of this study stated that the vehicle identification numbers, number plates and compliance plates are among the first items to be removed from improperly dumped vehicles. As a result, it is often impossible for local authorities to identify the owner of the abandoned vehicle in order to pursue legal recourse.

Key Finding

- *No legislative or regulatory requirements in Australia require the last owner to ensure the end of life vehicle enter the existing recycling infrastructure.*

Factors affecting the extent of ELVs being recycled

In the absence of regulated disposal requirements, key economic factors influencing the extent to which ELVs currently enter the recycling stream include:

- the economic value of the ELV – which may be derived, for instance, from recycling and resale of parts, or reclaiming ELV materials such as through metal recycling;
- variations in economic value related to geographical factors – which can affect demand (eg. proximity to markets) and supply (eg. number of ELVs in a particular location – critical mass issue);
- the availability of ELV collection and recycling infrastructure in response to that economic value (ie. market operating effectively); and
- consumer awareness of options for ELV disposal.

Environmental Impacts of Improper Disposal of ELVs

The improper disposal of ELVs gives rise to the possibility of operating fluids (oil, petrol, brake and transmission fluids etc) and other potentially harmful materials to be released into the environment. Improperly stored vehicles and components may also cause other environmental problems, including visual pollution, disruption to watercourses, “ponding” of water, and result in vermin breeding etc.

In addition to the direct pollution impact, there could be a significant environmental cost due to the resource loss from the ELV not being recycled to extent possible or commercially viable.

Other Consequences of Abandoned Vehicles

Some states (Western Australia in particular) highlighted abandoned vehicles as being of broader concern. Local authorities often incur significant costs in retrieving and storing abandoned vehicles. Local authorities are generally required to store recovered vehicles for some weeks before disposing of them.

In some cases metal recyclers will retrieve car hulks abandoned in the environment at minimal or no cost – this seems to occur when the hulks are readily accessible, and where there are several in reasonably close proximity. However, when dumped vehicles are located in remote areas, or beyond the accessible verges of roads, local authorities often incur significant costs in retrieving the ELV and taking it to a point for collection by a metal recycler.

The issue of additional funding to meet the costs of retrieving dumped ELVs was raised during the consultant's stakeholder discussions. States and Territories have not introduced charges specifically addressing the costs of retrieving abandoned vehicles (eg. additional registration or other levies). This may in part be due to the need for consistency between jurisdictions. Western Australia suggested that the provision of a funding stream to meet these costs should be considered at a national level (eg. through a levy on new cars).

Littering is primarily a state and local government responsibility. Other than policing anti-littering laws, States and Territories generally have not actively pursued programs to increase the level of ELV recycling and reduce the incidence of abandoned vehicles.

As well as the costs to local councils, abandoned vehicles often result in costs to society through the fraudulent and illegal use of vehicle identification numbers/compliance plates etc. These are often taken from dumped vehicles and reused in stolen or rebuilt cars (a practice known as "rebirthing"). Removal of vehicle identification plates makes it very difficult to identify the owner of the dumped ELV, greatly hampering the effectiveness of anti-littering laws.

This issue is also of considerable concern to industry organisations including the Federal Chamber of Automobile Industries (FCAI) and the Motor Trades Association of Australia (MTAA), as well as state and territory authorities. They were strongly supportive of measures to better regulate ELV disposal so as to reduce criminality, lost vehicle sales and brand image degradation, which result from vehicle rebirthing.

The National Motor Vehicle Theft Reduction Council (NMVTRC) has been established as a joint initiative of governments and the insurance industry to implement a raft of measures aimed at reducing the incidence of vehicle theft.

As discussed further below, there is a convergence of interest between environmental objectives and the interests of the motor trades industry and enforcement authorities which may produce broad support for new measures to regulate ELV disposal. In particular, the NMVTRC is currently investigating the feasibility of a code of conduct for the auto dismantling industry to address the often unwitting trade in stolen vehicle parts, and is also examining options for insurance company practices and procedures to produce improved outcomes in the auto repair and dismantling industries:

Proportion of total ELVs currently being recycled

There are no firm statistics available quantifying the number of ELVs which make their way to recycling facilities and hence any estimates need to be treated cautiously.

International studies have similarly had difficulty in accurately estimating the number of vehicles that enter the recycling stream – although as a guide it has been frequently stated that:

- "in most developed countries, more than 90% of ELVs are collected and processed for recycling" (4, p.28).

In the United States, a country of roughly the same land mass as Australia albeit with a much greater population, various studies estimate that about 95% (eg. 5, p.26) or 90% (eg. 22, p.6) of vehicles eventually enter the recycling system. In Europe, it is estimated that "in certain Member States (of the European Union) up to 7% of end of life vehicles are abandoned in the environment" (9, p2).

It might be hypothesised that the number of vehicles that fail to be recycled would be higher in Australia, due to Australia's vast landmass and low population density. In regional and remote areas in particular, it might be expected that the lack of infrastructure and the distance to recycling infrastructure would lead to a lack of economic value in vehicle hulks.

It should be noted, however, that the metal recycling industry provides a valuable service in retrieving ELVs from even quite remote areas. As is the case internationally, the economic value of ELVs is generally sufficient to warrant the costs of collecting most ELVs. It appears likely that the returns are marginal - fluctuations in the international price of scrap metal may determine the extent of ELV collection – and so continuation of this service should not be taken for granted. It is important to recognise the significant role of the metal recycling industry in achieving current ELV recycling levels, and to avoid any measures that might adversely impact on the viability of current recycling efforts. A 1996 Australian study estimated that only **70%** of scrapped cars are recycled (based on 1992 Federal Chamber of Automobile Industries (FCAI) data):

- "Because of logistical problems associated with Australia's vast landmass and scattered landscape in remote parts of the country, the number of cars brought to recyclers are comparatively low at 70%. The remaining car bodies remain undisposed with individual car owners or with town and city councils". (Ref. 50, p.320)

However, based on discussions during the course of this report it seems unlikely that 30% of ELVs are accumulating annually

- based on the Australian Bureau of Statistics' estimates of the annual vehicle attrition rate, this would equate to more than 150,000 ELVs stockpiling each year. That number of ELVs placed bumper to bumper would extend some 600 kilometres – or enough to reach from Sydney to Canberra and back.
- the cumulative effect over a number of years of such a large (and ever increasing) number of ELVs not entering the waste stream could not conceivably escape the attention of local and state authorities – discussions with State EPAs indicated no such level of concern.

APRAA estimates that auto dismantlers receive approximately 500,000 ELVs annually, with a roughly equivalent number exiting each year for metal salvaging. Of those, "competent" or "legitimate" operators handle approximately 80%. APRAA indicated that the figures were derived from registration and insurance company information and, although considered broadly indicative, should be treated with caution. The metal recycling industry expressed reservations about the quantities being discussed above.

Accordingly, in the absence of empirical data on the fate of ELVs, considerable caution should be exercised in the use of these rough estimates of ELVs entering the recycling stream.

Nevertheless, given:

- the apparent reliability of ABS statistics on total deregistered vehicle numbers;
- the lack of evidence to suggest a seriously worsening problem of abandoned or non-recycled ELVs;
- APRAA estimates; and
- international experience

It seems likely that that the proportion of ELVs entering the recycling stream is similar that estimated in other developed countries – ie. probably more than 90%.

The Economic Value of ELVs

The economic value of ELVs primarily arises from demand for recycled parts, and from the value of the metallic content to metal recyclers.

The scrap steel extracted from ELVs by metal shredders is worth roughly US$100/tonne CIF[2] into the Korean steel mills, with the non-ferrous metals worth substantially more.

[2] Cargo, Insurance and Freight

However, substantial transport, handling and processing costs are incurred in realising these returns.

In some areas, metal merchants may pay a nominal amount for a car body (about $25). Firms removing car bodies in the ACT quoted charges of around $30. Free removal is offered by auto dismantlers where there is considered to be value in the car for parts.

It seems likely that there is sufficient economic value to cover most of the costs of collecting and transporting ELVs to shredding facilities. Metal recyclers stressed their efforts in retrieving ELVs from outside metropolitan areas. Several excursions may be undertaken each year to regional areas – travelling to centres beyond Cooktown in north Queensland and to the western border of the Northern Territory, for instance. One firm that travels to regional areas for car bodies estimates that around 1000 are retrieved annually from "the bush".

Vehicles are recovered from roadsides and private properties, and from other areas identified by local councils. Vehicles are loaded onto a portable crusher by a truck-mounted crane, and once compacted, numerous ELVs are transported at a time to the nearest capital city for shredding.

The frequency of the visits to country areas to retrieve car bodies is dependent on the fluctuating prices for recycled steel and the non-ferrous ELV metal fractions. This suggests there is a commercial incentive for the recycling of ELVs, including those located considerable distances from the shredder sites. However, the returns from these ELV retrieval activities may be marginal and it is important to ensure that this valuable service provided by metal salvagers is not jeopardised. For example, it might well be inequitable and counter-productive for any financial burden from new ELV measures to fall on the last handler of an ELV.

Nevertheless, the desirability of a more coordinated approach so that ELVs could be collected from single points was stressed by some stakeholders.

Where there are problems in regional areas, it is likely that improved co-ordination and co-operation between local councils and the metal recyclers could produce better financial and environmental outcomes. In particular, the aggregation of supply of ELVs by councils, or more broadly at a regional or even State level, could lead to the negotiation of better arrangements with the metal shredders. These arrangements could incorporate (or offset) the cost of retrieving less accessible, abandoned ELVs. Better management of the supply of ELVs by local authorities could be achieved through the provision of central ELV drop off points. Alternatively, consumers with an ELV could register the location with the local authority. Organising and simplifying the collection of ELVs would increase their value to metal recyclers – and provide greater negotiating power for local authorities.

Key Findings

- *It seems likely that the proportion of ELVs reaching recycling facilities is probably over 90%.*
- *While ELVs are frequently removed from even remote parts of the country, potentially greater outcomes and reduced costs to local councils could be achieved through facilitating formal ELV collection points*.

Maximising the number of ELVs entering the recycling stream

It is important to ensure that it is as easy as possible for the last owner to properly dispose of ELVs.

From initial discussions with stakeholders, there may be a case for better provision of information to vehicle owners about the appropriate disposal of ELVs – eg. the dissemination of leaflets with registration notices by State/Territory registration authorities. There might also be merit in facilitating collection and drop-off points for ELVs.

While kerbside recycling has provided a simple solution for consumers to increase recycling of general household waste, there generally are no consumer-friendly solutions to the recycling of most consumer products. Combining ELVs with other end of life consumer products is also likely to increase the commercial viability of reuse and materials recycling through improved economies of scale.

Given the value of ELVs to metal recyclers, better organisation of the supply of ELVs by local authorities to the recyclers offers the potential to at least partly offset the current costs of retrieving the more inaccessible, abandoned wrecks.

APRAA indicated support for an arrangement whereby a requirement would be placed on the last owner to formally deregister ELVs, leading to their proper de-pollution and parts recycling at accredited auto dismantlers, perhaps akin to the new European requirements (Ref. 8). A regulated approach such as this would require cooperation between all State and Territory registration authorities but would probably optimise the number of ELVs entering the recycling stream, and produce flow on benefits for the regulation of environmental practices at recycling facilities.

This is discussed further in Chapter 10.

Key Finding

- *The current lack of any formal ELV deregistration requirements is likely to be contributing to the costs and inefficiencies of collecting and treating ELVs.*

6. Auto Parts Recycling

Introduction

For vehicles that enter the recycling stream the waste management hierarchy emphasises the benefits of product reuse over other options, such as materials recycling, incineration and landfill.

Significant savings in resource use, and environmental releases, result from substituting existing products for newly manufactured parts. The extent of parts recycling prior to the ELV being shredded is discussed in this chapter.

Issues associated with environmental releases from recyclers' sites are discussed at Chapter 10.

The Parts Recycling Industry

The Auto Parts Recycling Association of Australia (APRAA) was of considerable assistance during the course of the original study. APRAA operates as a peak body for the industry, and estimates that it represents 30 – 40 % of the 800 – 900 “competent” or “legitimate” operators. Auto parts recyclers also fall within the gamut of the Motor Trades Association of Australia (MTAA) representation, which was also consulted during the consultant’s original study.

The auto parts recycling market in Australia is sufficient to sustain 1000 - 1500 businesses (Source: APRAA). The market for recycled parts appears to work effectively, with these firms providing the option of recycled parts for consumers throughout Australia who seek them in preference to new parts, or where new parts are unavailable.

Despite the efforts of APRAA, the industry remains relatively fragmented in organisational terms. In order to achieve the improved environmental outcomes discussed in this chapter, greater coordination within the industry would be required. It should be noted that other measures affecting the industry, particularly those under investigation by the National Motor Vehicle Theft Reduction Council (NMVTRC), further suggest the need for greater industry co-ordination and hence a potentially greater role for APRAA in the future

Current requirement for ELV parts reuse

There is no regulatory requirement for automobile parts to be recycled, nor are automobile manufacturers required to achieve targets for the reuse and recycling of components in new vehicles, such as is now the case in Europe for instance.

The extent of parts recycling is therefore entirely dependent on the operation of the market for recycled components from ELVs. The level of ELV parts recycling is a factor of supply and demand side issues.

Extent of Parts Recycling

No reliable data were found on the incidence of parts recycling from ELVs in Australia. In international research papers, it has been estimated that parts recycling may account for up to 5% of an ELV (eg. Ref. 4, p.29). Parts typically removed include engines, transmissions, alternators, radiators and, depending on demand for particular vehicles, body panels and trim parts.

Trends in ELV parts recycling

During the course of this study, APRAA indicated their view that the market for spare parts is declining, and emphasised the significance of longer warranty periods as an important factor.

The trend towards newer vehicles, and declining cost effectiveness of repairing and maintaining older vehicles, is likely to have a detrimental impact on the market for recycled parts over time. In the absence of any government intervention measures to stimulate the reuse of ELV components, this is likely to result in the environmentally detrimental outcome of lower levels of reuse of ELV products. However, in so far as this is the result of a trend towards newer vehicles, lower reuse of ELV components may be at least partly offset by the greater overall environmental benefits of substituting new vehicles for old ones (see life cycle assessment at Chapter 12).

Supply side factors affecting ELV component reuse

Supply side issues affecting the extent and commercial viability of the ELV parts recycling industry include:

- The ease of parts removal, and hence the labour cost of disassembling reusable components. Related issues include the degree to which the vehicles design allows for ease of disassembly and removal; for instance the number and accessibility of fasteners, and the availability of information regarding disassembly

- Regulation & compliance costs, including (if required) water treatment facilities etc (oil separators)

- Other operational costs.

Demand side factors affecting the extent of ELV component reuse

The demand for recycled components is affected by:

- Trends in the age of the vehicle fleet (which is slowly declining as discussed earlier)
- The cost-benefit of maintaining older vehicles relative to purchasing a new vehicle (also declining) – the newer the vehicles on the road, the lower the demand for replacement parts
- The reliability and longevity of original components on vehicles (probably increasing)
- The cost of alternatives to recycled components, particularly the cost of new parts supplied through dealer networks
- The cost of after market new components produced by non-original equipment manufacturers
- The cost of parts imported from overseas (particularly Japan) where vehicles are often retired earlier than Australia due to regulations or financial disincentives to owning older vehicles (eg taxation arrangements). The importation of complete vehicles into Australia for dismantling was prohibited by the Commonwealth Government in 2000, a practice which the FCAI indicated had been misused to allow the "rebirthing" of stolen or written off vehicles. The importation of used components is still permitted (press release of 8 May 2000, Ref. 41)
- The increasing length of warranty periods, which reduces the demand for refurbished spares as dealerships supply, and customers expect, new components during the warranty period
- Beyond the warranty period, the availability of refurbished parts through the dealer network. Very few manufacturers offer second hand/refurbished parts through the dealer networks as an alternative to new parts - Volvo Australia is one exception found during the course of the study. This appears to be due to a number of factors. Firstly, the protection of brand image through the perceived superior performance and safety of new parts. Secondly, there seems to be some reluctance on the part of customers to accept used components. Finally, greater profitability for dealer networks. Manufacturers and their dealer networks are not in the business of parts recycling and naturally have a monopoly on the supply of replacement original equipment components. Of course, beyond the warranty period, consumers have the option of obtaining recycled components from non-dealer service and repair centres, or directly from parts recyclers

- The demand for recycled components by automotive manufacturers for reuse in new vehicles which appears to be very limited in Australian manufactured vehicles due to:

  - no regulated or market driven requirement for manufacturers to achieve higher levels of reuse/recycling in new vehicles (cf. Europe)
  - cost benefit issues - as domestic manufacturers are not involved in the ELV industry, commercial issues related to lack of control over supply, quality, reliability and cost of recycled components compared with manufacturing new components;
  - the fragmented nature of the ELV parts recycling industry;
  - the perceived negative impact on brand image of new vehicles; and
  - as a consequence, a general lack of commercial relationships between the manufacturing and the ELV industry. However, there are some instances of components from European manufactured ELVs being reused – for instance, BMW Australia indicated that they operate a program through which engines and transmissions from their ELVs are (to some extent) returned to Europe for reuse in new vehicles. Volvo Australia actively seeks to acquire many of its ELVs and offers refurbished parts through its dealer networks, although the extent to which parts are returned to Europe for reuse in new vehicles was not ascertained.

Maximising ELV parts recycling

Increasing the extent of parts recycling may produce resource savings, reduced environmental releases and lessened waste impacts.

Key Finding

- *there may be merit in considering measures to further increase the substitution of recycled components for new components in both new and existing vehicles.*

As discussed in Chapter 12, Vehicle Life Cycle Analysis, greater environmental outcomes may result from reducing the number of inefficient or highly polluting vehicles on the road. Consequently, any measures to increase parts recycling should be on the substitution impact, rather than increasing the attractiveness of reusing components in order to keep old vehicles on the road longer.

Accordingly, the supply and demand factors above which might usefully be influenced to achieve higher levels of component reuse are:

- The provision of recycled components as an alternative to new parts through dealer networks

- Greater use of recycled/rebuilt components in the manufacture of new vehicles
- Improved "design for disassembly" in new vehicles
- Increased communication and cooperation between new vehicle manufacturers/importers and the ELV recycling industry

Dealer networks offering refurbished components as an alternative to new parts

Dealers generally do not promote used or refurbished components as an alternative to new parts, with some exceptions such as Volvo Australia.

It is accepted that consumers currently have the option of going outside the dealer network should they prefer recycled components. However, dealer networks actively pursue customer retention within and beyond the warranty period – ongoing vehicle servicing and repair is an important commercial factor in the economics of new vehicle sales. There are several reasons why many consumers prefer to remain with the dealer network beyond the warranty period - a dealer service history may lead to greater residual vehicle values, for instance.

Accordingly, dealer networks could play an important role in increasing the level of reuse of components by offering them as a cheaper and more environmentally friendly alternative to new components. The reputation and after sales service of dealer networks could play a significant role in influencing consumer demand for used/refurbished components.

An important precursor to increased promotion or recycled components is likely to be closer cooperation between the dealer networks and the parts recycling industry. It is anticipated that increased demand from dealer networks for recycled components would lead to alliances with recycled parts suppliers to ensure reliability and quality of supply. In some countries, such as Japan, the United States and some European nations, some manufacturers have become directly involved in ELV dismantling. However, in those countries, it is still more common that commercial alliances with specialist recyclers are formed so that the manufacturers' focus remains on their core business.

In Europe manufacturers are now responsible, through legislation, for achieving progressively increasing targets for the reuse and recycling of ELVs (see Ref's. 8 and 44). In considering any policy approaches to increasing parts recycling, care would be needed to avoid regulations requiring manufacturers to increase the level of reuse and recycling of ELVs, at least until improved knowledge of the impediments to the development of markets for recycled ELV materials was investigated.

In the first instance, industry-developed initiatives to increased ELV reuse/recycling could emerge from better communication between the manufacturing and ELV recycling industries. This is discussed further in terms of materials recycling in Chapter 11.

Greater use of recycled/rebuilt components in the manufacture of new vehicles

Vehicle manufacturers also have the opportunity to increase the extent of ELV parts reuse through incorporation in the manufacture of new vehicles. While some importers return components from ELVs to manufacturing plants overseas for reuse, there appears to be limited reuse of existing components in Australian manufactured vehicles. The opportunities for reuse of components in this way would be greater in newer ELVs (ie. “write offs”) rather than older models.

The viability of this option is dependent on the extent to which rebuilt original components meet manufacturers’ safety, reliability and performance requirements for new vehicles. The commercial viability of reusing existing components relative to the cost of manufacturing new components is clearly also a key factor. However, to date the full environmental cost has not been a factor in this assessment, in so far as end of life and other environmental impacts are not fully incorporated in the cost of new materials and components.

As discussed above, it is desirable to allow the industry itself determine the most appropriate options for increasing the level of reuse/recycling of ELVs, rather than mandating particular solutions which may be economically sub-optimal. However, reuse of ELV components in new vehicles appears to be an option, which could be further investigated by manufacturers.

Improved “design for disassembly” in new vehicles

The commercial viability of parts reuse is in part dependent on the ease with which parts can be removed. The number, location and design of fasteners for instance, can have a significant bearing of the ease of disassembly and hence their economic value.

A related issue is the dissemination of information from manufacturers to assist in ELV disassembly. In Europe, manufacturers have cooperated to develop disassembly manuals for most if not all vehicles. The FCAI argued against such measures in Australia, citing the limited need given present levels of disassembly and reuse and recycling. It was seen to be an unnecessary additional cost burden on manufacturers.

Again, there may be merit in better communication between manufacturers and ELV recyclers to work towards industry developed solutions for higher levels of parts reuse.

Auto manufacturing industry views

Discussions with the Federal Chamber of Automobile Industries (FCAI) and their members indicated opposition to any requirement to impose reuse/recycling targets on Australian manufacturers. The cost impact on local manufacturers was seen as being unwarranted given the different conditions in Australia than, say Europe. This is discussed further in relation to materials recycling at Chapter 11.

7. Recycling of metals from ELVs

Introduction

As discussed above, parts are removed from ELVs to the extent that it is commercially viable by parts recyclers. The balance of the ELV is ultimately passed to metal "shredders" where the metal contents are separated for recycling. The balance of the vehicle, known as shredder "flock", "fluff", or "residue" is landfilled.

The environmental impacts of the landfilled, non-metal materials are discussed in Chapter 8.

However, it is important to recognise the positive environmental outcomes that already result from recycling the metal fraction of ELVs, and the importance of not jeopardising current recycling levels by decreasing the viability of ELV processing by metal recyclers.

Key Finding

- *between 65% and 75% of ELVs by weight are currently being recycled, which represents the metal fraction of an ELV.*

The Metal Separation Process

ELVs are processed through automated "shredders", along with other end of life metal products (such as white goods). Shredders were introduced from the 1960s, which, along with the advent of electric arc furnaces, transformed the metal recycling industry (useful history see Ref.4, pp.10-12).

Shredders are capable of processing ELVs at the rate of 200 per hour - equivalent to one ELV every 20 seconds. The efficiency of the highly expensive machines is a key element in the profitability of the metal recycling industry.

A powerful shredding action processes vehicles into fist-sized pieces of ferrous scrap of a high physical and chemical quality. The high quality ferrous scrap is sought after by steel makers, with ready domestic and international markets.

Many vehicle components are made of non-ferrous materials, such as copper, aluminium and zinc. In the shredding process, magnetic separation is used to remove the magnetic ferrous fraction from other materials. The non-ferrous metals pass to further stages for segregation into various material types. Eddy-current separators induce energy that will literally project one non-ferrous metal from another and any surrounding materials (6, p.1-2).

Efficiency of metal recovery from ELVs in Australia

The efficiency with which the metal fraction is recovered from ELVs varies according to the age and technology of the shredders used around Australia. International statistics indicate that the shredder residue (flock) comprises approximately 8% ferrous metal and 4% non-ferrous metals (4, p.29). These figures equate to approximately 98% efficiency in recovering ferrous metals, and 99% recovery of non-ferrous metals, from ELVs.

If all available technologies are used, virtually all metals can be recovered from ELVs. Further media separation technologies can be employed, which may use fluids or mineral suspensions of varying specific gravity that allow selected materials to float while others sink. (6, p.1-2).

Discussions with stakeholders suggested Australian metal shredders are at least as efficient at capturing the metal content as those internationally. It was argued that the concentration of the market in Australia (with only a few shredding companies) produces greater economies of scale allowing for higher levels of investment in the latest separation technology. This was contrasted to the large number (350 or so) of smaller scale shredder operators in Europe and the United States. Simsmetal's Melbourne shredder was claimed to be one of the largest in the world. Metalcorp recently installed a $10m shredder at their Brisbane facility, which was claimed to be state of the art.

One metal recycler recently undertook a study in association with the NSW Waste Boards which indicated that approximately 32% (by weight) of the shredder flock tested was magnetic. Subsequent trials of a "new and improved" shredder produced a 13.5% increase in material recovered, the majority of which was ferrous material.

The efficiency of the shredders also has a direct bearing on the quantity of heavy metals (such as lead, cadmium, hexavalent chromium etc) that end up in the waste from the process which is disposed to landfill (this issue is discussed further below). One recycler argued that the high recovery rates from the advanced eddy current systems used in their shredders produces significantly lower levels of heavy metals in shredder flock than that quoted in international statistics.

Positive Environmental Outcomes of recycling ELV metals

In the United States it has been claimed "the automobile is the country's most highly recycled consumer product" (5, p.1). While no data were obtained during this study to establish the recycling ranking of various products in Australia, it is apparent that there is already a relatively high level of ELV recycling as a result of the commercial value of the metal content.

If it is assumed that: 500,000 ELVs reach metal shredders each year; average ELV weight is 1,300 kilograms (this is conservative, see 27, p.2 for example); and 70% of the ELV is recoverable metal content, then:

- 500,000 * 1,300 * 0.7 = <u>455,000 tonnes</u> of recovered metals per annum.[3]

Recycled metals consume significantly less energy and water, and produce less air pollution, than smelting processes (eg. Refs: 1 and 6).

It has been estimated that, compared to manufacture from virgin materials, recycled steel:

- Uses 74% less energy
- Uses 40% less water
- Reduces air pollution by 86%
- Reduces water pollution by 76%

For other metals, the energy savings are: aluminium - 95%; copper – 85%; lead – 65%; zinc – 60%.

(sources: see for example: Ref: 1, p.12 and 6, p.2)

Findings

- *It is likely that some 455,000 tonnes of metal is recycled annually from ELVs, producing substantial environmental benefits from reduced environmental releases and resource reuse. The balance of the ELV is reduced in volume by 90% - producing benefits in terms of landfill space savings*.

Economics of Metal Recycling

Metal recycling in Australia is a competitive industry, with two large firms and a couple of smaller players making up the industry. A recent new entrant is the first in many years. As discussed earlier, demand for recycled metal is currently sufficient to warrant the extensive retrieval of ELVs from even remote parts of the country, with the shredder companies bearing most or all of the associated costs. However, any measures that increased the costs of processing ELVs could seriously affect current ELV recovery and recycling levels.

Recycled steel is the metal with the lowest value but greatest volume. As a rough guide,

[3] This calculation is based on unconfirmed figures. Environment Australia hopes that feedback from stakeholders will clarify how many tonnes of metal are recycled per annum

recycled metals may fetch:

- Steel US$100-110 CIF per tonne [4]
- Aluminium US $950 CIF per tonne
- Copper US $250 CIF per tonne

(Note: indicative only – no formal confirmation of these values has been sought)

Recovered metal is sold to domestic metal producers (such as BHP) or exported internationally (primarily to Asia) according to demand and prices in different markets.

A key point made by the metal recycling industry is that the profitability of ELV shredding is dependent to a significant degree on the non-ferrous metal fractions. They warned against recycling measures that would have the effect of reducing the amount of these high value metals that reached the shredders.

This claim could not be independently tested, nevertheless, the issue should be carefully considered when developing policy measures to address ELV environmental outcomes. A requirement for components to be removed which constitute a large proportion of the high value metals going to the shredders may have a negative impact on the level of ELV recycling overall.

Key Findings

- *ELVs are one of the most highly recycled consumer products, due to strong markets for recycled metals.*
- *Current ELV recovery and recycling levels could be jeopardised by measures which placed an additional ELV processing cost burden on metal recyclers.*

[4] CIF = Cargo, Insurance and Freight

8. ELV Waste – Shredder Flock

Introduction

While the metals in ELVs are generally recovered and recycled, the remainder of the ELV is not. This shredder residue, which constitutes approximately 25%-35% of the weight of the vehicle, and up to 60% of ELV volume (27, p.3), is sent to landfill.

Shredder flock is a key area of potential environmental concern in relation to ELVs. The areas of possible impacts are:

- Contribution to the volume of waste going to landfill.
- The chemical behaviour of materials in the waste when released to the environment.
- Resource loss through not reusing or recycling the materials which make up the shredder flock.

A couple of points should be noted at the outset. Firstly, shredder flock is dependent on the feeder materials entering the shredder – a large proportion of which is not ELV-related such as white goods, waste building materials etc.

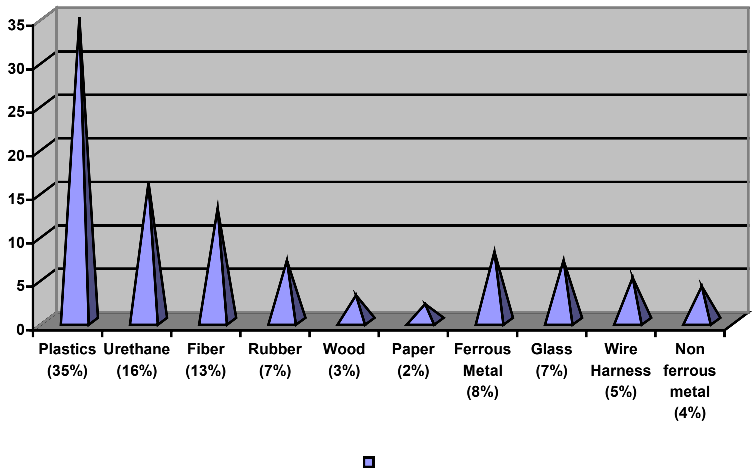
Secondly, in relation to ELVs, the shredding process does not of itself create any new hazardous materials – the shredder flock from ELVs is entirely comprised of materials which were present in the vehicle. Accordingly, it would also be wrong to interpret anything in this report as suggesting that the burden of any new measures for ELV processing should fall largely or entirely on the metal shredding industry. This may well be inequitable and counter productive.

As discussed in Chapters 9 and 10, responsibility for the vehicle waste stream could potentially rest with some or all of the following: manufacturers/importers; vehicle dealers; the original purchaser; subsequent owners; the last owner; governments and public instrumentalities; auto dismantlers and metal recyclers. Placing an undue financial burden upon metal recyclers would also threaten the current high levels of ELV recycling.

In short, the fact that metal recyclers generally constitute the "last stop" for ELVs ought not to be confused with the issue of responsibility for ELV waste.

Composition of Shredder Flock

The chart illustrates the materials found in shredder flock, which are resources lost to landfill.



(source: Ref. 4, p.29)

Note: indicative only - based on international data. There maybe slight variations in Australia given differences in the average type and age of shredded ELVs, and differences in the shredding processes. For instance, evidence provided during the review indicated that the **wire harnesses** are sometimes separated and sent overseas for recycling of the copper content.

Finding

- *plastics and foams may account for approximately 50% of the waste from ELVs.*

In addition to plastics, rubber (primarily from tyres) and glass (windscreen and other windows) account for the bulk of ELV waste.

Recycling these materials is more difficult than metals for technical and economic reasons. Issues associated with these wasted materials are discussed below.

Volume of ELV Waste

As discussed earlier, the non-metal portion of ELVs is estimated at between 25% and 35% of ELV weight.

The amount of shredder flock that can be attributed to ELVs has not been able to be established through available empirical data during the project, and this is an area that might warrant further investigation.

If it is assumed that about 500,000 ELVs are processed annually by metal shredders, and the average weight of an ELV is estimated at 1,300 kg, then:

- 500,000 * 1,300 * 30% = 195,000 tonnes of shredder flock waste per annum[5].

This is a rough estimate that needs to be tested further and should be treated cautiously. For instance, it is considerably greater than the total ELV-related flock output of less than 70,000 tonnes which has been estimated by one industry stakeholder. However, as discussed in Chapters 3 and 5, ABS vehicle "attrition" estimates and estimates of ELVs being processed by the auto recycling industry appear to be sound and broadly consistent. The reason for this discrepancy is thus not immediately apparent.

In the United States, it is estimated that shredder flock accounts for almost 2% of all landfilled material (5, p.9). In the United Kingdom, shredder flock is estimated to contribute 0.3% of total UK waste (1,p.11). It is unclear why there should be such a significant variation between these countries, and probably reflects the difficulties in obtaining accurate statistics of ELV-related shredder flock (as opposed to other products shredded in the same machines) and total landfill volumes.

There were no comparable figures found for Australia. While no firm statistics on annual landfill volumes in Australia were found (although this may warrant further investigation), various environmental protection agencies suggested around 1 tonne per person (or 20 million tonnes in total). On the basis of the rough estimate given above, shredder flock would account for 1% of total waste.

It also needs to be borne in mind that not all ELV waste is derived from shredder flock. ELVs that are not processed by shredders, and components that are removed from ELVs prior to shredding, are also likely to contribute to waste levels, although no statistics on this waste source were found.

Findings

- *initial estimations suggest that as much as 195,000 tonnes of waste could be produced from ELVs per annum, and may constitute around 1 % of total annual waste. However, these figures are not supported by at least one industry stakeholder which estimates the figure as being less than 70,000 tonnes.*
- *as a single product waste stream, ELVs constitute a significant source of waste.*

[5] This calculation is based on unconfirmed figures. Environment Australia hopes that feedback from stakeholders will clarify the quantity of shredder flock produced per annum.

Environmental Impact of ELV Waste Volumes

The volume of waste is considered a much greater problem in Europe and Japan, which is reflected in tipping fees which may be 10 times higher than in Australia

As in the United States, Australia's low landfilling charges reflect the lower population density and greater availability of land.

Recently in Australia, governments have taken a greater interest in waste volumes and the requirement for landfilling sites. The availability of landfill space in metropolitan areas, and social and environmental concerns, have led some States and Territories to release policies to reduce waste volume, or even aim to eliminate waste totally (see, eg. Ref. 56 and 57).

Concurrently, however, many states have privatised landfill sites – from discussions with some State EPAs this has the potential to create tensions between waste reduction objectives and the commercial viability of the privatised landfill sites.

The ACT indicated a particular concern with waste volumes, which is not surprising given its landfill constraints. This is reflected in a policy of "zero waste by 2010".

However, the overall conclusion drawn from consultations with the States and Territories was that land contamination and resource loss issues, rather than landfill volumes *per se*, were likely to be of greater interest.

Potentially hazardous materials in shredder flock

Several international jurisdictions see the contamination of the environment through the landfilling of waste as an important environmental issue associated with ELVs. This was one factor leading to the recent European Union directive on ELVs (Ref. 8). As noted above, the materials present in flock are not derived from the shredding process per se but from the materials already present in ELVs. As noted previously above, shredder flock also comes from a variety of products other than ELVs.

The composition of shredder flock will also vary considerably from batch to batch and shredder to shredder – due to the different mixes of raw materials being processed; and the differing levels of pre-processing and inspection by shredder operators.

It should also be noted that shredder flock is likely to vary significantly between shredders due to varying requirements under State and Territory licensing conditions, and the changes in those conditions over time. By way of example, amongst the conditions attached to a recent land and environment court approval for a scrap metal shredding operation were:

(a) a requirement to install a fully roofed decommissioning pit for motor vehicles, fitted with environmental safeguards and stormwater controls

(b) a requirement to remove, store and dispose of petrol, oil and all other fuels, fluids and substances from all raw materials entering the site;

(c) no crushed cars can be received on the site for processing except those vehicles inspected, treated and crushed by the shredder operator themselves;

(d) all petrol tanks to be drained of fuel and triple rinsed with water;

(e) the site is to be fully concreted with extensive stormwater cleaning devices installed; and

(f) all batteries are to be removed from ELVs prior to shredding.

Notwithstanding the variations in feedstock and pre-treatment procedures, shredder flock may contain a variety of materials including heavy metals used in vehicle manufacture:

- Lead (in resins, batteries, solder, wheel weight, fluids etc),
- Zinc, cadmium, and hexavalent chromium, (primarily as protective metal coatings) and
- Mercury (in HID headlights, mercury switches in early model vehicles).

When the metal substrates are separated, the heavy elements listed above which are used as coatings tend to go with the substrate, leaving only small quantities in the shredder flock (ie. in the unseparated metal).

These heavy metals may cause environmental degradation as toxic leachate seeping through landfill, and may be bio-accumulative, persistent toxins. In the absence of independent scientific test data on ELV related shredder flock, no firm conclusions can be drawn on the extent of these heavy metals in Australian flock, nor the propensity for leaching, other than noting overseas experience (eg. refs: 1, 5, 22 etc).

In cases where fluids are not removed from the ELVs prior to shredding, other potential environmental contaminants may include:

- brake fluid, petrol, steering fluid, motor oil, coolants and transmission fluid.

Some of these fluids are recognised as being of significant environmental concern - "one litre of motor oil alone has the potential to contaminate up to one million litres of water" (Ref. 22, p.9).

Overseas literature has also expressed environmental concern in relation to:

- PCBs; and
- PVC (noting that the plastics industry disputes the environmental significance of PVC. Ref. www.pacia.com.au)

The source or extent of PCBs in ELVs is, however, unclear as discussions with manufacturers did not lead to identification of a source of PCBs in Australian vehicles (although it may come from non-ELV sources).

The presence of these substances in shredder flock has been reported extensively in the literature surveyed during this review and is acknowledged by many of the manufacturers themselves and by the reactions of governments. For example, Japan and European governments require reduction or elimination of lead in motor vehicles.

A number of international jurisdictions (including in north America and Europe) have, or are moving towards, classifying shredder flock as hazardous waste, with separate (and significantly more expensive) disposal arrangements.

No published information was found to suggest that widespread independent tests of shredder flock contamination have been undertaken in Australia. One shredder operator did provide test results for one batch of NSW shredder flock which appeared to show low levels of heavy metals – apparently this data is required in relation to some State waste transport regulations.

State Environmental Protection Agencies, local councils and waste boards contacted during the review were also unable to provide any information on the extent of heavy metals and other contaminants in shredder flock.

The one jurisdiction that did have some information in this regard was the ACT. While the ACT does not have a metal shredder facility, interstate flock had been brought to ACT landfill sites since 1996. While initial testing of the shredder flock proved satisfactory, subsequent testing showed unacceptable concentrations of lead, PCBs and other contaminants. It should be noted that the validity of the testing methodology and results were not assessed as part of this report.

Extract from press article, Canberra Times, 9 October 1999

…The ACT Government closed the Belconnen tip and ordered health tests for workers yesterday afternoon over lead contamination fears.

Tests revealed that 2000 tonnes of metal waste or "flock" from interstate, which has been the subject of union bans, had lead levels up to 10 times the acceptable standard for landfill.

"I am advising workers at the plant that they may have been exposed for up to one year and as a result may require testing and treatment … We are yet to find out what lead levels are in the air" Dr Bowen (ACT Chief Health Officer) told ABC Radio.

The Construction, Forestry, Mining and Energy union imposed a ban on moving the metal flock … The union was alerted to the contamination by workers complaining of sore throats.

They said about five trucks from Sydney or Wollongong arrived at the tip each day to dump the flock in the three months before union intervention…

Shredder flock is no longer accepted at ACT landfill sites.

It would seem reasonable to conclude from the ACT experience (and international research) that the concentrations of heavy metals and other contaminants may vary significantly from batch to batch, and that at least some shredder flock may be unacceptable for landfilling for environmental (and health and safety) reasons.

State environment agencies consulted during the review appeared to have limited if any data available on the constitution of shredder flock, nor the extent of any environmental contamination resulting from its disposal in landfill.

A related issue is that some States (Queensland and Western Australia) indicated that there are several unattended landfill sites in regional and remote areas of the State. The potential exists for contaminated shredder waste that may not be accepted at other landfills to be dumped at these sites. While this possibility was raised during discussions, it should be stressed that it was beyond the scope of this review to assess whether this was occurring in practice.

The extent of environmental contamination resulting from hazardous fluids not being removed prior to shredding was also unable to be accurately quantified. Overseas efforts to quantify the extent of the oil content "has proved difficult to quantity by analytical techniques, and remains contentious … The true figure for operating fluid contamination of shredder residue is … unlikely to exceed 3% by mass" (Ref: 67 p.4).

Industry stakeholders agreed during discussions that the removal of fluids may be a concern. Although it was stated that the fluids are at least sometimes removed, one industry player argued that fluids should be removed before they arrive at the shredder facilities:

- As metal shredders can process ELVs at the rate of one every 20 seconds, the additional cost of physically removing all fluids prior to shredding would be a substantial additional cost and hence is likely to be commercially unpalatable to shredder operators;
- It could also be argued that de-polluting ELVs is at least as much the responsibility of the last owner, auto dismantlers and others who handle the ELV before it reaches metal shredders.

Any measures to enhance the removal of fluids, batteries, petrol tanks, air-conditioning gases and other contaminants should recognise the importance of not undermining the commercial viability of current recycling levels.

Key Findings

- *Negative environmental impacts may be occurring through the landfilling of heavy metals, hazardous fluids and other materials contained in shredder flock*
- *There is a lack of information on the composition of shredder flock and the extent of any environmental releases occurring through current disposal arrangements in Australia.*

Shredder flock - resource loss

Resource loss through landfilling the non-metal materials in ELVs constitutes the third main area of ELV environmental impact.

For technical and commercial reasons, the non-metal balance of ELVs (flock) has little if any current economic value and is dumped to landfill sites. The fact that this waste (primarily plastics, seat foam, rubber, glass, and carpet) is not recycled represents an environmental cost through not conserving raw materials and other resources.

Recycling of plastics for instance, the main component of shredder flock, produces energy savings of more than 80% over the production of new plastics from virgin materials, with substantially less emissions (Ref: 6, p.2).

7.5% of world plastic production is used in car manufacturing, using 4% of total annual world oil output. Not maximising the potential for recycling automobile plastics represents a significant environmental cost. The issues are discussed further in the next chapter.

Cost of Shredder Flock disposal

Although the metal recycling industry expressed concern about any increases to shredder flock disposal costs, Australia currently has amongst the lowest landfill fees of any developed country:

- Landfilling fees in western Europe range from US$175 – US$715 per ton and are increasing (Ref: 5, p.18);
- The waste levy for shredder flock in NSW is understood to be around A$17 per tonne.

The usefulness of waste levies as an incentive to increase recycling is problematic. In the absence of a commercially viable market or infrastructure for recycled shredder flock or its constituent ingredients, the current levels of ELV recycling may be jeopardised. These issues are discussed further in the next chapter. However, higher disposal costs may lead to alternative disposal options being pursued such as "thermal recycling" through incineration. This is discussed further in Chapter 11.

Whether the burden for waste disposal should fall entirely on the shredder operators is another important issue. Most international jurisdictions which have acted to implement ELV disposal regulations have decreed that the burden should not fall to the last owner of the vehicle, with the burden instead falling on manufacturers, governments and/or consumers.

In theory, waste levies should reflect the true economic cost of any environmental harm resulting from the dumping of shredder flock. However, the issue of waste disposal costs should not be considered in isolation from an overall strategy for managing the ELV waste stream that reflects the shared responsibility of the many stakeholders. Simply increasing the financial burden on shredder operators may lead to a decrease in current levels of ELV recycling.

Trends in the Use of Plastics

Given the contribution of plastics to ELV waste, it is prudent to consider the trends in the use of plastics in automobiles. As discussed above, plastics (including urethane) may already constitute some 50% of ELV waste, thereby potentially contributing some 95,000 tonnes of waste to landfill annually.

In the mid 1970s, plastics may have constituted only 4-5% of a car's weight, increasing to about 6-7% by the end of the 1980s, and now constituting 9-10% of total vehicle weight (eg. 27, p.2).

The trend towards the increased use of plastics in vehicle manufacture will continue to increase:

- The global demand for automotive plastics is predicted to grow by 22% between 2000 and 2007
- The weight of plastics in the average car will increase by 12% increase (ref 45, p.18).

Manufacturers have replaced many metal components with plastic ones to ensure lighter weight, more economical vehicles – including bumpers, interior components, splash guards, hoses etc. Increasingly, manufacturers are evaluating plastics for broader applications, including body panels.

As a raw material, plastics are significantly more expensive than steel, which only costs around $2 per kilogram. However, working with steel is generally far more expensive than plastics, due to the very expensive stamping presses and tooling needed to form the metal body panels. The use of composite resin panels offers the potential to replace dozens of individual, welded metal components with a single complex shape, thereby greatly reducing welding, assembly and other manufacturing costs.

As well as simpler and thus much cheaper manufacturing techniques, the use of plastic body panels offers manufacturers substantial weight savings. Reducing the weight of a vehicle in turn allows the use of smaller, lighter and cheaper engines, brakes, wheels, tyres, suspension and steering components to match the performance levels of equivalent steel bodied cars. As a result, the higher cost of plastics can potentially be offset to produce a price-competitive car. Furthermore, all things being equal, a lighter, more fuel-efficient car will produce significantly fewer emissions during its operational life.

There has been some limited use of plastics for car body panels by a number of manufacturers since the 1950s, in the form of glass fibre reinforced resins, primarily to produce lightweight performance cars. More recently a number of vehicles have been developed with thermoplastic body panels, primarily for the European and Japanese markets. The most notable is the Smart Car (now a division of Chrysler-Benz corporation), which may be released in Australia in 2002. Other plastic bodied vehicles include Chrysler's City Cabrio, released in Europe this year, General Motors' Saturn model along with a recent Honda model in Japan. Ford, amongst others, is evaluating prototype models such as the electric powered Think.

A number of other vehicles now contain some plastic body panels, such as the Landrover Freelander and Nissan X-Trail models recently released in Australia.

Conclusion

ELVs appear to be a reasonably significant contributor to waste volumes and hence resource loss. Furthermore, the substances contained within shredder flock may cause environmental degradation, although the extent of contamination is hampered by the lack of data. Issues associated with reducing these environmental impacts by lessening the amount of flock and reducing hazardous materials contained therein are discussed in following chapters.

Any improvements made to new vehicles are likely to have long lead time in redressing the environmental impact of ELVs - changes to vehicle design and materials, for instance, will not affect the 12 million future ELVs currently on the road.

Key Findings

- *With the increased use of plastics in new vehicles, the metal content will continue to decline leading to increased levels of shredder flock.*
- *Significant energy and emission savings might be possible by increasing the level of recycling of plastics from ELVs, including for use in new vehicles.*
- *Simply increasing the costs of flock disposal may increase the financial burden on metal recyclers and decrease the extent of ELV collection and recycling.*

9. Heavy metals

Introduction

This chapter discusses issues associated with reducing or eliminating the use of heavy metals in new vehicles.

There are long lead times before changes in manufacturing arrangements produce results for vehicles at the end of their lives. Accordingly, consideration also needs to be given to those vehicles which already on the roads.

Recent developments

The recent European Directive (2000/53/EC) (Ref: 8) on end of life vehicles sets stringent requirements on manufacturers to ensure the use of heavy metals is phased out as far as is practical in the manufacture of new vehicles.

Manufacturers themselves have also been increasingly responding to the threat of such legislation, and to some extent, their own corporate environmental goals, by working towards the reduction or elimination of these heavy metals.

During the review, information from local car manufacturers indicated that they have, to varying degrees, taken a real interest in this issue. Most have set in place various initiatives to reduce the use of these materials and indicated willingness to pursue the possibility of formalising and announcing targets with FCAI involvement.

Extract from European Parliament Directive on End of Life Vehicles

"It is important that preventative measures be applied from the conception phase of the vehicle onwards and take the form, in particular, of reduction and control of hazardous substances in vehicles, in order to prevent their release into the environment, to facilitate recycling and to avoid the disposal of hazardous waste**. In particular, the use of lead, mercury, cadmium, and hexavalent chromium should be prohibited. These heavy metals should only be used in certain applications according to a list which will be regularly reviewed.** This will help to ensure that certain materials and components do not become shredder residues, and are not incinerated or disposed of in landfill." Directive 2000/53/EC, 18 September 2000, Preamble, s.11, emphasis added).

Industry views and initiatives

Australian manufacturers and the FCAI indicated opposition to any measures to force the industry to phase out the use of these materials in domestically manufactured/assembled and imported vehicles. The FCAI commented that "with time, individual car company policies and technology changes would see the elimination of toxic materials such as lead, chromium and mercury".

It is accepted that manufacturers are moving to reduce or eliminate the use of these substances, as regulations loom in European and other major markets, and as they increasingly seek to project corporate cultures attuned to environmental concerns.

> **Further detail on hazardous substances and their application in vehicle manufacture**
>
> Ford Australia is particularly noteworthy in that they have worldwide requirements relating to the use of hazardous substances which their manufacturers and suppliers have to comply with and report on.

These changes will flow through to Australian vehicles with time. It is also needs to be recognised that Australia is very small market in the international context, with relatively low investment and low volume facilities, and that significant industry impacts could be expected if Australian regulators attempted to impose world leading environmental criteria.

In the case of Holden, which exports engines to Europe, the imminent regulatory changes for that market are already producing changes in the use of heavy metals in those components (eg. the use of chromate on zinc for fastener coatings). This is an exception to the rule. Australian manufacturers almost entirely provide for the domestic market and do not export to the large European, Japanese or North American markets (there are some exports to the Middle East, Brazil etc). Accordingly, the direct impact on Australian manufactured vehicles of international regulatory changes will be minimal.

However most Australian manufactures are intending to reduce or phase out the heavy metals of concern (where viable alternatives exist) with future product models. Head office directives were largely driving these requirements.

The manufacturers were helpful in providing broad details of their current forward planning in this regard. Given possible commercial sensitivities, those details are not described in this report.

If the pace of removing these materials is considered to be waining, then strategies to promote their removal might need to be developed.

Any regulated or other changes to requirements for the manufacturing process must also recognise the long lead times in new vehicles design and manufacture.

Any imposed requirement on industry could give rise to potential economic inefficiencies, and may not be necessary given the fact that the industry is already moving in the right direction. The size and nature of the local industry and market compared with Europe also needs to be recognised. Other objectives also need to be considered, particularly that of ensuring an economically sustainable domestic auto manufacturing industry.

Initial discussions with manufacturers suggest there may be merit in pursuing a co-operative approach to reducing the use of heavy metals in new vehicles. Any such approach would need to recognise the lead times and logistical realities of new vehicle model changes. The technical limitations of phasing out the materials also needs to be recognised – there are a very small number of applications in vehicle manufacture for which there are currently no readily available substitutes to heavy metals. This is also reflected in late amendments to the European legislation.

Formalising any such goals could also have benefits for the industry – with public relations/corporate image advantages, and, significantly, a strong statement that the Australian car industry is internationally competitive in addressing ELV environmental concerns.

Key Finding

- *Australian vehicle manufacturers are taking action to reduce or eliminate the use of heavy metals in the manufacture of vehicles.*

10. Operating fluids

Introduction

Besides the heavy metals discussed above, ELVs can contain a number of fluids (oil, petrol, brake fluids etc), along with lead acid batteries and air conditioning gasses, which are generally considered to pose potential threats to the environment if improperly disposed of.

Releases of these substances may occur both through:

- landfilled shredder flock (as discussed in Chapter 8); and
- inadequate environmental practices at ELV treatment facilities.

These two issues are related. The level of landfill contamination from hazardous fluids etc in shredder flock is entirely related to the degree to which these materials are removed from the ELVs prior to shredding. As a large proportion of ELVs which arrive at shredders come from intermediaries such as parts recyclers, the extent to which they remove these substances also affects the level of contamination of the flock.

Releases also occur at recycler's sites, where fluids may be released to land or water, and gasses and volatile organic compounds (VOCs) to air, through inadequate facilities and practices.

The way in which these substances in ELVs are managed was found to be an area of concern to most of the State and Territory EPAs consulted during the review.

Current situation

In Europe and elsewhere, new ELV treatment regulations recognise the importance of ensuring oil, petrol, air-conditioning gasses and other environmental contaminates are disposed of properly and in a properly regulated and monitored way.

In Australia there are currently no specific requirements for ELV treatment:

- There are however, broader regulations in all States and Territories, administered by local authorities, which for example prohibit the disposal of oil and other hazardous materials to storm water
- Although not tested, this may create disincentives for removing fluids from vehicles prior to passing them on to a shredder or other downstream ELV treatment facility.

As discussed earlier, no data were found during the study to indicate the precise levels of releases of fluids and gasses from ELVs to landfill through shredder residue although personal observations indicated it was occurring

Additionally, no Australian empirical data on the chemical behaviour of these materials in shredder flock when released to the environment have been found.

However, State and Territory EPAs, and the metal shredder companies, agreed that contamination from these substances was a potential concern.

Responsibility for removing operating fluids

A key issue is with whom the responsibility should lie for removing potentially contaminating materials prior to shredding. The shredder operators pointed out the fact that a large proportion of ELVs received by them has been passed through intermediaries (ELV dismantlers, local council collection points etc). However, some ELVs (and relevant components such as engines/transmissions) are passed directly to shredder operators:

- One option might be that the first recipient of an ELV for commercial gain (eg. auto dismantler, shredder etc) should be responsible for ensuring basic de-pollution measures are followed.
- Theoretically, de-polluted ELVs would then be of higher value when passed on to other ELV businesses (such as to a metal shredder) which may at least partly offset the costs. One instance where this principle might warrant further discussion is in relation to local collection points which could be established by local authorities (see Chapter 5).

As discussed previously, the volume of ELVs handled by the shredder operators creates commercial disincentives for labour intensive pre-shredder treatment. Nevertheless, the shredder operators interviewed argued that they generally follow good practices in this regard.

In the United Kingdom, the metal shredding industry has estimated that up to 40% of the vehicles that are shredded still contain significant quantities of "important environmental pollutants – used lead acid batteries, lubricating oils, brake fluid, coolant, fuel and tyres" (Ref: 67 p.4).

The conclusion drawn during the discussions for this review was that nobody denied the importance of removing hazardous materials, and agreed that it should already be occurring. The shredder operators argued that the substances should be removed before they were passed to the shredder facilities.

Environmental Practices at Auto Recyclers

Auto recyclers are a key source of potential environmental impact, both in terms of their role in treating ELVs before passing them on to shredder operators, and pollution through inappropriate practices at their sites.

The extent of contamination occurring at automobile parts recycling facilities has not been systematically surveyed in Australia. However, there is no reason to believe that the situation would be significantly better here than internationally. In the United States, it is stated that "motor vehicle salvage facilities, the infrastructure through which cars are recycled, are extremely polluted … At least 50 of Minnesota's 436 facilities were found to be polluted enough to require intense clean-up efforts… "Ref 5, p.9.

Most State and Territory EPAs consulted, indicated that this was an area of particular concern, as did the recyclers association. APRAA indicated that many parts recyclers do not follow suitable environmental practices and indicated a willingness to pursue discussions to tighten the industry's performance. A national approach to set standards for the recycling industry was proposed during this review, and received general initial support from most States.

Some States have developed voluntary environmental guidelines for the recycling industry – the guidelines from Western Australia and New South Wales were reviewed during the study (eg. Refs. 30,31). These guidelines might prove useful if the development of formal requirements is considered further.

APRAA also operates a 5-stage accreditation system for its members, which incorporates (among other requirements) increasingly stringent environmental standards at each accreditation stage. Members are encouraged to strive towards the highest (Stage 5) accreditation by APRAA, with potential marketing benefits for the recycler resulting from higher levels of accreditation. More information is available on the APRAA website at www.apraa.com.au and at Ref. 48. APRAA indicated it would welcome any requirements for the industry as a whole which improved environmental procedures for auto dismantlers/recyclers.

Any new guidelines should also consider other measures being considered for the auto dismantling industry (ie. vehicle theft reduction initiatives) to ensure consistency and lower compliance costs.

APRAA views

Other key points raised during discussions with (APRAA) were that:

- Generally fluids are drained and properly disposed of, batteries removed etc, by the reputable ELV dismantlers in the industry.

- Those which do not follow good environmental practice are wrongly being given a commercial advantage over sound operators.

- The requirements for proper disposal of (ozone depleting) air conditioning gasses are widely ignored by many in the industry.
- The economic value placed on batteries was minimal and declining, thus increasing the commercial burden for their proper disposal.
- Although not properly tested, there appeared to be a general availability of infrastructure for oil recycling (as this matter is already being addressed by EA it was not pursued).
- It is of high importance to ensure better dissemination of information to the recycling industry as to the availability of recyclers of fluids, batteries, tyres and other ELV products – by geographic regions.
- APRAA would welcome improved regulation and monitoring (in consultation with the industry) to ensure a "level playing field", and to reflect APRAA's objective of improving environmental awareness and outcomes amongst industry operators.

Minimum environmental requirements for recyclers

In summary, it seems that a set of minimum requirements could be readily developed to ensure minimal environmental pollution at auto dismantling and recycling facilities. Such requirements could include appropriate removal, storage and disposal of polluting materials, and operational standards such as ELV handling, bunding and site management.

The license conditions placed upon a recent new shredder plant (discussed in Chapter 8) may also be a useful guide.

Key Finding

- *Pollution to air, land and water is likely to be occurring at many auto-recycling facilities due to inadequate premises and practices. Most States and Territories consulted agreed this was a significant issue.*

Economics

The economic value of the ELV to the first recipient after the last owner should already factor in the cost of basic environmental precautions. Formalising what ought to already be occurring should not therefore significantly impact on the commercial viability of the parts recycling and shredding industries. The time taken to remove the materials discussed above was estimated by APRAA at less 30 minutes per ELV (although air-conditioning gasses and airbags may take longer). APRAA indicated that this is not a significant burden for dismantler/recyclers, and is accepted as a necessary part of ELV treatment by reputable operators. There is also the possibility of some commercial return from recycling the fluids and batteries.

In Europe the economic value of ELVs has become increasingly marginal, primarily due to high landfill costs, which are at least 10 times greater than in Australia. The new European requirements for ELV treatment extend far beyond removal of the hazardous substances (and include requirements for high levels of recycling of all ELV materials), which is estimated to cost approximately US $200 per ELV.

Low landfill costs, the nature of possible ELV pre-treatment requirements, and acknowledgment that sound pre-treatment practices should already be being followed, suggests formalising basic pre-dismantling requirements should not significantly impact on the existing economics of the ELV recycling industry.

Key Findings

- *The lack of clear requirements to remove operating fluids, batteries and other potentially polluting materials from ELVs prior to shredding may be a source of negative environmental impacts.*
- *De-polluting ELVs ought not impact on the viability of current recycling levels given the economic value of ELVs and the views of APRAA and the shredder operators that good practice is already(or should be) being followed.*

Formal de-registration of ELVs?

Many of the stakeholders consulted acknowledged that there may be merit in further consideration of a formal de-registration requirement on the last owner of a vehicle. Such a proposal could largely mirror the deregistration/certificate of disposal regulations recently agreed by the European Parliament (see Ref. 8 and 44 for more detail), although without the European requirement for vehicle manufacturers to achieve higher recycling levels through that infrastructure.

Clearly, any regulated approach would require national agreement to ensure ELVs were not moved between states to avoid the requirements.

The potential benefits of such a de-registration approach could include:

- Regulated control over the ELV stream
- Elimination of ELV dumping (eg. the last owner might face penalties similar to parking infringements etc if a certificate of disposal to a certified recycler was not provided)
- Provides a method for requiring recyclers to follow environmental standards and which also attaches commercial incentives (no certification to issue disposal certificates if not an accredited dismantler).

- ELVs would be treated quickly after disposal minimising the potential for environmental impacts, and would mean ELVs would be treated before reaching shredders (noting that shredder operators would also be able to be certified if the same standards are followed)
- By creating structure in the industry, establishes a framework to communicate better industry practice and may ultimately facilitate achievement of other environmental objectives by leading to better material sorting and collecting infrastructure for other ELV materials (such as bumpers, tyres, other plastics etc for recycling)
- Besides the environmental benefits, help eliminate the illegal practices of vehicle rebirthing by requiring formal deregistration. This is an issue of great concern to vehicle manufacturers, the FCAI and the MTAA, although now being addressed through the forthcoming "national written-off vehicles register".

The approach would need to recognise the valid cases in which vehicle owners may continue to own unregistered vehicles, for instance:

- Car collectors – ie for the storage of historic/collectable vehicles, although even in these cases there may be a case to argue that "historic" or similar special registration arrangements should apply;
- Vehicles which are not used on public roads – the main example being unregistered vehicles used only on farms or other private property.

Clearly a substantial amount of further work and discussions with state, territory and local governments, registration authorities, the recycling and shredding industries and other stakeholders is required before the viability of the proposal can be fully assessed. Key issues will be compliance costs for the industry and administrative costs for government.

However, to achieve any significant improvement in ELV recycling outcomes, better regulation of the waste stream seems an important precursor. It would maximise the number of ELVs entering existing recycling processes, and allow ELV de-pollution and other environmentally sound practices at recycling/dismantling facilities to be implemented.

Key Finding

- *There appears to be strong support from many stakeholders for some form of national vehicle de-registration process.*

11. Increasing the recycling of ELV materials

Introduction

In addition to environmental impacts related to the volume of ELV waste and potential pollution, resource loss from not maximising recycling of ELVs also represents a significant negative environmental loading.

Even if manufacturers pursue measures to further increase levels of ELV component reuse, the low overall demand for most ELV components is unlikely to produce substantial increases in parts reuse. Exceptions include operating fluids and batteries (and possibly tyres) that should already be removed and recycled as discussed in Chapter 10.

Accordingly, achieving lower levels of waste and higher levels of ELV recycling would require an increase in materials recycling. The non-recycled fraction of ELVs (ie. the non-metal materials) account for 30% of total vehicle weight – predominantly plastics as well as foam, glass and rubber (from tyres).

Internationally, there have been two approaches to increasing ELV recycling levels:

- Increased removal and recycling of materials prior to ELV shredding
- recycling the shredder flock itself.

Both are discussed below.

A useful summary of international developments is provided in Ref: 4.

Plastics in ELVs

Various plastics comprise the largest non-metal materials in automobile manufacture, with the ratio set to further increase in coming years. Cars contain more plastics than any other material by volume. These materials are increasingly being used to produce lighter-weight vehicles and to date have generally not been recovered from ELVs.

It should be noted that while the increased use of plastics in vehicles is likely to have a detrimental impact in terms of the end of life environmental impacts, the use of lighter materials has a significant positive impact in the “in service” life cycle phase (see Chapter 12). It should also be noted that the manufacture of plastics consumes considerably fewer resources and produces fewer environmental releases than metals, thereby also producing positive benefits in the “production” phase. Accordingly, policy responses should not distort the overall positive effect of plastic use in vehicles.

Nevertheless, landfilling ELV plastics represents a significant loss of resources. For instance, the production of plastic accounts for 4% of total world oil production, and 7.5% of world plastic production is used in car manufacturing. The use of plastics in car manufacture therefore accounts for 0.3% of world oil consumption. Recycling of plastic is estimated to produce an 80% saving in resources over production of virgin material, with substantial associated reductions in emissions and other environmental releases.

Technical difficulties

Recycling ELV plastics is difficult technically, primarily due to the difficulties in separating different resin types from single components. A dashboard, for example, may contain several plastic types, foam, and bonding agents. Separating seat coverings from the foam cushioning is another example.

Even in Europe where, manufacturers and regulators have been actively pursuing plastics recycling options for some years, it is estimated that only 8% of ELV plastics are recycled (Ref: 23, p.26).

Tyres, Batteries and Oils

Used tyres present a difficult waste management problem in landfill or when stockpiled because of their volume, the resource loss and the fire hazard they pose. Approximately 20 million tyres may be being discarded annually (eg. Ref. 27, p.9), many of which are shredded with ELVs (by extrapolation, perhaps 2.5 million per annum). Evidence from the metal shredders indicated that ELVs arriving at the shredders are frequently loaded up with old tyres, although one operator indicated that they have a policy allowing no more than 5 tyres per vehicle. However, the majority of waste tyres (at least 80%, eg Ref: 1, p.15) is attributable to operational, rather than end of life, vehicles.

Nevertheless, tyres constitute a significant proportion of landfilled ELV shredder flock (about 7-10%). Accordingly, the development of measures to increase the incidence of tyre recycling would produce meaningful reductions in flock levels.

Discussions with vehicle dismantlers indicated a general lack of knowledge of the existence of tyre recyclers – APRAA indicated that its members would be more than willing to assist with disseminating information, or other measures, to increase tyre recycling levels.

Rubber cannot be remoulded or economically recycled to equivalent grade, although retreading is an option. Australia already has the world's highest retreading rate (approximately 27% - Ref. 27, p.11), although it does not ultimately provide a solution to tyre disposal. Used tyres can be broken down into granulated or crumbed rubber particles, which can be used in a number of applications (eg. carpet underlay, hosepipe, rubber boots) or mixed with plastic waste for items like conveyor belts (Ref. 1, p.15). Small amounts of recycled rubber are used in the manufacture of new tyres.

The low levels of landfill charges in Australia appears to be a significant contributing factor to the limited adoption of alternative means of disposal and recycling of tyres, as with other shredder flock materials. However, as noted previously, responsibility ought not lie largely or solely with shredder operators. This may be inequitable and counterproductive as increasing landfill charges could reduce the commercial viability of current ELV recycling levels.

Lead acid batteries such as those used in motor vehicles account for the largest proportion of lead in the waste stream (Ref 27, p.9). Australian Refined Alloys (ARA) estimate that 85-90% of the 4 million or so batteries scrapped each year are recycled (1996 figures, Ref. ibid). In the case of ELVs, one recycler also operates a battery recycling facility – recycling both the lead and plastic casings. However, anecdotal evidence from ELV recyclers/dismantlers during the study suggested that the value of car batteries might be declining to the point where proper disposal was less economically viable.

There was conflicting evidence during the study as to the extent to which oils and other lubricants are removed and recycled prior to ELV shredding. Nevertheless, one metal recycler indicated the view that the failure of auto dismantlers (and others providing ELVs) to remove fluids from vehicles was a major concern. Environment Australia is pursuing oil stewardship arrangements to enhance the collection of used oil.

Foam

As with plastics, the difficulty in recycling the polyurethane foam (predominantly located in vehicle seats) is related to the time and cost in separating the foam from other materials. However, through better design, methods are now being employed by some manufacturers to readily separate the seat for recycling. Seat foam can be recycled into noise insulation for new cars (by Renault for example, see Ref. 23, p.27). Mitsubishi indicated that most Australian made cars have readily separable seat covers.

It appears likely that markets may exist for recycled foam – particularly for carpet underlay for instance – and some recycling occurs overseas (eg. Italy, UK). However, the low landfilling charges in Australia (perhaps a tenth of those in Europe) significantly mitigate against the development of commercial markets for recycled foam.

Glass

Glass is an environmentally innocuous although heavy material. Recycling of glass is problematic, as it usually laminated, coated with primer and bonded or butyl-taped. In addition, removing vehicle glass is becoming increasingly difficult with the need for special tools. As a result, no market exists for recycled vehicle glass in Australia.

While this is the case in most international markets, in Italy Fiat is coordinating the enhanced recovery of materials from nearly 300,000 vehicles per annum, including glass. The glass is separated from laminate and other contaminating materials for use in the manufacture of coloured glass containers. Italy is unusual in having high un-met demand for this type of scrap coloured cullet which is used for green and amber wine bottles, which makes the recycling of glass commercially feasible. This is not the case in other countries, such as the UK for instance, where such a market does not exist (Ref. 65, p.4).

Economics

In addition to the technical difficulties, the economics of ELV plastics (and other ELV material) recycling is currently marginal at best. The current infrastructure for plastics recycling, for instance, does not extend much beyond kerb-side collection of domestic waste plastics and some recycling of industrial scrap plastic. In both these cases, the volumes, ease of collection, and quality of the waste apparently produces commercially viable recycling.

The economics of ELV plastic recycling are more difficult given the dispersed nature of the material supply, frequent contamination (eg repairs to plastic bumpers), and the labour intensive removal and sorting processes. As well as the mixture of plastics in single components, the presence of contaminating materials (such as metal from fasteners) presents major problems. Perhaps the most scientific assessment of the difficulties of achieving higher levels of plastics recycling is contained in a thorough report by an amalgamation of relevant Swedish manufacturing firms, known as ECRIS. (See Ref. 28). Recycling of Volvo dashboards for instance was found not to be commercially viable.

During the review, discussions were had with a business (ABSAN, in Adelaide) which specialises in the recycling of plastic bumpers and certain other plastics which contain a single plastic type (generally polypropylene or ABS). However, the business solely recycles new plastic components rejected during the manufacture of Holdens – it was indicated that the commercial dynamics of recycling post-consumer ELV plastics would be unattractive for the reasons above.

As well as cost difficulties associated with removal and sorting of plastic materials, the value of recycled plastics is a further factor in the lack of economic value for ELV plastics. As the ABSAN example shows; if the plastics are sufficiently pure and different plastic types are not mixed, a commercial return can be attained. Less pure mixes of plastics are worth considerably less, and require higher proportions of virgin materials to be mixed with the recycled material. The cost of virgin plastics is relatively low – ABSAN sells recycled plastics back to Holden.

In the ECRIS project, it was concluded that:

- “An expanded level of car recycling in Sweden will result in higher costs under present conditions, with the costs tending to increase exponentially as the objectives become more ambitious. As a result, coordinated long term action (is needed) to develop markets and methods with aim of improving recycling economics.
- The time that is required for additional materials dismantling is one of the main reasons. Other factors are the price levels of those materials and long transport distances are also costly."

These conclusions are likely to apply equally, if not more so, to the Australian environment.

The issue of plastics and other ELV material recycling, and particularly the development of collection infrastructure and facilitation of secondary markets, is obviously an issue which extends beyond ELVs to all waste sources.

International Developments

The recent European Parliament directive on end of life vehicles makes manufacturers in Europe responsible for achieving increasing recycling targets.

Other significant measures under that directive are the requirement for standardised materials coding, and for producers to provide dismantling information for each type of new vehicle put on the market within 6 months of its release.

Extract from European Parliament Directive 2000/53/EC

"Member states shall take the necessary measure to ensure that the following targets are attained …:

(a) no later than 1 January 2006, for all end of life vehicles, the reuse and recovery shall be increased to a minimum of 85% by an average weight per vehicle and year…

(b) by no later than 1 January 2015, for all end of life vehicles, the reuse and recovery shall be increased to a minimum of 95% by an average weight per vehicle and year."

(note: up to 10% may be achieved through means other than reuse and recycling – eg. energy recovery)

By passing responsibility to the manufacturers for achieving higher recycling levels, incentives are created for the increased use of recycled ELV materials in new vehicles - thereby helping create a market for the secondary products.

Industry Views and initiatives

The manufacturers and the FCAI are opposed to Australia adopting a European style EPR model, arguing it would be likely to have a significant detrimental impact on other government policy objectives for the local car industry (ie sustainability).

- In Europe, the cost of implementing the new arrangements is estimated at US$10.6 billion.

Other relevant factors include the low investment/low volume nature of the local industry, landfill pressures/costs are lower, infrastructure and markets for recycled ELV materials are limited, and the costs of recycling associated technologies is not currently viable for the local market size. EPR for autos has not been formally adopted in most other nations.

The Australian manufacturers consulted during the review indicated that they are already pursuing many measures to facilitate ELV materials recycling. For instance, Holden described changes to certain vehicle components in future models to greatly increase the number of single resin components. It was found that coding of plastics using recognised markings (important for later sorting) is already widely practised.

Ford Australia seemed particularly well advanced in setting and working towards recyclability targets as part of global Ford initiatives.

Key Findings

- *It is likely that economic markets probably cannot exist at present for recycled plastics (and most other) ELV materials due to the mix of plastic types in components, contamination from other materials, the costs of disassembly, and the price for the recycled materials.*

- *Given the lack of economic markets, increasing the level of disassembly and recycling of ELV materials would entail significant additional costs – European experience suggests around $200 million (US$200 per ELV).*

Funding a Recycling Program

A major stumbling block for the European ELV initiatives involved the issue of funding – although it was initially proposed that the industry would meet the additional costs, the question was eventually left to individual member nations to resolve - although it was agreed that the last owner should not bear the cost.

In Europe, the cost of the new measures is estimated at approximately US$200 per ELV – this would equate to approximately A$200 million per annum in Australia. Given the economies of scale in the European market, existing materials recycling infrastructure, and other factors such as lower average transport distances and costs, it can be expected that the costs of subventing the market to achieve increased recycling of ELVs may be considerably higher in Australia.

Furthermore, it is still far from clear at this stage whether the European measures will be sufficient to overcome the current market factors limiting demand for ELV recycling.

Before determining what sources of financial intervention might be necessary to increase ELV recycling, it would seem advisable to first:

- Undertake a full analysis of the current economic and technical impediments limiting the level of non-metal ELV recycling; and

- Monitor the progress of the European initiatives for a reasonable period.

It should also be noted that similar initiatives have not been adopted outside of Europe, including competitors with Australian manufacturers in the domestic market (such as Asia and North America).

Recyclability

A key measure being adopted by manufacturers in response to the requirements for higher levels of recycling is the "recyclability" level of new vehicles.

Notwithstanding the current lack of commercially viable markets for ELV materials recycling, measures to improve the level of recyclability are important for the future:

- It can be expected that the environmental imperatives for ELV materials recycling will be greater, and the commercial viability increased, when vehicles currently being designed become ELVs in 20 years time
- It is desirable that Australian manufacturers do not use the current lack of markets as a reason to not pursue improved recyclability objectives for the future.

Manufacturers consulted, particularly Ford, are well advanced in quantifying and defining recyclability and implementing design changes to increase recyclability levels.

Recycling

Manufacturers can also play an important role in increasing recycling outcomes through their use of recycled material in new vehicles. A number of manufacturers both here and internationally already use recycled ELV plastics in certain applications (such as hidden "behind dash" components). It would be desirable for manufacturers to examine options for increasing the use of recycled ELV materials in new vehicles.

Government assistance to the industry

The Commonwealth currently provides over $1 billion in assistance to the car manufacturing industry under a program which is due to be reviewed in 2002 (administered by the Department of Industry, Science and Resources).

Increasing ELV material recycling

It could be argued that the greatest environmental outcomes could result from instituting an EPR model, as this would overcome the current disjunction between product design and manufacture and end of life treatment.

However, the impact of such an approach would need to be carefully considered before being introduced in Australia, given the significant detrimental impacts it could have on the local industry, the current lack commercially viable markets for recycled plastics materials, and other factors discussed earlier.

However, it must be recognised that manufacturers play a major role in determining the extent to which their vehicles can be recycled, and hence, the level of waste and resource loss that occurs.

In addition, there appears to be limited information on the technical and market impediments to achieving higher levels of recycling of the materials found in ELVs, including the development of collection infrastructure and secondary markets.

Successful models exist internationally for the co-operative development of solutions between manufacturers, ELV recyclers and other stakeholders, such as in the Netherlands (Auto Recycling Nederland – ARN – for further information see, for example, Ref. 4, p.29-30) and ACORD in the UK (see text box below).

More efficient solutions are likely to result from industry developed, rather than imposed, solutions.

EXAMPLE OF AN INUDSTRY FORUM - ACORD (UK)

The Automobile Consortium on Recycling and Disposal (ACORD) was set up in 1991 and includes car and materials' manufacturers, dismantlers and materials' recyclers. In 1997 they signed a voluntary agreement committing themselves to make significant improvements in the amount of material recovered from vehicles. In particular, targets have been agreed to improve the recovery of material to 85% by weight by 2002 and 95% by 2015.

A number of initiatives are covered by the ACORD agreement including:

- Designing vehicles to make them easier to dismantle;
- Using materials that are easier to recycle;
- Using more recycled materials in vehicles; and
- Using common parts coding standards to make them easier to identify. (Source: Ref. 1, p.17)

Recycling of shredder flock – pyrolysis

In overseas markets, pyrolysis has been touted as a possible solution to the problem shredder residue. It is still in its infancy, and appears not to have been profitably used as a means of treating shredder flock.

Pyrolysis relies on controlled thermal decomposition of shredder flock in an oxygen free chamber. The organic fraction of flock (approximately half) is condensed into gas and oil which are similar in composition and performance to natural gas and heavy crude oil. The residual inorganic material creates a solid that may have applications in plastics and asphalt.

As well as technical and commercial limitations, pyrolysis has also been criticised by some environmentalists for causing more pollution than fossil fuels. The way in which organochlorins (from PVC) are released is also unclear. It is not likely to be a practical solution to increased recycling in the near future in Australia.

The Argonne technique

A further thermal separation method, known as the Argonne technique (it was developed at the Argonne National Laboratory in Chicago), is being widely touted in Europe by a business called SALYP that has adopted the technology. It refers to the practice as "thermo plastic sorting" (tps). SALYP claims to separate various materials from shredder flock, including foam from seats, hard plastics and elastomers. The company states that the process will allow for low cost separation and recycling of these materials. (Further details are at Ref. 24). The system is in its infancy and its claims should be monitored as it is further tested in Europe – this technology is also unlikely to provide a practical solution in the near future.

Incineration

Waste disposal through incineration and energy recovery (for instance in cement kilns in place of fossil fuels) is widely practiced; particularly those with landfill shortages and high landfill charges (Europe, Japan etc).

Discussions during the review did not provide any examples of shredder flock being incinerated ("thermal recycling") in Australia. One metal recycler suggested that it might be partly due to the poor public perception of incinerators and the fact that landfill costs were sufficiently low to not warrant its pursuit as a disposal option.

Although studies show shredder flock has a high calorific value, one recycler indicated that shredder residue does not burn well or completely, leaving substantial residues. Other studies have referred to this difficulty: "it turns out that shredder residue is difficult to burn and, in many cases, incineration does little to reduce either its volume or its chemical potency" (Ref. 27, p4). In addition, the hazardous materials in shredder flock (including PCBs and PVC) may cause adverse environmental emissions.

Nevertheless, other countries have essentially outlawed the disposal of shredder flock in landfill and have instead promoted the development of incinerators (eg. Sweden, Netherlands). There is, therefore, conflicting information on the viability of incineration as a disposal option.

Flock Recycling

Shredder residue has potential applications as a feedstock for new plastic goods, such as fence posts, park benches etc. One metal recycler is currently working to investigate the potential for flock recycling. The shredder flock is mixed with other materials (ice cream containers, recycled tyres) and can be used to produce products such as timber substitutes. The product is low grade due to the variety of materials in the flock, but can be used as a substitute for Building materials. Its benefits in maritime applications were highlighted.

One advantage of this form of disposal is that hazardous materials in shredder residue are essentially rendered harmless by being bonded into a product with apparently minimal tendency to leach.

However, international literature indicates that the use of shredder flock as a feedstock has been slow to develop due to inexpensive substitutes, costs of maintaining the equipment, and insufficient demand to sustain the market (eg. Ref. 5, p.15).

Nevertheless discussions could continue to be pursued with metal recyclers and other interested parties.

12. Automobile Life Cycle Impacts

ELVs in context

The focus of this report is on the "retirement" stage of the automobile life cycle.

However, to properly scope the extent of the environmental problems arising from end-of-life vehicles (ELVs), and make judgements about the appropriate rigour and reach of any policy response, it is important to consider the issue in the context of the whole-of-life environmental load of automobiles.

Equally important is an understanding of the interrelationship of environmental considerations at different life stages of the vehicle. A policy response that has an advantageous environmental outcome when a vehicle is scrapped may have a greater negative environmental outcome at other stages in the product life cycle.

No original data were gathered during the review, and the following assessment should be treated only as a rough guide. From discussions with the Australian Greenhouse Office for instance, it is apparent that there is some technical debate about the relative proportion of emissions attributable to the manufacturing and in-service life cycle phases. Nevertheless, the general assertion that end of life considerations should not overshadow the greater impacts occurring in other life cycle phases is considered accurate.

Stage 1: acquisition and processing of virgin resources

Stage 1 comprises the extraction and refining of raw materials for input to the manufacturing process, such as metals, rubber, oil (for plastics) and water. Some issues associated with stage one include:

- Some of these materials are finite resources
- Substantial amounts of energy are consumed, particularly in producing aluminium, steel, plastic and glass
- Processing these materials involves a range of heavy metals, toxic chemicals, chlorinated solvents, and ozone depleting chemicals
- The largest waste contributor of all the automobile life cycle stages is mining waste related to energy generation and iron ore production necessary for vehicle manufacture *(Ref. 26, p.1)*

Stage 2: the manufacturing process

The impacts in this stage particularly relate to energy use (and associated emissions), as well as waste products from the manufacturing process such as airborne emissions, waste water and solid waste.

The most substantial environmental impact occurs in the painting and coating processes in vehicle manufacture, accounting for 56% of all releases and transfers to the environment (26, p2). The paint shop also consumes about half of the energy required for the whole production process. The painting processes generate substantial amounts of hazardous liquid waste, including lead, nickel, copper, sulphate, chromium and phosphate.

Manufacturers in Australia have made significant improvements in the environmental impacts of vehicle manufacture, with substantial reductions in emissions and resource use.

- The main contributors to solid waste streams in the manufacturing process are waste water treatment sludges, waste oil, plant refuse, and scrap metal (ibid)
- The Table below estimates the environmental impact from manufacturing the new vehicles sold in Australia in year 2000 (excluding the generation of raw materials).

Environmental Impact of Manufacturing 780,000 New Cars (Australian Sales 2000)

Resources Used	***Emissions***	***Waste***
2,160 GWh energy (electricity and gas)	32.1 tonnes sulphur dioxide	-
	408 tonnes nitrogen oxide	-
	708 tonnes carbon dioxide	-
4.3 billion litres water	-	Contaminated water, including approx 2.8 tonnes per annum of toxic metals (@0.65mg/l)
Materials	-	17,750 tonnes of landfill waste

Notes:
a) *indicative figures only – will depend on processes used in individual manufacturing plants*
b) *extrapolated from 1997 case study of Vauxhall plant in UK (1, p.6)*
c) *based on Federal Chamber of Automotive Industries forecast of 780,000 total new vehicle sales for year 2000 (59, p.1) (ie includes imported and domestically manufactured vehicles*

Stage 3: operational, or utilisation, stage

Operating and maintaining a vehicle during its working life contributes the greatest environmental impact:

- The 12 million or so vehicles on Australian roads travel approximately 180 billion kilometres in total annually, consuming approximately 25 billion litres of fuel *(source: ABS – ref. 42 p.2, 60 p.1)*

- Various studies put the primary energy consumption during the vehicle's operational life at between 80% and 90% of total energy consumption of all life cycle stages *(eg. ref. 26 p.2, 27 p.5)*

- There is additional resource consumption related to necessary infrastructure (roads, service stations etc)

- Air borne emissions are greater than any other life cycle stage – although the advice from the Australian Greenhouse Office, that emissions in the manufacturing phase may still account for some 40% of total emissions, is acknowledged.

- It has been estimated that a small Ford from 1976 generates 50 times the emissions of an equivalent modern small Ford (Ref. *Connecting with Society*, Ford, 1999)

- Repair and servicing operations also contribute significantly to environmental impact

Stage 4: retirement, or disposal, stage

- Impacts relate primarily to waste generation and energy depletion

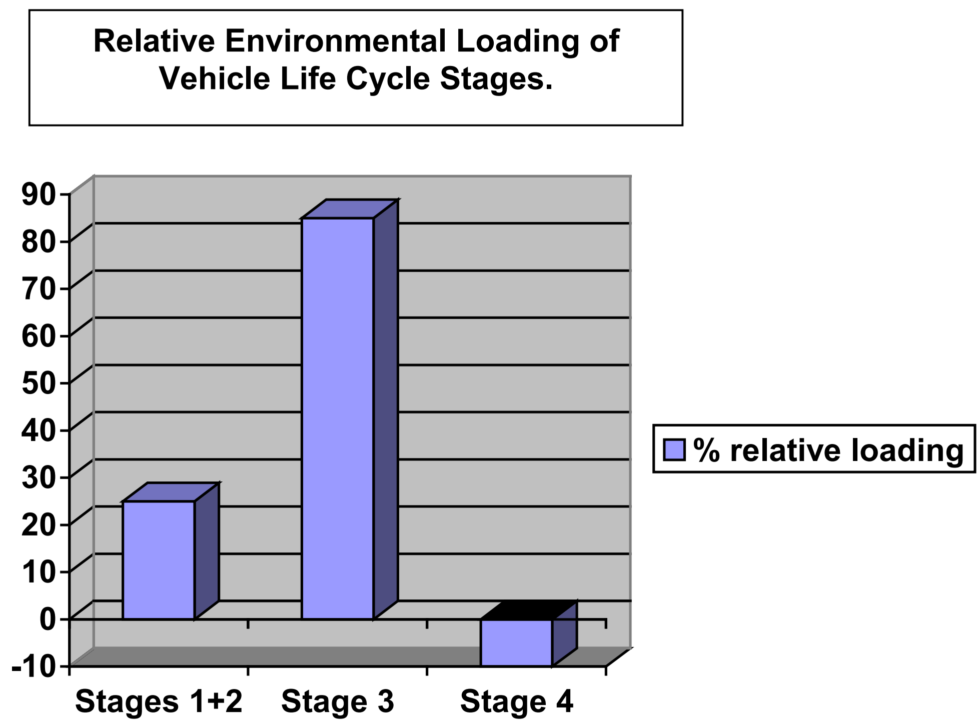
- Impact dependent on vehicle composition, recycling infrastructure, markets for used components and recyclable materials

- ELVs contain hazardous wastes including oil and other contaminating fluids, and heavy metals such as lead, hexavalent chromium and cadmium

- The current level of ELV recycling, primarily the recovery of metal, contributes a net reduction in the environmental loading of approximately 10% *(28, p.7)*

Conclusion - Life-cycle Environmental Impact

The operational and manufacturing life stages of a vehicle are the most significant contributor to the total environment loading of automobiles, and it is therefore appropriate that these have been the main areas of environmental focus.



Environmental gains in the operational stage of a vehicle, as the result of the increased use of plastics and other lightweight materials for instance, will normally outweigh the negative environmental impact resulting from less ELV recycling.

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