REPORT #1

An Overview of Waste Management: The Problem & Directions

Prepared for

THE TOTAL ENVIRONMENT CENTRE

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1 STUDY BRIEF AND SCOPE OF REPORT

The Total Environment Centre (TEC) received funding to assist in the preparation of submissions by community groups to the NSW Government's Alternative Waste Technologies and Practices Inquiry. The governments call for submissions stated that:

> "The purpose of the public inquiry is to investigate current and emerging waste management technologies and practices, taking into account the principles of ecologically sustainable development.
>
> The Terms of Reference of the Inquiry are as follows:
>
> "Describe and assess current and emerging waste management technologies and practices in Australia and overseas. These technologies are to be assessed in terms of:
> 1. Potential impact on the environment in terms of local, regional and global air, land and waster impacts and amenity
> 2. Contribution to waste avoidance and beneficial reuse of resources
> 3. Contribution to waste reduction
> 4. Environmental and economic benefits and costs of the alternative technologies and expressed: per tonne of waste input: per tonne of waste diverted from landfill; per tonne of recovered secondary resources or recovered energy value
> 5. technical performance and operational reliability
> 6. factors effecting the capacity for accelerating the implementation of alternative waste management technologies and practices in NSW in the short, medium or long term"

Environment groups are particularly concerned about establishment of mega-tips (city and country) for Sydney's waste and are focusing on environmentally acceptable alternative technologies and policy tools.

To assist community groups develop responses to the Government's Inquiry the TEC sought assistance from consultants to prepare reports on:
1. The likely (segregated) waste streams in firstly, the Sydney/Newcastle/Wollongong region and secondly a "typical' coastal region over the next 5, 10, 20 years – assuming major landfill and inclusion of other management regimes reasonably anticipated by waste management authorities.
2. A brief review of alternative technologies and practices in terms of feasibility (short, medium, long term) and assessment against ecologically sustainable development (ESD) principles and the inquiry terms of reference and employment generation.
3. A practical alternative waste management plan for the segregated waste streams for the next 5, 10, 20 years for Sydney/Newcastle/Wollongong region and "typical" coastal region that minimises landfill and maximises reuse and waste minimisation with data on resulting employment and economic activity.
4. Removal of barriers to accelerated implementation of the alternatives.

In response to the terms of reference of the Government's Inquiry into alternative waste technologies and practices this report only deals with technologies and practices applicable to management of solid wastes that are regulated under the *Waste Minimisation and Management Act 1995*.

This report deals with all of item 1 and the parts of item 2 listed above. A brief review of alternative technologies and practices in terms of feasibility is covered in this report and an introduction is made on the assessment of alternative technologies in terms of ESD. A more detailed assessment of alternative technologies in respect of ESD will be included in a following report to be provided to the TEC.

The report is limited to the brief outlined by the TEC and that is described in points 1 to 4 above. This report therefore is intended to provide and presents data and information for use by others in developing responses to the Alternative Waste Technologies and Practices Inquiry – it is not written or intended to be itself a report to the Inquiry.

1.1 Defining key terms

Throughout the waste planning and management field and literature in NSW there is a good deal of variation in terminology and its manner of use. As such following are definitions for terms used in this report.

ESD: *Ecologically sustainable development* is the principle under which development and activities in solid waste management should be undertaken as required by the *Waste Minimisation and Management Act 1995.* ESD:
Is considered to be the effective integration of economic and environmental considerations in decision-making processes, and can be achieved through the implementation of the following principles and programs:

(a) the precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:
(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
(ii) an assessment of the risk-weighted consequences of various options,

(b) inter-generational equity—namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations,

(c) conservation of biological diversity and ecological integrity—namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,

(d) improved valuation, pricing and incentive mechanisms—namely, that environmental factors should be included in the valuation of assets and services, such as:
(i) polluter pays—that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,
(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,
(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

CBA: *Cost benefit analysis* is an economic tool for quantifying costs and benefits (in monetary terms) of an activity / development.

CDL: *Container deposit legislation* – a form of financial levy imposed on packaging products aimed at facilitating reuse / recycling.

CP: *Cleaner production* is a planning tool for reducing environmental impacts through improved product design and production performance.

DoE: *Design for the Environment* – in principle is similar to cleaner production however focus is on materials efficiency and reduction of environmental burdens of a product or service through the design stage / process.

EMS: *Environmental Management System* is a management tool used to manage the environmental issues or factors relevant to an activity or business.

LCA: *Life cycle assessment* – a tool for studying, analysing and assess the environmental impacts of material and products use.

Recycled: The term "recycled" in this document is to be taken as a general description of a material that has been made available as material for re-manufacturing or further processing to ensure its remanufacture.

Recyclable: Materials that are potential materials for reuse or recycling are described as “recyclable”.

Direct recycling: Direct recycling means the processing of material into a similar non-waste product. That is the recycling of plastic bottles into plastic bottles.

Indirect recycling: Indirect recycling means the recycling of a material into another product via a transformation process. For example the recycling of plastic bottles into plastic chairs or the combustion of plastic to produce energy.

Technology: We adopt the broad definition of technology as being the terminology of an art, science etc. Where necessary we define particular types of technologies, ie technical (hard) or sociological (soft) technologies.

Waste management: Any reference to waste or waste management throughout this report, unless otherwise stated, relates to non-hazardous solid waste and its management, (although we recognise household hazardous type wastes are important in planning and managing solid waste streams we do not consider these in any particular detail). Any reading of the term “waste” should therefore be read in reference to this context.

1.2 Study boundaries and focus

It is important to recognise the parameters for the current debate of “technologies” and “practices” in the area of waste management are not fixed within society. In fact there are many ways that persons, groups, governments, associations etc. perceive, relate to and or approach the topic of waste and waste management.

In recognition of this we need to define and present the study boundaries and assumptions used in the reports.

Firstly, we take a “systems” approach in dealing with society management of wastes where a number of technologies and approaches (practices) occur within the waste management system shown in Figure 1-1.

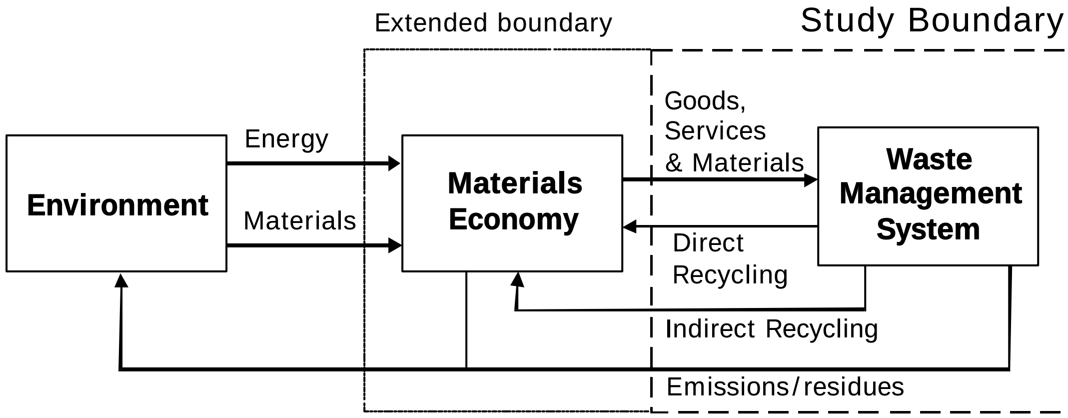


Figure 1-1: System boundaries under study

Within the materials-economy there are many and numerous complex relationships. These result from the many materials types chosen and used in the materials-economy and it involves the many and varied management styles and methods used to provide and move these through the materials-economy. This we can define as the waste management *problem*

It is not within the scope of this work to be able to explore, describe or evaluate all complexities within the *problem*. Our approach has been defined by the consultancy brief and terms of reference of the Inquiry and as such our view of the *problem* has needed to allow for a wide rather than narrow review and assessment of current and potential alternatives available within, the "waste management system" (Figure 1-1).

Recognising and considering waste outputs from the economy (Figure 1-1) and the multi-dimensional nature of decision making in waste management it is appropriate to consider and evaluate material flows and decision-making processes for evaluating key questions of this report, namely:

- What is the nature and problem of waste and its management
- What is sustainable waste management, and
- How should it be achieved?

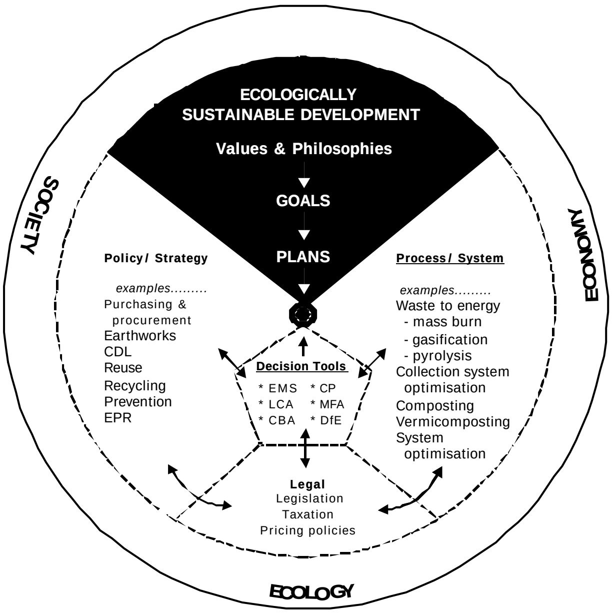
We have therefore developed our reports around materials (presenting as wastes) within the material economy and the management of these materials.

To undertake evaluation of alternative technologies and practices in terms of ESD however we need, at times, to expand the boundaries of the "system" under study as the economic, social and environmental impacts (costs, benefits etc) are not limited to or within the *waste management system*.

1.3 Decision-making, ESD & debate parameters

We also recognise many varied views exist on decision making. However Figure 1-2 provides our view of the many factors and processes involved in ESD evaluation of technologies and practices in the area of waste management.

It locates some of the many terms and processes used in the field of waste management with types of technologies available to society, eg. to the "soft" technologies of policy/ strategy or the "hard" technologies of systems or process engineering.



CDL	Container deposit legislation
EPR	Extended producer responsibility
EMS	Environmental management systems
LCA	Life cycle assessment
CBA	Cost benefit analysis
CP	Cleaner production
MFA	Materials flux analysis
DfE	Design for environment

Figure 1-2: Model for multi criteria decision-making & technology choice evaluation in waste management

1.4 Data and reporting

All reasonable attempts have been made to source up-to-date and relevant data on the flows of materials and wastes within the study areas.

The most consistent, up to date, comprehensive and publicly available data is for the year 1996 and as such that year has been the base year for all work conducted.

In line with the aims of the TEC to provide data and information to the public and community groups we have identified and reviewed a wide range of materials and data for this report. Much of the information or data we have referred to in our report is publicly and freely available on the world-wide-web. Where this is the case we either introduce the reader to the issue or provide a reference for readers to follow-up more detailed. Reference materials on waste and waste planning and management have also been provided and are accessible on the TEC Internet site.

1.5 Organisation of Reports

Four (4) reports and one reference volume are being developed as part of the project, as follows:

Report volume	Due date (Website presentation)	Contents
1. The Problem & Directions	13 September 1999	• Overview of problem, data & trends • Overview of parameters of the "waste debate" • Overview of technology types / practices • Overview of the Alternative Objective
2. Comparison & evaluation of alternatives	20 September 1999	• Environmental profiles of alternative technologies • Economic profile of alternatives • Review of feasibility of alternatives • Identification of "preferred" alternative approach
3. Alternative Plan	29 September 1999	• Presentation of alternative plan and outcomes
4. Barriers Report	29 September 1999	• Description of current system • Presentation of barriers and recommendations for change to implement an "Alternative Plan"
5. Reference Documents	20 September 1999	• Collation and presentation of detailed reference materials & reports • Views on the problem: a government agency-official, industry and community group representatives' view

2 MATERIALS, WASTE MANAGEMENT AND ESD

2.1 Basic principles & thermodynamic constraints

It as been said variously that:

"Everything ends up as waste"
"Eventually everything must be disposed of"
"Treating waste, once it is waste, is a waste of time!"

These views carry an ***underlying fundamental truth*** relating to the physical laws of nature, and the role of thermodynamics in dictating the shape and performance of our material economy.

In essence, these fundamental laws mean that there exists an inter-relationship between mass (including waste) and energy, and, furthermore, the ability to derive any useful function from materials (including waste) and energy within our economy is compromised by their continuous degradation caused by "use".

What this all means is that **we can only continue to extract useful function from materials in our economy by the continuous input of energy** – either directly or indirectly. It is this fact which limits the degree to which materials are either kept within or discarded as wastes from the economy. The choice of whether they are discarded and become "waste" is generally either on the basis that they are too degraded to perform their stated function, or the cost to reinstate that function (in energy and or monetary terms) is deemed to be excessive.

Any material or energy transformation therefore carries with it an environmental cost from the impacts of the energy input required to "maintain" or "transform" a material to make that material useful or useable by society. It is the overall consideration of these issues, informed by the guiding principles of ESD, which should direct our management practices.

This does not mean that there are no potential material use "cascades" – where the "waste" from one activity can serve as raw material to another (the so-called Industrial Ecology model), nor that there are attractive reuse / recycle opportunities. It does mean, though, that these should not be taken for granted as the preferred approach to materials handling in our economy – ***opportunities will be specific to the system under investigation***. For example if one considers only the system bounded by the study boundary line in Figure 1-1 opposed to studying the system within this plus the area within the extended boundary. For this reason, any true consideration of ESD and waste management must address all interactions between materials and energy in the delivery of the desired material, good and or service to society.

2.2 What is the problem with waste management?

> *"In the main it is still true that the way industry produces has a negative environmental impact: the amount of energy consumes the kinds of materials it uses; the nature of the chemicals it employs; the type of airborne emissions its produces the solid and liquid wastes it generates – all of these often cause deep ecological damage……. Fortunately we can do a great deal.*
>
> *We can change the nature of our economy- we can shift from a quantity to a quality-powered economy in which economic growth is still possible but without the environmental costs of current forms of economic conduct. More specifically we can shift away from the use of non-renewable energy, conserve materials (especially ones that can not be replaced), clean up production practices and make products that look good, work well and do little environmental damage. Equally we can make products that are easy to recycle at a low energy cost. We can take responsibility for what we make and use and develop ways of consuming that do consume. We can discover the link between our wish for a sound environmental present and future, what we buy and use and what we demand. As a result, we are better able to eliminate that which we find we do not need, reduce that which we do need (but not in excess), reuse much of that which still has life in it, and recycle/ re-consume that which is available as a continuing resource."*

Tony Fry, "Green Desires: Ecology-Design-Products". 1992

Fry (1992) pinpoints the fundamental nature of the waste management problem – the inefficient use of materials within the material economy.

We conventionally recognise a one-way flow of materials from the environment, through the economy and then "waste" to the environment with only one-cycle occurring for most materials. However this is recognised to be no longer acceptable.

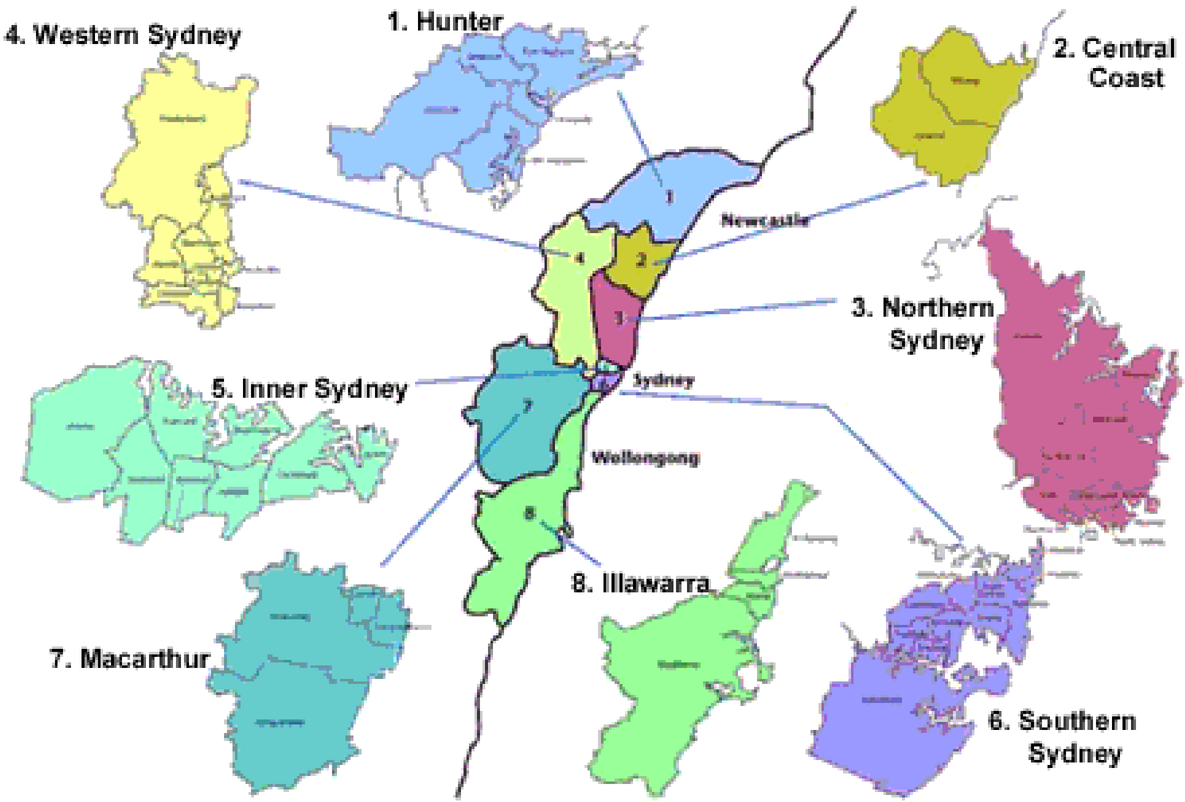
Additional to the physical problems of waste such as its collection, treatment and disposal, environmental and social problems also exist. A description of these is provided in Report 5 or at http://www.epa.nsw.gov.au/earthworks/getnotes.htm

3 SOLID WASTES IN THE GREATER SYDNEY (GSR) AND COFFS HARBOUR REGIONS

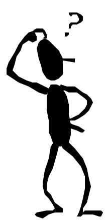
3.1 Overview of the GSR Region

Eight Regional Waste Boards (RWB) have legal jurisdiction for defined regional locations and aspects of waste planning and management within the GSR. These eight organisations are corporate government bodies as defined and regulated by the *Waste Minimisation and Management Act 1995* (WMMA).

Figure 3-1: Regional Waste Boards in NSW



Source: NSW Waste Boards



More information on Waste Boards can be found at *http://www.wasteboards.nsw.gov.au/*

3.2 Population

Population or specifically concentrations of populations are a major determinant in waste generation rates in any particular locality. Current and projected populations over the next 20 years within RWB Regions are shown in Table 3-1.

Table 3-1: Current and Projected Populations - Waste Board Regions

RWB AREA	YEAR							
	1996		2001		2006		2016	
	High	Low	High	Low	High	Low	High	Low
Central Coast	260,800	259,900	278,300	273,900	293,100	283,700	320,500	297,400
Hunter	468,000	465,300	493,300	481,900	517,200	494,900	564,800	514,700
Illawarra	336,700	334,100	359,500	349,300	412,300	362,200	424,400	382,700
Inner	277,900	276,800	295,200	290,560	312,200	302,000	343,000	318,200
Macarthur	259,200	258,200	282,300	277,400	306,000	295,200	343,800	316,900
Northern	742,600	740,000	764,800	752,600	785,900	760,700	831,000	771,200
Southern	963,300	960,100	988,400	972,600	1,015,300	982,900	1,076,500	1,002,000
Western	1,295,100	1,290,800	1,375,500	1,353,700	1,449,400	1,403,300	1,583,700	1,469,500
TOTAL	**4,603,600**	**4,585,200**	**4,837,300**	**4,751,960**	**5,091,400**	**4,884,900**	**5,487,700**	**5,072,600**

*Sources: * DUAP (1994) Population Projections. Non-Metropolitan Local Government Areas in NSW 1991-2021*
** DUAP (1995) Population Projections. Sydney region Local Government Areas 1991-2021*

Current and projected future populations for the "typical" coastal region to be considered in this report are shown for Coffs Harbour City Council in Table 3-2.

Table 3-2: Current and Projected Populations – Coffs Harbour City Council

	YEAR							
	1996		2001		2006		2016	
	High	Low	High	Low	High	Low	High	Low
Coffs Harbour	**57900**	**57200**	**66300**	**63700**	**74700**	**69700**	**92300**	**8100**

Source: DUAP (1995) Population Projections. Sydney region Local Government Areas 1991-2021

3.2.1 Solid Waste Trends

Three sectors are used to describe and measure the amount of solid wastes produced and managed in society. These generally relate to type of activity where wastes are generated and are:

- **Municipal,** this category includes the following sub-categories to which data is reported to the NSW Environment Protection Authority (EPA):
  - Domestic (mixed kerbside collections)
  - Domestic recyclables
  - Domestic other (clean-up collection wastes or other wastes generated by households)

  - Municipal Other (this includes all wastes generated by local government bodies whilst undertaking operational activities eg, engineering works, administration wastes etc.)

- **Building and Demolition,** and

- **Commercial and Industrial**

The domestic solid waste stream, which is part of the municipal waste stream, is currently the only stream where robust data on waste composition (types of materials within the waste stream) exists.

3.3 Waste Generation Rates

The rate of solid waste generation varies depending upon a number of factors. Key factors are socio-economic status of the study population or groups within a population (through aspects of purchasing power and purchasing preferences) and the condition (dynamism or stability) of the economy at any given time.

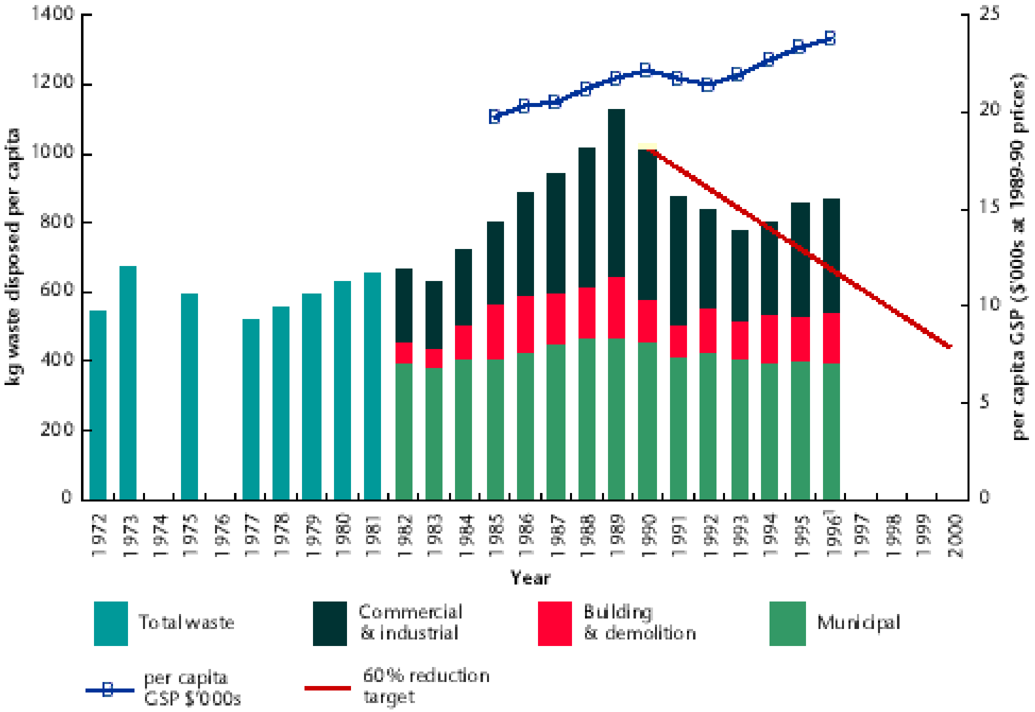
Demographic and historical data, both in Australia and internationally, suggests that as populations achieve higher socio-economic status and/or as positive economic activity/conditions occur, there is increased consumption of goods and services and hence resources. This relationship occurs under the current and prevailing western-style economic and industrial production and consumption modes and has a corresponding effect of increasing waste generation. Consequently landfill disposal rates during good times also increases. Conversely when poor economic indicators are consistent, consumption generally reduces and we see a corresponding reduction in the amount of waste sent to landfill for disposal.

Table 3-2 and Figure 3-2 show statistics for generation and disposal of solid wastes in 1996. Figure 3-2 highlights the general factors and trends discussed in the Sydney metropolitan area between 1972 and 1996.

Table 3-3: Solid Waste Generation across the GSR – 1996

		MUNICIPAL		COMMERCIAL & INDUSTRIAL		CONSTRUCTION & DEMOLITION	
WASTE REGION	**Pop. (1996)**	**Tonnes**	**Kg per person**	**Tonnes**	**Kg per person**	**Tonnes**	**Kg per person**
Central Coast	270,000	156,157	578	145,212	538	71,000	263
Hunter	466,900	254,949	546	180,239	386	44,100	94
Illawarra	323,521	161,544	499	108,911	337	37,893	117
Inner Sydney	276,800	120,420	435	203,156	734	410,000	1,481
Macarthur	274,000	116,428	425	68,847	251	88,626	323
Northern Sydney	741,100	336,976	455	297,187	401	100,600	136
Southern Sydney	961,800	534,852	556	376,209	391	190,392	198
Western Sydney	1,292,800	500,435	387	417,810	323	103,486	80
TOTALS	**4,606,921**	**2,181,761**	**431**	**1,797,571**	**373**	**1,046,097**	**299**

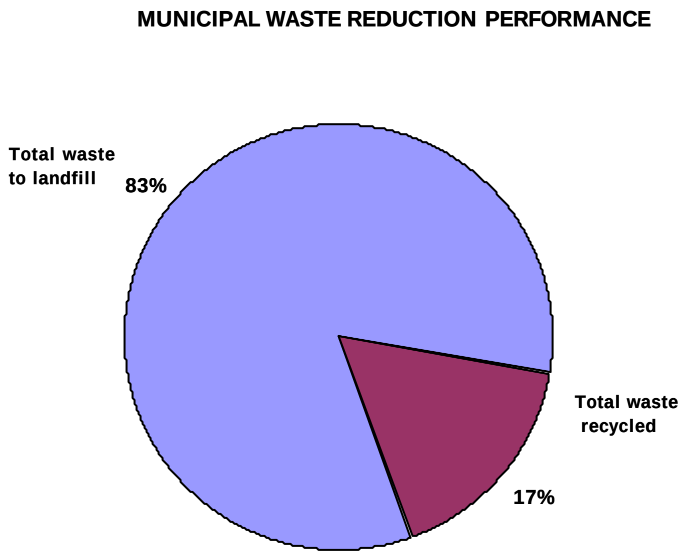
Source: NSW Waste Boards (1998)



Source: "NSW State of the Environment Report." NSWEPA, 1997.

Figure 3-2: Solid Waste Disposal and Gross State Product

The data used in Figure 3-2 can be found at:
http://www.epa.nsw.gov.au/soe/97/ch1/figs/download/ch5f06.xls



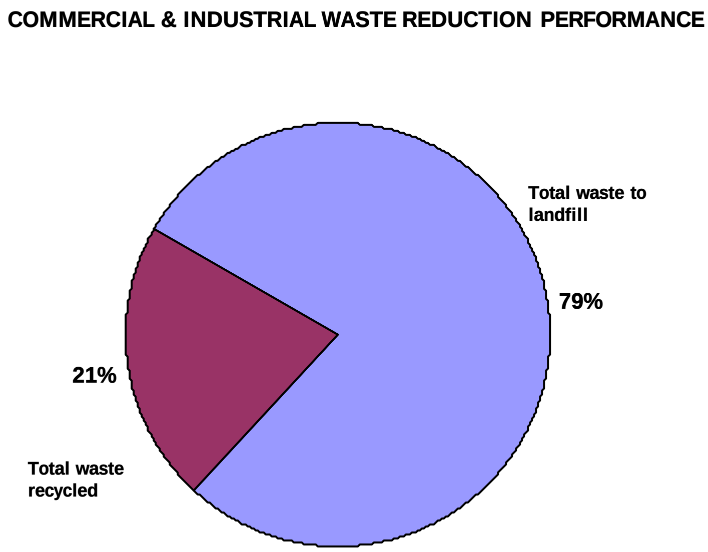


Figure 3-3: Solid Waste Reduction Performance 1996

3.4 Waste Disposal in the Greater Sydney Region

In 1996 and within the eight NSW waste board regions across the GSR:

- 1,813,800 tonnes of municipal wastes was disposed to landfill. This was:

  - about 43% of all wastes disposed in landfill, and

  - on average 83% of all materials presented as wastes[1] in the sector

- 1,922,900 tonnes of commercial and industrial waste was disposed to landfill, which was 33% of all solid wastes disposed, and was

  - about 81% of all materials presented as wastes in that sector

- 1,046,100 tonnes of construction and demolition waste was disposed which was 24% of all solid wastes disposed, and

  - 100% of materials presented as wastes in that sector.

Across all waste board regions this equates to a total landfill disposal rate based on total population of 931 kg per person per year. This can be broken down into:

- 394 kilograms of municipal wastes
- 310 kilograms of commercial and industrial wastes, and
- 227 kilograms of construction and demolition wastes

Table 3-4: Total Domestic Mixed Wastes Landfilled in GSR, 1996

		Total Mixed Domestic Wastes Landfilled		Estimated Recyclable Materials Disposed to Landfill in Mixed Wastes @			
				Paper	Glass	Plastics	Metals
REGION	Population	tonnes	Kg per person	Tonnes	tonnes	tonnes	tonnes
Inner Sydney	277,000	100,000	361	9,000	4,000	3,000	3,000
Macarthur	274,000	84,000	306	6,000	3,000	2,000	2,000
Northern Sydney	741,000	256,000	345	14,000	6,000	9,000	5,000
Southern Sydney	962,000	454,000	472	26,000	9,000	11,000	5,000
Western Sydney	1,293,000	433,000	335	8,000	6,000	8,000	4,000
Central Coast	270,000	142,000	524	9,000	3,000	3,000	2,000
Hunter	467,000	224,000	481	15,000	3,000	700	2,000
Illawarra	324,000	122,000	376	0	0	0	0
GSR Total	**4,608,000**	**1,815,000**	**394**	**87,000**	**34,000**	**36,700**	**23,000**

NOTE: @ This data represents the estimated additional recyclables that remain in wastes disposed to landfill, ie not recovered in recycling collections

[1] The phrase "presenting as wastes" is used because not all waste generated within any one sector is necessarily presented for collection, treatment and or disposal. As example the C&D industry data does not include wastes generated and sent for direct recycling.

Table 3-5: C&I and C&D Wastes Landfilled in GSR, 1996

		Commercial & Industrial Wastes		Construction & Demolition Wastes	
REGION	Population	tonnes	Kg per person #	tonnes	Kg per person #
Inner Sydney	277,000	180,000	650	410,000	1,481
Macarthur	274,000	68,000	250	89,000	323
Northern Sydney	741,000	378,000	510	101,000	136
Southern Sydney	962,000	420,000	437	190,000	198
Western Sydney	1,293,000	325,000	252	104,000	80
Central Coast	270,000	201,000	744	71,000	263
Hunter	467,000	230,000	493	44,000	94
Illawarra	324,000	117,000	370	38,000	117
GSR Total	**4,608,000**	**1,919,000**	**535**	**1,047,000**	**227**

NOTES
- data shown here may vary from that in RWPs by rounding to nearest 100 tonnes

\# Although consistent with EPA reporting protocols note however that the measure of kg/person shown is questionable as no direct relationship exists and therefore this measure does not properly represent a linkage to the waste generator

3.5 Waste Disposal Reduction in the GSR

In response to government policy there have been concerted efforts, particularly in the area of recycling, to reduce the total amount of waste sent for landfill disposal.

Success in recycling has been varied across each waste sector although in each waste sector there has been a different focus on types of materials targeted and recycled. Table 3-12 alludes to these differences.

As there is only a structure for reporting wastes recycled in the municipal waste sector, and even within this sector there is a focus on household sourced materials only, this is the only sector where available data exists for recycled materials. As at 1996 materials from municipal sources recycled are shown in Figure 3-3 and Table 3-6.

Table 3-6: Municipal waste reduction across the GSR – 1996

		Total materials diverted from landfill		
Region	**Population**	**Tonnes**	**Kg/capita/yr**	**% of total waste generated**
Central Coast	270,000	14,700	54	9
Hunter	466,900	30,500	65	12
Illawarra	323,500	39,900	123	25
Inner Sydney	276,800	20,400	73	17
Macarthur	274,000	32,600	119	28
Northern Sydney	741,100	79,600	107	23
Southern Sydney	961,800	81,000	84	15
Western Sydney	1,292,800	67,400	52	13
TOTAL	**4,606,900**	**366,100**	**75**	**17**

Note Totals may not add due to rounding

Table 3-7: Commercial and industrial waste reduction across the GSR – 1996

	Total materials diverted from landfill	
Region	**Tonnes**	**% of total waste generated**
Central Coast	21,900	15
Hunter	38,900	22
Illawarra	27,900	26
Inner Sydney	23,200	11
Macarthur	22,800	33
Northern Sydney	61,900	21
Southern Sydney	80,300	21
Western Sydney	107,900	26
TOTAL	**384,800**	**21**

Note Totals may not add due to rounding

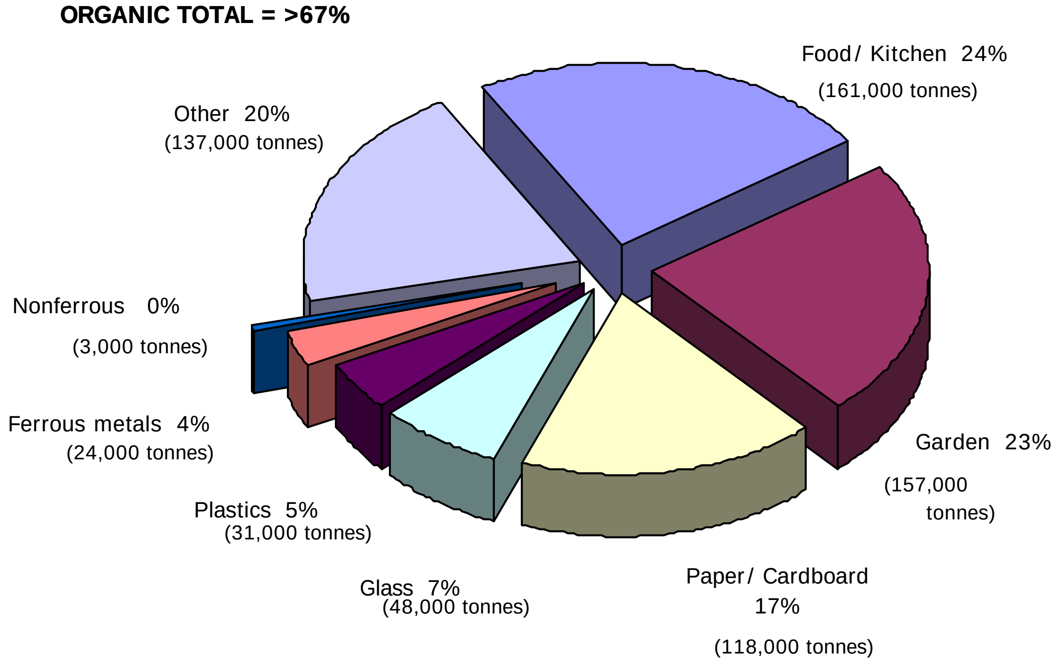


Figure 3-4: Composition of municipal wastes landfilled - 1996

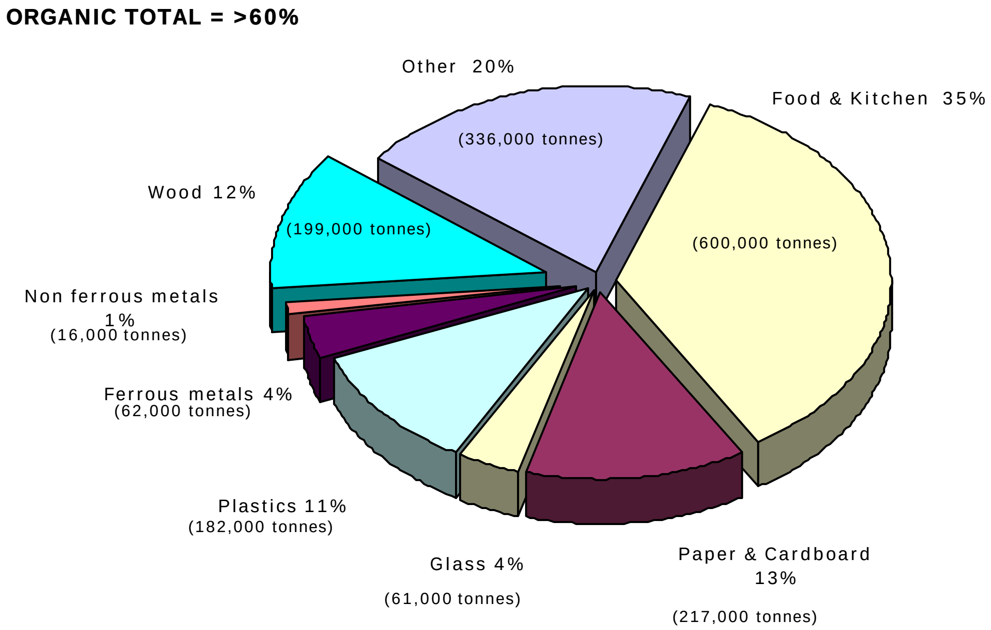


Figure 3-5: Composition of commercial and industrial landfilled - 1996

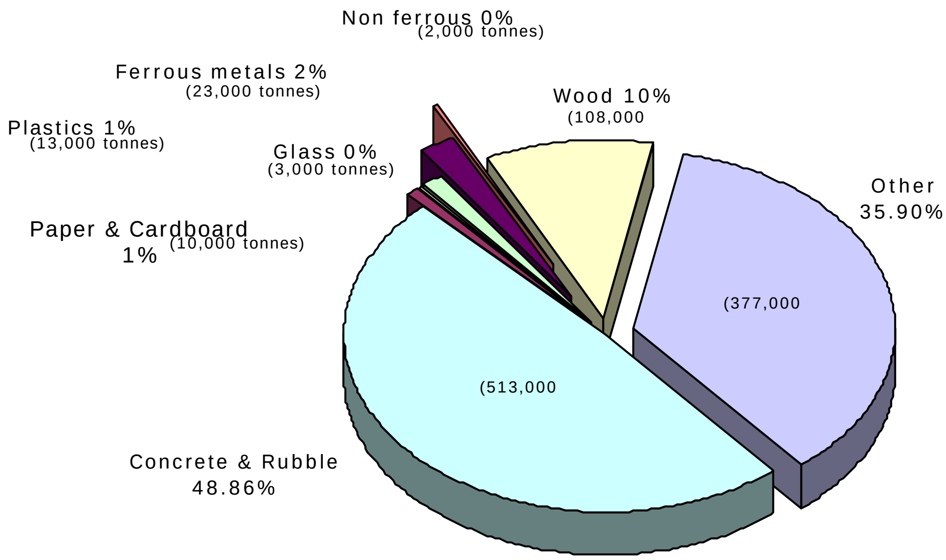


Figure 3-6: Composition of construction and demolition wastes landfilled - 1996

3.6 Waste generation, disposal and recycling in the Coffs Harbour local government area

3.6.1 Total waste stream characterisation

Table 3-8 shows projected waste stream composition. This data has been generated using the waste composition data available for waste streams within the GSR. Although these may vary due to regional variations these have been projected this way due to a lack of waste characterisation data for Coffs Harbour City Council region waste streams.

Table 3-8: Waste streams in the Coffs Harbour City Council LGA

	Percent of total wastes landfilled	Tonnes	Comments
Municipal	57	25,616	CHCC landfill survey data (1996/97)
Commercial	30	13,482	CHCC landfill survey data (1996/97)
Demolition	13	5,842	CHCC landfill survey data (1996/97)
Total 1996	100	44,941	"Grand total received" minus liquid wastes from CHCC 1996 data

Table 3-9: Breakdown of waste types disposed to landfill – 1996

	Municipal*		Commercial		Demolition	
	% of total	Tonnes	% of total	Tonnes	% of total	Tonnes
TOTAL	57	25,616	30	13,482	13	5,842
Mixed	50	12,859	100	13,482	100	5,842
Greenwaste	26	6,609	-	-	-	-
Recyclables	24	6,148	-	-	-	-

*Source: * Coffs Harbour City Council waste composition survey data - 1995*

Table 3-10: Estimation of composition of mixed-wastes landfilled – 1996

	Municipal #		Commercial #		Demolition #	
	% of total	Tonnes	% of total	Tonnes	% of total	tonnes
TOTAL	100	25,616	100	13,482	100	5,842
Concrete	-	-	-	-	49	2,855
Food Kitchen	24	3,044	36	4,836	-	-
Garden wastes	23	2,970	-	-	-	-
Wood	-	-	12	1,604	10	602
Paper/ cardboard	17	2,247	13	1,751	1	58
Plastics	5	579	11	1,463	1	74
Ferrous metal	4	454	4	502	2	130
Non ferrous metals	0	60	1	132	0	12
Glass	7	904	4	488	0	16
Other	20	2,601	20	2,706	36	2,097
Total	**100**	**12,859**	**100**	**13,482**	**100**	**5,845**

Notes: # - Projections carried out using waste sector composition data from GSR

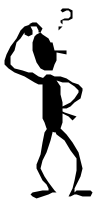
3.7 Recycling performance

Table 3-11 provides a comparison of recycling activity in NSW compared to other States in Australia and internationally. Table 3-12 provides an overview of recycling activities and factors in different waste sectors.

Table 3-11: Comparison of waste generation and recycling rates

	Waste Generation kg/capita/yr	**Waste Disposal** kg/capita/yr	**Recycling** kg/capita/yr
Australia			
ACT	-	760	73
NSW	1200	1120	77
Tasmania	-	-	-
Queensland	1320	1270	-
South Australia	960	890	-
Victoria	1210	1070	-
Western Australia	1340	1310	-
Northern Territory	-	-	-
International (1992)			
USA	730	-	-
Japan	400	-	-
Canada	660	-	-
Norway	510	-	-
France	470	-	-
Germany (1990)	340	-	-
Russian Fed. (1990)	159	-	-
Portugal	330	-	-
The Netherlands	500	-	-

Sources: Australian Bureau of Statistics, 1998. 1996-97 Waste Management Industry: Australia (8698.0). ABS, 1999. Australian Demographic Statistics (3101.0). http://www.abs.gov.au/wesitedbs



More information on waste disposal recycling in NSW can be found at:
http://www.epa.nsw.gov.au/soe/97/ch5/4.htm
http://www.civeng.unsw.edu.au/water/awdb/repfr1s.htm
http://www.arrnetwork.com.au/arrinfo/about.htm

Table 3-12: Overview of recycling activities in different waste sectors

Waste sector	Materials	Systems applied/ success of implementation	Data quality/ availability
Domestic	Generally: • Paper, • Glass, • PET, HDPE, some polyethylene plastics • Steel • Aluminium • Garden wastes	• Mixed kerbside collections generally well distributed esp. in high density populations • Source separated kerbside collections generally well-distributed esp. in high density populations • Generally trending toward automated systems. Manual systems also have application in particular situations	• Generally very good to excellent • Quality due to need for Local Government reporting requirements
Municipal LG Operations	Generally: paper cardboard, some construction materials recycling, some greenwaste recycling	• Mostly same as commercial recycling activities • Source separated construction materials • Councils very slow to take up waste prevention and reduction as part of business activities. Similar to that in private enterprise	• Poor data • Requirement to report exists through *LG Act 1997* under SoE reporting but this is not linked to performance assessment/ review by Dept of LG
Commercial and Industrial	• Mostly focused on high volume quality glass paper & cardboard. • Variety of small volume services exist for flexible and hard plastics, polystyrene • some construction materials recycling, • some greenwaste recycling	• Mostly private contractors/ collectors • Preference to source clean separated streams • Some drop off facilities exist	• Poor data in public domain due to commercial competitiveness • No requirement for reporting to EPA or LG • Some data outside city areas available as LG operates some of these services
Construction & Demolition	• Concrete and other aggregates • Timber • Ferrous and non ferrous metals	• Mostly private contractors/ collectors • Preference to source clean separated streams • Some drop off facilities exist • Some construction companies have developed in-house processes • Some raw material suppliers have instigated recycling services	• Poor data in public domain due to commercial competitiveness • No requirement for reporting to EPA or LG Some data outside city areas available as LG operates some of these services

3.8 DISCUSSION

3.8.1 60% target not to be met

The waste data indicates that waste generation rates compared to 1990 per capita waste generation rates are not significantly reducing as desired by government goals.

The data indicates that although there have been some impacts from waste diversion from landfill through recycling, landfill remains the predominant disposal point for materials emerging from the materials-economy, and that under the current system this trend is likely to continue. In other words there seems to have been little development of additional industrial capacity to absorb secondary materials from the economy, over and above that which occurred during development of recycling schemes for dry recyclables, primarily from municipal waste sources.

Considering it is six months until the target year 2000, this indicates the Governments goal of 60% diversion will not be met, nor will it be near being met. This indicates there has been little real impact from the soft-interventionist government policies and programs since 1990.

The two areas where some successes have been recorded are the Construction and Demolition (C&D) and Municipal sectors. In the C&D sector it is estimated a waste diversion of over 70% on average is regularly occurring. This is not represented in the data shown on table earlier as that data only indicates those materials actually presenting as wastes - not total waste generated.

There has been a continuing but slow increase in total dry recyclables being diverted from landfill since 1990. Data shows however that diversion rates vary quite markedly from region to region, but on average total diversion rates are around 17% of the total waste stream.

The key aspect of both the Municipal and Commercial and Industrial waste streams is the high level of organic wastes present - some 60% or more, depending upon the season, in total and on average across all regions.

Composition data indicates that there are very significant and, importantly from a commercial perspective, constant sources of secondary resources, of both renewable (organic) and non-renewable (oil based, metals, plastics) types. Sectors such as the ferrous and non-ferrous metals, plastics and glass sectors although recovering significant volumes could absorb still greater quantities of secondary resources than at present. While there are very significant amounts of these materials in all waste streams there are not mechanisms and or available infrastructure to facilitate greater recovery and recycling.

Overall waste data for NSW shows predominantly a once-only use pathway for all materials and a potential increase in total waste generated (on a per capita basis). The recycling of materials (other than in the C&D sector) still plays a small role in respect of total waste flows in waste regions.

3.8.2 Economic drivers of waste management practice

It is worth noting that economic drivers are the primary cause of the diversion of wastes from landfill in the C&D and Municipal sectors. The cost of waste disposal and the ability of the C&D industry, due to its nature or “leaning” towards materials management have aided that industry to undertake the restructure needed to recover and recycle materials and recover economic benefits as a response to increased costs of waste management.

Similarly the success in development and operation of dry-recyclables markets for plastics, steel, aluminium and glass have resulted from the Recycling Rebate Scheme for local government councils implemented in the Sydney metropolitan area. This economic incentive program facilitated both recovery industry and reprocessing/ remanufacturing development. Through the scheme millions of dollars were made available to “seed” further development of, primarily, a secondary resource market and industries (collection through to treatment and remanufacture) needed to realise the goal of a secondary resource utilisation of packaging wastes. This initial step was good but not enough as industry has resisted going beyond 20% use of recyclable materials and has remained primarily focused on domestic recyclables.

Incentives to date though have clearly not been broad enough when considering the imbalance that exists between the amount of materials flowing into and those flowing out of the economy, as opposed to them being captured and remaining in the materials-economy in recycling (direct and indirect) loops. The lack of industry led secondary-resource development programs infers that barriers exist to development which need to be overcome if greater resource recovery and utilisation is to occur. Overseas researcher who have looked at this problem in similar industrial and materials-based economies indicate barriers exists across the economy include economic, structural and cultural barriers (Ackerman, 1997).

4 FUTURE WASTE GENERATION IN THE ABSENCE OF ALTERNATIVE STRATEGIES

4.1 Projection of future waste generation scenarios

Figure 3-2 showed the 20-year trends in amounts of wastes generated and disposed across three waste producing sectors in NSW.

Projecting the future generation and disposal trends is not an easy or assured task. However using trends and waste data presented in the previous sections a number of potential future scenario's for waste generation and landfill disposal in the Greater Sydney and Coffs Harbour Regions can be produced.

Within this report four scenarios have been constructed. Except for Scenario 1 which outlines the proposed RWP impacts, the scenarios and data presented below are not projections of alternative waste management technologies or practices. Scenarios on these will be presented in a later report. Rather the data presented below attempts to provide insights into the likely future waste generation and disposal needs given current trends and no alternative strategies. The data also provides an opportunity to consider the impact of current waste generation and the availability of current waste treatment and disposal infrastructure to cope with the waste. The four scenarios explored were:

Scenario 1: *"RWB plans & projections "*

This scenario is made-up from the planned impacts (and data projecting these) of the combined eight RWPs. It assumes that RWB avoidance and reduction targets are achieved and that all waste management (collection, treatment, recycling etc) infrastructures are optimised to the goals of RWPs. Data for this scenario was sourced from NSW Waste Board (1998). This scenario is a very optimistic scenario and not one that could be considered to be realistic considering RWP assumptions in achievement of the 60% reduction target and the roll-out of infrastructure programs needed to achieve their stated goals.

Scenario 2: *"Business as usual"*

This is a conservative scenario developed around the assumption that waste generation grows on a par with the waste generation rate in 1996 (on a per person basis) with no increase above the current recycling rate in each sector

Scenario 3: *"Standard growth scenario"*

This scenario is developed on the assumption of growth in both population and consumption rates of goods and that these increase at a rate on par with historical trends over the past 10 years

Scenario 4: *"Standard growth combined with RWB plans work scenario"*

This scenario is a scenario that combines the assumptions of both Scenarios 1 and 3 above. It assumes the optimisation and effects of the RWPs and growth in economy occurs. In other words it is a scenario that attempts to map the successful impact of RWB infrastructure planning against failure of the RWB avoidance programs which are the key assumptions of Scenario 1 being successful.

4.1.1 Scenario data outputs

Table 4-1 and Figure 4-1 to Figure 4-4 below show the comparisons in outcome from the projections of the amounts (by weight) of wastes generated under each of the scenarios described above.

Figure 3-4 to Figure 12 show the projected amounts (by weight) of the various materials within waste streams. These are generated from that average composition data available in RWPs.

See attached spreadsheet data for detail on the data behind these graphs and detail at the regional waste board level.

NOTE

1: As these projections are based upon population figures and the Department of Urban Affairs and Planning (DUAP) are presently reviewing their population projections this data may be amended as these new figures become available
2: Projection results are described only briefly here, as these will be analysed in detail as part of report 5.
3: At this stage the data shown in all figures shows only the "high"-population figure data. Variation in total amounts for "low" is generally less than -5%.

4.2 Projected regional landfill availability

Although there are a large number of landfills within the GSR available data on existing and future landfill capacity is not readily available for all classes of landfill for number of reasons, particularly that remaining landfill volume (airspace) is considered a commercially confidential matter for landfill operators.

NSW Waste Boards (1998) report that total putrescible landfill (Class 1 solid waste landfill) availability in the Sydney area was 21 million tonnes or 12 years use as at 1996 and at 1996 disposal rates (1,753,000 tonnes per year of putrescible waste). No data is available for other classes of landfill.

In assessment of this data NSW Waste Boards (1998) state:

- the 12 years of landfill could be extended to 17 years if their programs for waste diversion and prevention occur, and

- to satisfy a need for 20 years of landfill disposal (at 1996 disposal rates) 3 million tonnes additional capacity is required.

NSW Waste Boards (1998) advises:

> "the above assessment however ignore the existing licensing conditions and other negotiated arrangements that have been made which place limitations on a number of facilities in terms of the maximum rates or input material. These input limitations are based on agreements with waste service providers and host Councils, groups of Councils or with residents. In addition, some Regional Waste Plans place limitations on waste imports from other regions. Although some of the legal implication of this debate are being explored at the time of writing, it can be concluded that a purely technical view of putrescible waste disposal capacity does not reflect the political reality of waste disposal."

Further NSW Waste Boards were advised by its consultant, that;

> "The total quantity of putrescible wastes that can be disposed to putrescible landfills in 2001 is 1.3 million tonnes per year[2]. By comparison, existing putrescible waste disposed is approximately 1.8 million tonnes per year. Indications are that these quantities are, at best, remaining constant", and "while the projected putrescible waste quantities requiring disposal by the year 2001 are estimated at 1 million tonnes year, the assumed waste diversions used to calculate these projections[3] are extremely ambitious and are contingent on all proposed waste diversion programs planned by the five metropolitan waste boards being successfully implemented within the next two years. Realistically, this may no occur in full within this short period timeframe."

---

2 This si the estimated amount of landfill space available to Waste Boards at 2001

3 See Scenario 1 description and data

Landfill capacity in the other areas outside the Sydney metropolitan as at 1996 landfill and generation rates are estimated as:

- Hunter Region - 20 years[4]
- Central Coast - 15 years[5]
- Illawarra - 37 years[6]
- Coffs Harbour - 20 years[7]

Coffs Harbour City Council Officers advised that Council recently assessed available landfill space and current landfill disposal rates. It found that although significant increases in diversion of materials from landfill have been achieved since 1995 recent increases in waste disposal have occurred. The result being gains made in diversion have begun to be cancelled-out by increased waste presentation at the landfill and available landfill volumes are decreasing at a faster rate than predicted and desired.

The EPA (personal communication) has advised that a number of applications for development consent for putrescible waste landfill development and extensions to existing facilities are being considered. Under current arrangements extensions totalling around 12 million cubic metres additional space are being considered for approved landfill sites in the Sydney metropolitan area. Assuming a landfill compaction volume of about 500kg / m^3 this equates to about 6 million tonnes or about 3 years landfilling at 1996 disposal rates. However this available space if approved under current arrangements would not be expected to be available to all regional areas across the GSR.

Whilst it is not possible to confidently project availability of landfill space across the GSR it is possible to highlight that at current waste generation and landfilling rates an immediate and additional impact exists to the landfill availability crisis if projections in any of Scenario 2 to 4 occur. The scale of the additional impact over the existing situation (1996 rates) can be seen in Table 4-2.

4 (NSW Waste Boards (1998)
5 NSW Waste Boards (1998)
6 NSW Waste Boards (1998)
7 Coffs Harbour City Council (personal communication)

Table 4-1: Summarised and aggregated data for future waste generation and disposal scenarios

WASTE SECTOR			Scenario 1		Scenario 2		Scenario 3		Scenario 4	
			Generated	Disposed	Generated	Disposed	Generated	Disposed	Generated	Disposed
MUNICIPAL	1996	High	2,182,000	1,816,000	2,182,000	1,816,000	1,704,000	1,415,000	1,704,000	1,415,000
		Low	NA	NA	NA	NA	NA	NA	NA	NA
	2001	High	2,013,000	1,144,000	2,255,000	1,876,000	2,252,000	1,874,000	2,252,000	1,280,000
		Low	2,000,000	1,137,000	2,247,000	1,870,000	2,244,000	1,868,000	2,244,000	1,276,000
	2006	High	1,905,000	969,000	2,248,000	1,867,000	2,245,000	1,864,000	2,245,000	1,142,000
		Low	1,880,000	956,000	2,308,000	1,920,000	2,305,000	1,918,000	2,305,000	1,172,000
	2016	High	1,941,000	856,000	2,397,000	1,990,000	2,393,000	1,988,000	2,393,000	1,056,000
		Low	1,879,000	829,000	2,394,000	1,993,000	2,391,000	1,989,000	2,391,000	1,055,000
COMMERCIAL & INDUSTRIAL	1996	High	1,798,000	1,413,000	1,798,000	1,413,000	1,798,000	1,413,000	1,798,000	1,413,000
		Low	NA	NA	NA	NA	NA	NA	NA	NA
	2001	High	1,742,000	985,000	1,866,000	1,466,000	1,903,000	1,496,000	1,903,000	1,076,000
		Low	1,731,000	979,000	1,854,000	1,457,000	1,890,000	1,486,000	1,890,000	1,069,000
	2006	High	1,675,000	837,000	1,931,000	1,517,000	1,969,000	1,547,000	1,969,000	983,000
		Low	1,652,000	825,000	1,904,000	1,496,000	1,942,000	1,526,000	1,942,000	969,000
	2016	High	1,678,000	819,000	2,046,000	1,607,000	2,087,000	1,639,000	2,087,00	1,018,000
		Low	1,622,000	791,000	1,977,000	1,553,000	2,016,000	1,584,000	2,016,000	983,000

WASTE SECTOR			Scenario 1		Scenario 2		Scenario 3		Scenario 4	
			Generated	Disposed	Generated	Disposed	Generated	Disposed	Generated	Disposed
CONSTRUCTION & DEMOLITION	1996	High	1,046,000	1,046,000	1,046,000	1,046,000	1,046,000	1,046,000	1,046,000	1,046,000
		Low	NA	NA	NA	NA	NA	NA	NA	NA
	2001	High	1,035,000	689,000	1,100,000	1,100,000	1,122,000	1,122,000	1,122,000	748,000
		Low	1,027,000	685,000	1,082,000	1,082,000	1,103,000	1,103,000	1,103,000	735,000
	2006	High	1,020,000	617,000	1,159,000	1,159,000	1,182,000	1,182,000	1,182,000	715,000
		Low	1,005,000	608,000	1,117,000	1,117,000	1,139,000	1,139,000	1,139,000	689,000
	2016	High	1,031,000	590,000	1,259,000	1,259,000	1,284,000	1,284,000	1,284,000	734,000
		Low	991,000	566,000	1,166,000	1,166,000	1,189,000	1,189,000	1,189,000	680,000
COMBINED	1996	High	5,025,000	4,274,000	5,025,000	4,274,000	4,548,000	3,874,000	4,548,000	3,874,000
		Low	NA	NA	NA	NA	NA	NA	NA	NA
	2001	High	4,790,000	2,819,000	5,221,000	4,443,000	5,277,000	4,491,000	5,277,000	3,104,000
		Low	4,759,000	2,800,000	5,183,000	4,408,000	5,238,000	4,456,000	5,238,000	3,079,000
	2006	High	4,600,000	2,422,000	5,338,000	4,543,000	5,397,000	4,594,000	5,397,000	2,840,000
		Low	4,538,000	2,389,000	5,329,000	4,533,000	5,386,000	4,583,000	5,386,000	2,831,000
	2016	High	4,651,000	2,265,000	5,702,000	4,857,000	5,764,000	4,911,000	5,764,000	2,809,000
		Low	4,492,000	2,186,000	5,537,000	4,711,000	5,596,000	4,762,000	5,596,000	2,718,000

Note: *Data has been rounded to nearest 1,000.*
NA – not applicable

Scenario 1 - Waste Board reduction targets are achieved and recycling infrastructure optimised
Scenario 2 - Waste generation grows on a 1996 per capita generation rate and no increase in recycling
Scenario 3 - Population and consumption rates increase along historical trends
Scenario 4 - Population and consumption rates increase along historical trends and increased recycling

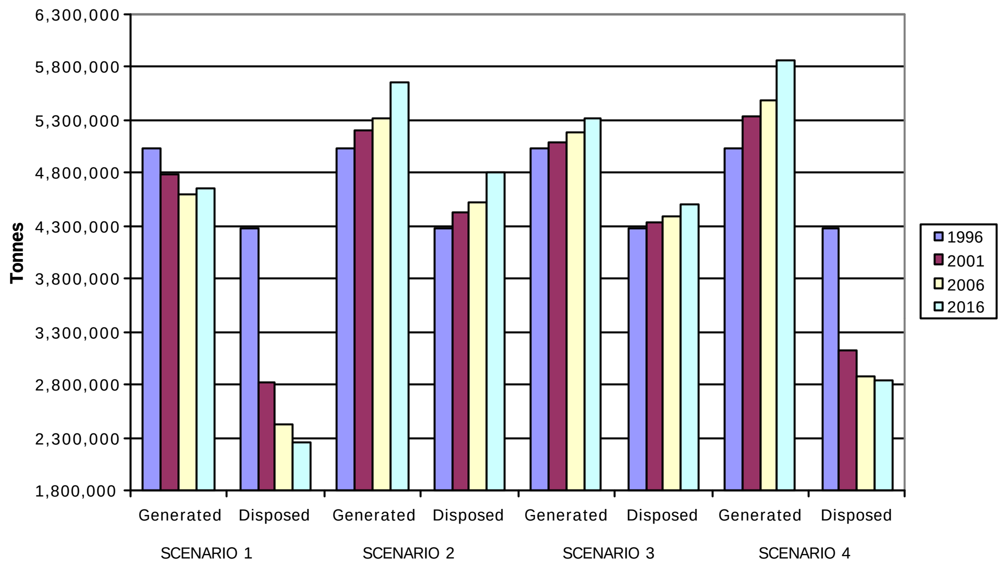


Figure 4-1: Scenario comparisons (combined waste sectors)

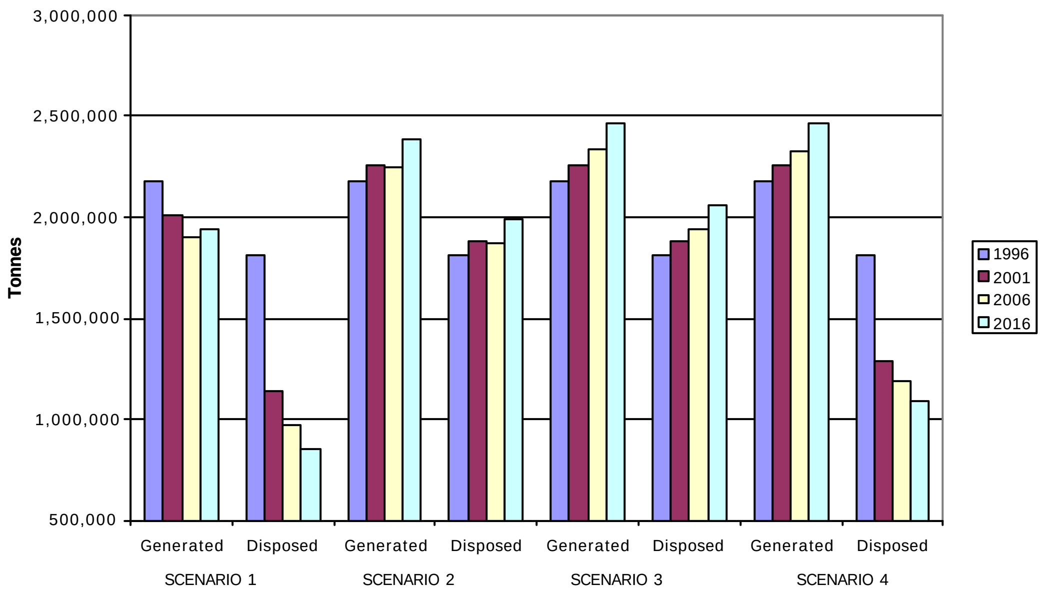


Figure 4-2 Municipal sector scenario comparisons

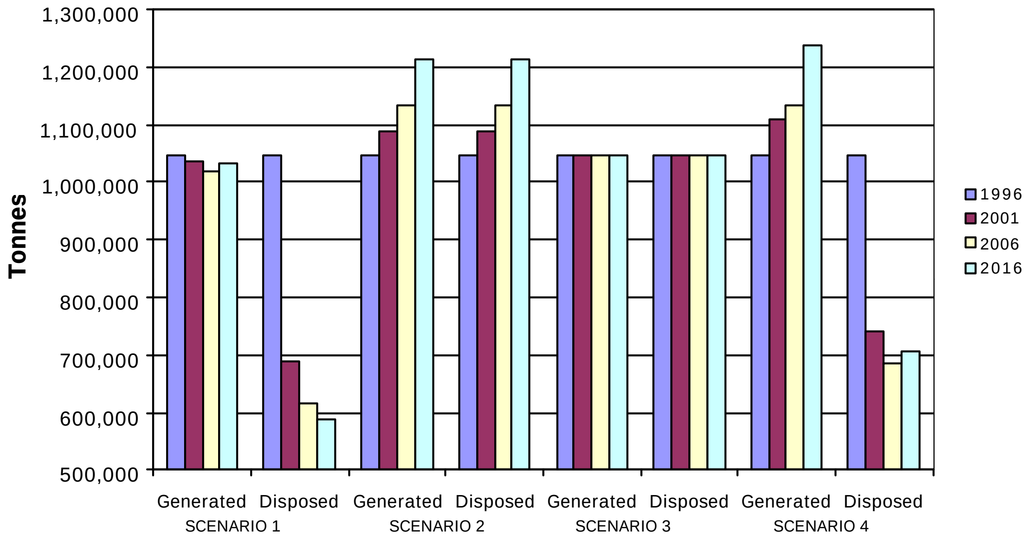


Figure 4-3: Construction & demolition sector scenario comparisons

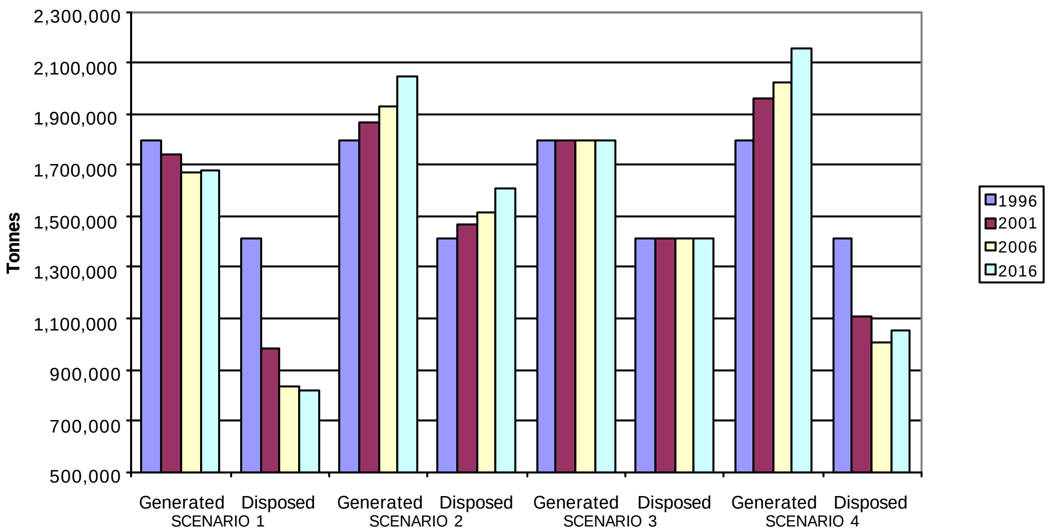


Figure 4-4: Commercial & Industrial sector scenario comparisons

Table 4-2: Results of scenario analysis

COMBINED WASTE SECTORS			Scenario 1		Scenario 2		Scenario 3		Scenario 4	
			Generated	Disposed	Generated	Disposed	Generated	Disposed	Generated	Disposed
	1996	High	0	0	0	0	0	0	0	0
		Low	NA	NA	NA	NA	NA	NA	NA	NA
	2001	High	-5	-34	4	4	16	16	16	-20
		Low	-5	-34	3	3	15	15	15	-21
	2006	High	-8	-43	6	6	19	19	19	-27
		Low	-10	-44	6	6	18	18	18	-27
	2016	High	-7	-47	13	14	27	27	27	-28
		Low	-11	-49	10	10	23	23	23	-30

Notes: NA – not applicable

Figure represent either percent reduction (-) or percent increase as measured against 1996 disposal rates (high)

4.3 Results of scenario development

♦ **Scenario 1**: ***"RWB plans & projections"***

The projections using the RWB plans, if successful would be likely to see:

- A marked reduction in both wastes generated and disposed to landfill. At the following rates:
  - At 2001, about 5 percent reduction in wastes generated and a 34 percent reduction in waste disposed. This would result from diversion of organic wastes
  - At 2006, a 8 to 10 percent reduction in wastes generated and a 43 percent reduction in materials to landfill.
  - At 2016 between 7 to 11 percent reduction in wastes generated and between 47 to 49 percent diversion of wastes from landfill

♦ **Scenario 2**: ***"Business as usual"***

The projections using the existing waste generation trend data, and considering nothing changes as a result of RWB activity we would be likely to see:

- A moderate and continuos growth in total wastes generated and disposed to landfill:
  - At 2001, around 4 percent increase in wastes generated and disposed to landfill
  - At 2006, around 6 percent increase in wastes generated and disposed to landfill
  - At 2016 between 10 and 13 in wastes generated and disposed to landfill

In each year, continued growth will primarily occur from increases in total population in the regions.

♦ **Scenario 3**: ***"Standard growth scenario"***

These projections use existing increases in waste generation from trend data as shown in Scenario 2 and added to this is a continuos linear increase in consumption of around 0.02 percent annum. Under these assumptions we would be likely to see:

- A strong and continuos growth in total wastes generated and disposed to landfill:
  - At 2001, around 16 percent increase in total wastes generated and disposed to landfill
  - At 2006, around 19 percent increase in total wastes generated and disposed to landfill
  - At 2016 between 23 and 27 percent increase in wastes generated and disposed to landfill

The projections using the existing waste generation trend data, and considering nothing changes as a result of RWB activity would be likely to see:

- A moderate and continuos growth in total wastes generated and disposed to landfill:
  - At 2001, around 4 percent increase in wastes generated and disposed to landfill
  - At 2006, around 6 percent increase in wastes generated and disposed to landfill
  - At 2016 between 10 and 13 in wastes generated and disposed to landfill

In each of year continued growth will primarily occur from increases in total population in the regions.

♦ **Scenario 4**: ***"Standard growth combined with RWB plans work scenario"***

In Scenario 4 the following assumptions were used to assess potential waste generation given that:

- RWB waste disposal reduction activities were successful however instead of assuming the total rate of waste generation would fall we assumed that consumption increased at the 0.02% per annum amount used in Scenario 3. This Scenario therefore could represent a more realistic case considering their limitations on effecting the materials- economy as highlighted in section 4.2.

Under these assumptions we would be likely to see:

- A strong and continuos growth in total wastes generated and disposed to landfill:
  - At 2001, around 16 percent increase in total wastes generated and a 20 percent reduction in waste disposed to landfill (as opposed to the anticipated 20 to 34 percent reduction under Scenario 1)
  - At 2006, around 19 percent increase in total wastes generated and a 27 percent reduction in waste disposed to landfill (as opposed to the anticipated 43 to 44 percent reduction under Scenario 1)
  - At 2016 between 23 percent increase in total wastes generated and a 28 to 30 percent reduction in waste disposed to landfill (as opposed to the anticipated 47 to 49 percent reduction under Scenario 1)

Under this scenario's assumptions there is a significant shortfall identified in the RWB planning projections if waste avoidance does not occur.

4.4 Future generation - conclusions

The data presented in this section outlines the foundation of the waste crisis - that without future local extensions there is technically 12 years capacity but only 2 years of accessible landfill capacity under current arrangements within the Sydney Metropolitan area. The sole focus on landfill volume by government and industry highlights the concern that the dialogue is incorrectly focused. It should instead be focused on the unsustainable management of the materials-economy <u>and</u> the role of landfill in a sustainable materials-economy.

The available landfill volume however does mean that in the very short term, 2 to 5 years, Sydney is facing a waste disposal crisis in management of putrescible wastes as RWB program implementation is not keeping pace with the needs of the region.

Data presented in Table 4-2 shows that all projections are a significant increase over that projected in RWB Plans. In concert with discussion in Section 4.2 this indicates that under “growth” scenarios the pressures of a lack of adequate treatment infrastructure become even more acute.

Overall the situation and scenarios provided, although highlighting short-term problems, are also showing there is immediate need to reconsider planning and “development” activities for diverting and managing waste flows via alternative systems and practices.

5 OVERVIEW OF TECHNOLOGIES AND PRACTICES IN WASTE MANAGEMENT

The following is a brief overview of the key technologies and practices utilised in waste management in NSW.

Much public data is available in the literature of the technologies and practices available and as such we have provided detailed references and some documents as part of Report 5 – “Reference Documents”.

5.1 Disposal Technology

5.1.1 Land disposal

Description

Landfill disposal involves deposition of materials no longer considered useful to society into a prepared void in the surface soils of the earth with the aim of encapsulating and containing the waste indefinitely.

Variations in landfill types generally relate to either their operational design requirements and or the types of materials that are intended to be stored within the landfill.

Landfill activities within NSW are widely linked to rehabilitation of extractive industry voids and are used in many cases as parallel activities during extraction itself. This has had the effect of reducing the transparency of the true cost of conducting landfill development, management and post-closure maintenance in the Sydney region.

The nature of mixed-waste landfill structures means that old landfill sites are not generally suitable for construction (as ground is unstable and gases are problematical for many years) most old sites become sterilised for many year. As this is the case for most old sites in the Sydney region they have been developed into sporting or recreational facilities.

Waste streams treated

Engineered landfills can fulfil a range of functions and there are various approved classifications of landfills used throughout NSW to deal with and or treat wastes. Their classifications are:

Solid Waste Class 1 Landfill
These are engineered landfills that can accept for treatment all solid wastes including putrescible and other wastes approved by the EPA

Solid Waste Class 2 Landfill
These are engineered landfills that can accept for treatment all solid wastes excluding putrescible wastes and other wastes approved by the EPA

Inert Solid Waste Landfill – Class 1
All inert wastes including stabilised asbestos cement and physically, chemically or biologically fixed, treated or processed wastes in accordance with EPA requirements

Inert Solid Waste Landfill – Class 2
All inert wastes including stabilised asbestos cement and physically, chemically or biologically fixed, treated or processed wastes in accordance with EPA requirements. These landfills are usually used to dispose of inert soils and or construction materials that are relatively benign materials. As such they are relatively less complicated in design and construction

Existing Uses

The engineered landfills known today have evolved from earlier less controlled processes known as sanitary landfills that were used to protect public health by controlling and regulating placement of potentially noxious materials (putrescible materials) into voids in the earth. This process controlled and managed risks from wastes associated with disease and vermin.

Sanitary landfills however have evolved to today's engineered landfills that encapsulate and control environmental processes in and surrounding the deposited wastes. The engineered landfill is designed not only to protect public health but also to actively mitigate against the potential negative environmental impacts that concentrating large volumes of solid wastes in one locality and facility can have.

Variations/ Alternatives

In the introduction to their *Environmental Guidelines: Solid Waste Landfills* NSWEPA (1996) identifies the role of landfill as being to treat and managing solid wastes that are no longer wanted or not economically viable to treat otherwise..

The Western Sydney Waste Board however has shown in its systems analysis of waste flows in it's RWP that landfills act to assist wastage in society by providing a repository for materials which are replaced with more materials and so on. This is because waste prevention can not happen at the landfill gate, only waste reduction can happen after waste is produced and that it involves diverting materials from landfill. The critical issue of waste production at source is not addressed, nor does it need to be if landfills are considered to be "removing the problem".

In recent years engineers have attempted to redefine landfill management to integrate their role in waste reduction program. Engineered landfills however can only perform a treatment function.

New modes of Landfill

As landfill voids have become more costly with reducing availability of new sites designs have been developing around more efficiently managing the available void spaces and the environmental impacts associated with development and operation.

Although the professional literature describes potential new landfill design and management as being able to manage materials for recovery at some future date predominant changes are and have been implemented around environmental control and impact reduction. This equates usually to leachate and landfill gas capture and treatment.

Viable alternative activities for landfill operation and management include;

Monofils:
This is a modification whereby placements of sorted or source separated materials occurs in dedicated landfill areas or "cells". As an integrated treatment system monofils seem to have potential for high value materials that are currently uneconomical for reprocessing or that are problematical because current supply of materials for markets are beyond that which the existing recycling processors can utilise.

One example known to the author is where a metal processor sends slag wastes to a particular landfill. Upon reaching the landfill the clients slag wastes are placed in a dedicated and separate location to where other wastes are deposited within the landfill void and the location and details of such deposits are logged on the company's records. The reason for this is that the slags contain valuable but presently not recoverable minerals and other materials that once economically and or technically viable (eg a new technology is invented) the materials can be recovered, processed and reused by society. The important factors here are that the opportunity the material presents to society is preserved through the amendment of what is currently considered standard "best-practice" solid waste management.

Active landfills:
These are basically engineered mixed waste landfills that have active air management systems incorporated into their design. This facilitates more efficient and effective landfill gas extraction and utilisation, namely combustion to derive energy for use in electricity or heating in cogeneration plants.

Most landfills are now incorporating such systems or are being retrofitted to utilise the technology. For example the Waste Service NSW is currently developing around 20 megawatts capacity on their old and new landfill sites. Much of the desire to integrate this technology is coming from the need to reduce greenhouse gas impacts of uncontrolled landfill emissions and to recover economic benefits of doing this environmental mitigation work.

5.1.2 Combustion Technology

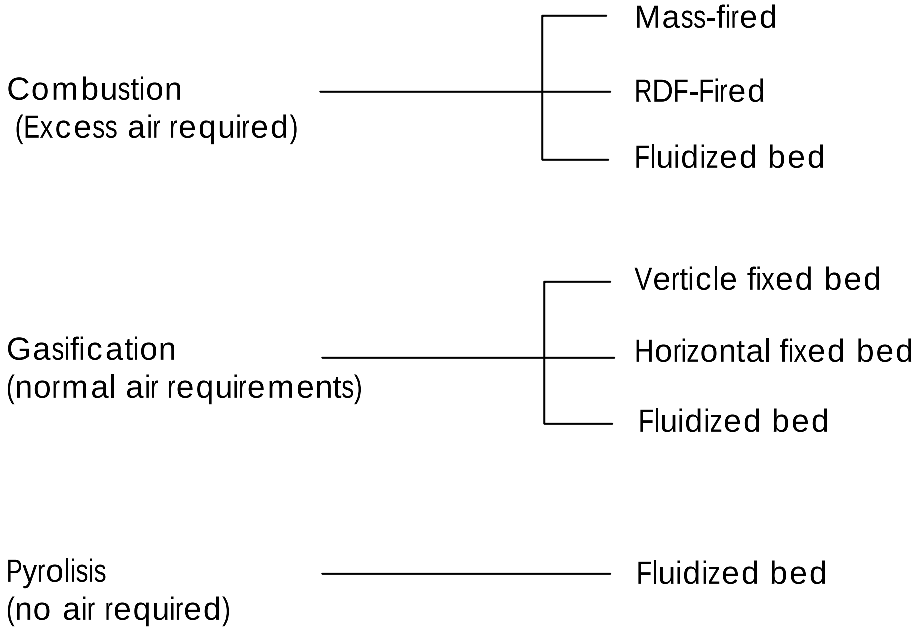
Description

Combustion technology applications for waste management are aimed at thermal processing of waste to achieve either, or both, volume reduction or energy recovery.

Development costs for thermal processing systems for waste management are in the order of $100's of millions so in countries where this technology is used its development is usually linked to other community infrastructure needs that utilise heat generated from combustion of the wastes. This is especially true for countries with extreme winters/ cold temperatures, eg community heating. Alternatively industrial cogeneration may be utilised.

Thermal processing systems can be categorised on the basis of their air requirements as shown in the following figure.

Figure 5-1: Categories of combustion processes



Source: Adapted from Tchobanoglous et al, 1993

Mass-Fired Combustion Systems

In a mass-fired combustion system, minimal processing is given to solid waste before it is processed. Therefore it must be assumed that any materials within waste streams, including hazardous materials may enter the system. As such the system must be designed to deal with this eventuality from an operational and environmental management perspective.

The energy content of mass-fired waste can be extremely variable, depending upon the climate, season or source of waste.

Waste streams treated

All solid waste streams can be treated with the technology

Existing Use

In spite of the potential disadvantages, mass-fired combustors have become the technology of choice for most existing and planned combustion facilities. This is probably due to the fact that they are able to deal with the variable and unpredictable mixed waste load that is their feedstock.

Gasification

Gasification is an energy efficient technique for reducing the volume of solid waste and the recovery of energy. Essentially the process involves partial combustion of a carbonaceous fuel to generate combustible fuel gas rich in carbon monoxide, hydrogen and some saturated hydrocarbons, principally methane. The combustible fuel gas can then be combusted in an internal combustion engine, gas turbine or boiler under excess air conditions. (Tchobanoglous et al, 1993)..

Waste streams treated

Cellulosic and carbonaceous materials.

Existing Use

Source separated waste streams have been used in the development and application of this technology. Wood and vegetative wastes, (and principally clean and well-controlled sources of these wastes such as from forestry operations have been treated in Europe and North America.

Theoretically a high potential exists to use the technology as a method to recover energy from non-recyclable hydrocarbon based wastes such as plastics and rubber products and from organic wastes such as vegetation and food wastes. For mixed waste streams there is a need to exert a considerable amount of energy to “clean-up” waste streams to remove those materials not suited to treatment using this process.

Development of this technology to mixed waste loads of these types of materials is yet to occur to a scale that could meet the current demand for processing in the GSR.

The technology has in the above examples been shown to be beneficial in regard to substitution of non-renewable fuel sources, primarily petroleum. In life cycle assessments (LCA) carried out on the processes. It is important to recognise these LCA studies looked at the application of these technologies only in regard to source separated waste streams - not mixed waste streams. The need remains then to carry out further evaluations and assessments to be able to comment on their applicability to the current problems faced with waste management in the GSR.

RDF Fired Combustion Systems

Refuse derived fuels (RDF) fired combustors utilise RDF fuels that are produced as a separate and preliminary process prior to their combustion.

RDF is generally made from the organic and high-energy combustible materials (eg. plastics and rubber) found in waste streams. These materials are separated from the mixed waste stream and processed by various means into products that meet desired specifications for the RDF combustor (eg energy content, moisture and ash content)..

Waste streams treated

See paragraph immediately above

Existing Use

The RDF can be produced in a shredded or fluff form or it can be made into pellets or cubes that can then be easily transported and stored for use. Densified RDF fuels (pellets and cubed) are more costly to produce but they can be more efficiently transported and stored. Either form can be burned by itself or with other fuels such as coal or other organic (renewable) energy sources. RDF has similar viabilities as gasification.

5.1.3 Pyrolysis

Pyrolysis is the term used to describe the processes of applying thermal cracking and condensation reactions in an oxygen free environment to the processing of organic substances. In contrast to the combustion process which is highly exothermic (energy giving) pyrolytic processes highly endothermic (energy consuming)..

The three major component fractions resulting from the pyrolysis of the organic fraction of MSW are:

- a gas stream containing primarily hydrogen, methane carbon monoxide, carbon dioxide and various other gases
- a tar and or oil stream that is liquid at room temperature and contains materials such as acetic acid, acetone and methanol, and
- a char consisting of almost pure carbon and inert materials that may have also entered the process. (Tchobanoglous et al, 1993)..

Existing Use

Tchobanoglous et al, (1993) report that only one full-scale MSW pyrolysis system was built in the USA and this system did not achieve its primary operational goal and was shut down after only two years of operation. The facility needed to employ a complex arrangement of systems to pre-treat and remove materials from the organic fractions found within the MSW. The ultimate failure of the system was attributed to several factors, including:

- failure of the front-end system to meet purity specifications for aluminium and glass, which affected the economics of the system
- failure of the system to produce a saleable pyrolysis oil. The oil produced had a moisture content of 52 percent, not the 14 percent predicted from the pilot plant results. The increasing moisture in the oil decreased energy content to 3600 Btu/lb as compared to the 9100 Btu/lb predicted by the pilot plant tests.

It was obvious therefore that scaling up the technology was an issue that forced the plant to be decommissioned. This should be an important matter for consideration in application of emerging technologies to large-scale waste treatment in the GSR.

Waste streams treated

Theoretically very similar to wastes used by gasification facilities

5.1.4 Mechanical-Biological Treatment (MBT)

Description

MBT is the mechanical conditioning and subsequent decomposition of residual (mixed) wastes.

Existing Uses

These systems have been used in a range of applications and principally to treat mixed solid wastes for volume reduction and stabilisation prior to landfilling.

Typical the technology is used to create two end products. One is a compostable organic type material suitable for recycled-organics (RO) markets (depending upon chemical quality) or as a source of alternative fuels. The other is a hard fraction that can have a high thermal value as it contains mostly plastics and other hard organic components. This is usually suitable for RDFs.

Waste streams treated

Mixed solid wastes. Generally some sorting and separation of materials occur prior to processing. The technology provides easy process control and tailorisation depending upon input waste quality and can be amended to operate as dedicated system for high quality product if sources of feedstock are available to make the venture viable.

The technology has been utilised in a range of modes including as a volume-reduction process through to development of market grade materials for indirect recycling. The technology development costs are high and as such viability is generally only relevant to mixed waste fractions where premium gate fees can be applied to support infrastructure amortisation over extended periods.

5.1.5 Composting – Vermi-composting

See section 5.2.2 below

5.2 Overview of alternative practices and economic and employment benefits from waste minimisation and materials efficiency

5.2.1 Introduction

Alternative practices are considered to be primarily "soft" technologies implemented to either prevent wastes from being generated or disposed or to facilitate better managing materials and wastes to divert them from presenting as wastes that have to be treated and or disposed to landfill.

Broadly alternative practices include, legislative/ regulatory controls, guidelines and policies and strategies and programs. Some examples include:

- **Purchasing and procurement policies and programs**
  This is a prevention activity that aims to reduce waste generation through better assessment of a material, good or service during the purchasing/ procurement process. It is used mostly in businesses and government agencies. Particular attention in this area has been focused on government as their combined purchasing power has a significant potential (billions of dollars annually) to impact production processes and the waste life-cycle.

- **Earthworks education courses**
  These educational programs involve training community to educate other community people in broad environmental management activities including waste prevention and management at the local level through informed purchasing and consumerism and composting and worm farming.

- **Container deposit legislation**
  Container deposit legislation is an economic instrument used in South Australia to prevent waste by facilitating recovery, reuse and recycling of packaging materials, particularly bottle and containers. It is basically an environmental tax or levy based approach similar to that of the recycling rebate scheme used in NSW and described in Section 3.8.2.

- **<u>Re-use and recycling centres</u>**
  These are either small local/ individual activities centres or large-scale systems that assist recovery and recycling of materials either through direct or indirect recycling into the local or regional economy. These have been successful to date in creating a significant amount of diversion of materials from landfill but it is considered the limit of these mechanisms to create a more cyclical materials-economy has been reached. To achieve future increases in recycling more interventionist recycling policies are considered necessary.

- **<u>Extended producer responsibility (EPR)</u>**
  Extended producer responsibility is an emerging principle for a new generation of pollution prevention policies that focus on product systems and function instead of production facilities and processes alone. It is about being anticipatory of waste and environmental impacts of products as opposed to reactionary to pollution and wastes after production has occurred.

  EPR relies for its implementation on life-cycle analysis to identify opportunities to prevent pollution and reduce resource and energy use in each stage of the product chain through changes in product design and process technology. It recognises that all actors along the product-chain share responsibility for the life-cycle environmental impacts of products, from the upstream impacts inherent in selection of materials and impacts from the manufacturing process itself to downstream impacts from the use and disposal of the products.

  EPR can be considered to be in an "emergent" stage in adoption as policy in Australia. However, with adoption of the National Environmental Protection Measure and the National Packaging Covenant which both deal with packaging it is evident pressure for more responsibility for producers and manufacturers could be forthcoming. Overseas the principle has been used effectively to develop and implement policies that have had significant impacts on waste generation and management. EPR has good potential to serve as an effective instrument for moving the current materials economy towards cyclical use and management of materials.

Other alternative practices exist. Some of these and those reviewed are described in practice in the following sections. In these International and Australian case studies of economic and employment costs and benefits, which have been realised through waste minimisation programs, legislation or other initiatives, are described. This review presents examples which are operational and, mostly, economically self sustaining. While brief, the review is intended to demonstrate the scope of and potential benefits from alternative approaches to managing waste not a comprehensive review of alternative practices.

5.2.2 Australian Case Studies

➢ The Earth Solutions Vertical Composting Unit is an in-vessel system for putrescible waste. It is a world patent that has been substantiated in the last 2 months. It has been 4 years in development and now operates commercially. The composter contains microbes that live at a temperature of 80-90^{0}C. These microbes digest gases that are produced which results in an odourless process. The unit is currently operating at Long Bay Jail and the UNSW. The end product of the process is a stabilised organic compost. At the UNSW 1 person is employed 2 hours a day to run the unit.

Source: - Peter Rutherford, Earth Solutions

- Vermitech, a NSW based company, uses vermicomposting to produce a soil conditioner from municipal green waste and biosolids or abattoir waste. Green waste is used as a bulking agent. The company has operations in NSW and Queensland. Vermitech's biosolids product is sold in bulk as a soil conditioner for horticultural application. It wholesales for around $250/tonne. The Redland Shire facility in Queensland processes around 400 tonnes per week and employs around 5. Intermittent technical expertise is required in overseeing operations and monitoring the quality of product. It is estimated that one full-time employee is required per 100 tonnes per week of capacity. It is assumed the ratio of green waste to sludge is 1:4.

  Sources: - Peter Brooks, Vermitech
  - Lotzof. M. (1999) *The Wonder of Worms for Sludge Stabilisation. Water.* Journal of the Australian Water and Wastewater Association. Jan/Feb: 38-42.

- At The Bower, the company salvages reusable household items from the roadside to provide an alternative to dumping, and subsequently transfer to landfill. This effectively promotes the benefits of reuse and repair of resources. The Southern Sydney Waste Board funds the store. The project is not breaking even at the moment, and to continue will have to be financially beneficially.

  Currently, a repair area has been set up and the following are being repaired:
  - electrical equipment;
  - whitegoods; and
  - furniture.

  Some repairs have resulted in a change of purpose of the original item (eg. "Junk Art"). Some limitations are imposed by the space available to work in. Restricted areas for white goods. The process aims to make use of old household furniture as reusable furniture and building materials, and to resell products to the community at the 'cheapest affordable prices'.

  There is a fairly constant flow through the store. The main restriction to the process is the lack of knowledge of the operation. 5 people are employed, 2 full time, 2 part time and 1 casual.

  Source: Rebecca Welsh, The Bower

- Reverse Garbage is non-profit organisation, financially self-sustaining with 15 full-time and 6 casual employees. The business collects and retails approximately 1,000 tonnes of industrial discards per year.

Source: Felicity Stenning, Reverse Garbage

- Two tip-face-salvaging operations, Revolve in Canberra and Resource in Hobart, employ around 30 people each. The activities undertaken are labour intensive and overheads are low. Both initiatives are geared towards providing meaningful work for the unemployed.

  Source: John Street, Illawarra Waste Board

- The Shoalhaven Mills recycle waste paper to produce printing and writing paper. The plant sources waste from manufacturers of paper products (off cuts) and uses post-consumer waste paper as well (approximately 15-20% of feedstock is post-consumer). Up to 45,000 tonnes of waste paper is processed annually at the plant, which employs 320 people (260 in processing and 60 in maintenance). Recycled products are on-sold and, while the market has been strong, there is increasing competition from importers of cheaper, virgin paper.

  Source: Ian Bain, Shoalhaven Mills.

- Stirling Council (WA) coordinates the **ATLAS** project, a municipal mixed waste sorting facility, which sorts waste into organics, ferrous metals and residual waste. The facility took all of the City of Stirling's mixed waste (300 tonnes/day from May 1997 to May 1999) employing 12 people full-time. Disposal fees at the facility were the same as local landfill fees ($14/tonne). The project was shut down due to a number of problems including resident resistance and regulatory difficulties, however operations will commence in December 1999 under a new set of conditions.

  Source: Viet Nysen, Stirling Council (WA)

- The Port Stephens Council has been operating an aerobic co-composting system called the **Bedminster System** that takes in a mixture of mixed solid waste and sewerage (ratio: 2.5:1). The waste is primarily domestic waste (70-80%). However, construction and demolition, and green waste can also be put into the digester. It spends three days in a digester and the temperature is taken to 55°C over 3 days. The waste is then fed through a screening process at the end of three days to remove large plastics etc. After 28 days on a maturation floor a final screening process removes anything with a diameter greater than 3mm. Usually about 10-20% of the material is landfilled at the end of the process. The final product has sold to the agricultural market. The aim is to produce 20,000 tons a year and to divert 90% of waste away from landfill by the end of 1999. The Port Stephens facility has 10 full-time employees. Currently there is no financial benefit to the council. They have signed an agreement whereby the site is leased, operated, maintained etc for 20 years. The council pays a fee at the gate of between $80-90/ton.

  Source: Michael Skins, Port Stephens Council

- South Australia is the only State in Australia with Container Deposit Legislation. A review of the economic impact of one-trip beverage containers found that the number of soft drink company employees in NSW fell by 80% between 1974 and 1989 while soft drink production increased by 50% over the same period. Part of this change was attributed to the centralisation of bottling activities, which was made possible by eliminating the need to transport empties back to the bottling plant. It was found that around 3,000 jobs would be created in NSW if container deposit legislation were introduced, leading to a market shift to refillable beverage containers.

  Source: - Hopper, P. (1992***) Container deposit legislation for New South Wales: Bringing back returnables***. Friends of the Earth (Sydney) Waste Minimisation Campaign. December, 1992.

- During the recycling of demolition waste of the former Nestle' Factory at Abbotsford by Metropolitan Demolitions Group to make way for a new residential development. Custom fitted machines were used to separate the timber, steel, black iron, rubbish brick and concrete. This was done after the hazardous materials had been removed from the site. Each of these materials was stacked separately to be collected and transferred to building material yards or recycling plants. Due to cost savings in recycling, the brick and concrete were reused in the new road works and drainage requirements. This was achieved through the use of a concrete pulveriser to remove most of the reinforcing steel. Once the material had been pulverised it was put through a mobile crushing plant and a screening plant to produce a range of road and haulage products.

  This resulted in a minimum amount of waste being taken to landfill, large amounts of materials used for recycling or reuse off site, and a major component of the waste materials remained on site for incorporation into the new development project.

  Source: - - Musch, B 1999 in NSW Waste Management Conference & Expo, ***Resourcing the new millennium*** '99:73

5.2.3 International Case Studies

Municipal Solid Waste

- In Chicago, volunteers began the city's first mobile buy-back recycling program, in co-operation with the Chicago Department of the Environment, the city's resource centre, the Chicago Housing Authority and Waste Management Inc., Oak Brook, Ill. The volunteers drive to drop-off sites in the city's housing developments where residents bring recyclables every Saturday. After the sorted materials are weighed, residents are given a voucher to be redeemed at a nearby store. So far, the program has created two jobs that involve light accounting, truck driving and manual labour. Approximately 500 residents participate; some bring materials to the truck, the elderly donate recyclables for pick up and children distribute fliers.

<u>Source</u>: - Lucius, A. (1996) ***Recycling program creates jobs, alleviates poverty***. ***<u>World Wastes</u>***. 39(7): 12-14. 1996 Jul.

- A study cited in Engel (1997) found that recycling 1 ton of materials in a typical kerbside recycling program could save at least $US183 worth of electricity, after deducting the cost of transportation to collect the materials.

  <u>Source</u>: - Engel, C. (1997) ***Taking note of the paper industry***. <u>Monthly Labor Review</u>. 120(9): 32-40. 1997 Sep.

- The region incorporating Baltimore, Washington DC and Richmond, achieved a recycling rate of 23% in 1995. Revenues from the recycling industry totalled more than $US2.1 billion regionally, whereas revenues from waste disposal amounted to less than $US404 million. More than 5,100 individuals were employed in recycling as compared with a little over 1,100 jobs in waste disposal, despite 4 times as much material going to disposal.

  <u>Source</u>: - Platt, B., Jeanes, H., and Kaufmann, A. (1995) ***Recycling boosts the local economy***. <u>Biocycle</u>. 36(8): 60-64. 1995 Aug.

Institutional

- Connecticut Department of Correction, USA, is trialing organics composting. The participating prison has a population of 2,610 that was generating 1,086 tons of MSW per year. Collection, transport and disposal of which cost $US 106,833/a. With the exception of meat, bones, and grease, all plate scrapings and pre-consumption (prep) scraps are collected for composting. The cost of establishing the composting facility and equipment was $US 130,000. In the first three months of operation, the facility processed 73.6 tons and saved $US 4,784 in tipping fees alone (based on above quoted collection, transport and tipping fees, the total saving was around $US 7,200 and estimated annual saving $US 28,900). The project employed 30 inmates although the author suggests that free labour resulted in a system that was more labour intensive than would have otherwise been the case.

  <u>Source</u>:: - Block, D. (1997) ***Composting prison food residuals***. <u>Biocycle</u> 38(8): 37-39. 1997 Aug.

- In an effort to support waste minimisation targets, create jobs and generate goodwill in local communities, Indiana Department of Correction (DOC) has started recycling and composting operations at prisons throughout the state. Between mid-1997 and early 1998, Putnamville Correctional Facility recycling and composting operations have saved over $US69,000 in waste disposal costs and more than 2,000 cubic yards of organic waste have been composted. Plainfield Correctional Facility recovered over 40 tons of recyclables between June 1997 and early 1998, resulting in a saving of more than $US 2,000 in tipping fees. Labour intensive hand sorting was selected and the program provides 32 ‘inmate work assignments’ (this probably means ‘jobs’). The Westville Correctional Facility and the LaPorte County Solid Waste District (LCSWD) are planning to construct and manage a materials recovery facility for the district on prison property which will employ approximately 25 inmates. Three Indiana prisons currently receive a cash return on their recyclables. It is anticipated that more this number will increase as operations become established.

<u>Source</u>: - Cureton, W. ***Composting and recycling at Indiana prisons***. <u>Biocycle</u>. 39(5): 76-80. 1998 May.

Infrastructure

- A company processing up to 1,000 tons of waste per day has a fleet of 85 trucks, a transfer station and recycling facility, 210 employees and a paper reprocessing plant. This company currently achieves a 17% reduction in total waste tonnage through recycling of paper, metal, glass, aluminium, plastic, iron, copper, brass, toilet pans, and steel.

  <u>Source</u>: - DeGrane, S. (1996) ***Heartland hauler extends its branches***. <u>World Wastes</u>. 39(7): 22-28. 1996 Jul.

- While the number of incinerator facilities in the USA has declined with increased recycling rates (131 facilities operating in 1997 and 119 in 1998) the number of transfer stations operating has increased. Between 1995 and 1998 the number of transfer stations increased from 3,100 to more than 3,500.

  <u>Source</u>: - Glenn, J. (1999) ***The state of garbage in America***. <u>Biocycle</u>. 40(4): 60-71. 1999 Apr.

Legislator or Regulator Initiatives

- In California in 1989, a solid waste diversion target was established to reduce waste to landfill by 50% by 2000. Recycling Market Development Zones (RMDZ) were established to provide low-interest loans and assistance for recycling businesses to increase uptake of recovered raw materials. Loans totalling $US29 million have been made to businesses, many of which are recycling organics. It is estimated that 2.3 million tons/year of solid waste will be diverted when all participating businesses complete capacity upgrades, and 721 jobs will be created.

  <u>Source</u>:: - Block, D. (1999***) Government financing and expertise boost recycling businesses***. <u>Biocycle</u>. 40(2): 45-48. 1999 Feb.

- A German government initiative called Recycling-Clearinghouse recycles bulky waste (eg. furniture and household appliances) and reusable building material. Materials are collected, refurbished where necessary, and offered for sale. This program are makes used furniture and household appliances available to low-income residents at an affordable price, preserves useable building materials, saves tipping fees and landfill space, helps keep toxic materials out of disposal sites and provides jobs. The Recycling-Clearinghouse currently provides 35 jobs through a government program for the unemployed. The program has not been able to cover program costs with proceeds from sales due to continual turnover, frequent absenteeism and competence level of workers, as well as customers' rising expectations and demands. There is some argument that the activities undertaken are public waste management and that the environmental benefits and cost savings derived from diverting materials from disposal justify funding through waste disposal fees.

Source:: - Kulik, A. (1993) ***German recycling programs serve multiple purposes***. World Wastes. 36(4): 16-18. 1993 Apr.

Industry

➢ Recycling initiatives, changes in technology and packaging practices and international trade liberalisation have impacted on employment patterns in paper-related industries.

Americans consume approximately 2 pounds of paper per person per day. Employment in paper manufacturing, which historically has been volatile, has fluctuated less in recent years. Around 16,000 jobs have been lost in the paper manufacturing sector in the USA since 1990. However, employment in recycling collection and paper distribution have far outweighed these job losses in paper manufacturing. Employment in recycling collection is driven in part by changing regulations and consumer demands.

The labour requirements for producing recycled fibre are similar to those for producing virgin fibre, although the total costs of recycling are approximately 20 percent less. Production using recycled paper takes less energy than production using virgin paper. The profitability of recycled products has caused some companies to replace pulp mills with de-inking plants and to expand their use of recovered paper in existing mills. Companies are increasing domestic recycling capacity, as worldwide demand for recovered paper is expected to rise to 150 million tons by the year 2000, up from 110 million tons in 1993.
Paper-related employment is scattered among several industry categories. They are:

- manufacture of paper and allied products. This industry employs 681,000 people, down slightly from its peak employment of 697,000 in 1990;
- the paper and paper product component of wholesale trade. This involves distribution of paper products and employs around 259,000. Not included in this figure are another 130,000 jobs in recycling activities where a significant portion of labour is directly tied to paper recycling; and
- government transportation services and production of equipment, chemicals, and processes to be used in paper mills. This area supports the consumption and production of paper in the USA and is estimated to employ more than one million people.

Source:: - Engel, C. (1997) ***Taking note of the paper industry***. Monthly Labor Review. 120(9): 32-40. 1997 Sep.

➢ A $US150 million paper recycling plant was to be constructed in Menominee, a city of 9,300 in the Upper Peninsula (U.P.). Great Lakes Pulp & Fibre Co. began construction on a de-inking facility in late summer 1993, with completion scheduled for mid-1994. The plant was expected to recycle mixed office waste paper to produce secondary fibre for new white paper products. The plant was expected to generate 100 permanent jobs and as many as 50 jobs in related industries such as chemical supply, waste supply and transportation.

Source:: - Power, C., and Halvorson, B. (1993) ***Upper peninsula of Michigan: U.P. economy welcomes Menominee paper recycling plant***. Federal Gazette. 5(1): 17. 1993 Jan.

- A study by Lewis and Seldman (1994) identified more than 2,000 businesses in the USA that manufactured new products from recycled materials. Scrap-based manufacturers were found to contribute large economic pay-offs by providing high skill industrial jobs and sizeable sales revenue, invigorating local industrial sectors while diminishing local waste streams. Documented examples include: in Washington State, 15,000 workers lost traditional manufacturing jobs between 1989 and 1992, but more than 2,000 workers found employment in scrap-based manufacturing companies. During that same period, private investment in these facilities totalled $US380 million. In Maine, recycling added nearly $US300 million and over 2,000 jobs to the state's economy in 1992. Of that total, scrap-based manufacturers represented $US140 million in value to feedstocks and employed 600 workers. Another 770 workers found employment at companies that support the scrap-based manufacturers, or $US100 million in value. More than 70 scrap-based manufacturers and 300 to 400 companies that sold and distributed recycled products contributed significantly to Pennsylvania's economy. An estimated 10,000 jobs are currently sustained by businesses in the overall recycling industry (which includes collection and processing). New Jersey recognised 9,000 employees working for scrap-based manufacturers in 1991. Massachusetts calculated that in 1991 more than 200 recycling-related facilities in the state added $US600 million of value to scrap, employing nearly 9,500 workers, more than half in the manufacturing sector.

  Scrap-based manufacturers add to a local economy's tax base via their revenue stream. For example, one maker of plastic kerbside recycling bins reports revenues of $US1,900 per ton of manufactured product. Paper products made from the various grades of scrap garner different levels of revenue. At the low end, one cellulose building insulation maker grosses $US170 per ton, while a maker of tissue products grosses $US1,000 per ton. Of special importance to recycling related industries is the value added to a ton of scrap material. The specific figure depends upon the cost of the scrap feedstock, the selling price of the end product, and the reject rate of the scrap material. For example, average values added to four recycled materials by scrap-based manufacturers in Maine were calculated to be: $US375 to corrugated containers, $US545 to newspapers and magazines, $US805 to high grade waste paper, and $US1,070 to textiles.

  In addition to supplying jobs, revenue, and products to the immediate region, scrap-based manufacturers create demand for local goods and services. A production plant relies on the region's business community for goods and services -- replacement parts, office supplies and administrative support, uniforms, insurance, and cleaning and maintenance -- adding to the local economy. The number of indirect jobs related to scrap-based manufacturing is estimated using a multiplier, many of which fall between 1.2 and 3.2 total related jobs for each one in the scrap-based manufacturing sector.

A production facility also may provide other companies with feedstock for their operations, as in the case of detinning plants and steel minimills. Detinning operations retrieve high grade steel from scrap tin plate, and sell the ferrous to steel mills. A local minimill can buy the scrap directly from the detinner, minimising shipping and brokerage fees.

Barriers to successful scrap manufacturing include: a steady supply of quality feedstock, reasonable financing, and adequate demand for recycled content products. Communities are improving the climate for scrap-based manufacturers through common sense policies, including minimum recycled content levels for products bought or sold within a jurisdiction, procurement guidelines for government, and special financing packages to attract scrap-based manufacturers. Joint venture enterprises that link the manufacturer with community development organisations are a rapidly expanding segment within this sector.

Existing operations testify to the viability of scrap-based manufacturing, examples include: Aluminium Waste Technologies, Inc. of Cleveland, Ohio, a dross recycler, has developed a system that recovers aluminium and three other saleable by-products (fine aluminium oxide, salts, and non-metallic product). Its 160 ton per day facility currently employs 50 workers. The company is interested in starting new ventures near secondary aluminium mills. Approximately 1.25 million tons of dross, a by-product of secondary aluminium smelting, are landfilled each year in the United States. The primary obstacle preventing dross recycling systems like the one available from Aluminium Waste Technologies from being installed on a wider basis is the reluctance among aluminium re-manufacturers to voluntarily recycle their wastes. Reauthorisation of the Resource Conservation and Recovery Act may force the issue; Wood Fibres International (WFI) of New Berlin, Wisconsin manufactures high added value products from urban wood waste. Its grading operation selects the highest quality wood from old pallets and shipping dunnage (including cherry, birch and mahogany) to produce home and office furnishings, jewellery boxes, and gift items. This process creates high skill jobs. A subsidiary, Wood Fibre-Wisc., Inc., operates a wood pallet repair company. This plant employs 28 people and processes over 5,000 pallets per week. WFI has a new facility that will employ 35 workers and process 90 tons of material per day. The company wants to expand into urban areas across the U.S. and is especially interested in forming joint ventures with community development organisations and private businesses; Carlee, Inc. of Rockleigh, New Jersey makes high loft non-woven fibre-fill for use in the quilting trades from recycled PET (polyethylene terephthalate) fibre at its two facilities. The company traditionally used virgin materials, but recently developed EcoFil, a recycled content product line for craft and commercial markets. Twenty of Carlee's 100 workers are involved in producing EcoFil, primarily at its Paterson, New Jersey factory. Coon Manufacturing of Spickard, Missouri makes flat and corrugated sheet, dimensional lumber, and rotational moulded products from scrap HDPE (high-density polyethylene). The company employs 22 workers at its 1,000 ton per year plant, and will consider offers for new ventures. The existing plant has created six new jobs with local materials handling companies.

Source:: - Lewis, M., and Seldman, N. (1994) ***Scrap-based manufacturing sparks economic development***. Biocycle. 35(4): 62-64. 1994 Apr.

Broad-scale Evaluations

- A study in Iowa found that, as at December 1995, recyclable materials processing had created 1,290 jobs in the State and stimulated more than $US100 million in industrial sales. The largest contributor was processing of recyclables. More than 650 processing jobs existed in Iowa in 1995. Resulting product sales generated a total of more than 1,290 total jobs and $US100.3 million total industrial sales state wide. The 1995 fiscal benefits from processing were $US3.9 million in local governmental revenue and $US2.4 million in state governmental revenue. However, end-use manufacturers provide the greatest economic value to the State. In 1995, this value reached $US359.5 million in total income and supplied 8,800 jobs.

  Source:: - Underwood, M. (1997) ***Iowa recycling industry raises revenue, creates jobs***. World Wastes. 40(6): 8-11. 1997 Jun.

- An economic model developed by the Institute for Local Self-Reliance shows that a city of one million people could fully or partially sustain 30 facilities on secondary resources that would otherwise be burned, buried, or exported (assuming a comprehensive recovery and source reduction program, and a waste stream similar to national characteristics). In addition to diverting more than 635,000 tons of solid waste annually from local landfills and incinerators, thereby saving nearly $US10 million in disposal costs (assuming a moderate $US15 per ton tipping fee), the 30 facilities would add an average value of $US470 to each ton of previously discarded material. In the process, they would bring three-quarters of a billion dollars and almost 2,000 manufacturing jobs to the community. An additional 2,550 jobs would be created in support of these manufacturing enterprises.

  Source:: - Lewis, M., and Seldman, N. (1994) ***Scrap-based manufacturing sparks economic development***. Biocycle. 35(4): 62-64. 1994 Apr.

- To date, three states have exceeded a 40 percent recycling recovery rate, nine states are at or above 30 percent, eight states are at or above 25 percent, five states are at or above 20 percent, and 16 states between 10 to 20 percent. More than 45 percent of the American population is served by kerbside recycling. Drop-off sites continue to grow, with more than 8,700 across the country (BioCycle magazine). There are more than 4,500 recycled content products that consumers can purchase. There are more than 3,000 businesses currently involved in processing recyclables and manufacturing recycled products. These businesses wouldn't be in business if it didn't make economic sense to manufacture with recycled feedstock.

Source:: - Lichtenstein, M. (1996) ***Creating jobs and preserving resources***. Biocycle. 37(8): 91. 1996 Aug.

- A study undertaken in North Carolina found recycling to be a significant job creator. In excess of 2,600 recycling jobs were created between 1989 (tabling of the Solid Waste Management Act) and 1995. A model based on changes in solid waste and virgin extraction material flows due to recycling, was developed. Using 1995 recycling rates, the model estimated that for every 100 recycling jobs created in North Carolina, 10 solid waste jobs were lost; less than 3 timber harvesting jobs were eliminated due to paper recycling, and less than one industrial sand extraction job was lost due to glass recovery. Of the 2,600 jobs created, 1,939 were established in the private sector, with 692 new recycling positions in the public sector. The job growth rate was expected to slow as recycling rates level off and diversion economies of scale are realised.

  Source:: - Shore, M., and Ewadinger, M. (1995) ***Recycling impact on jobs.*** Biocycle. 36(4): 36-37. 1995 Apr.

- A review by Skidmore College found that environmental regulation has a small positive effect on overall employment. This is because environmental protection requires the intensive use of labour or domestically produced materials in such projects as recycling and construction of sewage facilities. The jobs created by environmental regulation are heavily weighted to blue-collar sectors. Government jobs were found to account for just 11% of environment related employment compared with 17% economy-wide.

  Source:: - Ember, L. (1995) Myth that environmental regulations cause job loss is debunked. Chemical & Engineering News. 73(4): 19-20. 1995 Jan 23.

5.3 Review of landfill and economic effects

A 1996/97 ABS survey of the waste management industry revealed the following in NSW:

- 5,299 people were directly employed in waste management (36% of the national total), 3,255 in the private sector and 2,044 in government organisations
- Expenditure on salaries was $ 196.5m, $ 125.4m in the private sector and $ 71.7m in government organisations
- In the private sector, income from waste collection, transport and treatment/processing/disposal of waste was $ 545.0m. Income from recyclables collection, transport and treatment/processing/sale of recyclables was $ 57.2m
- In the government sector, expenditure on waste collection, transport and treatment/processing/disposal of waste was $ 88.8m. Expenditure on recyclables collection and transport of recyclables was $ 38.1m
- 7.2 million tonnes of waste were received and disposed of at landfills in NSW
- 0.5 million tonnes of recyclables were recovered and on-sold

Whilst this data is NSW State-wide a significant proportion of these figures relates to the industry within the GSR.

At a national level:

- 37% of waste management businesses and organisations collected or transported recyclables*
- 89% collected or transported waste*
- 27% owned or operated transfer stations*
- 65% owned or operated landfills*
  * *businesses may have been involved in more than one activity so total is greater than 100%*

These figures indicate the activity of whole waste management industry and landfill operations are therefore only a subset of these. A breakdowns of the landfill employment and economic value is not available at this time however we will be describing and assessing these in more detail in Report 3.

At a national level:

- Income from collection, transport and treatment/processing/disposal of waste accounted for 53.2% of total waste management sector income
- Income from collection, transport and treatment/processing/sale of recyclables accounted for 10.2% of total waste management sector income

(Reference: Australian Bureau of Statistics (1998) Waste Management Industry, Australia Report number 8698.0. November 30, 1998.)

6 CONCLUSION

6.1 Overview of the alternative objective

At this point the data and information presented shows that: with regard to technologies and practices there are numerous options and choices open to the community of NSW to apply ESD to materials and waste management.

It seems that the crisis within waste management is about planning and managing the transition from a society that uses materials in a linear – once only pattern to one that optimises cyclical and responsible management of materials from the cradle to the grave.

The data presented and the information reviewed indicates that the “doing” of sustainable waste management in NSW is yet to be integrated into planning and management practices throughout all levels of government.

Overall trends show society has not, and looks unlikely to, turn unaided from current consumption and materials-use patterns. We indicate also that in response to this fact there is a need for a more interventionist approach by Government to facilitate cross-sectorial and whole-of-government approaches to strategically managing material flows in concert with waste management within the GSR.

Reports following this one will focus on evaluation of the alternative options for planning and managing materials and wastes and it will review the viability of implementing an alternative and integrated suite of technologies that would lead toward achieving the governments goals and ESD.

7 REFERENCES

Ackerman, F. (1997). Why doe we recycle: Markets, Values and Public Policy. Island Press. USA

Australian Bureau of Statistics (1998) Waste Management Industry, Australia Report number 8698.0. November 30, 1998.

Block, D. (1997) Composting prison food residuals. Biocycle 38(8): 37-39. 1997 Aug.

Block, D. (1999) Government financing and expertise boost recycling businesses. Biocycle. 40(2): 45-48. 1999 Feb.

Cureton, W. Composting and recycling at Indiana prisons. Biocycle. 39(5): 76-80. 1998 May.

DeGrane, S. (1996) Heartland hauler extends its branches. World Wastes. 39(7): 22-28. 1996 Jul.

Ember, L. (1995) Myth that environmental regulations cause job loss is debunked. Chemical & Engineering News. 73(4): 19-20. 1995 Jan 23.

Engel, C. (1997) Taking note of the paper industry. Monthly Labor Review. 120(9): 32-40. 1997 Sep.

Fry, T. (1992). Green Desires: Ecology-Design-Products. EcoDesign Foundation. Sydney

Glenn, J. (1999) The state of garbage in America. Biocycle. 40(4): 60-71. 1999 Apr.

Hopper, P. (1992) Container deposit legislation for New South Wales: Bringing back returnables. Friends of the Earth (Sydney) Waste Minimisation Campaign. December 1992.

Kulik, A. (1993) German recycling programs serve multiple purposes. World Wastes. 36(4): 16-18. 1993 Apr.

IGAE 1992: 13-14

Lotzof. M. (1999) The Wonder of Worms for Sludge Stabilisation. Water. Journal of the Australian Water and Wastewater Association. Jan/Feb: 38-42.

Lewis, M., and Seldman, N. (1994) Scrap-based manufacturing sparks economic development. Biocycle. 35(4): 62-64. 1994 Apr.

Lichtenstein, M. (1996) Creating jobs and preserving resources. Biocycle. 37(8): 91. 1996 Aug.

Lucius, A. (1996) Recycling program creates jobs, alleviates poverty. World Wastes. 39(7): 12-14. 1996 Jul.

MacDonald, M. L. (1996) Bias issues in the utilisation of solid waste indicators. Journal of the American Planning Association. 62(2): 236-242. 1996 Spring.)

Musch,B 1999 in NSW Waste Management Conference & Expo, Resourcing the new millennium '99:73

NSW Waste Boards, (1998). Overview of Integrated Infrastructure Requirements: Greater Sydney Region. October. Nolan-ITU Pty Ltd. (Consultants report).

NWMRS, 1992

Platt, B., Jeanes, H., and Kaufmann, A. (1995) Recycling boosts the local economy. Biocycle. 36(8): 60-64. 1995 Aug.

Power, C., and Halvorson, B. (1993) Upper peninsula of Michigan: U.P. economy welcomes Menominee paper recycling plant. Fedgazette. 5(1): 17. 1993 Jan.

Shore, M., and Ewadinger, M. (1995) Recycling impact on jobs. Biocycle. 36(4): 36-37. 1995 Apr.

Underwood, M. (1997) Iowa recycling industry raises revenue, creates jobs. World Wastes. 40(6): 8-11. 1997 Jun.

WMMA. (1995) NSW Waste Minimisation and Management *Act*, 1995: Part 2

WMMA. (1995) NSW Waste Minimisation and Management Act, 1995: Section 6