Shaping the Vision and Strategy for Sustainable Waste Management in New South Wales

A background paper
prepared for Resource NSW
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Disclaimer.

This paper was prepared by Wright Corporate Strategy Pty Limited in consultation with the Board and CEO of Resource NSW. The views expressed in the paper are those of Wright Corporate Strategy Pty Limited.

CONTENTS

EXECUTIVE SUMMARY

The last decade has seen considerable progress in the way the people of New South Wales manage the waste associated with human settlement. Citizens and business enterprises have increasingly shown concern about creating waste and a thirst for guidance about new ways of conserving resources.

The community is now poised to move more boldly on waste avoidance and resource recovery in a way that contributes positively toward ecologically sustainable human settlement.[1] The Government has established legislative and institutional frameworks to facilitate the move. And Resource NSW will play an important leadership role in developing and implementing a state-wide waste management strategy.

This paper provides input to the Board and Executive of Resource NSW in developing the proposed NSW Waste Strategy. It addresses the strategic issues at stake in moving to the new, sustainable way of managing waste described in the NSW *Waste Avoidance and Resource Recovery Act, 2001*. The new way of managing waste starts with the idea of avoiding the creation of waste where possible. This quest relies on efficient production processes, product design for minimal materials intensity and toxicity, and packaging which just matches product protection requirements.

Beyond waste avoidance, sustainable waste management is based on the idea that all discarded materials are routinely regarded as a potential resource, not to be saved at all costs, but neither to be squandered without enlightened assessment of reuse, recycling or processing potential.

The vision of what might be achievable in moving to sustainable waste management is still forming. Innovative management practices and processing technologies are emerging to facilitate progress, but markets for recovered materials need to be further developed and stabilised. A tentative vision for the contribution of sustainable waste management could be formed by bringing together the main concepts:

- *Production processes, products and packaging are designed with an eye to avoiding creation of waste.*

- *All members of the community contribute to building a future in which the circular flow of materials is highly valued; from production to reproduction.*

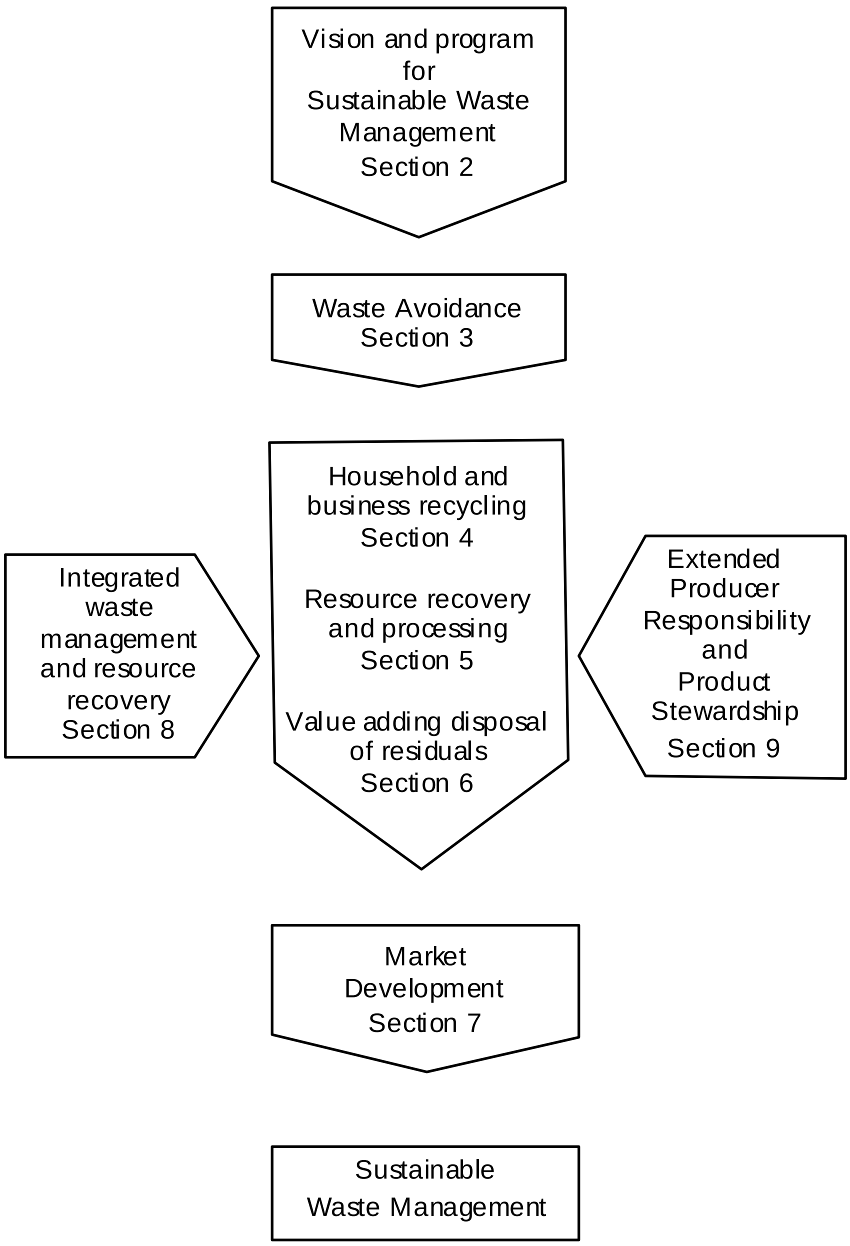
- *Discarded materials, unsuitable for circular flow, are regarded as potential resources and benefit is gained where feasible.*

- *The sustainable waste management economy is founded on dynamic investment initiatives and stewardship of assets and infrastructure.*

[1] For simplicity this phrase is shortened to *sustainable waste management* in this paper.

As Figure ES-1 illustrates, the issues described in this paper are intertwined in complex ways. The total system perspective facilitates the overview necessary to craft a strategy to accompany a big vision.

Figure ES-1 **Management of Waste as a Potential Resource**



Vision and Program for Sustainable Waste Management

The Vision summarised above is extended to a possible agenda in Section 2, where three progressively more challenging scenarios for improved resource recovery are detailed, with tangible programs for the municipal sector, the commercial and industrial (C&I) sector and the construction and demolition (C&D) sector. These scenarios are illustrated in Figure ES-2.

The strategic importance and basis for Waste Avoidance is discussed at Section 3.

Resource Recovery

The implications of programs for Recycling, Waste Processing and Landfilling of residuals are described in Sections 4, 5 and 6. This part of the paper describes progress toward sustainability and some of the issues to be overcome and options for moving forward. The theme in each case is geared to informing decision makers and stakeholders of feasible outcomes and describing reform agenda possibilities to make the progress sought by the Government.

Key Processes

Sections 7, 8 and 9 describe important facilitating mechanisms: Market Development; Integrated Waste and Resource Management; and Extended Producer Responsibility. The paper shows how each of these mechanisms can contribute in its own way to sustainable waste management.

Market Development is vital to establishing stable markets and increased demand for the products of recycling and waste processing. Market factors have throughout the world received only second-order consideration in the management of waste as a resource.

Integrated Waste and Resource Management has four related conditions: system integration, for maximum efficiency; collaboration of firms and agencies within the waste industry; a portfolio of management practices and technologies; and market integration so that demand for recovered material actually drives capital investment.

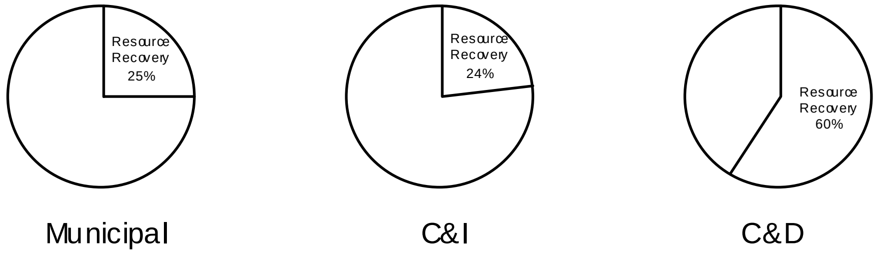
Many participants in the waste management chain argue that waste volumes will not decline until the original manufacturers of the product that becomes waste are responsible for managing it until its full life cycle is complete. *Extended Producer Responsibility* is now a feature of NSW waste management legislation, and is discussed in Section 9. The policy is based on the idea of: shifting responsibility up the value chain to manufacturing and away from community/local government level; and (importantly) providing a financial incentive for producers to design products with the post-consumer stage in mind.

International Trends

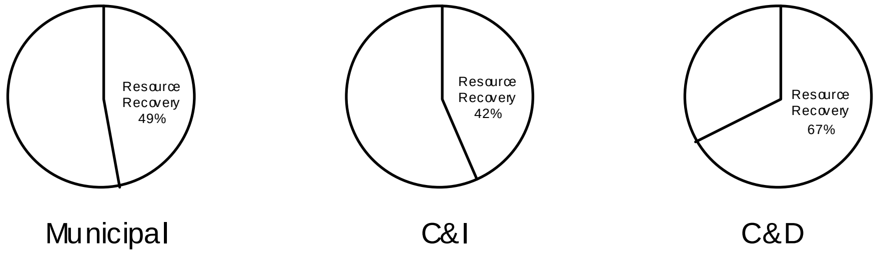
Section 10 presents a brief survey of international trends and concludes that New South Wales is well positioned to join the nations that perform best in managing waste as a resource.

Figure ES-2 **Scenarios for Progressively Improved Resource Recovery**

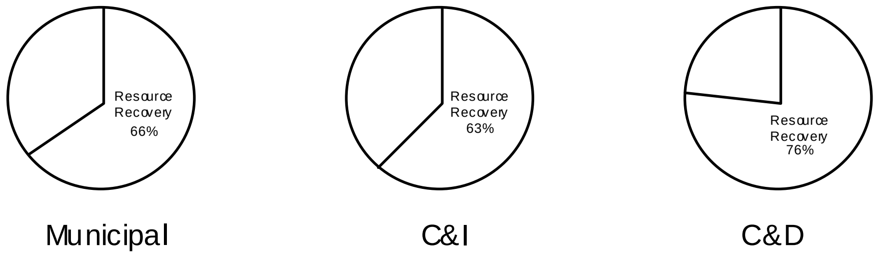
The Current Situation



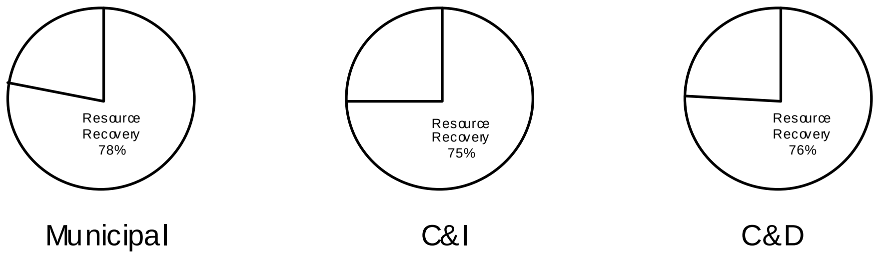
Scenario 2 – Improved Initiatives



Scenario 3 – Aggressive Initiatives



Scenario 4 – Ultimate Initiatives



1. INTRODUCTION

The last decade has seen considerable progress in the way the people of New South Wales manage the waste associated with human settlement. Citizens and business enterprises have increasingly shown concern about creating waste and a thirst for guidance about new ways of conserving resources.

The community is now poised to move more boldly on sustainable waste avoidance and resource recovery in a way that contributes positively toward ecologically sustainable human settlement.[2] The Government has established legislative and institutional frameworks to facilitate the move. And Resource NSW will play an important leadership role in developing and implementing a state-wide waste management strategy.

The most appropriate outcomes to strive for and strategy to adopt in New South Wales should be decided in the light of the State's unique sustainability equation, covering:

- feasible milestone outcomes in a progressive move to sustainable waste management;
- environment, social and economic impacts associated with the adopted vision;
- a strategy to capture the imagination of the community and engage citizens and business to achieve outcomes that match the adopted vision.

This paper provides input to the Board and Executive of Resource NSW in developing the proposed NSW Waste Strategy. It addresses the strategic issues at stake in moving to the new, sustainable way of managing waste described in the NSW *Waste Avoidance and Resource Recovery Act, 2001*. The new way of managing waste starts with the idea of avoiding waste creation where possible. This quest relies on efficient production processes, product design for minimal materials intensity and toxicity, and packaging which just matches product protection requirements.

Beyond waste avoidance, sustainable management is based on the idea that all discarded materials are routinely regarded as a potential resource, not to be saved at all costs, but neither to be squandered without enlightened assessment of reuse, recycling or processing potential.

The paper addresses strategic issues by setting the context for each, describing the current and emerging situation, referring back to the tentative vision and program postulated in Section 2, and then exploring options and issues associated with the outcomes sought. The following issues are covered:

[2] For simplicity this phrase is shortened to *sustainable waste management* in this paper.

- A vision and program for sustainable waste management. (Section 2).
- The place of Waste Avoidance in the sustainable waste management strategy. (Section 3).
- Household and business recycling and reuse of materials. (Section 4).
- Resource recovery and processing for energy or compost. (Section 5).
- Landfill disposal of residual waste. (Section 6).
- Developing markets for output products from recycling and beneficial processing. (Section 7).
- Achieving integrated waste management and resource recovery. (Section 8).
- Decoupling increased consumption and waste generation through extended producer responsibility. (Section 9).
- International waste management trends. (Section 10).

As a strategy input document, this paper does not itself set out a waste management strategy. By drawing together work completed for the New South Wales Government in recent years, and trends in Europe and North America, the paper presents a picture of some possibilities that may be worth further developing.

2. ESTABLISHING A VISION AND PROGRAM FOR SUSTAINABLE WASTE MANAGEMENT

There is widespread community agreement that waste materials should be regarded as potential resources. The NSW Government has signalled its commitment to sustainable waste management and introduced revolutionary legislation. The new framework provides for both avoiding waste creation where possible, and recovering value where feasible from materials that must be discarded.

Sustainability implies a position of long run equilibrium of economic, social and environmental factors associated with the impacts of human settlement. Sustainable waste management is an important contributor to sustainable human settlement; waste is a high consumer of discarded resources; a disproportionate contributor to overall vehicle kilometres travelled; and a contributor to local and global pollution.

The vision of what might be achievable in moving to sustainable waste management is still forming. Innovative management practices and processing technologies are emerging to facilitate progress, but markets for recovered materials need to be further developed and stabilised.

Long run protection of the environment demands that we work to both avoid environmental harm and conserve resources. The legislative framework and policy tools are now largely in place, and the vision captured in the Government's framework must be articulated to concrete reality.

Long run economic stability depends on prudent investment in assets, infrastructure and people to better reduce and manage waste. Investment is essential to improving business performance in avoiding waste and improving waste industry performance in recovery and processing waste. Investment confidence depends vitally on consistent policy and appropriate pricing signals.

Social factors contribute through changes in consumption patterns and willingness by business and households to contribute in a personal way to conserving resources and managing potential public health impacts of waste handling. Both aims can be pursued if community values shift to a position where waste is regarded more as a resource than a nuisance. Such a shift requires visionary leadership.

A tentative vision for the contribution of sustainable waste management could be formed by bringing these ideas together to include the following points:

- Production processes, products and packaging are designed with an eye to avoiding creation of waste.

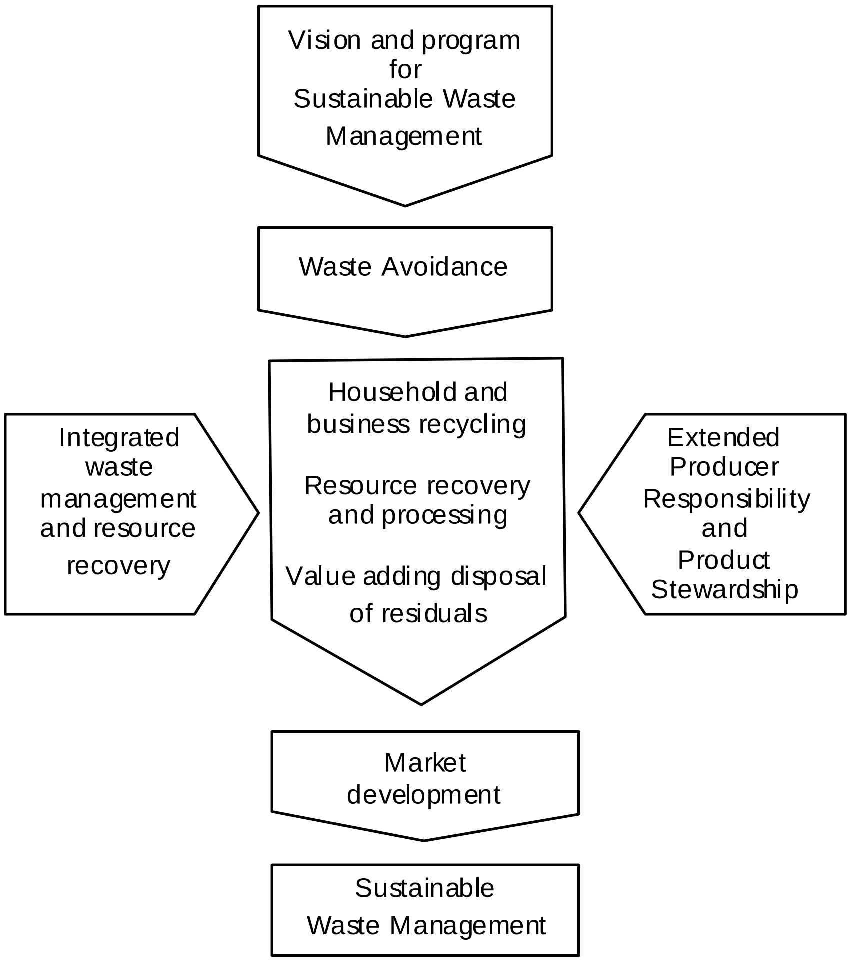
- All members of the community contribute to building a future in which the circular flow of materials is highly valued; from production to reproduction.

- Discarded materials unsuitable for circular flow are regarded as potential resources and benefit is gained where feasible.

- The sustainable waste management economy is founded on dynamic investment initiatives and stewardship of assets and infrastructure.

The issues associated with moving to this vision form the basis for this paper. These issues are illustrated in Figure 2-1.

Figure 2-1 **Sustainable Waste Management**



2.1. Context

The waste management industry comprises three main sectors generating solid waste: the municipal sector, which includes all domestic waste sources; the commercial and industrial (C&I) sector, including small to large business and public enterprises; and the construction and demolition (C&D) sector, which includes the building and construction industry.

These sectors generate around 9.0 million tonnes of discards each year throughout NSW. Some 3.5 million tonnes are recovered and recycled or processed for beneficial purposes and around 5.5 million tonnes are disposed of each year to landfills.[3]

2.2. Prospects for Beneficial Use of Waste Materials

The Government received advice, in determining the legislative framework, on a series of scenarios for progress toward increasingly more beneficial outcomes.

The *Waste Inquiry Report*[4] described three scenarios for future waste management in New South Wales; with progressively more resource recovery and processing for beneficial use, and less disposal to landfill. The three scenarios described were:

Scenario 1, Carry on much as now: (current situation)	*25 per cent municipal recovery, 24 per cent C&I recovery, 60 per cent C&D recovery.*
Scenario 2, Improved initiatives:	*49 per cent municipal recovery, 42 per cent C&I recovery, 67 per cent C&D recovery.*
Scenario 3, Aggressive initiatives:	*66 per cent municipal recovery, 63 per cent C&I recovery, 76 per cent C&D recovery.*

A further scenario was prepared for the *Independent Public Assessment - Landfill Capacity and Demand*[5]. This highly optimistic scenario goes beyond those proposed in the Waste Inquiry Report to reflect the outcome that might be achievable over a longer time horizon:

[3] The above estimates are based on industry estimates in lieu of official statistics which are not compiled for NSW at State level.

[4] NSW Government Alternative Waste Management Technologies and Practices Inquiry, 2000.

[5] NSW Government. Independent Public Assessment – Landfill Capacity and Demand. September 2000.

Scenario 4,	*78 per cent municipal recovery,*
Ultimate initiatives:	*75 per cent C&I recovery,*
	76 per cent C&D recovery.

These Scenarios form something of a tentative program for what might be achievable in moving to a more sustainable position in waste management.

Scenario 1, Current Arrangements

The current situation (Scenario 1) for Sydney is set out in detail in Table 2-1, which is based on the 1998 data used by the Waste Inquiry. Note that Sydney (only) data was used by the Waste Inquiry because reliable whole of State data is not available covering all waste flows.

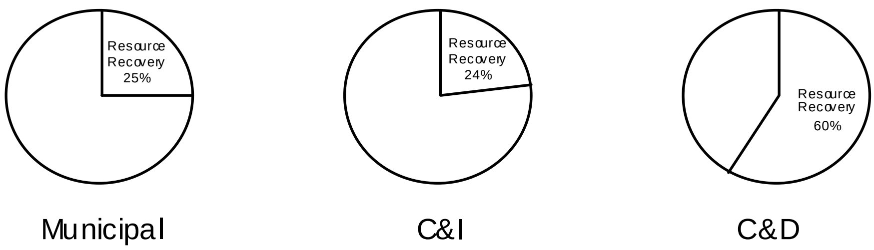
The current position remains broadly consistent with this situation, with two qualifications: significant scrap steel recycling was not recorded in the data available to the Waste Inquiry (see Section 6); and it is probable there has been a transfer of a measure of waste generation from the municipal to the C&I sector.

Table 2-1 **Current Waste Position, Sydney**

Recovery Flows	**Municipal** (million tpa)	**C&I** (million tpa)	**C&D** (million tpa)
Waste generated	1.800	2.100	2.500
Less dry materials recycling	0.300	0.405	0
Less garden waste processing	0.150	0.045	0
Less construction material recycling	0	0.050	1.500
Disposal	1.350	1.600	1.000

A diagrammatic overview of resource recovery against total waste generation in each sector is set out in Figure 2-2.

Figure 2–2 **Resource Recovery in the Current Situation**



Scenario 2, Improved Current Initiatives

The most attainable progress step is Scenario 2, Improved Current Initiatives. The net improvements, above the current arrangements, required to attain this Scenario are described below and set out in Table 2-2.

Table 2-2 **Net Resource Recovery Increase for Scenario 2, Improved Initiatives**

Recovery Flows	**Municipal** (million tpa)	**C&I** (million tpa)	**C&D** (million tpa)
Dry materials recycling	0.069	0.175	0
Garden waste processing	0.150	0	0
Food waste processing	0	0.130	0
Residual waste processing	0.217	0.083	0
Construction material recycling	0	0	0.182

This Scenario involves improvements in municipal and C&I sector recycling participation, improved source separation, streaming and collection of garden waste, C&I dry recyclables an C&I food waste. Further improvements in C&D recycling are also included.

The main initiatives taken in bringing this Scenario to fruition are:

Municipal

- *Collection of garden waste from all relevant areas on a frequent basis, using appropriate containers (a further 150,000 tpa from current level).*

- *Increased collection of recyclable materials from "partial participants" in relevant locations, achieved through targeted education/awareness programs (a further 69,000 tpa from current level).*

- *Treatment and reprocessing of a portion of the residual waste stream (some 217,000 tpa).*

C&I

- *Targeted food waste collection with focus on main producers currently disposing of food as mixed residual waste (a further 130,000 tpa from current organic waste collection level).*

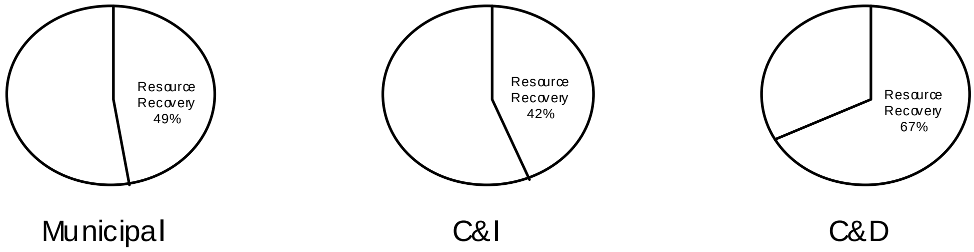
- *Increased source separation by SMEs of dry recyclable materials: paper, containers, industrial packaging plastics (a further 175,000 tpa from current level).*

C&D

- *Encouragement of further source separation initiatives (a further 182,000 tpa from current level).*

The overview resource recovery positions for Scenario 2 are shown at Figure 2-3.

Figure 2–3 **Resource Recovery in Scenario 2 – Improved Initiatives**



Scenario 3, Aggressive Initiatives

This scenario demands actions represented by a step-change from Scenario 2. A mix of initiatives within the framework of the new waste legislation is described below and summarised in Table 2-3 which shows the net improvements above current arrangements.

Table 2-3 **Net Resource Recovery Increase for Scenario 3, Aggressive Initiatives**

Recovery Flows	**Municipal** (million tpa)	**C&I** (million tpa)	**C&D** (million tpa)
Dry materials recycling	0.150	0.495	0
Garden waste processing	0.150	0	0
Food waste processing	0.150	0.205	0
Residual waste processing	0.288	0.119	0
Construction material recycling	0	0	0.400

This Scenario involves dramatic improvements in recycling, source separation, streaming and collection in all sectors.

The main initiatives taken in bringing this Scenario to fruition are:

Municipal

- *Collection of food waste (150,000 tpa) streamed with garden waste at a frequency to match seasonal demand (150,000 tpa from current level).*

- *Increased collection of recyclable materials, partly through expansion of public place collection systems (a further 150,000 tpa from current level).*

- *Treatment and reprocessing of a portion of the residual waste stream (some 288,000 tpa from current level).*

C&I

- *Expansion of food waste collection to SME food waste generators (a further 205,000 tpa from current organic waste collection level).*

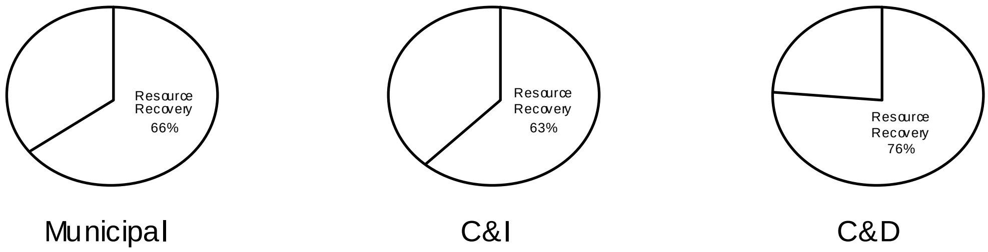
- *Increased capture of industrial recyclables and sorting through C&I specialist MRFs (a further 495,000 tpa from current level).*

C&D

- *Best practice demolition activities featuring source separation for local reuse or sale (a further 400,000 tpa from current level).*

The resource recovery levels associated with Scenario 3 are shown at Figure 2-4.

Figure 2–4 **Resource Recovery in Scenario 3 – Aggressive Initiatives**



Scenario 4, Ultimate Initiatives

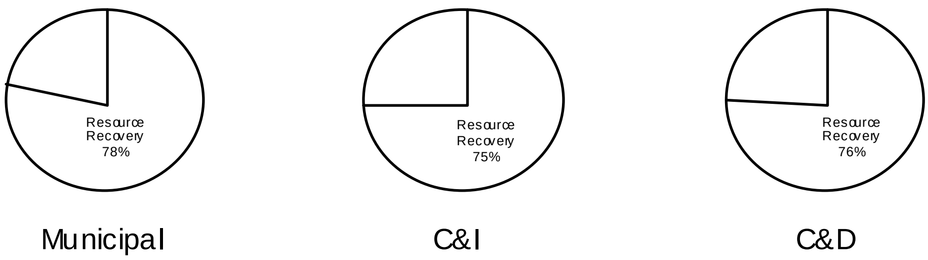
This highly optimistic scenario was included in the *Independent Assessment* to reflect the 20 year time frame over which the assessment was made. The initiatives considered appropriate are described below and summarised in Table 2-4 which shows net improvements above current arrangements.

Table 2-4 **Net Resource Recovery Increase for Scenario 4, Ultimate Initiatives**

Recovery Flows	**Municipal** (million tpa)	**C&I** (million tpa)	**C&D** (million tpa)
Dry materials recycling	0.225	0.495	0
Garden waste processing	0.150	0	0
Food waste processing	0.150	0.280	0
Residual waste processing	0.430	0.250	0
Construction material recycling	0	0	0.400

Resource recovery levels for Scenario 4 are set out at Figure 2-5.

Figure 2–5 **Resource Recovery in Scenario 4 – Ultimate Initiatives**



2.3. Implementing the Scenarios

These Scenarios set out one agenda for improved recovery, recycling and processing of waste for beneficial outcomes. Although devised two years ago, they remain plausible, however variations on some of the initiatives may be appropriate. In any case, business opportunities will provide a leading basis for action by the private sector.

The Aggressive Initiatives Scenario forms a worthy target and it should be achievable at moderate cost to governments, community and business.

Current legislation would facilitate each of the initiatives proposed. Various voluntary and mandatory schemes are available to drive the nominated initiatives.

The pace at which the Sydney domestic and business community is able to achieve increased resource recovery and beneficial outcomes is an issue of some significance. The time required to (simultaneously) implement the initiatives that comprise each scenario is the crucial issue under consideration. The key factors that determine implementation time are:

- The management of waste minimisation initiatives.
- Project development.
- Technology maturity.
- Contract arrangements.
- Financing availability.
- Behaviour change and opportunities.
- Market development.

Modelling was undertaken in 2000 to incorporate all permutations and determine the most realistic overall take-up rate for moving from Scenario 1 to Scenario 2, then Scenario 3 and Scenario 4. Nine Schemes were examined.

The carefully balanced analysis showed that Schemes 5 and 7 spanned the achievable to optimistic range of take-up rates. Scheme 5 is based on an eight year take-up time from 2000 in moving from Scenario 1 (Current Arrangements) to Scenario 2 (Improved Initiatives), followed by a further eight years, and so on. Scheme 7 is based on six year time frames. The take-up rates are shown below.

	Scheme 5	**Scheme 7**
Improved Initiatives Scenario	*8 years*	*6 years*
Aggressive Initiatives Scenario	*16 years*	*12 years*
Ultimate Initiatives Scenario	*24 years*	*18 years*

Both Scheme 5 and Scheme 7 provide for an achievable transition to a new way of managing waste. It is notable that two years have now elapsed, and progress is being made, but the exact level of resource recovery for each sector at 2002 is not yet known.

3. WASTE AVOIDANCE

3.1 Context

New South Wales, in common with most of the world's developed nations, has installed *Waste Avoidance* as a priority goal in sustainable waste management. The practice sits atop the hierarchy because the benefits of waste avoidance reach both forward and backward along the product value chain. Waste Avoidance at its purest level involves thoughtful action, at the product design or manufacturing stage, to **prevent the creation** of waste. This is distinctly different from minimising the amount of waste actually disposed of **after** the waste has been created.

Avoiding the use of some materials or components in products or packaging at this key decision point can be highly beneficial – it acts to reduce the extraction of resources, conversion to production materials, transport pre and post production, and the amount of material requiring post-consumer management. The potential gains in economic and environmental terms are considerable.

The OECD[6] points to three classes of waste avoidance:

Strict Avoidance – where products or production processes are redesigned so as to eliminate the need for certain parts or components, or where material specifications are changed to eliminate use of hazardous materials (eg, the revolution in radio received design).

Reduction at Source – where products or production processes are redesigned to use reduced amounts of materials (eg, reduced weight packaging, mobile phone miniaturisation).

Product Reuse – where the product is used in its original form to serve a further life (eg, clothing reuse). Because reuse is product oriented rather than material oriented, it can be accomplished without reprocessing, and often without transport.

The important distinction between waste avoidance and waste minimisation is that with avoidance the preventive action takes place before the product is created (except in Product Reuse, where the action still takes place before the product is discarded). Waste minimisation involves material recovery after use and processing to provide input for a new product.

3.2. Current Situation

The Government has available a variety of instruments and programs that can potentially make a contribution to waste avoidance:

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[6] OECD. *Strategic Waste Prevention. OECD Reference Manual.* 2000.

- The Extended Producer Responsibility (EPR) and Product Stewardship provisions of the *Waste Avoidance and Resource Recovery Act 2001,* provide the basis for incentives for manufacturers to redesign products, materials or processes to prevent waste and make recovery less resource intensive. These powerful tools are described at Section 9 of this paper.[7]

- The waste disposal levy provides a limited incentive for reduced material intensity, generally when retailers, faced with storing and discarding excessive wholesale packaging, exhort suppliers to meet retail specifications.

- The EPA's cleaner production program has been successful in assisting small to medium enterprises to capture the benefits of waste avoidance.

- The waste legislation provides for non-statutory waste reduction targets to be established by Resource NSW on the advice of an expert committee reporting to the Resource NSW Board. By setting such targets in a way that focuses on material types for specific industry sectors, and providing incentives and educative guidance, product redesign and waste avoidance should be feasible.

- Resource NSW has a key role in implementing programs to bring about increased "resource efficiency and waste reduction", as set out in the waste legislation. This should provide the basis for programs aimed at reducing materials in transit.

3.3. Issues and Options

The policy instruments and program options for Waste Avoidance form a worthy agenda for action over the next few years. A measure of urgency is warranted if waste growth is to be decoupled from consumption growth. However, it would be over-optimistic to count on rapid transition of initiatives to achieve *Strict Avoidance* of waste (using OECD terminology). This is more a medium to longer term proposition.

A measure of *Reduction at Source,* however, ought to be achievable in a short to medium time frame, depending on the power of the policy instruments and incentives used, and the ability to identify worthy candidates. It is clear that Waste Avoidance initiatives can make a valuable contribution to the quest for sustainable waste management.

A Waste Avoidance plan based on effectiveness review of all the program options (including the various EPR tools) appears to be an important planning priority.

[7] Tools commonly counted in the EPR armoury include: impact charges on specific raw materials; deposit/refund schemes; advance treatment/disposal fees; product take-back requirements; material-specific disposal bans or disposal levies; greener procurement actions; and politico-social goals for avoidance of certain materials. A number of these tools have little or no influence in actually avoiding creation of waste. Thus some EPR tools can contribute to Waste Avoidance, but EPR *per se* is not a synonym for Waste Avoidance.

4. HOUSEHOLD AND BUSINESS RECYCLING

4.1. Context

Recycling is a community and business program with considerable State significance. It is widely recognised as important for conservation of resources, capturing the imagination of many in the community and gaining the support of Governments. In this paper, recycling is taken to mean the use of discarded materials to manufacture products of like-nature. Thus, used PET beverage container, to new PET beverage container or other PET product. Material processing for compost or energy production is covered at Section 5.

Recycling not only conserves resources that would otherwise have been lost to final disposal, the practice also reduces potential environmental harm. But the success of recycling also depends greatly on the comparative cost and supply-certainty of the recycled product. Recycling ultimately needs to make economic sense, as well as environmental sense, for long-run sustainability to be achieved. The practice has been estimated to cost around $300 million each year in NSW across all sectors[8].

In activities where significant, non-market, community benefit factors apply, like recycling, some form of Government intervention is usually necessary, at least in the short term, to establish and nurture viability. The NSW Government has given Resource NSW a role in developing markets for recycled materials[9], an issue discussed in Section 7 of this paper.

4.2. The Current Situation

Recovery and recycling of used materials has strategic importance in NSW as a contribution for the environment. Household support for kerbside recycling is strong, and close to 20 per cent of the domestic waste stream is diverted to recycling. The proportion is increasing as community support gathers strength. Business recycling has been patchy, with the C&D sector making an outstanding contribution while, apart from steel recycling, the C&I sector has lagged in the recycling effort.

The market created for recyclable materials has proved unstable at times, and highly fragmented by variable material qualities. This is partly due to the lack of a formal market structure, with logical rules and predictable behaviour by buyers and sellers. The impact of periods of market instability has forced some business enterprises to make their own arrangements for supply of recycling materials to create new products. This provides them with greater certainty of quantity, quality and price, and helps create a closed loop effect, from production to reproduction.

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[8] WCS Market Intelligence. *Industry and Market Report Waste Management Industry.* 2001.

[9] NSW Government. *Waste Avoidance and Resource Recovery Act*, 2001.

Operating arrangements for recycling are also fragmented. Recyclable commodities are passed through numerous activities and owners in a long value chain that commences with product design. Recycling system infrastructure is not organised to maximise overall efficiency. Rather, organisations operating at each activity in the chain have invested in systems and technology to improve their own efficiency in the absence of total system optimisation.

The position is compounded by the existence of a proliferation of different sorting and handling systems at each activity point, particularly related to municipal and C&I material recycling. A durable outcome ultimately requires the cooperation of participants in the interest of a higher order goal. The imperative of sustainable recycling constitutes a mindset that is not present in many of the participants in the recycling value chain.

Recycling is a complex economic system operating in a highly fragmented industry structure. The outcome to date is an excessively costly, sub optimal recycling system, particularly at the municipal and commercial business level. The absence of market structure is bound to result in periods of market failure. The lack of organised system management, with incentives to reward improved recovery performance, results in ad hoc decision making.

4.3. Recycling Performance and Scope for Improvement

The estimates made by the Waste Inquiry[10] remain the best comprehensive perspective on recycling performance, as shown in Table 4-1[11].

These estimates are consistent with industry views that considerably improved recycling performance is feasible. Overall municipal sector kerbside recycling at around 20 per cent of waste generated roughly matches the European average, though is only half of the best performing nations. Sydney (and NSW generally) lags the US average by around 10 percentage points, but falls far short of the best performing cities, Seattle and Portland, that manage to recycle some 50 per cent of waste generated. The improved performance is attributable to innovative local recycling programs, and inclusion of many retail waste generators in municipal collection services.

Moreover, there is great disparity between various Sydney LGAs: the range is apparently between 12 per cent and 40 per cent of waste generated. The relative performance of the various jurisdictions in comparison with Sydney sets a rough benchmark for the level of kerbside recycling that might feasibly be attainable, albeit with far reaching programs.

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[10] NSW Government Alternative Waste Management Technologies and Practices Inquiry, 2000.

[11] It should be noted that these estimates are limited to the Sydney Metropolitan Area and greatly underestimate ferrous metal recycling from the C&I sector.

Table 4-1 **ESTIMATED WASTE DISPOSED AND RECYCLED – Sydney Metropolitan Area (tonnes per annum)**

	Municipal		C&I		C&D		
	Disposed	**Recycled**	**Disposed**	**Recycled**	**Disposed**	**Recycled**	**Total**
Paper/Cardboard	390,000	195,000	210,000	300,000	Nil	Nil	1,095,000
Plastic	100,000	10,000	150,000	20,000	Nil	Nil	280,000
Glass	150,000	90,000	30,000	40,000	Nil	Nil	310,000
Ferrous	30,000	5,000	50,000	40,000	20,000	40,000	185,000
Garden	240,000	150,000	60,000	70,000	30,000	Nil	550,000
Food	280,000	Nil	160,000	Nil	Nil	Nil	440,000
Timber	Nil	Nil	210,000	10,000	100,000	50,000	370,000
Soil/Rubble	Nil	Nil	150,000	10,000	360,000	800,000	1,320,000
Concrete	Nil	Nil	50,000	10,000	160,000	460,000	680,000
Other	160,000	Nil	530,000	Nil	330,000	150,000	1,170,000
	1,350,000	**450,000**	**1,600,000**	**500,000**	**1,000,000**	**1,500,000**	**6,400,000**

Source: Estimates compiled by the Waste Inquiry, drawing on EPA and Waste Board data, and discussions by the Inquiry with Industry.

Note: Waste avoided by on-site recycling, reprocessing or reuse is not covered in the “disposed” or “recycled” data.

What the Improvement Scenarios Mean for Recycling

Municipal Sector: Setting aside system constraints and behaviour changes required, the above analysis indicates that a 100 per cent increase in the municipal sector kerbside recycling haul forms a realistic upper limit. The *Waste Inquiry/Landfill Assessment* Scenarios sought a 23 per cent increase in municipal recycling performance for the Improved Initiatives Scenario; an overall 50 per cent increase (Aggressive Initiatives); and an overall 75 per cent increase (Ultimate Initiatives). Overall recovery of municipal recyclables is difficult to estimate, but at the Aggressive Scenario would be around 70 per cent of municipal recyclate generated.

C&I Sector: Recycling performance of the Sydney C&I sector in comparison with international counterparts is less clear than the municipal sector. Waste composition varies greatly between cities, and data availability is poor. However, there is scope for improvement in traditional dry recyclables recovery, including paper/ cardboard as well as beverage container materials including plastics, glass and metals. Increased timber recovery and industrial plastics capture is feasible and potentially rewarding.

The *Waste Inquiry/Landfill Assessment* Scenarios sought a 43 per cent increase (Improved Initiatives) in C&I recycling rates, an overall 121 per cent increase (Aggressive Initiatives); and maintaining an overall 121 per cent increase (Ultimate Initiatives). These increases may seem substantial, but there is ample scope for improvement. Overall recovery of C&I material at the Aggressive Scenario would be about 64 per cent of dry recyclable waste generated.

C&D Sector: The C&D sector performs well by international standards, largely due to the impact of the waste disposal levy on the relatively heavy mass of C&D waste, and the relative homogeneity of the materials, making for collection and sorting efficiency.

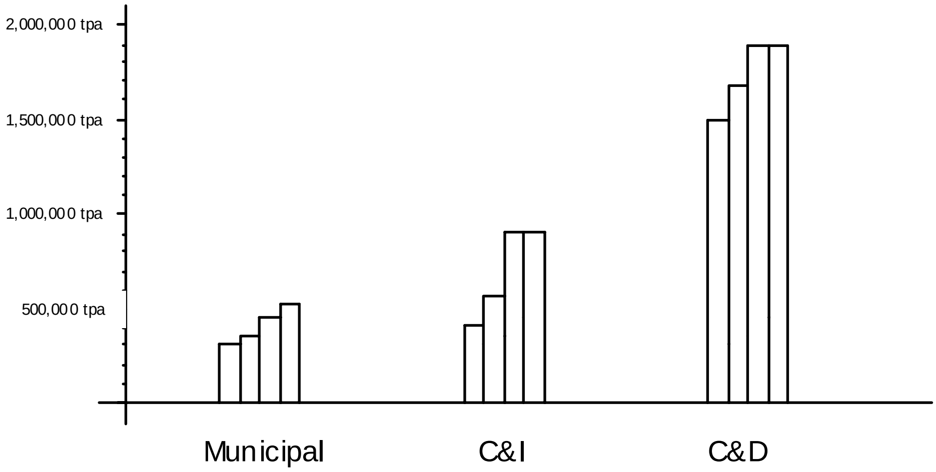
Waste Inquiry/Landfill Assessment Scenarios sought a 12 per cent increase in C&D recycling rates; (Improved Initiatives), an overall 27 per cent increase (Aggressive Initiatives); and maintaining the overall 27 per cent increase (Ultimate Initiatives). Overall recovery of C&D material at the Aggressive Scenario would be around 76 per cent of waste generated.

The progressive improvements in dry recyclate recovery for all sectors are shown in Figure 4-1.

4.4. Issues and Options

Two issues critical to the attainment of sustainable recycling are: improved system efficiency, so that recycling chain costs are reduced; and increased recyclate recovery so that more resources are conserved and market stability is enhanced.

Figure 4–1 **Progressive Improvement in Recyclate Recovery for Each Scenario**



Improving System Management Efficiency

Work done for the NSW Waste Boards in 1999[12] determined that significant improvements are feasible in recycling logistics, diversion rates, quality control and risk management. These improvements are available through a more business-based general management of kerbside recycling and regional, rather than LGA, coverage. Recycling would need to move from the loosely organised system to one which provides a contractual basis for improved recycling effectiveness and system efficiency.

The key operating and contractual principles for system improvement are:

- management and commercial frameworks that provide financial incentives in contract arrangements to reduce costs, recover increased recyclate volume from households, maximise MRF performance, and maximise revenue from sales;

- all operating and trading risk to be taken by competent private sector head contactors working at critical mass recycling levels.

One scheme that fits these principles is for a single private sector head contactor, responsible to the ROC or other relevant grouping as principal, and taking full commercial risk for recyclables collection, transport, sorting and selling to reprocessor. The fundamental role of the head contractor is in managing a series of activities which could be the subject of **separate contracts** between the head contractor and specialist sub-contractors operating in the various recycling activities.

The scheme was estimated to result in savings of nearly $30 million each year in net kerbside recycling costs for the Sydney region (municipal only)

[12] Western Sydney Waste Board. *The Business Case: Kerbside to Market Recycling.* 1999.

after full implementation. A drawback of the scheme is the need for progressive implementation as current collection contracts mature.

The scheme described above provides financial incentives for the head contractor to increase recyclate recovery. This was estimated to increase recyclate recovery by 15 to 20 per cent over a six year period.

Improved Recovery Effectiveness

Further improved **recovery effectiveness** is feasible, especially for plastic, metal and glass containers, but would require intervention that goes beyond recycling system improvement. The Extended Producer Responsibility provisions of the *Waste Avoidance and Resource Recovery Act, 2001* are critical to improved recycling effectiveness. Four clear options for greater recovery and recycling of beverage containers are available:

- Full implementation of the National Packaging Covenant with industry and local government support for the interim measures which are aimed at improving kerbside recycling arrangements.

- Improved recycling education and in-kitchen sorting systems with funding provided by the beverage industry and package providers, as well as the print media industry.

The above two options are complementary ways of achieving the increased recyclate capture available by adopting the head contactor with financial incentives. Further options, requiring a step-change in recovery arrangements, are:

- **Container Deposit Legislation (CDL)**, as a way of providing a community-based scheme to promote beverage container recovery. CDL is a deposit/refund scheme in which the deposit paid on purchase of a packaged beverage is refundable on presentation of the container to a designated facility. The scheme has been used in the USA with success and is currently operating in South Australia.

  The benefits of CDL are:

  - reduced beverage container contribution to the litter stream;

  - increased recovery of the containers to which the scheme applies.

  A drawback of CDL is that the scheme requires a new set of infrastructure and systems to operate alongside the existing recycling system, which must be maintained in order to capture non-beverage containers and paper/cardboard.

- **Advance Disposal Fee (ADF)** schemes applicable for all containers have been used in USA and Europe with success. A small disposal/recycling fee is levied on all packaging containers to compensate for its end of life disposal cost. The fee is subject to exemptions where the container material is able to reach a specified level of recovery and recycling and/or a specified level of recycled content is achieved. On the other hand, the ADF is increased for toxic packaging materials.

This scheme is based on the idea that container fillers will favour those packaging materials that can demonstrate reduced ADF for two reasons: the lower shelf price for the product within the container; and, more importantly, the scope to claim environmental responsibility by choosing packing material that is both recycled and is likely to again be recycled.

The funds gained from ADF are usually hypothecated to finance the start-up of a contactor-based recycling scheme (potentially of the type described above). As fee income inevitably reduces over time, with improvements in recycling, it follows that the recycling system will stabilise and reduced external funding will be required to support the recycling system.

The ADF scheme is being used in Australia at present to capture and recycle used oil. The scheme also has potential for electrical/electronic goods and household hazardous wastes.

The best mix of policy options for New South Wales is a matter for analysis. The best arrangement will be highly dependent on the vision and strategy adopted for waste as a potential resource. At this stage, the Government has committed to the National Packaging Covenant and has received a commissioned report on Container Deposit Legislation.[13] No policy analysis or benefit/cost analysis of the various options to increase recyclate recovery has been undertaken.

Public Place Recycling

Opportunities for public place recycling in New South Wales are minimal, though event based schemes have been successful. A widespread, consistent public place recycling scheme would capture vast quantities of recyclate and, more importantly, send powerful reinforcing messages. The demonstration effect is likely to have a positive effect on home and work recycling behaviour.

Figure 4-2 Public place recycling is easy in Germany

A fine example of public place recycling is shown at Figure 4-2.

Recovery and Recycling of Other Materials

The above discussion has dealt with traditional dry recyclate materials: paper, glass, plastics, container metals, and timber. These make up some 30 per cent of the municipal and C&I waste stream. Other products and materials in

[13] Institute for Sustainable Futures. *Independent Review of Container Deposit Legislation in New South Wales.* 2001.

the C&I waste stream have increased potential for recycling. These include white goods, tyres, electronic goods, oil, computers, industrial plastics, production metals, cars, batteries, etc.

Policy instruments such as producer take-back schemes, advance disposal fees, deposit/refund schemes all have potential to encourage recycling actions. Importantly, these extended producer responsibility schemes should also encourage product redesign in terms of enlightened self-interest by manufacturers in order to reduce their costs in organising post-consumption stewardship. Extended producer responsibility is covered more fully in Section 9 of this paper.

5. RESOURCE RECOVERY AND PROCESSING (for Energy or Compost)

5.1. Context and Basis for Waste Processing

Processing of the residual fraction of waste, after source separation of recyclables, is receiving increased consideration by Local and Regional Governments. This fraction presently comprises some 70 to 80 per cent of the municipal and C&I waste generated, and is currently disposed of to NSW putrescible waste landfills at the rate of around 3 million tonnes each year. In this paper, processing is taken to mean rapid decomposition of waste to manufacture compost, energy or boost

Beneficial processing of this bulk waste is becoming an appropriate option given our declining landfill space, increasing concern about local and global effects of landfill pollution, and the emergence of newly available waste treatment technologies. The focus of this form of resource recovery and processing is on reducing potential harm to the environment and capturing value from materials that would otherwise be disposed of to landfill. The value of this dual, protection and conservation, purpose is increasingly recognised and widely supported. A drawback is significantly increased cost over the alternative of landfill disposal.

Materials in the mixed waste stream include both organic and high calorific discards, including food waste, garden/agriculture wastes, plastics, timber, paper and textiles. Most often, these materials present as mixed residual waste for disposal at putrescible waste landfill facilities. For Sydney this amounts to around 2.0 million tpa (1.4 million tpa from the municipal sector and 0.6 million tpa from the C&I sector). A further 1.0 million tpa of this mixed residual waste are disposed of in other parts of the State.

Waste streaming at source can provide a relatively clean feedstock for processing and consequent improved output product. Examples include garden waste from some municipal locations, and food waste generated and streamed by some commercial manufacturers and retailers. The amount processed is small however, at around 150,000 tpa in Sydney and a further 100,000 tpa in other parts of NSW.

The Emerging Technologies for Waste Processing

Technologies are now available to process mixed residual waste or source separated organic materials, such as food waste. These technologies are at various stages of development and commercialisation. Excellent outcomes have been achieved in Europe, and technologies marketed in Australia promise similar success.

Two main classes of technologies are used for processing waste to achieve beneficial outcomes. Biological technologies rely on rapid decomposition of waste through microbial activity in controlled conditions. Prominent technology types in this class are enclosed composting and anaerobic digestion.

Thermal technologies, on the other hand, rely on direct or indirect heating to transform waste to a material that can be used as a fuel for internal combustion engines coupled to generators. The prominent alternative technology types in this class are pyrolysis and gasification, which use indirect heating of waste. Conventional incineration technologies, even with energy recovery, are generally regarded as disposal devices.

Australia has a handful of companies able to offer systems for waste processing. The systems on offer use a variety of Australian developed technologies as well as technologies developed in Europe, but adapted for use in Australia. The core processes used in the main emerging technology types are described at Box 5-1.

5.2. Alternative Technology Projects in New South Wales

Installed Capacity

A number of schemes are in operation in NSW for processing garden-sourced organic materials to produce compost and mulch. Processing of mixed waste and source separated household and business waste is far less well developed. However, NSW is further advanced than in any other State with the following schemes in operation or commissioning:

- A mechanical/biological composting facility processing mixed residual waste for Port Stephens Council. The scheme is owned by EWT Pty Ltd and has capacity of approximately 30,000 tpa.

- A mechanical/biological composting facility processing source separated household food waste and garden waste in one system, and processing mixed residual waste in a further system for Hastings Council. The scheme is owned by Rethmann Australia Environmental Services Pty Ltd and has capacity of approximately 20,000 tpa.

- A gasification facility for processing mixed residual waste for Wollongong City Council. The scheme is owned by Brightstar Environmental and has capacity of approximately 50,000 tpa.

Projects at Planning or Development Stage

Various waste processing projects are currently under consideration and will add significantly to installed processing capacity as they come to fruition. The following projects are either approved or at bid stage:

- An anaerobic digestion facility processing source separated food waste on a commercial basis. The scheme is owned by EarthPower Limited and has capacity of some 80,000 tpa.

- Waste processing scheme(s) for installation at Waste Service NSW Sydney facilities. No decision on capacity has been made as yet.

Box 5-1 **Main Technology Types**

(a) Enclosed Composting

These technologies facilitate decomposition of organic wastes through microbial activity in controlled atmosphere conditions. The scheme usually involves some form of pre-treatment to recover organic waste and commence biological degradation, a second stage, where microbial activity is encouraged, and a final maturation stage in which full stabilisation is achieved. Enclosed composting systems make use of a variety of drum, box tunnel or silo devices to provide aeration and odour containment.

(b) Anaerobic Digestion

Digestion systems bring about biological degradation of organic wastes through microbial activity in starved oxygen conditions. Pre-treatment separation systems are used to extract any inorganic materials and prepare the organic material for digestion. In the core process methane-rich gas is recovered, and a nutrient-rich organic digestate is available for use as a soil conditioner. The gas can be used for energy production, and the digestate can be further stabilised in a composting process.

(c) Pyrolysis/Gasification

These “new thermal” technologies involve indirect heating of waste materials. In pyrolysis feedstock is heated in oxygen-free conditions to produce a liquid fuel. This can be used to power industrial engines coupled to generators. Alternatively, the pyrolysis fuel (or direct waste) can be heated to a high temperature, converting the carbon-rich waste material to a gaseous form. This gas, which is rich in carbon monoxide, can be used as fuel for industrial engines coupled to generators. The resulting electricity can be used to power the system and return a portion to the electricity grid.

(d) Vermicomposting

These technologies make use of worms to consume organic wastes and reduce the material to a rich, stable compost. The system has been developed with sewage sludge as the main feedstock, sometimes accompanied by garden waste for bulk. Food waste is also a suitable feedstock.

(e) Bioreactor Landfill

International proponents of these purpose-designed facilities claim they should be regarded as a technology akin to anaerobic digestion. Microbial decomposition is enhanced in these landfills by designed recirculation of leachate and, in some cases, addition of sewage sludge to increase the concentration of methanogenic organisms. The system aims to accelerate the waste degradation process and improve landfill gas production and capture. The recovered methane-rich gas is used to power industrial engines coupled to generators, returning electricity to the grid.

- Tenders are being considered for a waste processing scheme for the lower Hunter Region comprising the LGAs of Newcastle, Lake Macquarie, Cessnock and Maitland. A capacity of around 150,000 tpa is planned.

- Coffs Harbour City Council is considering proposals for a waste processing scheme. Capacity of around 30,000 tpa is planned.

Two further projects at development stage warrant consideration as innovative projects:

- A mechanical pre-treatment facility is being developed for processing mixed residual waste at South Windsor. The scheme is owned by Thiess Services Pty Ltd and has a capacity of approximately 65,000 to 90,000 tpa. Tenders will be sought for the products of this scheme.

- A bioreactor landfill facility claimed by Collex Pty Ltd to be designed to recover 90 per cent of landfill gas emissions for conversion to electricity.

What the Improvement Scenarios Mean for Processing

The progressive improvements in resource recovery and processing for relevant sections are summarised below and shown diagrammatically in Figures 5-1(a), 5-1(b) and 5-1(c).

Municipal Sector: There is substantial scope to increase processing of streamed organics and mixed residual waste for beneficial outcomes. The *Waste Inquiry/Landfill Assessment* Scenarios sought a 100 per cent increase in municipal garden waste processing, and the introduction of municipal residual waste processing (of 217,000 tpa) for the Improved Initiatives Scenario. Figure 5-2 shows a high quality composting process.

For the Aggressive Initiatives Scenario, a further 33 per cent increase in municipal residual waste processing was proposed. In addition, the introduction of municipal sourced food waste processing (150,000 tpa) was planned for this Scenario, based on collection with garden waste. This Scenario would take food waste processing to 54 per cent of potential, and garden waste processing to 77 per cent of potential. Residual waste processing would be at 21 per cent of the available material currently disposed to landfill (including food waste and garden waste); possibly a conservative position as processing technologies develop further.

Figure 5-2 High quality composting

Figure 5 – 1(a) Progressive Improvement in Processing for Each Scenario – GARDEN WASTE

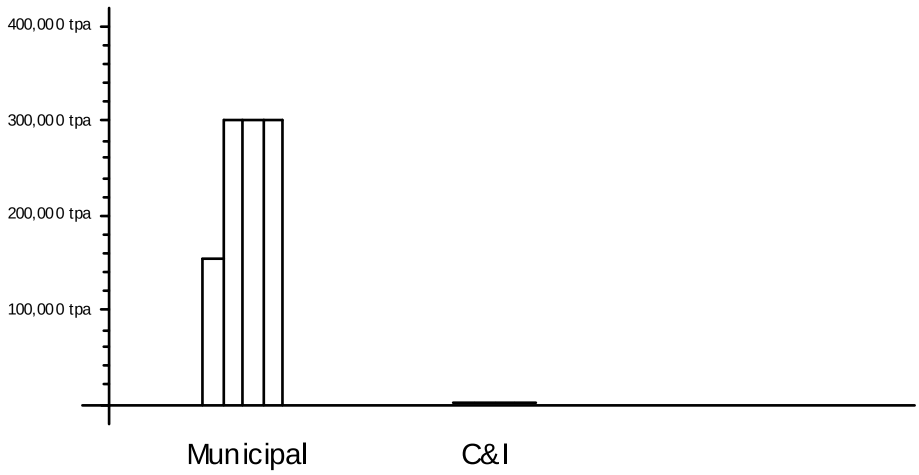


Figure 5 – 1(b) Progressive Improvement in Processing for Each Scenario – FOOD WASTE

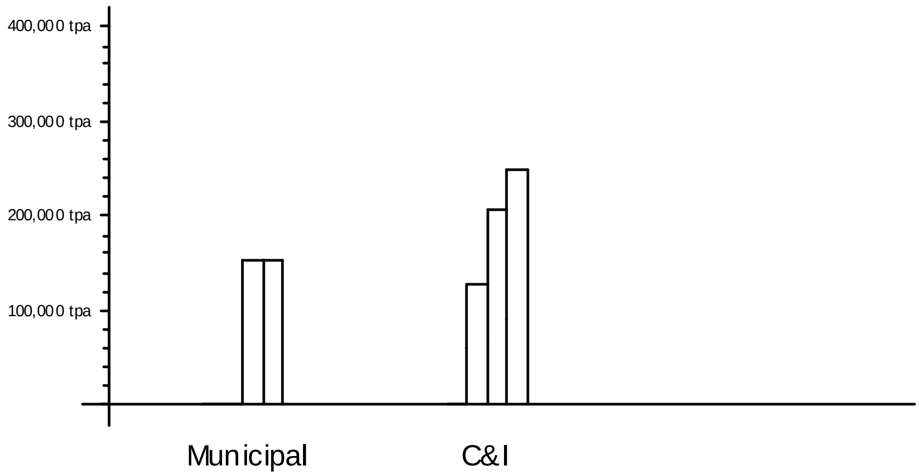
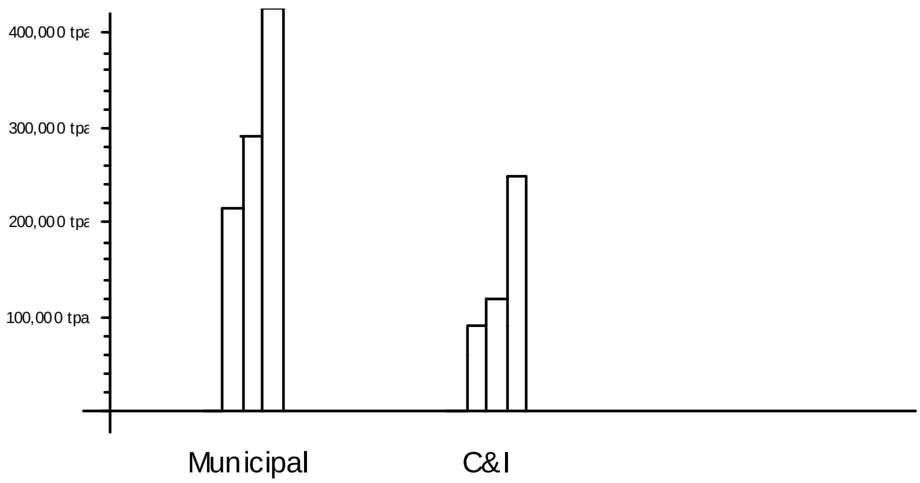


Figure 5 – 1(c) Progressive Improvement in Processing for Each Scenario – MIXED WASTE



For the Ultimate Initiatives Scenario, the only proposed increase in the municipal sector was a further 50 per cent increase in municipal residual waste processing.

C&I Sector: The C&I Sector was considered to hold considerable opportunity for organic processing. The *Waste Inquiry/Landfill Assessment* Scenarios sought the introduction of C&I food waste processing (130,000 tpa) and C&I residual waste processing (83,000 tpa) for the Improved Initiatives Scenario. Figure 5-3 shows a gasification system used for residual waste processing.

For the Aggressive Initiatives Scenario, a 58 per cent increase in C&I food waste processing was proposed, along with a 43 per cent increase in C&I residual waste processing. This would take food waste processing to around 96 per cent of current recovery limits. The potential for mixed waste processing from the C&I sector is unclear and around 8 per cent of the total currently disposed to landfill has been nominated.

For the Ultimate Initiatives Scenario further increases of 37 per cent and 110 per cent in food waste processing and residual waste processing respectively were proposed.

C&D Sector: No organic processing was proposed for the C&D sector.

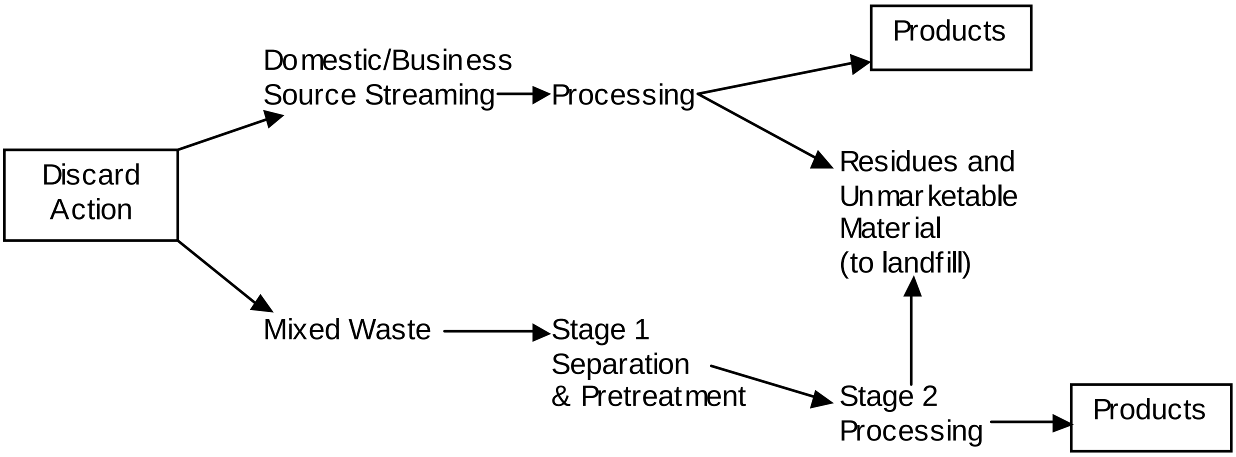
Figure 5-3 Residual waste gasification

5.3. What the Black Boxes Can Achieve

Many of the emerging waste treatment technologies excel at processing specific, streamed waste of a fairly consistent nature. Streaming at the point of waste generation and subsequent processing using appropriate technologies can produce high quality resources with potential to command electricity or compost markets.

Streaming at source however is not always feasible from a social or economic viewpoint. For strategic management of waste, therefore, successful processing of mixed residual waste, to provide resources suitable for beneficial use, is an important goal. These two alternative value chain pathways are illustrated at Figure 5-4.

Figure 5-4 **Alternative Processing Pathways**



This concept of mixed waste processing usually necessitates both pre-treatment and second-stage treatment. The emerging biological and new thermal technologies for mixed residual waste processing generally require such a two-stage process to reliably produce compost suitable for public consumption, consistent quality refuse derived fuel, or electricity.

Figure 5.5 Mixed waste material pre-treatment

Pre-treatment systems and devices (see Figure 5-5) have been developed to separate mixed residual waste into various fractions. The aim is to use drums, pulverisers and screen systems to create separate, fairly homogenous streams. Each stream would be suitable for further processing and beneficiation using a processing scheme appropriate for the material.

Fractions typically recovered from mixed waste pre-treatment systems are:

- an organic rich fraction (35-45 per cent of feedstock mass) that can be used as a feedstock for further biological processes or converted to energy using thermal processing;

- a moderately high calorific fraction (15-25 per cent by mass) consisting primarily of paper, plastics and timber, some of which has potential to be recycled or used as a fuel (RDF) for energy recovery;

- an inert fraction (~10 per cent by mass) consisting of bricks, stones, glass, etc; and

- a metal scrap fraction (~5 per cent by mass) recovered using metal separation techniques.

Issues and Options

Second-stage processing of pre-treated waste sometimes presents difficulties for some biological and some new thermal technologies due to imperfect preliminary separation of the mixed waste to form truly homogenous constituents, or inconsistency in batches presented for treatment due to variations between mixed waste input streams.

As a result, output quality and quantity may be compromised and/or plant commissioning periods may be extended. These sorts of issues can undermine the confidence of potential clients and in some notable overseas projects have threatened technology viability. The problem can be addressed in a number of ways:

- Adopting a public policy preference for source separation of organic materials in order to provide a clean, uncontaminated feedstock, despite potentially increased collection costs and perhaps some inconvenience in source streaming of food waste.

- Improving material separation devices used in the pretreatment processes used by technology proponents; a private sector, technology provider initiative.

- Adopting appropriate public policy measures to keep harmful materials out of the waste stream (chemicals, batteries, PVC, and treated timber, for instance).

The first course of action is unlikely to receive broad community support despite the potential for improved product outputs. The future widespread availability of biodegradable plastic bags may encourage household source separation of food waste. There is every reason, however, to encourage source separation of C&I sector organics where the scale of activity warrants the initiative. Public policy interventions to encourage streaming would have a powerful effect in stimulating private sector investment in processing technology projects for the C&I sector.

Improvements in material separation during pretreatment can be easily stimulated by a broad-based public sector client insistence on consistent output product quality suitable for public sale. A further step could be to require independent verification that certain, specified standards are attainable. (See Section 7, Market Development).

Keeping household and commercial hazardous wastes out of the mixed residual waste stream is a critical policy initiative if mixed residual waste processing is to make a serious contribution to sustainable waste management. Hazardous wastes can pollute emissions from thermal and biological processes, and pose a serious risk to compost quality in biological processes.

5.4. Principles to Guide the Choice of Processing Schemes and Technologies

Beyond the technology barriers to waste processing discussed above, decision makers at regional, local and corporate levels need a framework for considering (as a matter of policy) whether or not to incorporate waste processing as a potential part of the waste management strategy. Such a framework needs to lift consideration beyond confusing, futile comparisons of technology options. The real focus should be on the strategic and local policy issues associated with competing schemes for waste processing. Within this context three levels of decision making are appropriate:

- development of a waste management strategy including consideration of whether to incorporate beneficial processing as part of the strategy;

- choice of the broad type of waste processing scheme to adopt or at least favour as a basis for consideration;

- comparison of specific processing technologies within the strategy and processing scheme framework.

Waste Management Strategy as First Priority

No single technology class can offer a complete solution by treating and processing all waste materials generated in a particular region. Each can form part of an *integrated resource recovery and waste processing strategy* based on regional circumstances, together with the waste streams available and market demand for the products of processing. Determining the strategy should be the first priority. More specifically, regional sustainable waste management strategy selection relies on four critical issues:

- Current and evolving regional situations provide an important context for processing scheme choices. The complex intertwining of waste types generated, local planning and environment considerations, local industry resource demands and geographic circumstances can provide opportunities and critically influence choices of whether or not to adopt waste processing as part of the strategy.

- Investment and operating risks are best managed if input supply quantity and quality can be assured, or at least reasonably predicted, and product demand can be reasonably judged. The most efficient allocation of these and other risks is a key factor in controlling waste recovery and processing costs.

- Each generic technology has application to specific operating tasks which overlap at boundaries but differ in the main. Technology choice should logically be considered in the context of the specific waste stream to be used as feedstock (eg, organic waste, mixed waste, inert waste etc), which is part of the processing scheme decision described below.

- Technologies considered as part of an integrated system must play a pivotal role in linking markets for output products and the system of waste management practices adopted.

The strategy should be driven by a vision and goals that are based on outcomes required by the client, not the technology or service providers. Clients should take advice, but must ultimately be accountable for the choice of strategy and the decision on waste processing versus disposal.

The Important Choice of Waste Processing Schemes

Once an in-principle decision is made to include waste processing as part of the strategy, some tactical choices are available.

Three basic types of waste processing schemes are feasible and these form the basis for choosing the most appropriate pathway. Each of the generic schemes offers a fundamentally different way of achieving improved resource conservation and environment protection. Each is feasible using biological or thermal core processing technologies, together with varying levels of initial mechanical pretreatment.

The Generic Schemes are:

- Multi-stage processing of mixed residual waste.

- Source-separation of organics for single-stage processing.

- Single-stage processing of mixed residual waste.

Multi-Stage Processing

The focus of this scheme is the mixed residual waste that remains after source separation of recyclables. The mixed residual waste is separated into various fractions using the pretreatment and sorting technologies. The homogenous, largely organic, material is used as a feedstock to manufacture compost or energy, or both using the core processing technology. The recyclable materials are candidates for external processing. The high calorific value materials, including timber, plastics and textiles are candidates for refuse derived fuel applications, either on-site or in off-site facilities, such as power stations, cement kilns, or can be disposed of to a non-putrescible waste landfill.

Source-Separation of Organics

This scheme is based on separating food waste (and garden waste) at discard point to provide an homogenous organic feedstock for manufacture of relatively high grade compost or energy, or both using a core single-stage technology. In this scheme, the source streaming of organic waste overcomes the need for pretreatment and sorting. The mixed residual portion of the waste stream (relatively free of organics) can be processed using a separate single-stage or multi-stage configuration for manufacture of (inferior grade) compost and/or energy, and/or refuse derived fuel. Alternatively, some or all of the output may (depending on

EPA requirements) be disposed of as a partly stabilised waste to a non-putrescible waste landfill.

Single-Stage Processing

This scheme is based on the idea, held by some, that mixed residual waste has relatively low value and the cost of recovering (further) recyclables in a pretreatment process (apart from maximum source-separation at kerbside) outweighs the benefits. Accordingly, single-stage technology is used to process the feedstock, usually to recover energy.

Each of these schemes has legitimacy depending on circumstances, and failing an explicit tactical choice by the client, one of these processing schemes will be adopted implicitly by choosing a particular proposition.

Waste Processing Technology Assessment

Comparative assessment of technologies ought to be made in the context of an overall Waste Processing Scheme. This allows a robust comparison of technologies as applied to a nominated, clear purpose. In such a comparison, three issues are vital:

- the economic viability of the commercial arrangement secured with the proponent, covering both financial outgoings and local economy effects;
- the reliability of the technology as evidenced by a record of efficient commercial operating success;
- the environmental outcomes of the project, including emissions from the creation of product outputs suitable for public consumption.

Comparative assessment of rival technologies outside the regional waste strategy and notional processing scheme framework, is limited and unreliable except as a rough guide. Such assessments have limited value because:

- local variations such as socio-economic factors, transportation distances for wastes and recovered resources greatly affect economic, environment and social impacts;
- project scale greatly affects impacts, so technology performance is somewhat related to optimal project scale;
- the risks of environmental impacts to air, land, water and amenity from a facility are largely governed by the type and composition of waste handled.

Attainment of Highest Resource Value

An attractive goal in determining process scheme options is the concept of *highest resource value.* This is based on the idea that each part of the waste has a distinctive best value in post-consumer use. The proposition is that recovery and processing action ought to be organised to ensure that higher order value is sought before lower order values. Thus, it makes sense to recycle aluminium cans and PET in a closed loop rather than process them to create energy. The merit of this logic has been demonstrated in many studies both overseas and in Australia.[14]

The *highest resource value* principle lends itself to opportunities for keeping separate at source both recyclate materials (like metals, plastics, glass and paper) and organics (including food waste and garden waste). On the other hand, source separation incurs social and commercial costs that need to be considered in the net benefit equation.

Application of the *highest resource value* principle in processing mixed residual waste requires extra care. Much of the recyclable material recovered in pretreatment can be spoiled by its time in contact with putrescible waste and its overall value can be compromised. Metals and major plastics can often be recovered.

Some alternative technologies, on the other hand, process mixed residual waste without removal of (potentially recyclable) materials that would normally be considered unsuitable for processing. The argument in support of single-stage processing is that: once various waste types become mixed, the attainment of true highest resource value is compromised, and the pretreatment separation cost is expensive and yields resources of limited value. Proponents argue that the best solution is one that results in consistent beneficial outcomes of positive value. This proposition needs to be tested in the context of comparative costs and environmental impacts associated with separation at source or at the pretreatment stage.

The Proximity Principle

The logistics implications of moving materials to other locations for processing, sale or post-processing use should also be considered. The issue is that material value diminishes with distance travelled due to financial, social and environmental impacts.

Transport impacts are not necessarily related to distance: a short journey by road may have greater impact than a long journey by rail.

Other specific issues that should be taken into account include the following:

- The location of treatment technologies close to markets for potential products derived from waste processing may be warranted in some circumstances;

- Treatment or disposal within the region in which waste is generated may reinforce the merits of managing waste as a potential resource;

- The fact is that many of the resources that are used in Sydney are produced in other regions. Sydney will never be self-sufficient and back-loading economies may apply.

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[14] Nolan-ITU & Sinclair Knight Mertz. *Independent Assessment of Kerbside Recycling in Australia.* 2001.

- Production economies are critical to the reprocessing of recyclate. For example, the Coca Cola PET recycling facility near Liverpool draws resource from various States in order to operate efficiently. It would be inconceivable to have such a facility in each capital city.

Each application should be assessed as a unique proposition, however the following waste treatment/disposal principle should be considered:

Waste should as far as practicable be treated or disposed of in the region which provides the best outcome in terms of all economic, social and environmental factors.

6. LANDFILL DISPOSAL OF RESIDUAL WASTE

6.1. Context of the Landfill Situation

The public management of waste has evolved from an initial quest for convenient disposal, through community health protection and, more recently, to increasing concern about impacts of waste disposal on the environment. Immediate impacts include local pollution and social impacts from disposal of waste in landfills. Broader concerns now relate to emission of greenhouse gases from waste disposal sites.

Examples of poorly managed waste disposal facilities have led to (local and state) government reluctance to establish new landfill infrastructure near urban population precincts. Meanwhile, continued waste flow is progressively consuming existing landfill space. An important outcome has been that those local authorities with only moderate landfill space are now forced to consider alternative solutions in lieu of convenient and continuing disposal. The main options are: transport to distant landfill; or beneficial waste processing using a portfolio of innovative technologies.

A further, and important, outcome has been better management of landfills. Many local authorities have been prompted, by forceful EPA regulation in the 1990s, to improve operations at existing landfills. Significant advances have been made in leachate capture and treatment, odour and vermin control, and capture of landfill gas as a greenhouse gas reduction initiative. Landfill operations that recover landfill gas and convert it to electricity mare being installed in various NSW locations. Waste Service NSW has been a leader in both the above activities.

The newly developed bioreactor landfill scheme, being pioneered in Australia by Collex, will operate as a large-scale anaerobic digester in a quest to increase effectiveness in recovering landfill gas in commercial quantities.

These improvements have reduced the polluting effects and increased the resource recovery scope of landfill management. They have not yet been successful in winning public approval however for the practice that falls short of gaining highest resource value for all discarded resources.

Most State governments now have in place a landfill disposal levy. This levy is broadly aimed at incorporating in the gate price some measure of public compensation for the environmental impacts (externalities) encountered in landfill operations and/or less of potential resources. The variation between states is significant however, and NSW leads other states, with a current levy of $17 per tonne, rising to $25 per tonne over eight years from 2002.

6.2. The Landfill Capacity/Demand Squeeze

Unwanted materials are discarded daily from the municipal sector, the commercial and industrial (C&I) sector, and the construction and demolition

(C&D) sector. A proportion of this generated waste is captured in recycling and reprocessing programs, but the remaining bulk is disposed of to landfill.

Demand for landfill space for waste disposal is thus a function of two main determinants:

- Waste Generation: the absolute amount of unwanted materials actually created and discarded.

- Waste Reduction: the amount of discarded materials deliberately diverted to recycling and processing for beneficial purposes.

Waste disposed of at New South Wales landfills amounts to some 5.5 million tpa as shown at Table 6-1. The proportion of disposed waste sourced from the three waste sectors varies from year to year, but is usually around 35 per cent municipal, 40 per cent C&I and 25 per cent C&D.

The main centres comprising the conurbation from Newcastle through Central Coast, Sydney and Wollongong account for some 85 per cent of NSW disposal, or 4.7 million tpa. Sydney alone contributes some 4.0 million tonnes for disposal.

Table 6-1 **Waste Disposal, NSW**

Location	**Indicative Disposal Rate** (million tpa)
State total	5.5
Main centres[1]	4.7
Sydney metropolitan	4.0

Source: Estimated by WCS Market Intelligence.
[1] Sydney, Newcastle, Wollongong, Central Coast.

Some 7.2 million tonnes of waste are generated each year in the Sydney region. Around 3.2 million tpa are captured for recycling and reprocessing and around 4 million tpa are dispatched to various landfill sites for disposal. Thus around 2 million tpa are disposed of at putrescible waste landfill sites: a further 2 million tpa are disposed of at inert waste landfill sites. Table 6-2 sets out the estimated waste overview for each of the main waste generating sectors.

Table 6-2 **Estimated Sydney Waste Flows**

Waste Flow	**Municipal Sector** m.tpa	**C&I Sector** m.tpa	**C&D Sector** m.tpa	**Total** m.tpa
Waste Generated	1.8	2.9	2.5	7.2
Less				
Recycled/ Reprocessed	0.4	1.3	1.5	3.2
Leaves Disposed				
Inert landfill	0	1.0	1.0	2.0
Putrescible landfill	1.4	0.6	0	2.0

Source: Estimated by WCS Market Intelligence.

Landfill Capacity

Estimated Sydney putrescible waste landfill capacity at July 2002 will accommodate a further 17 million tonnes of waste as shown in Table 6-3. This capacity is being drawn down at a current rate of around two million tonnes per year.

Table 6-3 **Putrescible Waste Landfill Capacity Estimates**

Landfill Site	Current Capacity July 2002 (million tonnes)	Probable Input Rate from July 2002 (million tpa)
Belrose	0.380	0.100
Eastern Creek	3.750	1.180
Lucas Heights	10.400	0.575
Jacks Gully	2.350	0.140
South Windsor	0.300	0.005
	17.180	2.000

Source: Estimated by Wright Corporate Strategy, based on *Independent Assessment.*

The above information relates only to the position on landfill space for wastes presenting as *"putrescible wastes".* These wastes can only be disposed in Solid Waste Class I Landfills. In Sydney these are publicly owned.

Landfill capacity for wastes that are categorised as inert, solid (excluding putrescible) and industrial is not publicly known because these facilities are privately owned. Little data is available, but estimates made for planning purposes indicate that available capacity is in the order of 35 to 40 million tonnes; sufficient for some 20 years demand at current rates.

Scenario Implementation and Landfill Demand

A critical issue in respect of landfill input demand is the rate at which each of the Waste Inquiry scenarios might feasibly be adopted and actioned by taking up the various practices and technologies now becoming available for improved recycling and processing of mixed residual waste as well as source-streamed homogeneous waste. It will not be possible to move from the current position to even the *Improved Initiatives Scenario* (described in Section 2 of this report) as rapidly as we might wish because technology-based projects, behaviour change and market development actions take time to accomplish.

A landfill capacity and demand assessment[15] commissioned by the Government estimated the pace at which the transition to sustainable waste management practice could be accomplished. The report concluded that during the transition "… substantial increased landfill capacity will be required, by-and-large in the near-term". The Minister for Planning subsequently

[15] NSW Government. Independent Public Assessment – Landfill Capacity and Demand. September 2000.

approved Woodlawn as a further putrescible landfill site for limited (and decreasing) amounts of Sydney waste.

6.3. Issues and Options

The overall capacity/demand comparison for putrescible waste landfills in Sydney masks the time available until a capacity shortfall will occur. Waste input constraints on Lucas Heights and Jacks Gully mean that Eastern Creek Landfill must receive more than 1 million tpa from July 2002; more than double the current input rate.

The *Independent Assessment* found that a significant and chronic landfill capacity shortfall will be encountered after 2006 based on a realistic rate in implementing the waste diversion scenarios described above. This finding remains valid pending the start-up of Woodlawn landfill to provide supplementary capacity, and/or a considerable further expansion of Eastern Creek landfill.

The scope for further capacity at Eastern Creek is unclear.

The development consent for Woodlawn landfill provides for receipt of up to 400,000 tpa of Sydney waste, with provision for reduced input each five year period. Woodlawn has not yet commenced operations, pending development of a Sydney transfer station and intermodal access.

If Woodlawn was to accept waste from 2003, then breathing space would be provided for the take-up of the sorts of initiatives described in the Scenarios outlined above. Under the Scheme 5 take-up pace (eight year intervals) a capacity shortfall would be delayed to 2012 with Woodlawn taking waste from 2003 at input rates decreasing over time. Under Scheme 7 take-up pace (six year intervals) potential capacity shortfall should be avoided with Woodlawn taking waste or Eastern Creek developed further.

7. MARKET DEVELOPMENT

7.1. Context

Sustainable waste management relies on the existence of markets for the material created when discards are recovered and recycled or processed. Output products compete in markets that overlap with markets for virgin materials, where well developed product-to-market channels are in place. Continuing and stable demand is critical for two reasons:

- Adequate demand for the product outputs of recycling and processing is vital to completing the virtuous circle of resource conservation.

- Predictable demand instils confidence in both buyers and sellers. This facilitates the funding of projects by investment interests, and enables business judgements to be made by equity investors.

The importance of markets is underlined by appreciation of the considerable value of output product income in waste processing projects. The direct processing fee may contribute as little as 50 to 60 per cent of total project revenue, supplemented by direct revenue from energy, compost and/or recyclable metals, plastics and glass. In waste to energy projects, Renewable Energy Certificates also form a source of revenue, and in future carbon credits may further contribute.

7.2. Current Situation

Market factors have received second-order consideration in the management of waste as a resource. The major effort has been on supply-side activities, including promoting increased recycling and encouraging processing of mixed residual waste. Promotion of diverse and sustained demand for the products of these efforts has received only moderate support from business interests and governments the world over.

Markets for household recyclate have proved unstable at times during the last ten years, and prices have rarely matched costs of collecting, transporting and reprocessing recyclable materials. This is at least partly because pricing of rival virgin materials does not fully cover non-market factors such as non-renewable resource depletion, and partly because diverse market demand has not yet emerged for most recycled materials.[16]

The current status of New South Wales markets for resources is highly variable according to material type, as shown in Box 7-1.

[16] Frank Ackerman. *Why do we recycle: markets, values and public policy.* 1997.

Box 7-1 **Indicative Market Demand for Various Materials**

Material	Current Demand	Latent Demand	Comment
Plastic Materials			
PET (polyethylene terephthalate)	High	Moderate	Substantial bottle to bottle, closed loop. Some sent to China.
HDPE (high density polyethylene)	Moderate	Moderate	Manufacturing uses.
LDPE (low density polyethylene)	Low	Moderate	Market yet to develop.
PVC (polyvinyl chloride)	Low	Low	Future of material in doubt.
Mixed contaminated polymers	Low	High	Potential RDF.
Paper/Cardboard			
Office white paper	Low	High	High collection cost, but high market value.
ONP (old news paper)	High	High	New uses being developed.
OCC (old corrugated containers)	High	Moderate	High local and international demand.
Mixed low grade papers	Low	Moderate	Potential RDF.
Glass			
Uniform cullet	Moderate	Moderate	Potential for higher quality recovery.
Mixed cullet	Low	Low	Low value.
Organic Materials[17]			
Garden organics	Moderate	Low	Limited demand.
Food-based residuals	Low	High	High potential with market development, with value adding nutrients.
Mixed residual waste	Low	Low	Potential for broad-acre agriculture application.
Metals			
Scrap steel	High	High	Developed market.
Scrap aluminium	High	High	Developed market.
Other metals	High	High	Developed market.
Other Materials/Products			
Electrical/Electronic materials	Low	Moderate	Needs market development.
Electricity (at green prices)	Low	Moderate	Good potential with Government support.
Heat	Low	Low	Limited applications.
Tyre materials	Low	Moderate	Some potential if marketed as various material types.
Building Materials			
Timber	Low	Moderate	Good potential with multi-product market development.
Spoil/rubble	Moderate	Moderate	Waste disposal levy promotes recycling.

Source: Estimated by Wright Corporate Strategy.

[17] A variety of organic feedstock materials from multiple sources may be combined to enrich compost quality.

7.3. Issues and Options

The challenge of achieving sustainable management of waste as a resource requires a substantial and supportive effort to identify and create markets, and stabilise demand. Development and expansion of markets for recycled and processed materials will require a coalition of effort by government, business and the broader community.

Quality Standards

The broad concept of best value for money is applied by manufacturers in choosing materials suppliers. Price, quality and consistency are the critical mix that manufacturers seek to optimise. The quality framework is fundamental to winning the confidence of the various purchasers engaged in the product value chain. For instance, full maturity is critical to compost quality (see Figure 7-1).

Figure 7 – 1 Compost storage

A broad system of input materials standards (or recognised specifications) and output product standards would bring rigour to the discarded resource markets. The system of multiple grades established in paper markets is complex, but provides a wide array of choice for buyers and many variations in supply grades, so that a market niche is available for all paper classes, from high grade to low quality mixed papers. This sets the benchmark for comprehensive systems for organic materials, building materials, plastics and other materials.

Alternative Recyclate Uses

Traditional dry recycling is founded on the closed loop concept of feeding recycled materials into like-product development. The quest for alternative uses for recyclate is based on the idea that diversification of end-use applications can help to strengthen and stabilise demand. Market diversity moderates exposure to downturns in specific segments.

The general aim in creating diverse applications is to discover innovative uses (to absorb economic fluctuations) and high in value (to increase returns). The challenge is to achieve the highest value overall portfolio for each resource stream. This may not always result in attainment of the highest resource value for every tonne of materials recovered, but should maximise overall resource value for the total material stream.

- Used paper is finding applications as animal excreta absorbent and as insulation material. It also has potential as refuse derived fuel.

- Mixed glass cullet, of relatively low value, is finding applications in building and construction industries.

- PET is being used successfully in the manufacture of synthetic fibres.

- Recovered liquid paperboard is used in manufacture of industrial sheet/ board products.

- Rail track ballast is being recycled successfully to manufacture aggregate for use in concrete and road base.

Market Stabilisation

Business cycle conditions always result in price fluctuations in resource markets, and the market for recovered resources is no exception. Reducing price volatility to within business cycle fluctuations is a worthy aim and ought to be achievable as markets diversity and mature.

One way to hasten this maturity is by establishing futures markets for the main recovered resources. Futures markets provide a measure of predictability for resource demand and pricing as well as advance purchase contracts. The Chicago Board of Trade pioneered the scheme in the USA, with application to recycled materials.

Recycled Content

Market demand for recovered resources can of course be stimulated by policy initiatives to encourage a measure of recovered resource content in new products. Such a scheme could be implemented on a voluntary basis as part of EPR development or, if warranted by market failure, could be advanced on a mandatory basis.

8. INTEGRATED WASTE MANAGEMENT AND RESOURCE RECOVERY

8.1. Context

Much of the discussion in this paper is founded on the principles of *Integrated Waste Management*:

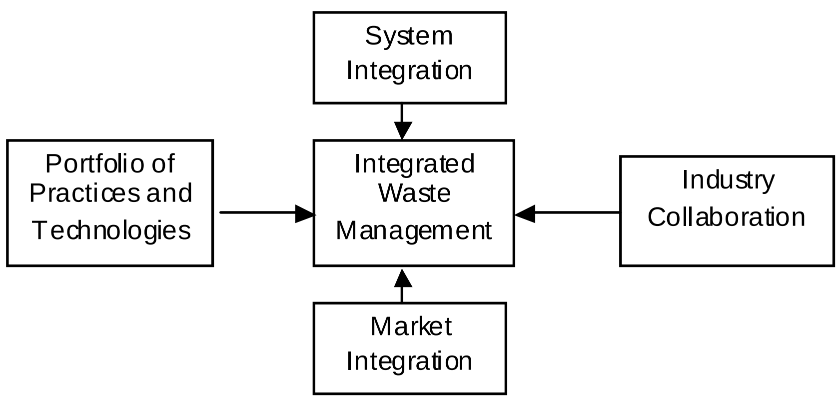
- where all activities in managing waste as a resource are enacted as integral parts of the whole system;
- where the roles of all stakeholders are clear and differentiated; and
- where resource markets drive waste recovery and value adding actions.

Integrated waste management is an overall approach that reaches beyond the current fragmented management of waste, to enhance system efficiency and improve resource recovery effectiveness. In contrast to waste avoidance, the focus is on better managing the potential resource once created.

8.2. Current Situation

Integrated waste management has four related conditions: system integration, for maximum efficiency; collaboration of firms and agencies within the waste industry; a portfolio of management practices and technologies; and market integration so that demand for recycled and reprocessed material actually drives capital investment (see Figure 8-1). The force of these conditions, and their level of integration is powerful in facilitating overall waste management performance.

Figure 8-1 **The Related Conditions of Integrated Waste Management**



System Integration

Waste management activities in New South Wales are organised as sequential steps in which management and materials ownership shifts from one participant to the next. For the municipal streams, four and sometimes five organisations play a part in the journey from discarding to disposal or rebirth. Adding the C&I and C&D discard streams brings further participants into the business of (separately) managing wastes.

At present each participant in the management process logically seeks to optimise their own position which works against the interests of the best overall system. This way of managing is inefficient and limits potential for discovering and exploiting opportunities for recycling and processing materials.

A better way forward is for various waste streams and geographic areas to be aligned and broadened. System integration can also provide contractors with financial incentives to maximise revenue from waste resources, as well as minimise costs.

Waste Industry Collaboration

With the adoption of the *Waste Avoidance and Resource Recovery Act, 2001*, the NSW Government has positioned the State for sustainable waste management.

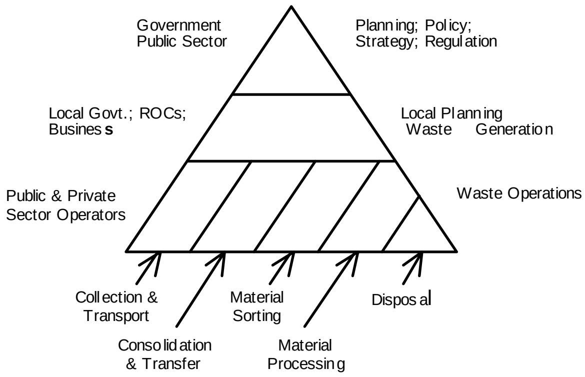
The newly formed Resource NSW has the clear and pressing role of developing the State Waste Strategy and managing implementation of Government policy objectives to bring management of waste as a potential resource. The EPA has a role in coordinating the vision for sustainable waste management and developing and managing the strategic policy framework, as well as the task of environmental regulation.

And the newly corporatised Waste Service has been enabled to better perform in the competitive waste management industry that prevails in New South Wales. Waste Service is required to operate within the principles of ESD, and provide effective stewardship of important public infrastructure.

The private sector waste management industry in NSW has embraced these changes and has shown great interest in working with the public sector waste agencies in the interests of sustainable waste management. There is an important opportunity for leadership in bringing the whole of the waste management industry together to work in harmony to better service the interests of the environment and the waste generators.

Figure 8-2 shows the configuration of the waste management industry in NSW, depicting public sector agencies in influential positions in a sector dominated by private sector operators. It is notable that the main participants in the waste industry are local subsidiaries of large international utility companies.

Figure 8 – 2 Waste Management Industry Structure



Portfolio of Practices and Technologies

The *Waste Inquiry* showed that no single waste management practice and no one technology can bring about sustainable waste management. A portfolio can be geared to differing waste streams and differing market requirements so that the collective strength of each part of the portfolio contributes to the complete strategy.

Market Integration

Resource markets do not yet drive resource recovery and recycling or processing. The dominant driver is supply-push rather than market-pull. This is partly because clear messages cannot easily be passed to citizens and business through the fragmented system for managing wastes and resource recovery.

To achieve behavioural changes it is essential that business and community members can see the impact of their involvement and efforts and appreciate the virtuous circle of closed loop recycling and reuse. When the complete picture is widely internalised, the act of purchasing recycled and processed products will be valued as much as the act of committing discards to the recycling bin. Strong market demand for recovered materials will drive investment in innovative practices and technologies. This will be a critical point in the path to sustainable waste management.

8.3. Issues and Options

Waste management and resource recovery could be greatly improved by adoption of a more integrated approach which strengthens the linkages between steps in the supply chain, waste streams, geographic areas, processing activities and markets.

System integration implies an approach that incorporates in single contracts and/or agreements:

- increased value chain activities, including collection, transfer, transport, MRF sorting, treatment, selling, and/or disposal;

- larger geographic areas than a single local council collection zone;

- joint organisation of waste management by firms within a relevant location or with similar types of wastes;

- inclusion of recyclables, special collections, such as garden waste collection, and residual waste;

- scope for capture, by private treaty between the contractor and private sector waste generators, of C&I and C&D waste and recyclables from these streams within the relevant geographic area.

Some preliminary indications have been received that lumping-up contracts in this way may be viewed as anti-competitive. The rationale for this view is that such contracts could be so large as to force unsuccessful firms out of the market. This logic is inconsistent with the facts: there are hundreds of thousands of waste generators; many hundreds of waste contractors; and competitive tenders would necessarily be called before awarding contracts.

Any concerns should be accommodated by ensuring that contract size does not annex a disproportionate part of the market, and that rival firms are not disadvantaged in pursuit of local C&I and C&D waste collection and recovery.

The development of a State Waste Strategy presents an opportunity to bring about new levels of collaboration within the waste management industry. The industry is well positioned to work with its business and local government clients to offer a more diverse array of service options than is currently available. This could include wider recovery choices (including opportunities for streamed putrescible discards) and increased vertical services (including in factory/office capture of discards). High level leadership and coordination will be critical in achieving positive outcomes.

The State Waste Strategy also provides an opportunity to progressively incorporate the portfolio approach into NSW waste management. This logically links to the concept of establishing market needs and bringing greater focus to market-pull as the driver of investment in practices and technologies.

9. EXTENDED PRODUCER RESPONSIBILITY AND PRODUCT STEWARDSHIP

9.1. Context

Many participants in the waste management chain argue that waste volumes will not decline until the original manufacturers of the product that becomes waste are responsible for managing it until its full life cycle is complete. Formerly termed "cradle to grave" and now called "cradle to cradle" because of the implicit eye toward resource recovery, *Extended Producer Responsibility (EPR)* is now a feature of NSW waste management legislation.

The Contribution of EPR

OECD defines EPR as "…. *an environmental policy approach in which a producer's responsibility, physical and/or financial, for a product is extended to the post-consumer stage of the product's life cycle*"[18]. The policy is based on the idea of: shifting responsibility up the value chain to manufacturing and away from the community/local government level; and (importantly) providing a financial incentive for producers to design products with the post-consumer stage in mind.

This second point is critical to the effectiveness of EPR. If the outcome of the policy is simply to transfer the cost of disposal from product users to product producers, without a positive environmental impact, then little will have been achieved. After all, EPR is one tool, among many policy options, to reduce environmental harm and conserve resources.

The signal to the producer should propel moves to design products for ease of recovery and recycling or processing. A complementary goal might be product redesign to reduce materials intensity and toxicity in disposal. The logic chain is as follows:

- a producer faced with extended responsibility will initially move to cover the cost of disposal or recovery and recycling by adding this cost to the price of the product;
- the increased shelf price will reduce product demand;
- the producer will then seek to reduce the cost of disposal or improve the attractiveness of the product by redesigning it to reduce environmental impacts;
- thus the shelf price of the product will be reduced and demand will increase.

[18] OECD. *Extended Producer Responsibility.* A Guidance Manual for Governments. OECD Publications 2001.

The EPR signal can come in various forms: market-based, with pricing as the driver; regulation based, with financial penalty and potentially damaged image as the driver; or educative/voluntary, with interest in the environment and/or positive publicity as the driver.

How EPR Improves Product Design

Various scenarios are feasible, but the logic of market based or voluntary schemes ultimately relies on the producer gaining competitive advantage in the market by being able to either:

- make changes in design to reduce the disposal cost and thus the shelf price of the product in comparison to rival products (comprehensive of post consumer disposal/recovery requirements); and/or

- make changes in design to reduce material toxicity and promote this as a positive feature.

For EPR policy to send powerful signals to producers, disposal prices must be sufficiently high to motivate action to reduce material intensity and/or toxicity. This can be achieved if recycling costs are organised to be lower than disposal costs for particular materials or products. One option is for nominated materials or products to incur a special disposal levy that might equate to the environmental externalities associated with disposal. This would bring about real gains in waste avoidance.

EPR Variations

Three generic types of EPR schemes can be distinguished:

- Take-back schemes, where the producer or retailer takes responsibility for retrieving end of life products and arranging for recovery and recycling of components, or for safe disposal of hazardous materials. These can be either mandatory or voluntary.

- Financial incentive schemes, in which market dynamics are altered by the introduction of fees, levies, or deposits at some stage in the value chain. The aim here is behaviour modification and the target can be at various levels in the value chain. These tend to be mandatory.

- Material specification schemes, which call for certain material content targets. These can be either mandatory or voluntary.

A broad summary of the impacts of these EPR variations is set out at Box 9-1.

A Role for Product Stewardship?

Definitions of EPR vary between nations, particularly in respect of the weight of *responsibility*. The general perspective, consistent with the logic explained in 9.1 above, is that EPR schemes place responsibility with the *producer.*

Box 9-1 **EPR Examples and Impacts**

Generic EPR Category	Environmental Impact	Industry/Economic Impact	Example
Product Take Back Schemes	Design for recovery or reduced disposal cost.	Shift in disposal responsibility to producer/retailer.	Packaging. White goods. Motor vehicles. Electrical/electronic goods.
Financial Incentive Schemes			
- Deposit/Refund	Increased recovery for recycling.	Increased but reclaimable product cost. Shift in collection responsibility away from local government.	Beverage containers.
- Advance Disposal	Design for recovery or reduced disposal cost.	Slight increase in product cost.	White goods. Beverage containers. Batteries.
- Material Tax	Reduced environmental harm, virgin resource conservation.	Slight increase in product cost.	Tax on high toxicity materials. Tax on virgin materials.
Material Specification			
- Recycled Content	Increased use of recycled materials.	Possible increased product cost.	Newspapers. Beverage containers.

A related policy instrument is *Product Stewardship*, defined according to the Waste Act[19] as: "… shared responsibility for the life-cycle of products…". In this model all participants in the product value chain, from raw materials suppliers to producers, retailers, consumers and waste managers share responsibility for managing environmental impacts. The arguments in favour of this approach revolve around the concept that the most efficiently able to manage impact prevention at each state in the value chain should take the responsibility. This system has merit as long as each party is aware of its best role, and how it contributes to the total responsibility system, and is willing and able to perform its best role.

Some consider *Product Stewardship* to be a voluntary variant of EPR. This is not the case; both schemes can be implemented on either a voluntary or a mandatory basis. The Waste Act provides for both *EPR* and *Product Stewardship* approaches, and it is most likely that each will have special relevance for certain product categories. In fact some schemes, such as Deposit/Refund schemes (described below) might more accurately be classed as *Product Stewardship* tools than EPR tools. This is because in CDL, the consumer plays an active role, as does the retailer and the producer. Further, there is no incentive for the producer to redesign the product.

9.2. Current Situation

EPR schemes have been used principally for packaging waste, electrical and electronic equipment, waste oil, containers, tyres, and various other products. Waste policy in Europe and North America incorporates various forms of EPR and associated policy instruments. Well known examples are:

- the German Packaging Ordinance, which mandates for manufacturers and distributors to take back packaging and organise reuse or recycling;
- the Dutch Packaging Covenant, which is a voluntary, negotiated agreement with clear industry roles for responsible packaging design and recycling;
- the German take-back program for white goods involves dis-assembly (see Figure 9-2);

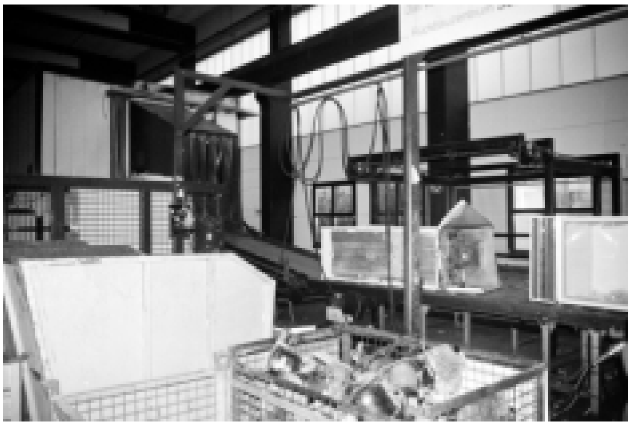


Figure 9 – 2 Most components from Whitegoods have a second life

[19] NSW Government. *Waste Avoidance and Resource Recovery Act,* 2001.

Figure 9 –3 Electrical/Electronic devices yield high value resources

- the Swedish program for electrical and electronic equipment, in which it is mandatory for manufacturers and retailers to take back and recycle used products in replacement for new products also involves dis-assembly (see Figure 9-3);
- minimum recycled content requirements in various US States;
- bottle deposits and advance disposal fees in various US States.

Australian Experience with EPR

Three notable examples of EPR variants are in currency in Australia. The most notable, the National Packaging Covenant is a voluntary scheme in which all relevant stakeholders have accepted roles and given undertakings to bring about sustainable packaging management. Critics of the scheme point to slow progress in the three years of operation. Proponents point to action plans in place and to package improvements resulting from the covenant.

The Commonwealth Government has recently commenced an EPR scheme for waste oil. The scheme operates on the basis of a small levy applied to all new lubricant at point of sale. This levy is collected by a regulator and used to fund directly the operations of accredited waste oil collectors and recyclers. The levy, in effect, bridges the gap between the revenue available from used oil recycling and the base costs of collecting and recycling the oil.

The South Australian Container Deposit Legislation (CDL) has been in operation for some 25 years. The scheme commenced as a litter reduction initiative, but has been successful in recovering beverage containers for recycling, and operates alongside kerbside recycling arrangements.

Under the NSW *Waste Minimisation and Management Act 1995*, Industry Waste Reduction Plans were negotiated with the Dairy industry, the Tyre industry and the Beer and Soft Drink Industry. A further plan was developed for Used Packaging Materials as part of the National Packaging Covenant. These voluntary agreements were aimed at increasing recycling and reducing disposal of used materials. However, no plan has been successful in meeting the targets set by industry.

9.3. Issues and Options

EPR provides a policy framework and an array of tools to enhance resource recovery. Some of the tools can influence waste avoidance. Many of the tools are inventive, some are onerous and complex to administer. But EPR is not an end in itself. The choice of one or a combination of tools from the policy framework should be driven by waste management goals; a function of the vision and outcomes sought. Four principal goals are cited by OECD for EPR:

- reduction of source material usage;
- prevention of waste;
- design of environmentally compatible products;
- closure of materials loops.

Getting these drivers into focus is a critical first step in designing an EPR plan.

10. INTERNATIONAL WASTE MANAGEMENT

At the Agenda 21 meeting in Rio ten years ago, it was agreed that the world should move toward a more sustainable waste management position. Safe disposal of waste, resource recovery, and waste avoidance were areas nominated for special focus. The broad agenda proposed was to:

- minimise generation of waste by achieving changes in production and consumption patterns;

- maximise recovery and reuse or recycling of waste (including bio waste composting);

- promote environmentally sound waste disposal.

Ten years on, waste generation remains closely linked to economic activity in developed countries, including Australia. Progress has been made in recycling, though the overall amount of disposal has increased; and broad progress has been made in the way residual waste is disposed of to landfill and incineration.

10.1. European Union Progress

The European Union has developed a unified high level waste management strategy, based on a series of waste management directives with specific targets for recycling, recovery and disposal. The waste hierarchy is the main focus and is intended as a general guidance model. Targets have not been met by some member nations, but have been exceeded by others. By the end of the century however, all EU members had established waste management plans incorporating local objectives and strategies in keeping with EU targets.

Germany has made notable progress, with municipal recycling at 32 per cent of waste generated (1999), composting 12 per cent, incineration around 26 per cent and landfilling around 30 per cent. Performance in the C&I sector and the C&D sector is in keeping with NSW performance.

Resource recovery performance in the United Kingdom does not match the German position. In 1999/2000, some 9 per cent of municipal waste was recycled, 2 per cent was composted, 8 per cent incinerated and 81 per cent landfilled.

Both Germany and UK have adopted aggressive improvement targets for coming years.

10.2. United States Progress

Action on waste management in the US has focused on recycling and improving landfill disposal. Product Stewardship and EPR provisions have been used to reduce package weight and recover materials. Overall results disguise the outstanding performance of some US States, however the national average for municipal waste in 1999 was: 22 per cent recycling, 6 per cent composting, 15 per cent incineration, and 57 per cent landfilled.

10.3. International Trends

Several clear trends are evident in both EU and North America. The first is a search for measures aimed at “waste prevention”. The aim here is to find ways to decouple waste generation from economic growth and consumption. Cleaner production concepts and dematerialisation of products and packaging are in currency as concepts aimed at avoiding creation of waste in the first place.

For waste materials that do arise, an important focus is on engaging producers (using EPR) and all stakeholders (using product stewardship) in a quest to maximise resource recovery. Specific waste streams, like end of life vehicles, hazardous wastes (including batteries) and electronic/electrical equipment are being targeted for recovery action.

A further issue, particularly in the EU nations, is the increasing cost of moving toward environmentally sustainable waste management. This is leading to interest in ways to improve efficiency and, reportedly, some questioning of targets.

Notes