Independent Public Assessment — Landfill Capacity and Demand

A.G. Wright
September 2000

Disclaimer
This report was prepared by Wright Corporate Strategy Pty Ltd for the State Government of New South Wales. The views expressed in the report are those of Wright Corporate Strategy Pty Ltd.

Published by
State Government of New South Wales
Office of the Minister of Urban Affairs and Planning

ISBN 0 7347 0136 5
September 2000

Printed on recyclable paper made with Elemental Chlorine Free pulp harvested from sustainably managed plantations and forests.

WRIGHT CORPORATE STRATEGY PTY LTD

Focused Innovation ACN 060 526 123

7 September 2000

The Hon. Dr Andrew Refshauge, MP
Deputy Premier
Minister for Urban Affairs and Planning
Level 31
Governor Macquaries Tower
1 Farrer Place
SYDNEY NSW 2000

Dear Minister,

I enclose a copy of the Report of the Independent Assessment of Landfill Capacity and Needs which you commissioned in July 2000. The public assessment has been completed in line with your Terms of Reference, and clear conclusions have been reached.

I hope the advice contained in this Report is helpful to you and your Government colleagues in making determinations on proposed waste management facilities and in shaping the new way of managing waste in New South Wales.

Yours sincerely,

A G Wright
Joint Managing Director

Suite 8, 174-180 Pacific Highway, North Sydney NSW 2060
PO Box 176 Crows Nest, NSW 1585 Email: admin@wrightstrategy.com
Tel: (02) 9954 1200 Fax: (02) 9954 1195
Web: www.wrightstrategy.com

TABLE OF CONTENTS

Acknowledgements

This assessment process benefited greatly from the many submissions received and discussions to elaborate on positions put forward. This input is gratefully acknowledged.

Mr Sam Haddad and his colleagues at the Department of Urban Affairs and Planning made a valuable contribution and I am grateful for Mr Haddad's encouragement and advice during the assessment process.

The Environment Protection Authority of New South Wales played an important part in the assessment by providing an expert analysis of landfill capacity based on survey results and final landform to be achieved. I thank Graeme Head and the Waste Technical Advisory Unit for their contributions.

I am deeply grateful to my colleagues Paul Howlett and Judy Myers for their invaluable advice and assistance throughout the project.

Tony Wright

TERMS OF REFERENCE

Assessment of Current and Projected Needs for Landfill Proposals
(including the currently proposed landfill at Woodlawn)

In light of the findings and recommendations of the Alternative Waste Management Technologies and Practices report, independently advise the Minister for Urban Affairs and Planning by 31 August 2000 on the following:

A. Available landfill capacity for solid putrescible (non hazardous) waste in the Sydney Region, to accommodate current and projected demand from 2001 to 2020, for three scenarios as outlined in the Inquiry report, viz: current; improved; and aggressive.

B. The implications of the above on the need or otherwise for the proposed Woodlawn landfill at the proposed (400,000 to 500,000 tonnes of putrescible waste per annum capacity) in the immediate, mid term (eg 2005), and long term (eg 2010 and beyond).

C. Scope for a new major landfill to compromise the likely rate of introduction of improved technologies and practices, and if so, the scope for such an issue to be managed.

D. Likely mid to long term justification of such a new major landfill in the light of the various assumptions on the likely rate of the introduction of improved technology and practices, and any comments on the "justifiable demand" for additional landfill capacities in the short, medium and long terms in light of the Inquiry findings and recommendations.

Procedural

A. it is intended that the report of findings and recommendations of the public assessment will be used in the decision making by the Minister of the Woodlawn (and any other) proposed landfill. The report will be made publicly available.

B. The public assessment would be undertaken with input as considered appropriate by Mr Wright from relevant stakeholders, including government agencies, the industry, community and environment groups and may comprise the calling of submissions and round table discussions as Mr Wright considers appropriate.

EXECUTIVE SUMMARY AND RECOMMENDATIONS

Many complex strategic issues must be resolved as we shape out a new way of managing waste. One of the most fundamental, at a time of rapid change in technology, practices and behaviour, is how best to manage through the transition to sustainable waste management. What infrastructure is needed for the transition? What are the merits and drawbacks associated with the options? And what infrastructure will be needed for the long term?

A fair view of the way we want to manage waste as a potential resource is now emerging. Progress has already been made toward the developing vision. This report is focused on the needs of the transition period. But it maintains a clear view of the new way of managing waste outlined in the Report of the Alternative Waste Management Technologies and Practices Inquiry.

1. Purpose and Approach

The Report presents the outcomes of an independent assessment of landfill capacity and needs for the Sydney Region. The assessment was commissioned by the Minister for Urban Affairs and Planning as input to Consent Authority decision making on proposed waste management facilities. A central requirement was advice on how future waste flows might change as a result of the findings and recommendations of the Alternative Waste Management Technologies and Practices Inquiry.

The assessment process has been conducted in an open, objective way. Thirty-two submissions were received and these provided an important contribution to the assessment. Discussions were held with various stakeholders and these were highly beneficial in clarifying positions and issues. All views were thankfully received and carefully considered.

The centrepiece of the assessment is a detailed analysis of landfill capacity and demand. The demand analysis is based on making a reliable estimate of the time it will take to achieve various waste diversion scenarios.

The implications of a potential capacity shortfall are next reviewed, and options to overcome a shortfall are considered. The vexed question of whether an addition to landfill capacity would compromise resource management initiatives is tackled and various broad issues of strategic significance are also addressed.

2. Transition to a New Way of Managing Waste

Waste management is in a period of transition. Many already regard waste as a potential resource; others are moving toward that view. Innovative technologies and practices are emerging to facilitate this modern regard for waste, and markets are being further developed for the new products we can create.

The old way is strongly felt by many in the community to be wrong; and the new way of managing waste is equally felt to be right. But a difficult period of transition must be negotiated before Sydney is able to make full use of waste

as a resource. This assessment has focused on the transition period. The central question addressed in this report is "… how long will it take us as a community to bring about a position of minimal reliance on waste disposal?"

Integrated waste management, that strives for maximum resource conservation**, must** rely on a portfolio of treatment and disposal technologies. Landfill will remain a part of the technology mix, but should make a decreasing contribution to the way waste resources are managed.

3. **Landfill Capacity and Demand (Chapter 2)**

Sydney putrescible waste landfill capacity at January 2001 will accommodate a further 20.8 million tonnes of waste. See Table 1. This capacity is being drawn down at a current rate of around 2.0 million tonnes a year.

Table 1 **PUTRESCIBLE WASTE LANDFILL CAPACITY ESTIMATES**

Landfill Site	**Current Capacity July 2000** (million tonnes)	**Estimated Capacity January 2001** (million tonnes)
Belrose	0.588	0.548
Eastern Creek	0.167	5.224*
Lucas Heights	12.792	12.192
Jacks Gully	2.636	2.529
Grange Avenue	0.020	0
South Windsor	0.315	0.311
Total Capacity	16.518	20.784

*assumes approval of current DAs.

Source: Estimated on basis of information provided by Waste Service NSW and NSW EPA.

3.1. **The Source of Putrescible Waste**

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 and the remaining bulk is disposed of to landfill. Around half of this mixed residual waste is disposed of to putrescible waste landfills because it comprises a proportion of organic materials that decompose through microbial activity. The other half of the bulk waste goes to inert waste landfills.

In Sydney, virtually all municipal residual waste is disposed to putrescible waste landfills, and some 39 per cent of C&I waste is presented to putrescible waste landfills. Little waste from the C&D sector is disposed of to these types of landfills.

A perspective on the waste quantities involved is presented in Table 2. (These data are as presented in the Waste Inquiry Report, though C&I sector waste generation has increased since 1998).

Table 2 **Estimates of Waste Flows, 1998**

	Municipal Sector mt/yr	**C&I Sector** mt/yr	**Total** mt/yr
Waste Generated	1.800	2.100	3.900
Less Recycled/Reprocessed	0.450	0.500	0.950
Leaves Disposed			
Inert waste landfill	0	0.975	0.975
Putrescible waste landfill	1.350	0.625	1.975

Source: Waste Inquiry Report.

3.2. **Landfill Demand Analysis**

The report examines demand for putrescible waste landfill space under various scenarios in contrast to available landfill capacity. Alignment of capacity and demand futures is complex due to uncertainties about the rate of commercialisation of emerging technologies, the speed at which they might be adopted and their impact in economic, social and environmental terms. The position is compounded by the difficulty of forecasting waste generation over a long period.

The analysis brings together various estimates for three main variables:

- **Waste Diversion Scenario:** the actual waste diversion scenario level achieved over time, described in the Waste Inquiry Report as *Improved Initiatives Scenario* and *Aggressive Initiatives Scenario*. A further *Ultimate Initiatives Scenario* has been added for this Assessment. (Box 1).

Box 1 **Waste Diversion Scenario**

The Waste Inquiry Report described three scenarios for future waste management, with progressively more diversion for beneficial use and less disposal.

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

A further but highly optimistic scenario has been prepared for this report.

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

- **Time Required to Implement Waste Diversion Scenarios: th**e rate of take-up of initiatives to bring about these scenarios as specified in nine Schemes, with varying take-up rates spanning the range from Business-as-Usual to a Rapid implementation time frame. (Box 2).

Box 2 **Waste Diversion Take-up Schemes**

1. Business as Usual.
   - Stable waste diversion at current level.

2. Gradual take-up Scheme, to Improved Scenario.
   - Gains to achieve Improved Scenario over 10 year period, then level off.

3. Gradual take-up Scheme, to Aggressive Scenario.
   - Gains to achieve Improved Scenario over a 10 year period, then to Aggressive Scenario over a further 10 years.

4. Progressive take-up Scheme, to Improved Scenario.
   - Gains to achieve Improved Scenario over an 8 year period, then level off.

5. Progressive take-up Scheme, to Aggressive Scenario.
   - Gains to achieve Improved Scenario over 8 years, then to Aggressive Scenario over a further 8 years, then level off.

6. Fast take-up Scheme, to Aggressive Scenario.
   - Gains to achieve Improved Scenario over 6 years, then to Aggressive Scenario over a further 6 years, then level off.

7. Fast take-up Scheme, to Ultimate Scenario.
   - Gains to achieve Improved Scenario over 6 years, then to Aggressive Scenario over a further 6 years, then to Ultimate Scenario over a further 6 years, then level off.

8. Rapid take-up Scheme, to Aggressive Scenario.
   - Gains to achieve Improved Scenario over 4 years, then to Aggressive Scenario over a further 4 years, then level off.

9. Rapid take-up Scheme, to Ultimate Scenario.
   - Gains to achieve Improved Scenario over 4 years, then to Aggressive Scenario over a further 4 years, then to Ultimate Scenario over a further 4 years, then level off.

- **Landfill Input Rate Mix:** the allocation of waste input among the available landfills in order to make best use of available landfill capacity at an impact acceptable to the community. (Box 3).

Box 3. **Landfill Input Rate Mix**

Three main options exist for allocating waste input to the various Sydney landfills.

Plan A. Constrained Input Rates. Input rates constrained to current levels, save for the proposed reduced input to Lucas Heights after 2002.

Plan B. Variable Input Rates. Input rates to Eastern Creek (and later to Jacks Gully) increased to absorb the shortfall created after the proposed reduction is made to the waste input rate to Lucas Heights after 2002.

Plan C. Prolonged Current Input Rate to Lucas Heights. Prolonged current input rates to Lucas Heights held at the present rate of 1.2 million tpa, and input rates to Eastern Creek and other landfills increased to suit requirements.

The modelling undertaken for this assessment was informed by:

- developing a detailed implementation plan for each of the 16 types of initiatives which make up the waste diversion scenarios, in order to develop reasonable estimates for the take-up time of each initiative and therefore each scenario (Annex B and Chapter 2);

- reviewing US and European waste management practice, achievements and goals, with a focus on the best performing states and cities. (Chapter 2.).

The time required to implement the waste diversion scenarios is the most direct issue affecting drawdown of landfill capacity.

There are six types of initiatives and up to 18 major projects required to implement the *Improved Initiatives Scenario.* Capital expenditure funding of some $130 million will be required. A further six initiative types and 17 projects are required for the *Aggressive Initiatives Scenario*, with capital expenditure of around $120 million. Further work is required to bring about the *Ultimate Initiatives Scenario*.

The pace of implementation is governed by numerous factors, most of which impinge on each initiative. These have been taken into consideration in estimating the take-up time for each initiative. The requirements for each initiative type, for each waste diversion scenario are examined in detail in Annex B, Waste Inquiry Scenario Implementation.

The analysis covers:

- Concept description
- Participants
- Investment requirements
- Market availability
- Timing to implement
- Enforcement.

The more general factors that determine implementation time are described in the report at Chapter 2. These factors are:

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

3.3. **Demand Analysis Results**

This review confirms the Waste Inquiry view that Sydney could progressively accomplish the *Improved Initiatives Scenario* and (later) the *Aggressive Initiatives Scenario.* The *Ultimate Initiatives Scenario* is a worthwhile long term goal.

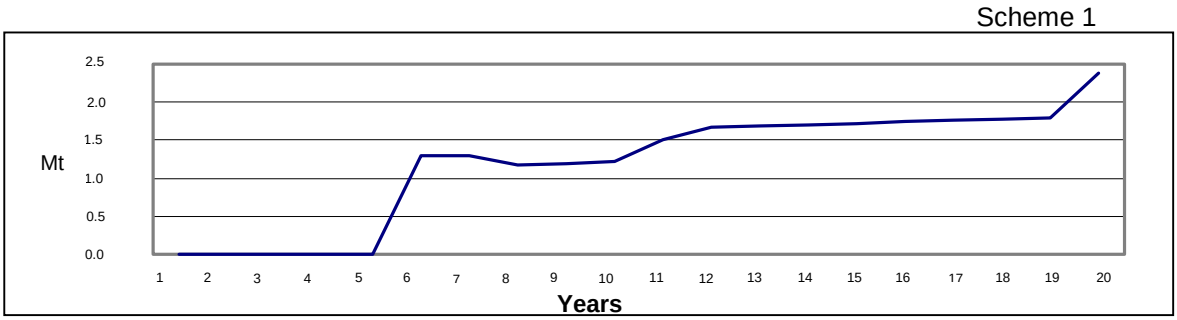
On the basis of this review, the Rapid take-up Scheme (Scheme 9) must be regarded as unrealistic. The four year time phases it requires to bring about each Scenario would not be sufficient to allow the various initiatives to be simultaneously implemented. (Section 2.4.3.).

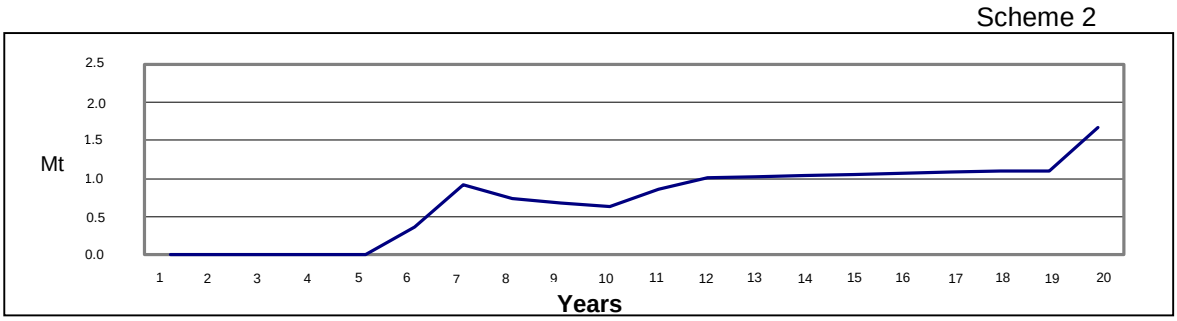
The Fast take-up Scheme (Scheme 7), with its six year time phasing, is optimistic but possibly achievable. The drivers would need to be installed without delay and the pressure maintained for 18 years. The main drivers needed are economic instruments, Government leadership to ensure commitment, and cooperation by the stakeholders, business, citizens, local government, and, most importantly, the waste management industry. Regulatory controls on waste movement may be required. Sydney's waste management reform pace would exceed the world's best and our waste diversion performance would also outshine the best.

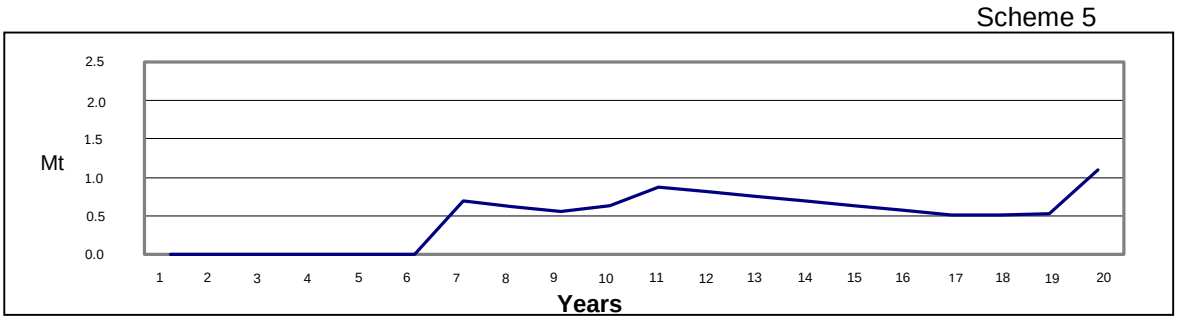
The Progressive take-up Scheme (Scheme 5) is in keeping with the pace of reform achieved in the best-performing US cities. The eight year time phasing is consistent with the plans of these cities to achieve further beneficial use of discarded materials. The pace required for this scheme should ensure a reasonable alignment of market development, deployment of new technologies and practices, and behavioural change. This should ensure better cost control and improved management of technology risks.

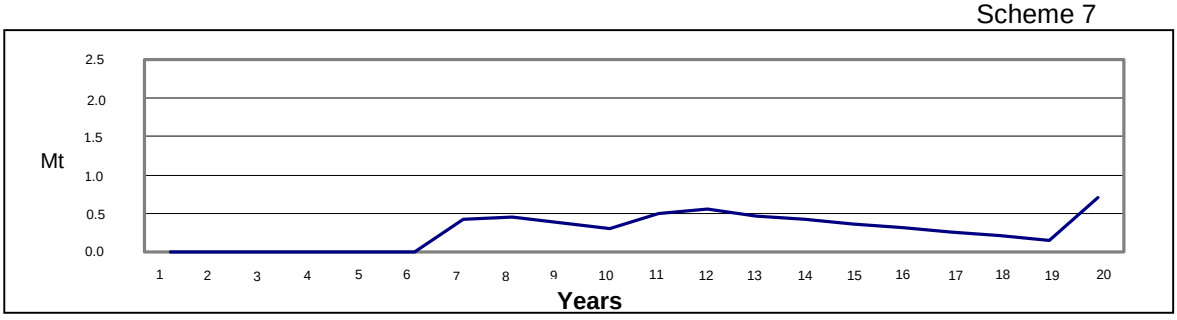
At the Progressive and Fast take-up rates (Schemes 5 and 7 respectively), a significant and continuing landfill capacity shortfall **will** be encountered after 2006. The extent of the capacity shortfall for the main take-up schemes is shown at Figure 1. It is unlikely that any unforeseen technology solution could satisfactorily rescue the day within this timeframe. The shortfall is inevitable, unless the (unrealistic) Rapid take-up scheme (Scheme 9) could somehow be delivered. The capacity shortfall will prevail, even if, as expected, by 2007 Sydney is among the top waste recycling and recovery performers in the world under the Fast take-up scheme to reach the *Improved Initiatives Scenario*, with:

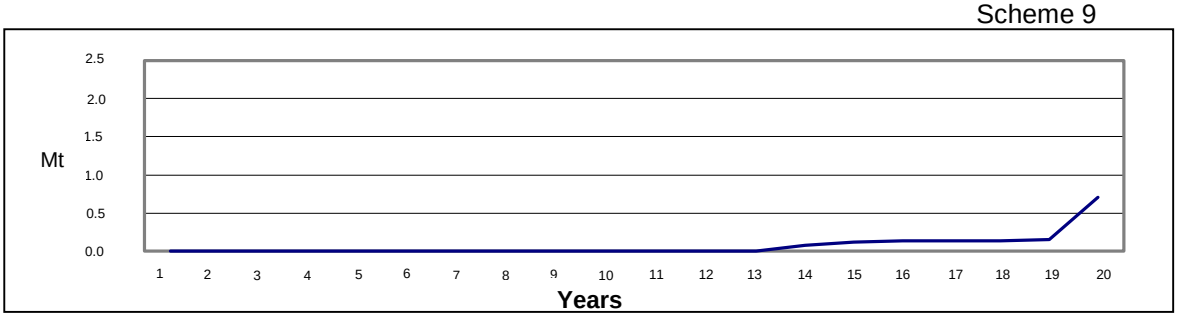
Figure 1. ANNUAL CAPACITY SHORTFALL
PLAN B: VARIABLE INPUT RATES











49 per cent municipal diversion;
42 per cent C&I diversion; plus
67 per cent C&D diversion.

A realistic but challenging proposition is for achievement of scenario take-up as follows:

Improved Initiatives Scenario:	7 years
Aggressive Initiatives Scenario:	14 years
Ultimate Initiatives Scenario:	20 years or more.

The seven year time phasing at this take-up rate is between the Progressive take-up Scheme and the Fast take-up Scheme. At this take-up rate it may be tempting to imagine that if Sydney can get by with the capacity available until 2006, then, by that time, new ideas and new technologies will be in place and no further landfill will be needed. This is entirely faulty logic: the new ideas and new technologies are already incorporated in the analysis undertaken in order to achieve the waste reduction necessary to get to 2006 without capacity shortfall. The further gains beyond 2006 are also incorporated in the analysis.

Both above schemes are adopted on the basis of Plan B, which reduces waste input to Lucas Heights landfill in the short term to the input rate of 575,000 tpa. This accords with the current Consent Agreement, the wishes of the local community and the pending Deed of Agreement between Waste Service NSW and Sutherland Shire Council. This input rate would moderate the environmental and social issues that have led to the joint agreement.

Plan B is clearly the most realistic capacity deployment concept. Plan A fails to take best advantage of available capacity. Plan C is conceivable, but likely to be fraught with implementation difficulties.

Under Plan C the impending capacity shortfall may possibly be delayed until about 2010/2012 if the current 1.2 million tonnes a year of waste input to the Lucas Heights Landfill was prolonged until the site was exhausted. The merits of this proposition need to be considered in contrast with the alternative of providing long haul landfill capacity. These issues are discussed at Section 4, below.

Recommendation 1

The analysis has confirmed the Waste Inquiry finding that an exciting program of waste diversion for beneficial use is feasible. This report has demonstrated that the waste diversion scenarios outlined in the Waste Inquiry Report would take a considerable time to progressively accomplish. During the transition to a new way of managing waste, substantial increased landfill capacity **will** be required, by-and-large in the near term.

Due to the inevitably long time-frame from landfill project conception to commissioning, it is Recommended that early action to establish a satisfactory new landfill site should be taken. Moreover, a measure of contingency capacity ought to be provided in view of the risks and uncertainties associated with moving from Sydney's current waste diversion position to the Scenarios proposed in the Waste Inquiry Report.

4. **Capacity Shortfall Implications and Options (Chapter 3)**

The landfill capacity/demand analysis has shown that insufficient landfill capacity is available in Sydney to accommodate decreasing putrescible waste landfill requirements, even with fast implementation of the proposed waste diversion scenario initiatives. This should not dim the resolve of Government to work, without delay, with the waste management industry and the community to implement the *Improved* and *Aggressive Initiatives Scenarios*. Ongoing progress will itself help to generate new and productive uses for discarded resources.

Sufficient landfill capacity will be required to provide breathing space while emerging technologies and practices can be installed to reap more value from a larger proportion of residual waste. Moreover, landfill has a vital continuing role to play as one of various technologies in the future treatment/disposal portfolio, as it does throughout the world, even in countries that use conventional mass burn incineration technologies.

Substantial additional landfill disposal capacity will be required during the short, medium and long term future. This capacity could be provided by either:

(a) Prolonged continuation of current (1.2 million tpa) waste input rates to Lucas Heights Landfill until the site is exhausted around 2010/2012 leaving Sydney without landfill capacity. A new, long haul landfill would need to be established well in advance of this date, to cater for medium to long term needs and provide contingency capacity for the short to medium term future.

(b) Establishing a long haul landfill site in the near term, and reducing waste input to Lucas Heights to 575,000 tpa in accordance with the current Consent Agreement and the pending Deed of Agreement between Waste Service NSW and Sutherland Shire Council.

It can be seen that a new long haul landfill site is required as a strategic imperative in both options.

It must be emphasised that these options are not intended to substitute for solutions which gain more beneficial use from waste. Rather, they are two ways of providing the required landfill capacity.

A simple, qualitative review was undertaken to compare the main environment, social and economic features of only a part of the two options: the now to medium term impacts of continuing Lucas Heights input at 1.2 million tpa for 10 to 12 years, versus the now to medium term impacts of establishing a long haul landfill. The review was confined to describing issues and making comparisons to provide a measure of guidance in what must essentially remain a subjective judgement. The position is summarised in Table 3.

On the basis of this review an early move to long haul landfill is unlikely to be inferior to continuing to dispose of waste to Lucas Heights Landfill at the high rate of 1.2 million tonnes a year to the medium term, then moving to long haul

landfill. Rather, long haul landfill is likely to be more favourable than continued high rate input to Lucas Heights, in environment and social terms, particularly as a long haul landfill is required in any case. At the proposed waste input rate of 575,000 tonnes a year, the social and environmental issues associated with waste input to Lucas Heights will be more manageable.

Table 3 **Issues Assessment**

Issue	Option A Lucas Heights	Option B Long Haul Landfill
Greenhouse emission management	Moderate	Moderate/Good
Pollution emission risk	Moderate	Moderate
Resource conservation	Fair	Fair
Transport impact	Fair	Moderate
Local amenity impact	Poor	Good
Employment	Fair	Moderate
Equity	Moderate	Moderate
Logistics costs	Moderate	Fair
Operating costs	Good	Good
Revenue benefits	Fair	Fair

Other options that might conceivably be implemented more rapidly than the Waste Inquiry Scenarios include provision of new putrescible landfill capacity in Sydney and incineration of pre-treated mixed residual waste in power stations. These options are unlikely to be satisfactory or rapid.

Recommendation 2

It is recommended that the Government take action to secure a suitable long haul landfill site as a strategic addition to the portfolio of waste management technologies to form the new way of managing waste as a potential resource.

The initiative should be accompanied by the following Government undertakings:

(a) Reaffirm the intention to establish the strategic policy framework and to put in place robust arrangements to drive progress toward the *Improved Initiatives Scenario* and *Aggressive Initiatives Scenario.*

(b) Support the winding-back of waste input to Lucas Heights Landfill in keeping with the spirit of the impending Agreement between Waste Service NSW and Sutherland Shire Council.

5. **The Scope for New Capacity to Compromise Resource Management Initiatives (Chapter 4)**

Would an abundance of landfill capacity dampen our future collective zeal to extract the best possible benefit from discarded resources? The issues surrounding this important question are complex and deserve serious consideration.

This Assessment has found scant evidence that the existence of additional landfill capacity would crowd-out recycling and other beneficial use initiatives. Rather, the level of diversion to beneficial use is strongly linked to intangible factors that impinge on our collective sense of the worth of the environment.

The current position contradicts the notion that landfill scarcity contributes to recycling effort:

- Landfill disposal costs are increasing due to environmental requirements, transport and levy application, while alternative technology costs are tending to decrease.

- Nations and cities that perform at outstanding levels in recycling and reprocessing rely significantly on landfill. Portland and Seattle, for instance, with around 50 per cent diversion, use landfill as the exclusive destination for the 50 per cent disposed. Austria, with 34 per cent recycling and 14 per cent reprocessing, despatch 35 per cent of waste to landfill and 17 per cent to incineration.

- Unlike high capital cost conventional mass burn incinerators, landfills don't rely on a maximum feed to operate effectively. Rather, they operate best with a predictable waste input rate.

The challenge Sydney now faces is to bring about the behavioural change, get the technologies in place and develop markets for the resources gained from a greater commitment to recycling. The main ingredients to make these things happen are a sound strategic policy framework and the leadership to drive improvement. The proposed waste management legislation review is critical to both. Getting these factors right will have a far greater positive impact than any negative impact additional landfill capacity could create.

Recommendation 3

The Government should limit the flow of material to landfills by driving aggressive programs to minimise waste creation, and to divert waste created to beneficial use. Best value can be gained from discarded materials if they are streamed at source with compatible materials. This task must be made convenient and a measure of reward for effort must flow back to those who make the effort. Economic instruments, such as disposal/treatment levies and load-based licensing on waste generators, can and should play a dramatic part in the management of waste as a potential resource.

At the "end-of-pipe" level, an appropriate economic instrument regime should be accompanied by flow controls on one or all landfills. For instance, specific existing or new landfill Consent Agreements could be framed to constrain input rates or to permit only a diminishing input regime. These sorts of management controls are less desirable than market controls through economic instruments. Some form of flow management may be desirable over the short term while market mechanism tools are developed further and fully implemented.

The Government should make progressively greater use of economic instruments to guide waste management decisions, but in the short term

should monitor waste and resource flows so that action may be taken as necessary to maximise beneficial diversion.

6. Justifiable Demand and Issues of Broad Significance (Chapter 5)

How might our transition to a new way of managing waste best be facilitated? Will command-and-control and the usual forms of regulation serve the purpose, or should we engage innovative, market-based systems to bring about change? Can we judge policies and programs in terms of their impacts, measured in terms of economic, social and environmental criteria – not just one factor?

Submissions made to this Assessment were instructive in considering various complex strategic issues associated with mid to long term landfill requirements and further waste management reform. Numerous submissions raised themes related to broader issues such as the importance of waste avoidance in curtailing the waste we need to manage.

6.1. The Justifiable Demand Concept

The State planning provisions for putrescible landfill sites require that justifiable demand must exist for approval of significant additions to capacity. Under SEPP 48, the Consent Authority must have regard to waste disposal capacity requirements. If surplus landfill capacity is created, then price-cutting, it is argued, may act to divert waste from more beneficial uses.

The logic of this proposition is defeated if the gate price at which landfills can operate is no more attractive than for other technologies which gain greater benefits from waste resources. The Waste Inquiry Report argued that gate prices for landfills (and other technologies) should include a levy component which takes account of (or internalises) non market (social and environmental) externalities.

Clever use of this and other economic instruments would ensure an even playing field and obviate the need for artificial planning controls. Development Applications for waste management facilities of all kinds might then be considered more fully on their specific social and environmental merits as projects.

Recommendation 4

The future purpose and basis of Clause 12 of SEPP 48 should be considered in the light of the broad reforms planned for waste management. In particular the case for gradually phasing-in market mechanisms, as the tools become available, should be tested.

6.2. Waste Avoidance

Numerous submissions made reference to the merit of waste avoidance (as distinct from waste reduction). They argued that waste avoidance efforts in New South Wales should be strengthened.

Waste avoidance is highly rewarding in terms of both environment and economic outcomes. It adds a critical dimension in limiting waste generation

because it focuses on maximising resource productivity. Excessive packaging, discarded by retailers or by customers further along the value chain is not only wasteful but adds to product costs. The customer ultimately bears the resource manufacturing cost and the disposal or recycling and reprocessing cost. This is inefficient in economic terms and hardly responsible in environment terms.

The challenge however of achieving good gains is considerable, and progress is difficult to measure.

Recommendation 5

It is important that waste avoidance becomes more fully a part of mainstream waste minimisation initiatives. The Government should consider ways to strengthen waste avoidance initiatives as a focus of the proposed review of waste management legislation to be undertaken this financial year.

6.3. Competition in Waste Management

Issues surrounding putrescible waste landfill were raised in various discussions held during this Assessment process. Although Waste Service NSW is presently the dominant provider of putrescible landfill capacity, its positioning as a Government Authority should ensure that pricing and strategic decisions that impinge on environmental outcomes are appropriate to achieving sustainable waste management outcomes.

Recommendation 6

With the increased adoption of alternative treatment technologies, service competition will be created in Waste treatment and disposal. If the Government approves a privately owned long haul landfill, then a service market for putrescible waste landfill will also be created. In this newly dynamic market situation the Government should establish a basis to closely monitor industry competitive positioning and pricing, possibly through licence regulation.

Recommendation 7

The conditions of future contracts are important in ensuring an orderly basis for a competitive market. Contract arrangements for waste disposal, reprocessing and even collection should be framed so that the contractor takes the flow continuity risk.

The next step, and this applies more generally, ought to be that all contracts are framed to promote extraction of maximum value from the discarded resource. For example, a future single contract of municipal residual waste and kerbside recyclables collection could be framed to provide higher financial rewards for increased recyclables collection and decreased residuals collection.

6.4. The Proximity Principle

This principle was included in the UK waste management strategy and has been widely misinterpreted as meaning that waste should be treated or

disposed of in the specific location it is generated. The principle was actually developed to stop cross country road transporting of waste to low cost, poorly run landfills in Eastern Europe.

Transport of course does bring with it undesirable impacts that ought to be minimised. As pointed out in the UK strategy, these 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:

- Locating treatment technologies close to markets for potential products derived from waste processing may be warranted in some circumstances.
- Treating or disposing within the region in which waste is generated may reinforce the merits of managing waste as a potential resource.
- Sydney will never be self-sufficient: many resources used in the Sydney Region are produced in other Regions.
- 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 Waste Board region, or even in each capital city.

Recommendation 8

The Government should adopt as a **long term goal** the following waste treatment/disposal principle.

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.

This rather theoretical principle **may** result over the long term in treatment of much waste in the broad region in which it is generated in view of the economic, social and environmental impacts of transporting waste. On the other hand, it may well be that some waste processing to create compost is best accomplished outside Sydney, where a market need exists.

To give effect to this principle, tools for evaluation of economic, social and environmental factors will be required and we will need to adopt a bigger view of region (not the arbitrarily determined Waste Board region, but rather, broad geographic region).

1. INTRODUCTION

This Report presents the outcomes of an independent assessment of landfill capacity and needs for the Sydney Region. The assessment was commissioned by the Minister for Urban Affairs and Planning as input to Consent Authority decision making on proposed waste management facilities. A central requirement was advice on how future waste flows might change as a result of the findings and recommendations of the Alternative Waste Management Technologies and Practice Inquiry.[1]

The assessment process has been conducted in an open, objective way. Thirty two submissions were received and these provided an important contribution to the assessment. Discussions held with various stakeholders were highly beneficial in clarifying positions and issues. All views were thankfully received and carefully considered.

Waste management is in a period of transition. Many already regard waste as a potential resource; others are moving toward that view. Innovative technologies are emerging to facilitate this modern regard to waste, entrepreneurial companies are finding and seizing opportunities to invent new practices, and markets are being further developed for the new products we can create.

The old way is strongly felt by many in the community to be wrong; and the new way of managing waste is equally felt to be right. But a significant period of transition must be negotiated before Sydney is able to make full use of waste as a resource. This assessment has focused on the transition period. The main question addressed in this report is "… how long will it take us as a community to bring about a position of minimal reliance on waste disposal?"

The report comprises four main sections. The detailed landfill capacity/ demand analysis is at Chapter 2. The implications of a potential capacity shortfall and options to overcome such a shortfall are reviewed at Chapter 3.

Chapter 4 considers the vexed question of whether an addition to landfill capacity would compromise the rate of transition to sustainability. And various broader issues of strategic significance are reviewed at Chapter 5.

The Executive Summary and Recommendations Chapter sets out the inescapable conclusions arising from the assessment.

[1] State Government of New South Wales. **Report of the Alternative Waste Management Technologies and Practices Inquiry**. 2000. Referred to in this report as **The Waste Inquiry.**

2. LANDFILL CAPACITY/DEMAND ANALYSIS

Integrated waste management, that strives for maximum resource conservation, must rely on a portfolio of treatment and disposal technologies. Landfill will remain a part of the technology mix, but should make a decreasing contribution to the way waste resources are managed. The question at issue is "… how rapidly can we in Sydney bring about reliable solutions to decrease our reliance on landfill as the main recipient of discarded resources?"

This Chapter examines landfill *capacity* and *demand* for the Sydney Region under various scenarios. The purpose is to establish whether additional putrescible waste landfill capacity is in fact required in the short, medium and/or long term.

Alignment of capacity and demand futures is complex due to uncertainties about the rate of commercialisation of emerging technologies, the speed at which they might be adopted and their impact in economic, social and environmental terms. The position is compounded by the difficulty of forecasting waste generation over a long period.

The analysis features various estimates for the rate of take-up and adoption of new practices and technologies for increased beneficial use of waste resources. The resulting waste *demand* scenarios are contrasted with estimates of the available putrescible landfill *capacity* in the Sydney Region.

International waste management performance is reviewed in this Chapter and contrasted with the proposals for increased waste diversion presented in the Waste Inquiry Report.

Overall conclusions of the Chapter are presented at Section 2.5.

2.1. Landfill Capacity

Landfill capacity data were obtained from Waste Service NSW, and the NSW EPA was requested to provide an expert analysis of landfill capacity based on the final approved landform to be achieved. This has been based on regular surveys which include capacity absorbed over time. The position is set out at Table 2-1. This analysis shows that current capacity in the Sydney Region is 16.5 million tonnes. A current proposal for increased capacity at Eastern Creek putrescible waste landfill would expand capacity to 20.8 million tonnes at January 2001 after accounting for capacity drawdown during 2000.

Estimates of future landfill capacity take into consideration the density to which waste can be compacted, the capacity absorbed by operational cover material, and final capping material. All three factors are influenced by progressive changes in the way landfills are managed. Compaction density is also influenced by the changing composition of waste material received over time.

Table 2-1 **PUTRESCIBLE WASTE LANDFILL CAPACITY ESTIMATES**

Landfill Site	**Current Capacity July 2000** (million tonnes)	**Estimated Capacity January 2001** (million tonnes)
Belrose	0.588	0.548
Eastern Creek	0.167	5.224*
Lucas Heights	12.792	12.192
Jacks Gully	2.636	2.529
Grange Avenue	0.020	0
South Windsor	0.315	0.311
Total Capacity	16.518	20.784

*assumes approval of current DAs.

Source: Estimated on basis of information provided by Waste Service NSW and NSW EPA.

The EPA's expert technical advice has been important in assisting in the formation of views on these issues, as part of the estimate of landfill capacity.

Two areas of uncertainty warrant special note: future Lucas Heights input restrictions; and proposed Eastern Creek capacity increase. These issues are discussed below.

The Lucas Heights putrescible waste landfill has for many years received waste from various parts of Sydney including the northern suburbs. Transport and odour impacts have long been regarded by the Sutherland Shire Council and the local community as of critical concern. This prompted Council and Waste Service NSW (the owner of the Waste Management Centre) to negotiate a Deed of Agreement for managing the centre and to submit to the Minister for Urban Affairs and Planning a Development Application relating to future operations.

The Development Application determined on 12 November 1999 allows capacity expansion to 16.225 million tonnes from July 1997, but restricts putrescible waste input to 575,000 tonnes per annum from January 2001.

The draft Deed of Agreement, limiting putrescible waste input to 575,000 tpa, was prepared at February 2000, but has not yet been signed by the parties. It is expected that the Agreement will be signed early in September. Waste Service currently operates the landfill at a waste input rate of around 1.2 million tonnes per annum.

The Deed of Agreement allows Waste Service an opportunity to put forward a proposal to submit an application to the Minister for Urban Affairs and Planning to vary the conditions of Consent. That submission must be put forward within three months of signing of the Agreement.

Any such modification:

- will not allow more than 1.2 million tonnes of waste input each year beyond 31 December 2000;
- will not increase the total waste capacity of the landfill;
- will be deemed by the Council in its absolute discretion, to provide significant material benefit to the community.

If Council agrees to sign the application to vary the Minister's consent, the application can then be dealt with under the Environmental Planning and Assessment Act. The application would be publicly exhibited and the Minister would make the determination. If Council does not agree to sign the application, the Deed of Agreement tonnages from 1 January 2001 will apply; that is 575,000 tpa, putrescible waste input.

The main variation proposal in currency involves continuation of the current 1.2 million tpa waste input rate in an interim arrangement until December 2002, after which input would be reduced to 575,000 tpa.

Eastern Creek putrescible waste landfill has reached its capacity limit and Waste Service has submitted Development Applications for capacity expansion amounting to 5.3 million tonnes.

Table 2-2 sets out current and possible input rate configurations for Sydney landfills. This is based on a notional 2 million tonne input per year and no new landfill creation. The purpose of this table is merely to provide an indication of current and possible short term future destinations for waste disposal.

Table 2-2 **PUTRESCIBLE WASTE LANDFILL INPUT RATES**

Landfill Site	**Notional Current Input Rates** (mt/yr)	**Approximate Input Rates January 2001** (mt/yr)	**Possible Input Rates January 2003** (mt/yr)
Belrose	0.095	0.095	0.095
Eastern Creek	0.460	0.560	1.185
Lucas Heights	1.200	1.200	0.575
Jacks Gully	0.140	0.140	0.140
Grange Avenue	0.100	Closed.	Closed.
South Windsor	0.005	0.005	0.005
Total Input	2.000	2.000	2.000

2.2. **Landfill Input Demand Overview**

Unwanted materials are discarded daily from the municipal sector, the commercial and industrial (C&I) sector, and the construction and demolition (C&D) sector. This makes up the total solid **waste generated**. A proportion

of this generated waste is captured in recycling and reprocessing programs and the remaining bulk is disposed of to landfill. Around half of this bulk waste is disposed of to putrescible waste landfills because it comprises a proportion of organic materials that decompose through microbial activity.

In Sydney, virtually all municipal disposed waste goes to putrescible waste landfills, and some 39 per cent of C&I waste is presented to putrescible waste landfills. Little waste from the C&D sector is disposed of to these types of landfills.

A perspective on the waste quantities involved is presented in Table 2-3. (These data are as presented in the Waste Inquiry Report, though C&I sector waste generation has increased since 1998).

Table 2-3 **ESTIMATES OF WASTE FLOWS, 1998**

	Municipal Sector mt/yr	**C&I Sector** mt/yr
Waste Generated	1.800	2.100
Recycled/Reprocessed	0.450	0.500
Disposed		
Inert waste landfill	0	0.976
Putrescible waste landfill	1.350	0.624

Source: Waste Inquiry Report.

Various driving forces are relevant to the consideration of the overall amount of future waste generated. Key factors that have in recent times increased waste generation are population (both resident and tourist) and economic conditions. Both have in recent times tended to result in increased consumption and concomitant waste creation. Waste Service has adopted, for long-run estimates, a basis of 2 per cent per annum increase in waste throughput. This is consistent with the historical data on waste received by Waste Service.

On the other hand, potential waste generation can be reduced by waste **avoidance** measures, including cleaner production, reduced packaging, creative product design etc. There has been much discussion of both waste avoidance and waste **reduction** in recent months. There is a clear distinction between the two actions and it is not well understood.

Waste avoidance is rightly at the top of the hierarchy not only in New South Wales, but in many nations and states. Avoidance is based on the idea of preventing the creation of waste in the first instance. Waste avoided cannot be directly measured, and our record as a community in avoiding waste creation is unclear. Two key initiatives associated with avoidance are described below:

- The NSW EPA's Cleaner Industries Unit is fostering partnerships in various industry sectors and has been operating since 1998. The focus of

the Unit is cleaner production, especially in small to medium sized companies.

- The National Packaging Covenant has a mandate which covers not only packaging waste avoidance, through innovative packaging design, but also improved lifecycle management of packaging and paper once created. This lifecycle management will result in waste reduction through recovery and reprocessing.

The best example of household waste avoidance derives from garden planning to avoid the need for pruning and to minimise the need for lawn mowing.

The decrease in waste generation brought about by new waste avoidance initiatives is unlikely to be more than about 1 per cent per year. This is consistent with United States practice.

There are numerous **waste reduction** initiatives under discussion in various quarters to deal with waste once it has been created: extended producer responsibility schemes, deposit-refund schemes, advanced disposal schemes etc. These initiatives facilitate material recycling. Such initiatives were broadly anticipated as part of the scenarios described in the Report of the Alternative Waste Management Technologies and Practices Inquiry (Waste Inquiry). The analysis contained in the Waste Inquiry Report held constant only waste avoidance measures, not waste reduction measures.

2.2.1. **Prospects for Beneficial Use of Waste Materials**

The primary options for discarded materials are disposal, or processing for beneficial use. The Waste Inquiry Report described three scenarios for future waste management in New South Wales; with progressively more diversion for beneficial use and less disposal. The three scenarios described were:

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

A further scenario has been prepared for this report. This highly optimistic scenario goes beyond those proposed in the Waste Inquiry Report to reflect the 20 year time horizon nominated for this assessment:

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

The disposal/processing deployment schedules for these scenarios are shown at Figures 2-1 and 2-2.

The characteristics of these scenarios are set out at Box 2-1.

FIGURE 2-1 MUNICIPAL WASTE SCENARIOS

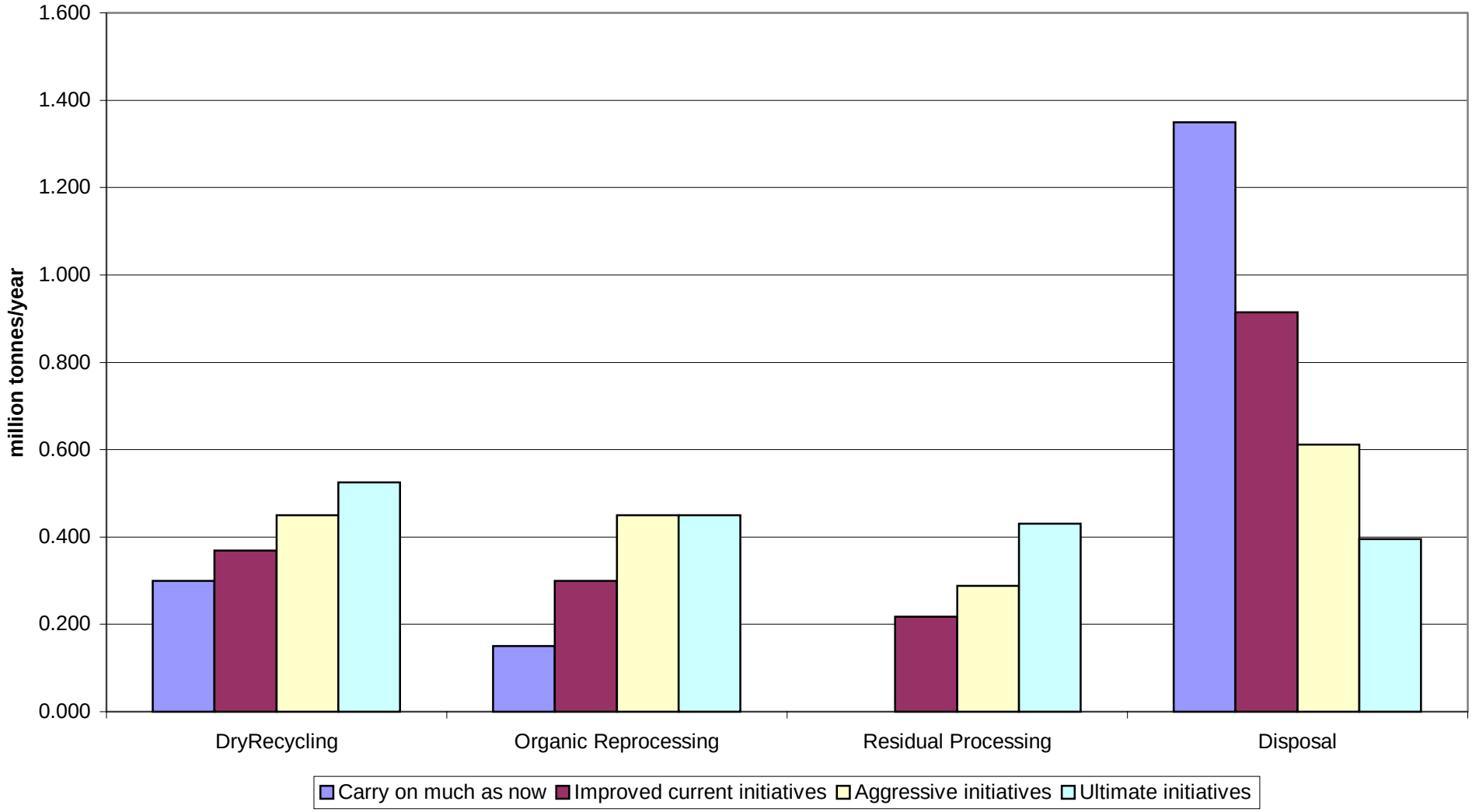
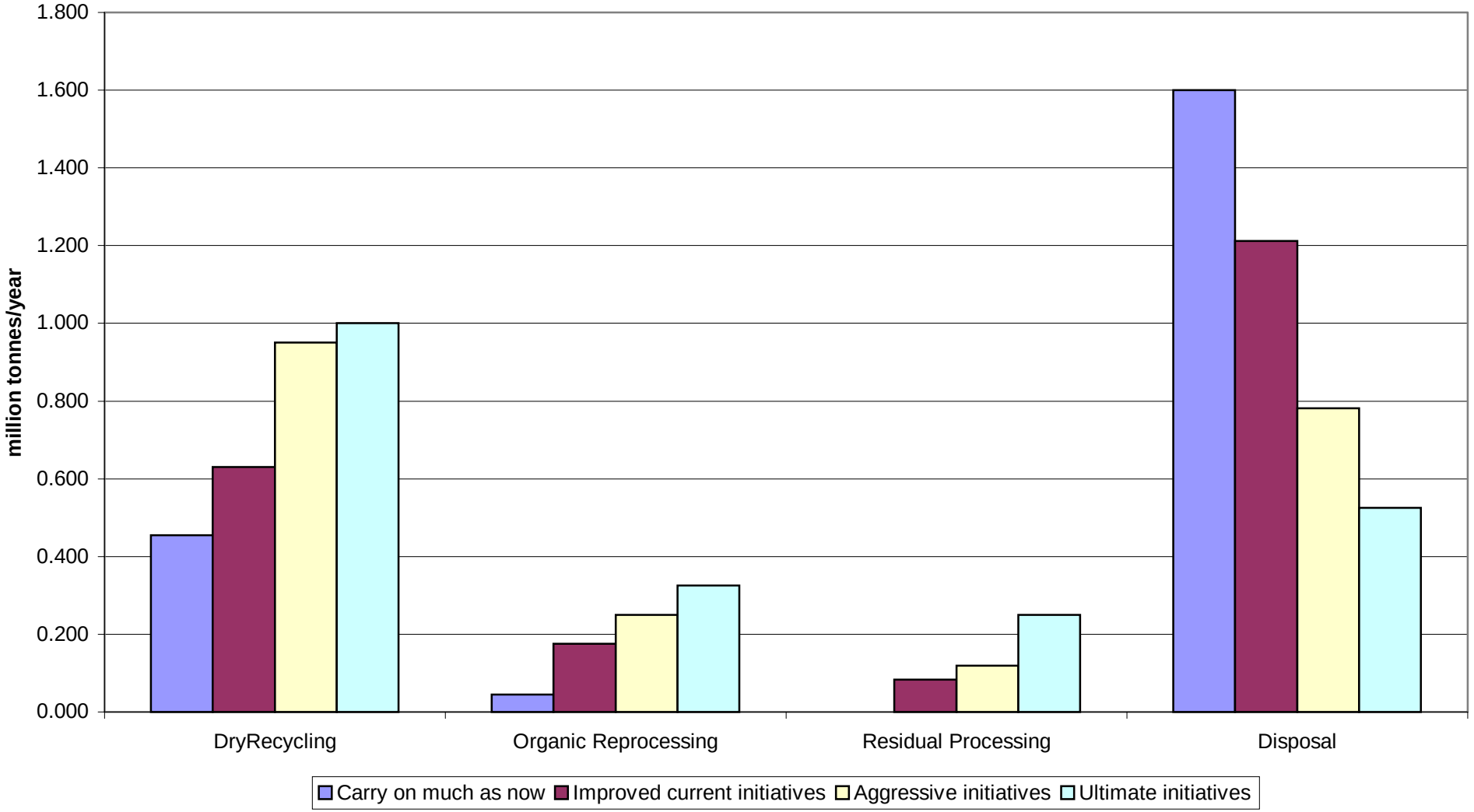


FIGURE 2-2 COMMERCIAL & INDUSTRIAL WASTE SCENARIOS



Box 2-1 **CHARACTERISTICS OF SCENARIOS**

These Scenarios are as presented in the Waste Inquiry Report.

Scenario 1. Carry on Much as Now

This involves maintaining current initiatives with no improvement over the next 20 years. The following resources flow plan would apply in order to maintain 25 per cent municipal diversion and 24 per cent C&I diversion.

Scenario 1. Flow Plan (million tonnes per year)

Sector	Dry Recycling	Organic Recycling	Residual Reprocessing	Disposal	Total Waste
Municipal	0.300	0.150	0	1.350	1.800
C&I	0.455	0.045	0	1.600	2.100

Scenario 2. Improved Current Initiatives

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 and C&I food waste. The outcomes summarised below provide for 45 per cent municipal diversion and 42 per cent C&I diversion.

Scenario 2. Flow Plan (million tonnes per year)

Sector	Dry Recycling	Organic Recycling	Residual Reprocessing	Disposal	Total Waste
Municipal	0.369	0.300	0.217	0.914	1.800
C&I	0.630	0.175	0.083	1.212	2.100

Scenario 3. Aggressive Initiatives

This scenario involves dramatic improvements in recycling, source separation, streaming and collection in all sectors. The outcomes summarised below provide for 66 per cent municipal diversion and 63 per cent C&I diversion.

Scenario 3. Flow Plan (million tonnes per year)

Sector	Dry Recycling	Organic Recycling	Residual Reprocessing	Disposal	Total Waste
Municipal	0.450	0.450	0.288	0.612	1.800
C&I	0.950	0.250	0.119	0.781	2.100

Scenario 4. Ultimate Initiatives

This scenario involves a further increase in municipal and C&I sector recycling participation, a modest increase in C&I sector food streaming and significant increase in reprocessing of mixed residual waste. The outcomes summarised below provide for 78 per cent municipal diversion and 75 per cent C&I diversion.

Scenario 4. Flow Plan (million tonnes per year)

Sector	Dry Recycling	Organic Recycling	Residual Reprocessing	Disposal	Total Waste
Municipal	0.525	0.450	0.430	0.395	1.800
C&I	1.000	0.325	0.250	0.525	2.100

Numerous submissions to this Assessment argued that New South Wales ought to adopt the *Aggressive Initiatives Scenario* immediately. A primary purpose of this report is to present an objective view on just how long it would take Sydney's current level of waste diversion to reach Scenario 2, then 3, then possibly advance to Scenario 4.

2.3. How do these Scenarios Compare with International Practice?

It is often instructive to consider local aspirations in the light of achievements made and goals set in other parts of the world. Comparisons are not always straightforward, and in this case it has been necessary to manipulate local data and the intent of the waste reduction scenarios to enable a reasonable comparison with overseas data.

Figure 2-3 presents the results of a detailed analysis of resource recovery outcomes described in the Waste Inquiry Report Scenarios. The analysis covers municipal sector and C&I sector waste, incorporates estimates of proportions of organic recycling and residual recycling used for compost production versus energy generation, and anticipates a proportion of post-processing residuals will go to landfill. (Due to the data manipulation required, the estimates used in Figure 2-3 do not exactly coincide with those in Figures 2-1 and 2-2).

2.3.1. European Waste Management Performance

Figure 2-4 presents a similar picture for waste management in Europe. It should be noted that incineration is virtually all by use of conventional incineration technologies with energy recovery, not "new" thermal technologies including pyrolysis/gasification. Conventional incineration technologies are unlikely to receive favourable consideration in New South Wales and are now viewed with increasing skepticism in parts of Europe.

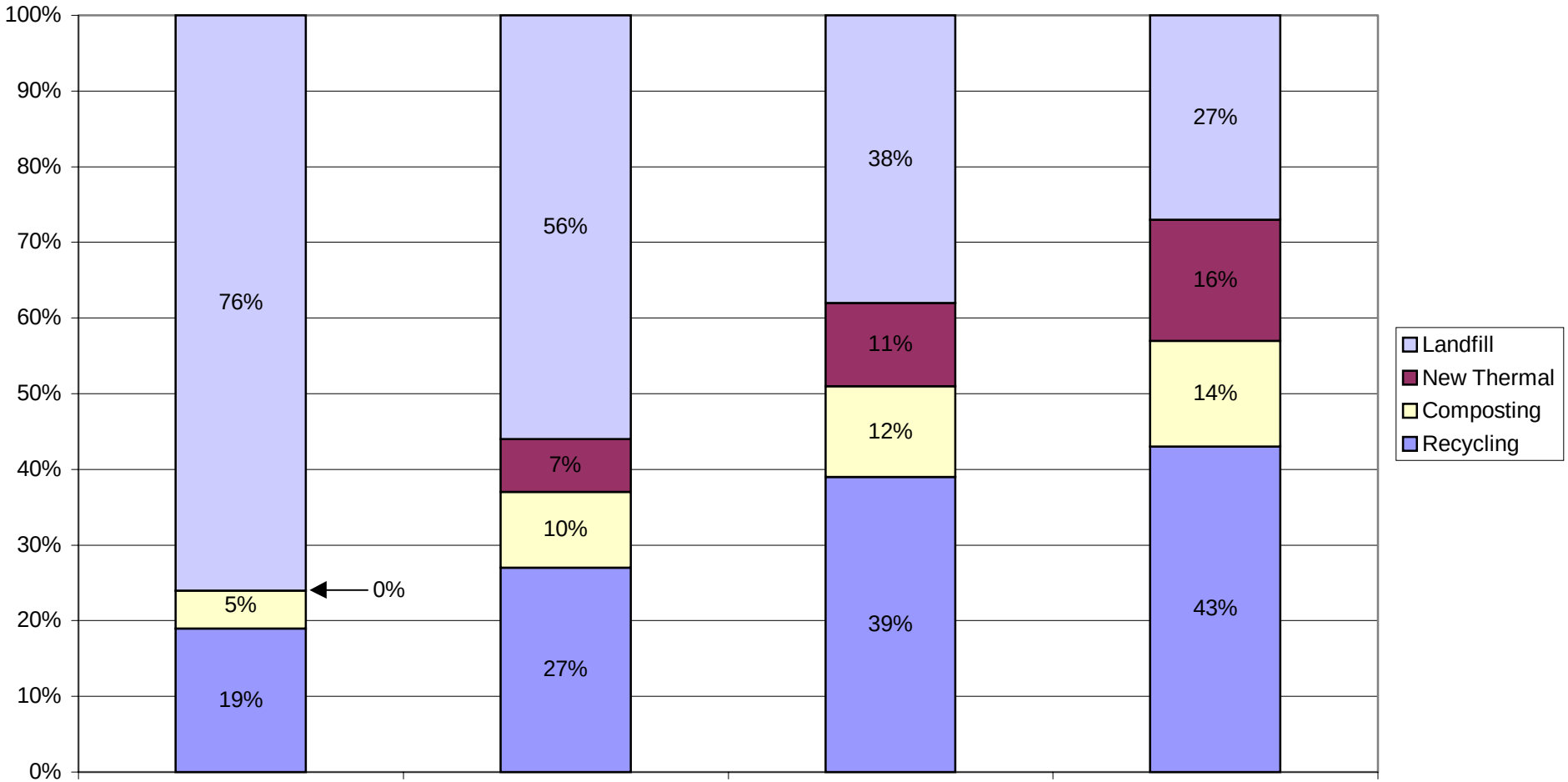
European landfills are not generally operated to the standards adopted in Sydney, in particular, with respect to gas and energy recovery.

The rough average recycling and composting rates for all countries represented is 30 per cent. Sydney compares reasonably at current recycling and composting levels.

At the *Improved Initiatives Scenario* level, New South Wales would be among the best performing nations in Europe. At the *Aggressive Initiatives Scenario* level, and beyond, New South Wales would exceed the performance of even the best European nations.

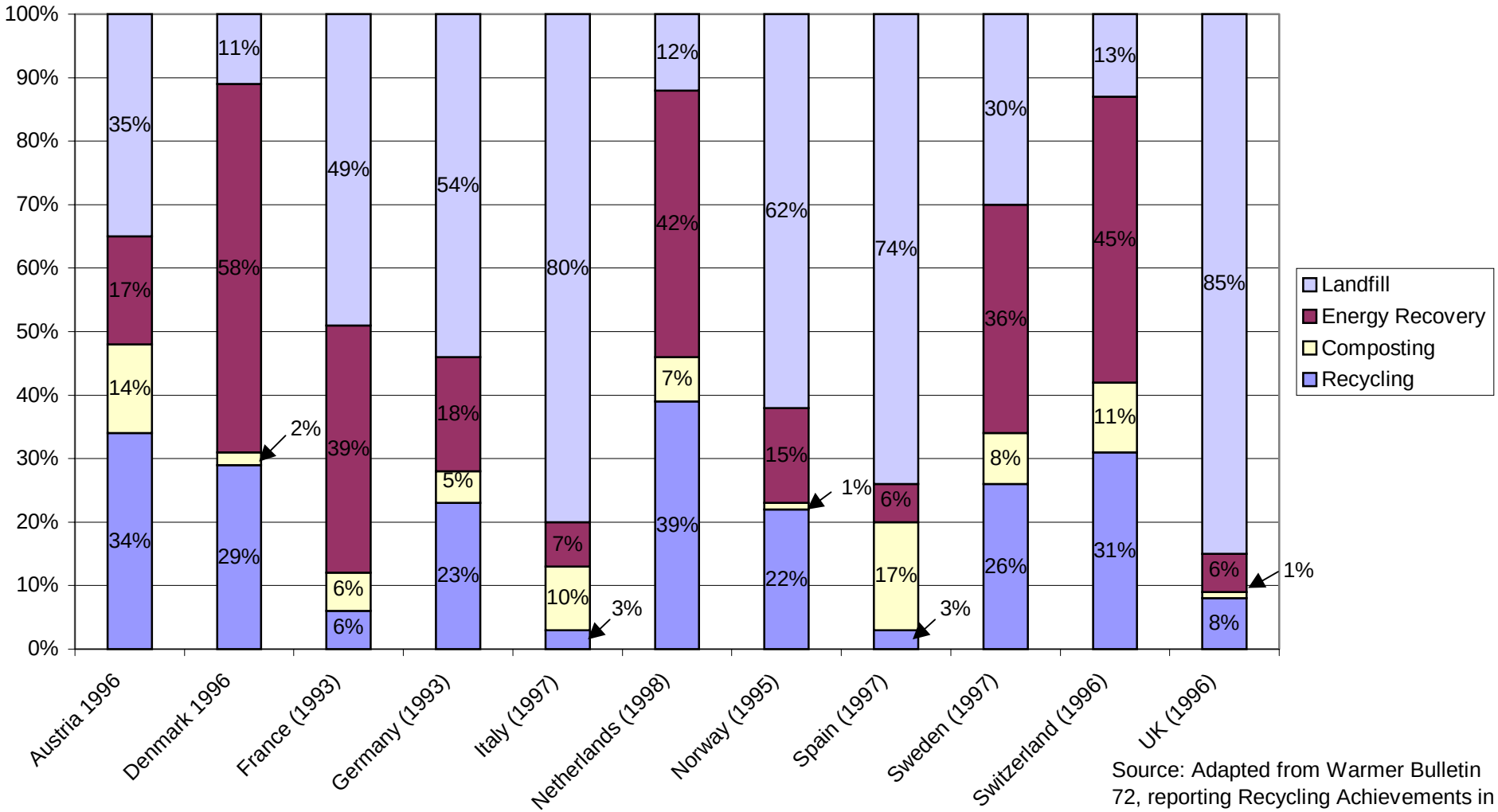
With a fanfare of publicity Germany has advanced from the position reported for recycling in Figure 2-4. Municipal sector dry recycling is now reportedly around 32 per cent and composting around 12 per cent. Incineration has increased and landfilling has dropped to 25-30 per cent. The recycling and composting targets for 2005 are 37 per cent and 16 per cent respectively. In the C&I sector around 20 per cent of waste is recycled and the 2005 target is 36 per cent. These municipal and C&I sector targets are similar to the beneficial use goals in the *Improved Initiatives Scenario*.

FIGURE 2-3. PROPOSED RESOURCE DIVERSION OUTCOMES BASED ON WASTE INQUIRY SCENARIOS



Source: Derived from Waste Inquiry Scenarios

FIGURE 2-4. EUROPE WASTE MANAGEMENT PERFORMANCE



Source: Adapted from Warmer Bulletin 72, reporting Recycling Achievements in Europe (2000), Enviros Aspinwall

In line with the EC Landfill Directive, the UK has set the following goals for recycling and composting performance:

1998:	9 per cent
2003/04:	17 per cent
2005:	25 per cent
2010:	30 per cent
2015:	33 per cent.

This does not match the *Improved Initiatives Scenario*, despite a 17 year take-up time for a gain of 24 percentage points of diversion.

2.3.2. **United States Waste Management Performance**

United States waste management performance is slightly ahead of New South Wales performance. Figure 2-5 presents waste recycling and disposal data for the USA and several of its main centres. Sydney compares reasonably well with overall US performance, but lags well behind the recycling and composting performance of Portland and Seattle.

The US EPA national goal of 35 per cent recycling and composting by 2005 is in line with the *Improved Initiatives Scenario*, and is to be attained in a seven year time frame from 1998. Residual waste reprocessing using new thermal technologies is not envisaged in the US strategy, due largely to the notion that this task is already performed by conventional incinerators equipped with energy recovery capability.

Portland and Seattle have been internationally recognised for their performance in diverting waste from disposal to beneficial use. Both eschew incineration but have reached recycling/composting rates which exceed the proposed *Improved Initiatives Scenario*: around 53 per cent for Portland and 44 per cent for Seattle.

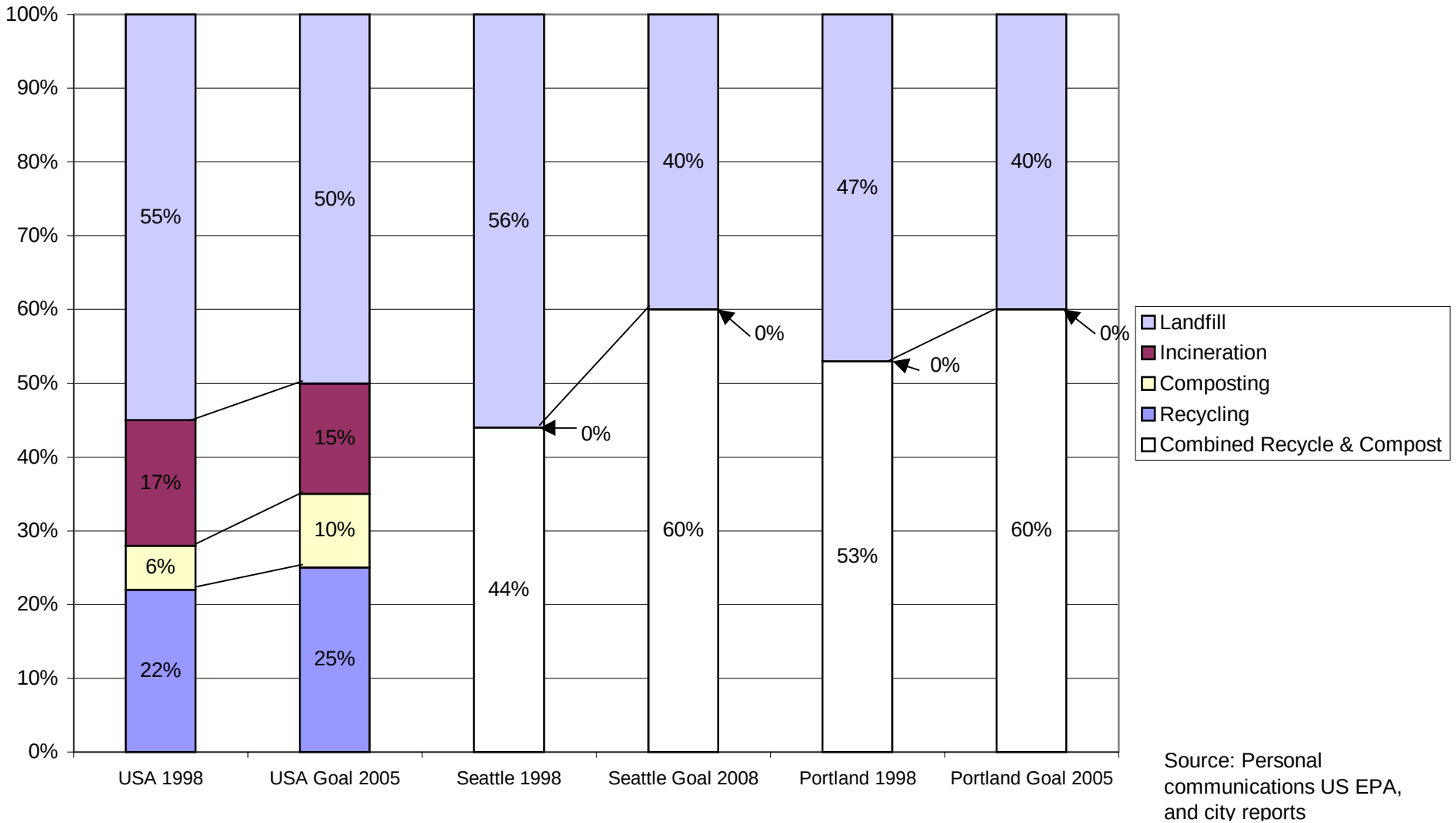
A landfill cost crisis in 1987 was the driver for Seattle to lift diversion from 28 per cent in 1988 to 44 per cent in 1995: a seven year take-up rate. Diversion has remained constant at 44 per cent to 1998, in spite of a 60 per cent diversion goal (set in 1989). The 60 per cent goal has now been adopted for 2008.

The history is similar for Portland (a much smaller city than Sydney). The goal of 60 per cent diversion by 2005 has now been set: a seven year take-up rate for a gain of seven percentage points, but still short of the proposed *Aggressive Initiatives Scenario*.

The performance unfolding in these cities sets a benchmark for the level of diversion and the take-up rate that might reasonably be attainable, albeit with aggressive programs. The focus in these cities has been on increased recycling, garden waste and some food waste composting.

On the bright side, it should be noted that the Waste Inquiry Scenarios include not only increased recycling and composting, but also mixed residual waste processing. If successful, this can help New South Wales secure diversion rates that match Portland and Seattle.

FIGURE 2-5. UNITED STATES WASTE MANAGEMENT PERFORMANCE AND GOALS



Source: Personal communications US EPA, and city reports

Incineration technologies are increasingly out of favour in the US, but considerable research and development is being undertaken on landfill operation to maximise greenhouse gas recovery and energy generation.

2.4. **Scenario Implementation Timing Analysis**

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 treatment 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* as rapidly as we might wish because technology projects, markets and behaviour change take time to establish.

Thus, the principal areas of input demand uncertainty are:

- extent of diversion to beneficial use (as described in the above four scenarios);

- rate of take-up of diversion to beneficial use.

To encompass the bounds of take-up rate possibilities, eight possible implementation timing schemes above the "Business as Usual" scheme were established for consideration. Each scheme relates to both extent of diversion and rate of take-up of diversion. These schemes are summarised at Table 2-4 and fully described at Box 2-2.

Table 2-4 **SCENARIO TAKE-UP RATE COMPARISON**

Diversion Scenario	**Pace of Scenario Implementation**			
	Gradual	**Progressive**	**Fast**	**Rapid**
	(Years to reach full attainment: Municipal/C&I)			
Improved	10	8	6	4
Aggressive	20	16	12	8
Ultimate	N/a	N/a	18	12

The main five benchmark schemes are described below. These five benchmark schemes have been used as a focus for comparison in the analysis that follows.

Scheme 1. Business as Usual:

Carry on much as now Scenario maintained for 20 years
- 25 per cent municipal diversion
- 24 per cent C&I diversion.

Scheme 2. Gradual take-up Scheme, to Improved Scenario: Comfortably achievable

Improved Scenario attained in 10 years
- 49 per cent municipal diversion
- 42 per cent C&I diversion.

Scheme 5. Progressive take-up Scheme, to Aggressive Scenario: Possibly achievable

Improved Scenario attained in 8 years
- 49 per cent municipal diversion
- 42 per cent C&I diversion.

Aggressive Scenario attained in 16 years
- 66 per cent municipal diversion
- 63 per cent C&I diversion.

Scheme 7. Fast take-up Scheme, to Ultimate Scenario: Optimistic

Improved Scenario attained in 6 years
- 49 per cent municipal diversion
- 42 per cent C&I diversion.

Aggressive Scenario attained in 12 years
- 66 per cent municipal diversion
- 63 per cent C&I diversion.

Ultimate Scenario attained in 18 years
- 78 per cent municipal diversion
- 75 per cent C&I diversion.

Scheme 9. Rapid take-up Scheme, to Ultimate Scenario: Highly optimistic, unlikely to be attainable

Improved Scenario attained in 4 years
- 49 per cent municipal diversion
- 42 per cent C&I diversion.

Aggressive Scenario attained in 8 years
- 66 per cent municipal diversion
- 63 per cent C&I diversion.

Ultimate Scenario attained in 12 years
- 78 per cent municipal diversion
- 75 per cent C&I diversion.

Box 2-2 **WASTE DIVERSION TAKE-UP SCHEMES**

1. Business as Usual.
   - Stable waste diversion at current level.

2. Gradual take-up Scheme, to Improved Scenario.
   - Gains to achieve Improved Scenario over 10 year period, then level off.

3. Gradual take-up Scheme, to Aggressive Scenario.
   - Gains to achieve Improved Scenario over a 10 year period, then to Aggressive Scenario over a further 10 years.

4. Progressive take-up Scheme, to Improved Scenario.
   - Gains to achieve Improved Scenario over an 8 year period, then level off.

5. Progressive take-up Scheme, to Aggressive Scenario.
   - Gains to achieve Improved Scenario over 8 years, then to Aggressive Scenario over a further 8 years, then level off.

6. Fast take-up Scheme, to Aggressive Scenario.
   - Gains to achieve Improved Scenario over 6 years, then to Aggressive Scenario over a further 6 years, then level off.

7. Fast take-up Scheme, to Ultimate Scenario.
   - Gains to achieve Improved Scenario over 6 years, then to Aggressive Scenario over a further 6 years, then to Ultimate Scenario over a further 6 years, then level off.

8. Rapid take-up Scheme, to Aggressive Scenario.
   - Gains to achieve Improved Scenario over 4 years, then to Aggressive Scenario over a further 4 years, then level off.

9. Rapid take-up Scheme, to Ultimate Scenario.
   - Gains to achieve Improved Scenario over 4 years, then to Aggressive Scenario over a further 4 years, then to Ultimate Scenario over a further 4 years, then level off.

2.4.1. **Macro Perspective**

The residual putrescible waste to be landfilled under each of the nine Schemes was calculated on the basis of take-up rates determined for each scheme. Details of the estimated residual flows to landfill under each take-up scheme are set out at Annex A.

Total input demand requirements for the benchmark schemes over the 20 year period nominated for this assessment are as follows:

Scheme 2:	Gradual take-up:	34.9 million tonnes
Scheme 5:	Progressive take-up:	30.0 million tonnes
Scheme 7:	Fast take-up:	26.0 million tonnes
Scheme 9:	Rapid take-up:	22.0 million tonnes.

These landfill input demands compare with the following putrescible waste landfill capacity picture for the Sydney Metropolitan Area:

July 2000 capacity:	16.5 million tonnes
Probable January 2001 capacity:	20.8 million tonnes.

This broad analysis indicates that only Scheme 9 (with the most rapid take-up rate) might feasibly almost match the remaining SMA putrescible waste landfill capacity (assuming granting of consent to the current Eastern Creek Development Application).

For all schemes, new putrescible waste landfill capacity **will** be required during the 20 year time frame. For Schemes 1 to 8, that landfill capacity **will** be required in the near term. The detailed analysis below explains why.

2.4.2. **A Detailed Analysis**

The detailed analysis is reported here and elaborated at Annex A. This provides a comprehensive comparison between various estimates of waste presenting for disposal each year, and corresponding estimates of decreasing landfill capacity available. The key variables which provide the basis for this analysis are:

- the actual waste diversion scenario level achieved over time (Improved, Aggressive, Ultimate);

- the rate of take-up of these waste diversion scenarios (as specified in the nine alternative take-up schemes described above).

A third set of variables is introduced to facilitate this detailed analysis: the scope to alter the input rates to various landfills. Three alternative input rate plans are listed:

Plan A. Input rates constrained to current levels, save for the proposed reduced input to Lucas Heights after 2002.

Plan B. Input rates to Eastern Creek (and later to Jacks Gully) varied to absorb the shortfall created after the proposed reduction is made to the waste input rate to Lucas Heights after 2002.

Plan C. Prolonged current input rates to Lucas Heights held at the present rate of 1.2 million tpa, and input rates to Eastern Creek and other landfills varied to suit requirements.

(a) **Results**

Plan A is included to provide a perspective of the situation that will apply if no action is taken to gain additional landfill capacity or redistribute input to other Sydney landfills after Lucas Heights input rate is cut back.

The outcomes for this plan, set out at Figure 2-6, show an unacceptable position. A massive and growing shortfall of capacity will be experienced immediately with all benchmark Schemes. The detailed analysis is at Annex A.

Plan B employs the simplest and most obvious way to create breathing space. When Lucas Heights input is cut back to 575,000 tpa, the logical move is to direct the surplus waste created to Eastern Creek initially and, when the available (and proposed supplementary) capacity is exhausted, direct progressively more waste to Jacks Gully.

The outcomes for this plan, which is considered to be the most realistic of the three, are shown at Figure 2-7.

The analysis confirms the macro perspective that an unmanageable shortfall of capacity will arise under all take-up schemes other than Scheme 9, and new landfill capacity will be required. Scheme 9 may possibly be accommodated by careful manipulation of logistics and capacity. No contingency capacity is available under this scheme.

The analyses show that, even by diverting disposal flows to maximise overall time to capacity exhaustion, a significant and chronic capacity shortfall occurs after 2006 with Schemes 5 and 7, and after 205 with Schemes 1 and 2. This means that for all but the most highly optimistic (and probably implausible) waste diversion take-up rates substantial new landfill capacity **will** be required, as early as 2005.

If the Scheme 9 take-up rate could be achieved, then the inevitable requirement for additional capacity could be delayed until after 2013.

Plan C is based on overriding the impending input reduction agreement (to 575,000 tpa) between Sutherland Shire Council and Waste Service, and maintaining prolonged input to Lucas Heights at 1.2 million tpa until the landfill capacity is exhausted. Significant community action against such a plan could be expected.

The outcomes of this plan demonstrate that the plan would create some breathing space, and prolong available capacity to about 2010/2012. After this period, substantial new landfill capacity **will** be required, despite Sydney's probable status as among the most successful recycling cities in the world. If the waste diversion take-up rate actually achieved is less favourable, then additional capacity will be required sooner.

On the other hand, if the highly optimistic Scheme 9 take-up rate could be achieved, then the inevitable requirement for additional capacity could be delayed until after 2017.

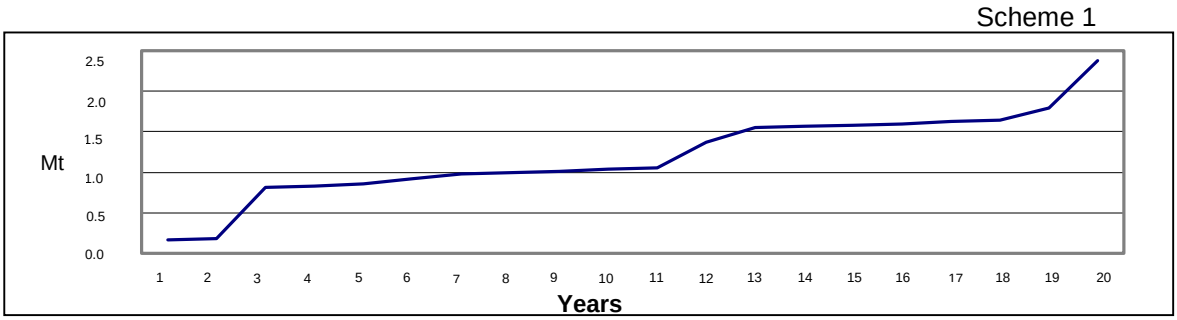
(b) **Summary Position**

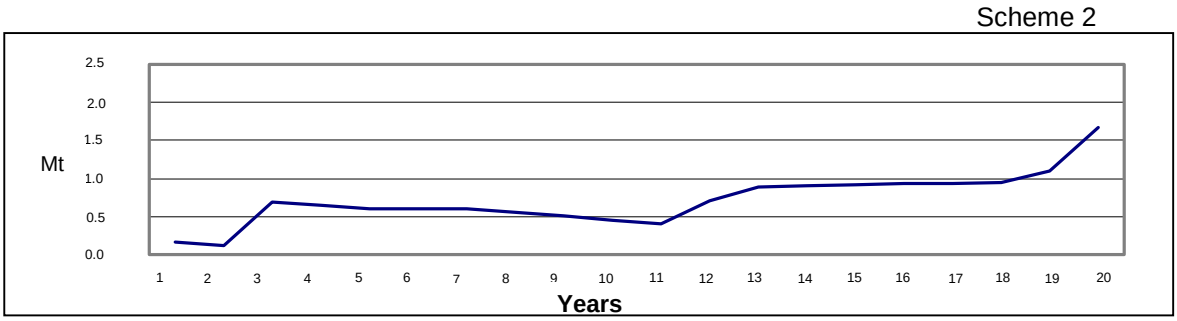
Plan B is clearly the most realistic capacity deployment concept. Plan A fails to take best advantage of available capacity. Plan C is conceivable, but likely to be fraught with implementation difficulties.

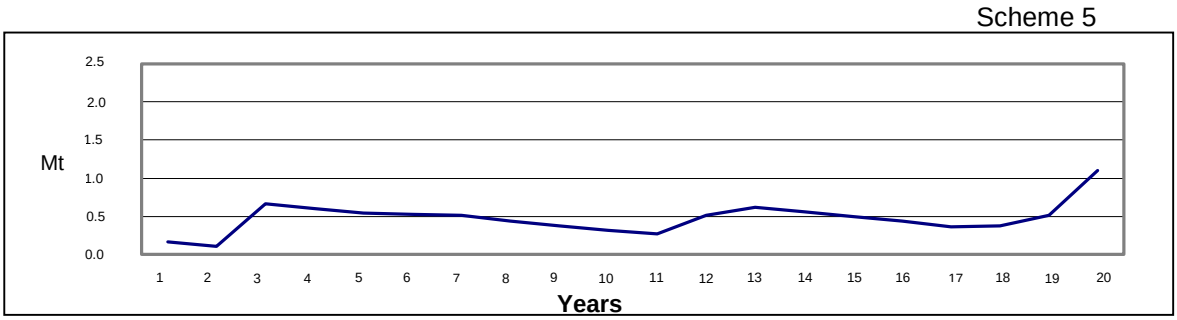
The most realistic diversion take-up schemes are Scheme 5 and Scheme 7. These span the *Possibly Achievable to Optimistic* range. The scope to slip back to Scheme 1 or Scheme 2 should not however be discounted.

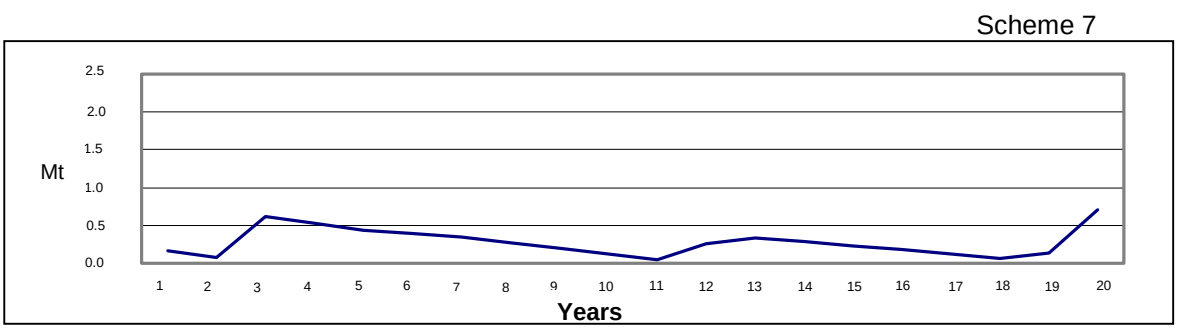
On the other hand Scheme 9 needs to be considered and tested because it holds the potential to considerably delay the need for additional capacity.

Figure 2-6. ANNUAL CAPACITY SHORTFALL
PLAN A: CONSTRAINED INPUT RATES









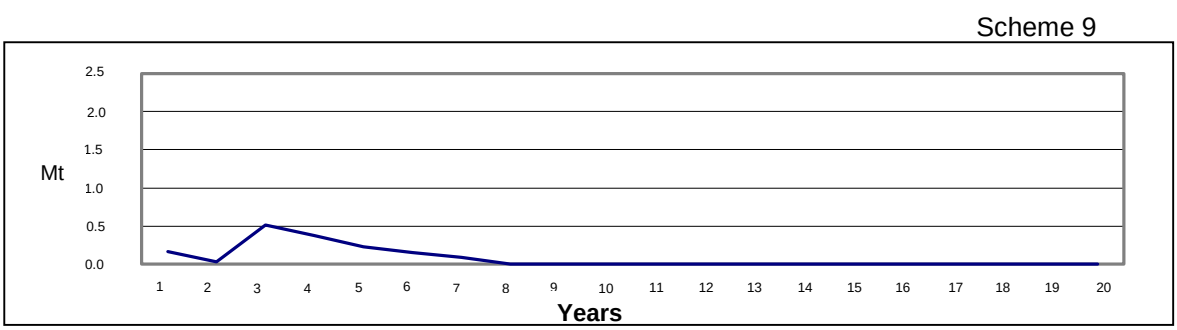
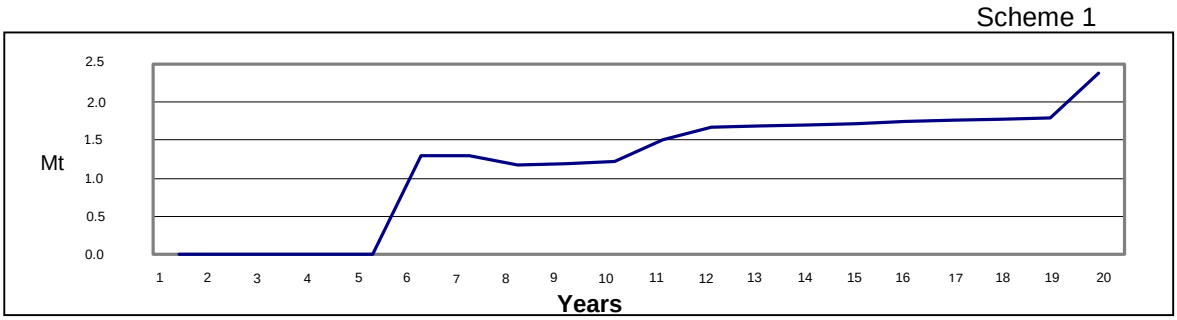
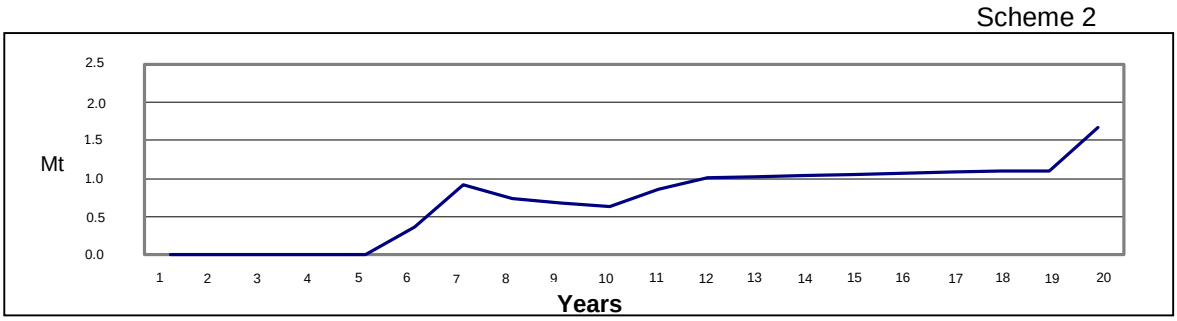
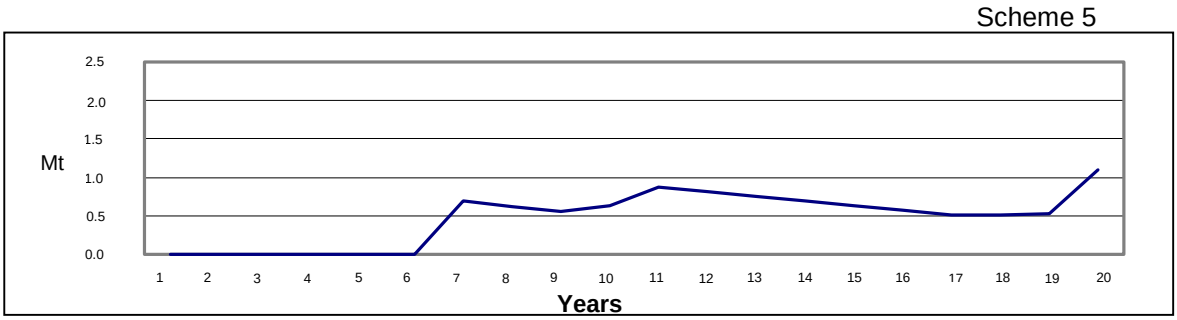
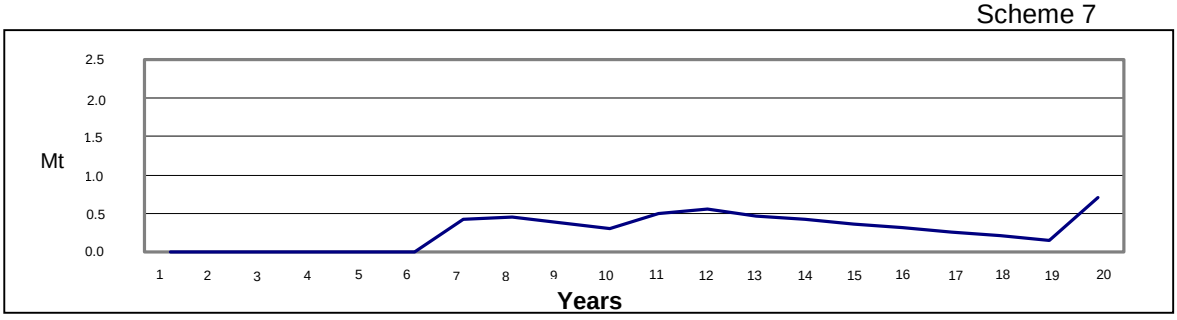


Figure 2-7. ANNUAL CAPACITY SHORTFALL
PLAN B: VARIABLE INPUT RATES









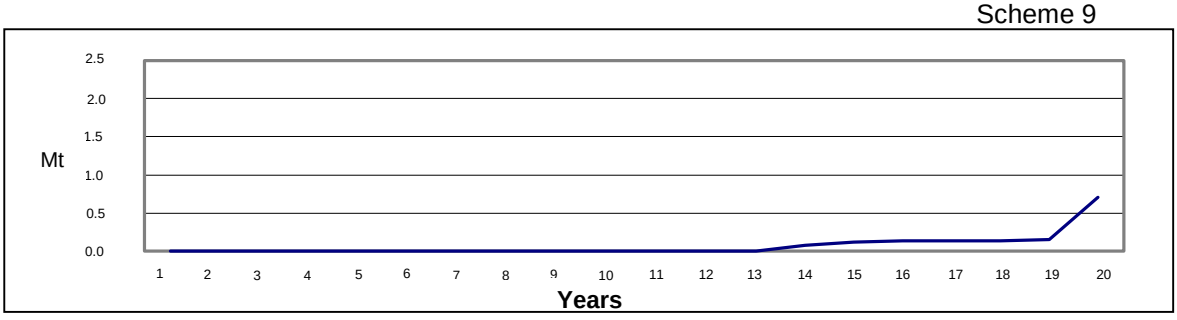
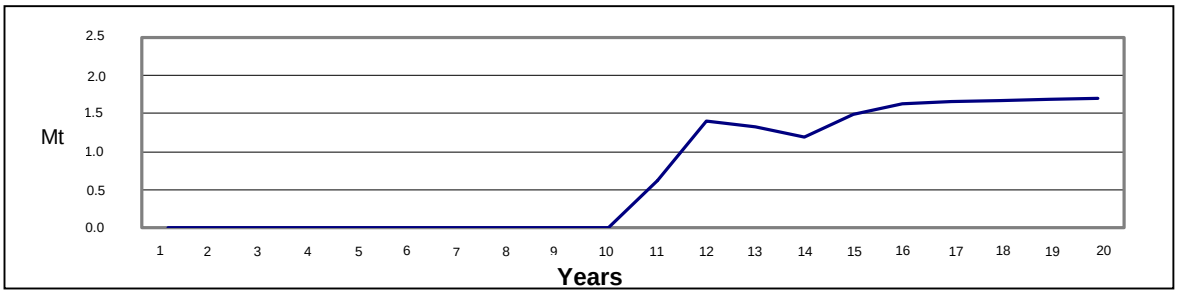


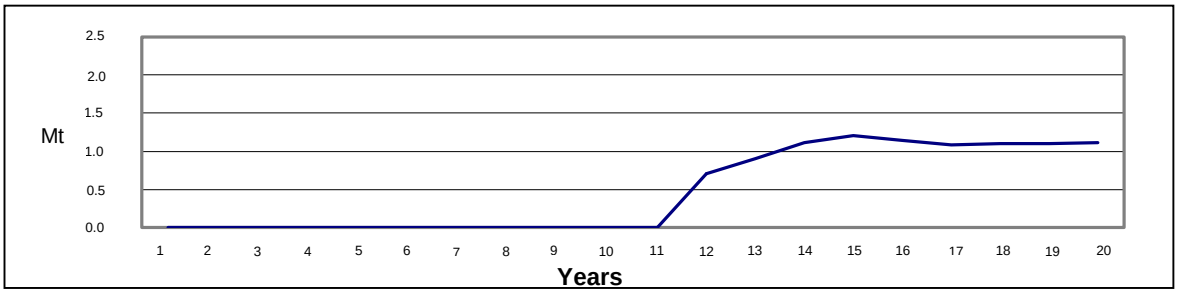
Figure 2-8. ANNUAL CAPACITY SHORTFALL PLAN C: PROLONGED CURRENT INPUT RATES TO LUCAS HEIGHTS

Scheme 1

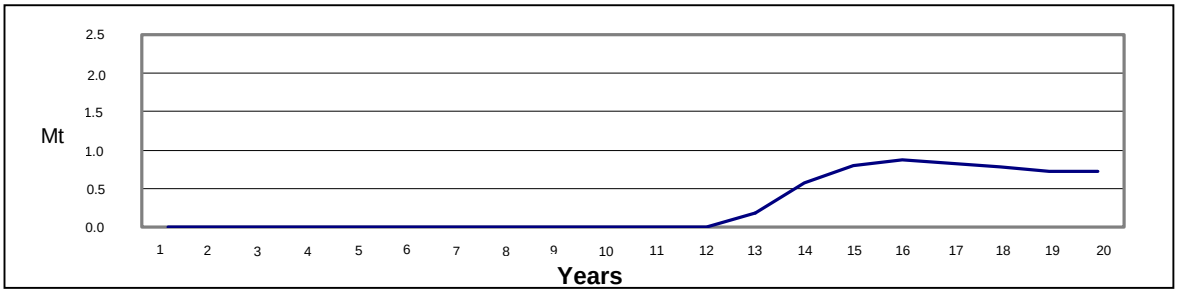
Scheme 2



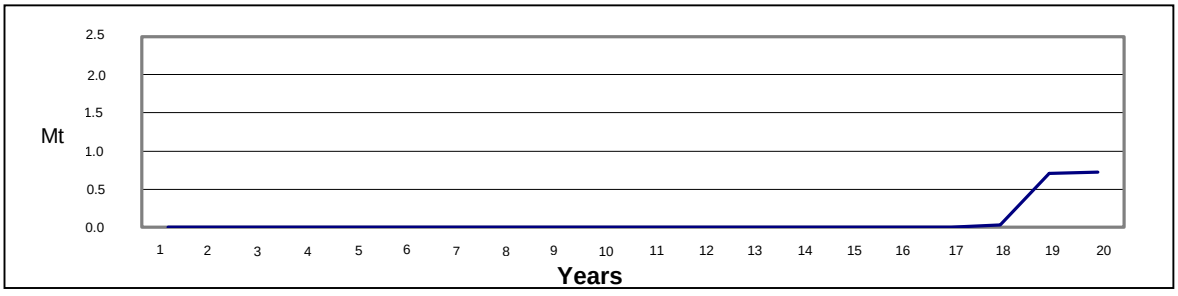
Scheme 5



Scheme 7



Scheme 9



2.4.3. **Feasibility of Scheme 9**

Scheme 9 relies on rapid take-up and deployment of innovative practices and technologies to reach the *Improved Initiatives Scenario* in four years, the *Aggressive Initiatives Scenario* in eight years, and on to the *Ultimate Initiatives Scenario* in 12 years.

Is this realistic?

Timing considerations are a crucial part of the analysis of each initiative. The pace of implementation is governed by numerous factors, most of which impinge on each initiative. Some factors however form effective time constraints to implementing specific initiatives. These have been taken into consideration in estimating the take-up time of each initiative. The main factors are described below and the implementation requirements for each initiative type for each waste diversion scenario are examined in detail in Annex B Waste Inquiry Scenario Implementation.

(a) **The Management of Waste Minimisation Initiatives**

The Waste Inquiry Report recognised the importance of both Government leadership and commercial action in identifying and converting opportunities to use waste as a resource. An appropriate disposal tax policy was proposed in the Report in order to bring to account non-market (social and environment) externalities that affect waste management decisions and reflect these externalities in gate prices. Such a policy would provide a level playing field for all waste management options based on the true impact of economic, social and environmental considerations.

A key premise of the Waste Inquiry Report was that Government should establish the right strategic policy framework and allow the framework to drive the private sector to identify and take up novel management practices and innovative treatment technologies. The important principle here is that commercial risks associated with new ventures should be taken by those best placed to manage such risks.

A further concept proposed in the Report was that Government agencies could play an important role in guiding and facilitating commercial interests in making investment decisions. In this way Government policy could be clarified and consistency ensured. Innovation barriers could effectively be managed to achieve required outcomes.

This model of technology and practice innovation is based on the idea that business will respond in the right commercial environment and identify opportunities where advantage can be gained. The merit of this approach is that the dynamics are based on business interests rather than public funding of all infrastructure and technology projects. A drawback of this approach is that commercial interests may not coincide with the Government's agenda, priorities, or the pace of implementation needed.

An alternative approach is for the implementation of initiatives to be identified by appropriate Government agencies. The Waste Boards, for instance, could call tenders on behalf of constituent Councils for facilities applicable to the proposed municipal initiatives outlined in the Waste Inquiry Report. In the

C&I sector, Waste Boards could be charged with identifying opportunities, facilitating resource aggregation by bringing together clusters of waste generators, and, possibly, calling tenders for collection, treatment and marketing.

The merit of this approach is that public agencies retain control of the change agenda and the flow of materials. A drawback is that additional Government funding may be required for agencies to drive the process and possibly to fund infrastructure capital costs or cover any margin between resource costs and revenues.

The best approach would combine ideas drawn from both models: a clear collective vision of the outcomes required and the broad strategy; a framework that incorporates smart economic incentives and a measure of regulation; with flexible implementation driven by public agencies, but allowing good scope for commercial opportunity outside any rigid implementation plan.

Getting the strategic policy framework and leadership arrangements right is crucial to the rate of implementing the proposed waste reduction scenarios. With the review of waste management legislation at hand, these changes will not be in place for 12 to 18 months.

(b) **Project Development**

The lead-time from project conception to commissioning is highly variable depending on many external and internal factors: financing, community consultation, EIS preparation, planning approvals, securing of supply and product markets, design, construction, commissioning, etc. This lead-time can vary depending on the nature, newness, and risks associated with the project. Social and political issues at local project level can be crucial in the planning of waste projects for locating sites for putrescible waste treatment technologies may be as difficult as finding acceptable landfill sites. The Sydney community has a record of diversion to such facilities.

Projects using emerging technologies for treating and processing putrescible waste invariably incur delays in the feasibility and planning stages. This must be taken into account when considering project timing.

This Assessment has adopted an estimated project development period of 3.5 to 4.5 years for a $25 million Sydney project using commercially proven technology to treat a known waste stream for which the market is robust. A longer period should be contemplated for projects involving unproven technologies. Up to 18 projects are required for the Improved Scenario and 17 further projects for the Aggressive Scenario.

(c) **Technology Maturity**

Waste treatment technologies have reached varying stages of commercial maturity. Many of the emerging technology types excel at processing specific, streamed waste of a fairly consistent nature. This is important because streaming at the point of waste generation and subsequent processing using appropriate technologies can provide high quality resources

that readily command markets. Streaming at source is a central recommendation of the Waste Inquiry.

Full processing of **mixed residual wastes** has historically presented difficulties for some emerging biological and thermal technologies operating in international settings. For strategic management of waste however, successful processing of mixed residual waste, to provide resources suitable for beneficial use, is an important goal. This concept of full processing was recommended in the Waste Inquiry Report and pre-treatment and second stage processing is a key part of both the *Improved Initiatives Scenario* and the *Aggressive Initiatives Scenario*.

To implement these scenarios, full pre-treatment and second-stage treatment of mixed residual waste for beneficial purposes is a requirement.

The emerging biological and new thermal technologies for mixed residual waste processing generally require such a two-stage process in order to produce compost suitable for public consumption, consistent quality refuse derived fuel, or electricity.

Pre-treatment waste separation technologies have been developed to separate mixed residual waste into various fractions. The aim is to use these drums, pulverisers and screen systems to create separate streams suitable for further processing and beneficiation.

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

- an organic rich fraction (40-50 per cent by mass) that can be used as a feedstock for further biological processes or converted to energy or chemical feedstocks using pyrolysis/gasification. This material is generally not composted for public consumption due to contamination levels;

- a high calorific fraction (20-30 per cent by mass) consisting primarily of plastics, which can be recycled, used as a fuel for energy recovery or landfilled;

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

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

Second-stage processing of pre-treated separated 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; inconsistency in batches presented for treatment due to variations between mixed waste input streams. These issues are progressively and innovatively being overcome. However, the potential for time delays must be anticipated in planning the take-up of technologies to treat mixed residual waste to a level suitable for public consumption.

(d) **Contract Arrangements**

Waste management and recycling collection contracts typically run for five to seven years in the municipal sector. Contract arrangements in the C&I sector are typically shorter and less explicit.

The time required to renegotiate existing municipal waste collection contracts or create new contract arrangements is a factor in the implementation timing of some initiatives. For the municipal sector, relevant waste management industry initiatives are: new organics collection activities; increased kerbside recycling loads; and possible redirection of existing residual loads to new destinations. This would entail some new contracts and some renegotiation. It presents an opportunity for structural reform toward integrated waste management arrangements operating at regional level.

Moreover, new processing contracts may be required for organics and recyclables processing. New contract arrangements would certainly be required for mixed residual waste processing. As recommended in the Waste Inquiry Report these contracts should be organised so that business risks and operating decisions are taken by the commercial sector. Suitable contract arrangements should be defined, reviewed and then broadly applied under rigorous administrative controls. Commercial contracts involving new technologies, new risk assumptions, and public health and environment considerations will take time to frame and award.

For the C&I sector, relevant initiatives are: food waste collection; dry recyclables collection; and possible redirection of existing residual loads. New contract arrangements may be required and are feasible for these initiatives. Opportunities for integrated waste management may be available through Waste Board or proposed C&I Taskforce coordination.

In summary, new and innovative contract arrangements will need to be developed, and awarded after proper consideration and evaluation. It must be recognised that this will add to the implementation time for the proposed initiatives.

(e) **Financing Availability**

Financing is a consideration, and will involve substantial private sector investment and public sector funds allocation. As shown in Table 2-5, substantial investment funds are required to implement each scenario: some $130 million for the *Improved Initiatives Scenario*; $119 million for the *Aggressive Initiatives Scenario*; and $92 million for the *Ultimate Initiatives Scenario*. Marshalling the required funds will require the installation of clear, consistent policies that engender investor and Government confidence.

(f) **Behaviour Change and Opportunities**

To implement the initiatives spelled out in the Improved, Aggressive and/or Ultimate scenarios, we are asking the business and domestic community to make a greater contribution. There is little doubt that this contribution ought be forthcoming in the C&I sector and there are some exciting projects underway.

Table 2-5 **CAPITAL COST ESTIMATES**

Scenario		Capital Cost Range $m	Probable Capital Cost $m
Improved Current Initiatives Scenario			
Initiative 1.	Increased Garden Waste Diversion	7 to 22	14
Initiative 2.	Increased Collection of Kerbside Recyclables	9 to 11	10
Initiative 3.	Treatment and Processing Mixed Residual Waste	40 to 50	45
Initiative 4.	Targeted Food Waste Collection	30 to 39	34
Initiative 5.	Increased Source Separation of Industrial Dry Recyclable Materials	8 to 10	9
Initiative 6.	Treatment and Processing of Mixed Residual Waste	16 to 20	18
Sub Total		110 to 152	130
Aggressive Initiatives Scenario			
Initiative 7.	Collection of Food Waste with Garden Waste	35 to 50	42
Initiative 8.	Increased Collection of Kerbside Recyclables	12 to 14	13
Initiative 9.	Treatment and Processing of Mixed Residual Waste	12 to 16	14
Initiative 10.	Targeted Food Waste Collection	20 to 26	23
Initiative 11.	Increased Capture of Industrial Dry Recyclable Materials	16 to 20	18
Initiative 12.	Treatment and Processing Mixed Residual Waste	8 to 10	9
Sub Total		103 to 136	119
Ultimate Initiatives Scenario			
Initiative 13.	Increased Collection of Kerbside Recyclables	11 to 13	12
Initiative 14.	Treatment and Processing of Mixed Residual Waste	24 to 36	30
Initiative 15.	Targeted Food Waste Collection	20 to 26	23
Initiative 16.	Treatment and Processing of Mixed Residual Waste	24 to 30	27
Sub Total		79 to 105	92
Grand Total		292 to 393	341

But the willing contribution of business will spread if and only if the waste management industry service providers are willing to offer real opportunities to waste generating businesses to make a greater contribution to streaming and recycling. The opportunities must be convenient to apply and free of significant cost penalty to business. They must present perceived and actual added value to business. New entrants, like Visy Recycling, have been adept at creating such opportunities.

Convenience is also needed to bring about greater domestic recycling if municipal kerbside collection hauls are to be increased in accordance with the goals described in the initiatives. These goals will not be met without the addition of convenient in-kitchen recycling systems: people need both education **and** direct assistance with simple storage technology.

The sorts of changes necessary to gain greater business and citizen commitment to recycling and streaming will need to be driven by the Government, waste management industry, local government, business interests and Waste Boards working in partnership. The time-frame for these types of behavioural changes to be made can easily be under-estimated.

To put part of the task in perspective, the *Improved Initiatives Scenario* requires domestic recycling (kerbside dry recyclables plus organics) to increase from 25 per cent to 37 per cent, while the *Aggressive Initiatives Scenario* requires that 50 per cent of domestic discards are recycled. It is difficult to see these gains being achieved in four years plus a further four years as required for Scheme 9.

(g) Market Development

The Waste Inquiry Report cited market stimulation as fundamental to the enhanced success of waste minimisation initiatives. The analysis in this report has been based on staged development of markets for paper, plastic polymers, metals, glass, compost and green energy. The order of increase required in beneficial use markets is substantial but achievable. See Table 2-6 below.

Table 2-6 **SCALE OF IMPROVEMENT REQUIRED**

	Increase in Beneficial Use	
Scenario Movement	**Annual million tonnes**	**Per cent**
Current to Improved	0.824	87
Improved to Aggressive	0.733	41
Aggressive to Ultimate	0.473	19

Other jurisdictions have been successful in creating markets to match the supply of newly available resources. The city of Seattle for instance substantially increased recycling performance in the early 1990s. The effort of citizens and agencies was rewarded by strong market development initiatives through the Clean Washington Centre. The outcome was market availability to absorb all recycled materials including compost.

(h) **Contingency Capacity**

It is critical to provide some form of reliable contingency disposal capacity over the first phase of implementation. The analysis in this Chapter does not include contingency capacity. There are many uncertainties and risks that must be tested over the next five to ten years:

- the viability and cost of emerging technologies many of which are as yet unproven in commercial scale operation;
- the scope for increased market demand for recycled recovered resources;
- risks on implementation timing for new technology projects that have social and environment impacts;
- risks in actually making gains in the C&I sector where limited scope for flow control exists;
- inevitable delays in creating new putrescible landfill capacity should it be required;
- risk that waste generation will continue to grow each year in spite of new waste avoidance measures.

2.5. **Conclusions**

Sydney putrescible waste landfill capacity at January 2001 will accommodate a further 20.8 million tonnes of waste. This capacity is being drawn down at a current rate of around 2.0 million tonnes per year. Progressive implementation of the waste diversion Scenarios described in the Waste Inquiry Report will tend to reduce the amount of putrescible waste presenting for disposal to landfill. Various propositions for the rate of waste reduction are possible and have been analysed.

Consent Agreements provide for reasonable limits on the amount of waste disposed each year at various landfills. The objective of such agreements is to control social and environmental issues associated with waste transport and disposal. These constraints, together with uneven landfill capacity deployment, mean that straight arithmetic does not apply in estimating the time available to capacity exhaustion.

The analysis in this Chapter has demonstrated that an exciting program of waste diversion for beneficial use is feasible, but would take a considerable time to progressively accomplish. With all but the most rapid of nine waste diversion uptake schemes, substantial increased landfill capacity **will** be required, by-and-large in the near term.

Scenario Implementation Timing

On the basis of this review, the Rapid take-up scheme must be regarded as unrealistic. The four year time phases would not be sufficient to allow the various initiatives to be simultaneously implemented.

The Fast take-up scheme, with its six year time phasing, is optimistic but possibly achievable. The drivers would need to be installed without delay and the pressure maintained for 18 years. The main drivers needed are economic instruments, Government leadership to ensure commitment, and cooperation by the stakeholders, business, citizens, local government, and, most importantly, the waste management industry. Regulatory controls on waste movement may be required. Sydney's waste management reform pace would exceed the world's best and our diversion performance would far outshine the best.

The Progressive take-up scheme is in keeping with the pace of reform achieved in the best-performing US cities. It is consistent with the plans of these cities to achieve further beneficial use of discarded materials. The pace required for this scheme should ensure a reasonable alignment of market development, deployment of new technologies and practices, and behavioural change. This should ensure better cost control and improved management of technology failure risks.

If the level of urgency created is out of keeping with the pace at which technologies can realistically be trialled and proved, then technology failures can be expected. There are numerous well-known overseas examples of technology systems not meeting the promise of consistently creating valuable resources from garbage.

The Gradual Take-up scheme provides a comfortable pace of implementation so that steady advances are made. The *Improved Initiatives Scenario* would be reached within 10 years and the *Aggressive Initiatives Scenario* secured within 20 years.

A more realistic proposition is for achievement of scenario take-up as follows:

Improved Initiatives Scenario:	7 years
Aggressive Initiatives Scenario:	14 years
Ultimate Initiatives Scenario:	20 years or more.

At this take-up rate, a significant and chronic landfill capacity shortfall **will** be encountered after 2006. It is most unlikely that an unforeseen technology solution could satisfactorily rescue that day within this timeframe. The shortfall will be inevitable, despite the fact that by 2007 Sydney will be among the top waste recycling and recovery performers in the world, with:

49 per cent municipal diversion;
42 per cent C&I diversion; plus
67 per cent C&D diversion.

It may be tempting to imagine that if Sydney can get by with the capacity available until 2006, then, by that time, new ideas and new technologies will be in place and no further landfill will be needed. This is faulty logic: the new ideas and new technologies are already incorporated in the analysis undertaken in order to achieve the waste reduction necessary to get to 2006 without capacity shortfall. The further gains beyond 2006 are also incorporated in the analysis.

Due to the inevitably long time-frame from landfill project conception to commissioning, early action to establish a satisfactory site is essential. Moreover, a measure of contingency capacity ought to be provided in view of the risks and uncertainties associated with moving from Sydney's current waste diversion position to the Scenarios proposed in the Waste Inquiry Report.

3. CAPACITY SHORTFALL IMPLICATIONS AND OPTIONS

The landfill capacity/demand analysis has shown that insufficient landfill capacity is available in Sydney to accommodate decreasing residual waste landfill requirements, even with fast implementation of the diversion scenario initiatives. This should not dim the resolve of Government to work, without delay, with the waste management industry and the community to implement the Improved, Aggressive and Ultimate scenarios. Ongoing progress will itself help to generate new and productive uses for discarded resources.

This Chapter deals only with last choice options.

The options reviewed are not intended to substitute for solutions which gain more beneficial use of waste.

In the short to medium term, additional disposal capacity will be necessary, even assuming approval of the current DA for significant additional capacity at Eastern Creek Waste Management Centre. Moreover, it will be necessary to provide a contingency buffer capacity in case of delay in scenario take-up or unexpected increase in waste generation.

Landfill has a continuing role to play in a future treatment/disposal portfolio as it does throughout the world, even in countries that use conventional mass burn incineration technologies. Further, sufficient capacity will be required to provide breathing space while emerging technologies and practices can be installed to reap more value from a larger proportion of residual waste.

There are two main options for provision of additional disposal capacity:

A. Maintain current input rates at Lucas Heights Landfill over the medium to long term, against the wishes of Sutherland community. This is a proposal in currency and would prolong available capacity to about 2011 depending on the actual waste diversion take-up rate achieved. Further capacity would need to be planned **and** secured well in advance of this date.

B. A major new landfill outside the Sydney Region (eg the proposed Woodlawn Landfill for which Northern Sydney Waste Board has nominated Collex Waste Management as preferred tenderer, the Thiess proposal for a landfill at Ravensworth, etc).

The Woodlawn Landfill proposal has been subjected to intense public scrutiny over the past year or so. Other long-haul landfill schemes have also been seriously considered. The Lucas Heights proposal however has not been viewed in the context of viable competing alternative to a remote landfill.

Options A and B offer alternative solutions as landfill sites for mixed residual waste that cannot yet be used more beneficially. Two further possibilities warrant brief consideration:

- the potential for a new putrescible waste landfill site in Western Sydney;

- the scope for pre-treatment of mixed residual waste (without second-stage processing) to successfully replace the Waste Inquiry Report diversion scenario initiatives for full treatment of mixed residual waste.

A New Putrescible Waste Landfill Site for Western Sydney?

Various sites in Western Sydney have been proposed since 1986, for putrescible landfill operations. None has survived the vigorous environmental, social and political scrutiny that rightly accompanies proposed establishment of putrescible waste landfills.

The issues surrounding such applications have not abated in recent years. In fact, increased settlement and infrastructure needs have compounded the incidence of land-use conflicts. The waste management industry has clearly received the message that the community would not support a new Sydney putrescible waste landfill.

There is no reason now to believe that a new putrescible waste landfill site could be established in Western Sydney within the foreseeable future. This possibility has not therefore been included as a serious option for review.

Pre-treatment of Mixed Residual Waste

The issues surrounding pre-treatment and second-stage processing of mixed residual waste were discussed in Chapter 3. Of all the initiatives comprising the Waste Inquiry Report scenarios, the multi stage processing for beneficial use is the most difficult to ascribe a clear time frame for widespread uptake.

Some have sought to cut the development time-line by adopting only the pre-treatment phase with the view that the materials separated in this activity will be suitable for direct, immediate beneficial use, or for later second-stage processing by other parties. The case for pre-treatment alone, to provide material direct for immediate beneficial use, is worth considering. If feasible it may conceivably cut the time-line by obviating the need for second stage processing technologies. This technology was described in the Waste Inquiry as *Waste Separation.*

Where pre-treatment is used as a sole treatment activity for mixed residual waste, the organic fraction yielded may be suitable as a substitute fuel for power stations.

The argument in favour of fuelling power stations is based on the existence of a 2 per cent renewable energy target for the energy industry. But an opposing view is that the target ought to be reached by developing and diffusing new technologies based on natural systems (eg sunlight, wind and water) which avoid consumption of resources that could be used to more beneficial effect elsewhere. Further, emission control and operating arrangements using pre-treated (in lieu of second stage treated materials – also known as Refuse Derived Fuel) putrescible waste as a fuel source are likely to present difficulties due to the impurities remaining in pre-treated waste and the inconsistency of the resource.

This scheme is unlikely to prove sustainable in power stations, and therefore a second stage treatment process is most likely to be required.

A further option for this material is for use as landfill cover or landfill rehabilitation material. The EPA has advised that this material is likely to remain putrescible however in the absence of second-stage processing.

3.1. Options Review

This simple review aims to compare the main environment, social and economic features of the two main options. An exhaustive analysis has not been undertaken because these options do not compete with emerging technologies and practices. Rather they are required to accommodate the inevitable, and diminishing, pool of mixed residual waste that cannot yet be managed to better advantage.

The review is confined to describing issues and making comparisons to provide a measure of guidance in what must essentially remain a subjective judgement.

The position is summarised in Table 3-1. The issues are described and reviewed below.

Table 3-1 **ISSUES ASSESSMENT**

Issue	Option A Lucas Heights	Option B Long Haul Landfill
Greenhouse emission management	Moderate	Moderate/Good
Pollution emission risk	Moderate	Moderate
Resource conservation	Fair	Fair
Transport impact	Fair	Moderate
Local amenity impact	Poor	Good
Employment	Fair	Moderate
Equity	Moderate	Moderate
Logistics costs	Moderate	Fair
Operating costs	Good	Good
Revenue benefits	Fair	Fair

(a) Greenhouse Emissions

Landfill gas is generated during the progressive decomposition of organic waste. The gas comprises about 50 per cent methane and 50 per cent carbon dioxide. Methane is regarded as a highly potent greenhouse gas and its effective capture from landfill sites makes an important contribution to the effort to reduce global warming. Where it can be used to generate electricity,

additional greenhouse benefits apply, as coal-fired electricity generation is reduced.

Capture of landfill gas is increasingly regarded as mandatory. Moreover, recent evidence suggests that well-run landfills with gas capture are very cost-effective at reducing methane emissions from waste disposal. A UK report[1] demonstrates that landfill technologies are next only to paper recycling in cost-effectiveness at this task. Biological and thermal technologies rank as significantly less cost-effective at reducing methane emissions. Care must be taken in interpreting this result as the report does not provide straight methane reduction effectiveness scores or rankings.

Option A.

Landfill gas capture and conversion to energy is practised at Lucas Heights, a conventional wet landfill. The electricity produced is fully accredited as green power. Brightstar Environmental (formerly Energy Developments-EDL) has two landfill gas power generation installations operating at Lucas Heights. These facilities, at 5 MW capacity and 12 MW capacity, are claimed to capture some 60 to 80 per cent of the landfill gas emitted at the site.

Option B.

Effective landfill gas capture and conversion is a feature of bioreactor landfills and is presented as a major benefit of the proposed Woodlawn Landfill. A power generation facility of 20 MW capacity is proposed. The proposed Ravensworth landfill is also presented as a potential bioreactor.

Bioreactor landfill technologies have advantages over conventional wet landfills. The decomposition of waste is accelerated through leachate recirculation and controlled infiltration of rainwater. The process has been shown to improve effectiveness of methane recovery (in some cases to 90 per cent), and electricity generation.[2]

The improved pace of waste degradation should lead to early stabilisation of the material and reduced need for long-term aftercare. Early use of the landform for other purposes is one of the claims made in favour of bioreactor landfills.

(b) Potential Pollution Emissions

Pollution prevention is a vital concern for landfill and incineration projects. Fortunately the NSW EPA has strict licence conditions and regulations to which all relevant projects must adhere.

The risk that standards may not always be met was recognised in the technology evaluation undertaken as part of the Waste Inquiry. This analysis used an event probability/consequence matrix to determine emission risk

---

1 AEA Technology Environment. **Options to Reduce Methane Emissions**. A report produced for DGXI. November, 1998.

2 See for instance, D. Augenstein et al. **Yolo County Controlled Landfill Project**, presented at Second International Methane Mitigation Conference, Akademgorodok, Novosibirsk, Russia, June 18-23, 2000.

scores for water and air emissions. The analysis indicated that risks of air and water emissions from these general technology types are at an acceptable level in well-run operations. Each specific project would require careful consideration and scrutiny.

The Commission of Inquiry on the proposed Woodlawn facility found that potential environmental impacts were manageable through the proposals in the EIS. A Commission of Inquiry has yet to be held on the Thiess Ravensworth proposal.

Where landfilling at long haul sites acts to rehabilitate voids created by extractive industries, a local asset can be created from a site that may pose ongoing pollution issues.

(c) Resource Conservation

In any hierarchy of resource conservation associated with waste management initiatives, waste avoidance and dry recycling achieve prominence. Energy production is generally regarded as part of the hierarchy, but at a lower level.

Mixed residual waste does in fact have substantial potential energy, and incineration and other waste to energy technology systems seek to capture this potential and efficiently convert it to electricity. System losses however generally restrict conversion efficiency.

The Waste Inquiry received submissions from both Waste Service and SEDA with accompanying reports prepared by Nolan-ITU. These reports provided a comparison of energy output for landfill and other technologies. Key data of relevance to this assessment are summarised in Table 3-2. The performance of conventional grate incineration technologies is included simply as a benchmark for comparison.

Table 3-2 **ELECTRICITY OUTPUT COMPARISON**

Technology	Electricity Output (kWh/tonne)
Landfill with gas extraction	233
Conventional grate incinerator	330

Source: Nolan-ITU addendum to Waste Inquiry submissions by Waste Service and SEDA.
Note: This output refers only to material actually subjected to disposal. In each case, recyclable materials may be diverted from the stream prior to disposal.

The landfill system in this comparison is based on a high capacity, best-practice managed system, capturing 70 per cent of the available landfill gas. This order of magnitude output rate has been confirmed with a second, expert source.

This table indicates that landfills with gas extraction and energy conversion can in fact make a reasonable contribution to green energy production. It can be expected that in controlled conditions, such as with pyrolysis/gasification technologies, a considerably increased electricity output will be generated. Gas capture and energy generation comparisons between Options A and B were described above in Section 3.1(a).

(d) **Local Amenity Impact**

Local amenity is affected greatly by traffic movements (frequency and noise), facility operating activities (dust, noise, odour, vermin and litter), and visual impact. Landfill operations generally rate poorly on many of these potential impacts. This is a major reason why no new putrescible waste landfill site has gained approval in the Sydney Metropolitan Area since 1986.

Option A.

Amenity impacts have been clearly demonstrated as unsatisfactory to parts of the Sutherland Shire community. Traffic nuisance and odour have been substantial complaints in recent years.

Option B.

Long haul landfill has potential for similar amenity issues to be present in access and operations. Rail transport where applicable would mitigate traffic nuisance and in general potential sites are distant from local towns.

(e) **Employment Impact**

Job creation is a factor for consideration, and in both options employment in logistics and operations is relevant.

Option A.

This would provide for continuing employment in transporting waste to Lucas Heights and operating the landfill at close to maximum receival capacity. The various professional/technical and operating roles associated with the facility would be required over the long term operation of this facility. Employment will be reduced when the waste input is cut back to 575,000 tpa.

Option B.

This would result in job creation associated with new transport activities, including waste containerisation, modal transfer, rail haul and local short distance road haul. New jobs would also be created in relation to the bioreactor technology. According to its submission to this Assessment, Collex proposes the following economic and employment generating activities:

- 25 new jobs at the landfill site;

- payment of employee entitlements amounting to $6.5 million to the now redundant, but unpaid, former employees of the mine owner;

- establishment of horticulture activities with consequent local employment;

The employment position in respect of the Thiess proposal is not finally established; the scope for 15 new jobs is mentioned in the Ravensworth EIS.

(f) **Transport**

Waste transport activities can bring about significant environmental impacts that are well recognised by the community: smog production, greenhouse emissions, energy consumption and noise nuisance. Distance is a key factor, but so too is the general location: a short journey through crowded residential suburbs may have a more significant environmental impact than a long journey on a major highway. Transport mode can also make an appreciable difference to environmental outcomes: rail transport is widely recognised as environmentally preferable to road transport.

The transport implications of the options are described below.

Option A.

Putrescible waste is currently collected and transported to Waste Service Transfer Stations for compaction to long-haul trailer/truck and road transport to Lucas Heights. Waste from the Sutherland and nearby areas is transported direct to site after collection.

Option B.

For long haul options, putrescible waste would be collected and transported to Transfer Stations for compaction and loading to freight containers. These would be road trucked to rail head, transferred to freight train and railed to remote site rail head. The freight containers would be transferred to road truck for the short haul to the proposed landfill site.

(g) **Equity Impacts**

Is it equitable for waste from one region to be transferred to another region for treatment or disposal? On the other hand, is it feasible for each region to fully treat or dispose of its waste within the region? The proximity principle is discussed at Section 5.4. These issues have had application in a much wider context than waste management for many years without satisfactory resolution.

Option A.

The people of Sutherland, through the Sutherland Shire Council, have determined to limit the waste input from outside the Southern Sydney region. This position is driven by both landfill space stewardship, and social/environmental perspectives.

Option B.

There is minimal interim putrescible landfill space in the Northern Region and little prospect of any new capacity being created in the region. The people of Tarago have reportedly welcomed the landfill proposal. The community in the Ravensworth area is apparently divided on the proposal described in the EIS currently on exhibition.

(h) **Costs**

Logistics costs are a substantial part of the waste management options under consideration. In each case this involves collection, transport, consolidation, loading and discharging. These activities, practised on around two million tonnes of putrescible waste each year, present a considerable financial impost on the waste generating community.

It follows of course that action to reduce waste generation, and to treat or dispose locally can have a powerful impact on transport costs. On the other hand it must be recognised that social and economic circumstances make entirely local treatment and disposal impractical.

Cost factors relevant to the options under consideration include logistics and operating activities.

Option A.

Landfill pricing is well established and pre GST was charged at $57/tonne for landfilling and $15/tonne for transfer and transport, making $72 in all. The "blanket" transport charge is based on average Sydney-wide costs. It may not therefore accurately represent the specific transfer and transport cost for waste from Northern Sydney to Eastern Creek.

Option B.

Cost details are commercial-in-confidence, but may be approximately $100/tonne. The cost difference is due to the addition of a rail transport component and a reduced road transport component.

(i) **Benefits**

Product revenue would be gained from both options. It is reasonable to assume that this revenue is available to defray operating costs. For landfill operated at international best practice, electrical output of some 233 kWh/tonne may be generated. At a premium rate of $0-06 for green power, this amounts to $14 per tonne of waste. The Waste Inquiry concluded a more modest electrical output and long term revenue of around $10 per tonne of waste from a bioreactor landfill.

3.2. **Conclusions**

Considerable landfill disposal capacity will be required during the transition to sustainable waste management. This capacity could be provided by prolonged continuation of current input rates to Lucas Heights landfill, or by establishing a long-haul landfill site.

On the basis of this review a long-haul landfill scheme is unlikely to be inferior to continuing to dispose of 1.2 million tonnes a year to Lucas Heights Landfill. Rather, a long-haul landfill scheme is most likely to be more favourable than continued high rate input to Lucas Heights, in environment and social terms.

On the other hand, the prolonged input of a high waste input rate to Lucas Heights and elevated inputs to Eastern Creek (as would be necessary) would result in a continuing shortfall of Sydney landfill capacity by 2010/2012.

Other options that might conceivably be implemented more rapidly than the Waste Inquiry Report Scenarios include provision of new putrescible landfill capacity in Sydney and incineration of the organic fraction of pre-treated waste in power stations. These options are unlikely to be satisfactory.

4. SCOPE FOR A MAJOR LANDFILL TO COMPROMISE RESOURCE MANAGEMENT INITIATIVES

Would an abundance of landfill capacity dampen our future collective zeal to extract the best possible benefit from discarded resources? The issues surrounding this important question are complex and deserve serious consideration.

One proposition is that the existence of new landfill capacity would make too easy the disposal decision: why bother to seek value from waste in the absence of an imperative to bring about better solutions?

This logic stems in part from the frequent alarms over the past 20 years that Sydney is about to exhaust its last remaining landfill space. These recurring threats have gone largely unnoticed by the community at large. They may possibly have provided a driver to local government to seek greater recycling effort by the municipal sector. This is unlikely however, as recycling participation has been driven by councils, agencies and citizens with a bigger view of the merit of recycling.

The C&I sector has turned-in a similar level of effort, especially in respect of some specific materials. It has mostly been through the efforts of entrepreneurial firms seeking-out opportunities for increased recycling in collaboration with specific business enterprises.

If the threat of landfill capacity exhaustion has played any part in driving increased recycling efforts, it can only have been in an indirect way.

4.1. The Case for Maintaining Landfill Scarcity

The primary argument for keeping landfill space a scarce resource is based on the idea that disposal is an easy, inexpensive option with a poor environmental record. The logic is that disposal is relatively convenient – no source streaming required, and out of sight, out of mind – and less costly than other treatment options. The thinking continues that in these conditions it is difficult to inspire the strong commitment of public institutions, businesses and citizens to adopt beneficial-use programs.

Thus, it is argued, commitment to recycling and reprocessing may depend more fully on influential political leaders, executive managers, and individual citizens maintaining a stronger view on environment factors than on economic factors. And (perhaps too) a willingness to incur a little inconvenience. If this is the case, then the rapidly growing waste stream disposed from the C&I sector is likely to be the most resistant to beneficial use effort.

This thinking holds that a measure of scarcity is an additional driver to bring about a sense of urgency for resource management reform. And there is little doubt that the further waste reform agenda will benefit from having an array of drivers.

Several factors however impinge on these arguments and the idea of disposal being easy and inexpensive. The first is that landfill management is in fact becoming more complex and expensive. Leachate control and long-term after-care are established requirements. Improved odour control and landfill gas recovery are now virtually mandatory requirements.

A second factor is that long-haul landfill is usually more costly than local landfill. Rail transport and intermodal transfers add to the cost structure and must ultimately be reflected in gate pricing.

Finally, landfill disposal taxes add to the price of landfill in comparison with other technologies. The Waste Inquiry Report recommended that the waste levy should reflect the full environmental and social impacts of the various treatment or disposal technologies to which it should be widely applied. It should not be limited to landfill and it should be pitched at various levels to reflect landfill quality.

Waste management costs associated with remote landfills are in fact likely to match more closely the costs associated with mixed residual waste reprocessing using alternative technologies. Where discards can be streamed at site, so that clear resource streams can be fed to specific technologies, overall costs should undercut remote landfill costs.

On balance, it is conceivable that landfill scarcity may have once contributed to driving recycling efforts. Now, the cost of landfill disposal is increasing and the cost of new technology solutions is declining. The old order is changing.

4.2. **The Lessons from Best Practice**

In the United States, two cities are well recognised for excellence in recycling and reprocessing. Portland, at 1998 diverted some 53 per cent of waste to beneficial use, while Seattle reached 44 per cent diversion. Both cities aim to reach 60 per cent diversion, by 2005 and 2008 respectively. These cities take justifiable pride in the achievements made and they have attracted visitors from all parts of the world, including Sydney.

Officials in both cities don't regard their long term contracts with a major, remote landfill as having any negative impact on recycling behaviour. On the contrary, Seattle's 1989 Solid Waste Management Plan, which set the 60 per cent diversion goal, was inspired by the high cost of landfill.

Both cities have eschewed incineration in favour of landfill for the diminishing proportion of residual waste. Both have adopted aggressive recycling and reprocessing programs, targeting specific types of discards, including food, and targeting specific segments within the domestic and business community. In these cities landfill forms part of a planned, integrated waste management strategy, and it takes the full balance of all materials not diverted, ie 47 per cent and 66 per cent respectively

4.3. **Would a Large Capacity Landfill Unduly Attract Waste?**

A further proposition is that a large capacity landfill may act as a magnet because the proponent would need to maximise input to defray capital costs. This argument has validity in relation to technologies such as conventional

mass burn incinerators which need to be large capacity, high capital intensive facilities. They operate best at continuous, maximum feed.

Landfills don't have the same operating imperatives as mass burn incinerators: they are more labour intensive and have lower initial capital costs. What they do need however is a predictable waste stream so that operating equipment such as compactors and gas recovery systems can be used efficiently.

4.4. Controlling Waste Quantities to Landfills

The best way to limit the flow of material to landfills is to drive aggressive programs to minimise waste creation, and to divert waste created to beneficial use. Best value can be gained from discarded materials if they are streamed at source with compatible materials. This task must be made convenient and a measure of reward for effort must flow back to those who make the effort. Economic instruments, such as disposal/treatment levies and load based licensing of waste generators, can and should play a dramatic part in the management of waste as a potential resource.

The waste management industry and public agencies have important roles here in both the C&I sector and the municipal sector. A positive attitude to opportunities is needed, and a consistent strategy across Sydney, in line with the Waste Inquiry scenarios would be helpful.

At the "end-of-pipe" level, an appropriate economic instrument regime could be accompanied by flow controls on one or all landfills. For instance, specific existing or new landfill Consent Agreements could be framed to constrain input rates or to permit only a diminishing input regime. These sorts of management controls are less desirable than market controls through economic instruments. The Government should however monitor waste and resource flows so that action may be taken as necessary to maximise beneficial diversion.

4.5. Conclusions

In his fine book "Why do we Recycle?", Professor Frank Ackerman[3] eloquently demonstrates that millions of people participate in recycling for reasons beyond the logic of the marketplace. The Waste Inquiry confirmed this view and found that the strong community support for recycling is "… based on the well developed sense that the practice is both good for the environment and is an accessible way of making a personal contribution …"[4]

The challenge Sydney now faces is to bring about the behavioural change, get the technologies in place and develop markets for the resources gained from a greater commitment to recycling. The main ingredients to make these things happen are a sound strategic policy framework and the leadership to

---

[3] Professor Frank Ackerman. **Why do we Recycle?: markets, values and public policy.** Island Press. 1997.

[4] NSW Government. **Report of the Alternative Waste Management Technologies and Practices Inquiry.** 2000.

drive improvement. The proposed waste management legislation review is critical to both. Getting these factors right will have a far greater positive impact than any negative impact additional landfill capacity could create.

5. BROADER ISSUES OF SIGNIFICANCE

How might our transition to a new way of managing waste best be facilitated? Will command-and-control and the usual forms of regulation serve the purpose, or should we engage innovative, market-based systems to bring about change? Can we judge policies and programs in terms of their impacts on economic, social and environmental criteria – not just one factor?

This Assessment was required to advise on broader issues associated with mid to long term landfill requirements. The submissions made to this Assessment were instructive in considering various complex strategic issues associated with further waste management reform. Numerous submissions raised themes related to broader issues such as the importance of waste avoidance in curtailing the waste we need to manage.

This Chapter briefly reviews the following issues:

- the justifiable demand concept;
- waste avoidance as a priority;
- competition and contract arrangements;
- the proximity principle.

5.1. The Justifiable Demand Concept

The State planning provisions for putrescible landfill sites require that justifiable demand must exist for approval of significant additions to capacity. Under SEPP 48, the Consent Authority must have regard to waste disposal capacity requirements and regional waste plans.

The implication of this clause is that, without such a control, unwanted capacity would be created and this may result in adverse outcomes. Indeed, if the market factors that potentially limit the need for landfill are not properly managed, then surplus landfill capacity may in fact be created. Price-cutting, it is argued, may then act to divert waste from more beneficial uses to provide a continuity of supply at a predictable level to ensure operating efficiency.

The logic of this proposition is defeated if the gate price at which landfills can operate is no more attractive than other technologies which gain greater benefits from waste resources. The Waste Inquiry Report argued that gate prices for landfills (and other technologies) should include a levy component which takes account of (or internalises) non market externalities. Social and environmental impacts for instance may not be fully reflected in the current disposal levy.

Clever use of this and other economic instruments would ensure an even playing field and obviate the need for artificial planning controls. Development Applications for waste management facilities of all kinds might

then be considered more fully on their specific social and environmental merits as projects.

The future of Clause 12 of SEPP 48 should be considered in the light of these questions and the broader reforms planned for waste management. In particular the case for gradual phasing-in of market mechanisms as the tools become available should be tested.

5.2. Waste Avoidance

Numerous submissions to this Assessment made reference to the merit of waste avoidance (as distinct from waste reduction). These submissions argued that waste avoidance efforts in New South Wales should be strengthened. The distinction between avoidance and reduction was clarified in Chapter 2 of this Report.

Waste avoidance is highly rewarding in terms of both environment and economic outcomes. It adds a critical dimension in limiting waste generation because it focuses on maximising resource productivity. Excessive packaging, discarded by retailers or by customers further along the value chain is not only wasteful but adds to product costs. The customer ultimately bears the resource manufacturing cost and the disposal or recycling and reprocessing cost. This is inefficient in economic terms and hardly responsible in environment terms.

The challenge however of achieving good gains is considerable, and progress is difficult to measure.

It is important that this issue becomes more fully a part of mainstream waste minimisation initiatives. A good way to amplify existing efforts would be to include waste avoidance initiatives as a focus of the proposed review of waste management legislation to be undertaken this financial year.

5.3. Competition in Waste Management

The merit of avoiding a landfill monopoly situation was raised in discussions held during this Assessment process. Although Waste Service NSW is presently the dominant provider of putrescible landfill capacity, its positioning as a Government Authority should ensure that pricing is appropriate to ensure sustainable waste management outcomes.

If the Government approves a privately owned long-haul landfill, then a service market for putrescible waste landfill will be created. This will soon be supplemented by service competition offered by alternative treatment technologies. In this newly dynamic market situation the Government should closely monitor industry competitive positioning and pricing, possibly through licence regulation.

The conditions of future contracts are important in ensuring an orderly basis for a competitive market. Contract arrangements for waste disposal, reprocessing and even collection should be framed more cleverly. To its credit, the Northern Sydney Waste Board has framed its proposed waste disposal contract in a way that sets no downside limit on waste disposed. Thus, the contractor takes the flow continuity risk.

The next step, and this applies more generally, ought to be that all contracts are framed to promote extraction of maximum value from the discarded resource. For example, a future single contract of municipal residual waste and kerbside recyclables collection could be framed to provide higher financial rewards for increased recyclables collection and decreased residuals collection.

5.4. The Proximity Principle

This principle was included in the UK waste management strategy and has been widely misinterpreted as meaning that waste should be treated or disposed of in the specific location it is generated. The principle was actually developed to stop cross country road transporting of waste to low cost, poorly run landfills in Eastern Europe. This position has been verified with the authors of the strategy, and its execution will reflect this reality.

Transport of course does bring with it undesirable impacts that ought to be minimised. As pointed out in the UK strategy, these 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 that many of the resources that are used in Sydney are produced in other regions. Sydney will never be self-sufficient.

- 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.

This Assessment takes the view that as a **long term goal** the following waste treatment/disposal principle should apply.

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.

This rather theoretical principle **may** result over the long term in treatment of much waste in the broad region in which it is generated in view of the economic, social and environmental impacts of transporting waste. For example, it may well be that some waste processing to create compost is best accomplished outside Sydney, where a market need exists.

To give effect to this principle, tools for evaluation of economic, social and environmental factors will be required and we will need to adopt a bigger view of region (not the arbitrarily determined Waste Board Region, but rather, broad geographic region).

Annex A. ASSUMPTIONS AND ESTIMATES FOR SCENARIO TAKE-UP SCHEMES

This Annex briefly sets out the assumptions and estimates on which the scenario take-up schemes are based. The information here supplements that contained at Chapter 2. The results obtained are not sensitive to realistic changes to the assumptions and estimates adopted.

A1. Methodology

The base level waste generation and disposal position for municipal and C&I sectors is set out at Table A-1. This is based on the business as usual position of 25 per cent municipal recycling and reprocessing and 24 per cent C&I recycling and reprocessing.

Table A-2 sets out the waste presenting for putrescible waste landfill disposal under each of the nine take-up schemes (described above and at Chapter 2). This table shows:

- the name of the take-up scheme and the diversion scenario reached during the course of the 20 year period under consideration;
- the rate of decline in waste presenting for putrescible disposal under each scheme;
- the total amount of waste presenting for disposal over the 20 year period under consideration.

Tables A3 to A7 show that, at current input rates to landfill (under Plan A), a shortfall is evident immediately for the benchmark Schemes 1, 2, 5, 7 and 9, and this continues through the period for all but Scheme 9. A key factor in this analysis is Eastern Creek emerges as the most promising site to receive the shortfall.

The outcome achieved with Plan B by manipulating the waste input rates to various landfill sites is set out Table A8 to A12 for the benchmark Schemes. This plan is considered to be the most realistic of the three tested. Eastern Creek is selected first to take the shortfall, and when its capacity is exhausted (assuming approval of the currently proposed additional capacity) waste is diverted to Jacks Gully. A realistic ramp-up of waste to Jacks Gully fails to absorb the waste disposal required and an unmanageable shortfall is encountered after 2005 for Schemes 1 and 2, and after 2006 for Schemes 5 and 7. This shortfall continues through the 20 year assessment period.

Tables A13 to A17 present the situation when current input rates are maintained at Lucas Heights against the wishes of the Sutherland community.

Plan C is based on overriding the impending input reduction agreement (to 575,000 tpa) between Sutherland Shire Council and Waste Service, and maintaining prolonged input to Lucas Heights at 1.2 million tpa until the landfill

capacity is exhausted. Significant community action against such a plan could be expected.

The outcomes of this plan demonstrate that the plan would create some breathing space, and prolong available capacity to about 2010/2012. After this period, substantial new landfill capacity **will** be required, despite Sydney's probable status as among the most successful recycling cities in the world. If the waste diversion take-up rate actually achieved is less favourable, then additional capacity will be required sooner.

On the other hand, if the highly optimistic Scheme 9 take-up rate could be achieved, then the inevitable requirement for additional capacity could be delayed until after 2017.

The outcome of the full analysis is reported at Chapter 2.

A2. **Key Assumptions and Estimates**

(a) The amount of waste generated at the start year, 2001, has been estimated on the basis of Waste Inquiry data adjusted by the latest available information on disposal, recycling and reprocessing. The following estimates have been adopted:

	Municipal	**C&I**
Waste Generated:	1,800,000 tonnes	2,400,000 tonnes
Waste Disposed (total):	1,350,000 tonnes	1,824,000 tonnes
Waste Disposed (putrescible):	As above.	711,360 tonnes

(b) At 2001 base year, 39 per cent of total C&I waste disposed presents as putrescible waste. This proportion is maintained though the total C&I waste disposed in absolute terms will decline over the 20 year period.

(c) Scenarios start take-up with significant diversion gains immediately after 2001, ie from 2002. An even rate of take-up is applied within the phase period of each scheme.

(d) The following uptake bases apply:

Rapid:
- 4 years from 2002 to complete the Improved Initiatives Scenario at end 2005.
- 4 years from 2006 to complete the Aggressive Initiatives Scenario at end 2009.
- 4 years from 2010 to complete the Ultimate Initiatives Scenario at end 2013.

Fast:
- 6 years from 2002 to complete the Improved Initiatives Scenario at end 2007.
- 6 years from 2008 to complete the Aggressive Initiatives Scenario at end 2013.
- 6 years from 2014 to complete the Ultimate Initiatives Scenario at end 2019.

Progressive: 8 years from 2002 to complete the Improved Initiatives Scenario at end 2009.

8 years from 2010 to complete the Aggressive Initiatives Scenario at end 2017.

Gradual: 10 years from 2002 to complete the Improved Initiatives Scenario at end 2011.

10 years from 2012 to complete the Aggressive Initiatives Scenario at end 2021.

From these bases, nine uptake schemes were derived as described at Box 2-2.

1. Business as Usual.
   - Stable waste disposal quantity despite increased population and State Product.

2. Gradual to Improved Scenario.
   - Gains to achieve Improved Scenario over 10 year period, then level off.

3. Gradual to Aggressive Scenario.
   - Gains to achieve Improved Scenario over a 10 year period, then to Aggressive Scenario over a further 10 years.

4. Progressive to Improved Scenario.
   - Gains to achieve Improved Scenario over an 8 year period, then level off.

5. Progressive to Aggressive Scenario.
   - Gains to achieve Improved Scenario over 8 years, then to Aggressive Scenario over a further 8 years.

6. Fast to Aggressive Scenario.
   - Gains to achieve Improved Scenario over 6 years, then to Aggressive Scenario over a further 6 years, then level off.

7. Fast to Ultimate Scenario.
   - Gains to achieve Improved Scenario over 6 years, then to Aggressive Scenario over a further 6 years, then to Ultimate Scenario over a further 6 years.

8. Rapid to Aggressive Scenario.
   - Gains to achieve Improved Scenario over 4 years, then to Aggressive Scenario over a further 4 years, then level off.

9. Rapid to Ultimate Scenario.
   - Gains to achieve Improved Scenario over 4 years, then to Aggressive Scenario over a further 4 years, then to Ultimate Scenario over a further 4 years, then level off.

(e) Waste potentially generated, and subject to disposal or beneficial use, increases by 1.2 per cent each year from end 2001 for municipal waste due to population increase, and 2 per cent each year for C&I waste due to economic growth.

(f) Waste avoidance (ie not created due to cleaner production type initiatives) results in waste generation decline by 0.5 per cent each year from end 2001 for the municipal sector and 1 per cent each year for the C&I sector.

(g) Recycling and reprocessing at 2001 amounts to 25 per cent of municipal waste generated and 24 per cent of C&I waste generated.

(h) It is assumed that the currently proposed additional capacity for Eastern Creek is approved. No further extension of Eastern Creek capacity is anticipated.

TABLE A1. BASE WASTE GENERATION AND DISPOSAL

MUNICIPAL WASTE PRESENTING FOR DISPOSAL

Year	Total Tonnes Generated	Tonnes for Pute Disposal
2001	1,800,000	1,350,000
2002	1,812,492	1,359,369
2003	1,825,071	1,368,803
2004	1,837,737	1,378,303
2005	1,850,491	1,387,868
2006	1,863,333	1,397,500
2007	1,876,265	1,407,198
2008	1,889,286	1,416,964
2009	1,902,397	1,426,798
2010	1,915,600	1,436,700
2011	1,928,894	1,446,671
2012	1,942,281	1,456,711
2013	1,955,760	1,466,820
2014	1,969,333	1,477,000
2015	1,983,000	1,487,250
2016	1,996,762	1,497,572
2017	2,010,620	1,507,965
2018	2,024,574	1,518,430
2019	2,038,624	1,528,968
2020	2,052,772	1,539,579
Totals:	**38,475,293**	**28,856,469**

Annual Variance Factors:

Starting tonnes:	1,800,000
Population Growth:	1.20%
Economic Growth:	0.00%
Avoidance Growth (negative):	0.50%
Percent Putrecible:	100.00%
Recycling Rate in 2001:	25.00%

C&I WASTE PRESENTING FOR DISPOSAL

Year	Total Tonnes Generated	Tonnes C&I for Disposal	Tonnes for Pute Disposal
2001	2,400,000	1,824,000	711,360
2002	2,423,520	1,841,875	718,331
2003	2,447,270	1,859,926	725,371
2004	2,471,254	1,878,153	732,480
2005	2,495,472	1,896,559	739,658
2006	2,519,928	1,915,145	746,907
2007	2,544,623	1,933,913	754,226
2008	2,569,560	1,952,866	761,618
2009	2,594,742	1,972,004	769,082
2010	2,620,170	1,991,330	776,619
2011	2,645,848	2,010,845	784,229
2012	2,671,777	2,030,551	791,915
2013	2,697,961	2,050,450	799,676
2014	2,724,401	2,070,545	807,512
2015	2,751,100	2,090,836	815,426
2016	2,778,061	2,111,326	823,417
2017	2,805,286	2,132,017	831,487
2018	2,832,778	2,152,911	839,635
2019	2,860,539	2,174,009	847,864
2020	2,888,572	2,195,315	856,173
Totals:	**52,742,861**	**40,084,575**	**15,632,984**

Annual Variance Factors:

Starting tonnes:	2,400,000
Population Growth:	0.00%
Economic Growth:	2.00%
Avoidance Growth (negative):	1.00%
Percent Putrecible:	39.00%
Recycling Rate in 2001:	24.00%

TABLE A2. WASTE PRESENTING FOR DISPOSAL UNDER EACH TAKE-UP SCHEME

	Scheme 1 Business as Usual			Scheme 2 Gradual to Improved			Scheme 3 Gradual to Aggressive		
Year	**Municipal**	**C&I**	**Total**	**Municipal**	**C&I**	**Total**	**Municipal**	**C&I**	**Total**
2001	1,350,000	711,360	2,061,360	1,350,000	711,360	2,061,360	1,350,000	711,360	2,061,360
2002	1,359,369	718,331	2,077,700	1,315,869	701,318	2,017,187	1,315,869	701,318	2,017,187
2003	1,368,803	725,371	2,094,174	1,281,200	691,011	1,972,211	1,281,200	691,011	1,972,211
2004	1,378,303	732,480	2,110,782	1,245,985	680,435	1,926,420	1,245,985	680,435	1,926,420
2005	1,387,868	739,658	2,127,526	1,210,221	669,585	1,879,806	1,210,221	669,585	1,879,806
2006	1,397,500	746,907	2,144,406	1,173,900	658,457	1,832,357	1,173,900	658,457	1,832,357
2007	1,407,198	754,226	2,161,425	1,137,016	647,047	1,784,063	1,137,016	647,047	1,784,063
2008	1,416,964	761,618	2,178,582	1,099,564	635,349	1,734,914	1,099,564	635,349	1,734,914
2009	1,426,798	769,082	2,195,880	1,061,538	623,361	1,684,899	1,061,538	623,361	1,684,899
2010	1,436,700	776,619	2,213,319	1,022,930	611,076	1,634,007	1,022,930	611,076	1,634,007
2011	1,446,671	784,229	2,230,900	983,736	598,491	1,582,227	983,736	598,491	1,582,227
2012	1,456,711	791,915	2,248,625	990,563	604,356	1,594,919	957,544	582,474	1,540,019
2013	1,466,820	799,676	2,266,496	997,438	610,279	1,607,716	930,942	566,086	1,497,028
2014	1,477,000	807,512	2,284,512	1,004,360	616,259	1,620,619	903,924	549,321	1,453,245
2015	1,487,250	815,426	2,302,676	1,011,330	622,299	1,633,629	876,486	532,173	1,408,659
2016	1,497,572	823,417	2,320,989	1,018,349	628,397	1,646,746	848,624	514,636	1,363,260
2017	1,507,965	831,487	2,339,452	1,025,416	634,556	1,659,972	820,333	496,704	1,317,037
2018	1,518,430	839,635	2,358,066	1,032,533	640,774	1,673,307	791,608	478,371	1,269,979
2019	1,528,968	847,864	2,376,832	1,039,698	647,054	1,686,752	762,445	459,631	1,222,077
2020	1,539,579	856,173	2,395,752	1,046,914	653,395	1,700,309	732,840	440,478	1,173,318
Totals:	**28,856,469**	**15,632,984**	**44,489,454**	**22,048,561**	**12,884,860**	**34,933,421**	**20,506,707**	**11,847,365**	**32,354,072**

TABLE A2. WASTE PRESENTING FOR DISPOSAL UNDER EACH TAKE-UP SCHEME (cont.)

Scheme 4 Progressive to improved			Scheme 5 Progressive to Aggressive			Scheme 6 Fast to Aggressive		
Municipal	**C&I**	**Total**	**Municipal**	**C&I**	**Total**	**Municipal**	**C&I**	**Total**
1,350,000	711,360	2,061,360	1,350,000	711,360	2,061,360	1,350,000	711,360	2,061,360
1,304,994	697,065	2,002,059	1,304,994	697,065	2,002,059	1,286,869	689,976	1,976,845
1,259,299	682,421	1,941,720	1,259,299	682,421	1,941,720	1,222,797	668,105	1,890,902
1,212,906	667,424	1,880,330	1,212,906	667,424	1,880,330	1,157,774	645,739	1,803,513
1,165,809	652,067	1,817,876	1,165,809	652,067	1,817,876	1,091,789	622,870	1,714,659
1,118,000	636,345	1,754,345	1,118,000	636,345	1,754,345	1,024,833	599,491	1,624,324
1,069,471	620,252	1,689,723	1,069,471	620,252	1,689,723	956,895	575,594	1,532,489
1,020,214	603,782	1,623,997	1,020,214	603,782	1,623,997	910,006	546,160	1,456,166
970,223	586,931	1,557,153	970,223	586,931	1,557,153	862,420	516,094	1,378,514
976,956	592,683	1,569,639	936,250	565,859	1,502,108	814,130	485,387	1,299,517
983,736	598,491	1,582,227	901,758	544,317	1,446,075	765,128	454,028	1,219,156
990,563	604,356	1,594,919	866,743	522,299	1,389,042	715,407	422,007	1,137,414
997,438	610,279	1,607,716	831,198	499,797	1,330,995	664,958	389,316	1,054,274
1,004,360	616,259	1,620,619	795,118	476,804	1,271,923	669,573	393,131	1,062,704
1,011,330	622,299	1,633,629	758,498	453,312	1,211,810	674,220	396,984	1,071,204
1,018,349	628,397	1,646,746	721,330	429,315	1,150,645	678,899	400,874	1,079,773
1,025,416	634,556	1,659,972	683,611	404,803	1,088,414	683,611	404,803	1,088,414
1,032,533	640,774	1,673,307	688,355	408,770	1,097,125	688,355	408,770	1,097,125
1,039,698	647,054	1,686,752	693,132	412,776	1,105,908	693,132	412,776	1,105,908
1,046,914	653,395	1,700,309	697,943	416,821	1,114,764	697,943	416,821	1,114,764
21,598,209	**12,706,189**	**34,304,398**	**19,044,852**	**10,992,519**	**30,037,371**	**17,608,741**	**10,160,283**	**27,769,025**

TABLE A2. WASTE PRESENTING FOR DISPOSAL UNDER EACH TAKE-UP SCHEME (cont.)

Scheme 7 Fast to Ultimate			Scheme 8 Rapid to Aggressive			Scheme 9 Rapid to Ultimate		
Municipal	**C&I**	**Total**	**Municipal**	**C&I**	**Total**	**Municipal**	**C&I**	**Total**
1,350,000	711,360	2,061,360	1,350,000	711,360	2,061,360	1,350,000	711,360	2,061,360
1,286,869	689,976	1,976,845	1,250,619	675,799	1,926,418	1,250,619	675,799	1,926,418
1,222,797	668,105	1,890,902	1,149,795	639,472	1,789,266	1,149,795	639,472	1,789,266
1,157,774	645,739	1,803,513	1,047,510	602,368	1,649,878	1,047,510	602,368	1,649,878
1,091,789	622,870	1,714,659	943,750	564,476	1,508,226	943,750	564,476	1,508,226
1,024,833	599,491	1,624,324	871,108	518,412	1,389,520	871,108	518,412	1,389,520
956,895	575,594	1,532,489	797,412	471,391	1,268,804	797,412	471,391	1,268,804
910,006	546,160	1,456,166	722,652	423,399	1,146,051	722,652	423,399	1,146,051
862,420	516,094	1,378,514	646,815	374,421	1,021,236	646,815	374,421	1,021,236
814,130	485,387	1,299,517	651,304	378,091	1,029,395	593,836	347,435	941,271
765,128	454,028	1,219,156	655,824	381,796	1,037,620	540,090	319,883	859,973
715,407	422,007	1,137,414	660,375	385,537	1,045,913	485,570	291,758	777,328
664,958	389,316	1,054,274	664,958	389,316	1,054,274	430,267	263,051	693,318
630,187	371,881	1,002,067	669,573	393,131	1,062,704	433,253	265,629	698,882
594,900	354,067	948,967	674,220	396,984	1,071,204	436,260	268,232	704,492
559,093	335,868	894,961	678,899	400,874	1,079,773	439,288	270,861	710,149
522,761	317,278	840,039	683,611	404,803	1,088,414	442,336	273,515	715,852
485,898	298,291	784,189	688,355	408,770	1,097,125	445,406	276,196	721,602
448,497	278,903	727,400	693,132	412,776	1,105,908	448,497	278,903	727,400
451,610	281,636	733,246	697,943	416,821	1,114,764	451,610	281,636	733,246
16,515,954	**9,564,048**	**26,080,002**	**16,197,857**	**9,349,996**	**25,547,853**	**13,926,077**	**8,118,197**	**22,044,273**

TABLE A3. CONSTRAINED INPUT RATES PLAN - PLAN A - SCHEME 1

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 1 Requirement	Capacity Shortfall
2001	95,000	460,000	1,200,000	140,000	5,000	**1,900,000**	2,061,360	161,360
2002	95,000	460,000	1,200,000	140,000	5,000	**1,900,000**	2,077,700	177,700
2003	95,000	460,000	575,000	140,000	5,000	**1,275,000**	2,094,174	819,174
2004	95,000	460,000	575,000	140,000	5,000	**1,275,000**	2,110,782	835,782
2005	95,000	460,000	575,000	140,000	5,000	**1,275,000**	2,127,526	852,526
2006	53,000	460,000	575,000	140,000	5,000	**1,233,000**	2,144,406	911,406
2007		460,000	575,000	140,000	5,000	**1,180,000**	2,161,425	981,425
2008		460,000	575,000	140,000	5,000	**1,180,000**	2,178,582	998,582
2009		460,000	575,000	140,000	5,000	**1,180,000**	2,195,880	1,015,880
2010		460,000	575,000	140,000	5,000	**1,180,000**	2,213,319	1,033,319
2011		460,000	575,000	140,000	5,000	**1,180,000**	2,230,900	1,050,900
2012		164,000	575,000	140,000	5,000	**884,000**	2,248,625	1,364,625
2013			575,000	140,000	5,000	**720,000**	2,266,496	1,546,496
2014			575,000	140,000	5,000	**720,000**	2,284,512	1,564,512
2015			575,000	140,000	5,000	**720,000**	2,302,676	1,582,676
2016			575,000	140,000	5,000	**720,000**	2,320,989	1,600,989
2017			575,000	140,000	5,000	**720,000**	2,339,452	1,619,452
2018			575,000	140,000	5,000	**720,000**	2,358,066	1,638,066
2019			575,000	9,000	5,000	**589,000**	2,376,832	1,787,832
2020			17,000		5,000	**22,000**	2,395,752	2,373,752
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**44,489,454**	**23,916,454**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A4. CONSTRAINED INPUT RATES PLAN - PLAN A - SCHEME 2

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 2 Requirement	Capacity Shortfall
2001	95,000	460,000	1,200,000	140,000	5,000	**1,900,000**	2,061,360	161,360
2002	95,000	460,000	1,200,000	140,000	5,000	**1,900,000**	2,017,187	117,187
2003	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,972,211	697,211
2004	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,926,420	651,420
2005	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,879,806	604,806
2006	53,000	460,000	575,000	140,000	5,000	**1,233,000**	1,832,357	599,357
2007		460,000	575,000	140,000	5,000	**1,180,000**	1,784,063	604,063
2008		460,000	575,000	140,000	5,000	**1,180,000**	1,734,914	554,914
2009		460,000	575,000	140,000	5,000	**1,180,000**	1,684,899	504,899
2010		460,000	575,000	140,000	5,000	**1,180,000**	1,634,007	454,007
2011		460,000	575,000	140,000	5,000	**1,180,000**	1,582,227	402,227
2012		164,000	575,000	140,000	5,000	**884,000**	1,594,919	710,919
2013			575,000	140,000	5,000	**720,000**	1,607,716	887,716
2014			575,000	140,000	5,000	**720,000**	1,620,619	900,619
2015			575,000	140,000	5,000	**720,000**	1,633,629	913,629
2016			575,000	140,000	5,000	**720,000**	1,646,746	926,746
2017			575,000	140,000	5,000	**720,000**	1,659,972	939,972
2018			575,000	140,000	5,000	**720,000**	1,673,307	953,307
2019			575,000	9,000	5,000	**589,000**	1,686,752	1,097,752
2020			17,000		5,000	**22,000**	1,700,309	1,678,309
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**34,933,421**	**14,360,421**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A5. CONSTRAINED INPUT RATES PLAN - PLAN A - SCHEME 5

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 5 Requirement	Capacity Shortfall
2001	95,000	460,000	1,200,000	140,000	5,000	**1,900,000**	2,061,360	161,360
2002	95,000	460,000	1,200,000	140,000	5,000	**1,900,000**	2,002,059	102,059
2003	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,941,720	666,720
2004	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,880,330	605,330
2005	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,817,876	542,876
2006	53,000	460,000	575,000	140,000	5,000	**1,233,000**	1,754,345	521,345
2007		460,000	575,000	140,000	5,000	**1,180,000**	1,689,723	509,723
2008		460,000	575,000	140,000	5,000	**1,180,000**	1,623,997	443,997
2009		460,000	575,000	140,000	5,000	**1,180,000**	1,557,153	377,153
2010		460,000	575,000	140,000	5,000	**1,180,000**	1,502,108	322,108
2011		460,000	575,000	140,000	5,000	**1,180,000**	1,446,075	266,075
2012		164,000	575,000	140,000	5,000	**884,000**	1,389,042	505,042
2013			575,000	140,000	5,000	**720,000**	1,330,995	610,995
2014			575,000	140,000	5,000	**720,000**	1,271,923	551,923
2015			575,000	140,000	5,000	**720,000**	1,211,810	491,810
2016			575,000	140,000	5,000	**720,000**	1,150,645	430,645
2017			575,000	140,000	5,000	**720,000**	1,088,414	368,414
2018			575,000	140,000	5,000	**720,000**	1,097,125	377,125
2019			575,000	9,000	5,000	**589,000**	1,105,908	516,908
2020			17,000		5,000	**22,000**	1,114,764	1,092,764
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**30,037,371**	**9,464,371**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A6. CONSTRAINED INPUT RATES PLAN - PLAN A - SCHEME 7

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 7 Requirement	Capacity Shortfall
2001	95,000	460,000	1,200,000	140,000	5,000	**1,900,000**	2,061,360	161,360
2002	95,000	460,000	1,200,000	140,000	5,000	**1,900,000**	1,976,845	76,845
2003	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,890,902	615,902
2004	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,803,513	528,513
2005	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,714,659	439,659
2006	53,000	460,000	575,000	140,000	5,000	**1,233,000**	1,624,324	391,324
2007		460,000	575,000	140,000	5,000	**1,180,000**	1,532,489	352,489
2008		460,000	575,000	140,000	5,000	**1,180,000**	1,456,166	276,166
2009		460,000	575,000	140,000	5,000	**1,180,000**	1,378,514	198,514
2010		460,000	575,000	140,000	5,000	**1,180,000**	1,299,517	119,517
2011		460,000	575,000	140,000	5,000	**1,180,000**	1,219,156	39,156
2012		164,000	575,000	140,000	5,000	**884,000**	1,137,414	253,414
2013			575,000	140,000	5,000	**720,000**	1,054,274	334,274
2014			575,000	140,000	5,000	**720,000**	1,002,067	282,067
2015			575,000	140,000	5,000	**720,000**	948,967	228,967
2016			575,000	140,000	5,000	**720,000**	894,961	174,961
2017			575,000	140,000	5,000	**720,000**	840,039	120,039
2018			575,000	140,000	5,000	**720,000**	784,189	64,189
2019			575,000	9,000	5,000	**589,000**	727,400	138,400
2020			17,000		5,000	**22,000**	733,246	711,246
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**26,080,002**	**5,507,002**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A7. CONSTRAINED INPUT RATES PLAN - PLAN A - SCHEME 9

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 9 Requirement	Capacity Shortfall
2001	95,000	460,000	1,200,000	140,000	5,000	**1,900,000**	2,061,360	161,360
2002	95,000	460,000	1,200,000	140,000	5,000	**1,900,000**	1,926,418	26,418
2003	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,789,266	514,266
2004	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,649,878	374,878
2005	95,000	460,000	575,000	140,000	5,000	**1,275,000**	1,508,226	233,226
2006	53,000	460,000	575,000	140,000	5,000	**1,233,000**	1,389,520	156,520
2007		460,000	575,000	140,000	5,000	**1,180,000**	1,268,804	88,804
2008		426,051	575,000	140,000	5,000	**1,146,051**	1,146,051	0
2009		301,236	575,000	140,000	5,000	**1,021,236**	1,021,236	0
2010		221,271	575,000	140,000	5,000	**941,271**	941,271	0
2011		139,973	575,000	140,000	5,000	**859,973**	859,973	0
2012		57,328	575,000	140,000	5,000	**777,328**	777,328	0
2013		43,318	575,000	70,000	5,000	**693,318**	693,318	0
2014		48,882	575,000	70,000	5,000	**698,882**	698,882	0
2015		54,492	575,000	70,000	5,000	**704,492**	704,492	0
2016		60,149	575,000	70,000	5,000	**710,149**	710,149	0
2017		65,852	575,000	70,000	5,000	**715,852**	715,852	0
2018		71,602	575,000	70,000	5,000	**721,602**	721,602	0
2019		77,400	575,000	70,000	5,000	**727,400**	727,400	0
2020		436,445	17,000	274,801	5,000	**733,246**	733,246	0
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,444,801**	**100,000**	**20,488,801**	**22,044,273**	**1,555,472**
Residual Capacity:	**nil**	**nil**	**nil**	**84,199**	**211,000**			

TABLE A8. VARIABLE INPUT RATES PLAN - PLAN B - SCHEME 1

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 1 Requirement	Capacity Shortfall
2001	95,000	621,360	1,200,000	140,000	5,000	**2,061,360**	2,061,360	0
2002	95,000	637,700	1,200,000	140,000	5,000	**2,077,700**	2,077,700	0
2003	95,000	1,279,174	575,000	140,000	5,000	**2,094,174**	2,094,174	0
2004	95,000	1,295,782	575,000	140,000	5,000	**2,110,782**	2,110,782	0
2005	95,000	1,312,526	575,000	140,000	5,000	**2,127,526**	2,127,526	0
2006	53,000	77,458	575,000	140,000	5,000	**850,458**	2,144,406	1,293,949
2007			575,000	280,000	5,000	**860,000**	2,161,425	1,301,425
2008			575,000	420,000	5,000	**1,000,000**	2,178,582	1,178,582
2009			575,000	420,000	5,000	**1,000,000**	2,195,880	1,195,880
2010			575,000	420,000	5,000	**1,000,000**	2,213,319	1,213,319
2011			575,000	149,000	5,000	**729,000**	2,230,900	1,501,900
2012			575,000		5,000	**580,000**	2,248,625	1,668,625
2013			575,000		5,000	**580,000**	2,266,496	1,686,496
2014			575,000		5,000	**580,000**	2,284,512	1,704,512
2015			575,000		5,000	**580,000**	2,302,676	1,722,676
2016			575,000		5,000	**580,000**	2,320,989	1,740,989
2017			575,000		5,000	**580,000**	2,339,452	1,759,452
2018			575,000		5,000	**580,000**	2,358,066	1,778,066
2019			575,000		5,000	**580,000**	2,376,832	1,796,832
2020			17,000		5,000	**22,000**	2,395,752	2,373,752
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**44,489,454**	**23,916,454**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A9. VARIABLE INPUT RATES PLAN - PLAN B - SCHEME 2

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 2 Requirement	Capacity Shortfall
2001	95,000	621,360	1,200,000	140,000	5,000	**2,061,360**	2,061,360	0
2002	95,000	577,187	1,200,000	140,000	5,000	**2,017,187**	2,017,187	0
2003	95,000	1,157,211	575,000	140,000	5,000	**1,972,211**	1,972,211	0
2004	95,000	1,111,420	575,000	140,000	5,000	**1,926,420**	1,926,420	0
2005	95,000	1,064,806	575,000	140,000	5,000	**1,879,806**	1,879,806	0
2006	53,000	692,015	575,000	140,000	5,000	**1,465,015**	1,832,357	367,342
2007			575,000	280,000	5,000	**860,000**	1,784,063	924,063
2008			575,000	420,000	5,000	**1,000,000**	1,734,914	734,914
2009			575,000	420,000	5,000	**1,000,000**	1,684,899	684,899
2010			575,000	420,000	5,000	**1,000,000**	1,634,007	634,007
2011			575,000	149,000	5,000	**729,000**	1,582,227	853,227
2012			575,000		5,000	**580,000**	1,594,919	1,014,919
2013			575,000		5,000	**580,000**	1,607,716	1,027,716
2014			575,000		5,000	**580,000**	1,620,619	1,040,619
2015			575,000		5,000	**580,000**	1,633,629	1,053,629
2016			575,000		5,000	**580,000**	1,646,746	1,066,746
2017			575,000		5,000	**580,000**	1,659,972	1,079,972
2018			575,000		5,000	**580,000**	1,673,307	1,093,307
2019			575,000		5,000	**580,000**	1,686,752	1,106,752
2020			17,000		5,000	**22,000**	1,700,309	1,678,309
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**34,933,421**	**14,360,421**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A10. VARIABLE INPUT RATES PLAN - PLAN B - SCHEME 5

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 5 Requirement	Capacity Shortfall
2001	95,000	621,360	1,200,000	140,000	5,000	**2,061,360**	2,061,360	0
2002	95,000	562,059	1,200,000	140,000	5,000	**2,002,059**	2,002,059	0
2003	95,000	1,126,720	575,000	140,000	5,000	**1,941,720**	1,941,720	0
2004	95,000	1,065,330	575,000	140,000	5,000	**1,880,330**	1,880,330	0
2005	95,000	1,002,876	575,000	140,000	5,000	**1,817,876**	1,817,876	0
2006	53,000	845,655	575,000	275,690	5,000	**1,754,345**	1,754,345	0
2007			575,000	420,000	5,000	**1,000,000**	1,689,723	689,723
2008			575,000	420,000	5,000	**1,000,000**	1,623,997	623,997
2009			575,000	420,000	5,000	**1,000,000**	1,557,153	557,153
2010			575,000	293,310	5,000	**873,310**	1,502,108	628,798
2011			575,000		5,000	**580,000**	1,446,075	866,075
2012			575,000		5,000	**580,000**	1,389,042	809,042
2013			575,000		5,000	**580,000**	1,330,995	750,995
2014			575,000		5,000	**580,000**	1,271,923	691,923
2015			575,000		5,000	**580,000**	1,211,810	631,810
2016			575,000		5,000	**580,000**	1,150,645	570,645
2017			575,000		5,000	**580,000**	1,088,414	508,414
2018			575,000		5,000	**580,000**	1,097,125	517,125
2019			575,000		5,000	**580,000**	1,105,908	525,908
2020			17,000		5,000	**22,000**	1,114,764	1,092,764
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**30,037,371**	**9,464,371**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A11. VARIABLE INPUT RATES PLAN - PLAN B - SCHEME 7

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 7 Requirement	Capacity Shortfall
2001	95,000	621,360	1,200,000	140,000	5,000	**2,061,360**	2,061,360	0
2002	95,000	536,845	1,200,000	140,000	5,000	**1,976,845**	1,976,845	0
2003	95,000	1,075,902	575,000	140,000	5,000	**1,890,902**	1,890,902	0
2004	95,000	988,513	575,000	140,000	5,000	**1,803,513**	1,803,513	0
2005	95,000	899,659	575,000	140,000	5,000	**1,714,659**	1,714,659	0
2006	53,000	851,324	575,000	140,000	5,000	**1,624,324**	1,624,324	0
2007		250,396	575,000	280,000	5,000	**1,110,396**	1,532,489	422,092
2008			575,000	420,000	5,000	**1,000,000**	1,456,166	456,166
2009			575,000	420,000	5,000	**1,000,000**	1,378,514	378,514
2010			575,000	420,000	5,000	**1,000,000**	1,299,517	299,517
2011			575,000	149,000	5,000	**729,000**	1,219,156	490,156
2012			575,000		5,000	**580,000**	1,137,414	557,414
2013			575,000		5,000	**580,000**	1,054,274	474,274
2014			575,000		5,000	**580,000**	1,002,067	422,067
2015			575,000		5,000	**580,000**	948,967	368,967
2016			575,000		5,000	**580,000**	894,961	314,961
2017			575,000		5,000	**580,000**	840,039	260,039
2018			575,000		5,000	**580,000**	784,189	204,189
2019			575,000		5,000	**580,000**	727,400	147,400
2020			17,000		5,000	**22,000**	733,246	711,246
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**26,080,002**	**5,507,002**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A12. VARIABLE INPUT RATES PLAN - PLAN B - SCHEME 9

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 9 Requirement	Capacity Shortfall
2001	95,000	621,360	1,200,000	140,000	5,000	**2,061,360**	2,061,360	0
2002	95,000	486,418	1,200,000	140,000	5,000	**1,926,418**	1,926,418	0
2003	95,000	974,266	575,000	140,000	5,000	**1,789,266**	1,789,266	0
2004	95,000	834,878	575,000	140,000	5,000	**1,649,878**	1,649,878	0
2005	95,000	693,226	575,000	140,000	5,000	**1,508,226**	1,508,226	0
2006	53,000	616,520	575,000	140,000	5,000	**1,389,520**	1,389,520	0
2007		548,804	575,000	140,000	5,000	**1,268,804**	1,268,804	0
2008		286,051	575,000	280,000	5,000	**1,146,051**	1,146,051	0
2009		161,236	575,000	280,000	5,000	**1,021,236**	1,021,236	0
2010		1,240	575,000	360,031	5,000	**941,271**	941,271	0
2011			575,000	279,973	5,000	**859,973**	859,973	0
2012			575,000	197,328	5,000	**777,328**	777,328	0
2013			575,000	113,318	5,000	**693,318**	693,318	0
2014			575,000	38,349	5,000	**618,349**	698,882	80,533
2015			575,000		5,000	**580,000**	704,492	124,492
2016			575,000		5,000	**580,000**	710,149	130,149
2017			575,000		5,000	**580,000**	715,852	135,852
2018			575,000		5,000	**580,000**	721,602	141,602
2019			575,000		5,000	**580,000**	727,400	147,400
2020			17,000		5,000	**22,000**	733,246	711,246
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**22,044,273**	**1,471,273**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A13. PROLONGED CURRENT INPUT RATES TO LUCAS HEIGHTS - PLAN C - SCHEME 1

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 1 Requirement	Capacity Shortfall
2001	95,000	621,360	1,200,000	140,000	5,000	**2,061,360**	2,061,360	0
2002	95,000	637,700	1,200,000	140,000	5,000	**2,077,700**	2,077,700	0
2003	95,000	654,174	1,200,000	140,000	5,000	**2,094,174**	2,094,174	0
2004	95,000	670,782	1,200,000	140,000	5,000	**2,110,782**	2,110,782	0
2005	95,000	687,526	1,200,000	140,000	5,000	**2,127,526**	2,127,526	0
2006	53,000	746,406	1,200,000	140,000	5,000	**2,144,406**	2,144,406	0
2007		816,425	1,200,000	140,000	5,000	**2,161,425**	2,161,425	0
2008		389,627	1,200,000	140,000	5,000	**1,734,627**	2,178,582	443,955
2009			1,200,000	140,000	5,000	**1,345,000**	2,195,880	850,880
2010			575,000	140,000	5,000	**720,000**	2,213,319	1,493,319
2011			575,000	140,000	5,000	**720,000**	2,230,900	1,510,900
2012			242,000	140,000	5,000	**387,000**	2,248,625	1,861,625
2013				280,000	5,000	**285,000**	2,266,496	1,981,496
2014				420,000	5,000	**425,000**	2,284,512	1,859,512
2015				140,000	5,000	**145,000**	2,302,676	2,157,676
2016				9,000	5,000	**14,000**	2,320,989	2,306,989
2017					5,000	**5,000**	2,339,452	2,334,452
2018					5,000	**5,000**	2,358,066	2,353,066
2019					5,000	**5,000**	2,376,832	2,371,832
2020					5,000	**5,000**	2,395,752	2,390,752
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**44,489,454**	**23,916,454**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A14. PROLONGED CURRENT INPUT RATES TO LUCAS HEIGHTS - PLAN C - SCHEME 2

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 2 Requirement	Capacity Shortfall
2001	95,000	621,360	1,200,000	140,000	5,000	**2,061,360**	2,061,360	0
2002	95,000	577,187	1,200,000	140,000	5,000	**2,017,187**	2,017,187	0
2003	95,000	532,211	1,200,000	140,000	5,000	**1,972,211**	1,972,211	0
2004	95,000	486,420	1,200,000	140,000	5,000	**1,926,420**	1,926,420	0
2005	95,000	439,806	1,200,000	140,000	5,000	**1,879,806**	1,879,806	0
2006	53,000	434,357	1,200,000	140,000	5,000	**1,832,357**	1,832,357	0
2007		439,063	1,200,000	140,000	5,000	**1,784,063**	1,784,063	0
2008		389,914	1,200,000	140,000	5,000	**1,734,914**	1,734,914	0
2009		339,899	1,200,000	140,000	5,000	**1,684,899**	1,684,899	0
2010		714,007	775,000	140,000	5,000	**1,634,007**	1,634,007	0
2011		249,776	575,000	140,000	5,000	**969,776**	1,582,227	612,451
2012			42,000	140,000	5,000	**187,000**	1,594,919	1,407,919
2013				280,000	5,000	**285,000**	1,607,716	1,322,716
2014				420,000	5,000	**425,000**	1,620,619	1,195,619
2015				140,000	5,000	**145,000**	1,633,629	1,488,629
2016				9,000	5,000	**14,000**	1,646,746	1,632,746
2017					5,000	**5,000**	1,659,972	1,654,972
2018					5,000	**5,000**	1,673,307	1,668,307
2019					5,000	**5,000**	1,686,752	1,681,752
2020					5,000	**5,000**	1,700,309	1,695,309
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**34,933,421**	**14,360,421**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A15. PROLONGED CURRENT INPUT RATES TO LUCAS HEIGHTS - PLAN C - SCHEME 5

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 5 Requirement	Capacity Shortfall
2001	95,000	621,360	1,200,000	140,000	5,000	**2,061,360**	2,061,360	0
2002	95,000	562,059	1,200,000	140,000	5,000	**2,002,059**	2,002,059	0
2003	95,000	501,720	1,200,000	140,000	5,000	**1,941,720**	1,941,720	0
2004	95,000	440,330	1,200,000	140,000	5,000	**1,880,330**	1,880,330	0
2005	95,000	377,876	1,200,000	140,000	5,000	**1,817,876**	1,817,876	0
2006	53,000	356,345	1,200,000	140,000	5,000	**1,754,345**	1,754,345	0
2007		344,723	1,200,000	140,000	5,000	**1,689,723**	1,689,723	0
2008		278,997	1,200,000	140,000	5,000	**1,623,997**	1,623,997	0
2009		212,153	1,200,000	140,000	5,000	**1,557,153**	1,557,153	0
2010		357,108	1,000,000	140,000	5,000	**1,502,108**	1,502,108	0
2011		769,075	392,000	280,000	5,000	**1,446,075**	1,446,075	0
2012		402,254		280,000	5,000	**687,254**	1,389,042	701,788
2013				420,000	5,000	**425,000**	1,330,995	905,995
2014				149,000	5,000	**154,000**	1,271,923	1,117,923
2015					5,000	**5,000**	1,211,810	1,206,810
2016					5,000	**5,000**	1,150,645	1,145,645
2017					5,000	**5,000**	1,088,414	1,083,414
2018					5,000	**5,000**	1,097,125	1,092,125
2019					5,000	**5,000**	1,105,908	1,100,908
2020					5,000	**5,000**	1,114,764	1,109,764
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**30,037,371**	**9,464,371**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A16. PROLONGED CURRENT INPUT RATES TO LUCAS HEIGHTS - PLAN C - SCHEME 7

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 7 Requirement	Capacity Shortfall
2001	95,000	621,360	1,200,000	140,000	5,000	**2,061,360**	2,061,360	0
2002	95,000	536,845	1,200,000	140,000	5,000	**1,976,845**	1,976,845	0
2003	95,000	450,902	1,200,000	140,000	5,000	**1,890,902**	1,890,902	0
2004	95,000	363,513	1,200,000	140,000	5,000	**1,803,513**	1,803,513	0
2005	95,000	274,659	1,200,000	140,000	5,000	**1,714,659**	1,714,659	0
2006	53,000	226,324	1,200,000	140,000	5,000	**1,624,324**	1,624,324	0
2007		187,489	1,200,000	140,000	5,000	**1,532,489**	1,532,489	0
2008		311,166	1,000,000	140,000	5,000	**1,456,166**	1,456,166	0
2009		483,514	750,000	140,000	5,000	**1,378,514**	1,378,514	0
2010		579,517	575,000	140,000	5,000	**1,299,517**	1,299,517	0
2011		499,156	575,000	140,000	5,000	**1,219,156**	1,219,156	0
2012		592,414	400,000	140,000	5,000	**1,137,414**	1,137,414	0
2013		97,141	492,000	280,000	5,000	**874,141**	1,054,274	180,133
2014				420,000	5,000	**425,000**	1,002,067	577,067
2015				140,000	5,000	**145,000**	948,967	803,967
2016				9,000	5,000	**14,000**	894,961	880,961
2017					5,000	**5,000**	840,039	835,039
2018					5,000	**5,000**	784,189	779,189
2019					5,000	**5,000**	727,400	722,400
2020					5,000	**5,000**	733,246	728,246
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**26,080,002**	**5,507,002**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

TABLE A17. PROLONGED CURRENT INPUT RATES TO LUCAS HEIGHTS - PLAN C - SCHEME 9

Year	Belrose	Eastern Creek	Lucas Heights	Jacks Gully	South Windsor	Total Emplaced	Scheme 9 Requirement	Capacity Shortfall
2001	95,000	621,360	1,200,000	140,000	5,000	**2,061,360**	2,061,360	0
2002	95,000	486,418	1,200,000	140,000	5,000	**1,926,418**	1,926,418	0
2003	95,000	349,266	1,200,000	140,000	5,000	**1,789,266**	1,789,266	0
2004	95,000	209,878	1,200,000	140,000	5,000	**1,649,878**	1,649,878	0
2005	95,000	368,226	900,000	140,000	5,000	**1,508,226**	1,508,226	0
2006	53,000	391,520	800,000	140,000	5,000	**1,389,520**	1,389,520	0
2007		323,804	800,000	140,000	5,000	**1,268,804**	1,268,804	0
2008		301,051	700,000	140,000	5,000	**1,146,051**	1,146,051	0
2009		276,236	600,000	140,000	5,000	**1,021,236**	1,021,236	0
2010		296,271	500,000	140,000	5,000	**941,271**	941,271	0
2011		314,973	400,000	140,000	5,000	**859,973**	859,973	0
2012		232,328	400,000	140,000	5,000	**777,328**	777,328	0
2013		148,318	400,000	140,000	5,000	**693,318**	693,318	0
2014		153,882	400,000	140,000	5,000	**698,882**	698,882	0
2015		159,492	400,000	140,000	5,000	**704,492**	704,492	0
2016		165,149	400,000	140,000	5,000	**710,149**	710,149	0
2017		170,852	400,000	140,000	5,000	**715,852**	715,852	0
2018		254,974	292,000	140,000	5,000	**691,974**	721,602	29,628
2019				9,000	5,000	**14,000**	727,400	713,400
2020					5,000	**5,000**	733,246	728,246
Totals:	**528,000**	**5,224,000**	**12,192,000**	**2,529,000**	**100,000**	**20,573,000**	**22,044,273**	**1,471,273**
Residual Capacity:	**nil**	**nil**	**nil**	**nil**	**211,000**			

Annex B. WASTE INQUIRY SCENARIO IMPLEMENTATION

This Annex examines the implementation requirements and likely timing to bring to fruition the waste reduction scenarios described in the Waste Inquiry Report. A primary purpose is to test the feasibility of the alternative take-up scenarios outlined in Chapter 2 of this report.

The Waste Inquiry presented two plausible waste reduction scenarios beyond the current base case, to encompass efficient waste streaming options: *Improved Current Initiatives Scenario* and *Aggressive Initiatives Scenario*. Each scenario includes six specific types of initiatives relating to waste which in the main becomes classified as putrescible. The pace with which these initiatives can be fully implemented is crucial to the stewardship of remaining putrescible waste landfill space in the Sydney area. Each initiative type is therefore examined in detail in this Annex in order to determine its scope and the issues likely to be critical to smooth implementation. The analysis covers:

- Concept description
- Participants
- Investment requirements
- Market availability
- Timing to implement
- Enforcement.

A further scenario has been added for this Assessment in order to test the scope to press beyond the *Aggressive Initiatives Scenario*. This *Ultimate Initiatives Scenario* is based on achieving a maximum of value from waste resources, regardless of cost for the resources gained beyond the *Aggressive Initiatives Scenario.*

These three scenarios comprise 16 separate initiatives. They are summarised at Table B-1.

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 described in the report at Chapter 2. These factors are:

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

These factors have all been taken into account in estimating the implementation time for each initiative. The fact however that simultaneous action is required to bring about all the initiatives that make up each scenario is recognised in the overall findings.

Table B-1 **LIST OF SCENARIO INITIATIVES**

Scenario/Initiative		Proposed Further Capture (tpa)
Improved Current Initiatives Scenario		
Municipal Sector		
Initiative 1.	Increased Garden Waste Diversion	150,000
Initiative 2.	Increased Collection of Kerbside Recyclables	69,000
Initiative 3.	Treatment and Processing of Mixed Residual Waste	217,000
C&I Sector		
Initiative 4.	Targeted Food Waste Collection	130,000
Initiative 5.	Increased Source Separation of Industrial Dry Recyclable Materials	175,000
Initiative 6.	Treatment and Processing of Mixed Residual Waste	83,000
Aggressive Initiatives Scenario		
Municipal Sector		
Initiative 7.	Collection of Food Waste with Garden Waste	150,000
Initiative 8.	Increased Collection of Kerbside Recyclables	85,000
Initiative 9.	Treatment and Processing of Mixed Residual Waste	71,000
C&I Sector		
Initiative 10.	Targeted Food Waste Collection	75,000
Initiative 11.	Increased Capture of Industrial Dry Recyclable Materials	320,000
Initiative 12.	Treatment and Processing of Mixed Residual Waste	36,000
Ultimate Initiatives Scenario		
Municipal Sector		
Initiative 13.	Increased Collection of Kerbside Recyclables	75,000
Initiative 14.	Treatment and Processing of Mixed Residual Waste	142,000
C&I Sector		
Initiative 15.	Targeted Food Waste Collection	75,000
Initiative 16.	Treatment and Processing of Mixed Residual Waste	131,000

Note: The proposed capture rates are specific to each initiative and each Scenario is attained in sequence.

B.1. Findings

There are six types of initiatives and up to 18 major projects required to implement the *Improved Initiatives Scenario*. A further six initiative types and 17 projects are required for the *Aggressive Initiatives Scenario*. Further work is required to bring about the *Ultimate Initiatives Scenario*.

Capital costs amount to around $130 million, $119 million and $92 million respectively, thus significant initial funding is required.

The analysis shows that most types of initiatives can be implemented within about three to eight years. When simultaneous implementation is required however, industry capacity may be stretched at planning, contract formulation, bidding, tender evaluation and technology provision stages. Thus it is inappropriate to assume that parallel take-up of initiatives won't result in some delays.

Substantial residual waste treatment is proposed in each scenario. Technologies for this purpose are nearing commercial status, but more development work is required to:

- provide a confident expectation that products suitable for public consumption can be created at a cost acceptable to the community as a whole;
- create a competitive market with numerous brands available within each technology type.

The position in respect of all initiatives is summarised at Table B-2.

B.2. Improved Current Initiatives Scenario

B.2.1. Municipal Sector

Initiative 1. Increased Garden Waste Diversion

Concept

Collect, treat and market a further 150,000 tpa of garden waste. Treatment by biological or new thermal processes for production of compost or energy.

Participants

Local Councils, community and waste management industry (collection, treatment, processing).

Investment Requirements

Say five, 30,000 tpa facilities at approximately $1.5m to $4.5m each. Total capital cost estimate: $7.5m to $22.5m. Additional collection systems and vehicles also required.

Market Availability

Expansion of compost supply and green energy should be matched to demand creation.

Table B-2

	Proposed Further Capture (tpa)	Plants & Capacities	Capital Cost–Min ($mil)	Capital Cost-Max ($mil)	Time Frame -Min (yrs)	Time Frame-Max (yrs)
Improved Current Initiatives Scenario						
Municipal Sector						
Initiative 1 – Increased Garden Waste Diversion	150,000	5 @ 30,000	7	22	5	6
Initiative 2 – Increased Collection of Kerbside Recyclables	69,000	1 @ 70,000	9	11	6	8
Initiative 3 – Treatment and Processing of Mixed Residual Waste	217,000	5 @ 45,000	40	50	7	8
Sub-Total Municipal	**436,000**		**56**	**83**	**7**	**8**
C&I Sector						
Initiative 4 – Targeted Food Waste Collection	130,000	3 @ 45,000	30	39	4	5
Initiative 5 – Increased Source Separation of Industrial Dry Recyclable Materials	175,000	2 @ 90,000	8	10	4	5
Initiative 6 – Treatment and Processing of Mixed Residual Waste	83,000	2 @ 45,000	16	20	4	5
Sub-Total C&I	**388,000**		**24**	**34**	**4**	**5**
Aggressive Initiatives Scenario						
Municipal Sector						
Initiative 7 – Collection of Food Waste with Garden Waste	150,000	5 @ 30,000	35	50	6	6
Initiative 8 – Increased Collection of Kerbside Recyclables	85,000	1 @ 85,000	12	14	4	8
Initiative 9 – Treatment and Processing of Mixed Residual Waste	71,000	2 @ 35,000	12	16	4	5
Sub-Total Municipal	**306,000**		**59**	**80**	**6**	**8**
C&I Sector						
Initiative 10 – Targeted Food Waste Collection	75,000	2 @ 40,000	20	26	4	5
Initiative 11 – Increased Capture of Industrial Dry Recyclable Materials	320,000	6 @ 55,000	16	20	6	8
Initiative 12 – Treatment and Processing Mixed Residual Waste	36,000	1 @ 40,000	8	10	4	5
Sub-Total C&I	**431,000**		**44**	**56**	**6**	**8**

Table B-2 (continued)

	Proposed Further Capture (tpa)	Plants & Capacities	Capital Cost–Min ($mil)	Capital Cost-Max ($mil)	Time Frame -Min (yrs)	Time Frame-Max (yrs)
Ultimate Initiatives Scenario						
Municipal Sector						
Initiative 13 – Increased Collection of Kerbside Recyclables	75,000	1 @ 75,000	11	13	4	6
Initiative 14 – Treatment and Processing of Mixed Residual Wastes	142,000	3 @ 50,000	24	36	3	5
Sub-Total Municipal	**217,000**		**35**	**49**	**4**	**6**
C&I Sector						
Initiative 15 – Targeted Food Waste Collection	75,000	2 @ 40,000	20	26	4	4
Initiative 16 – Treatment and Processing of Mixed Residual Waste	131,000	3 @ 45,000	24	30	5	5
Sub-Total C&I	**206,000**		**44**	**56**	**5**	**5**

Timing

Estimated time to develop facilities and increase market demand for potential products is four to five years. Estimated time to award contracts and change behaviour is five to six years.

Enforcement

Collection action could be organised by Local Councils working in partnership with Waste Boards and could be enforced through existing Waste Board powers. Treatment and processing could be driven by Waste Boards calling tenders for processing and beneficial use of garden waste on a Regional basis.

Initiative 2. Increased Collection of Kerbside Recyclables

Concept

Increased kerbside collection of recyclables by targeting specific groups and facilitating greater participation to collect a further 69,000 tpa. Separation at MRFs for reprocessing of specific materials.

Participants

Local Councils, community, waste management industry, and material manufacturers.

Investment Requirements

Additional MRF capacity of 70,000 tpa, approximately $9m to $11m capital cost. Additional collection vehicle capacity may be required. An increased investment in education and possibly in-house recyclables storage containers will be essential.

Market Availability

The markets for recyclate appear to be sufficiently robust to absorb the increase to 37 per cent kerbside recyclables collection over a five or six year period.

Timing

Estimated time to develop facilities and create supply/demand equilibrium is approximately four years. Estimated time to further increase recycling behaviour is six to eight years.

Enforcement

This initiative would be difficult to enforce, but Waste Boards could play a key role in encouraging Local Council action and assisting in education. Pricing incentives proposed in the Waste Inquiry Report may be an important driver.

Initiative 3. Treatment and Processing of Mixed Residual Waste

Concept

Treat, process and market around 217,000 tpa of mixed residual waste. Treatment by biological or new thermal processes with separation and recovery of recyclable metals, plastics and glass. The predominantly organic fraction would be processed for production of energy or chemicals. Compost production may be possible with thorough separation of input materials, provided a satisfactory quality can be attained. As it is proposed to excavate shale from Eastern Creek landfill in order to gain space, use of treated waste for landfill cover is improbable.

Investment requirements

Say five, 45,000 tpa facilities at approximately $8m to $10m each. Total capital cost estimate: $40m to $50m.

Market Availability

Supply of green energy should be matched to demand creation; demand for secondary compost is unclear, but directly related to quality and inversely related to distance from source.

Timing

Estimated time to develop and commission five such facilities is seven to eight years.

Participants

Local Councils, waste management industry, material manufacturers, energy industry.

Enforcement

This initiative would be difficult to enforce by regulation, and should more properly be geared to market pull. It could be driven by the Waste Boards calling tenders for facilities, possibly with a guaranteed input supply of residual waste material, or by Government direction to Waste Service. However, the market for supply of such technologies is not well developed in Australia.

Alternatively, a high cost disposal-to-landfill regime would stimulate demand for such technologies without regulation or intervention by Government.

B.2.2. Commercial and Industrial Sector

Initiative 4. Targeted Food Waste Collection

Concept

Target 130,000 tpa streamed food waste collection from producers currently disposing of food as mixed residual waste. Treatment by biological or thermal processes for production of compost or energy.

Participants

Food waste generators and waste management industry (collection, treatment and processing). Waste Boards could facilitate action.

Investment Requirements

Say three, 45,000 tpa facilities at approximately $10m to $13m each. Total capital cost estimate: $30m to $39m.

Market Availability

The market for high quality compost is strong. Supply of green energy should be matched to market demand.

Timing

Estimated time to develop facilities and systems, and change behaviour is four to five years.

Enforcement

This initiative would be difficult to drive and enforce. One option is to restrict the amount of predominantly food (or broadly organic) waste despatched to landfill by the waste management industry. Alternatively, a high cost disposal-to-landfill regime, through increased disposal tax, would stimulate demand for streaming and treatment of food wastes.

The Waste Boards could be charged with detecting opportunities brought about by demand for resources, and facilitating alliance contracts between waste generators, waste management industry (collection and treatment) and resource purchasers.

Initiative 5. Increased Source Separation of Industrial Dry Recyclable Materials

Concept

Increased site separation, collection and reprocessing of industrial packaging materials, particularly paper, cardboard, plastics and (possibly) timber to recover a further 175,000 tpa, of which 30 per cent is assumed to present currently as putrescible waste.

Participants

Shopping centres, offices and SMEs in cluster park settings; waste management industry, and material manufacturers.

Investment Requirements

Site separation/discard bins; and some additional commercial/industrial MRF capacity for discard streams that incur mixing at site. Additional reprocessing capacity may be required for material manufacturers. Total capital cost estimate $8m to $10m.

Market Availability

Markets for plastics and paper/cardboard are quite strong. Timber materials would join the general organics market for shredding, compost or green energy production via new thermal technologies.

Timing

Estimated time to develop equipment and facilities, and to develop cooperative arrangements with shopping centres, office cleaning contractors and waste management industry contractors to recover 175,000 tonnes is four to five years.

Enforcement

This option would be difficult to drive and enforce and is probably best organised as a business-to-business opportunity. Southern Sydney Waste Board is actively exploring the business concept and Visy Recycling has already developed activities to recover some key materials.

A high cost disposal-to-landfill regime would further stimulate demand for streaming and reprocessing industrial packaging materials.

Initiative 6. Treatment and Processing of Mixed Residual Waste

Concept

Treat, process and market some 83,000 tpa of mixed residual waste. Treatment by biological or new thermal processes with separation and recovery of recyclable metals, plastics and glass. The predominantly organic fraction would be processed for production of energy or chemicals. Compost production may be possible with thorough separation of input materials, provided a satisfactory quality can be attained.

Participants

Businesses, waste management industry, material manufacturers, energy industry.

Investment requirements

Say two, 45,000 tpa facilities at approximately $8m to $10m each. Total capital cost estimate: $16m to $20m.

Market Availability

Supply of green energy should be matched to demand creation; demand for secondary compost is unclear, but inversely related to distance from source.

Timing

Estimated time to develop and commission two such facilities is four to five years.

Enforcement

This initiative would be difficult to enforce by regulation, and should more properly be geared to market pull. It could be driven by the Waste Boards calling tenders for supply and treatment of C&I residual waste material to specific standards. Alternatively, a high cost disposal-to-landfill regime would stimulate demand for such technologies without regulation or intervention by Government.

B.3. Aggressive Initiatives Scenario

By the time the initiatives described below are in contention, treatment technologies and management practices may well have advanced considerably.

B.3.1. Municipal Sector

Initiative 7. Collection of Food Waste with Garden Waste

Concept

Collect, treat and market an ambitious 150,000 tpa domestic food waste in the same bin as used for garden waste collection. Treatment by biological or new thermal processes for production of compost or energy.

Participants

Local Councils, community and waste management industry (collection, treating, processing).

Investment Requirements

Say five, 30,000 tpa facilities at $7m to $10m each. Total capital cost estimate $35m to $50m. Some additional collection vehicles may be required, as well as a major change in collection contract arrangements.

Market Availability

Expansion of compost supply and green energy should be matched to demand.

Timing

Estimated time to develop facilities, stimulate demand and bring about behavioural change to ensure widespread kerbside presentation, amounting to 150,000 tpa, is around six years beyond the Improved Scenario.

Enforcement

Collection action could be organised by Local Councils working in partnership with Waste Boards and could be enforced through existing Waste Board powers. Treatment and processing could be driven by Waste Boards calling tenders for facilities or by Government direction of Waste Service.

Alternatively, a high cost disposal-to-landfill regime would stimulate demand without Government intervention.

Initiative 8. Increased Collection of Kerbside Recyclables

Concept

Increased kerbside collection of recyclables by targeting specific groups and facilitating greater participation to collect a further 81,000 tpa. Separation at MRFs for reprocessing of specific materials.

Participants

Local Councils, community, waste management industry, and material manufacturers.

Investment Requirements

Additional MRF capacity of say 85,000 tpa for approximately $12m to $14m capital cost. Additional collection vehicle capacity may be required. Reprocessing capacity may be required.

An investment in education and possibly in-house recyclables storage containers will be essential.

Market Availability

The markets for recyclate should be sufficiently robust enough to absorb the increase to 50 per cent kerbside recyclables collection over a six year period.

Timing

Estimated time to develop facilities and create supply/demand equilibrium is approximately four years. Estimated time to further increase recycling behaviour is eight years.

Enforcement

This initiative would be difficult to enforce, but Waste Boards could play a key role in encouraging Local Council action and assisting in education. Pricing initiatives described in the Waste Inquiry Report may be an important driver.

Initiative 9. Treatment and Processing of Mixed Residual Waste

Concept

Treat, process and market a further 71,000 tpa of mixed residual waste. Treatment by biological or new thermal processes with separation and recovery of recyclable metals, plastics and glass. The predominantly organic fraction would be processed for production of energy or chemicals. Compost production may be possible with thorough separation of input materials, provided a satisfactory quality can be attained.

Participants

Local Councils, waste management industry, material manufacturers, energy industry.

Investment requirements

Say two, 35,000 tpa facilities at approximately $6m to $8m each. Total capital cost estimate: $12m to $16m.

Market Availability

Supply of green energy should be matched to demand creation; demand for secondary compost is unclear but inversely related to distance from source.

Timing

Estimated time to develop and commission two such facilities is four to five years.

Enforcement

This initiative would be difficult to enforce by regulation, and should more properly be geared to market pull. It could be driven by the Waste Boards

calling tenders for facilities, possibly with a guaranteed input supply of residual waste material, or by Government direction to Waste Service. However, the market for such technologies is not well developed in Australia.

Alternatively, a high cost disposal-to-landfill regime would stimulate demand for such technologies without regulation or intervention by Government.

B.3.2. Commercial and Industrial Sector

Initiative 10. Targeted Food Waste Collection

Concept

Target a further 75,000 tpa streamed food waste collection from producers currently disposing of food as mixed residual waste. Treatment by biological or thermal processes for production of compost or energy.

Participants

Food waste generators and waste management industry (collection, treatment and processing). Waste Boards could facilitate action.

Investment Requirements

Say two, 40,000 tpa facilities at approximately $10m to $13m each. Total capital cost estimate: $20m to $26m.

Market Availability

The market for high quality compost is strong. Supply of green energy should be matched to market demand.

Timing

Estimated time to develop facilities and systems, and further change behaviour is four to five years.

Enforcement

This initiative would be difficult to drive and enforce. One option is to restrict the amount of predominantly food (or broadly organic) waste despatched to landfill by the waste management industry. Alternatively, a high cost disposal-to-landfill regime, through increased disposal tax, would stimulate demand for streaming and treatment of food wastes.

The Waste Boards could be charged with detecting opportunities brought about by demand for resources, and facilitating alliance contracts between waste generators, waste management industry (collection and treatment) and resource purchasers.

Initiative 11. Increased Capture of Industrial Dry Recyclable Materials

Concept

Increased site separation, collection and reprocessing of industrial packaging materials, particularly paper, cardboard, plastics and (possibly) timber to recover a further 320,000 tpa, of which an assumed 30 per cent currently presents as putrescible waste.

Participants

Shopping centres, offices and SMEs in cluster park settings; waste management industry, and material manufacturers.

Investment Requirements

Site separation/discard bins; and some additional commercial/industrial MRF capacity for discard streams that incur mixing at site. Additional reprocessing capacity may be required for material manufacturers. Total capital cost estimate $16m to $20m.

Market Availability

Markets for plastics and paper/cardboard are quite strong. Timber materials would join the general organics market for shredding, compost or green energy production via new thermal technologies.

Timing

Estimated time to develop equipment and facilities, and to develop cooperative arrangements with shopping centres, office cleaning contractors and waste management industry contractors to recover 320,000 tpa is six to eight years.

Enforcement

This option would be difficult to enforce and is probably better organised as a business-to-business opportunity. Southern Sydney Waste Board is actively exploring the business concept and Visy Recycling has already developed activities to recover some key materials.

A high cost disposal-to-landfill regime would further stimulate demand for streaming and reprocessing industrial packaging materials.

Initiative 12. Treatment and Processing Mixed Residual Waste

Concept

Treat, process and market a further 36,000 tpa of mixed residual waste. Treatment by biological or new thermal processes with separation and recovery of recyclable metals, plastics and glass. The predominantly organic fraction would be processed for production of energy or chemicals. Compost

production may be possible with thorough separation of input materials, provided a satisfactory quality can be attained.

Investment requirements

Say one, 40,000 tpa facilities at approximately $8m to $10m. Total capital cost: $8m to $10m.

Market Availability

Supply of green energy should be matched to demand creation; demand for secondary compost is unclear, but inversely related to distance from source.

Timing

Estimated time to develop and commission one facility is four to five years.

Enforcement

This initiative would be difficult to enforce by regulation, and should more properly be geared to market pull. It could be driven by the Waste Boards calling tenders for supply and treatment of C&I residual waste material to specific standards. Alternatively, a high cost disposal-to-landfill regime would stimulate demand for such technologies without regulation or intervention by Government.

Participants

Businesses, waste management industry, material manufacturers, energy industry.

B.4. Ultimate Initiatives Scenario

This scenario is a somewhat tentative addition to the scenarios described in the Waste Inquiry Report. By the time the initiatives described below are in contention, many aspects of waste management may have changed either positively or negatively. This scenario must be considered as indicative only.

B.4.1. Municipal Sector

Initiative 13. Increased Collection of Kerbside Recyclables

Concept

Increased kerbside collection of recyclables by targeting specific groups and facilitating greater participation to collect a further 75,000 tpa. Separation at MRFs for reprocessing of specific materials.

Participants

Local Councils, community, Waste Service and waste management industry, and material manufacturers.

Investment Requirements

Additional MRF capacity of say 75,000 tpa for approximately $12m capital cost. Additional collection vehicle capacity may be required. Reprocessing capacity may be required.

An investment in education and possibly in-house recyclables storage containers will be essential.

Market Availability

The markets for recyclate should be sufficiently robust enough to absorb the increase of 17 per cent over a period.

Timing

Estimated time to develop facilities and create supply/demand equilibrium is approximately four years. Estimated time to award contacts and change behaviour is six years.

Enforcement

Enforcement arrangements this far out are unclear. Pricing incentives may be important to bring all parts of the community into the initiative.

Initiative 14. Treatment and Processing of Mixed Residual Waste

Concept

Treat, process and market a further 142,000 tpa of mixed residual waste. Treatment by biological or new thermal processes with separation and recovery of recyclable metals, plastics and glass. The predominantly organic fraction would be processed for production of cover material, energy or chemicals. Compost production may be possible with thorough separation of input materials, or as a secondary compost if permitted by the EPA.

Participants

Local Councils, waste management industry, material manufacturers, energy industry.

Investment requirements

Say three, 50,000 tpa facilities at approximately $8m to $10m each. Total capital cost estimate: $24m to $30m.

Market Availability

Supply of green energy should be matched to demand creation; demand for secondary compost is unclear but inversely related to distance from source.

Timing

Estimated time to develop and commission three such facilities is five years.

Enforcement

Enforcement arrangements this far out are unclear.

B.4.2. Commercial and Industrial Sector

Initiative 15. Targeted Food Waste Collection

Concept

Target a further 75,000 tpa streamed food waste collection from producers currently disposing of food as mixed residual waste. Treatment by biological or thermal processes for production of compost or energy.

Participants

Food waste generators and waste management industry (collection, treatment and processing). Waste Boards could facilitate action.

Investment Requirements

Say two, 40,000 tpa facilities at approximately $10m to $13m each. Total capital cost estimate: $20m to $26m.

Market Availability

The markets for high quality compost is strong. Supply of green energy should be matched to market demand.

Timing

Estimated time to develop facilities and systems, and change behaviour is four years.

Enforcement

This initiative would be difficult to enforce. One option is to restrict the amount of predominantly food (or broadly organic) waste despatched to landfill by the waste management industry. Alternatively, a high cost disposal-to-landfill regime would stimulate demand for streaming and treatment of food wastes.

Initiative 16. Treatment and Processing of Mixed Residual Waste

Concept

Treat, process and market a further 131,000 tpa of mixed residual waste. Treatment by biological or new thermal processes with separation and

recovery of recyclable metals, plastics and glass. The predominantly organic fraction would be processed for production of energy or chemicals. Compost production may be possible with thorough separation of input materials, provided a satisfactory quality can be attained.

Investment requirements

Say three, 45,000 tpa facilities at approximately $8m to $10m each. Total capital cost estimate: $24m to $30m.

Market Availability

Supply of green energy should be matched to demand creation; demand for secondary compost is unclear, but inversely related to distance from source.

Timing

Estimated time to develop and commission three such facilities is five years.

Enforcement

Enforcement arrangements this far out are unclear.

Annex C. SUBMISSIONS RECEIVED

1. The Council of Sutherland Shire.
2. Manly Council.
3. Pacific Waste Management Pty Limited.
4. Ms Neela Jones.
5. Ms Liz Ramzan.
6. Hunter Environment Lobby.
7. Private Landfillers Association.
8. The Manly Greens.
9. Waste Service, NSW.
10. Mr Tony Laffan.
11. Collex Waste Management Pty Ltd.
12. Sydney Catchment Authority.
13. Thiess Environmental Services Pty Limited.
14. Western Sydney Waste Board.
15. Pioneer Construction Materials Pty Ltd.
16. Sustainable Energy Development Authority of NSW.
17. Australian Industry Group.
18. Inner Sydney Waste Board.
19. Brightstar Environmental.
20. Hunter Residents Against Sydney Garbage Dump.
21. Northern Sydney Waste Board.
22. Australian Manufacturing Workers Union.
23. Breen Holdings Pty Limited.
24. Ms Lyndall McCormack.
25. Friends of the Earth.
26. Nature Conservation Council.
27. Total Environment Centre Inc.
28. Southern Sydney Waste Board.
29. Waste Management Association of Australia.
30. Ms Anne Burton and Mr Anthony Johnson.
31. Mr J.M. Holmes.
32. Environment Protection Authority of NSW.