Impact of Landfill Levy on the Steel Recycling Sector in Victoria

A report prepared by Marsden Jacob Associates and Warnken ISE for EPA Victoria

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Executive Summary

Introduction

1. Marsden Jacob Associates (MJA), in conjunction with Warnken ISE has been engaged by EPA Victoria to undertake an analysis of the impact of the landfill levy on the steel recycling sector. There are two key aims for the study.

   a. Broadly assess the impact of landfill levies on the steel recycling sector in Victoria under a number of scenarios.

   b. Identify potential opportunities for the increased collection and recovery of (ferrous metal) products for recycling and barriers that currently inhibit increased recycling.

2. In recent years, high international prices for steel, aided to some extent by government policies designed to encourage recycling generally, has lead to sustained high demand for and use of ferrous scrap in steel production internationally. In Australia, the proportion of ferrous metal scrap being reprocessed nationally has increased from around 65 percent in the early 1990s to 80-85 percent by the mid 2000s. In Victoria, the amount of ferrous metals recovered for reprocessing has increased from around 0.5 million tonnes in 1993 to over 1 million tonnes in 2005-06.

3. Like steel, many other materials have experienced increases in recycling since the early 1990s. One of the principal waste recovery policy instruments applied in most Australian jurisdictions, is a levy on waste going to landfill. All Australian mainland states, except Queensland, currently apply a landfill levy.

4. Landfill levies were first introduced in Victoria in 1992. They currently apply to municipal, commercial and industrial and prescribed industrial wastes deposited onto land at licensed facilities throughout Victoria. Levy rates have increased steadily in recent years, although current rates - \$6-8 for municipal waste and \$11-13 for industrial waste – are, with the exception of prescribed waste, still significantly below rates currently applied in NSW.

5. The process of metal recycling involves the size reduction of metal products with shredders and shears into small pieces. Different metals are separated out magnetically leaving a residue, usually referred to as 'shredder floc', which contains remnant rubber, glass, insulating foam, plastic, dirt and traces of ferrous and non-ferrous metals.

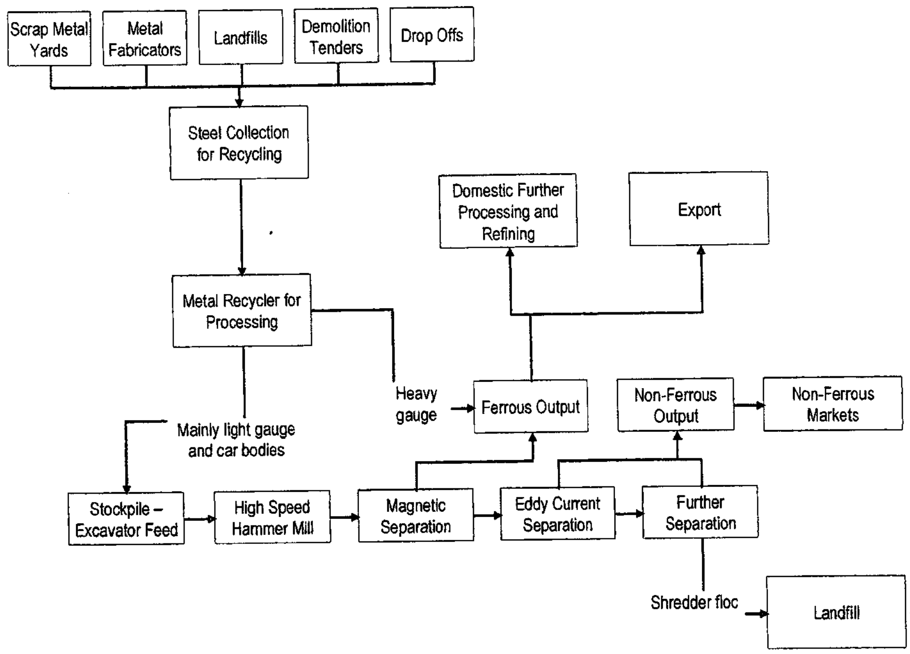
6. Shredder floc is disposed to landfill as non-prescribed urban industrial waste. This means that, in addition to gate fee charges, it currently attracts a landfill levy of \$13/tonne. This is set to rise to \$15/tonne in 2007-08.

7. Representations made to EPA Victoria by the industry have highlighted that the landfill levy could adversely impact the recovery and recycling of steel in Victoria, since products with marginal levels of recyclable content may not be processed but instead be sent straight to landfill. This study aims to assess whether this is indeed the case.

Steel recycling

8. A schematic of the steel recycling process is shown in Figure ES 1.

Figure ES 1 – Steel Recycling Process

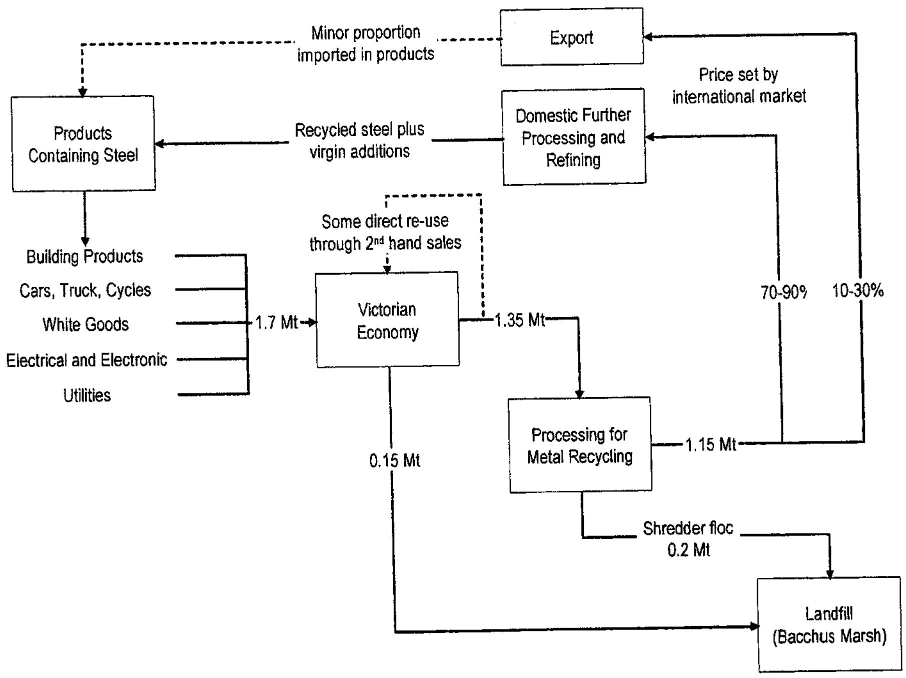


9. At the end of its service life, steel containing products enter the recycling stream through one of a number of channels. Streams containing steel will be recovered through these channels and be transported to one of the three metal recyclers in Victoria for processing and recovery of the steel and non-ferrous materials.

10. A number of benefits are associated with the recovery of steel from scrap, rather than manufacturing products from virgin materials. In order to quantify the relative impacts of recycling versus virgin steel manufacture, calculations of impacts need to be done on a life cycle basis. Data used in this study estimating the life cycle impacts of steel production is from the United States in 1995. Although this data is somewhat dated, it is suggested that the trends are still relevant, and show significant reductions in a number of categories including water usage, coal, total primary energy, greenhouse gas, SO_x NO_x and hydrocarbon emissions, and solid waste generation in recovery of secondary steel rather than primary steel.

11. The flow of steel in the Victorian economy is shown schematically in Figure ES 2. In 2004/2005, 19,000 tonnes of packaging steel and 932,000 tonnes of other steel was recycled in Victoria, representing 82 per cent by weight of the total metals stream of 1,157,000 tonnes recovered by recycling. Between 70 and 90 per cent of the recovered steel is used domestically, with the remainder being exported. If a total of 1.7 million tonnes of steel enters the Victorian economy each year, this suggests that between 47 per cent and 61 per cent of the total steel entering the Victorian economy is met by recycled material.

Figure ES 2 – Flow of Steel in the Victorian Economy



12. The total recovery of steel continues to increase in Victoria, with the total metal being recovered up 12% in 2004/2005 from the previous year. However, there are a number of barriers to increased recycling. These include include transportation costs, particularly in more remote areas, limited incentives to prompt recycling rather than disposal, lack of collection systems and, potentially, increases in the landfill levy.

Financial analysis

13. The financial assessment is centred on the operations of a 'typical', but hypothetical, steel recycling business in Victoria. The typical business has the following characteristics:

- It is an established steel recycling business.
- Its core business is ferrous metals reprocessing, based on the 'shredder' process.
- Revenue is also generated through the collection and cutting of heavy gauge steel.
- Some non-ferrous metals are also recycled, essentially as by-products of its ferrous operations.
- The business has approximately 1/3 of Victoria's ferrous shredding market.
- A range of ferrous scrap metal products are processed, some of which have a high floc content, some of which have low or zero floc content. Floc typically comprises about 18% of all ferrous scrap processed. This must all be disposed to landfill.

14. Two linked spreadsheet models have been developed to test the impact of the landfill levy on the financial viability of this typical business – a steel reprocessing (material flows) model and a financial model. Sensitivity analysis is undertaken to test the impact of changes to a range of key variables on financial viability.

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15. In terms of exploring where steel is recovered, and to explore the impact of transport costs on the typical reprocesser, the state was divided into four zones: 'Inner Urban', 'Outer Urban', 'Inner Regional' and 'Outer Regional' as shown in Figure ES 3. An estimate of the current recovery of steel within the various zones was then made. This is presented in Table ES 1.

Figure ES 3 – Zones of Recovery for Transport Analysis

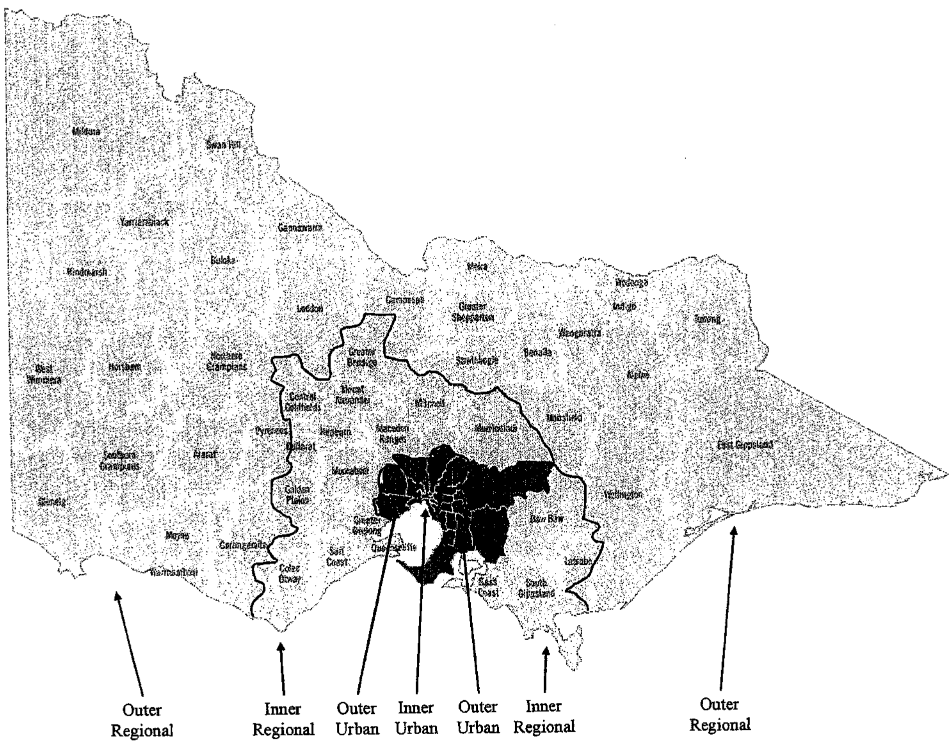


Table ES 1 – Estimated Totals of Steel Recovery and Location

Type of processed scrap	Inner Urban	Outer Urban	Inner Regional	Outer Regional	Totals	% Recovery
- HMS (industrial)	112,275	66,127	59,603	31,995	270,000	98%
- HMS (shredable)	29,940	17,634	15,894	8,532	72,000	98%
- swarf (manufacturing offcuts)	9,356	5,511	4,967	2,666	22,500	98%
- tin plate	9,903	5,511	4,704	2,382	22,500	80%
- packaging	18,964	11,021	9,813	5,202	45,000	90%
- car bodies	56,819	33,064	29,475	15,643	135,000	95%
- light gauge (whitegoods, lgt construction)	162,698	81,557	61,890	26,855	333,000	60%
Total	399,955	220,425	186,347	93,273	900,000	78%

16. In order to undertake the financial assessment, values have had to be assigned to numerous other variables. In summary, the variables fall into three broad categories: financial; operating conditions and costs; and capital equipment and costs.

17. Financial analysis of the impact of the landfill levy has been undertaken by modelling the variables outlined above using three standard cases. These cases, referred to as 'low', 'mid', and 'high', differ in the way in which key costs associated with reprocessing scrap are treated.

18. Table ES 2 provides a summary of the financial performance of the typical steel reprocessing business under the low, moderate and high cases, at three different landfill levy rates, $0, $15 and $30. It is apparent that the reprocessing business is a viable concern overall, generating high rates of return, strongly positive NPVs and positive net margins under the low, mid and high cases. However, it should be recognised that the apparent strong financial position of the business comes in the context of strong international markets for ferrous and non-ferrous metals.

Table ES 2 – Financial Performance of the Typical Reprocessing Business

Financial variable	Levy Rate		
	$0	$15	$30
Internal rate of return (IRR) (%)			
Low	39.7%	37.8%	35.9%
Mid	48.2%	46.5%	44.8%
High	53.4%	51.6%	49.8%
Modified IRR (MIRR) (%)			
Low	21.2%	20.8%	20.5%
Mid	21.7%	21.2%	20.6%
High	25.5%	25.1%	24.6%
Net present value ($)			
Low	42,892,562	39,834,708	36,776,855
Mid	65,898,619	62,840,765	59,782,911
High	81,893,654	77,829,027	73,764,399
Net margin ($ / tonne)			
Low	22.8	21.3	19.8
Mid	28.4	26.9	25.4
High	34.0	32.5	31.0

19. The impact of the landfill levy on the company's financial performance overall appears, *prima facie*, to be relatively minor at the current (July 2007) rate of $15 / tonne of floc. Each additional $15 of levy represents an annual cost impost to the company of about $783,000 (assuming a standard volume of processed scrap and a standard floc content of the scrap). This translates to a reduction in IRR of approximately 1.7% and a reduction in the average net margin of approximately $1.50 / tonne of scrap processed.

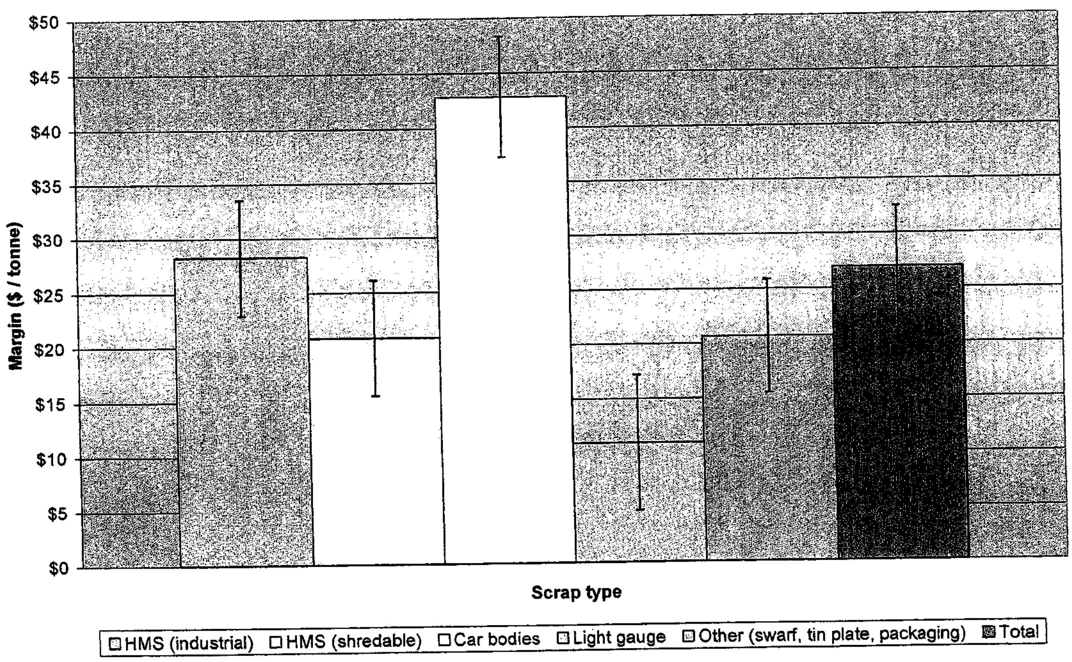
20. At higher levy rates though, the impact of the levy becomes more significant. At $50 / tonne of floc for example, the average margin earned on processed scrap reduces to $23.40 / tonne ± $5.60, down from $28.40 / tonne ± $5.60 with zero levy. And at $130 / tonne the average margin earned on processed scrap falls to just $15.50 / tonne. Furthermore, the impact of the levy on overall financial

performance, including average net margins, hides potentially more significant impacts on individual scrap types or scrap sourced from particular regions.

21. Figure ES 4 provides an overview of estimates of net margins earned by the typical reprocessing business on different types of scrap.

Figure ES 4 – Net Margins by Scrap Type

(mid case with $15 levy, with error bars indicating margins for low and high cases)



22. Two key points are highlighted in Figure ES 4:

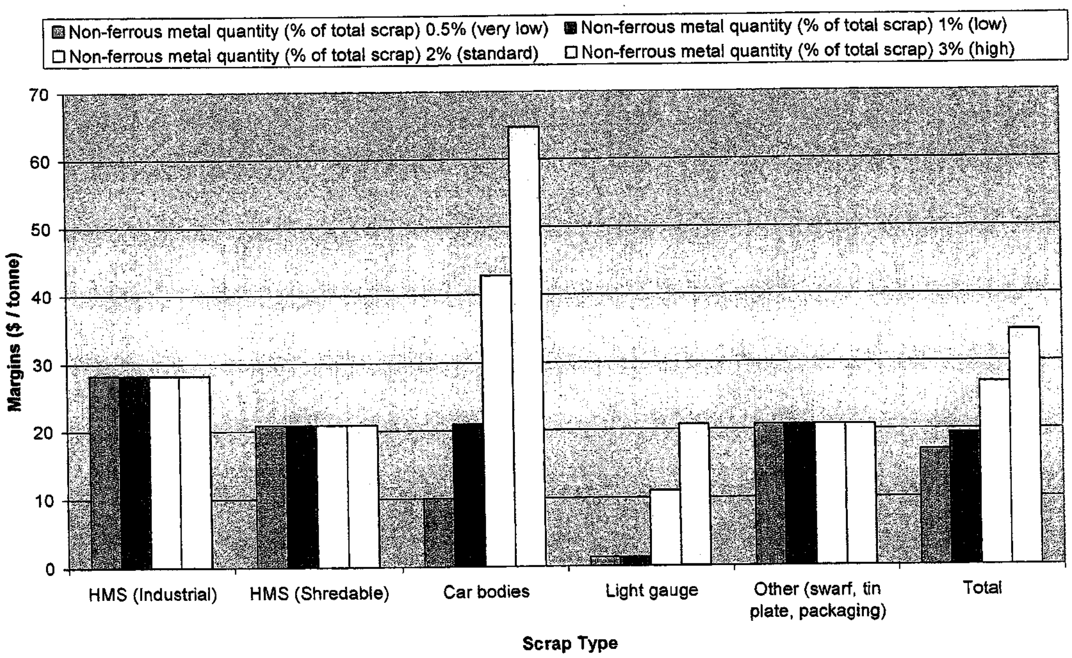
- First, is the apparent high margin earned on cars across all regions, despite car bodies having significant floc content and, as a consequence, relatively high processing costs. The high margin earned on cars is principally a function of the non-ferrous scrap component of the cars which in the standard case is assumed to be about 5% of the car bodies by weight. If the volume of non-ferrous metals retrieved from cars is significantly less than the standard, then the margin earned on them falls away substantially.
- The second significant point relates to the margins earned on light gauge scrap, estimated at $4.80, $11.00 and $17.10 under the low, mid and high cases respectively. These (relatively low) margins reflect the high collection and transport costs associated with light gauge and its high floc content. Margins on light gauge collected from (inner and outer) regional areas are especially low and in some circumstances, may even be negative.

23. An initial conclusion that can be drawn from the financial analysis therefore, is that an increase in the landfill levy, say from $15 to $30, would result in the average net margin earned on processing scrap falling by about $1.50. This is unlikely to affect the viability of the business overall. However, it could significantly impact on the ES

viability of reprocessing light gauge scrap, particularly scrap that is sourced from regional areas.

24. It is important to consider the sensitivity of the reprocessing business' viability to changes in key variables. Sensitivity analysis has been undertaken on tonnage of scrap processed, steel prices and non-ferrous metal prices and volumes. As noted, the financial performance of the business is particularly sensitive to non-ferrous metal prices and volumes (see Figure ES 5).

Figure ES 5 – Net Margins on Scrap Types at Different Non-Ferrous Metal Quantities



25. In summary, the following general conclusions can be drawn as a consequence of the financial analysis undertaken for this study:

- Every $15 of levy reduces the IRR of a 'typical' steel recycling business by about 1.7 percentage points and the net margin on processed scrap by about $1.50.
- When the typical business is performing strongly, as would appear to be the case given current scrap volumes and metal prices, this represents a relatively minor impact on overall financial performance.
- However, for a business reprocessing a lower total quantity of scrap than standard (300,000 tonnes), or reprocessing a lower proportion of non-ferrous metals than the standard (2% of total scrap), impacts of this magnitude would be more significant for overall financial viability.
- Further, net margins earned from the processing of light gauge scrap are relatively low, particularly in regional areas. Thus a significant increase in the landfill levy rate could affect the viability of reprocessing light gauge in these areas.
- Margins earned on light gauge steel and car bodies are also very sensitive to non-ferrous metal prices and quantities. A significant increase in the landfill

levy rate could therefore also affect the viability of reprocessing car bodies or light gauge if they have low non-ferrous metal content, again especially in regional areas.

26. These outcomes would be compounded for a business that reprocesses a relatively small total quantity of scrap.

Environmental Implications of the Levy

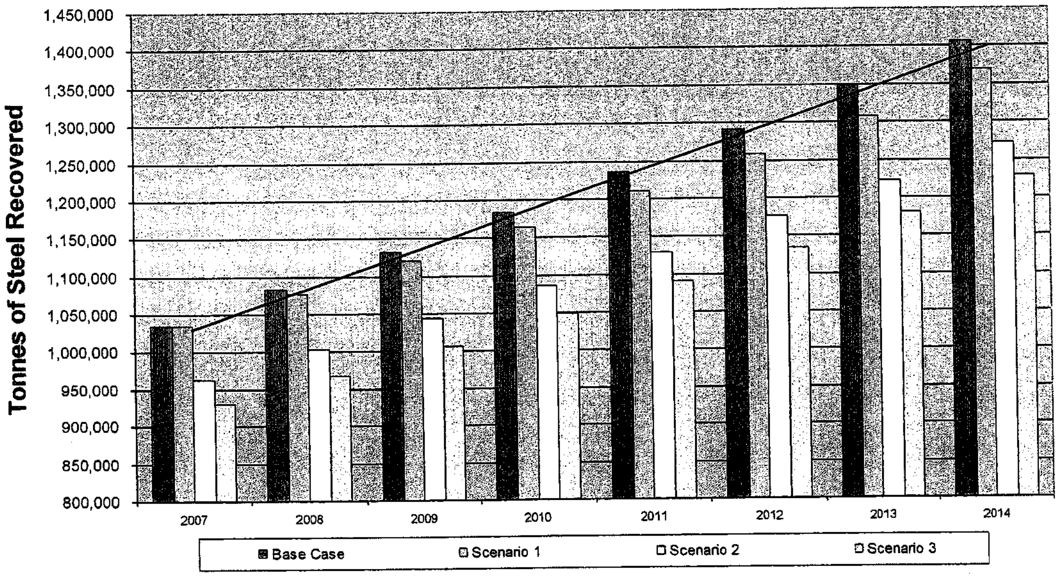
27. The impact of increasing the levy was shown potentially to have a financial impact on metal recyclers. One response to a decreased net margin on a given material input is to remove that product stream from recycling. Increases in the levy could thus act to reduce steel recycling rates. The actual impact is difficult to predict because of the unknown industry response to the increase, and also because of the fluidity of the market for the recovered metals.

28. A scenario based approach has thus been adopted to investigate plausible future outcomes in response to increases in the levy involving decreased steel recycling. The three scenarios explored include:

- Scenario 1 – increase in levy to $30 prevents further increase in processing of light gauge in regional areas (i.e. remaining scrap in the inner regional and outer regional areas remains unprocessed)
- Scenario 2 - = scenario 1 + the loss of existing light gauge in outer regional areas and half of existing light gauge in inner regional areas because it is no longer viable to process light gauge from these areas as a result of the cost to dispose of floc in combination with transport costs
- Scenario 3 - = scenario 1 + scenario 2 + in addition to the loss of cars in outer regional areas and half of existing cars in inner regional areas because it is no longer viable to process cars in these areas as a result of the cost to dispose of floc in combination with transport costs.

29. A model of steel waste generation, broken down according to geographic distribution and steel product type, was used to test the impact of the levy according to a comparison of the three scenarios against a base case consistent with meeting Victorian recovery targets at 2014. The results of this analysis are presented in Figure ES 6 below.

Figure ES 6 – Comparison of levy impact scenarios on steel recycling



30. From the above analysis it is shown that:

- Scenario 1 – loses 172,502 tonnes of steel recovery from the base resource recovery case between 2007 and 2014 (an annual average of 24,644 tonnes)
- Scenario 2 - loses 818,592 tonnes of steel recovery from the base resource recovery case 2014 (an annual average of 116,942 tonnes)
- Scenario 3 loses 1,127,956 tonnes of steel recovery from the base resource recovery case between 2007 and 2014 (an annual average of 161,137 tonnes).

31. The environmental impacts arising from lost recycling because of increases in the landfill levy have been estimated. They include:

- Scenario 1 – 172,502 tonnes of extra landfill, 703,018 tonnes of carbon dioxide equivalent (CO_2e) in greenhouse gas emissions, 4,600 olympic swimming pools in extra water use, 265,000 tonnes of brown coal equivalent in energy usage, and 3,205 tonnes of air pollution.
- Scenario 2 – 818,592 tonnes of extra landfill, 3.3 million tonnes of CO_2e in greenhouse gas emissions, 21,800 olympic swimming pools in extra water use, 1.3 million tonnes of brown coal equivalent in energy usage, and 15,200 tonnes of air pollution.
- Scenario 3 – 1,127,956 tonnes of extra landfill, 4.6 million tonnes of CO_2e in greenhouse gas emissions, 30,100 olympic swimming pools in extra water use, 1.7 million tonnes of brown coal equivalent in energy usage, and 21,000 tonnes of air pollution.

32. An initial estimate has been made of some of the economic costs associated with the three scenarios discussed above. Estimates have been made for only a very limited range of environmental variables due. These are: CO_2 emissions; and fine particulate emissions (PM_{10}).

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33. We have applied two prices to CO_2 emissions: \$15 / t CO2 as the short run price; and \$ 30 / t CO2 as the long run price.

34. To estimate the costs of particulate emissions associated with scenarios 1 to 3 we have drawn on an economic assessment of the 'Health Costs of Air Pollution in the Greater Sydney Metropolitan Region'. The NSW DEC study calculated the annual health costs of air pollution in the Illawarra region to be in the range \$ 6 – 63 / tonne of PM_{10}.

35. Applying the prices for CO_2 and particulate emissions inferred above provides the following estimates of the imputed economic values of the environmental impacts of lost recycling, as investigated using the three scenarios (see Table ES 3 below).

Table ES 3 – Economic cost of environmental impacts from reduced recycling

Cumulative impacts	Scenario 1 low	Scenario 2 low	Scenario 3 low	Scenario 1 high	Scenario 2 high	Scenario 3 high
Greenhouse	$ 10,545,269	$ 50,041,669	$ 68,953,519	$ 21,090,538	$100,083,339	$137,907,039
Particulate Matter (PM)	$ 15,744	$ 74,710	$ 102,945	$ 165,308	$ 784,457	$ 1,080,920
Total Environmental Cost	$ 10,561,013	$ 50,116,379	$ 69,056,464	$ 21,255,846	$100,867,795	$138,987,959

Discussion and conclusions

36. The sound position of the 'typical' reprocessing company business has meant that, until now at least, the cost of the landfill levy has been borne by the business without significantly affecting the overall viability of its steel reprocessing operations.

37. Our analysis also suggests that the imposition of the landfill levy on floc generated through the steel recycling process could lead to a reduction in recycling rates and a commensurate increase in the quantity of waste going to landfill.

38. This situation applies especially to light gauge metal sourced from regional areas and may even apply to car bodies sourced from regional areas that have minimal or no non-ferrous metal content. If the levy rate was to substantially increase, then recycling rates of these scrap products could be adversely impacted in the medium to long term.

39. It is not possible to be precise about the rate of landfill levy increase that would lead to an adverse affect on steel recovery or the extent to which recovery levels would be affected by any particular landfill levy rate. However, by examining a number of scenarios, some plausible estimates have been made of the quantities of scrap metal that could potentially be affected by a doubling in the rate of landfill levy imposed on floc disposal (from \$15 to \$30).

40. A range of options for overcoming the potential barriers posed to steel recycling by the landfill levy on floc have been examined. These are:

- current situation;
- full exemption from the levy;
- partial exemption from the levy;

- extension of the levy grants program;
- product stewardship; and
- ACCC authorisation.

41. These options were assessed against a range of cost sharing principles set out within a welfare economics framework. Assessment of the options against those principles was neither exhaustive nor definitive however.

42. With the possible exception of ACCC authorisation, all of the options have some potential drawbacks. Nevertheless, a number of the options are worthy of further consideration.

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1. Introduction

1.1. Study purpose

Marsden Jacob Associates (MJA), in conjunction with Warnken ISE has been engaged by EPA Victoria to undertake an analysis of the impact of the landfill levy on the steel recycling sector.

The objective of the study overall is to '*identify means by which steel recycling in Victoria can be enhanced in the context of a sustainable steel recycling business sector*'. Consistent with this objective are two key aims for the study.

1. Broadly assess the impact of landfill levies on the steel recycling sector in Victoria under a number of scenarios, including a range of landfill costs, in particular assessing:
   - the impact (of landfill costs) on steel recycling businesses;
   - the impact on the level of metal recovery; and
   - the environmental impact of changes in the level of recovery.
2. Identify potential opportunities for the increased collection and recovery of (ferrous metal) products for recycling and barriers that currently inhibit increased recycling, addressing issues such as:
   - the impact of transport costs, steel price fluctuations and waste disposal costs for regional and remote areas within Victoria; and
   - changes that could be made to encourage and enhance the recycling of commingled scrap metal streams, often with high waste contents.

In undertaking the study, comparisons are to be made between Victoria and other Australian states and with overseas experience.

1.2. Background and context

1.2.1. Steel recycling

Steel is one of the world's most recycled and recyclable products, having a theoretical potential to be 100 percent recycled. Ferrous scrap has essentially always been an input into the production of new steel. In recent years however, high international prices for steel, aided to some extent by government policies designed to encourage recycling generally, has lead to sustained high demand for and use of ferrous scrap in steel production internationally.

A similar trend is evident in Australia. Available estimates suggest that the proportion of ferrous metal scrap being reprocessed nationally has increased from around 65 percent in the early 1990s to 80-85 percent by the mid 2000s (BHP Steel, 1993; Hyder Consulting, 2006)[1]. Similarly in Victoria, the amount of ferrous metals recovered for reprocessing has increased from around 0.5 million tonnes in 1993 to over 1 million tonnes in 2005-06, which is likely

[1] It is difficult to be certain on this point though, as precise data on Australia-wide trends are not available.

to represent between 80 and 90 percent of total ferrous scrap generated. Particularly strong growth in ferrous scrap reprocessing has occurred in the 2000s in Victoria. (Sustainability Victoria, 2006)

1.2.2. Landfill levies

Like steel, many other materials have experienced increases in recycling since the early 1990s. In Victoria, the recovery rate for waste generated overall has increased from 26 percent in 1993 to 55 percent in 2004-05. Construction and demolition waste, paper and cardboard and plastics have all experienced substantial growth in rates of recycling. (Sustainability Victoria, 2006)

Government policies have been major drivers of growth in recycling rates of many of these materials. In Victoria, as elsewhere in Australia and internationally, governments have introduced a range of policies purposely designed to reduce waste going landfill and to increase resource recovery. One of the principal waste recovery policy instruments applied in Victoria, as in most other Australian jurisdictions, is a levy on waste going to landfill. All Australian mainland states, except Queensland, currently apply a landfill levy. The levy rate varies significantly from jurisdiction to jurisdiction however, and depending on the location of the landfill and/or the type of waste being disposed (see Table 1).

Table 1: Landfill levies in Australian States, 2006-07

	Levy ($/tonne)			
Waste Type	Victoria	NSW	WA*	SA
Rural municipal	6.00	23.10	0.00	5.40
Metropolitan municipal	8.00	30.40	3.00/6.00	10.80
Rural industrial	11.00	23.10	0.00	5.40
Metropolitan industrial	13.00	30.40	3.00/6.00	10.80
Prescribed industrial	26.00	..	..	..

*The WA levy is charged according to whether the waste is inert ($3/tonne) or putrescible ($6/m^3)
Sources: EPA Victoria, 2007; NSW EPA, 2007; Zero Waste SA, 2007, Zero Waste WA, 2007

1.2.3. The Victorian levy

Landfill levies were first introduced in Victoria in 1992 under the *Environment Protection Act 1970*. They currently apply to municipal, commercial and industrial and prescribed industrial wastes deposited onto land at licensed facilities throughout Victoria. The primary purpose of the levies, according to EPA Victoria, is for "environment protection and fostering environmentally sustainable use of resources and best practice in waste management" (EPA Victoria, 2007). They have an additional purpose of funding the activities of regional waste management groups (RWMGs), Sustainability Victoria and EPA Victoria to establish waste management infrastructure, industry waste reduction programs, education programs, regulatory controls and enforcement regimes.

The landfill levy structure for Victoria is set out in Table 2 below. The levy structure aims to reflect differences in the magnitude of environmental risk posed by the different waste streams and also seeks to accommodate regional differences.

Table 2: The Victorian Landfill Levy

Year	Levy ($/tonne)				
	Rural Municipal	Urban Municipal	Rural Industrial	Urban Industrial	Prescribed Industrial
2002-03	2	4	3	5	10
2003-04	3	5	5	7	14
2004-05	4	6	7	9	18
2005-06	5	7	9	11	22
2006-07	6	8	11	13	26
2007-08	7	9	13	15	30/50/130
2008-09	na	na	na	na	30/70/250

na = not available

Source: EPA Victoria 2002, 2007

As can be seen in Table 2.1, levy rates have increased steadily in recent years, although current rates - $6-8 for municipal waste and $11-13 for industrial waste – are, with the exception of prescribed waste, still significantly below rates currently applied in NSW. This will continue to be the case after a further rise in Victorian rates scheduled for July 2007. In January 2007, the Victorian Government announced a further increase in levy rates for prescribed waste, to apply from July 2007. The rates will vary, according to the category of prescribed waste, from $30 to $130 in 2007-08, increasing to $30 to $250 in 2008-09.

1.2.4. Implications of the levy for steel recycling in Victoria

As noted, Victoria has a history of successful steel recycling with over 1 million tonnes of ferrous metals reprocessed in 2005-06 by the three major metal recyclers: Norstar Steel Recyclers, Sims Metal, and Smorgon Steel. The process of metal recycling involves the size reduction of metal products with shredders and shears into small pieces. Different metals are separated out magnetically leaving a residue, usually referred to as 'shredder floc', which contains remnant rubber, glass, insulating foam, plastic, dirt and traces of ferrous and non-ferrous metals.

Shredder floc is disposed to landfill as non-prescribed urban industrial waste. This means that, in addition to gate fee charges, it currently attracts a landfill levy of $13/tonne. This is set to rise to $15/tonne in 2007-08. The cost of shredder floc disposal, and in particular the levy component, now constitutes *prima facie* a significant operational expense for metal recyclers. This is not only because of increases in the landfill levy, but also as a result of increasing ferrous metal recycling rates - as more ferrous metals are recycled, a higher proportion of 'low grade' ferrous products (notably car bodies and whitegoods) that contain relatively high proportions of shredder floc are being recycled.

Representations made to EPA Victoria by the industry have highlighted that the landfill levy, arguably an economic instrument aimed at reducing landfill and increasing recycling, has the potential to have a 'perverse effect'. That is, it could adversely impact the recovery and recycling of steel in Victoria since products with marginal levels of recyclable content may

not be processed but instead be sent straight to landfill. This study aims to assess whether this is indeed the case.

1.3. Study approach and report structure

The study discussed in this report is essentially a financial and material flows modelling exercise, supported with a qualitative assessment of the steel recycling industry including trends, barriers and environmental impacts.

Chapter 2 of this report provides an overview of the steel recycling industry in Victoria including trends and key drivers and a comparison with developments in other states and overseas.

Chapter 3 of the report sets out the analysis of the financial and reprocessing impacts of imposing the landfill levy on the steel recycling industry. The analysis is focussed on answering a number of pertinent questions including:

- What are the financial implications for the steel recycling industry in Victoria of the landfill levy, applied at different rates?
- How important are the levies relative to other major variables such as steel prices and transport and processing costs?
- How do the levies at different rates affect the viability of reprocessing ferrous scrap containing high quantities of residue?

Chapter 4 examines the potential environmental implications of reduced steel recycling rates that could result from misapplication of the levy

Chapter 5 draws some general conclusions about the implications of the levy and examines a range of additional relevant questions including:

- Does the current application of the levy create a barrier to steel recycling in Victoria?
- In any case, is current application of the levy fair and equitable?
- Are there other barriers to increased recycling of ferrous metals in Victoria.
- How can barriers be overcome?

1.4. Limitations and uncertainties of study

This study does not constitute a full cost benefit analysis of the landfill levy. An analysis of that nature, which would typically aim to assess the appropriate rate(s) at which to apply the levy based on its economy wide impacts – i.e. the point at which the marginal costs associated with levy equal the marginal benefits – is beyond the scope of the study. Instead, the study provides a financial assessment of the impact of the levy on just one industry, the steel recycling industry.

Much of the information and data used in the study is publicly available. However, a considerable amount of information was obtained through consultations with the steel recycling industry and other industry participants. To avoid concerns about the use of potential commercial-in-confidence information therefore, analysis of the impacts of the levy

on the viability of the steel recycling has been undertaken by assessing the impacts of the levy on a 'typical' steel recycling operation rather than on a specific business. For this reason, numerous assumptions have had to be made relating to capital and operating costs, revenue and material flows associated with a typical operation. This means that care needs to be taken with interpreting the results of the analysis. Certainly, the results cannot and should not be ascribed to any steel recycling business currently operating in Victoria or elsewhere in Australia.

2. Steel Recycling

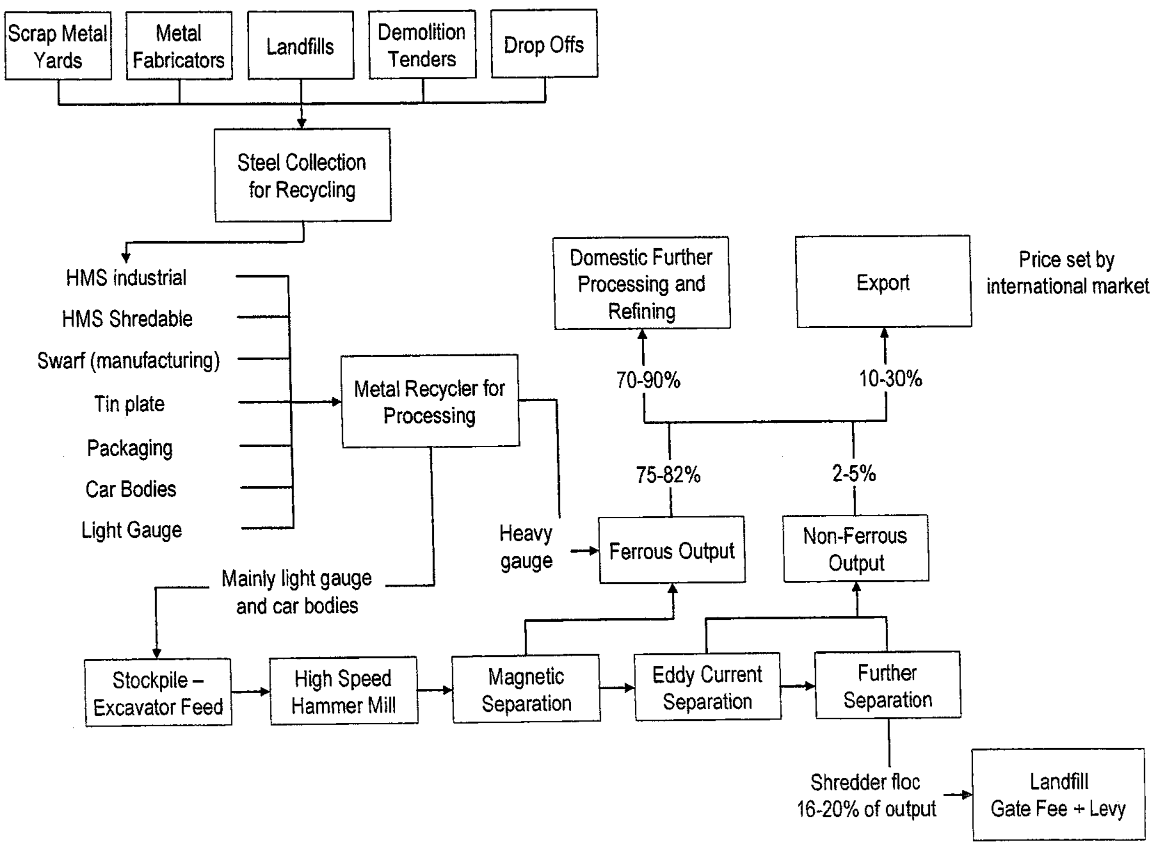
2.1. Overview

This section presents the framework for understanding current steel recycling. Firstly, the steps required in the steel recycling process are discussed, followed by a description of the environmental benefits of recycling. Thereafter current international and Australian trends in recycling are presented and some of the issues, barriers and drivers associated with recycling in Victoria are discussed.

2.1.1. The steel recycling process

A schematic of the steel recycling process is shown in Figure 1. (Proportions of flows were derived through discussions with the Victorian steel recycling industry.

Figure 1 – Steel Recycling Process



At the end of its service life, steel containing products enter the recycling stream through one of a number of channels including:

- scrap metal yards where end of life vehicles and other large metal items such as appliances and construction wastes are collected by the yard operator for processing and recovery. The yard operator will either go out and recover these items themselves, or will pay a certain amount for metal containing products delivered to their yard;

- manufacturers who use metals for manufacturing products the will collect off-cuts and either deliver these to scrap metal yards or directly to the metal recyclers;
- landfill sites, where recovery of metals from mixed waste streams is undertaken prior to final placement of the material;
- demolition sites, where steel and other metals are recovered for recycling during the demolition of buildings;
- recycling centres, where the general public is able to deliver end-of-life appliances and other metal containing items.

Streams containing steel will be recovered through these channels and be transported to one of the three metal recyclers in Victoria for processing and recovery of the steel and non-ferrous materials.

The steel recovery process depends on how the metal is combined within the stream. Heavy gauge materials generally do not require processing and separation and hence are recovered directly for reprocessing. The remainder of the scrap metal stream, which includes car bodies and appliances, contain the metals and other components attached to plastic, rubber, textiles and other materials. This part of the waste stream thus requires separation of the various components prior to recycling.

Typical steps in the separation process are shown in Figure 1. Materials are taken from a stockpile using an excavator and fed into size reduction equipment such as a high speed hammer mill. Size reduction is an essential step in the recovery process as it liberates those materials which are encased in or attached to other components of the stream which are either not going to be recycled or are recovered in a different part of the recycling process.

Magnetic separation is then used for removal of ferrous metals including iron and steel. The principle of operation is straight forward – the stream is brought into close proximity with a magnet and magnetic components attach to the magnet. Two main configurations are used for magnetic separation, the first being when the material is passed adjacent to a magnetised overhead belt, and the second when it comes into contact with a magnetised drum which is typically installed at the end of conveyor outfeed. Both permanent and electromagnets can be used, with permanent magnets are cheaper and easier to maintain while electromagnets offer operational flexibility in that their field strengths can be adjusted.

Eddy current separation is then used to remove non-ferrous metals such as aluminium, copper and brass from waste streams. An eddy current is caused by a moving magnetic field in a conductor or vice-versa. The relative motion causes a circulating flow of electrons, or current, within the conductor. The circulating eddies of current create electromagnets with magnetic fields. The eddy currents also induce a secondary magnetic field around non-ferrous particles. This field reacts with the magnetic field of the electromagnets, resulting in a combined driving and repelling force which ejects the conducting particle from the stream of mixed materials. The stronger the magnetic field, or greater the electrical conductivity of the conductor, the greater the currents developed and the greater the opposing force. Eddy current separation is usually conducted after magnetic separation because ferrous metals interfere with effective separation of the non-ferrous metals.

Where necessary further separation of non-ferrous metals is conducted, and finally any material not recovered in the ferrous and non-ferrous metals stream is sent to landfill. This residue, known as 'shredder floc', contains remnant rubber, glass, insulating foam and plastic.

With respect to the recovered ferrous and non-ferrous metal, a proportion of this stream is re-smelted and processed domestically, with the remainder being exported for processing.

2.1.2. Environmental benefits and impacts of steel recycling

A number of benefits are associated with the recovery of steel from scrap, rather than manufacturing products from virgin materials. The first of these is associated with the mining of ores. Impacts associated with mining include depletion of natural resources, land disturbance during open cast mining, and water and energy consumption. Secondly, during refining of the ore for recovery of the steel requires a significant energy investment, which is typically met using coal. Re-smelting of recovered material uses significantly less coal than production of steel from virgin ores, thus reducing both the utilisation of fossil fuel and its attendant greenhouse impacts (in other words the embodied energy of recycled steel is lower than that of steel manufactured from virgin resources). The final benefit of recycling of steel is the savings of landfill air space, which is becoming a significant issue in many parts of the world.

The impacts associated with recycling are significantly lower, and include the energy investment required for collection of ores, energy associated with processing and steel separation, and that required for smelting the steel to return to the manufacture of products.

In order to quantify the relative impacts of recycling versus virgin steel manufacture, calculations of impacts need to be done on a life cycle basis to incorporate all off the considerations described above. Although some recent data which serves to meet this requirement is available in proprietary software such as the ecoinvent (2007) database, this information cannot be accessed for commercial use. Other data does not separate out primary steel from secondary steel, and reports data for the overall steel product, making this comparison difficult.[2]

The only other detailed data that explicitly compared the impacts of steel production with steel recycling found for this study was for steel production in the United States in 1995.[3] This data is reproduced in Table 3. Although this data is somewhat dated, and significant efficiency improvements have been made in recent years in the steel industry, it is suggested that the trends are still relevant, and show significant reductions in a number of categories including water usage, coal, total primary energy, greenhouse gas, SO_x NO_x and hydrocarbon emissions, and solid waste generation in recovery of secondary steel rather than primary steel.

2 As, for example, is contained in the annual reports of steel manufacturers such as Corus Steel (2004).

3 Data reported in: Ugaya. and Walter (2004).

Table 3 : Comparison of the Impacts Associated with Primary, Secondary and Mixed Steel Product (US Data, 1995, Based on Production of 1 kg of Steel)

Input / Output	Unit	Primary steel	Secondary steel	% Savings
Water	litres	82.3	1.2	99%
Coking coal	kg	0.6	0	100%
Iron ore	kg	1.2	0	100%
Electric power	kWh	0.4	0.4	0%
Limestone	g	121	0	100%
Total primary Energy	MJ	21.1	2.4	89%
Total	MJ	21.1	21.1	0%
Particulate Matter (PM)	g	18.7	0.2	99%
CO_2+CO	g	1884.5	169.6	91%
Carbon Monoxide (CO)	g	1	1.3	-30%
Sulphur Oxides (SOx)	g	4.2	1	76%
Ammonia (NH_3(l))	g	0.1	0	100%
Nitrogen Oxides (NOx)	g	1.4	0.5	64%
Hydrocarbons (HC)	g	15.6	1.2	92%
Solid residues	g	432.3	54.7	87%

2.1.3. Steel recycling internationally

Steel recycling has been practiced extensively around the world as steel is relatively easy to recover. As such many of the recycling markets are well established and there is a large international market for scrap steel. However the extent of recovery is a function of the type of material, the country in which the activity is taking place, and legislative drivers.

The International Iron and Steel Institute (IISI 2002) estimates that globally about 40% of all steel produced is recovered from scrap.

In the United States, the Steel Recycling Institute (2007) reports that in 2005 the overall steel recycling rate was 76 per cent, with over 90 per cent recycling rates for steel from cars, 63 per cent of steel cans, 90 per cent of the steel contained in appliances, 97.5 per cent of beams and plates and 65 per cent of reinforcement bars from construction being recycled. In contrast to the US, only 23 per cent of steel cans produced in the UK were recycled in 2005, while in 2004 the recycling recovery rate of steel packaging in the EU was 62.5 per cent (APEAL 2007).

A UK study analysed ferrous metal consumption data for the UK, along with household recycling trends, between 1988 and 1998. In 1998 the estimated amount of steel recycled into steel manufacture was 5.9 million tonnes (DEFRA 2003). More recent figures suggest, however, that a slightly lower amount of 4.4 million tonnes of steel used in the manufacture of new products was recovered from scrap in 2005. This represented one third of the total crude steel produced in the UK for that year.[4]

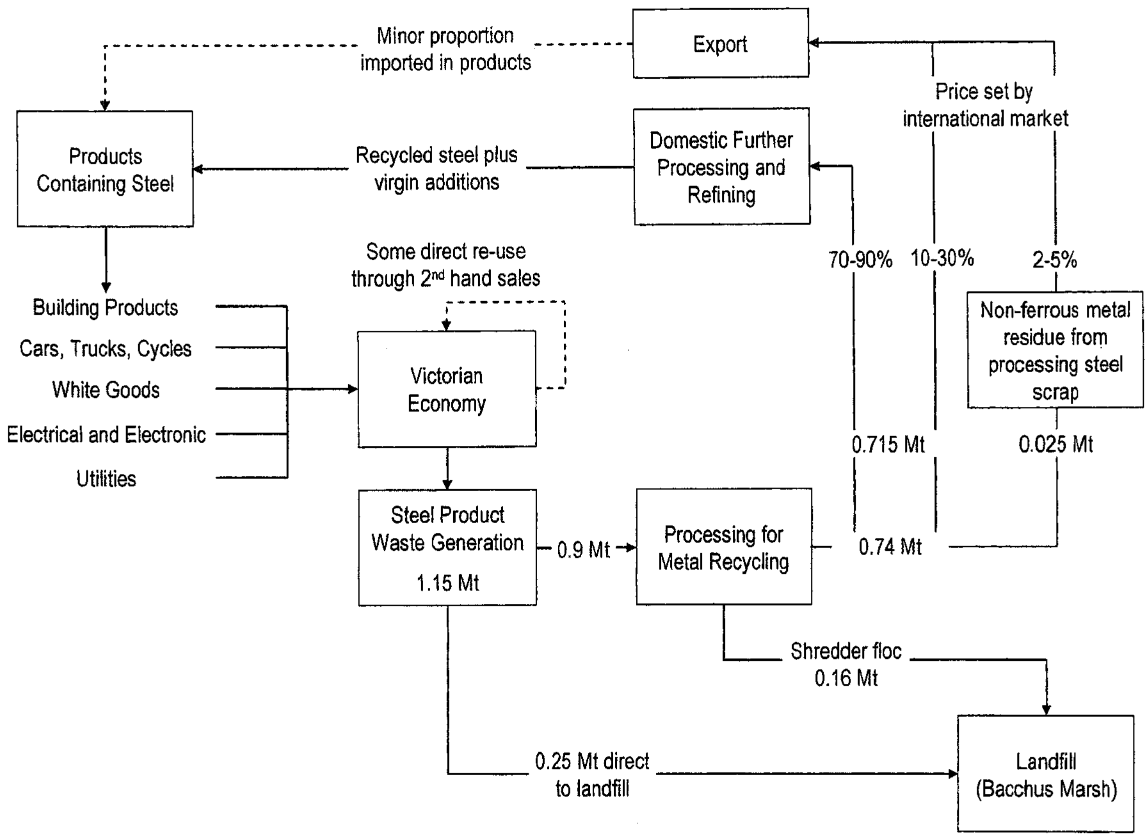
[4] UK Steel (2006), *UK Steel Key Statistics 2006*, accessed online at http://www.uksteel.org.uk/Download/uk%20steel%20stats%20guide%202006.pdf, May 2007.

2.2. Steel recycling in Victoria

2.2.1. The current situation

The flow of steel in the Victorian economy is shown schematically in Figure 2.

Figure 2 – Flow of Steel in the Victorian Economy



It is estimated that approximately 1.15 million tonnes of steel products were generated as waste in Victoria during 2005/06. This estimation is based on unpublished Sustainability Victoria data on the amount of steel products that were recovered for recycling (892,706 tonnes rounded up to 900,000 tonnes for the flow analysis). Unpublished EPA Victoria data was used to estimate the amount of shredder floc disposed of to landfill (160,000 tonnes). This recovery rate of 78 per cent compares to the 2004/05 steel recovery rate of 82 per cent, when 1,032,000 tonnes of steel products were recovered (including car bodies and packaging - Sustainability Victoria 2005).

With a population of 5.02 million at the end of 2005 (ABS 2005), this represents an average per capita recycling rate of 206 kilograms of steel recovery for 2004/05 and 179 kg of steel recovery for 2005/06.

Based on discussions with the Victorian steel recycling industry it is estimated that between 70 and 90 per cent of the recovered steel is used domestically, with the remainder being exported.

2.2.2. Comparison with other jurisdictions

In the 2003/2004 financial year, 992,159 tonnes of ferrous/steel scrap were recycled in New South Wales, with a further 5,554 tonnes of steel cans being recovered (DEC 2006). In the 2004/2005 year the total reported steel recovery from all sources (Municipal, Commercial &Industrial, and Construction & Demolition) had increased to 1,297,712 tonnes.[5] At an estimated population in June 2005 of 6.77 million people (ABS 2006), this represents average recycling of 192 kg per person of steel recovery, which is in the middle of the Victorian performance between 2004 and 2006. Approximately 155,000 tonnes of shredder floc is disposed of to landfills every year in NSW.

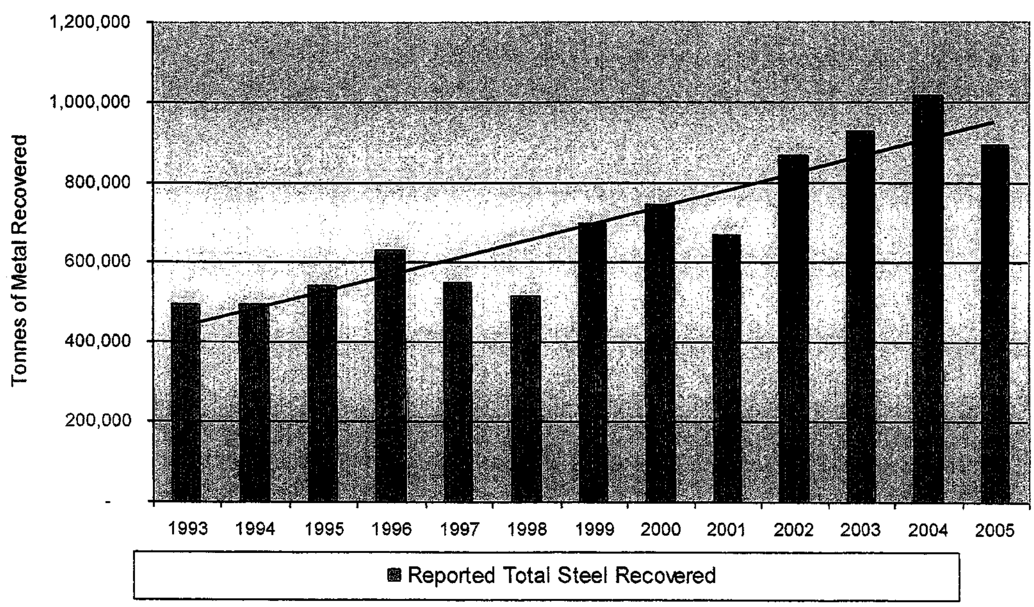
In Queensland, where there is no landfill levy, limited information on the total amount of steel recycled was found. The total mass of steel cans recycled was 5,354 tonnes in the 2004/2005 financial year, similar to NSW (Qld EPA 2006).

The limited data availability make it difficult to conclude any similarities and differences in metal recycling between Victoria with NSW and Queensland, especially on any differences arising from differences in levy amounts.

2.2.3. Trends, drivers and barriers

Figure 3 shows the trends in steel recovery in Victoria since 1993. The total recovery of steel shows overall growth. It is noted that recovery of steel dropped in 2005/2006, however it is suggested, based on historical data, that this drop in recovery, represents a temporary reduction as opposed to a negative trend.

Figure 3 – Recycling of Packaging and other Steel in Victoria (derived from data in Sustainability Victoria 2006)



[5] Informal estimates used internally by NSW Government sources, likely to contain a major underestimation.

The trend towards steel recycling observed in Victoria is reflected around Australia and in many other parts of the world (see for example Steel Recycling Institute 2007). These trends are being driven by national and international recycling and landfill diversion targets, extended producer responsibility type schemes (particularly in the case of packaging), improved recycling infrastructure, rising steel prices and international demand for steel, particularly from China.

Barriers to increased recycling include transportation costs, particularly in more remote areas, limited incentives to prompt recycling rather than disposal, lack of collection systems and, potentially, increases in the landfill levy. The following section examines the financial impacts of the levy on metal recycling in Victora.

3. Financial Analysis of Levy Impacts

As outlined in Section 1.3, the main focus of the study is a material and financial flows' modelling exercise. The modelling exercise, discussed in this chapter, aims to address a number of key questions. These are:

- What are the financial implications for the steel recycling industry in Victoria of the landfill levy, applied at different rates?
- How important are the levies relative to other major variables such as steel and non-ferrous prices and transport and processing costs?
- How do the levies at different rates affect the viability of reprocessing ferrous scrap containing high quantities of residue?

3.1. Method

3.1.1. Overview

The assessment is centred on the operations of a 'typical', but hypothetical, steel recycling business in Victoria. The typical business has the following characteristics:

- It is an established steel recycling business.
- Its core business is ferrous metals reprocessing, based on the 'shredder' process.
- Revenue is also generated through the collection and cutting of heavy gauge steel.
- Some non-ferrous metals are also recycled, essentially as by-products of its ferrous operations.
- The business has approximately 1/3 of Victoria's ferrous shredding market.
- A range of ferrous scrap metal products are processed, some of which have a high floc content, some of which have low or zero floc content. Floc typically comprises about 18% of all ferrous scrap processed. This must all be disposed to landfill.

Two linked spreadsheet models have been developed to test the impact of the landfill levy on the financial viability of this typical business – a steel reprocessing (material flows) model and a financial model. The analysis includes an assessment of the overall financial viability of the business, as well as margins on individual scrap metal products (overall and sourced from different regions).

3.1.2. Key variables

Sensitivity analysis is undertaken to test the impact of changes to a range of key variables on financial viability.

- **The landfill levy**. A levy rate of $15 / tonne of floc[6] has been set as the 'standard' rate, however landfill levy rates ranging from $0 to 30 have also been modelled, as well as $50 / tonne and $130 / tonne to reflect potential future levy rates[7].
- **Volume of scrap processed**. 300,000 tonnes / annum has been set as the standard quantity of scrap processed by the typical recycling business, however volumes ranging from 225,000 to 382,000 tonnes have also been modelled reflecting a range of operating levels relative to capacity. Further discussion of metals flows is provided in 3.2.2 below.
- **Steel price**. $308 / tonne has been set as the standard price received for reprocessed steel scrap, based on the 12 month international average for steel scrap, however prices ranging from $269 – $368 / tonne have been modelled, reflecting price movements over the past 2 years.
- **Non-ferrous metals.** The business is assumed to reprocess quantities of non-ferrous scrap as part of its operations, including aluminium, copper, lead and zinc. A standard non-ferrous metals proportion of 2% of total scrap processed is assumed, although proportions ranging from 1% to 3% have been assessed.
- **Non-ferrous prices.** The standard price received for non-ferrous metals has been set at $1650 / tonne, based on a 12 month average price for non-ferrous metals, weighted in proportion to the major non-ferrous metals assumed to have been reprocessed by the reprocesser. Weighted average non-ferrous metal prices ranging from $1000 to $2250 have also been modelled, reflecting international non-ferrous metal price movements over the past two years.

3.1.3. Metal flows

In terms of exploring where steel is recovered, and to explore the impact of transport costs on the typical reprocesser, the state was divided into four zones: 'Inner Urban', 'Outer Urban', 'Inner Regional' and 'Outer Regional' as shown in Figure 4 (following page), based on local government boundaries and distance from the Melbourne CBD.

An estimate of the current recovery of steel within the various zones shown in Figure 4 was then made based on steel product categories of Heavy Metal Sheet (HMS) (industrial); HMS (shredable); swarf (manufacturing offcuts); tin plate; packaging; car bodies and light gauge (whitegoods and light construction). The breakdown according to product type was compiled using information from metal recyclers and on estimated floc composition of product categories, in addition to reconciling with Sustainability Victoria unpublished information. Furthermore, it was assumed that recovery rates decreased in line with distance from Melbourne. The breakdown of steel recovery by product category and location is presented in Table 4.

[6] From July 2007 a landfill levy rate of $15 will apply to urban industrial waste.

[7] From July 2007 levy rates of $30 / tonne, $50 / tonne and $130 / tonne will apply to urban industrial, Category C prescribed waste, and Category B prescribed waste respectively.

Figure 4 – Zones of Recovery for Transport Analysis (derived from MAV undated)

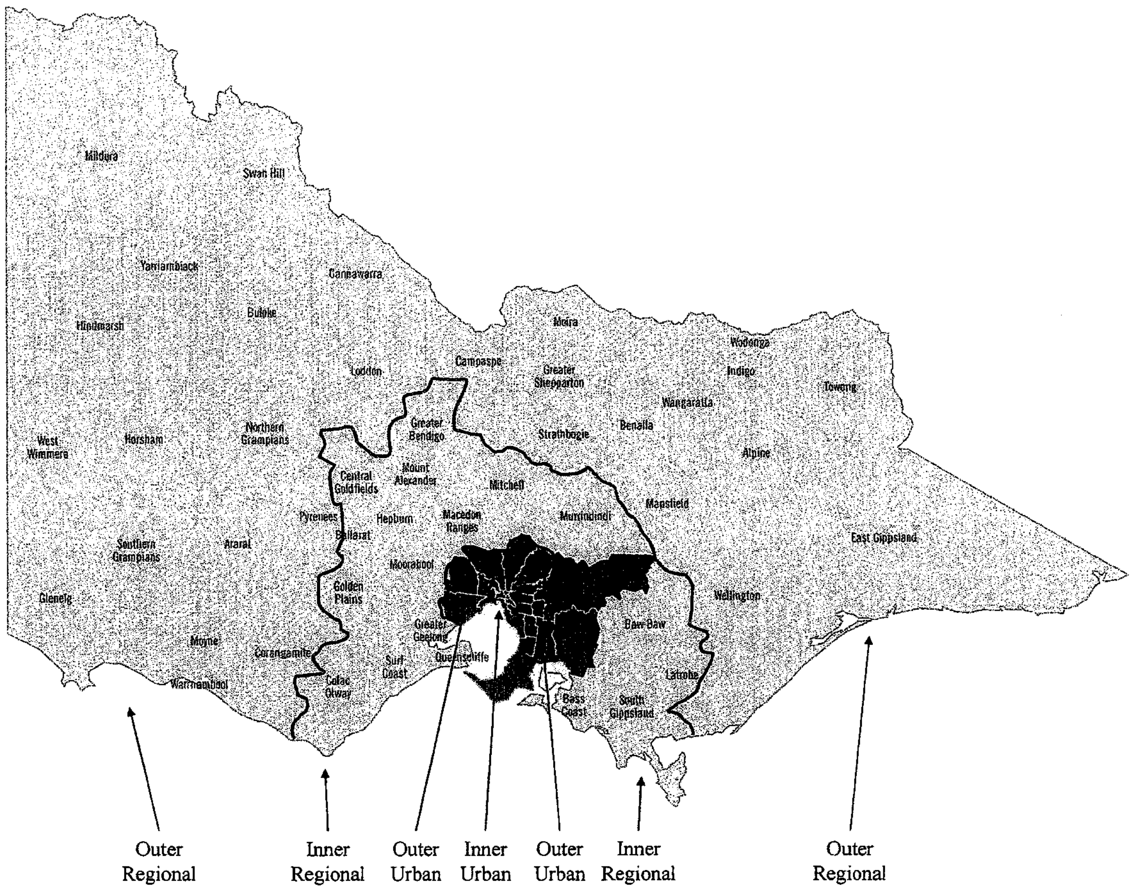


Table 4 – Estimated Totals of Steel Recovery and Location

Type of processed scrap	Inner Urban	Outer Urban	Inner Regional	Outer Regional	Totals	% Recovery
- HMS (industrial)	112,275	66,127	59,603	31,995	270,000	98%
- HMS (shredable)	29,940	17,634	15,894	8,532	72,000	98%
- swarf (manufacturing offcuts)	9,356	5,511	4,967	2,666	22,500	98%
- tin plate	9,903	5,511	4,704	2,382	22,500	80%
- packaging	18,964	11,021	9,813	5,202	45,000	90%
- car bodies	56,819	33,064	29,475	15,643	135,000	95%
- light gauge (whitegoods, lgt construction)	162,698	81,557	61,890	26,855	333,000	60%
Total	399,955	220,425	186,347	93,273	900,000	78%

3.1.4. Other variables

In order to undertake the financial assessment, values have had to be assigned to numerous other variables. A full listing of these variables and the values that have been assigned to them is contained in Appendix 1 'General Inputs'. In summary, the variables fall into three broad categories:

- **Financial**
  - weighted average cost of capital (WACC)
  - interest rates
  - price movements etc;
- **Operating conditions and costs**
  - transport distances and costs (including scrap, reprocessed metal and floc)
  - labour (onsite and offsite)
  - bailing costs
  - maintenance
  - fuel (principally electricity and diesel)
  - floc disposal (additional to the landfill levy);
- **Capital equipment and costs**
  - costs of major equipment (shredder, excavators, bailers)
  - operating life, depreciation and replacement values
  - land and buildings.

Standard values were assigned to all of these variables, although the model has been designed to allow the impacts of changes to any of them to be assessed.

3.1.5. Cases

Financial analysis of the impact of the landfill levy has been undertaken by modelling the variables outlined above using three standard cases. These cases, referred to as 'low', 'mid', and 'high', differ in the way in which key costs associated with reprocessing scrap are treated:

- In the low case, the market for reprocessing steel scrap is assumed to be ultra competitive and the reprocesser is under pressure to maximise its throughput of scrap. Reflecting this:
  - the price paid by the reprocesser for scrap is high, fully reflecting recent international steel price increases;
  - costs borne by the reprocesser in sourcing, bailing and transporting scrap are not fully passed back to the seller (i.e. are not fully reflected in the price paid for scrap).
- In the high case, the market for reprocessing steel scrap is still mature but not as competitive, thus:

- the price paid by the reprocesser for scrap lags, to some extent, behind the international price for steel;
- the reprocesser is in a position to pass back to the scrap seller virtually all of its costs associated with sourcing, bailing and transporting scrap.

- The moderate case falls between the high and low cases in the treatment of costs.

In all cases, it is assumed that the cost of the landfill levy (at whatever rate) cannot be passed on to the reprocessed scrap purchaser or back through the reprocessing chain, reflecting a very mature steel reprocessing market.

3.2. Results - overall financial viability[8]

Table 5 (below) provides a summary of the financial performance of the typical steel reprocessing business under the low, moderate and high cases, at three different landfill levy rates, $0, $15 and $30. The financial analysis of the business has been undertaken over three periods: short term (5 years); medium term (15 years); and long term (25 years), with the data presented in the table being for the medium term. 'Standard' values (as described in section 3.1.2) have been applied to all other key variables.

Table 5 - Financial Performance of the Typical Reprocessing Business at Different Levy Rates, Assuming 'Standard' Values for Other Variables

Financial variable	Levy Rate		
	$0	$15	$30
Internal rate of return (IRR) (%)			
Low	39.7%	37.8%	35.9%
Mid	48.2%	46.5%	44.8%
High	53.4%	51.6%	49.8%
Modified IRR (MIRR) (%)			
Low	21.2%	20.8%	20.5%
Mid	21.7%	21.2%	20.6%
High	25.5%	25.1%	24.6%
Net present value ($)			
Low	42,892,562	39,834,708	36,776,855
Mid	65,898,619	62,840,765	59,782,911
High	81,893,654	77,829,027	73,764,399
Net margin ($ / tonne)			
Low	22.8	21.3	19.8
Mid	28.4	26.9	25.4
High	34.0	32.5	31.0

[8] Full details of the financial analysis are set out in Appendix 1 'Financial Analysis'

From the information presented in the table, it is apparent that the reprocessing business is a viable concern overall, generating high rates of return[9], strongly positive NPVs and positive net margins[10] under the low, mid and high cases.

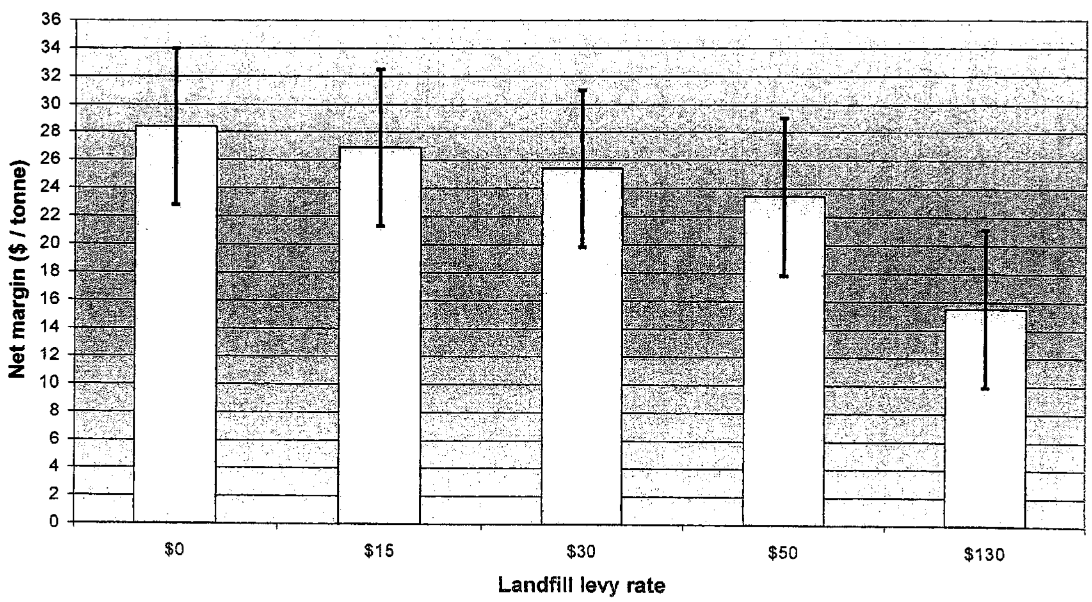
However, it should be recognised that the apparent strong financial position of the business comes in the context of strong international markets for ferrous and non-ferrous metals, with the business receiving historically high prices for both steel scrap and non-ferrous scrap in recent times. These factors will be discussed further later in this chapter.

3.3. Impact of levy on financial performance

The impact of the landfill levy on the company's financial performance overall appears, *prima facie*, to be relatively minor at the current (July 2007) rate of $15 / tonne of floc. Each additional $15 of levy represents an annual cost impost to the company of about $783,000 (assuming a standard volume of processed scrap and a standard floc content of the scrap). This translates to a reduction in IRR of approximately 1.7% (for the mid case over 15 years – see Table 5) and a reduction in the average net margin of approximately $1.50 / tonne of scrap processed (see Figure 5).

Figure 5 – Impact of the Landfill Levy on Net Margins at Different Levy Rates

(mid case, with error bars indicating margins for low and high cases)



[9] Note the IRR is a calculated on an assumption that 'gains' are invested at the same return as the initial investment. Calculation of the MIRR, on the other hand, is based on an assumption that the WACC (weighted average cost of capital) must be paid, with only the balance earning a return to the company. In effect therefore, it is a measure of the difference between the IRR and the 'hurdle' rate.

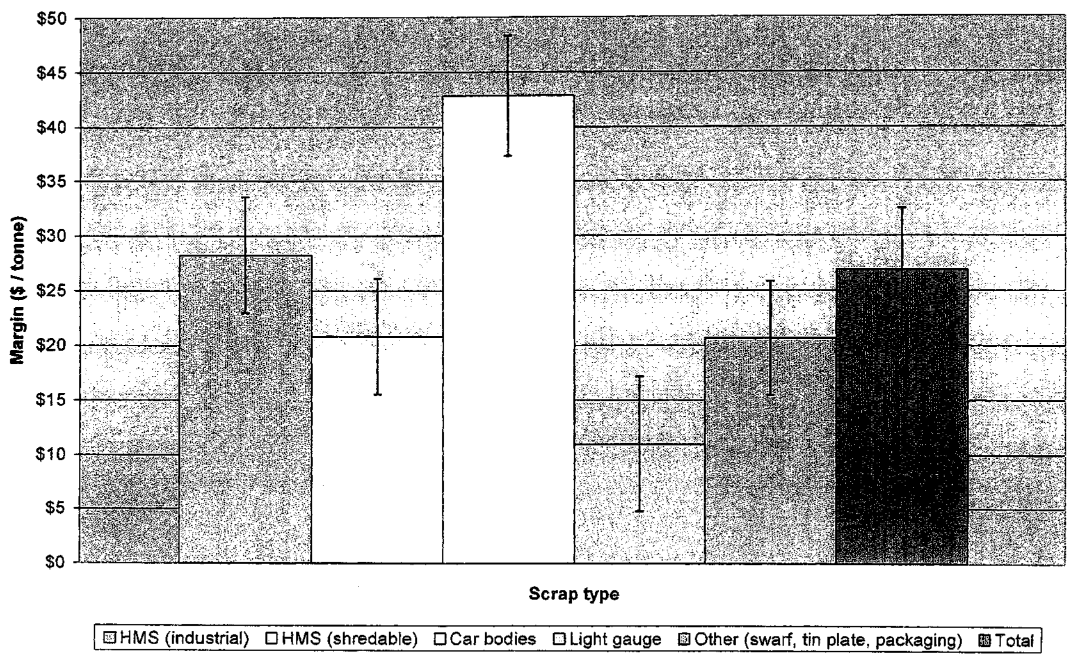
[10] All margins presented are pre-tax net margins, including both operating and fixed costs.

At higher levy rates though, the impact of the levy becomes more significant. At $50 / tonne of floc[11] for example, the average margin earned on processed scrap reduces to $23.40 / tonne ± $5.60, down from $28.40 / tonne ± $5.60 with zero levy. And at $130 / tonne the average margin earned on processed scrap falls to just $15.50 / tonne. Furthermore, the impact of the levy on overall financial performance, including average net margins, hides potentially more significant impacts on individual scrap types or scrap sourced from particular regions. Thus to fully gauge the affect of the landfill levy at different rates on the viability of reprocessing steel scrap it is necessary to disaggregate financial results, examining the impact of the levy on margins for different scrap types and in different regions.

Figures 6 and 7 (below) provide an overview of estimates of net margins earned by the typical reprocessing business on different types of scrap. Figure 6 provides estimates of net margins for scrap types collected from all regions in Victoria assuming a $15 landfill levy, with error bars indicating margin ranges under the low, mid and high cases. Figure 7 shows estimates of margins by both scrap type and region (for the mid case with a $15 levy), showing the affect of transport and regional collection costs on margins.

Figure 6 – Net Margins by Scrap Type

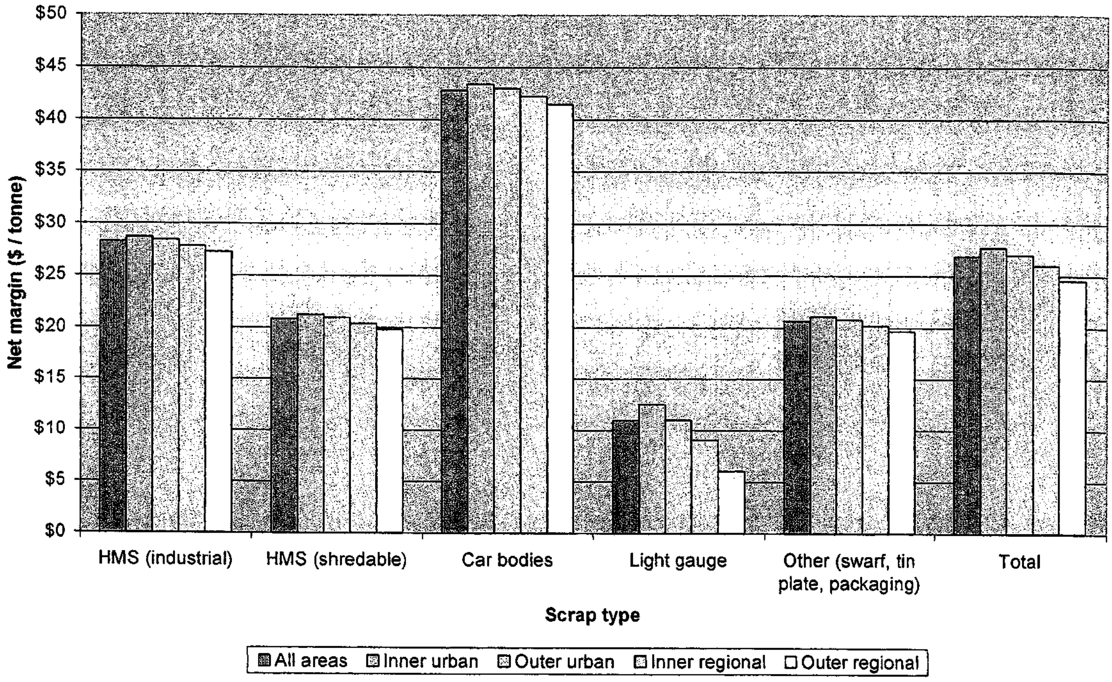
(mid case with $15 levy, with error bars indicating margins for low and high cases)



[11] The rate to be applied to Category C prescribed waste from July 2007.

Figure 7 – Net Margins by Scrap Type and Region

(mid case with $15 levy)

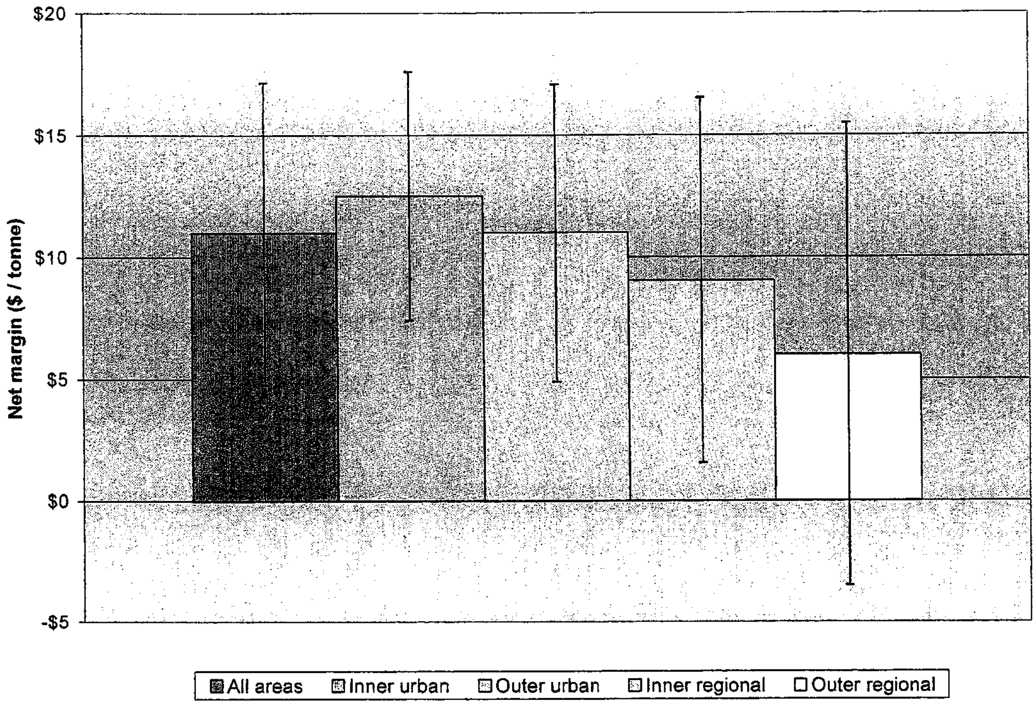


Two key points are highlighted in Figures 6 and 7:

- First, is the apparent high margin earned on cars across all regions, despite car bodies having significant floc content and, as a consequence, relatively high processing costs. The high margin earned on cars is principally a function of the non-ferrous scrap component of the cars which in the standard case is assumed to be about 5% of the car bodies by weight. As discussed further in section 3.6 though, if the volume of non-ferrous metals retrieved from cars is significantly less than the standard, then the margin earned on them falls away substantially.
- The second significant point relates to the margins earned on light gauge scrap, estimated at $4.80, $11.00 and $17.10 under the low, mid and high cases respectively. These (relatively low) margins reflect the high collection and transport costs associated with light gauge and its high floc content. Margins on light gauge collected from (inner and outer) regional areas are especially low and in some circumstances, may even be negative (see Figure 8).

Figure 8 – Net Margin on Light Gauge by Region

(mid case with $15 levy, with error bars indicating margins for low and high cases)



3.4. Sensitivity analysis of scrap tonnage processed

It is important to consider the sensitivity of the reprocessing business' viability to changes in key variables.

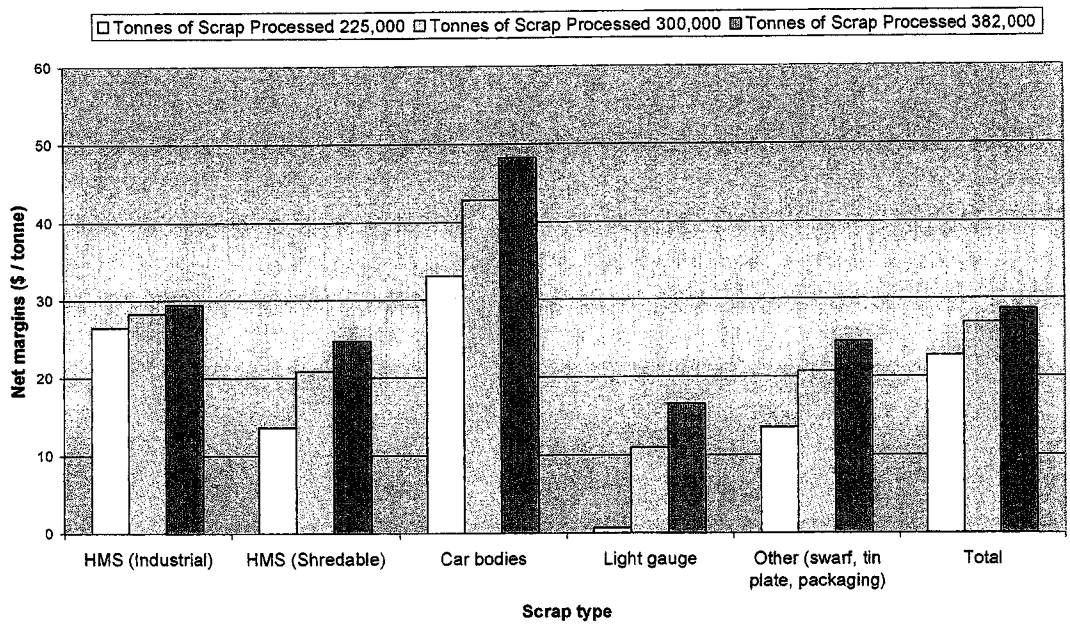
The first of the variables examined is the tonnage of scrap processed by the business. Under the standard case, the tonnage of scrap processed is assumed to be 300,000 tonnes. Sensitivity analysis has been undertaken to examine the impact on business viability of processing lower and higher tonnages of scrap. The high volume was set at 382,000 tonnes, based on maintaining one-third market share and utilisation of virtually all remaining available scrap in the Victorian market. The low tonnage was set at 225,000 tonnes, with the shredder operating at only 55-60% capacity.

Results of the sensitivity analysis are summarised in Table 6 and Figure 9.

Table 6 – Financial Performance of the Business at Different Tonnages of Scrap Processing

Financial variable	Tonnes of Scrap Processed		
	225,000 (low)	300,000 (standard)	382,000 (high)
Internal rate of return (IRR) (%)	36.0%	46.5%	56.0%
Modified IRR (MIRR) (%)	18.6%	20.8%	22.5%
Net present value ($)	53,231,753	77,829,027	100,495,966
Net margin ($ / tonne)	22.7	26.9	28.6

Figure 9 – Net Margins on Scrap Types at Different Tonnages of Scrap Processing



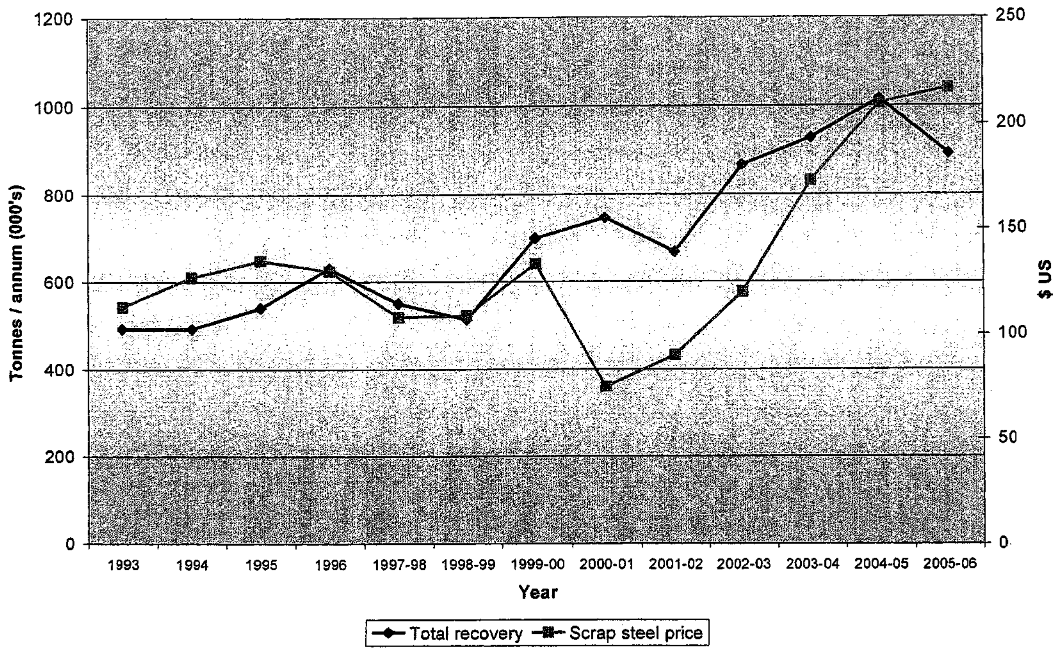
The data in Table 6 indicates that decreasing the total tonnage of scrap processed annually decreases the financial performance of the business over the medium term (similar outcomes are also achieved for the short and long terms). This is not surprising given the significant fixed costs associated with parts of the business' operations. Thus net margins on scrap types with high fixed costs (notably cars and light gauge) are particularly adversely affected by a drop in the volume of scrap processed. This situation highlights two potentially countervailing pressures on the business – the need on the one hand to maximise market share, throughput and total revenue, and on the other hand, the downwards pressure that this objective could place on gross operating margins.

3.5. Sensitivity analysis of steel prices

A second key variable potentially affecting business viability is the price of steel. As noted in 3.2, prices for steel scrap are at historically high levels, driven by strong international growth in demand for steel, notably in China. Figure 10 shows the trend in international price for steel scrap since 1993, showing particularly strong growth in the price since 2000-2001. Scrap steel recovery rates in Victoria would appear to be quite closely correlated to

the movement in steel prices, although there are other important factors which need to be considered when examining recovery rates including non-ferrous metal prices (see section 3.6) and possibly government policies.

Figure 10 – International Scrap Steel Price v Recovery Level of Scrap Steel in Victoria

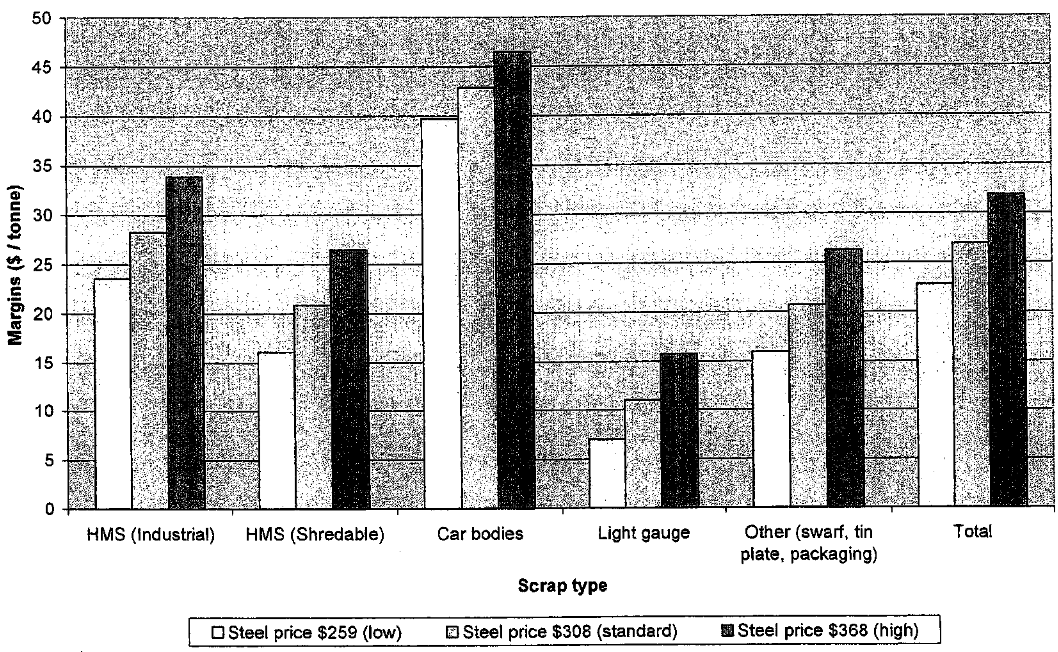


Sensitivity analysis has been undertaken to test the impact of changes to steel prices on business performance. Steel prices ranging from A$ 259 / tonne to $368 / tonne have been tested, reflecting price movements over the 12 months to March 2007. Table 7 and Figure 11 summarise output from this analysis. Table 7 shows that increasing international steel prices improve the financial performance of the business overall. This is unsurprising. However, because most of the increased price received by the reprocessing business is assumed to have been passed on to the scrap seller, an increase in steel price of approximately $50 / tonne only increases the margin earned on most scrap types by about $5 / tonne in the mid case (see Figure 11). This is because the market for steel scrap is assumed to be mature and highly competitive.

Table 7 - Financial Performance of the Business at Different Steel Prices

Financial variable	Steel price		
	$259 (low)	$308 (standard)	$368 (high)
Internal rate of return (IRR) (%)	41.7%	46.5%	52.2%
Modified IRR (MIRR) (%)	19.9%	20.8%	21.9%
Net present value ($)	66,484,044	77,829,027	91,405,816
Net margin ($ / tonne)	22.7	26.9	31.9

Figure 11 - Net Margins on Scrap Types at Different Steel Prices



3.6. Sensitivity analysis of non-ferrous metal prices and quantities

The third key variable potentially affecting business viability is the processing of non-ferrous metals. As noted in 3.2, prices for non-ferrous scrap, as with steel, are also at historically high levels. Over a two year period to March 2007, the weighted average spot price of non-ferrous metals used in this study (aluminium, copper, lead and zinc) has increased from just over A$ 1000 / tonne to $2250 / tonne. However, because non-ferrous prices have increased so greatly, there is increasing competition for non-ferrous scrap. This has the potential to limit availability of non-ferrous metals to steel reprocessing businesses[12]. It is important therefore to test the sensitivity of business viability to changes in the price and/or quantity of non-ferrous metals processed by the business. Sensitivity of business financial performance to a range of non-ferrous prices and quantities has been tested. The results are summarised in Tables 8 and 9 and Figure 12.

[12] Indeed, some of the reprocessing companies interviewed by the study authors indicated that scrap metal merchants and other suppliers of scrap metal are often now removing as much of the non-ferrous metal components of scrap from scrap products such as cars before on-selling them.

Table 8 - Financial Performance of the Business at Different Non-Ferrous Metal Prices

Financial variable	Non-ferrous metal price (weighted average)		
	$1000 (low)	$1650 (standard)	$2250 (high)
Internal rate of return (IRR) (%)	37.9%	46.5%	52.2%
Modified IRR (MIRR) (%)	19.1%	20.8%	21.9%
Net present value ($)	57,684,982	77,829,027	91,405,816
Net margin ($ / tonne)	19.5	26.9	33.7

Table 9 - Financial Performance of the Business at Different Non-Ferrous Metal Quantities

Financial variable	Non-ferrous metal quantity (% of total scrap)		
	1% (low)	2% (standard)	3% (high)
Internal rate of return (IRR) (%)	37.6%	46.5%	55.2%
Modified IRR (MIRR) (%)	19.0%	20.8%	22.4%
Net present value ($)	57,034,175	77,829,027	98,623,878
Net margin ($ / tonne)	19.3	26.9	34.5

Figure 12 - Net Margins on Scrap Types at Different Non-Ferrous Metal Quantities

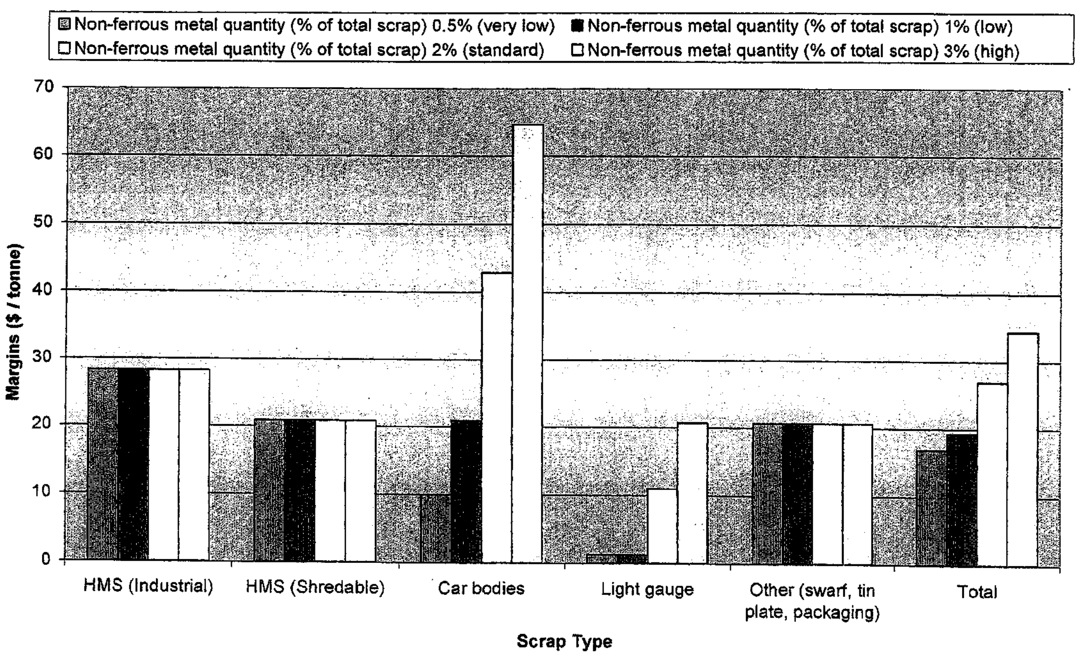


Table 8 shows that increasing international non-ferrous metal prices substantially improves the financial performance of the business overall. The outcome is similar if the quantity of non-ferrous metals processed by the business increases (Table 9). Margins on some scrap types, notably cars and light gauge scrap, are particularly sensitive to non-ferrous price movements or the quantity of non-ferrous metals processed (Figure 12), suggesting that in

some circumstances reprocessing of these products is only viable because of their non-ferrous metal components[13].

Overall, the outcomes presented in Tables 8 and 9 and Figure 12 suggest that the financial performance of the business may be more sensitive to non-ferrous metal price movements and non-ferrous quantities processed than even steel price movements.

3.7. Conclusions

In summary, the following general conclusions can be drawn as a consequence of the financial analysis undertaken for this study:

- Every $15 of levy reduces the IRR of a 'typical' steel recycling business by about 1.7 percentage points and the net margin on processed scrap by about $1.50.
- When the typical business is performing strongly, as would appear to be the case given current scrap volumes and metal prices, this represents a relatively minor impact on overall financial performance.
- However, for a business reprocessing a lower total quantity of scrap than standard (300,000 tonnes), or reprocessing a lower proportion of non-ferrous metals than the standard (2% of total scrap), impacts of this magnitude would be more significant for overall financial viability.
- Further, net margins earned from the processing of light gauge scrap are relatively low, particularly in regional areas. Thus a significant increase in the landfill levy rate could affect the viability of reprocessing light gauge in these areas.
- Margins earned on light gauge steel and car bodies are also very sensitive to non-ferrous metal prices and quantities. A significant increase in the landfill levy rate could therefore also affect the viability of reprocessing car bodies or light gauge if they have low non-ferrous metal content, again especially in regional areas.
- These outcomes would be compounded for a business that reprocesses a relatively small total quantity of scrap.

[13] This view was put by at least one of the reprocessing companies interviewed for this study. The information presented in Figure 12 would appear to support that view.

4. Environmental Implications of the Levy

4.1. Potential impact of levy on recycling rates

The impact of increasing the levy was shown potentially to have a financial impact on metal recyclers, as shown in the previous section (see conclusions from Section 3.7). One response to a decreased net margin on a given material input is to remove that product stream from recycling. Increases in the levy could thus act to reduce steel recycling rates. The actual impact is difficult to predict because of the unknown industry response to the increase, and also because of the fluidity of the market for the recovered metals. (For example Table 7 in Section 3 showed the sensitivity of metal recycling performance to movements in the international steel market, and Table 9 demonstrated sensitivity to non-ferrous metal prices).

A scenario based approach has thus been adopted to investigate plausible future outcomes in response to increases in the levy involving decreased steel recycling. The three scenarios explored include:

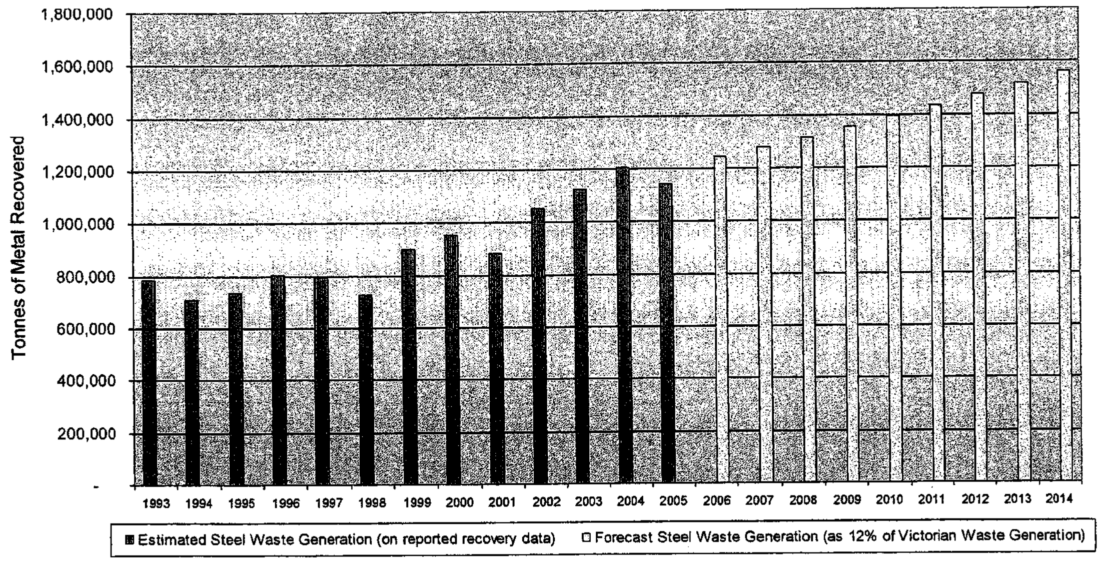
- Scenario 1 – increase in levy to $30 prevents further increase in processing of light gauge in regional areas (i.e. remaining scrap in the inner regional and outer regional areas remains unprocessed)
- Scenario 2 - = scenario 1 + the loss of existing light gauge in outer regional areas and half of existing light gauge in inner regional areas because it is no longer viable to process light gauge from these areas as a result of the cost to dispose of floc in combination with transport costs
- Scenario 3 - = scenario 1 + scenario 2 + in addition to the loss of cars in outer regional areas and half of existing cars in inner regional areas because it is no longer viable to process cars in these areas as a result of the cost to dispose of floc in combination with transport costs.

In order to undertake an assessment of the three above scenarios, a number of assumptions have been made. These include:

- seven year horizon of impact (the impact remains constant over the next seven years to 2014)
- steel generation is maintained at a constant 11.9 per cent of Victorian waste generation (the basis for this assumption is detailed in Appendix 2)
- the geographical distribution of steel waste generation remains constant until 2014 (based on per capita levels – Inner Urban, Outer Urban, Inner Regional and Outer Regional – see Figure 4)
- the proportion of steel product types remains constant at 2005 estimates
- the 'Towards Zero Waste' (The State of Victoria 2005) target of 75 per cent reduction by 2014 is interpreted as involving 90 per cent recovery of steel products
- the base case for steel recycling rate was assumed to increase by 1.3 percentage points each year to reach 90 per cent by 2014.

The estimated amounts of steel waste generation to 2014 are shown below in Figure 13.

Figure 13 – Forecast steel waste generation to 2014



A model of steel waste generation, using the above assumptions, and broken down according to geographic distribution and steel product type, was used to test the impact of the levy according to a comparison of the three scenarios against a base case consistent with meeting Victorian recovery targets at 2014. The results of this analysis are presented in Figure 14 below.

Figure 14 – Comparison of levy impact scenarios on steel recycling

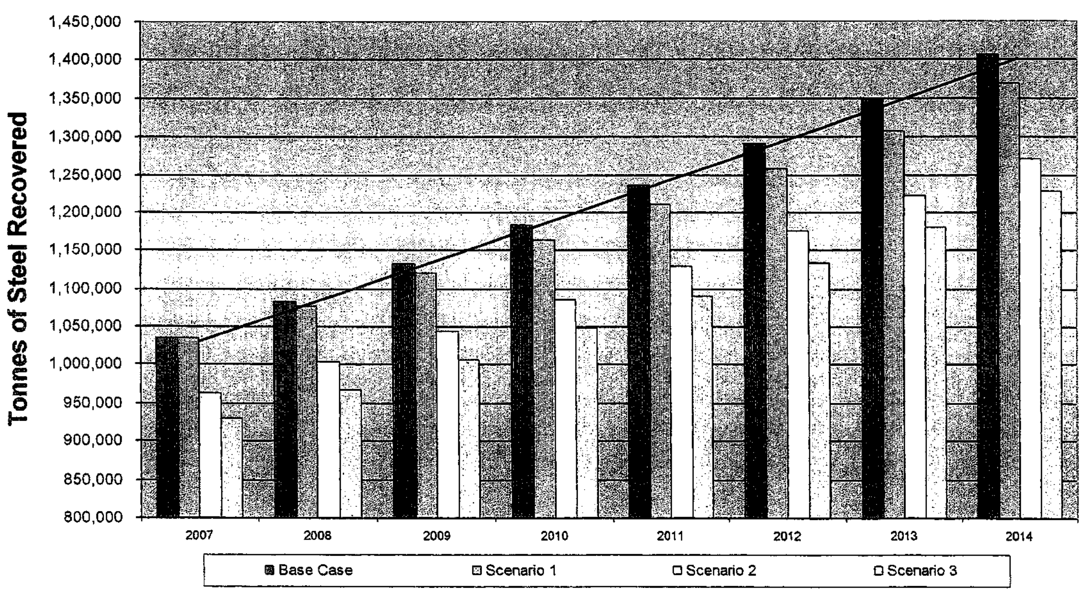


Table 10 below shows the cumulative difference in lost tonnes of steel recycling, and the lost tonnes of steel recycling at 2014 for each scenario as compared against the forecast base case.

Table 10 – Comparison of scenario performance against base case

Scenario	Tonnes to 2014	Difference from Base Case Tonnes	Difference from Base Case %	Tonnes at 2014	Difference from Base Case Tonnes	Difference from Base Case %
Base Case	9,714,201	-	0.0%	1,407,217	-	0.0%
Scenario 1	9,541,699	172,502	1.8%	1,368,487	38,730	2.8%
Scenario 2	8,895,609	818,592	8.4%	1,271,285	135,932	9.7%
Scenario 3	8,586,245	1,127,956	11.6%	1,228,120	179,097	12.7%

From the above table it is shown that:

- Scenario 1 – loses 172,502 tonnes of steel recovery from the base resource recovery case between 2007 and 2014 (an annual average of 24,644 tonnes)
- Scenario 2 - loses 818,592 tonnes of steel recovery from the base resource recovery case 2014 (an annual average of 116,942 tonnes)
- Scenario 3 loses 1,127,956 tonnes of steel recovery from the base resource recovery case between 2007 and 2014 (an annual average of 161,137 tonnes).

Assuming that demand for steel remains constant (does not enter negative growth), each tonne of steel lost from recycling needs to be replaced with one tonne of virgin steel. However, the estimates above do not account for shredder floc, as they are tonnes of steel products recovered for recycling. The materials flow data from Section 2.2.1 estimated that shredder floc comprised 18 per cent of steel product recovery. Assuming that this proportion remains constant to 2014, the tonnes of steel that are not recycled in each scenario are presented in Table 11 below.

Table 11 – Adjusting for shredder floc - comparison of scenario performance against base case

Scenario	Tonnes to 2014	Difference from Base Case Tonnes	Difference from Base Case %	Tonnes at 2014	Difference from Base Case Tonnes	Difference from Base Case %
Base Case	7,987,232	-	0.0%	1,157,045	-	0.0%
Scenario 1	7,845,397	141,835	1.8%	1,125,201	31,845	2.8%
Scenario 2	7,314,167	673,064	8.4%	1,045,279	111,766	9.7%
Scenario 3	7,059,801	927,430	11.6%	1,009,788	147,258	12.7%

The environmental impacts of this additional steel production caused from a decrease in recycling are presented in the following section.

4.2. Environmental implications of changes in recycling rates

Section 2.1.2 presented the environmental benefits arising from the recycling of steel products. The reverse side of the environmental value proposition of steel recycling is the environmental 'disbenefit' or lost opportunity cost of landfilling materials instead of recycling them. The environmental impacts arising from lost recycling because of increases in the landfill levy are presented in Table 12 below.

Table 12 – Adjusting for shredder floc - comparison of scenario performance against base case

Inputs	Unit	Recycling Savings/ tonne	Scenario 1 Cumulative loss	Scenario 2 Cumulative loss	Scenario 3 Cumulative loss
Water	kilolitres	81.10	11,502,795	54,585,527	75,214,602
Coking coal	tonnes	0.60	85,101	403,839	556,458
Iron ore	tonnes	1.20	170,202	807,677	1,112,916
Limestone	tonnes	0.12	17,162	81,441	112,219
Total primary energy	gigajoules	18.70	2,652,309	12,586,305	17,342,948
Particulate Matter (PM)	kilogrammes	18.50	2,623,942	12,451,692	17,157,462
CO_2+CO	tonnes	1.71	243,232	1,154,238	1,590,450
SO_x	kilogrammes	3.2	453,871	2,153,806	2,967,777
NH_3(l)	kilogrammes	0.1	14,183	67,306	92,743
NO_x	kilogrammes	0.9	127,651	605,758	834,687
HC	tonnes	0.01	2,042	9,692	13,355
Solid residues	tonnes	0.38	53,557	254,149	350,198

From Table 12 above, it is calculated that the impacts of three scenarios that model impacts of levy increases on recycling (in reference to a base case that is not disrupted by the landfill levy) include:

- Scenario 1 – 172,502 tonnes of extra landfill, 703,018 tonnes of carbon dioxide equivalent (CO_2e) in greenhouse gas emissions, 4,600 olympic swimming pools in extra water use, 265,000 tonnes of brown coal equivalent in energy usage, and 3,205 tonnes of air pollution[14]
- Scenario 2 – 818,592 tonnes of extra landfill, 3.3 million tonnes of CO_2e in greenhouse gas emissions, 21,800 olympic swimming pools in extra water use, 1.3 million tonnes of brown coal equivalent in energy usage, and 15,200 tonnes of air pollution
- Scenario 3 – 1,127,956 tonnes of extra landfill, 4.6 million tonnes of CO_2e in greenhouse gas emissions, 30,100 olympic swimming pools in extra water use, 1.7 million tonnes of brown coal equivalent in energy usage, and 21,000 tonnes of air pollution.

[14] Coking coal was assumed to be 90% carbon, Calcium has a molecular mass of 20, Carbon – 12 and Oxygen 16, brown coal has a calorific value of 10 GJ/tn, there are 2,500,000 litres of water in an Olympic swimming pool (2 m*50m*25m), and air pollution incorporates particulate matter, NOx and SOx.

4.3. Estimating the economic cost of environmental impacts

The environmental impacts of replacing recycled steel with virgin manufactured steel also have an economic cost. An initial estimate has been made of the economic cost of some of the environmental impacts associated with the three scenarios discussed in sections 4.1 and 4.2 above. Only non-market, 'external costs', which are not currently reflected in the price for steel, are considered. Thus, for example, market costs associated with energy and water supply are not assessed. As well, estimates have been made for only a very limited range of environmental variables, reflecting limited data availability for a number of environmental variables. Economic costs of the following impacts are assessed:

- CO_2 emissions; and
- fine particulate emissions (PM_{10}).

4.3.1. Imputed price of CO_2 emissions

Increasing attention is now being given to the economics of climate change, with the Stern Review on the Economics of Climate Change (Stern, 2006), regarded as something of a watershed in the field. Essentially, there are two broad approaches that can be applied to valuing the environmental impacts of CO_2 and other greenhouse gas emissions. The first is to assess the market and non-market impacts of climate change associated with enhanced atmospheric greenhouse gas concentrations. The second is to examine defensive expenditure associated with mitigating greenhouse gas emissions (i.e. the price of carbon). The second approach is used in this study, as it is likely to provide more robust short to medium term cost estimates, particularly at the national level.

In Australia, the only fully operating market for carbon at present is for NSW Greenhouse Abatement Certificates (NGACs), which are traded through the NSW Greenhouse Gas Abatement Scheme (NGAS). NGAS imposes mandatory greenhouse gas benchmarks on all NSW electricity retailers and certain other parties (referred to as benchmark participants) to abate the emission of greenhouse gases from the consumption of electricity in NSW. The price of traded NGACs is not publicly released, however quoted prices over the past two years appear to be in the $12 - 15 per certificate range (1 certificate being equal to one tonne of CO_2 abatement). Arguably, this price equates to the short run marginal cost of emission abatement. In the longer run, the 'price of carbon' is almost certainly set to rise in response to international and domestic measures designed to meet long term emission reduction objectives (e.g. a national emissions trading scheme mooted for Australia by 2012). In Australia, estimating the future price of carbon is quite a speculative exercise, since the price will depend on government emission reduction objectives, both short and long term, the design of the emissions trading scheme and emission reduction potential. Nevertheless, two economic assessments of the impact of an emissions trading scheme undertaken in Australia recently indicate that domestic CO_2 prices could well rise after 2010 from the current price of around $12 - $15 to $25-35 after 2020 (Allen Consulting 2006; PMTGET 2007).

Based on this information, we have applied two prices to CO_2 emissions:

- $15 / t CO2 as the short run price;
- $ 30 / t CO2 as the long run price.

4.3.2. Imputed price of particulate emissions

To estimate the costs of particulate emissions associated with scenarios 1 to 3 we have drawn on an economic assessment of the 'Health Costs of Air Pollution in the Greater Sydney Metropolitan Region' (NSW DEC, 2005). A review of numerous international and Australian studies yielded the NSW DEC study as the most relevant for this study because:

- the air sheds it examines include the Illawara region, which is the major steel making region in Australia; and
- it provides an indicative estimate of the health costs per tonne of particulate emissions.

The NSW study uses willingness to pay (value of a statistical life) and direct cost of illness methods to assess two general classes of health effects — mortality and morbidity, based on exposure-response estimates in three regions: Sydney; Newcastle Hunter; and Wollongong, Illawara. In summary the approach used to estimate the health costs was as follows:

- Prevalence data adjusted for baseline (or threshold) = population at risk
- Relative risk × adjusted prevalence data = number of people at risk
- Number at risk × per-unit health cost = health cost per health endpoint
- Sum each health impact to get regional impact
- Calculate cost per region at mean ambient level
- Divide total cost by total emissions = health cost per tonne

Using this methodology, the NSW DEC study calculated the annual health costs of air pollution in the Illawarra region to be in the range \$ 6 – 63 / tonne of PM_{10}.[15]

4.3.3. Economic costs of environmental impacts

Applying the prices for CO_2 and particulate emissions inferred above provides the following estimates of the imputed economic values of the environmental impacts of lost recycling, as investigated using the three scenarios (see Table 13 below).

Table 13 – Economic cost of environmental impacts from reduced recycling (cumulative)

Cumulative impacts	Scenario 1 low	Scenario 2 low	Scenario 3 low	Scenario 1 high	Scenario 2 high	Scenario 3 high
Greenhouse	\$ 10,545,269	\$ 50,041,669	\$ 68,953,519	\$ 21,090,538	\$100,083,339	\$137,907,039
Particulate Matter (PM)	\$ 15,744	\$ 74,710	\$ 102,945	\$ 165,308	\$ 784,457	\$ 1,080,920
Total Environmental Cost	\$ 10,561,013	\$ 50,116,379	\$ 69,056,464	\$ 21,255,846	\$100,867,795	\$138,987,959

[15] Note, the NSW DEC regards its estimates as conservative because: PM10 costs were calculated using a threshold effect (i.e. assuming no costs up to the threshold); and many additional chronic illnesses associated with air pollution were not included in the calculations.

The above table of environmental costs indicates the significance of impacts arising from even seemingly small losses in steel recycling. For example, in Scenario 1, the cumulative loss of 172,502 tonnes of steel recycling over seven years (1.8 per cent loss on the base case), results in the release of an additional 703,018 tonnes of carbon dioxide equivalent (CO_2e) in greenhouse gas emissions, with an associated economic cost of between \$10.5 million and \$21.1 million. The ranges of estimated environmental cost include:

- Scenario 1 – \$10.6 million to \$21.3 million
- Scenario 2 – \$50.1 million to \$100.9 million
- Scenario 3 – \$69.0 million to \$139.0 million.

These estimates are very broad and, in the case of the costs of CO_2, are somewhat speculative. They therefore need to be treated with considerable care. Nevertheless, they provided an indication of the possible magnitude of the economic costs of non-market impacts associated with the current and future application of the landfill levy on floc relative to revenue that is generated through the levy.

5. Discussion and conclusions

5.1. Review of analysis

As discussed in Chapter 2, the recovery of steel and non-ferrous for reprocessing has been rising steadily in Victoria over the past 10 to 15 years, driven by strong international markets for metals. The growth in recovery has meant that between 80 and 85 percent of all ferrous metals generated in Victoria are now being reprocessed. This puts Victoria at close to international best practice. The high level of steel reprocessing undoubtedly generates lifecycle environmental benefits in terms of reduced energy and water consumption, greenhouse gas emissions, other emissions and waste going to landfill.

Analysis described in Chapter 3 of this report suggests that the 'typical' steel reprocessing business is currently in a sound position financially, influenced by the (aforementioned) strong markets for scrap steel and non-ferrous metals. High ferrous and non-ferrous scrap prices have increased revenue and, to some extent, margins on its reprocessing operations. The cost of the landfill levy imposed on the floc generated through the business' operations is significant, at more than $750,000 per annum. Nonetheless, the sound position of the business has meant that, until now at least, this cost has been borne by the business without significantly affecting the overall viability of its steel reprocessing operations.

Notwithstanding this conclusion, our analysis also suggests that the imposition of the landfill levy on floc generated through the steel recycling process has the potential to lead to a perverse outcome relative to its major intended objective. That is, in the medium term it could lead to a reduction in recycling rates and a commensurate increase in the quantity of waste going to landfill. In some circumstances, reprocessing margins on some scrap steel products may already be low due to high marginal costs of recovery, high floc content of the scrap and/or the need for the reprocessing business to maintain market share in a mature and competitive market. This situation applies especially to light gauge metal sourced from regional areas and could also apply to car bodies sourced from regional areas that have minimal or no non-ferrous metal content.

If the levy rate was to substantially increase, then recycling rates of these scrap products could be adversely impacted in the medium to long term. This is because the international nature of the steel market precludes the business from passing on (to the purchaser) the increased costs of floc disposal. Further, the mature and competitive nature of the domestic reprocessing market means that, in effect, it would be difficult for a reprocessing business, acting alone, to pass back the costs of floc disposal to the scrap seller

It is not possible to be precise about the rate of landfill levy increase that would lead to an adverse affect on steel recovery or the extent to which recovery levels would be affected by any particular landfill levy rate. However, by examining a number of scenarios (Chapter 4), some plausible estimates have been made of the quantities of scrap metal that could potentially be affected by a doubling in the rate of landfill levy imposed on floc disposal (from $15 to $30). These estimates range from the loss of 172,502 of steel product up to the loss of 1,127,956 of steel product for recovery (a loss of between 1.8 and 11.6 per cent on the base case).

While the percentage losses in steel product recovery may seem significant, the associated environmental 'lost opportunity' cost is considerable. For example, even assuming a low cost of carbon dioxide equivalent of $15 per tonne, the loss of 1.8 per cent of steel recycling translates to greenhouse gas emissions with a cost of $10.5 million.

5.2. Options for overcoming barriers associated with the landfill levy

A key question stemming from the scenarios just described is '*what are the options for dealing with the potential negative impacts of the levy*?'

To address this question, a range of options for overcoming the potential barriers posed to steel recycling by the landfill levy on floc have been examined:

- current situation;
- full exemption from the levy;
- partial exemption from the levy;
- extension of the levy grants program;
- product stewardship; and
- ACCC authorisation.

A range of cost sharing principles relevant to examination of these options is discussed below followed by a brief examination of each option.

5.2.1. Cost sharing principles

Before examining options for dealing with the impacts of the landfill levy, it is important to consider the principles or criteria against which options can be assessed. Welfare economics provides a broad framework to evaluate alternative approaches to the application of instruments such as the landfill levy. Essentially, any instrument must meet the dual objectives of **efficiency** and **equity**[16]. Efficiency requires that the instrument be applied in way that minimises compliance costs and at a level that maximises net societal benefits. Equity provides that like situated individuals or entities are treated equally and that individuals or entities that are better able to meet their share of costs should bear more.

While these objectives can be universally applied, we would not expect them to generate identical outcomes. In particular, there will be differences in the information available on which to make decisions. It may be imperfect and costly to gather. Second, there may be imperfections in the formation of markets and the attendant property rights. The application of the principles will therefore differ on a case by case basis. As a consequence, judgements must be made. In making these judgements it is important that decision makers are informed, explicit and transparent.

Thus a set of principles that captures both the objectives and the need for judgements to be made in the decision making process can be applied. Theses are:

16 Note, a broad (and arguably correct) interpretation of the objectives of efficiency and equity would include a range of sustainability objectives.

- **Efficient 'pricing'.** The purpose of efficient pricing is to provide individuals or entities with a signal of the costs of an activity, so as to determine required service levels and to modify behaviour in the light of changing costs. Efficient pricing therefore relates both to price level (it should be set at a level that maximises net social benefit) and to the way a pricing instrument is applied (it should not lead to distortions or unintended outcomes).
- **Recognition of transaction costs.** These typically increase with the complexity of the pricing and tariff structure associated with an instrument. The efficiency gains from the application of an instrument should exceed the transaction costs.
- **'Horizontal' equity.** This requires that equally situated groups or individuals are treated equally, taking into account:
  - ability to pay;
  - the distribution of benefits;
  - simplicity and practicalities; and
  - judgements on the importance of maintaining the commercial or social contract.
- **Transparency.** This is required to allow the cost recovery or pricing regime to be explainable and credible to those affected and defendable to government and regulators.

When applying these principles and exercising judgment decision makers have two basic options available for determining which individuals or entities should be required to pay – the net gainer or the net loser pays, usually referred to as 'impactor/polluter pays' and 'beneficiary/user pays'.

An impactor/polluter can be defined as any individual, entity or group whose activities generate impacts or pollution. The **impactor/polluter pays principle** therefore seeks to allocate costs (of avoiding or compensating for the pollution) to different individuals or entities in proportion to the contribution that each has made to creating the pollution. Australian governments (Federal and State) appear, at least in theory, to have adopted the polluter pays principle. Section 3.5.4 of the Intergovernmental Agreement on the Environment commits governments to the polluter pays principle stating, *inter alia*, that

> *"those who generate pollution and waste should bear the cost of containment, avoidance, or abatement",*

and that

> *"the users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes."*

A beneficiary, on the other hand, can be defined as any individual, entity or group who derives benefit from a good or a service. The **beneficiary/user pays principle** therefore seeks to allocate costs to different individuals or entities in proportion to the benefits that that each derives from provision of the good or service.

Thus there is a subtle but distinct difference the two principles, although in reality, as identified in another context by Hajowicz and Young (2000), a continuum of cost sharing options between these two basic options is available and often the beneficiary is also the impactor.

5.2.2. Options

Current situation

Current application of the levy appears, *prima facie*, to meet with a number of cost sharing principles. It achieves horizontal equity, in that it applies equally to all steel reprocessing businesses. The way in which it is calculated and applied is clear and transparent. And, without having undertaken a thorough analysis of administration of the levy, there is nothing to suggest that it is likely to entail high transaction costs. As previously discussed, insufficient analysis has been undertaken to know whether the current levy rate, as applied to floc, is at an efficient level (the same can be said of all possible options for dealing with the levy). However, our analysis as described in Chapters 3 and 4, suggests that the current application of the levy could lead an unintended outcome. Further, the current situation is contrary to the impactor pays principle.

Full exemption

One option being canvassed is that steel reprocessors be fully exempted from the levy. That is, steel reprocessing businesses no longer pay the levy for disposal of the floc to landfill. Under this option, the costs of shredder floc disposal would also not be levied any other individuals or entities. The main drawback with this option is that, in the absence of an alternative instrument, exemption effectively amounts to placing a zero price on the environmental and social costs associated with floc disposal – this is clearly an inefficient outcome. It follows too that, with no price being put on the environmental and social costs of levy disposal, the impactor pays principle is being contravened.

Partial exemption

Another option being canvassed is that steel reprocessing businesses only be levied on the quantity of floc that is disposed above a baseline level, the baseline be determined by, 'world's best practice' in floc generation. For example, the floc produced by steel reprocessing businesses in Victoria currently represents approximately 18-20 % of total scrap processed, by weight. Reprocessing companies argue that, proportionally, this is a considerable reduction in floc – down from 25-30% of scrap only a few years ago – achieved through a combination of more efficient processing and stringent sorting practices. The current level of floc, they assert, is now close to world's best practice, which is currently about 15% of processed scrap disposed as floc.

This option has quite strong initial appeal: it would still provide an incentive for reprocessing companies to minimise their generation of floc; and would amount to a reasonably equitable and transparent approach to internalising the costs of floc disposal. However, there are also potential downsides to the option. Most obvious is that the option is likely to be administratively complex (baseline setting, monitoring and reporting processes etc) which

would lead to high transactions costs. Further, a significant part of the floc that is disposed to landfill will be exempted from the levy; that floc will still be generating externalities.

Extension of grants program

Revenue raised through the levy on shredder floc disposed to landfill is, along with the revenue raised from other waste disposed to landfill, currently being used to fund industry waste reduction programs, education programs, regulatory controls and enforcement regimes. Only a small proportion of the revenue raised through the levy on shredder floc is being used to fund programs that could lead to a reduction in floc disposed to landfill (e.g. research into alternative uses of the floc). One option for dealing with this anomaly would be to specifically earmark all floc landfill levy revenue for floc reduction programs. In commenting on this option we note that considerable research has been undertaken, both in Australia and overseas to find alternative uses for the floc (see for example: O'Neill, 2005; Rapoport, 2006; Sendijarevic, 1997). Some of the research has led to improved separation processes (and therefore a proportional reduction in the floc generated) and niche uses for the floc (such as waste to energy – which itself creates some environmental issues). To date however, a viable wide scale alternative use for the floc does not seem to have been found as yet. It is possible that substantial additional funding for floc residue research in Victoria may lead to further reductions in floc generated or an alternative use for the floc. This is not guaranteed though. Importantly, for the purpose of this assessment, implementation of this option would not overcome the fundamental shortcoming identified with the current application of the landfill levy on floc, that it does not meet the polluter pays principle. On that point we note that there is no compelling reason why the steel shredding sector should pay all or most of the costs of research into alternative uses for shredder floc.

Product stewardship/EPR

A number of overseas jurisdictions, notably the European Union (EU) and Japan, are now moving towards a product stewardship or extended producer responsibility (EPR) type approach to dealing with shredder floc, especially of automobile shredder residue (ASR). In both the EU and Japan, the car manufacturer is deemed to have the primary role in the system of waste prevention, collection and treatment of ELVs. In Japan, the Automobile Recycling Law, introduced in 2005, requires automobile manufacturers to collect and properly recycle various components and waste products from ELVs, including ASR. The law requires automakers and car importers to accept and recycle or reuse ASR. Similarly, the EU ELV Directive, which was enacted in EU member states in 2002, requires car manufacturers and importers to establish an ELV collection and recycling network, to cover all new vehicles sold from 1 July 2003. The network is based on the auto suppliers working closely with ELV collectors, and dismantlers and shredder operators. The primary focus of the directive is to reduce ASR to less than 5 % of the ELV by weight. In some EU countries the cost of floc disposal resides with the auto suppliers. In other countries though (notably Germany), the cost resides with the shredder companies.

The main advantage of the type of approach outlined above is that, prima facie, it observes the polluter pays principle. Before such an approach could be considered for Australia or Victoria however, it would need to be assessed. In particular, potential difficulties in relation to efficient pricing (costs of the scheme, avoiding distortions), horizontal equity (addressing both ASR and non-ASR) and transaction costs (avoiding high administrative costs) would

need to be carefully explored. Because of the size and nature of markets it is likely (and desirable) that such a scheme only be introduced at the national level.

ACCC authorisation for a collective agreement

In discussions with the project team, steel reprocessing companies expressed a view that a key factor preventing them from passing the cost of the landfill levy back up the supply chain (thereby enabling the costs of floc disposal to be borne by the parties ultimately responsible for generating the waste) is that a collective agreement between the steel recycling businesses to charge the levy would be required to avoid the competitive position of each individual business being adversely affected. The businesses are concerned that a collective arrangement of this nature would be deemed anti-competitive under the Trade Practices Act.

This need not be an insurmountable problem though. **Authorisation** is a process under which the Australian Competition and Consumer Commission (ACCC) can grant immunity for potential breaches of the competition provisions of the Act – including an anti-competitive agreement on prices - if it is satisfied the conduct is ".. *likely to result in a public benefit which outweighs the likely public detriment constituted by any lessening of competition*" (ACCC 2007, p.9). To gain authorisation requires an application for authorisation to be lodged with an application fee (that can be waivered in whole or in part). The authorisation process tales place over a period not exceeding six months and involves: lodgement of submissions; meetings between the ACCC and interested parties; and issuance of draft and final determinations. The ACCC also encourages applicants to hold informal discussions with it prior to lodging an application.

Our initial assessment suggests that ACCC authorisation should it be granted, and subsequent agreement between the steel processing businesses, has the potential to overcome many of the shortcomings associated with the current situation.

5.2.3. Conclusion

Preceding discussions on options for overcoming barriers to steel recycling associated with the landfill levy are neither exhaustive nor definitive. With the possible exception of option 6 (ACCC authorisation) all of the options have some potential drawbacks. Nevertheless, a number of the options are worthy of further consideration. This generally will involve further in depth assessment, both in terms of design and application, to determine their feasibility. In examining the options further, it is worth noting that they are not necessarily mutually exclusive. For example, it may be feasible to implement one option in the short term – such as ACCC authorisation – while examining in detail other options that suite a broader or longer term objective.

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Appendix 1: Metal Flows Analysis

Detailed results of analysis for section 3.1

Standard case – 350,000 tonnes – approximately one third of existing market

Table 14 – Estimated Composition of Base Case

Type of processed scrap	Inner Urban	Outer Urban	Inner Regional	Outer Regional	Totals
- HMS (industrial)	29,163	17,121	15,432	8,284	70,000
- HMS (shredable)	36,358	21,442	19,326	10,374	87,500
- swarf (manufacturing offcuts)	3,598	2,160	1,947	1,045	8,750
- tin plate	3,823	2,155	1,840	931	8,750
- packaging	7,433	4,262	3,794	2,011	17,500
- car bodies	22,057	12,874	11,477	6,091	52,500
- light gauge (whitegoods, lgt construction)	51,301	25,716	19,515	8,468	105,000
Total	153,733	85,730	73,331	37,205	350,000

High Volume case – approx 430,000 tonnes – accesses one third of currently landfilled goods containing steel – mainly light gauge

Table 15 – Estimated Composition of High Volume Processing

Type of processed scrap	Inner Urban	Outer Urban	Inner Regional	Outer Regional	Totals	Increase on Base
- HMS (industrial)	29,324	17,471	15,909	8,629	71,333	1,333
- HMS (shredable)	36,724	21,879	19,924	10,806	89,333	1,833
- swarf (manufacturing offcuts)	3,700	2,204	2,007	1,089	9,000	250
- tin plate	4,522	2,694	2,453	1,331	11,000	2,250
- packaging	7,948	4,735	4,312	2,339	19,333	1,833
- car bodies	22,747	13,552	12,341	6,694	55,333	2,833
- light gauge (whitegoods, lgt construction)	71,941	42,860	39,030	21,169	175,000	70,000
Total	176,905	105,396	95,976	52,056	430,333	80,333

Low Volume case – approx 280,000 tonnes – decrease amounts overall, primarily materials with floc and high transport

Table 16 – Estimated Composition of Low Volume Processing

Type of processed scrap	Inner Urban	Outer Urban	Inner Regional	Outer Regional	Totals	Decrease on Base
- HMS (industrial)	28,871	16,779	14,815	7,621	68,086	1,914
- HMS (shredable)	35,631	20,584	17,780	8,714	82,709	4,791
- swarf (manufacturing offcuts)	3,562	2,117	1,869	962	8,509	241
- tin plate	3,747	2,069	1,693	782	8,291	459
- packaging	7,061	3,835	3,225	1,609	15,731	1,769
- car bodies	17,646	9,012	5,738	609	33,006	19,494
- light gauge (whitegoods, lgt construction)	35,911	12,858	5,854	847	55,470	49,530
Total	132,429	67,254	50,975	21,144	271,802	78,198

Table 17 – Decreased proportions for low volume recycling

Type of processed scrap	Inner Urban	Outer Urban	Inner Regional	Outer Regional
- HMS (industrial)	1%	2%	4%	8%
- HMS (shredable)	2%	4%	8%	16%
- swarf (manufacturing offcuts)	1%	2%	4%	8%
- tin plate	2%	4%	8%	16%
- packaging	5%	10%	15%	20%
- car bodies	20%	30%	50%	90%
- light gauge (whitegoods, lgt construction)	30%	50%	70%	90%

d are for mid case, standard values only, unless otherwise stated)

	$308.00	
	$1,650.00	
	1.274	1.274
	5.91%	5.91%
	16.5%	
	6.00%	
	2.00%	
	30%	50%
	13.97%	
	10.23%	
	20.67%	
	4.00%	
	6.00%	
	2.50%	
ial)	$4.17	
	$450,000	
nistration	$350,000.00	
, marketing	$1,275,000.00	

/ tonne	Base year
	$15.00
	$5.71
	$1.71
	$2.40
	$0.15
f floc)	$20.00
	$5.00
	1.50 hours
	2.50 hours
	4.50 hours
	6.50 hours
	2.50 hours
hour	$4.00

Base year cost	Life Tax
$5,000,000	100
$5,000,000	50
$20,000,000	20
$750,000	20
$2,000,000	20
$1,000,000	

Volume adjustments

Case used in first instance: Base

Adjust total volume — *New volume*

Total volume 300,000

Common growth in volumes? Yes

Growth rate 0.00%

Change overall distribution

Starting | Set | New | New

Source related inputs

	Labour sorting	Floc proportio	Non-ferrous p	Ferrous proportion
HMS (Industrial)	$0.00	0.0%	0.0%	100.0%
HMS (Shredable)	$0.00	0.0%	0.0%	100.0%
Swarf	$0.00	0.0%	0.0%	100.0%
Tin plate	$0.00	0.0%	0.0%	100.0%
Packaging	$10.00	5.0%	10.0%	85.0%
Car bodies	$10.00	28.0%	5.0%	67.0%
Light gauge	$10.00	35.0%	2.0%	63.0%

Bailing cost	Inner urban	Outer urban	Inner regional	Outer regional
HMS (Industrial)	$0.00	$0.00	$0.00	$0.00
HMS (Shredable)	$0.00	$0.00	$0.00	$0.00
Swarf	$0.00	$0.00	$0.00	$0.00
Tin plate	$0.00	$0.00	$0.00	$0.00
Packaging	$0.00	$10.00	$20.00	$40.00
Car bodies	$0.00	$0.00	$0.00	$0.00
Light gauge	$0.00	$10.00	$20.00	$40.00

Price to dealer	Inner urban	Outer urban	Inner regional	Outer regional
HMS (Industrial)	$214.90	$211.50	$204.70	$197.90
HMS (Shredable)	$214.90	$211.50	$204.70	$197.90
Swarf	$214.90	$211.50	$204.70	$197.90
Tin plate	$214.90	$211.50	$204.70	$197.90
Packaging	$203.90	$192.00	$176.70	$152.90
Car bodies	$153.30	$149.90	$143.10	$136.30
Light gauge	$137.90	$126.00	$110.70	$86.90

Implied cost of input steel — Price at factory gate (excl floc)

Source:	Inner urban	Outer urban	Inner regional	Outer regional
HMS (Industrial)	$220.90	$221.50	$222.70	$223.90
HMS (Shredable)	$220.90	$221.50	$222.70	$223.90
Swarf	$220.90	$221.50	$222.70	$223.90
Tin plate	$220.90	$221.50	$222.70	$223.90
Packaging	$220.95	$223.16	$226.00	$230.42
Car bodies	$221.25	$222.08	$223.75	$225.42
Light gauge	$221.38	$224.62	$228.77	$235.23

Implied cost of input steel — Price at factory gate (incl floc)

Source:	Inner urban	Outer urban	Inner regional	Outer regional
HMS (Industrial)	$220.90	$221.50	$222.70	$223.90
HMS (Shredable)	$220.90	$221.50	$222.70	$223.90
Swarf	$220.90	$221.50	$222.70	$223.90
Tin plate	$220.90	$221.50	$222.70	$223.90
Packaging	$209.90	$212.00	$214.70	$218.90
Car bodies	$159.30	$159.90	$161.10	$162.30
Light gauge	$143.90	$146.00	$148.70	$152.90

Transport costs

	Inner urban	Outer urban	Inner regional	Outer regional
HMS (Industrial)	$6.00	$10.00	$18.00	$26.00
HMS (Shredable)	$6.00	$10.00	$18.00	$26.00
Swarf	$6.00	$10.00	$18.00	$26.00
Tin plate	$6.00	$10.00	$18.00	$26.00
Packaging	$6.00	$10.00	$18.00	$26.00
Car bodies	$6.00	$10.00	$18.00	$26.00
Light gauge	$6.00	$10.00	$18.00	$26.00

Labour sorting costs

Inner | Outer

ntent inputs - base case	Units		Volume input	Proportion Inner Urban	Proportion Outer Urban	Inner Regional	Outer Re[illegible]al
			tonnes				
HMS (Industrial)			90,000	41.5%	24.5%	22.1%	11.9%
HMS (Shredable)			24,000	42.0%	24.3%	21.9%	11.8%
Swarf			7,500	41.5%	24.5%	22.1%	11.9%
Tin plate			7,500	44.3%	24.4%	20.8%	10.5%
Packaging			15,000	42.1%	24.5%	21.8%	11.6%
Car bodies			45,000	42.1%	24.5%	21.8%	11.6%
Light gauge			111,000	48.9%	24.5%	18.6%	8.1%
of what this row or block is	Units	User Notes - source of data, who last changed it, any issues					

n volume	Units		Volume input				
			tonnes				
ription of what this row or block is							
HMS (Industrial)			92,000	41.1%	24.5%	22.3%	12.1%
HMS (Shredable)			24,333	41.1%	24.5%	22.3%	12.1%
Swarf			7,667	41.1%	24.5%	22.3%	12.1%
Tin plate			9,333	41.1%	24.5%	22.3%	12.1%
Packaging			16,667	41.1%	24.5%	22.3%	12.1%
Car bodies			47,333	41.1%	24.5%	22.3%	12.1%
Light gauge			185,000	41.1%	24.5%	22.3%	12.1%

volume	Units		Volume input				
			tonnes				
ription of what this row or block is							
HMS (Industrial)			87,534	42.2%	24.7%	21.8%	11.2%
HMS (Shredable)			22,692	43.5%	24.7%	21.3%	10.5%
Swarf			7,295	42.2%	24.7%	21.8%	11.2%
Tin plate			7,109	45.8%	24.7%	20.2%	9.3%
Packaging			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
strial)	$0	$6,392,874	$6,562,071	$6,735,498	$6,913,260	$7,095,_7	$7,282,228	$7,473,659	$7,669,876	$7,870,998
edable)	$0	$1,863,743	$1,910,336	$1,958,095	$2,007,047	$2,057,223	$2,108,654	$2,161,370	$2,215,405	$2,270,790
	$0	$582,365	$596,924	$611,847	$627,143	$642,821	$658,892	$675,364	$692,248	$709,555
	$0	$582,847	$597,418	$612,353	$627,662	$643,354	$659,438	$675,923	$692,822	$710,142
	$0	$2,903,229	$2,975,810	$3,050,205	$3,126,460	$3,204,622	$3,284,737	$3,366,856	$3,451,027	$3,537,303
	$0	$4,452,889	$4,564,211	$4,678,316	$4,795,274	$4,915,156	$5,038,035	$5,163,986	$5,293,086	$5,425,413
e	$0	$5,389,912	$5,524,659	$5,662,776	$5,804,345	$5,949,454	$6,098,190	$6,250,645	$6,406,911	$6,567,084
d fixed and common (input weight)	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
strial)	$3,000,000	$487,500	$499,688	$512,180	$524,984	$538,109	$551,562	$565,351	$579,484	$593,971
edable)	$3,400,000	$181,429	$185,964	$190,613	$195,379	$200,263	$205,270	$210,402	$215,662	$221,053
	$1,062,500	$56,696	$58,114	$59,567	$61,056	$62,582	$64,147	$65,750	$67,394	$69,079
	$1,062,500	$56,696	$58,114	$59,567	$61,056	$62,582	$64,147	$65,750	$67,394	$69,079
	$2,125,000	$113,393	$116,228	$119,133	$122,112	$125,164	$128,294	$131,501	$134,788	$138,158
s	$6,375,000	$340,179	$348,683	$357,400	$366,335	$375,493	$384,881	$394,503	$404,365	$414,475
e	$15,725,000	$839,107	$860,085	$881,587	$903,627	$926,217	$949,373	$973,107	$997,435	$1,022,371
ax margin	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
strial)	-$3,000,000	$5,905,374	$6,062,384	$6,223,318	$6,388,276	$6,557,358	$6,730,667	$6,908,309	$7,090,391	$7,277,026
edable)	-$3,400,000	$1,682,314	$1,724,372	$1,767,481	$1,811,668	$1,856,960	$1,903,384	$1,950,969	$1,999,743	$2,049,737
	-$1,062,500	$525,668	$538,810	$552,280	$566,087	$580,239	$594,745	$609,614	$624,854	$640,476
	-$1,062,500	$526,150	$539,304	$552,787	$566,606	$580,771	$595,291	$610,173	$625,427	$641,063
l	-$2,125,000	$2,789,836	$2,859,582	$2,931,072	$3,004,349	$3,079,457	$3,156,444	$3,235,355	$3,316,239	$3,399,145
s	-$6,375,000	$4,112,710	$4,215,528	$4,320,916	$4,428,939	$4,539,663	$4,653,154	$4,769,483	$4,888,720	$5,010,938
je	-$15,725,000	$4,550,805	$4,664,575	$4,781,189	$4,900,719	$5,023,237	$5,148,818	$5,277,538	$5,409,477	$5,544,713
	-$32,750,000	$20,092,858	$20,604,555	$21,129,043	$21,666,645	$22,217,686	$22,782,503	$23,361,440	$23,954,851	$24,563,098
volumes	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
strial)		90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000
edable)		24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000
		7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
		7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
l		14,250	14,250	14,250	14,250	14,250	14,250	14,250	14,250	14,250
s		32,400	32,400	32,400	32,400	32,400	32,400	32,400	32,400	32,400
je		72,150	72,150	72,150	72,150	72,150	72,150	72,150	72,150	72,150
		247,800	247,800	247,800	247,800	247,800	247,800	247,800	247,800	247,800
gin / tonne of output (pre tax)	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
ustrial)	**$28.2**									
edable)	**$20.8**									
	$42.8									

andard prices, $15 levy

rm	Medium term		Long term		
5	15		25		
6%	36%		37%		
3%	19%		16%		
)67	$53,231,753		$77,092,443		
ne	All areas	Inner urban	Outer urban	Inner regional	Outer regional
	$26.5	$26.9	$26.6	$26.0	$25.5
	$13.7	$14.1	$13.8	$13.2	$12.7
	$33.1	$33.4	$33.0	$32.3	$31.5
	$0.7	$1.5	$0.0	-$2.0	-$5.0
te, packaging)	$13.6	$14.0	$13.7	$13.1	$12.6
	$22.7	$23.2	$22.6	$21.7	$20.5
y	$436,853				

Standard volume d prices, $15 levy

Period	Short term	Medium term		Long term	
	5	15		25	
IRR	29%	46%		47%	
MIRR	21%	21%		18%	
NPV	$13,192,915	$77,829,027		$108,871,890	
Net margin $ / tonne		All areas	Inner urban	Outer urban	Inne regiona
HMS (Industrial)		$28.2	$28.7	$28.4	$27.
HMS (Shredable)		$20.8	$21.2	$21.0	$20.
Car bodies		$42.8	$43.4	$43.0	$42.
Light gauge		$11.0	$12.5	$11.0	$9.
Other (swarf, tin plate, packaging)		$20.7	$21.1	$20.8	$20.
Total		$26.9	$27.7	$27.0	$26.
Annual cost of levy		$783,000			

ne and prices, $0 levy

m	Medium term		Long term		
5	15		25		
32%	48%		48%		
22%	21%		18%		
364	$81,893,654		$114,122,743		
ne	All areas	Inner urban	Outer urban	Inner regional	Outer regional
	$28.2	$28.7	$28.4	$27.8	$27.3
	$20.8	$21.2	$21.0	$20.4	$19.8
	$45.6	$46.1	$45.8	$45.0	$44.2
	$14.8	$16.3	$14.8	$12.8	$9.8
ate, packaging)	$20.7	$21.1	$20.8	$20.2	$19.7
	$28.4	$29.2	$28.5	$27.5	$26.0
y	$0				

Standard volume and prices, $15 levy

Period	Short term	Medium term		Long term	
	5	15		25	
IRR	29%	46%		47%	
MIRR	21%	21%		18%	
NPV	$13,192,915	$77,829,027		$108,871,890	
Net margin $ / tonne		All areas	Inner urban	Outer urban	Inne regiona
HMS (Industrial)		$28.2	$28.7	$28.4	$27.
HMS (Shredable)		$20.8	$21.2	$21.0	$20.
Car bodies		$42.8	$43.4	$43.0	$42.
Light gauge		$11.0	$12.5	$11.0	$9.
Other (swarf, tin plate, packaging)		$20.7	$21.1	$20.8	$20.
Total		$26.9	$27.7	$27.0	$26.
Annual cost of levy		$783,000			

es, non-ferrous prices and non-ferrous volumes)

ne and prices, $15 levy ($308 steel price)					
erm	Medium term		Long term		
5	15		25		
29%	46%		47%		
21%	21%		18%		
2,915	$77,829,027		$108,871,890		
ne	All areas	Inner urban	Outer urban	Inner regional	Outer regional
	$28.2	$28.7	$28.4	$27.8	$27.3
	$20.8	$21.2	$21.0	$20.4	$19.8
	$42.8	$43.4	$43.0	$42.2	$41.4
	$11.0	$12.5	$11.0	$9.0	$6.0
ite, packaging)	$20.7	$21.1	$20.8	$20.2	$19.7
	$26.9	$27.7	$27.0	$26.0	$24.6
y	$783,000				

Standard + $259 steel price ($181 price at gate)					
Period	Short term	Medium term		Long term	
	5	15		25	
IRR	23%	42%		42%	
MIRR	18%	20%		17%	
NPV	$8,700,701	$66,484,044		$94,215,977	
Net margin $ / tonne		All areas	Inner urban	Outer urban	Inner regional
HMS (Industrial)		$23.5	$24.0	$23.7	$23.1
HMS (Shredable)		$16.1	$16.5	$16.3	$15.7
Car bodies		$39.7	$40.3	$39.9	$39.1
Light gauge		$7.0	$8.5	$7.0	$5.0
Other (swarf, tin plate, packaging)		$16.0	$16.4	$16.1	$15.6
Total		$22.7	$23.6	$22.9	$21.8
Annual cost of levy		$783,000			

ne and prices, $15 levy ($1650 non-ferrous price)					
term	Medium term		Long term		
5	15		25		
29%	46%		47%		
21%	21%		18%		
2,915	$77,829,027		$108,871,890		
ne	All areas	Inner urban	Outer urban	Inner regional	Outer regional
	$28.2	$28.7	$28.4	$27.8	$27.3
	$20.8	$21.2	$21.0	$20.4	$19.8
	$42.8	$43.4	$43.0	$42.2	$41.4
	$11.0	$12.5	$11.0	$9.0	$6.0
ite, packaging)	$20.7	$21.1	$20.8	$20.2	$19.7
	$26.9	$27.7	$27.0	$26.0	$24.6
y	$783,000				

Standard + $1000 non-ferrous price					
Period	Short term	Medium term		Long term	
	5	15		25	
IRR	18%	38%		38%	
MIRR	15%	19%		17%	
NPV	$5,216,582	$57,684,982		$82,848,988	
Net margin $ / tonne		All areas	Inner urban	Outer urban	Inner regional
HMS (Industrial)		$28.2	$28.7	$28.4	$27.8
HMS (Shredable)		$20.8	$21.2	$21.0	$20.4
Car bodies		$21.6	$22.2	$21.8	$21.0
Light gauge		$1.6	$3.1	$1.6	-$0.4
Other (swarf, tin plate, packaging)		$20.7	$21.1	$20.8	$20.2
Total		$19.5	$20.3	$19.6	$18.6
Annual cost of levy		$783,000			

	5	15	25		
	29%	46%	47%		
	21%	21%	18%		
	,915	$77,829,027	$108,871,890		

ne	All areas	Inner urban	Outer urban	Inner regional	Outer regional
	$28.2	$28.7	$28.4	$27.8	$27.3
	$20.8	$21.2	$21.0	$20.4	$19.8
	$42.8	$43.4	$43.0	$42.2	$41.4
	$11.0	$12.5	$11.0	$9.0	$6.0
ite, packaging)	$20.7	$21.1	$20.8	$20.2	$19.7
	$26.9	$27.7	$27.0	$26.0	$24.6
y	$783,000				

	5	15	25
IRR	18%	38%	38%
MIRR	15%	19%	16%
NPV	$4,958,886	$57,034,175	$82,008,248

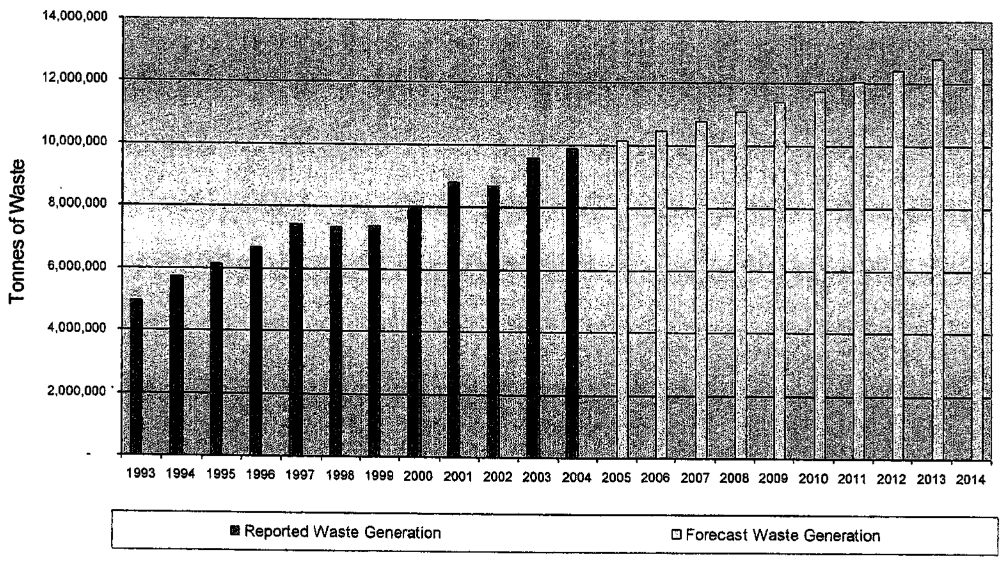
Net margin $ / tonne	All areas	Inner urban	Outer urban	Inner regional	re
HMS (Industrial)	$28.2	$28.7	$28.4	$27.8	
HMS (Shredable)	$20.8	$21.2	$21.0	$20.4	
Car bodies	$20.9	$22.2	$21.1	$20.3	
Light gauge	$1.3	$3.1	$1.3	-$0.7	
Other (swarf, tin plate, packaging)	$20.7	$21.1	$20.8	$20.2	
Total	$19.3	$20.3	$19.4	$18.4	
Annual cost of levy	$783,000				

Appendix 3: Steel Generation Forecasts

In order to forecast steel generation rates for Victoria, it was first necessary to forecast waste generation rates for the state, based on trend lines established by past waste generation performance. Sustainability Victoria (2005) reported tonnes of waste recovered from between 1993 to 2004, and the proportion of resource recovery this represented. These data were used to calculated the amount of waste generation and waste disposed of to landfill for this period.

The State of Victoria (2005) estimated that the base case of waste generation would be 12 million tonnes of waste generation by 2013/14, but that only 10.5 million tonnes would be generated because of waste minimisation initiatives. However, Sustainability Victoria (2005) reported waste generation rates of nearly 10 million tonnes for 2004/05. This indicated that 'avoided waste with strategy' in 2014 would be higher than 10.5 million tonnes. The growth rate of the base case was used in this study (2.9 per cent), and applied going forward on 2004/05 waste generation date. The figure below presents the forecast waste generation rates to 2014.

Figure 15 – Reported and estimated Victorian Waste Generation



In order to estimate metal waste generation rates, EcoRecycle Victoria (2000) and Hyder Consulting (2006) data were used to estimate the metal composition of landfilled waste for 1998/99 and 2002/03 respectively. These two points were used to estimate the proportion of metal in landfilled waste from 1993 to 2004. Sustainability Victoria (2005) data on metal recovery was then added together with metal waste landfilled to estimate the amount of metal waste generation in Victoria.

Data from Sustainability Victoria (2005) was then used to estimate the amount of steel present in metal recovery between 1993 and 2004. It was assumed that this proportion was constant in metal waste generation in order to estimate steel waste generation. The average proportion of steel generation in waste generation between 1993 and 2004 (11.9 per cent) was then used against waste generation forecasts to 2014.