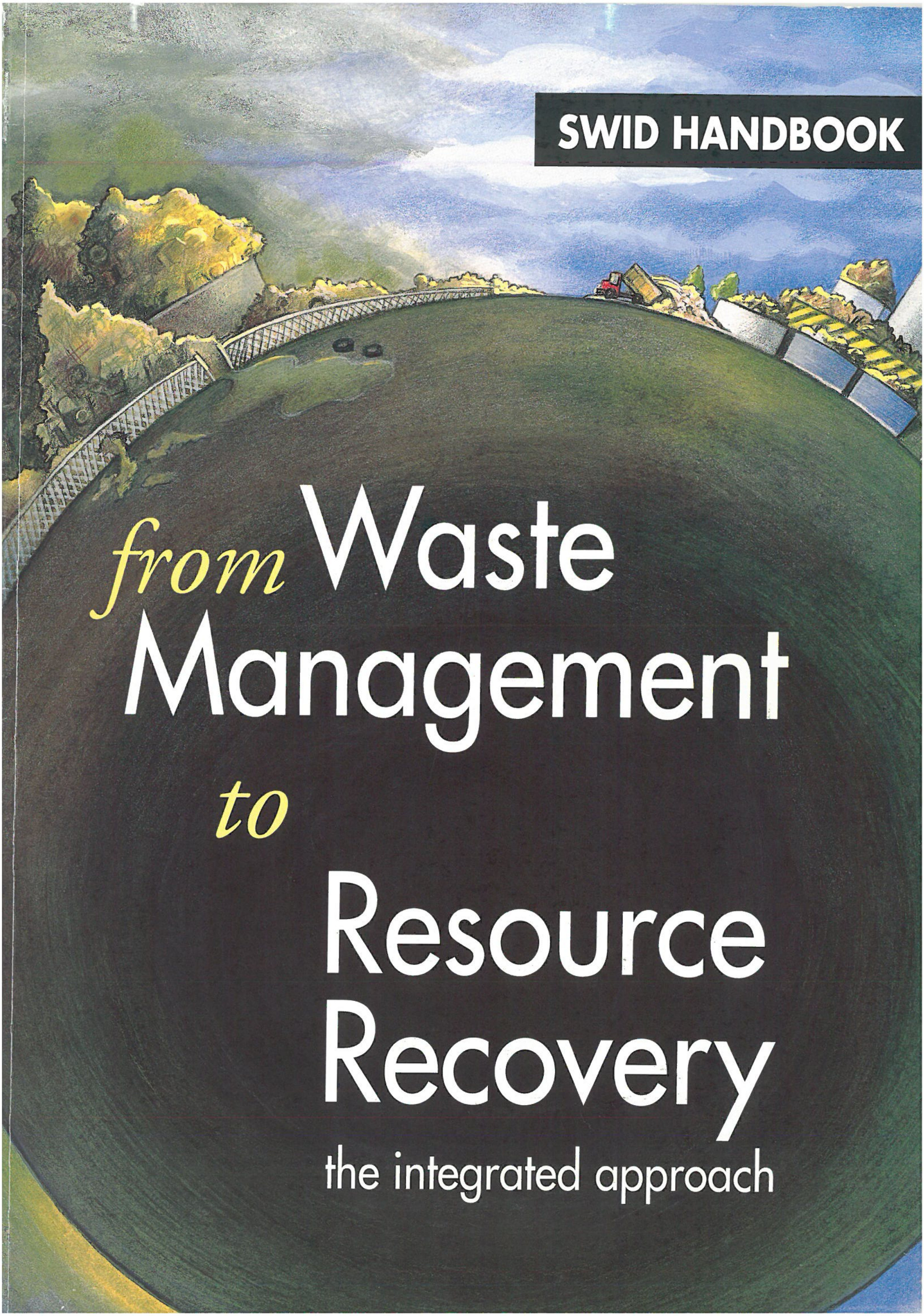

SWID HANDBOOK

from Waste Management *to* Resource Recovery

the integrated approach

SWID Handbook

Solid Waste Infrastructure Development Group of the Grocery Manufacturers of Australia

From Waste Management to Resource Recovery

The Integrated Approach

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Introduction

HOW THIS HANDBOOK CAME TO BE WRITTEN

This handbook has been produced by the Solid Waste Infrastructure Development (SWID) group of the Grocery Manufacturers of Australia as a contribution toward the development of a more effective solid waste management infrastructure in Australia.

The SWID group comprises 11 leading companies in the grocery manufacturing and convenience food industries under the auspices of the GMA environment committee.

SWID members are committed to helping to ensure that integrated, environmentally and economically sound solutions are found to deal with Australia's municipal solid waste, and are committed to working with local, state and federal governments to achieve a more sustainable and efficient solid waste infrastructure.

The first major initiative of the SWID group was to host a consensus conference on solid waste in Sydney in May 1994. The objective was to reach agreement among a broad assembly of interest groups and experts on the underlying issues and first principles which will shape the development of an environmentally and economically sustainable municipal solid waste infrastructure.

Discussion papers prepared by nine contributors, each an authority on a particular subject, were circulated in advance to allow delegates time to prepare for the day and to ensure that all available time was devoted to constructive discussion.

The conference was attended by the nine contributors and a peer review group of 15 people, and co-chaired by Dr Ron Sampson, of Procter & Gamble, and Professor David Russell, of the University of Western Sydney.

This handbook is based on the original papers prepared for the conference, the lively discussion and debate which occurred on the day, and the consensus points and minority opinions which were identified at its end.

This book looks towards a future waste management infrastructure which functions far more effectively and efficiently than our present systems. It is not a rigid blueprint, but instead sets out the principles which should govern the future development of a new solid waste infrastructure. These are, however, first principles in that if they are ignored or altered, the economic and environmental outcomes will also change dramatically.

The SWID group does not believe there is any one "correct" system to manage the waste stream, or that any single waste-management technology can be judged superior to another without taking the specific application and local conditions into account. In fact, far from narrowing the choices for the direction of waste management, we hope this handbook will expand them by focusing on the underlying principles and objectives rather than processes and technologies.

Australia is in a unique position to develop lasting and sustainable strategies that build on the rich legacy of experimentation from overseas. In the past 50 years or so, many management systems, technologies and government policy initiatives have been tried, and these are a valuable resource to be studied and learnt from.

This handbook sets out to identify and explore the issues inherent in achieving the nationally adopted target of a 50 per cent reduction of wastes to landfill, so that in 2001 we have established lasting, sustainable and cost-effective infrastructure. Australia could be the example of international best practice in these matters, with all the environmental and economic benefits that would flow from that status.

With the research that went into this handbook came the realisation that no significant technological, economic or social impediments are blocking the possible solutions to today's problems. The greatest impediment is a lack of focus by the parties involved—focus on what can and should be achieved, focus on which party is properly capable and responsible for the various functions, and focus on how to take the early initiatives. This handbook, having thoroughly explored the basic issues, aims to better define the appropriate roles for the main parties involved.

Though designated as a handbook, only sections of Chapter 9 attempt to prescribe "how to" information. The rest of the book sets out to describe, analyse and argue the range of fundamental issues and options that developed the logic behind the final methodology. The user, implementor or the community at large can then feel more comfortable with the outcomes, being fully conversant with the background and rationale.

The handbook has been designed to be of primary use and benefit to any organisation or individual in a position to make decisions that will affect how much and what type of wastes are produced, the integrated development and operation of the infrastructure available to handle these materials, and the regulatory framework that over-arches the entire sector.

The handbook is researched and presented to advance the interests of the community, not to advance the interests of any particular group or sector. The government and industry sectors with an exposure to the issues naturally have a perspective coloured by their own expertise or sphere of influence. However, the community should eventually be able to make informed consumer choices about the level of service, the net costs and the economic, environmental and social results of the waste-handling infrastructure of the future.

We would like to offer our sincere thanks to those who prepared papers and to the peer review group for their time, interest and participation in this project.

CO-CHAIRPERSONS

Dr Ron Sampson, Chairman of the SWID Group, Procter & Gamble
Professor David Russell, Department of Social Ecology, University of Western Sydney

PAPERS

The Composting of Municipal Solid Wastes
CSIRO Soils Division — Kevin Handreck

Composting Green Waste — The Disease & Liability Perspective
Debco P/L — David Nicholls & Chris Drysdale

Waste to Energy
Waverley Woollahra Process Plant — Colin Ferguson

The Changing Face of Landfill
AGC Woodward Clyde P/L — Stephen Hancock

The Challenge Facing Local Government
Penrith City Council — Peter Rimmer

You Can't Do It Without The Rate Payers
University of Western Sydney — David Russell

A Model Regional Resource Recovery Strategy
CRC for Water & Waste Management — Ray Frost & Allen Moore

The Resource Recovery Business Approach
Boral Limited — Anthony Sive

The Staged Approach to Strategy Development
Eco Waste & Associates P/L — Mark Glover

PEER REVIEW GROUP

EFFEM Foods — Roger Bektash
WWF Worldwide Fund For Nature — David Butcher & Scott Lyle
Boral Resource Recovery Management — Brian Donahue
Kimberly-Clark — Peter Crowfoot
Waste Management Council of Victoria — Noel Denton,
Healey Management Group — Harry Healey
NSW EPA — Tim Hoffman (Roz Hall)
Clean Up Australia — Victoria Johnson
Plastic Industry Association of Australia — Helen Lewis
Ku-ring-gai Municipal Council — Murray McCafferty
Packaging Council of Australia — Jo Mitchell
Waste Management Association of Australia — Leanne Philpot & Bert van den Broek
CSR Waste Management & Resource Recovery — Bob Reid
EMU Environmental Marketing Unit — David Said
Resource Recovery and Recycling Council of Victoria — John Stanley

The conference was held in Sydney on May 3, 1994.

The Grocery Manufacturers of Australia (GMA) sponsors the development of this handbook as the representative body for a significant sector of Australian commercial activity. Grocery manufacturing is Australia's largest manufacturing enterprise, contributing more than 20 per cent of our national manufacturing turnover. As an industry, it employs about 180,000 people, pays out almost $5 billion a year in salaries and wages, and turns over some $40 billion annually.

Grocery manufacturers are in a unique position in the debate on solid waste management. They specialise in responding to community demands for products and services—designing, manufacturing and marketing products in a competitive commercial environment.

This means that they can make fundamental decisions about the life-cycle design of their products: what the real demand or need is; how and where to source the raw materials and ingredients; the choice of manufacturing method and therefore the likely impact of production and the resultant waste streams; how to package, transport and distribute the finished products; and to consider and plan for the consumer use and disposal of the products and services.

The problem is that, given the waste management and resource recovery infrastructure in Australia, it is hard to determine whether products should be designed to be recycled, reused, reprocessed, composted or landfilled. Should they be durable, biodegradable or burnable (to recover energy)?

Designing products, services and packaging to accommodate any of these post-consumer processes is technologically possible. Most of the costs of changing the products and packaging may not be prohibitive. The issue in Australia is that most solid wastes are still destined for landfill. The essential infrastructure to plan for efficient and sustainable alternative higher-value use is still in its infancy.

Designing products and packages for a post-consumer fate that is unlikely to occur—and thereby adding unnecessary increases into the costs of production—is not a sensible option.

The GMA has well defined environmental principles which all its members support. These include the recognition of environmental management as an integral component of corporate management, and the development of industry-wide policies and programs which encourage sound environmental management practices.

The issue for the grocery industry is that although it is not directly involved in the solid waste industry, where the public debate is occurring, it *can, must* and *does* have a significant influence over the outcomes and solutions through its commercial and operational relationships with all levels of government; primary producers; material converters; the packaging industry; transport, distribution and wholesale; the retail industry—and with the community as a whole as customers with needs.

From this position, the Solid Waste Infrastructure Development group of companies within the GMA sees considerable advantage in sponsoring the production of this handbook to set out the main issues and first principles that must determine the rate and cost of the move from the waste management practices of the past to the resource recovery infrastructure of the future. We owe it to our customers to ensure that cost effective solutions are implemented.

Executive Summary

The community is genuinely and justifiably demanding improvement in waste management practices. This demand is reflected in the nationally adopted "halve the waste by the year 2000" target, but it also influences many other areas of commercial and public authority decision making.

As the same community will have to pay for whatever system is implemented as taxpayers, ratepayers or consumers, there is a justifiable expectation of efficiency and accountability in the solutions.

To make informed choices, the community must be kept informed of the options, issues and expected outcomes. Misunderstandings resulting from unreal expectations or solutions that are obviously simplistic must be avoided.

The achievement of the final objectives must be measured against performance in environmental sustainability, resource conservation and cost effectiveness.

Waste minimisation and the efficient recovery of value from the waste stream are vital to the future competitiveness and prosperity of Australia.

The grocery industry is committed to helping Australia develop environmentally and economically responsible solutions to the minimisation and management of solid wastes.

Current and future solid waste management infrastructure will directly impact on product and packaging design decisions and the likely fate of post-consumer packaging.

This handbook has been designed to be of primary use and benefit to any organisation or individual in a position to make decisions that will affect:

- how much and what type of wastes are produced;
- the integrated development and operation of the infrastructure available to handle these materials; and
- the regulatory framework that over-arches the entire sector.

Existing systems have developed piecemeal. The familiar "collect and dispose" schemes we have today grew from the "out of sight, out of mind" infrastructure of the past. Modern recycling is essentially an extension of the traditional "rag and bone" industry with the formalisation of kerbside collection and drop-off schemes for selected materials. But the "rag and bone" man of the past picked up or bought only what he knew he could sell or use at a profit. Have we forgotten or ignored this commercial imperative and simply pursued social and political objectives in isolation?

The concept of a new, streamlined waste management infrastructure designed to go directly towards the destination of more efficient resource recovery and more effective waste management can be compared to an expressway which replaces an existing trunk road.

The existing road certainly gets from A to B, but it is not necessarily the most direct route. Over the years, the road is upgraded and overhauled. A new bridge here. An overtaking lane there. Eventually, however, it is realised that patching and improving can only go so far, and the only way to upgrade the route is to survey and build a new expressway. Of course, this expressway also goes from A to B, just like the old road did. It is made from similar materials and still carries both local and long distance traffic, but it gets you there a lot more efficiently and safely.

Similarly, we believe the conceptual framework outlined in this document will get us towards the real objectives of the National Waste Management and Recycling Strategy more efficiently than the well travelled road we have been patching and improving for the past decades.

Modern collection and disposal systems face few technological or economic constraints in delivering the immediate environmental results the community demands. However, the adoption of widespread, integrated and market-driven resource recovery infrastructure could:

- reduce volumes for treatment and disposal;
- lessen the toxicity or reactivity of materials to be disposed of;
- conserve resources, especially non-renewable ones; and,
- if market driven, produce net receipts to offset the costs of the basic service of environmental protection.

The "half by 2000" target has done an excellent job of concentrating the community's mind on the problems of solid waste and invigorated the search for answers, but it is vital to be much more specific and focused to maintain the momentum toward genuine and lasting solutions.

The choice for Australia is simple and challenging:

- continue with approaches driven by regulation and technologies, or
- develop "best practice", market-driven waste management approaches which could provide the dual benefits of competitive advantage and peace of mind.

The "best practice" approach means that industry, government and the community must recognise the following principles of sound waste management:

Waste minimisation

. . . the avoidance of producing waste in the first place.

This is primarily an industry responsibility. It has been enthusiastically embraced because avoiding waste production almost always reduces manufacturing costs and improves efficiencies. "Cleaner production" techniques are being applied to most manufacturing operations in the pursuit of "best practice", and a range of everyday products is now produced in a more environmentally friendly manner, utilising less resources in production and packaging.

Resource recovery

. . . includes re-use, recycling and reprocessing of wastes which have not been "minimised" and which can achieve a higher-value use than landfill disposal.

Such materials can be used in only one of two ways:

- competing with virgin supplies, or
- stimulating a new product or process that is possible only because the "wastes" exist as potential raw materials (fly ash to cement, abattoir waste to pet food or fertiliser, finger-jointed offcuts into new timbers).

In both cases, the recipient of the reclaimed materials will make a significant investment in plant and machinery to be able to use the materials properly.

This means that the main issue is to supply reclaimed resources to satisfy and sustain potential end users, concentrating on the vital issues of quality, quantity and price.

The viability of resource recovery hinges on this issue, which is why the "market driven" focus is given such prominence in this handbook.

Landfill disposal

. . . the inevitable last stage for all materials which have not been minimised or recovered.

Actively managed landfills can have several important roles including, in the short to medium term, the storage of materials and energy that may eventually find a higher value, and the active stabilisation of some putrescible or reactive materials. To assist these processes, "pretreatment" of wastes to hasten stability or lessen environmental risks can have considerable merit. Such pre-treatment by sorting, composting or incinerating can prove significantly more cost-effective in the long term than simply relying on containment engineering approaches. The cost of landfill must reflect the true cost of operating, post closure and replacement of the facilities.

Future directions

In establishing the integrated solid waste management systems and infrastructure of the future, it is important to remember that we are dealing with inherently low-value materials. If this value is less than the costs of recovery, there is unlikely to be demand. However, the more efficient the infrastructure and recovery systems, the larger the potential role for resource recovery overall.

The opportunity is now to address resource recovery from the entire waste stream and not individual materials, and to move from the "one solution fits all" approach to one that accepts and uses localised situations. This means a fundamental change in the role of local or regional government from operator/manager of waste services to the "accountable client" who sets the standards and administers the contracts. This will allow the increased investment necessary in the next generation of waste management infrastructure, probably by private enterprise.

Local government has made most of the running of these issues until now because the topic was a natural extension of its continuing public health responsibilities. Councils have developed most of the expertise so far, but solutions will now require all other branches of commerce to play their full and appropriate role. As this happens, local government will have to step back from some functions or areas of influence to allow the best party to do the job. Local government has been calling on "industry" to do more, especially in developing markets for recovered resources. As this starts to happen, tensions will grow as the new parties demonstrate genuine commitment and capability, and councils concentrate more on core business.

Of all the available technologies, systems and strategies for delivering integrated solid waste management infrastructure, the concept of siting, under common management, the primary resource-recovery and actively managed landfill facilities promises the most significant efficiency gains. Such "resource recovery parks" offer improved transport and planning efficiencies, combined with the potential for the optimum use of materials and eventual pretreatment of residues for landfill. To achieve the greatest synergy and efficiency it is essential that the facilities be grouped together rather than have disparate operations spread throughout the community.

Ownership and operation of such facilities should be in the hands of the party taking the marketing risk for the reclaimed resources—inevitably, private enterprise. This should not be a threat to the public sector any more than it is in other areas of public utility development.

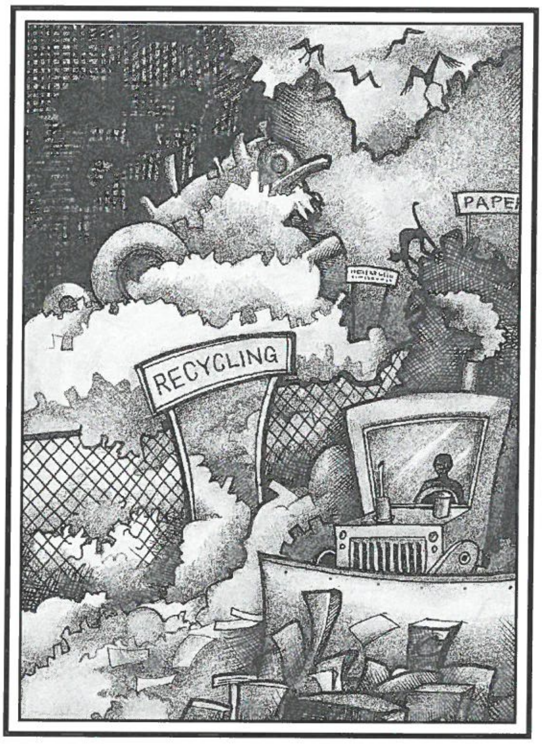
The emphasis must also be on multiple "trickle down" markets based on quality and price to avoid the dependence on single-industry "closed shop" markets that sustain current recycling activity. To achieve the greatest sustainable value, reclaimed resources must be freely tradeable as commodities rather than simply returned to the company that made them.

To move toward the goal of sustainable and integrated solid waste management infrastructure, the next steps are **not** new legislation or the advent of new technologies, or even the wholesale adoption of existing technology, but a willingness of the main parties involved to cooperate in an atmosphere of shared and common objectives, and for each party to acknowledge the areas of expertise and responsibility of the others.

This handbook has been produced to provide the basis for a common understanding of the issues and to identify the directions in which to look for solutions.

It offers realistic ways to establish a popular and viable infrastructure of waste management against which products can be designed so that every part of their life cycle is pre-planned.

To revisit the road building analogy, piecemeal road widening and bridge building must now give way to the construction of a purpose-built expressway.



The Problems, the Needs, the Issues

1. Key Issues in the Waste Management/ Resource Recovery Debate – An Overview

Now that the public demand for change and improvement in waste management is established, the debate is focusing on results. How we achieve these results—the processes and techniques—will reach into almost every area of commercial activity. It is therefore important to understand the fundamental concerns and issues, and especially the potential role for resource recovery as a key element of the most workable solutions.

1.1 What are the stimuli for change?

Australia's historical waste management infrastructure developed from an "out of sight, out of mind" approach. This was a logical response when the community's concerns were focused mainly on the public health issues associated with waste, especially putrescible waste.

In practical terms, what is wrong with the range of activities that occur now? Two main factors must be considered:

Rising costs—Improved collection services and waste management practices have gradually increased the costs to the community. These costs are expected to rise further as landfill operational procedures are tightened to meet new standards in environmental protection.

Increased public demand for lower environmental impacts—Because Australians have a high degree of concern for environmental issues there is on-going public pressure to reduce wastes and their environmental impact and to consume fewer resources. Recovery of materials from the waste stream and diversion of wastes from landfill are social and political issues as well as being a waste management challenge.

These issues should probably be considered as stimuli for change and improvement. All can combine in one simple logic. If disposal facilities were to be so upgraded as to deliver all the apparent environment safeguards and re-establishment of local amenity to host communities, sooner or later the question must be asked: "If we have to spend all this money for waste disposal, which is inherently wasting resources, surely we can do better than just landfill the material?"

Any proposal for a lasting and sustainable solution to today's waste management issues must be evaluated against performance in two main areas:

- provision of environmental improvement and pollution control, and not just at the point of disposal; and
- provision of infrastructure for resource conservation or recovery.

A sustainable solution must achieve both of these objectives at the least possible cost.

1.2 Right priority, wrong target?

In 1991, the Commonwealth Government produced a public discussion paper defining a National Waste Minimisation and Recycling Strategy which was officially adopted in 1992 as part of the Ecologically Sustainable Development Program.

The primary objective of the national strategy was defined as waste minimisation, expressed as the need to avoid the production of waste at source. The avoidance of post-consumer waste was a secondary objective, with a heavy reliance on recycling.

Most people would agree that the priorities of the National Waste Minimisation and Recycling Strategy are sound. Creating less waste in the first place is a logical priority compared with the recovery and reuse of as much as possible from the waste stream after it has been created.

In spite of this prioritisation, however, the outcome of the strategy was not defined in terms of waste minimisation. Instead, it was defined as a reduction of 50 per cent in waste going to landfill by the year 2000, measured in weight per capita and based on 1990 levels.

Part of this difficulty may revolve around confused definitions of the term "waste minimisation" *(see Chapter 3)* but it also reflects a popularly held perception that landfill itself is the problem.

The "half by 2000" target, has focused the nation's attention on waste issues, especially since it has been adopted by all the states, but to the analyst, the target raises far more questions than it answers. How to achieve it? What is so wrong with landfill that it is cited as the alternative to be avoided? And what will we be left with in 2001?

To be fair, the "half by 2000" target was chosen more as a rallying cry than a literal objective. Fifty per cent was seen as achievable, 80 per cent was not, and 30 per cent was not enough. The target galvanised effort and encouraged improvement and there is still a view that any improvement is better than none. However, the target now must be revisited and redefined. Some people, cynical of the arbitrariness of the target, have no intention of striving for it; others will achieve it by any means possible, but without a thought for the sustainability or appropriateness of their methods.

Chapter 5 concludes that landfill is not necessarily the ogre that the "half by 2000" target suggests. In fact, appropriately operated with the latest active management techniques, landfill should serve an essential function in any strategy. Despite political agitation for significant improvements in landfill management and greater resource recovery, only material which can reliably find higher-value use or markets—be that 20 per cent or 90 per cent—will be sustainably diverted. The eventual figure will be a product of systematically addressing the fundamentals for genuine and lasting solutions. To implement the "half by 2000" target disregarding the economic and environmental fundamentals must mean either a considerable extra cost to the community or a slide back to the status quo from 2001 onward.

So what are the key issues that must be addressed and accommodated?

1.3 The essence of the issue

At its most concise, this issue becomes "what does not go to landfill must go somewhere else" and the "somewhere else" can be only one of two options:

- the recovered materials (or energy) can compete with or replace virgin resources, or
- they can be used to produce a new product or service that is possible only because of the particular recovered materials that are available (e.g., finger-jointed timber from off-cuts, pet food or fertiliser from abattoir waste, or cement from power station fly ash).

In both of these options, the party using the reclaimed materials will have to make significant investment in the specialist equipment or processes to efficiently accept the reclaimed resources as feedstock materials. Examples include a de-inking plant to accept used paper; a de-tinning plant to accept steel cans; washing, sorting and granulating plant for plastics; and a compost plant to make quality products from organic wastes. Cement manufacturers have made significant commitment to fly ash handling equipment, and finger-jointing timber off-cuts to make "as new" timber requires major capital expenditure.

To be a reliable user or "market" for reclaimed resources (which is the level of certainty that local councils are looking for), the user must commit to significant capital expenditure. This commitment can therefore occur only where the supply of recovered resource, as feedstock, will be totally reliable. This reliability is essential not only to service the operation but because alternative feedstock supplies will have been given up in the commitment to the recovered resource. For example, a paper manufacturer who commits to accepting significant volumes of used paper to satisfy new product demand will simultaneously lessen dependence on new plantation stocks. Plantations can take 30 years to mature, so any unscheduled shortage in used paper feedstock, once committed to this alternative, can be devastating for the paper producer. Similar situations occur in the glass, metals and energy sectors.

The corollary to this is that for reliable "markets" or uses to develop as the ultimate alternative to materials being landfilled, a symbiosis must develop between the user and the supplier. As with any other branch of industry or enterprise, the supplier (of reclaimed resources) must provide the market with feedstock of reliable quality, in sufficient quantity and at a price that underpins the enterprise's viability for both parties.

1.4 Resource recovery must be market focussed

There is still a view in local government that the only problem with current recycling activities is that industry "will not pay a realistic price to get their materials back". In Chapter 6, the market realities for recovered resources in general and recycling in particular are discussed in greater depth. The conclusion is that viable resource recovery must focus attention on the demand of the market. Viable recycling is a process that includes the collection, sorting and reuse into new products that can sustain their market position, and so it must be for all materials that have not been "minimised" and are to find higher-value uses than landfill.

This fundamental is the cornerstone of the move from waste management to resource recovery. Where materials have no higher value or available outlet, they can be safely landfilled without polluting or losing the materials (or energy) forever. However, where materials are to be recovered for subsequent uses, the development of the processes and infrastructure must first focus on the requirements of the market or user, secondly on the processes to produce the reliability of supply to that market, and thirdly on appropriate collection methods to source the wastes to complement reclamation.

There is an argument that councils are generally adopting collection methods compatible with, or even suggested by, the likely end markets currently available, but this is more a product of the limited choices available than a reflection of the potential shape of future strategies and infrastructure.

In a market-focused resource recovery infrastructure, a greater proportion of the available market value is likely to be spent on the processing and beneficiation of the materials to ensure greatest market certainty, with less emphasis placed on the purity at collection. Our current system places the primary responsibility for product quality on the collection system alone, which can be the most expensive function if over-capitalised. In most metropolitan areas, the community is provided with every shape, type and colour of containers and collection systems, but there are not many sustainable places to receive all the materials or any significant long-term market for the products.

1.5 A new solid waste infrastructure is urgently needed

For resource recovery to achieve its full potential to reduce waste, new solid waste infrastructure has to be designed backwards, from the market to the reprocessing systems and then to the collection.

With such reliable infrastructure in place, industry will be able to design for the known post-consumer fate of products and services, and will know whether to make products to be recycled, reused, reprocessed, composted or landfilled.

The achievement of this indirect benefit highlights the inevitability of changing roles for all concerned. Whilst local government must maintain control as politically accountable managers, the roles for all other industry sectors must be redefined and based on their respective skills and capabilities. This must see a much greater operational and marketing role for private enterprise.

This need not be threatening for local government but should be implemented as a welcome relief to councils to have some focus and support to supplement their core business: to service the ratepayers and be politically accountable for their requirements.

As the new infrastructure develops and the various parties assume their new roles, it will be important to see that this combination of talents addresses the fundamentals of the task: to develop new, effective and sustainable waste management/resource recovery infrastructure, delivered at the least possible cost to the community.

Developing a national agenda from the ground up, based on these fundamentals, will achieve the greatest sustainable diversion of materials from landfill (probably closer to 70 per cent than 50 per cent) and, after 2000, the infrastructure will still be valid, appropriate and unsubsidised to sustain long-term development.

2. The Community's Determining Role in Future Developments

To what degree is municipal solid waste management and its infrastructure shaped by the expectations and attitudes of its "customers", the millions of households who want change and improvement on past practices, who will ultimately be affected by, and pay for, the improvements and who will be directly influenced by the siting of new facilities? There is little doubt that broad community support must be maintained as changes are planned and implemented.

2.1 The demand for change

Each year, more than 14 million tonnes of domestic, commercial and industrial solid wastes are disposed of in Australia's landfills. Wastes collected by councils make up almost half this total.

The basic waste management industry is worth $1.3 to $1.5 billion a year, and waste collection and disposal usually account for 25-33 per cent of local councils' budgets and management effort.

If this considerable industry is to undergo major change, with a potential increase in capitalisation and cost to the community, it is important to understand who is asking for the change and analyse what changes are required to satisfy the demand.

Empirical evidence for the community's demand for change is hard to gather. However, if we assume that in a democracy the community's aspirations will be reflected in government actions, then "half by 2000" is the focus of a broader public discussion. A reflection of the need for resource conservation, environmental improvements and the general need to adopt sustainable life styles which will not leave the world a more denuded and threatened place with the passing of each generation.

At least three factors are at work: public opinion, government regulation and economics. Of these, public opinion can be the most important as it will often stimulate changes in regulation and economics. To fix a starting point against which to measure results, let us assume that as waste facilities in general, and landfills in particular, are perceived (usually accurately) to be unsightly, noisy and smelly, no community seems to want them next door, degrading the local amenity and threatening property values. Therefore, the community should also consider it unreasonable to send its own wastes somewhere else.

This reinforces the fact that the "out of sight, out of mind" era of waste management has ended. The "half by 2000" rallying call can then be interpreted as a demand from the community for the problem of solid waste to be fixed once and for all. Whichever way we view it, the task must be to produce sustainable environmental improvements.

The immediate, apparent solutions have to be evaluated against all consequences to ensure that tangible benefits accrue and that the problems are not merely transferred to some other place or to future generations.

Evidence of the community's general push for change can be found in one of the few areas where people can make a direct contribution—kerbside recycling.

Social researcher and commentator Hugh McKay has compared participation in kerbside recycling to attending church—so widespread that it has become a personal virtue rather than being just a resource recovery technique.

This not only indicates community support for change but also points to the more complex issue of fully informing and involving the community in evaluating and implementing options. However, to try to summarise the actual community demand for improvements, we must accept that the "half by 2000" target is the expressed manifestation of the broader public debate for a cleaner environment and a sustainable future. Though not directly stated, this must mean solving the various forms of pollution inherent in the current system and conserving resources at the least possible cost.

2.2 The need for the community to be fully informed

The costs of waste management are set to rise at rates far greater than the CPI, whatever approach is eventually adopted.

The option to continue to landfill much as at present will attract significantly higher charges as more distant sites are developed, which will reflect more rigorous regulation and greater transport distances. Also, the establishment and operational costs will be increased to deliver the improved environmental outcomes. The costs of restoring landfill sites after they are closed will also have to be worked out. Efficient recycling, reuse and reprocessing options are likely to have an overall net cost to the community similar to the landfill costs. These increased costs will have to be paid for by the same community that established the need for change in the first place, either in municipal rates, state or federal taxes or in the costs of goods or services.

If an increased cost is involved, the community should be fully informed of the options and benefits so that, as with any branch of commerce, they can make informed choices.

An informed and involved public has another advantage: speeding up the acceptance of siting decisions for new facilities. If decision-making processes were genuinely transparent, the proposed solutions should benefit from a broader input of ideas from a fully informed community about the logic inherent in the proposals. They can feel satisfied that they understand the issues and have had every chance to contribute to the solutions.

2.3 Environmental citizenship in Australia

Australia's grass-roots environmental movement began as an interest in nature and conservation earlier this century, experienced a rebirth during the 1970s because of concerns for environmental degradation caused by pesticides and reached a peak at the time of the Franklin Dam issue in 1983.

Australians have a high interest in environmental issues, and about two thirds of them believe that the environment is the most important long-term problem facing the country. However, waste is not the most important consumer environmental issue—clean air, clean water and chemical pollution are consistently ranked as being of greater priority.

But waste is the one environmental issue which every citizen can get involved in as a kerbside recycler, ratepayer or consumer.

Waste management engineers and administrators sometimes find it difficult accept or deal with public attitudes which are often a mixture of facts, misinformation and emotion.

Garbage, for example, is an unpleasant and low-interest issue. Waste, on the other hand, is a political and emotional issue. The very word "waste" is negative, implying unnecessary squandering of resources rather than the unemotional definition of an unwanted residue at the end of a process.

Landfill, too, has become a negative concept. It has been designated the villain of waste management through wide publicity of the target of reducing waste disposed of to landfill by 50 per cent by 2000, and people have been warned over and over that Australia is running out of landfill space and that we must divert waste from it.

In fact, there need not be any real landfill shortage, and properly managed landfill is a valid and beneficial process (Chapter 5). But if the public accepts the warnings as true, they will influence the waste management debate just as if they were true.

This is a reality which waste infrastructure planners can try to alter (through education and information) but not ignore.

2.4 The kerbside revolution

Local council recycling services were initiated in response to demands of local residents' pressure groups. Recycling has become a mainstream behaviour and the vast majority of local authorities in Australia offer regular weekly or fortnightly kerbside collection services.

The appeal of recycling is not hard to understand. Most of us are brought up to regard wastefulness as wicked and imprudent, and the idea of saving something from being wasted has appeal.

The motivation for the popularity of recycling has also been explained by the fact that separating and putting out recyclables is one of the few ways in which individuals feel empowered to do something positive and practical for the environment.

This is important because while advertising and educational material routinely stresses the need to minimise waste at source by rejecting over-packaging and other means, the reality is that ordinary Australians have little control of the minimisation process beyond a limited range of purchase decisions—refill packs instead of original packs for cleaners and detergents, for example.

There is also considerable peer group pressure to recycle in some areas, although participation in kerbside collection schemes is not as widespread as it might seem.

Several councils have participation rates in excess of 95 per cent, but the average in some urban areas is less than 60 per cent. In Sydney, the data suggest that more affluent suburbs recycle at a higher rate than less affluent suburbs, which correlates with the findings of most social surveys that environmental concern increases as people rise up the educational and income scale.

Public enthusiasm for kerbside recycling does not correlate to a high level of understanding of the realities of waste management. In a recent survey in NSW, for example, respondents were asked if they thought most recycling schemes in Australia ran at a profit. Thirty four per cent said (correctly) that they did not, 19.5 per cent thought that they were profitable and 46.6 per cent were not sure.

2.5 Public opinion and infrastructure siting

Much of the future solid waste infrastructure of Australia will require new facilities in new locations and expanded facilities in current locations.

In the Sydney region, for example, traditional landfills are rapidly running out of space, and new sites will have to be developed. Even in other states, where the shortage of landfill sites is not as acute, provisions may have to be made for regional transfer stations, new sorting facilities, composting sites, waste-to-energy incinerators and other technologies.

Waste management planners often refer to public objections to the siting of facilities dismissively as the "NIMBY" or "not in my back yard" syndrome.

The fact remains, however, that the fears and concerns of the local population are real to them and often justified, at least in terms of added traffic and loss of amenity in the surrounding area, and local government planners have developed considerable skills in addressing such issues.

Community opposition to the establishment of any type of waste management facility can usually be expected in any but the most remote of areas, although opposition may be reduced if the facility is established in a large industrial park or as an extension of an existing facility.

The major fear of most householders seems to be that the value of their property will be affected by health fears, loss of visual amenity, noise, increased traffic, smells or simply by the odium of living "on top of" a waste facility.

Moreover, objection to the siting of waste facilities rarely remains within the host community. The dispute will almost invariably widen to include green pressure groups objecting in principle, other government departments and suppliers of competitive technologies.

For example, discussion surrounding the proposed Waverley-Woollahra waste-to-energy incinerator in Sydney expanded beyond a negotiation between these two councils and the residents in the Waterloo area (the site of the existing incinerator which was to be replaced). The discussion grew to include a widespread and acrimonious debate led by green organisations opposed to incineration on principle against the host council for the facility on behalf of the most directly affected residents. As a result, media focus on the issue sharpened, and resistance to the project has become firmly entrenched.

Increasingly, if a significant section of the community is vehemently opposed to a particular development, the cost escalates because of delays and legal fees, or the project may even be cancelled, as in 1991, when the NSW Government was forced to abandon its plans for a new "mega tip" in the Londonderry area.

It is therefore advisable to use an established community consultation process to ensure that the NIMBY syndrome is tempered during the early planning period.

2.6 The challenge of genuinely involving the public

The community demanding change in waste management will eventually pay for any changes and will be directly involved in the siting of new facilities. There is therefore a strong need to involve the public in decision making. If this is done, more ideas should be provided to improve the overall project and, more importantly, the project should be much less expensive when not vehemently opposed.

The first principle of community consultation is that control of decision making should be shared, not token or one-sided. This approach is diametrically opposite to the more traditional DAD (decide, announce, defend) approach which the public resists.

"Information programs" which offer scientific data in defence of a decision to site waste-disposal facilities are seldom effective in reassuring people who fear the consequences of the siting.

Community consultation should also be clearly distinguished from "communications programs" which aim information at a community audience in the form of public relations, media releases, advertising and brochures.

This is a one-way form of communication, whereas community consultation is two-way, with the overall goal of reaching better decisions supported by the public.

Community consultation also goes beyond merely listening to points of view. It should embrace the concept of shared decision making which legitimises the outcome.

People usually want to concentrate more on due process than on intellectual exercises such as a scientific comparison of risk. Thus, what makes a decision "legitimate" is not only its substance but also the perception that the process by which it was reached was fair, open to negotiation and based on the best available data. It is also important to involve all the "publics" in the process, including community groups, green organisations, government bodies and the local authority.

It is important to identify the equity or fairness of the proposal to the host community. If the community accepts the risks of a waste management facility in its area, there should be compensating benefits. As part of the process, a common database should be created through which all parties have equal access to relevant economic and environmental data. Restricting access to some of the data creates mistrust and promotes adversarial positions.

Public participation begins with agreement on the preferred and planned-for results. Discussion then moves through the range of siting and technological possibilities, the cost-benefit implications of the various options and, eventually, to an objective assessment of the best environmental results of each scenario posed.

It should be stressed that proponents of a particular facility, who have the responsibility for its planning, financing and implementation, share but do not lose control of the process through community consultation. It is essential that the public voice is heard before the decision is made (as opposed to the DAD approach) so that the public has a chance to influence the decision from beginning to end

Not every public participation program will result in a consensus. However if some groups do not like the final decision, the fact that the decision-making process was open to all relevant information, visible and fair, makes it legitimate in the eyes of the public.

Finally, through negotiation, strategies can be developed to overcome community apprehension and mistrust. For example, doubts over the implementation of safety standards could be allayed by having one or more residents on the board of management of the facility.

Effective community consultation could provide the key to the successful location and management of the solid waste infrastructure of the future because participation in decision making gives residents a sense of ownership of the decision, so that, even if they do not fully agree with it, they will largely support it and want to see it work.

One objective of this handbook is to present most of the generic issues in waste management so that the public can understand them and take part in future decision making.

3. Waste Minimisation: A Priority Industry Accepts

The National Waste Minimisation and Recycling Strategy states that waste minimisation, or reduction of waste at source, is the first priority. This area of waste management is the major responsibility of industry, because manufacturers control where the raw materials come from, the manufacturing process and the packaging of the finished product. Cleaner production and life-cycle design of products and packaging are the key elements of waste minimisation.

3.1 Introduction

In 1.3, "waste minimisation" was defined as the "avoidance of producing waste in the first place" rather than the more widely used "avoidance of wastes requiring landfill" which is easily confused with separate issues such as "reuse", "recycling" and "reprocessing", each of which has its own role, function and position in a strategy and requires different skills to implement.

Therefore, waste minimisation must remain primarily the responsibility of industry—the producer and packager of groceries, foodstuffs, white goods and furniture or even building materials. The consumer, having bought the materials can only return, reuse, recycle, reprocess, or dispose of them.

The only obvious exception is garden waste, where the private resident assumes the industry role—and industry will have to adopt the thought processes of the home gardener to balance the desirability of its products and services against the effect of the waste streams on the environment. Home gardeners, while planning, planting and managing their gardens, balance their aesthetic objectives of seasonal flowering sequences, practicality and the overall pleasure they get against the potential effects on the communal waste system. A home composter recycles waste in much the same way as, say, an extrusion moulder regrinds moulding offcuts or a softwood mill uses bark and trimmings.

Such closed loop, internal recycling options can be considered as legitimate parts of a manufacturer's overall waste minimisation strategy. Waste management and/or resource recovery come into play only when the products or wastes impinge on the wider community.

3.2 Industry's impact on the solid waste infrastructure

Waste minimisation through cleaner production includes not only less solid waste but also reduced energy use, reduced atmospheric emissions, reduction and recovery of liquid wastes and reuse of waste water.

In terms of solid wastes, many manufacturing decisions, including the selection of raw materials and their processing and packaging, affect the waste stream. The extent of this impact can be reduced by careful planning of the production process and detailed attention to the full life-cycle design of the product or service.

Manufacturers have a responsibility to the community to minimise the environmental impact of their operations. However, it is equally important to appreciate that to run a successful business, environmental obligations must be balanced with responsibility to shareholders to make a profit and the need to produce a quality product which meets the needs of the consumer.

Industry's solid wastes can be created during production (trade and industrial wastes) and when consumers dispose of its products (post-consumer wastes).

Industrial trade wastes equal a net loss of income to the manufacturer because they represent a loss of raw materials and often have a high disposal cost, particularly hazardous and intractable wastes.

An important objective of cleaner and more efficient production is to be 100 per cent waste-free. This goal is fast becoming a reality in Australian factories through a combination of more careful raw material selection, a review of production and operational practices, and internal reprocessing. For example, some members of the GMA have reduced factory waste by as much as 95 per cent in modern plants. Industrial trade wastes are reduced by more efficient sourcing of raw materials (less waste production), reduction of product spoilage through quality control, and the creation of markets for post-industrial waste products.

Most industrial solid waste is collected by private contractors and, although a proportion will be disposed of to municipal landfills, some is removed from the municipal waste stream through recycling of trade wastes ex-factory (paper offcuts, scrap metals, pallets) or separation of hazardous wastes for special treatment.

3.3 Packaging's contribution to the waste stream

Packaging in Australia accounts for less than one tenth of the total municipal waste stream by volume and around one third of household waste.

According to Recycle NSW, the composition of the packaging component of total domestic waste is: paper 15.7 per cent, glass 7.4 per cent, steel 1.8 per cent, PET 0.5 per cent and other plastic rigid containers 1.4 per cent, plastic bags and film 0.8 per cent, LPB cartons 0.4 per cent, and aluminium cans 0.2 per cent.

Not all this packaging is produced in Australia. Much of it is from imported products and must be dealt with as part of the Australian waste stream. For example, as much as a third of all plastic in the waste stream could be imported. However, Australia is also an exporter of manufactured packaged goods, especially foodstuffs and these items will in turn affect the waste streams of the importing countries.

3.4 Packaging reduces waste and waste production

The primary role of packaging is to keep food and other products clean, safe and saleable. Thus, packaging is a waste avoidance exercise in its own right, preventing spillage and spoilage of the item which is packaged.

This waste avoidance function is strongly supported by an analysis of the waste streams of developed and undeveloped countries.

"Garbage archaeologist" Dr William Rathje compared garbage generated by households in Mexico City and in the US. He found that Mexicans use less packaging but produce 40 per cent more waste. In fact, the volume of food waste was 300 per cent higher in Mexico than in the US, creating a far more significant municipal waste disposal problem.

Nostalgia for the "good old days" of the corner grocery, where food was measured out from bulk containers, is misplaced. Disadvantages often forgotten include rodent and insect infestations which could be a health risk, spoilage through handling, spillage, moisture or exposure to air, and the labour-intensive nature of filling and weighing.

3.5 Non-environmental factors affecting packaging design

To stay in business, manufacturers must meet consumer demand—and convenience is an important need of today's consumers. The convenience of a pre-measured, safely sealed, easily transportable, "tamper proof" and often long-life packaged product is obvious.

Moreover, the nature of grocery products themselves has changed over the years. Staples such a flour, rice and salt are now a less important part of the grocery market, but processed and convenience products are growing.

Sometimes the package itself is an indispensable part of the product, as with microwaveable meals, canned foods or long-life UHT milk.

Two important roles for packaging are often overlooked:

- The pack identifies the brand of the produce. As many consumers shop by brand, this is an important need.

- Packages act as "silent sellers" in a self-service supermarket environment, not just saying "Hey, look at me", but also conveying quality and appetite appeal, instructions for use, ingredients and other information, much of it mandatory.

These branding, selling and informational roles for packaging are just as important to the manufacturer and the customer as the functional efficiency of the package and its ultimate disposal and environmental impact.

They are legitimate business concerns, and it should be accepted that packaging design and specification is a complex and extremely important business decision in which the environmental impact is only one part, although a significant one.

3.6 Use of recycled materials in packaging

Packaging can be a major end use for reclaimed materials.

Almost all corrugated board outers made in Australia and much of the card used for cartons is produced from recycled materials.

Almost all aluminium cans and glass bottles contain recycled material. Many PET bottles are either completely recycled (where food and other regulations allow) or incorporate recycled material using a tri-laminate construction.

Without manufacturers' support and readiness to use recycled material in packaging, there would be far fewer markets for recycled products. In closing these loops, industry performs a vital role.

Industry bears some of the cost of recycling by subsidising the collection and processing of recycled materials. The subsidies are generally considered necessary to promote the recycling of a particular container or materials initially, but the hope is that the increasingly efficient public reuse, recycling and reprocessing will eventually remove the need for them.

As all production costs, including packaging, must be reflected in the final retail price, there is a limit beyond which the additional cost of subsidising recycling, by creating post-consumer markets, cannot be passed on to the consumer. Consumers need to be much more fully informed of this limitation on manufacturers. Often, the costs of the community's demand for change and improvement in waste management/resource recovery is measured purely in terms of council collection costs and local tip gate fees. But if consumers are to make informed choices, they should be aware of issues such as the inclusion of cross-subsidy costs in the price of new products or items.

3.7 Waste disposal as a factor in packaging design

Manufacturers and packaging designers are, generally speaking, sensitive to environmental considerations. For example, they have been quick to seize the opportunities presented by lightweighting and new packaging materials such as tri-laminate polymers, liquid paperboard cartons and laminated pouch packs.

Designers and manufacturers also appreciate the need to control packaging costs and realise that consumers approve of environmentally friendly packaging—a powerful double incentive.

One of the major problems facing the designer of an environmentally appropriate package is uncertainty over its disposal.

The logical first questions for a designer to ask are: What will happen to the pack after use? Will it be recycled? Is there any point in making it of recyclable material if it will not be recycled? Should it be readily combustible for waste-to-energy conversion? Refillable? Compostable? Or low volume or biodegradable to minimise space occupied in landfill?

Considering Australia's solid waste infrastructure and the unreliability of post-recovery markets, it is most likely that the empty pack will end up in landfill.

If this is so, the new lightweight, compressible, laminated refill pouches might be the best environmental option for many products, as they occupy little space in landfill and are inert and stable the moment they are buried. However, this represents zero recovery of the energy and materials used in their manufacture.

3.8 The trend toward lightweighting

Manufacturers have a real incentive to minimise packaging because it is a significant percentage of the manufacturing cost of any item. Much effort is expended in developing packaging which will protect the contents and meet consumer expectations at the lightest weight and lowest possible cost.

Refill and concentrate packs are one logical outcome of this process and serve as an excellent example of the concept of "lightweighting", which is the use of less packaging material or a substitute packaging material to produce a package containing the same volume. The trend toward refill and concentrated packs for products such as household cleaners, laundry detergents and even instant coffee is growing steadily and will have a considerable effect on waste reduction. For example, a two-litre plastic bottle to hold dishwashing liquid weighs 165g; its concentrated refill is packed in a laminated pouch weighing 16g, a 90 per cent reduction.

Lightweighting can either result in a reduced amount of material per package, (for example, glass containers were lightweighted by a further 15 per cent between 1991-1995) or in the substitution of one material for another (for example, a 600ml glass milk bottle weighs 360g, while a liquid paper board carton weighs 20g.)

An example of the contribution lightweighting can make to waste minimisation is the fact that between 1986 and 1990, beverage consumption in the UK increased by 20 per cent but the volume of post-consumer waste from beverage containers was reduced by 13 per cent.

An irony is that lightweighting makes materials less suitable for recycling. Far more of a particular lightweighted item is needed to make the same commercial quantities as before. This means a higher collection, sorting and beneficiation cost for traditional recycling, reducing the attractiveness of recycling for a particular commodity. However, manufacturers are moving toward lightweighting because they can make an immediate and guaranteed impact on the waste stream and cut production costs at the same time.

3.9 Future developments in packaging

It seems likely that the trend toward lightweight, concentrate and refill packs will continue. These are non-traditional packaging forms (until recently, consumers were unfamiliar with the concept of buying a refill laundry detergent packed in a milk carton) and their successful introduction may encourage other manufacturers to consider material substitutions.

We may see measurable changes in the waste stream, with rigid plastic, glass and aluminium declining as they are replaced by plastic laminate pouches and cartons. This in turn could affect the intrinsic resource value of the waste stream.

New and potentially more benign packaging materials are being developed. For example, biodegradable starch-based polymers can be made into a wide range of film or moulded products.

Despite these promising developments, it should not be taken for granted that the total volume of packaging in the waste stream will decline significantly. Athough the weight and landfill volume of individual units of packaging are lower because of developments such as lightweighting, the total volume of packaging produced will be affected by economic conditions, market factors and the needs of consumers as well as by environmental concerns.

New forms of packaging will also be generated by changes in the lifestyle of consumers—for example, individual "grazing" as opposed to regular family meals and demands for new products and new levels of convenience and variety. However, this new packaging should be lighter in weight and more easy to dispose of or recycle. Certainly it should be designed to suit the post-consumer waste management/resource recovery facilities available in any given community.

3.10 Conclusion: A better waste management infrastructure will result in better packaging

The Australian grocery industry is an environmentally responsible industry and is committed to sound environmental management and waste minimisation as an integral part of corporate management.

Much progress has already been made in the minimisation of post-consumer packaging waste by the use of recycled materials, lightweighting of the original packaging material (glass, aluminium) and lightweighting through substitution (laminated pouches and cartons replacing glass, metal, and rigid plastics).

However, there may not be a direct correlation between waste reduction measures and the total volume of packaging in the waste stream. The packaging volume reflects economic conditions and the important and continuing role of packaging in modern society.

One of the most important factors inhibiting greater progress in packaging design is the lack of knowledge of how the package will ultimately be disposed of, because environmentally responsible packaging must be designed not only by using low-impact materials but also with ultimate disposal methods in mind.

Thus the development of a more efficient solid waste infrastructure is the best possible way to ensure more responsible packaging design.

4. The Changing Role of Local Government: The Challenge and the Opportunities

As the traditional providers of most waste management services to the community, the more than 800 local councils across Australia are at a crossroads. The level of service now required is beyond any one council to provide in its entirety; a move away from total control toward integration with other parties is inevitable. Yet for local government—the branch of government most directly involved and politically accountable—the move to shared responsibility is proving a considerable challenge.

4.1 Introduction

Each state in Australia has different operational groupings or organisations for councils or waste management in general.

For this chapter, the term local government or council refers to the primary operational service provider for waste management. This could mean a single council, a group or region of councils, or a state government agency that conducts services for and on behalf of councils as the primary customer. The broad fundamentals discussed hold true whatever the arrangement in each state.

Chapter 3 has established waste minimisation at the top of the hierarchy as the avoidance of producing wastes in the first place and as an industry responsibility. The issue for local government, therefore, begins where waste minimisation finishes: no waste management is needed for materials that have not been created. The focus for local government in waste minimisation is two-fold:

- as a waste producing "industry" in their own right, they must practise the principles of avoiding the production of wastes in all municipal operations, and
- as key players in the development of the waste management infrastructure of the future, they must ensure that incentives remain firmly in place to reinforce and support the efforts of "up-stream" waste minimisation.

For example, the provision of a cheap, copious and convenient waste collection service may have ensured a tidy environment, but there was little incentive for manufacturers to genuinely "minimise". Only when waste collection is a major community issue will consumers begin to demonstrate sustained purchase preference for the less "wasteful" products or services. This maintains the commercial pressure for change by industry and reinforces the other benefits of raw material conservation.

This throws up an early challenge for councils to reinforce waste minimisation by restricting their waste collection service, yet maintaining their public health responsibility to ensure that wastes are regularly and efficiently cleared.

Chapter 1 started to explore the issue that wastes which have not been minimised are destined for disposal to landfill unless they can be recovered for some higher-value use. Chapter 5 will establish that landfill management and operations are likely to be specialist functions undertaken on behalf of a region or group of councils by a third party. In Chapter 8, market-driven resource recovery is discussed as a specialist, regional operation, probably conducted by private enterprise. This will mean a major change for councils as they move, over a relatively short time, from being effectively sole service providers to team players. The acceptance of such changes and the management of the transition is the greatest single challenge facing the community in the overall move from waste management approaches of the past to the resource recovery infrastructure of the future.

4.2 Historical perspective

Traditionally, councils have always provided a waste collection and disposal service in the execution of their public health responsibilities. Originally, the services were of greatest public importance in the area of "night soil", food wastes and any other putrescible materials which could affect public health. Reticulation of the sewage system has gradually solved the "night soil" problems for most councils, but a regular garbage service for household solid wastes remains a primary function. This service accounts for 25-33 per cent of most councils' budgets and management time.

In the past, councils usually had their own "tip" and so had management, budgetary and environmental control of the whole operation.

For many shire councils this situation still exists, but in the main metropolitan centres the competing pressures for land use and the apparent benefits of regional coordination have often seen the introduction of state government authorities to oversee aspects of disposal. Metropolitan councils have had little difficulty adapting to a position where they delivered their communities' wastes to regional or state-run facilities when their own disposal options were exhausted. The next changes were in the collection area.

The period from the mid-70s to the mid-80s saw the transformation of waste collection to a largely mechanised process, mainly as a result of 55-litre and 70-litre garbage tins being replaced by 240-litre mobile garbage bins (MGBs) and the associated large compaction vehicles, with automated lifters which resolved the occupational health and safety situation of back and lower body injury to garbage workers.

Before this, garbage collection involved a midnight-to-dawn clatter, littered footpaths from animals interfering with the loosely contained waste, and small tipper-type trucks emptying at landfills dotted across the metropolitan area.

To convert from the old system to the new, garbage rates were increased significantly, and waste disposal tonnages generally increased by more than 150 per cent in summer coupled with increases in disposal fees. The immediate impact of the MGBs was total community acceptance and a decline in rubbish dumping. The community was noticeably tidier.

The next progression was the systematic introduction of recycling. During the mid- to late-80s, a wave of environmental consciousness swept across the councils. Residents wanted to do something for their environment and recycling seemed the most immediate and accessible solution. This led to the gradual formalisation of monthly services and drop off centres into weekly or bi-weekly collections and professionalisation of a former rag-and-bone industry. However, the services were introduced because they were demanded and not necessarily because they reduced overall costs.

Section 1.1 showed that resource conservation is one of the underlying stimuli for change. However, recycling was introduced as a service that involved the collection of easily separable materials which, it was perceived, should have a value to some subsequent user. Chapter 6 will discuss how recycling has operated in the past and how it should in the future, but of greatest interest in a historical context is to see how councils responded to community demand for recycling services rather than to operational improvement or efficiency generated by the introduction of this extra service.

As the most accessible point of political contact with the community, councils are the first to feel the need for change. This has been especially so in determining the level of service provided, the difficulty in siting new landfills and in assessing the community's willingness to pay for improved services.

4.3 Local government's expertise

Waste management/resource recovery, as an industry, is moving toward a point that will require the cooperation of several specialist parties. Progress will be a measure of how well the different parties cooperate and coordinate their activities.

As an example, it is interesting to look at the level of sophistication on the "supply side" of the waste issue. For goods, packaging, services and materials to reach the community as consumers, we have

- primary producers (mines, forests, agriculture),
- converters,
- industry/manufacturers,
- wholesalers,
- retailers

and, in between, any number of brokers, agents, transporters and niche operators.

All operate in areas of specific expertise and add value to the flow of goods and materials reaching the consumers. However, post consumer, all we have is a waste collection and transport industry, and a small but specialist scrap industry for certain items. Against this background, the community is demanding improved environmental results for disposal and resource recovery and until now local councils have almost single-handedly been trying to deliver the whole range of services.

Clearly this is not sustainable, and though specialist operators will emerge for most resource recovery functions and specialist environmental services, it is important to fully appreciate local government's unique skill and specialist expertise, which is to service the ratepayers and be politically accountable.

Until now, councils have led the movement for change and improvement in overall waste management services. They have tested, researched and implemented many different collection systems and regimes; regularly polled ratepayers' opinions and continually run campaigns to inform and educate ratepayers about issues and participation. In addition, councils are regularly in the forefront of new waste facility siting disputes on both sides of the arguments. Clearly, no other single party has the depth of experience in all aspects of waste management as local government. But our current infrastructure is not delivering the required levels of environmental protection, resource conservation and economic efficiency *(as outlined Chapter 1)*.

A change of direction is necessary. Local government has often called for industry to do more. But which branches of industry? And is local government prepared to become a team player?

In exploring how these outcomes can be achieved, it appears that all the other parties to the waste management debate must be encouraged to play their full and appropriate roles. These roles may be new, such as commodity traders for reclaimed resources or operators of the new style of integrated resource recovery facilities; but they may also include functions which have traditionally been undertaken by the public sector, such as the operators of actively managed landfills or collection contractors. Certainly, in the area of markets for recovered resources, a much healthier and more sustainable position will be achieved when secondary resources can be offered and freely traded to a wide range of users. This will contrast strongly with the current position, where there are effectively only one or two main users of reclaimed materials in each sector. These tend to be the parties or industries which produced the materials in the first place. This closed-loop recycling limits the potential for various grades of a material to find appropriate uses.

However, the obvious conclusion is that with many other parties taking new or appropriate roles in the delivery of effective and sustainable solutions, councils will have to step back from some of these functions.

This is where tensions are bound to arise. Local councils have taken most of the running until now and if a broad range of new players are to take up specialist functions, operations and responsibilities, councils will naturally want to be sure that "natural monopolies" will not develop that might effectively work against the interests of ratepayers.

4.4 Local government as a team player

As the impetus toward regional waste management continues, either through amalgamation of local councils or the introduction of regional waste management policies, waste management must become more of a team effort.

What role will local government assume on the team? Player? Manager? Referee? It is important to investigate the more sophisticated relationships that local government will have to develop with the other parties and service providers.

At its simplest, local government could fear that if the traditional private waste contractors are allowed to own and operate landfill disposal facilities, the councils, either directly or through a state agency, will lose control of the gate fee costs that make up a significant part of the garbage charge to ratepayers. Also, private contractors might be keen to maximise the tonnage of wastes received rather than work with the rest of the community to minimise waste.

Given the current state of the private waste industry, these fears are probably well founded, but the contractors have grown up in the same period of rapid change as local government and will have to adapt to changes as well.

These issues are discussed in detail in Chapter 9 as possible strategies are formulated to deliver the outcomes required and avoid the problems of the past; however, in defining local government's future role, it is worth repeating the key points.

The traditional operational hierarchy involved the collection of wastes and disposal to a tip that was usually council owned. The current hierarchy of operational activities required can be simplified to:

- **Waste collection** (non-industrial) and the execution of a level of political accountability in servicing the ratepayers must remain the primary focus of the public sector's activities. However, most councils now contract the actual operational function to the traditional waste industry, maintaining control of the service delivery while having the efficiency and overall lower operating costs that the private sector has been able to deliver.

- **Resource recovery**, including reuse, recycling and reprocessing, in its viable and sustainable form, entirely focused on sustaining and supporting the potential markets for a broad range of recovered resources. These include the full spectrum of glass, metals, papers, plastics, composts and energy products. The operator of this activity must be experienced and committed to "manufacturing" products from the waste stream to supply markets. The skills required involve sorting, processing and beneficiating the materials to a point where they can be traded as recognisable commodities. The efficiency of this process will be closely related to its adequate capitalisation (8.7.1) and the flexibility (8.7.3) to respond to changing market circumstances without being primarily driven by waste-management concerns. The public sector generally, and local councils in particular, do not seem to be the right parties to be taking the primary marketing risks that underpin the whole purpose for undertaking resource recovery. Resource recovery seems to be a function that should remain entirely with the private sector once the relationship between the operator and the public sector customers (the level of service and fair and accountable gate fees) has been thoroughly thought through *(see Section 8.9).*

- **Landfill disposal** could be simply an inert by-product of resource recovery, or at least a highly specified, actively managed and environmentally sound process. The old dumps will certainly be phased out with the style of operators who advocated them.

There is bound to be resistance to change if it adversely affects a significant part of local government revenue and severely limits the ability to exercise political accountability, but there is no evidence that this will happen. The three activities above are separate sectors of enterprise, so statements that faceless multinationals will take over are not borne out by the facts.

The provision of the waste management/resource recovery infrastructure that the community seems to be demanding is no more complicated than many other public utilities such as power, roads, prisons and water, where the public and private sectors are continually combining to deliver services efficiently. The issue in the waste debate seems to be for all concerned to properly and fully understand the key elements of a sustainable waste strategy and then to negotiate the contracts and service agreements that will ensure the objectives are met.

As local government responded to the call for simple recycling services only to find that the generation and servicing of viable, long-term markets was outside their expertise, and as the economic and environmental requirements and standards for landfills are tending toward regional rather than local facilities, the involvement of other specialist parties should be a relief, not a threat. One issue is that the whole local government structure is biased toward independence and against amalgamation and cooperation.

The opportunity to be a major and integral player rather than to struggle on as sole service provider should allow councils the opportunity to expand their “core business”, servicing the ratepayers, but several issues will have to be fully accommodated in any new solutions.

4.5 Summary of the key issues

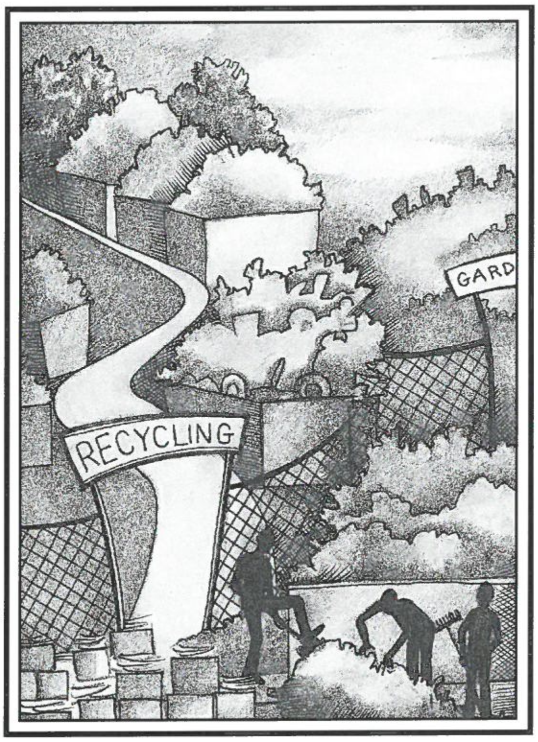
Waste management is moving to a much greater level of sophistication than the historical “collect and bury” processes of the past.

Future solutions must demonstrate real and tangible economic and environmental net benefits, and significant changes are inevitable. Overseas experience and experiments in North America and Europe provide a wealth of information about what can work and what just adds costs. As the new waste management/resource recovery infrastructure develops in Australia, there is an opportunity to develop Australian best-practice legislation, strategies and operational systems if the focus remains on the fundamental issues.

Issues that local government will have to tackle and resolve include:

- Councils should maintain primary responsibility for servicing the immediate needs of their ratepayers and exercising political accountability while aiming to minimise the cost of the required services.
- Councils will continue to raise the bulk of the funds for waste management and infrastructure development from ratepayers and should be able to monitor and control downstream costs.
- Councils must develop sustainable relationships with down-stream service providers for resource recovery and specialist environmental services, including disposal.
- Councils must develop sustainable relationships with neighbouring councils to exploit synergies and generate economies of scale, leading to net efficiencies. (State agencies may over-arch in this area.)

In achieving these results, the potential threats to councils of working with private enterprise must be avoided. Councils should not lose control of gate fee costs or the ability to implement the waste reduction demanded by the community.



The Key Processes & Technologies

5. Landfill

Landfill disposal will always remain the ultimate repository for materials that were not "minimised" or "recovered" for some higher-value use or market. A dislike of what landfills stand for apparently drives the community's main demand for change. It is important to understand the essential processes in landfill, why traditional methods were unacceptable and what the future role for landfill can and should be.

5.1 Introduction

Chapter 1 established that the two main community objections to landfill are pollution and the apparent waste of resources. The act of burying discarded and unwanted materials implies that they have no higher value, at least without advanced infrastructure to process them. The role of landfill is therefore to receive unwanted materials and contain them out of sight and mind.

The old-style tip or dump was open to anyone who wanted to use it and the tip face was often ignited to hasten degradation, minimise the attractiveness to vermin and vectors, control litter and conserve air space. A few smaller country landfills still operate like this. One advantage of this type of operation was their short stabilisation time after they were closed (5-20 years); most of the reactive and putrescible materials had stabilised during the exposed and/or ignited phases.

A major advance in landfill management was to regularly cover materials with a layer of soil. The objective was to limit air pollution (from burning), litter, access to vermin and vectors, and keep rain water from generating unnecessarily large volumes of leachate. Materials were usually compacted to conserve air space as the cover was applied. This approach generally achieved its primary objectives, but rehabilitation after they were closed was greatly extended as methane and leachate production continued over a prolonged period (20-100 years) and the slowing of biodegradation by limiting air and moisture to the materials meant that physical stability was also a long-term prospect.

More recently, leachate and methane production has been controlled by ever more sophisticated covering and sealing methods in the belief that without air or moisture, the site will have a minimal environmental impact. This was always muddled logic, and is now being recognised as such. Modern engineering approaches may postpone the inevitable degradation but will never stop it. So the role of landfill should be acknowledged *and planned for* as:

- to neutralise and stabilise putrescible and reactive wastes in a controlled manner;
- to act as temporary storage for materials, energy or resources that have no current higher value; and
- to act as long-term repository for basically inert and unwanted materials.

As there is now a nationally adopted target expressed in terms of avoiding landfill, it is important to see how landfill came into such disrepute and the sort of role it should play in the future.

5.2 Historical context

The disposal of municipal (putrescible) solid wastes (MSW) and industrial solid wastes (ISW) by burial has been common in society for millennia. In the developed world, more than 80 per cent of solid waste generated passes to landfills. This has included the infilling of degraded lands or valleys, filling specially designed holes in the ground, or the use of landfill mounds extending in some cases hundreds of metres above ground level.

Landfills are still recognised as the cheapest way of disposing of solid waste.

The inclusion of liquid municipal (sewage sludges) and industrial wastes with MSW (co-disposal) and industrial chemical dumping, particularly during the 1950s and 60s, gave rise to occasional occurrences of extreme environmental and public health damage. This was most exemplified by the Love Canal incident in the US in 1972, but counterparts existed in Australia, with the toxic chemical dumping in old mine shafts near Kingston in Queensland.

Such occurrences have caused politicians and regulators to progressively introduce guidelines and prescriptive codes in all the developed "western countries" aimed at protecting public health and the environment from the impact of landfilled wastes.

The regulatory approach to controlling landfills initially concentrated on excluding potentially toxic or hazardous chemicals from them. Later, desirable siting parameters were defined. These were then followed by regulations to:

- constrain the generation and release of landfill leachates,
- minimise wastes going to landfills and, most recently,
- control landfill gas (which is a greenhouse gas).

Legislation and regulations generated worldwide have varied depending upon the population density, the perceived value of groundwater resources, the level of environmental concern expressed in the community and the influences of industry as they moved to exploit opportunities progressively opened up by waste management and environmental regulations.

Regulations are often transposed in whole or part from country to country and state to state. This usually occurs with little recognition of the real reasons for their original development. The results have been a progressive and massive increase in waste disposal cost to the community and a flow-on of cost penalties to industry.

Increasing cost has, especially in Europe and to a lesser degree in Australia, led to intense and productive research into landfill design and management. This research has focused on gaining a better understanding of the behaviour of landfills and their impact on the environment, and to better defining their most appropriate role within overall waste management strategies.

Leading practitioners now recognise that appropriately designed sanitary landfills can be managed as bioreactors to degrade putrescible wastes. In addition, they are recognised as an energy source and as a safe repository for a variety of heavy metal and other compounds which are not otherwise readily or practicably recyclable, recoverable in their present form (e.g., process sludges) or desirably stored in the surface environment.

Landfill will probably remain the ultimate storage for a large part of the solid wastes that society produces, although various measures will reduce the volume and range of wastes it contains. The definition of waste in this context, however, should be "a resource misplaced in time and space". Hence the role of landfills should not be as "ultimate repositories" but as temporary storage from which these resources can either be used to benefit society or from which resources can be recovered. All of this must be achieved, however, in such a way that landfills are not so degraded that they cannot be used in some way in the future.

5.3 The bioreaction process of landfill

Modern sanitary landfills receive a wide range of wastes which, with resource recovery and recycling in place, include increasing proportions of readily or moderately-to-slowly biodegradable material. The wastes are acted upon by a variety of "soil bacteria" adapted to various chemical conditions which can be defined by the availability of oxygen (aerobic composting), oxides (anaerobic composting/acetogenesis/fermentation) or by the absence of oxygen and oxides (methanogenesis).

These processes have been shown to be capable of the broad-scale degradation and/or fixation of a wide range of organic and heavy metal compounds if moisture is available in reasonable quantities.

Many of the simple compounds resulting from biodegradation which remain mobile (mostly in solution), as well as some persistent organics, are capable of further degradation and fixation as leachates emerge from the geochemical environment of the landfill into the natural environment. Biological and biologically catalysed reactions reduce complex organic forms—including hydrocarbons, chlorinated organics and PAH—to simple natural salts, water and gas. Final leachate, after treatment, can be little more than a brackish water which may simply be allowed to disperse in many environments.

The extent to which landfill bioreactors are effective depends on the form of management applied, including loose-placed waste compacted under its own weight (up to 500kg/m^3), machine-compacted waste (750-1100kg/m^3), compacted baled garbage (700-800kg/m^3) and shredded machine-compacted garbage (800-1300kg/m^3).

With the exception of shredded garbage, these systems have been adopted on the basis of site use and management economics. They result in waste masses having different permeability and moisture-retention levels. These significantly affect the dominant decomposition processes—and hence the time for waste stabilisation (*in-situ* degradation)—the strengths and chemical components in leachates, and the gas and gas flow rates which may result.

In simple terms, baled compacted waste achieves high density early, but low permeability makes it slow to decompose and subject to late-stage heave and settlement. Shredded compacted waste achieves the best results by generating an environment in which uniform saturation occurs, uniform degradation rates are experienced and breakdown and settlement are more predictable. This is the preferred approach. Variations relate only to the use and application of cover, which in itself introduces other chemical effects and environmental consequences.

Overall, the sequence of degradation within landfills is manageable irrespective of the manner and type of fill placement. Indeed, the regulations guiding sanitary landfill management are already exercising controls. For example:

- the relatively thick (300mm) daily cover required in Victoria immediately limits the extent to which aerobic composting takes place;
- the thicker landfill sequences (frequently more than 10m) and subgrade siting give rise to higher temperatures and expedited but foreshortened acetogenic phases;
- excess of moisture similarly leads to early onset of methanogenesis and stimulated gas production which purges upper layers of oxygen.

Management of leachate release is recognised as an option, but with few exceptions it occurs only on an *ad hoc* basis or as a waste-water disposal exercise.

In the past, leachates were rarely collected and removed for separate treatment and disposal but this is now common. It involves the effective sealing of the base of the landfill using clays and/or geosynthetic membranes and drain materials. The leachate is drawn to sumps and is then removed for discharge to sewer, treatment on site and disposal or, where possible, for use in irrigation with or without treatment.

This process of collection was intended to protect groundwater, which may be justifiable, though sometimes it simply blocks the natural processes and releases the unstabilised contaminant load to surface facilities which may not have the capacity to handle the contaminants before their release to surface waters.

At this stage, research has not reached the point where the critical elements, components and proportions in the waste stream have been identified, which would allow the best use of the "landfill as a bioreactor". This is an important task for the future as it affects the extent to which waste minimisation and alternative pretreatment or degradation systems should be developed.

Sewage sludge additions to landfills can be beneficial by accelerating methanogenesis and by stimulating methane production, nitrification and denitrification. It is not known whether removal of moderately degradable matter such as newsprint and paper products will curtail gas production and extend the period of final biostabilisation of wastes.

Neither is it known what proportions of hydrocarbons and PAH and halogenated organic compounds may be added to an MSW landfill and be degraded. It *is* known, however, that many are entirely degraded and that some of their degradation products are absorbed with stable organic carbon. Equally, many heavy metal sludges are degraded and their heavy metal compounds are precipitated with iron compounds (pyrite, siderite, hydroxides).

The trends are toward cautious optimisation of landfill use as bioreactors because they can:

- degrade otherwise persistent and hazardous compounds,
- be sources of energy through landfill gas,
- become concentrators of stabilised and fixed compounds, and
- be interim storage sites for materials which may represent future economic resources.

Research into landfill bioreactor and management optimisation is long term and is being carried out in pilot programs using isolated segments of operational landfills. It has to be a field operation because it is virtually impossible to create the physical, chemical and biological diversity and kinetics in the laboratory.

5.4 Intergenerational equity

A central tenet of the sustainable development philosophy is that this generation should not burden future generations with the problems of our waste. This highlights the problem of landfills—it takes a long time for digestion and stabilisation to finish.

Waste entombment—where the immediate environmental control of methane and leachate production in landfills is managed by sealing the reactive wastes with impervious clay liners and daily compaction and covering and final capping—is more likely to postpone the inevitable processes of degradation, not stop them. The result is that instead of a landfill reaching stability in, say, five to 30 years, it is likely to take 30-100 years as the assumption must be that moisture and/or air will eventually percolate through, especially with subsequent subsidence. So modern entombment practices are effectively sending time capsules of environmental problems for future generations to deal with. By that time, those that managed and profited from the original landfill will no longer be around to take responsibility.

5.5 Responsibilities for landfills

Landfill management and maintenance must be recognised as a long-term commitment based on "fail safe" principles. Management can accelerate the major part of biostabilisation of the material in the landfill and engineering can restrict the outflow rate of mobile products, but ultimately the landfill must reach an equilibrium with the environment. This involves moisture, temperature, density and chemistry. The periods over which this stabilisation will take place may need to be measured in decades, if not centuries, depending on the management systems applied. The processes which are active include physical and chemical changes in the liners and cap materials, the occurrence of earthquakes, floods and fire and a variety of surface and surrounding modifications.

Responsibility for landfills will pass through various hands. Initially, the operator will be responsible to regulatory authorities for its performance under licence. Such licences now commonly encompass the active life of the site and at least 30 years beyond. During this period, responsibility for the site may pass to another owner, protected from liability by financial assurances, at least until the licence is allowed to be terminated.

Beyond the licence period, responsibility for the site rests with the owner, who may, under some legislation, seek compensation from the original licensee, if the entity still exists.

Changing levels of environmental impairment acceptability and/or changing legislation could result in owner liability despite the site condition being as predicted decades before.

It is impossible to predict where responsibility will lie, but it is clear that it can only be in the community. This could be exercised through regional waste management groups which could include and involve the council and commercial waste management organisations.

Financial liability assurance pools have been recognised and are being accumulated in bodies serving metropolitan regions, but these groups do not include commercial operators. So, at present, the community and the environment are not protected against long-term liabilities which may arise after the licence has been allowed to expire.

It should be a goal of today's waste managers, planners and operators to process this generation's wastes within the generation that produced them rather than leave an unplanned for and unbudgeted problem for future generations.

5.6 The potential for actively managed landfills

Section 5.1 identified the legitimate role of landfill in a modern waste management strategy as:

- to neutralise and stabilise putrescible and reactive wastes in a controlled manner,
- to act as temporary storage for materials, energy or resources that have no current higher value, and
- to act as long-term repository for basically inert and unwanted materials.

The materials come to landfills because they have not been considered valuable enough to warrant recovery in the prevailing market conditions. The primary focus of landfill management is to achieve the above objectives in an environmentally acceptable manner (as determined by the current generation) and as cost effectively as possible.

5.6.1 Landfill bioreaction as a neutralising/stabilising process

Section 5.3 explored how the landfilling of mixed wastes sets up a complex series of chemical degradation processes that, in time, can fix even persistent and hazardous compounds and, through biological and biologically catalysed chemical reactions, complex organic forms can be reduced to simple natural salts, water and gas, leaving the leachate as little more than a brackish water.

Though optimisation of landfill as a bioreactor is in its infancy, and critical information which allows this optimisation, through better management practices, is not yet available, a range of management practices can be instituted to encourage, and thus shorten, the processes.

If the degradation processes are to be controlled and completed within a reasonable period (say 10-20 years), especially if the site air space is to be recycled (5.6.5), then the pretreating (5.6) and laying down of the materials must be managed with this in mind. In most cases, methane extraction will be a useful by-product (5.6.6) and can be planned for as the materials are deposited.

An actively managed approach to landfilling reactive and putrescible wastes plans for the task and controls the predictable results. The old style of landfill management, and even many current facilities, bury and entomb wastes for a neat and tidy immediate result but without any real thought for the future.

5.6.2 Monofill

In an actively managed landfill, there will be a continual flow of material which has no immediate market or use but could be valuable in the future because of changing market conditions, the advent of new technology for processing or treating, or simply due to the quantity accumulated. The opportunity should not be lost to "store" these materials so that they could be readily accessible in the future. Examples might include:

- tyres (whole, not shredded),
- surplus or unsold MRF product, especially plastics,
- building and demolition wastes,
- engineering wastes such as asphalts or soil exchange, and
- putrescible materials or biodegradable materials (composts/papers) stored with the minimum of cover contamination for possible re-extraction and low-grade energy source or soil amendments (methane extracted during decomposition).

An important management principle in monofilling is not to overcapitalise or pre-process materials in an attempt to second guess what the eventual market might be.

For example, new technologies have now established that the long-term, viable reprocessing option for tyres starts with whole tyres not shredded ones, so that the operator who has shredded tyres before disposal has incurred a significant shredding cost and simultaneously closed off any option to supply the quality, high-return end of market.

Monofills should keep separate obviously homogeneous materials and, except for putrescible or biodegradable materials, not speculate upon the eventual market requirements.

5.6.3 Long-term storage

A residue of rejected and unwanted materials will build up over time and gradually fill the landfill space for ever. These materials will be inert and non-degradable and would be deposited and compacted to allow for the eventual long-term reuse of the site for recreation or as playing fields, parks, bushland or building sites. The completed, actively managed site would contain no residual putrescible degrading wastes, so its stability would open up greater opportunities than are usually considered today.

5.6.4 Recycling landfill capacity

With active landfill management, materials can be recovered when market conditions allow (monofill materials) and the air space can be reclaimed for new materials to be deposited in. Similarly, the putrescible materials will have reduced to a substance with an energy value similar to La Trobe brown coal, the methane having been beneficially removed separately. If these high-energy residues are not too contaminated with inert cover materials, this air space can also be reclaimed.

Overall, it is desirable that waste degradation in landfills should take place as efficiently and rapidly as possible, and that landfill recycling should be the aim for the future. Conceptual works, experimentation and some recycling is already being carried out in Germany, the United Kingdom and in the US.

Eventually it seems likely that these philosophies will be implemented, but for some sites and areas where insufficient planning for recycling was applied, the recycle period may be one to two generations and full implementation may still be a generation away.

5.6.5 Potential landfill products

Landfills, tips and dumps have always attracted a negative, last-resort connotation, but their potential products and benefits are worth noting:

- Energy as methane during decomposition and as solid fuel during air-space recycling;
- Monofilled or screened resources for subsequent markets or uses including raw materials, ores, building materials and aggregates;

- Reclaimed sites which might have been degraded before the landfill operation; and
- A cost-effective processing, fixing, stabilising facility for a wide range of low-priority items.

Landfills should have a much more integrated and essential role than merely being the "end of the road" for certain materials.

5.6.6 Pretreating materials for landfill

Landfill pretreatment is mostly about sorting, mixing, shredding and pulverising to support the three main objectives (5.6). However, incineration is also landfill pretreatment because it reduces the volume of organic materials and stabilises them. (Waste-to-energy by incineration to produce heat to drive a turbine is resource recovery, as the primary focus is using a low-cost energy source to reliably service an end user. Ash and waste volume reduction would be considered by-products.)

We have seen how the clays in liners, cover and capping materials can absorb and fix heavy metals. This occurs much faster and more thoroughly if the materials are mixed rather than layered. Similarly, the putrescible materials degrade, stabilise and generate useful methane faster and more efficiently if shredded or pulverised together before deposition. The established technologies of rotary pulverising drums therefore may be set for a comeback. These drums mix, pulverise and partly compost materials in readiness for landfill, reducing initial volumes by 50 per cent immediately and without expensive compaction. The mixed wastes, some cover material, ash and even sewage sludges can be preprocessed in this way to hasten their stabilisation.

Sorting materials for monofilling or separate storage is also pretreating for landfill.

Chapter 8 explores how "resource recovery parks", if developed in conjunction with their own landfills, could perform most of the essential pretreatment functions.

5.7 Siting of landfills

The actively managed, recyclable landfill of the future will bear little resemblance to the smoking, smelly and vermin-infested dumps of the past. It will be a well planned and operated *non*-putrescible facility (within the terms currently applied to landfills) able to receive putrescible wastes for active "processing" to a stable and inert state. Its site would be next to an industrial area (or "resource recovery park"—Chapter 8) not only to minimise the overall environmental impact but also because an adjacent industrial user would benefit from the availability of a major energy product of landfill—methane.

Australia's mining industries are creating holes and air space at about 2.5 times the rate that wastes are available to fill them, so using the sites for landfills has an obvious appeal. However, mining sites tend to be in remote regions, away from the waste-producing areas, or in unsuitable rock types.

Much has been made of the geotextiles and membranes used for lining landfills. Their effectiveness has been marketed well to the public, even though their performance is generally much less than is claimed. In future, the effectiveness of clay liners in leachate retention and in the attenuation of contaminants in leachates will become apparent. Experiments and research into optimising processes including waste shredding, compaction, matrix mixtures and moisture control will lead to major changes in the rates of gas and energy recovery. Similarly, new management procedures are doing much to relieve smell and dust problems.

The recognition of the impacts of these new technologies will make landfill siting less contentious.

Modern landfills seek to achieve benefits starting with site selection. Landfills have been commonly used to reclaim what was seen as degraded or low-value land (quarries, mines, swamps, tidal land and flood plains). Many such sites have been filled worldwide. Many show localised impacts resulting from poor siting, engineering and site management, but remarkably few have caused major problems.

Regulations and policies now restrict the sites which can be landfilled and demand high standards of site preparation, management during active landfilling, and engineering during and after the site's closure.

Benefits from rehabilitating genuinely degraded land have frequently been offset by long periods of surface subsidence and gas emission, which restrict revegetation; localised rising of the water table; and production of leachates. Sometimes the sites have attracted vermin and produced allergens such as bacterial spores.

These problems are now mostly solvable by using better design and compaction models and processes from the outset, by continuous leachate and gas control and by vastly improved landfill cover design. Through these measures, degraded land can be returned to the community and wider choices are available for their use, including parks and urban forests, sporting complexes and building sites.

5.8 Summary

Landfill, as the essential final repository for unwanted materials, need not be a problem to be avoided at all costs, which is a potential outcome of the "half by 2000" target. Costs are a major factor in all sectors of waste management. In resource recovery, the equation is easier, as market conditions will determine the level of capitalisation and efficiency in supplying the reclaimed products. For landfills, the higher costs of actively managing the facility and pretreating most incoming materials will be offset by easier (and cheaper) siting of the more professional facilities and the sale of the products of the process.

The costs of landfilling, as reflected in gate fees, must be whatever is required to perform the primary objectives (5.6). Government agencies can strictly police the operations to ensure that the net environmental outcomes are achieved for this and future generations.

6. Resource Recovery

Recovering resources from the waste stream by recycling, reuse, composting, waste-to-energy or any other processes could provide a substantial alternative supply of raw materials and reduce our dependence on virgin supplies. But for genuine long-term benefit, recovered materials have to find viable markets and uses.

6.1 Resource recovery—The desirable objectives

Previous sections of this handbook have shown that proper management techniques can control pollution and allow the viability of various resource recovery options to be played out over a longer time scale to ensure the least "waste of resources". This means that the focus of all resource recovery can be the essential requirements of the market.

The recovered products must meet the fundamentals of market resource security—reliable quality, quantity and price. This is essential for the customer or end user to make the commitment to be a reliable market.

6.2 Recycling and reuse

Recovering materials from waste streams for recycling, for another use or productive life cycle, is most successful at a manufacturing or an industrial level. For example, it makes excellent sense for plastic converters to collect all scrap and trimmings for immediate regrinding into useful feed material. Similar in-house recycling occurs throughout industry, including metals, paper/cardboard and glass, but this should probably be regarded as "waste minimisation" in the context of clean production.

Section 1.3 gave the examples of timber off-cuts, abattoir waste and power station fly ash, where a business-to-business relationship flourishes on the reliability of one party's waste being an essential raw material to another. The strength and reliability of these relationships reinforce the fundamental issues for post-consumer recycling efforts. Between the two industrial parties, the control of the quantity, quality and price of the waste/raw materials can be readily assessed and controlled. Security of resource for the user can be satisfactorily provided by the "waste" producer. Operational strategies can be efficiently designed and implemented for the mutual advantage of both parties. For the supplier, a "waste" becomes a "resource" and for the user, a cheaper or alternative raw material supply provides an opportunity or a commercial advantage.

Though such business-to-business relationships are undoubtedly "recycling", for the purposes of this handbook such operations probably still qualify as waste minimisation or a logical extension of the concept of clean production. It is in the post-consumer area that the notions of "resource security" are most pertinent to the broader issues of resource recovery.

The tensions between local councils on behalf of the community, and industry as the apparently reluctant market for reclaimed or recycled materials, revolve around security of resource for the potential user or "market".

6.2.1 Two perspectives of recycling as currently practised

Councils' view of recycling in general, and industry's role in particular, includes such notions as:

- They made the product, they should be prepared to take it back.
- Council will collect any material that there is a viable market for.
- It has cost $x to collect and forward; we should receive at least this amount as a fair return for our effort in collecting it for them.
- Industry can afford to pay us a fair price for the materials because they can always pass on the costs to the consumer.

Industry's view of the issues:

- Cheap and reliable sources of raw materials are always welcome, whether they were originally ours or not. The supply must be regular in quantity and quality and at a price that demonstrates an advantage over virgin or more traditional supplies.
- If the combined cost of collecting and sorting materials is more than a market will offer, either the whole enterprise should be discontinued or the collecting and sorting processes need to be made more efficient, or the quality should be tailored to attract a commensurate price.
- Australian industry is now exposed to world competition and subsidising raw material costs is unsustainable for all concerned.
- To ensure optimum use of specialist equipment to process secondary resources, an often adopted strategy for industry is under-capitalisation. If, say, research showed that about 100,000 tonnes a year of a particular reclaimed resource was potentially available, a plant could be commissioned with a capacity of 50,000 or 60,000 tonnes a year. The effect of this decision is to ensure that the selected plant will always run to capacity on the available

supply and that the surplus material will tend to keep the price down and the quality up.

It is important to remember that until five or 10 years ago, the only formal suppliers of many secondary resources were charity groups and scout troops. Installation of expensive reprocessing plant will usually be approved on 15 to 20 year investment cycles, so a level of prudent conservatism is understandable.

Recycling as a popular phenomenon in Australia had its beginnings in the resurgence of the grass roots environmental movement in the 1970s.

Australia became a nation of recyclers, representing a major change of behaviour by ratepayers and a new demand on services for local government. Local council recycling services started mainly in response to ratepayer demand (confirmed in an Australia-wide survey of local councils in 1989). The recycling ethos is already more than 20 years old in Australia. In 1994, more than 74 per cent of households recycled in some form or another and more than 50 per cent of Australian households recycled at kerbside where this service was provided.

The most powerful motivation for people to recycle is considered to be the ability to make a personal contribution to the quality of the environment. Social pressure to conform is also a strong influence.

Materials are recovered from the municipal waste streams for recycling more because they are obvious or easy to isolate than because there is sustained demand for them as essential raw materials. Most plastics, papers, cardboards, metals or glasses are technically recyclable, but few qualify on economic grounds because the combined costs of collection, sorting, transporting, cleaning and reformulating are greater than those of virgin extraction, especially to achieve a comparable quality and usefulness.

This highlights one of the major challenges for parties involved in the waste management/resource recovery debate: to focus on the development of universal strategies and infrastructure for the collection, sorting, transport and beneficiation of materials designed for reuse/recycling. Then there will be fewer economic constraints on the technical potential for widespread recycling.

The greatest recycling challenge facing solid waste infrastructure is not in the process of collecting, separating and supplying resources recovered from the waste stream, but in doing so at a realistic cost, and in marketing the materials at a price, quality and quantity competitive with virgin materials.

For local councils, the challenge is to provide recycled materials to sustainable markets with a security of quality, quantity and price similar to that which exists between industries.

Simply collecting obvious materials and hoping someone will pay enough to produce a profit is not recycling, it is wasting ratepayers' money. It would be better to do it as a precursor to the monofill function of landfills (5.6.2).

6.3 Composting

Green and putrescible wastes make up almost half of urban domestic waste. It is therefore theoretically possible to reduce the volume of solid waste to landfill by 50 per cent through composting alone. The real challenge of composting, however, is to produce an economically sustainable, readily marketable product. Quality rather than quantity should be the key requirement.

Composting is the controlled biological decomposition of organic materials and takes place spontaneously when they are brought together in large enough concentrations in the presence of sufficient air and moisture. It is a natural process of decay for plant material and occurs throughout the natural world, on forest floors or wherever there is an accumulation of organic material. Micro-organisms reduce dead plant material to its constituent elements, releasing water vapour and carbon dioxide.

Composting requires the control of several variables, such as source material, particle size, moisture content, temperature and air supply. Generally speaking, the greater the control and precision of these factors, the faster the process and the better the product.

Composting also has a valuable place as a pretreatment process for putrescible materials destined for landfill. This nil-value end use allows a much simplified landfill process to be employed. But for market-focused composting, the development process must be to research and define market requirement, select the most cost-effective procedures to satisfy it, then source suitable raw materials. Where the raw materials are "waste" products, issues of source separation, containment levels and delivery methods may mean that the selected process must accommodate the "waste processing" issues as well, especially odour and environmental controls.

Composting's place in resource recovery will depend on developing and sustaining viable markets and beneficial uses. A vast range of soil amendment, mulch, compost and potting mix products can result from a composting operation, but quality and reliable fitness for use must be the driving factors.

Composting is a waste minimisation option for the private gardener, but will it work as a systematic resource recovery option? Many people bake their own bread or brew their own beer, but the domestic technologies used would not be suitable for commercial bakeries or breweries. Commercial composting operations handling organic wastes in various climatic conditions to produce quality assured products require adequate capitalisation for appropriate process technologies.

Quality compost products begin by selecting and sourcing the raw materials—preferably with the party taking the marketing risk controlling their selection *(see Chapter 8)*. How often do we see local councils buying or contracting-in a shredder to reduce green wastes and then wondering why they have difficulty selling this "valuable" product? A professional composter, with an eye on the requirements of the market, wants to be able to control the process—and that includes the raw materials.

For example, visible contaminants such as glass and plastic can seriously affect the product's sales potential. The only effective solution is to remove all plastic, glass and other foreign matter before composting begins. The alternative is costly removal of foreign matter from mature compost using expensive and not completely effective machinery.

Potential invisible contaminants in compost include weed seeds, insect eggs, pesticide residues, heavy metals and pathogens which may cause diseases in humans, animals and plants. Feedstock may also be infected with spores, moulds and fungi which may cause health problems if inhaled, or spread disease to other plants.

Fortunately, composting generates enough heat to break down common invisible pollutants and organisms if properly controlled and managed. Organic matter, with the addition of moisture and with access to oxygen, will produce temperatures of 60°C or more at the centre of the heap. This is a natural pasteurisation process which destroys most weed seeds, common pathogens and organic pesticides.

The first and most important principle of successful municipal composting should be that compost which is unsaleable should not be produced.

High-quality compost can be produced only from high-quality materials. Source separation and control of sources for composting feedstock is important in minimising contamination.

The first requirement, therefore, is that not all the compostable part of municipal waste should be composted—only raw materials which produce high-quality compost.

Compost produced from clean metropolitan green wastes is an extremely beneficial product for Australian soils, which are generally low in humus. Theoretically, Australia cannot over-produce quality compost because the need for it is so great. So compost can be a truly economically sustainable form of waste processing.

6.4 Waste to energy by combustion (WTE)

As discussed in section 5.6, the incineration of wastes can be considered a landfill pretreatment if volume reduction and detoxification is the primary aim. In this resource recovery context, waste to energy involves the addition of power generation equipment to combustion for the recovery of process heat.

The main products of incineration are carbon dioxide, water, ash residue and heat energy. Unfortunately, by-products having environmental importance are also generated, such as sulphur, nitrogen and chlorinated compounds including "dioxin" and some heavy metal compounds of lead, mercury and cadmium.

6.4.1 Technical requirements of combustion

Combustion, equipment must be designed around the three "Ts" of combustion: time, temperature and turbulence in the presence of oxygen. Systems without these factors in their design usually experience operating and maintenance problems as well as posing environmental hazards. The better a system is at controlling these factors, the lower the environmental impact.

Time is usually accounted for by the volume allowed for the combustion chamber. It must be large enough to retain the gas flow for sufficient time to allow complete combustion of the fuel and volatile gases.

Temperature is a critical consideration. Organic matter usually oxidises at a relatively low temperature (600°-700°C) and usually has enough calorific value for combustion. A few refractory organics need a much higher temperature to achieve full decomposition. Other organic wastes have such a high moisture content that they require a subsidiary fuel for combustion. These moist green wastes are probably more valuable as composts.

The higher the temperature, the greater the assurance of complete combustion—and the higher the maintenance and running costs of a facility and often the lower the reliability.

For other than the extremes of organic matter, temperatures between 850°C and 950°C are enough for the safe and efficient combustion of organics.

Turbulence of the gas flows is necessary to promote mixing of the hot products of combustion and the oxidising substance, air. Turbulence can be achieved by duct design or by the injection of a substance into the hot gas flow. The conversion of water to steam in a hot gas flow creates good turbulent flow conditions.

Industrial incinerators are integrated systems of raw waste handling and storage equipment, combustion chambers, energy and by-product recovery operations, exhaust gas cleaning facilities and effluent and solids discharge control devices.

6.4.2 Refuse-derived fuels

The concept of treating waste products to obtain a cheap, transportable and storable fuel has been around for more than 30 years.

In most countries, the quantity of waste products increases during spring, summer and autumn and reaches a low point in winter. Researchers have always aimed to transform or treat these wastes so they could be stored, transported and used as a fuel during winter. Waste-to-energy plants often supply district heat in Europe and demand is highest in winter when the availability of normal waste fuel is at its lowest point.

It is technically possible to transform normal waste into pellets or briquettes with increased calorific value and greater bulk density for transport.

Refuse-derived fuels (RDF) can be used by themselves but more often they are mixed with another solid fuel such as coal in steam or hot-water generating plants.

One form of RDF being used comes from the increase in the number of material recovery facilities (MRF). One stream from these facilities normally contains contaminated dry combustible matter, an ideal fuel for waste-to-energy plants.

Some industries which incorporate fuel-burning equipment can be used for "niche" burning. The displacement of normal fuel by RDF is a true waste-to-energy application. Blast furnaces, hot-melt cupolas and cement kilns are some of the industrial plants using waste fuel.

Industry will usually use an alternative fuel only when it is offered at a price premium to compensate for inconvenience.

Contaminated petroleum products and plastics are used as fuel in cement kilns only when the price of waste disposal is high and the cost of normal fuel is appreciable.

6.4.3 Economics of waste-to-energy plants

Only a few years ago, a plant with a capacity of less than 500 tonnes a day was considered too small for energy recovery, but a growing appreciation that the world has a finite amount of energy-producing fuel, and the subsequent rise in the cost of energy, has changed this. Australia is a net energy-exporting country with substantial reserves, which will always tend to make the waste-to-energy option more attractive in other countries than here.

The choice of adopting waste-to-energy rather than landfill disposal is seldom based only on energy or landfill costs. Even if landfill operators in Australia were forced to adopt the stringent standards that exist elsewhere, landfill would still be cheaper than incineration *unless* landfill costs included a large transport component. It is often cheaper to carry waste over 200-400km to a landfill than burn it.

A combination of factors is leading many entities overseas to adopt waste-to-energy plants:

- Consistent production or availability of a waste product.
- Consistent need for high-grade and low-grade energy.
- A desire to maintain control over waste products.
- A desire to minimise the environmental impacts of a waste product.

6.4.4 Environmental impacts of waste to energy

Modern plants pose little danger of adverse health effects to their neighbourhood.

A recent British Royal Commission came to the following conclusion:

> The evidence is that the emissions from a well operated incineration plant complying with the new HMIP Standards (British Standards) are most unlikely to cause any health effects.

The German 17BlmSchV Standard proposed for incinerators in NSW is even more stringent than the British Standard.

The royal commissioners did, however, stress that environmental impacts of incineration plants should go beyond health considerations. Other factors should include:

- visual intrusion,
- odour and noise,
- vehicle movement, and
- socio-economic effects.

Parts of the waste stream can have potential energy recovered only before or after a period of landfill. Where a reliable end user of the energy is available, the recovery of energy by combustion must be a legitimate option. Much opposition to combustion comes from the potential of waste-to-energy plants to mindlessly consume materials that should have been recycled, reused, composted or put to some higher-value use. This view has the potential to deny the valuable role of incineration to recover energy that might otherwise be lost.

6.5 Other resource recovery technologies

Several generic resource recovery processes and technologies are often canvassed as potential solutions to waste problems. The main ones include:

6.5.1 Biofermentation

Biofermentation is the in-vessel fermentation of the organic parts of waste streams to produce methane (for power generation) and simultaneously stabilise putrescible wastes. This process is receiving renewed interest as a method of pretreating and stabilising putrescible or organic wastes to recover methane. The residues can then be aerobically composted. The energy recovered is hoped to be enough to run the overall plant. As a volume-reduction technique, only about 7-10 per cent of the material in the waste stream will be affected by biodegradation without a prior hydrolysis process to convert the ligno-cellulosic material into fermentable sugars.

6.5.2 Hydrolysis

Hydrolysis converts the cellulose content of ligno-cellulosic wastes (paper and wood) into fermentable sugars so that methane or ethanol can be produced as alternative fuels.

The traditional method is for a high temperature and pressure process, in the presence of acid, to break down the cellulose materials. More recently, especially in Australia, enzyme hydrolysis (which is basically the industrialisation of the natural processes of degradation from the forest floor) and steam explosion hydrolysis have been receiving significant development interest. However, all hydrolysis processes are sensitive to continuity of feedstock in quality and quantity, which make them unsuitable for mixed wastes and more suitable for agricultural residues such as sawdust, straw or specially grown crops.

6.5.3 Pyrolysis

Pyrolysis is the process of heating waste materials in the absence of oxygen to produce volatile gases, fuel oils and inert charred residues. It is sensitive to reliability and quality of feedstock if valuable products are to be produced.

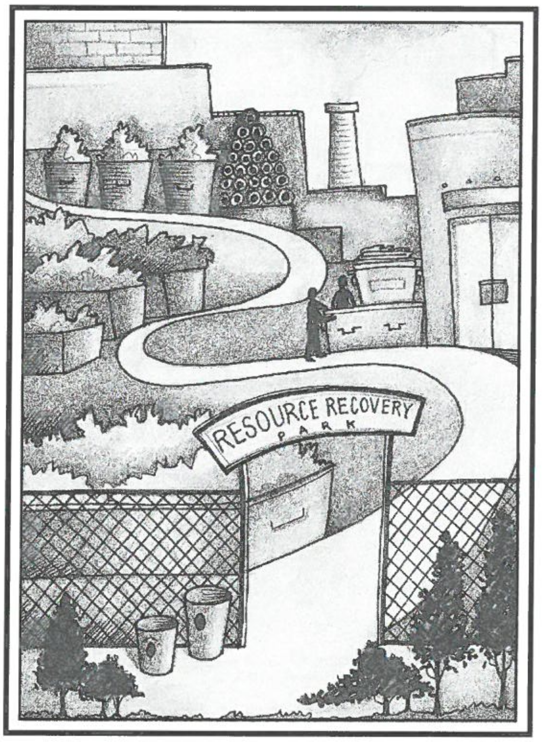
6.6 Summary

Within the resource recovery area a range of technologies are available to complete the recycling loop or add value to reprocessed materials, but a key factor in every case is that the viability of any process or option should be determined by deducting recovery and processing costs from the market price. If this process is subsidised for political purposes to ensure its viability, it is effectively consuming a greater value of production cost than it is generating. This is wasteful in economic and environmental terms.

Because of the "under capitalisation" requirement for major investment in certain recycling capacity it is essential that a range of markets are encouraged. Such markets would have "trickle down" values such that lesser grades of material would go to less sensitive uses. The current position in glass and PET is therefore unstable as the market for both commodities is far too centralised and the lack of alternatives could be a major impediment to councils in the future.

Avoided landfill credits may provide additional income, but resource recovery is generally *not* constrained by low landfill gate fees, more by the resource security requirements of any investor to develop the process, infrastructure and markets for the available materials.

With local councils driven by community demand for recycling, a predictable (and perhaps avoidable) imbalance exists between supply and demand for recovered resources. This "inefficiency" is manifesting itself as a cost to the community and industry which is much higher than it need be.



Possible Solutions & Outcomes

7. Private Enterprise in Solid Waste Management – New Relationships to be Forged

Throughout local government there are numerous pockets of apparent suspicion and resistance to the increasing involvement of the private sector. Are these concerns justified and what key factors will shape the future relationships between the parties?

7.1 Traditional roles

In the past, local councils, in the execution of their public health obligations, offered comprehensive collection and disposal services with the primary objective of keeping the community clean and tidy. It was normal for the entire collection-to-disposal service to be controlled by each municipality, including the operation of its own tip. This approach offered control of the costs and level of service within each council.

Gradually, as individual council tips closed and new facilities had to be shared with other councils, state intervention was common to oversee the longer-term provision of disposal facilities. The involvement of state organisations involved some loss of cost-service control by councils, but this was at least to public authorities which were publicly accountable. Gate prices were usually maintained at relatively low levels to encourage orderly disposal. These developments are generally accepted as commonsense initiatives and have operated smoothly in some states for years.

The next development was for some councils to use contractors to perform the collection services. The contractor, usually less constrained by public service employment awards and conditions, was able to demonstrate savings to the recurring collection budget. More importantly, the council's contract maintained its control of service delivery.

Providing a waste service can account for between 25 and 33 per cent of a council's gross annual expenditure. That level of expenditure is roughly reflected in a similar percentage of employment within council administration staff and total management time. It is also a major area of interest and involvement for elected councillors, especially as waste and the environmental issues that surround it attract more and more community attention at election time.

Councils are worried about the potential to lose control of activities that account for a major part of their budget and the jobs that go with it, and elected councillors worry about how they would respond to community concerns if the activity were substantially out of council control.

7.2 A corporate response

Why is there an apparent resistance in the community to private enterprise involvement in waste management?

At the Consensus Conference that provided the basic material for this handbook, Dr Anthony Sive of Boral Ltd gave a paper, "The Resource Recovery Business Approach", which referred to many of the relationships between the public and private sector. Boral has incorporated Boral Resource Recovery Management to operate, and become market leaders, in this specific area of activity.

To demonstrate that the private sector is well aware of the sensitivities involved, some of Dr Sive's comments are reproduced below.

Extracts from paper given to Consensus Conference, May 1994 by Dr Anthony Sive:

> "Opportunities exist for Australian businesses in resource recovery rather than in waste management. The resource recovery business offers growth at a time when many other business opportunities in Australia are likely to show little natural growth. The total waste stream is a valuable resource and will be cheaper if non-selectively sourced. As the cost of disposal to landfill increases, due to community pressure, so the economics of resource recovery will improve. The need for resource recovery is driven by community demand rather than by a shortage of landfill. *It is public business, and open access to facilities will be a necessity"* [emphasis added]. The market place will be dynamic requiring an ever-changing mix of products and processing techniques with maximum economic benefit only possible through focused marketing. Failures in the past have been due to a process rather than a market focus. Variability in both the composition of the waste stream and in the market for recycled products will require low-cost production, only possible through integration."

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> "Governments should control the waste stream and must become partners with industry. Tip fees will be used by government to control return on investment. Profit will be like that of utilities:

- virtually assured, but
- excesses will be limited through tip fees."

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"In Australia, the resources recovery business is in its infancy. No benchmarks exist because there are no significant operations and there are no Australian standards. There is concern from collectors and sorters with onward selling price and product acceptance by end-use manufacturers. When examined, this is not so much that there is a limited market but more a need for high-quality, uncontaminated, consistent recovered materials which must compete with traditional virgin materials. Failures in the past are due to companies being process oriented rather than market focused. Composting in America is an example: large quantities of unmarketable compost have been produced in expensive, purpose-built equipment. After an initial correction, the business is now achieving success through market segmentation and focused supply. End-use markets have been restricted because of a lack of high-quality recovered materials due to limited separation technologies, influenced by a reluctance to invest the capital required for the appropriate equipment."

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"There will be a few large, capital-intensive regulated companies in resource recovery in the future with limited competition, operating as utilities under government franchise."

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"Resource recovery businesses must have a prominent public profile because resource recovery is driven by community demand, not by a shortage of landfill space.

Waste is a political issue: Throughout Australia there is increasing public concern about the environmental impacts of wastes and pollution. Processing waste may heighten concerns unless unrestricted access to facilities is given to the community, both those in favour, and those against, all associated activities.

Location of waste-handling facilities: In future, the government's approach will have to recognise that local communities should be given the opportunity to participate actively in decisions which affect the environment in which they live. Local communities will have an active role in deciding where new waste facilities should be located and compensation should be paid for loss of amenity values which could be financial, or in the form of improved community facilities such as parks. Local communities will have the option to accept waste facilities in exchange for certain benefits or they could pay to have their waste transported away. Business will need to involve local communities if it is to economically select the type of processing and the location of resource recovery activities.

Corporate responsibility: Resource recovery and recycling are politically positive. Business will benefit from the image created as a good corporate citizen playing a prominent role through technology and marketing in solving some of the major problems associated with waste and helping government to meet its environmental objectives.

As long as there is no mandate from governments to recycle, landfill is always cheapest, but their constituencies will eventually demand resource recovery and provide the mandate. Governments can also control the waste stream and can provide source security.

- Resource recovery is a public policy issue largely because of the market failures that have prevented resource conservation and waste minimisation activities from reaching their full potential.
- Governments can legislate waste stream control and raise revenue to fund resource recovery and waste management.
- Waste stream control will ensure source security essential for the long-term economic survival of any resource recovery business.

Resource recovery profit will be similar in structure to that of a utility—virtually assured—but excesses will be limited through control of tip fees. A tip fee is the payment associated with the transfer of ownership of waste to a processor, paid at a transfer station, MRF or landfill and represents the processor's first revenue stream. The economics of waste management and resource recovery are driven by public awareness and concern for the environment which drives increasing environmental standards. Tip fees will be used to mitigate increased environmental standards and the cost of resource recovery.

Factors that will increase tip fees include:

- Closure of facilities that do not meet the latest environmental standards and cannot afford the cost of upgrading.
- Government insistence on recycling.
- Restricted access for some wastes to landfill.

Factors that will decrease tip fees include:

- Excessive profits being made by resource recovery or waste management companies.
- Reduction in community-driven environmental demands.
- Increasing acceptance and therefore increases in the market price of recycled materials."

***

"With waste management and landfill companies excluded, the resource recovery industry in Australia is highly fragmented. No substantial companies exist from which to create a base for future growth. Integrated resource recovery is a new concept worldwide and will require a new business approach."

7.3 Summary

Old-style solutions to the issues of waste management are no longer available, appropriate or even accepted.

On the production-of-goods side of the post-consumer waste stream, many layers of commercial and industrial expertise combine without difficulty to deliver the full range of products and services that our consumer society demands.

The resource recovery industry must be developed to close the loops seamlessly from post-consumer to the reuse options. This will mean changing roles and responsibilities for all concerned but it should not threaten the public sector—it should increase the range of sustainable options to allow a better level of overall service delivery to the community.

8. A Possible Model for an Integrated Regional Approach

This handbook does not aim to be too prescriptive about exact procedures or the adoption of precise technologies, but the problems and issues raised so far seem to be reconcilable by the adoption of a regional, integrated "recovery park" concept.

8.1 Basic objectives

Wastes that have not or cannot be minimised are destined for landfill unless a higher-value outcome is possible through resource recovery in some form (reuse, recycling or reprocessing).

The requirements for actively handling or treating these "unminimised" materials can be summarised as:

- recovery and processing of materials to sustain viable markets (resource recovery), and
- pretreatment of putrescible and reactive wastes and segregation of potentially valuable materials for delivery to landfill.

The benefits of moving toward active landfill management techniques (Chapter 5) are more obvious than the requirements to significantly upgrade Australia's fledgling resource recovery infrastructure.

The current approach to resource recovery has been characterised as "nibbling away bits and pieces from the waste stream on its way to landfill".

Most of the recycling efforts, material recovery facility operations and compost operations that have been struggling into existence in more recent times suffer from a lack of economies of scale, variable and unreliable feedstock quality and volume, and the disposal costs of their own rejected materials and residues.

For example, a MRF, handling the usual range of dry recyclables (glass, aluminium, PET, HDPE, paper and cans etc.) supplied by a council collection system, is prevented from achieving its optimum potential as a resource recovery process by:

- the scale of operation (designed to handle only the potential volume of material available from the commissioning council),
- limited access to markets (not big enough to supply some potential users and therefore being a "price taker" in the general market), and
- potential disposal costs of unsold materials or other potentially recyclable materials that could not be stored until available in usable quantities.

A possible solution to these problems of scale and viability which simultaneously completes the two basic tasks above is the "resource recovery park" (RRP) or "cluster park" concept.

8.2 The resource recovery park concept

The name "resource recovery park" is used here as a generic description of an approach that seeks to locate a wide range of recycling, reprocessing and waste treatment activities together on one site, under the common management of the party taking the ultimate marketing risk to create a single facility that can fully service a community in three main areas:

- providing a convenient, comprehensive waste acceptance facility to fully accommodate the public health and tidiness demands of a surrounding region,
- providing pre-treatment and sorting functions for all materials requiring subsequent landfill disposal, and
- recovering resources to supply and sustain markets or higher-value uses than landfill.

See Annexure A for a conceptual material flow diagram.

The overall aim is to achieve significant benefits by harnessing the efficiencies available from locating a range of activities together on one site. Wastes, residues or by-products are processed and become feedstock or raw material for another process.

This range of activities on one site would provide the facility management with options and flexibility to continue to provide the three main services.

Wastes must be received continually, regardless of market conditions for potential products or the temporary unserviceability of particular processes. Putrescible or reactive wastes cannot be stored untreated for any length of time.

Similarly, seasonal or market fluctuations of demand for some recovered materials requires facility management to be able to divert materials to alternative, although lower-value, outlets to maintain the overall material flows.

Thus RRPs can provide a buffer in the gross waste materials flows for the benefit of the waste-producing community, the environment generally and the customers of recovered resources in particular.

8.3 Potential RRP inputs and products

Inputs

The likely sources of waste streams for RRPs would include:

- domestic solid wastes from ratepayers and light commercial premises,
- small-vehicle drop-off materials including green and garden wastes, white and brown goods, light building and renovation materials,
- council-generated engineering wastes and parks and gardens wastes,
- general non-hazardous, commercial and industrial wastes (usually delivered by private contractors),
- building and demolition wastes, and
- other specialised wastes that the RRP has the approved capacity to process.

Products

Products from a RRP might include:

- the main recyclables
  - sorted glass,
  - sorted plastics (by polymer),
  - sorted metals (especially iron and aluminium),
  - paper and cardboard,
  - second-hand goods and materials;
- the main reprocessing products
  - compost mulches and soil-amendment products,
  - energy products;
- pretreated and sorted landfill streams;
- special or value-added products
  - oils,
  - rubber crumb,
  - general scrap metals; and
- crushed and screened aggregates, clean fill products.

Equally important for the community and the industry are the intangible “products” of RRPs:

- The optimum conservation of resources.
- The avoidance of the real and perceived pollution problems associated with landfills.

Both results would be achieved at the least possible net cost to do the job to standards demanded by the community, and with the flexibility to respond to market forces while striving to achieve the highest possible use for each "waste" material.

8.4 Likely constituent processes and procedures for a RRP

Most of the technologies and processes that would be assembled on a RRP are operating as individual facilities today.

The gate/weighbridge would accept all non-hazardous solid wastes offered for treatment and/or disposal. Some hazardous or semi-hazardous materials may be received where approved receival, handling and treatment facilities are available (e.g., asbestos to the secure section of a landfill or mineral oil as a fuel source).

Facilities must provide local councils and communities with ready access in the interests of their main, and historical, concern for public health issues and a clean and tidy environment. A graduated scale of gate fees for the full range of incoming materials would ensure the relative incentives/compensation to support the broader issues of cost effectiveness.

A **materials recovery facility** would receive all source-separated recyclables from the council-operated, door-to-door collection, various drop off facilities and materials recovered from other waste streams elsewhere in the facility. By a mixture of manual and mechanical sorting, the products could be the full range of materials that have been selected for specific market opportunities, including colour-sorted glass, paper/cardboard, aluminium, ferrous metals and selected plastic polymer types.

Just as some MRF inputs can come from other sorting processes on the facility, reject materials can be directed to compost (paper), waste-to-energy (paper, plastics) or the landfill pretreatment pulverising drum.

Second-hand goods exchanges can operate as exchange, barter or scavenge-for-sale facilities, receiving potentially valuable items, bric-a-brac and building materials from incoming vehicles (mostly private) and reselling from the site. Such facilities are useful in extending the potential life of products even if the overall disposal diversion function may be limited.

Specific processing operations for separable incoming wastes may include:

- soil exchange for clean fill;
- building and demolition materials—crushed, screened and blended to produce products ranging from decorative gravels (crushed roof tiles) to structural aggregates and fill materials. Building wastes can also include ferrous scrap, aluminium, glass and reusable timbers. Unusable timbers can go to the wood-waste processing area for conversion to mulch or compost bulking agent products, or to the waste-to-energy facility;
- wood-waste processing for size reduction and screening to produce mulch, compost or energy products;

- oil receival to collect used oils for re-refining or to produce energy products;
- tyre collection, sorting and preprocessing for downstream reprocessing into value-added crumb products; and
- green and organic waste receival, sorting and processing to feed composting facilities. Simple green and garden wastes come from either resident drop-offs, specific council collection, parks and gardens departments' wastes and garden-care contractors. The materials can be composted in simple external windrow operations or mixed with woody carbonaceous amendment to produce mulch and compost.

Windrow composting operations may be on or off site depending on the available space (an average external windrow composting operation can require 2-4 hectares including final screening and product storage). For simple green/garden wastes, these uncomplicated external operations can produce the best balance between operating cost and product value but exposure to the atmosphere can limit total process control. This means that for the potentially more difficult (and smelly) organics (food scraps and industrial food-processing residues), an enclosed, more expensive facility is needed.

Enclosed composting facilities offer complete control of moisture, oxygen and temperature, usually in a negative air pressure environment building or vessel. They will usually include automatic compost-turning technology and are designed to beneficially process the more difficult organics such as:

- household food wastes and putrescibles (where a council collection system is instituted),
- industrial food-process wastes and sludges,
- market and greengrocer residues,
- hotel or restaurant wastes, and
- sewage sludges or animal husbandry wastes.

These materials can seldom be aerobically composted alone and usually require bulking with processed wood or garden waste materials to maintain the designed C:N ratio and initial moisture conditions. Thus there are essential synergies in operating wood-waste processing, external windrow composting and enclosed controlled environment composting on the same site and under common management, not just for the flexibility offered with feedstock materials but also for the common marketing of the finished products. The products will range from simple mulches to soil amendments, composts and even a range of organic fertilisers.

These potentially more difficult organic wastes could be processed anaerobically in proprietary biofermentation systems to produce methane (for sale or use as an energy source on site). An intensive initial methane (biogas) production phase can be followed by traditional aerobic composting.

Waste to energy can take many different forms, but on any RRP there will always be a range of materials, rejects and residues from which energy extraction offers a higher-value end use than simple landfilling and simultaneously achieves volume reduction and pretreating or stabilisation before landfill. Examples include:

- biofermentation for methane extraction,
- incineration with power generation or process heat recovery,
- refuse derived fuel (RDF) pellets or fluff produced from a selection of combustible materials for on-site use in more standard furnaces or sold for off-site use,
- landfill methane gas extraction, and
- smaller-scale combustion of high-energy residual wastes such as oils, plastics, wood and paper for on-site process heat use.

Landfill pretreatment and transfer of reject materials for disposal. As the landfill should follow the active management format (Chapter 5), putrescible or reactive residues from the previous processes should be prepared for segregated disposal. Size or volume reduction is unlikely to be a primary consideration at this point, but whether the landfill is next to the RRP or some way off, the needs are similar.

Inputs to the pretreatment and transfer stage will include:

- material directed from the gate as having no higher value,
- rejects and residues from any other on-site process, and
- waste-to-energy ash and residues.

Compaction or baling will have no benefit and will only impede the biodegradation of residual organic material.

A possible option could be a rotary pulverising drum into which the mix of materials would be:

- size reduced,
- aerobically decomposed,
- pasteurised, and
- screened to produce fines for cover material and a coarse fraction of inert materials for short-, medium- or long-term disposal and storage in line with the Chapter 5 objectives.

These drums have an added benefit: the mixing action greatly speeds up the normal biodegradation and stabilisation, which could take 10-100 years in landfills without such pretreatment.

Value-adding activities can be added to the mix of operations on a RRP. Sorting, washing and regranulating recovered plastics on site could allow the washing residues (labels and content residues) to be passed for composting, the waste water used in composting and rejected plastics to be burnt. The effect would be lower process costs, cheaper waste disposal and more cost-effective transport to end users. Similar benefits could accrue to metals, glass, paper and tyre processing.

Every extra process will cost more for capital and operation but will generate a greater return from the value-added product.

Initial receiving and sorting functions will usually remain constant, but individual RRPs may have different mixes of secondary processing, with variable emphasis in the blend of composting, waste-to-energy and landfill to suit local circumstances.

8.5 Economic viability

There are no fixed criteria for the economic viability assessment, and a range of local factors and market conditions will make each case different. However, factors that will tend to improve the economics for a purpose-built RRP to replace the same range of activities operating in isolation throughout the community or region include:

- Each process stage will receive a more defined, reliable and concentrated input stream to allow better controls and procedures.
- Transport costs are almost eliminated within the facility, lowering the input costs and reject disposal costs.
- Land, building, licensing and buffer zone constraints and costs are shared and minimised for each facility or operation.
- Process, marketing and output flexibility provides greater capital security and therefore allows increased investment in appropriate technologies.
- Products, residues and by-products find immediate outlets and markets.
- Product marketing is streamlined by the overall facility operator and by the economies of scale achieved.

Each operation or facility should be able to service its own capital requirements and operation costs from its sales income and any part of the gate fee it gets. Only the gate administration and landfill operation (including the transfer/pretreating drum) would be a net cost, and they would be covered by the gate fee that the RRP received from the community for providing the basic waste acceptance and disposal service.

8.6 Siting requirements

RRPs should be able to be sited on any suitably large area of appropriately zoned industrial land. Surrounding buffer zones would alleviate any impact on industrial neighbours, but the ideal would be a site on or next to an existing landfill.

8.7 Ownership and management options

Benefits that RRPs offer in making the transition from waste management to resource recovery come with essential disciplines and requirements to make them work as designed. Four of the most crucial are capital adequacy, resource security, flexibility, and common ownership and/or control of the constituent operations. Attention to these issues tends to dramatically reduce the possible ownership/management options.

8.7.1 Capital adequacy

Traditionally, the treatment and management of wastes have been synonymous with spending as little as possible because "it's only worthless waste". As the focus of a RRP is resource recovery to supply materials to sensitive markets, where quality of reclaimed product will be compared with virgin resources, there is a vital requirement to adopt the latest technologies and to capitalise the processes as for any other productive industrial sector. Investing in new advanced technologies is an expensive and high-risk business. Technologies can be developed and introduced regularly, often leaving recently introduced processes competitively obsolete. This is especially so in speciality processing and value adding of basically sorted commodities.

The most profitable areas of the waste industry are in the collection and transport sector. Competition for contracts has progressively driven the move from the hand-loaded dustcart of yesterday to the technologically advanced, one-man-operator, split bin, collection systems of today.

Sorting, reprocessing and beneficiation technologies are already undergoing similar change and advancement. Promoters and operators of RRPs have to be large enough to provide the level of capital funding required. This limits entry to only a few companies with strong balance sheets, but the high entry cost offers commercial protection. However, once a commitment is made to the development of resource recovery facilities, the next crucial issue is to ensure that there will be enough wastes to process over the planned life of the facility.

8.7.2 Resource security

Resource security, or the assurance that waste materials will always be available (to enable an assured return on capital invested) is an area that could be contractually simple but tends to be politically difficult.

At its simplest, a council or group of councils acting as a region could assess the volumes of waste they are likely to produce and encourage the development of an appropriately sized RRP on a "put or pay" contract.

This type of contract assures the RRP developer that if the prescribed volumes of waste are not available, the council(s) will still pay for the unused capacity. The contracts provide the commercial comfort required by the developer, but the councils are, in effect, contracting to produce wastes or suffer a financial penalty. This is diametrically opposed to the principles of waste minimisation and politically unacceptable.

Options include having smaller and more flexible RRPs or for the RRP operator to assume the input volume risk by assessing future needs and trends and ensuring that a council area will direct all its wastes to the facility, whatever the volume.

A facility operator can manage this risk by slightly "under capitalising" the expensive functions and maintaining their optimum throughputs, but providing ample landfill pretreatment capability to accommodate the possible range of incoming materials. The crucial resource security issue remains one of the most important to be negotiated.

8.7.3 Flexibility to handle changing market conditions

Flexibility to handle changing market conditions, variable input volumes and waste stream constituents is not only an essential requirement for a RRP but also one of the main advantages it has over scattered operations.

For health reasons, the community's putrescible wastes cannot be stockpiled untreated, so a RRP must use other processes for surges or breakdowns in supply. Access to landfill through the pretreatment/transfer operation can provide this fall-back service.

Generally, composting, waste-to-energy and landfill can provide safety net outlets for materials that the other processing or MRF operations cannot use or for which market conditions have become unfavourable. Surplus wood or paper/cardboard can go to either composting or waste-to-energy, surplus plastics can go to waste-to-energy or monofill. In fact the monofill capacity can play a useful market stabilisation role for all inorganic products.

RRPs under common management and control can beneficially direct materials to the highest-value use for the prevailing circumstances. Such control is one of the most important reasons a RRP can be viable whereas the same operations spread throughout the community are far more constrained by raw material supply and outlet options for products, by-products and residues. Transport considerations alone can limit the options for stand-alone facilities.

Common management and control, though essential to implement the market focus and operating efficiency, can be politically sensitive if the community feels the levels of service and net costs might slip from its control or influence.

8.7.4 Facility ownership and management

Facility ownership and management have to achieve and facilitate the following as an essential minimum:

(i) **Public accountability**. This is "public business" and the basic provision of a waste acceptance and treatment service is a public utility function. A RRP is basically set up to satisfy the public demand for better pollution control than the current system and to conserve resources. These costs are reduced by the sustainable resource recovery procedures of a RRP, but the market-driven focus most remain in harmony with the public-service element, meaning that RRPs must ultimately be politically accountable.

(ii) **Adequate capital funding**. A RRP's ability to satisfy public demands and provide a service at the lowest possible cost depend on a high level of initial capital. This demands a commensurate level of financial and business management skill. Control of business decisions should usually rest with the party taking the ultimate market risks—invariably private enterprise.

(iii) **Making the best use of the flexibility or synergy available through the range of process and product options available on the site.** The unfettered management of the material flows through the site is one of the main reasons RRPs are more efficient than scattered operations.

(iv) **Return on investment**. For the private sector, this is simply measured in terms of profitability and return on investment. For the public sector, it is measured in terms of satisfaction of the community's demand for improved service at the lowest possible net cost.

With this spread of overall objectives, should ownership and control of RRPs rest wholly with the public or private sectors or somewhere in between?

As (ii), (iii) and (iv) above seem to favour private control, and public accountability is primarily focused to achieving (i and iv), this suggests that the answer is "somewhere in between".

Model One—the publicly controlled and managed approach

One model is for the public sector to provide a site and an existing landfill and to control the "gate", then contract in the full range of specialty service and process providers to the one site. This might look like a resource recovery park as described above, but it would fail to achieve the best results, as it could not fully exploit the synergy or optimum material flow between the various operations.

For example, a stand-alone MRF operator, faced with a surplus of marketable plastics would have to negotiate deals with the waste-to-energy or monofill operator to avoid simply landfilling the material. The "why bother" argument might prevail and a potential resource would continue to be lost, much as occurs now. Thus no material advantage accrues from developing a RRP, other than transport efficiencies.

This model could also see the public sector at the "gate" approving incoming loads and directing material flows to certain facilities without being accountable for the ultimate marketing of the products.

For maximum operating efficiency, the party at the "gate" collecting revenues and directing waste streams should be the party taking the overall market risk for the products and the party ultimately responsible for return on investment on the separable parts of the facility.

This model may have some advantage in political expediency but would ultimately fail to provide a cost-effective and sustainable solution.

Model Two—the joint-venture approach

In the joint-venture approach, the party representing the public may be a council, a group of councils as a region, or a state government department, but the principle is the same. The joint venture is likely to be 40/60 or 30/70 public/private, reflecting the relative contributions and risk taking. The public may or may not provide the land and a landfill facility.

The public and private joint-venture partners, in developing the RRP facility and managing the operations, bring the respective skills of public accountability and commercial management. The joint venture controls the gate so that material flows are directed in the broad public interest. The operational facilities of sorting, reprocessing, value adding and disposal are established on the site as wholly-owned subsidiaries of the private joint-venture partner, or franchised under tight specifications. In some specialised value-adding operations an outside operator may be contracted to the site by the joint-venture management group.

This approach, which can have many variations, can achieve all four of the above objectives more easily than if the facility is wholly publicly or privately owned.

Model Three—private ownership of the facility with public controls

This third model would see a private operator mandated to establish and manage the entire facility. A landfill facility may or may not be provided by the public sector. Public accountability is controlled by the community through contractual/service agreement provisions in the original contract, and a degree of financial control is provided through an agreed gate-fee-setting formula. Environmental outcomes are controlled by contractual obligations and policed by the relevant authorities. This total private ownership and operation model ensures the optimum efficiencies in capital invested and maintains the vital link between operational control and management of the marketing risk.

8.8 Size of RRP operation

How big should a RRP be?

Larger facilities should be able to provide a wider range of processing options and achieve economies of scale. They can maintain flexibility because of the internal range of processing options, but the size alone and the capitalisation to be serviced can make them hungry for wastes and therefore not compatible with waste minimisation.

Large facilities also require more wastes to be brought in from longer distances, adding cost and raising the politically sensitive issue of bringing "other people's wastes into our backyard". Large facilities are less adaptable to the introduction of new processing methods as they have such a heavy commitment to the older technologies. A larger number of smaller facilities may lose some economies of scale, but improving technologies will tend to make this up over time.

RRPs that serve communities of 250,000 to 500,000 population seem to offer the greatest cost-benefit because:

- The collection compactor vehicles can deliver direct without the need for transfer stations.
- This population will usually involve the cooperation of only one to five councils, making the host-donor relationship less sensitive and the "region" much easier to administer.
- The volume of total solid waste produced by this population will allow all the key process elements to operate at peak efficiency.

Some regionalisation of councils in the past has focused on each region being self contained, including their own landfills. With a properly functioning number of RRPs around the major metropolitan areas, the residues for landfill would be non-putrescible and reduced enough to allow several smaller regions to comfortably share a common disposal facility.

However, fully functioning RRPs require all the parties to review their essential roles and relationships.

8.9 Relationships between RRP operators and the community they serve

The relationship between the public and private sectors—the new breed of facility operators and the community that they serve—is crucial. It revolves around resource security, public accountability and the history of councils wanting to maintain autonomy to better service the needs of their local community.

Whether the RRP owner/operator is a joint venturer or a private operator, the need for resource security to underpin the initial investment is vital. "Put or pay" contracts are unacceptable but some mechanism is needed to help the facility operator assess potential future volumes and capitalise the RRP to process the wastes as efficiently as possible.

Forecasts of overall waste-generation rates for a given community are usually reliable, so it could be an acceptable commercial risk to establish a RRP on them as long as some assurance could be received that the wastes from a given area would all come to the RRP for processing, whatever the volume. Such calculations are made all the time for future housing demand, roads, water and power and even shopping centres. If the negotiations are between one council and a RRP developer, there should not be much difficulty, but if the community to be served is made up of two or more council areas the negotiations could be more complicated.

Most states have imposed regional groupings on councils. The regional bureaucracy could make the commitments on behalf of the councils involved, which solves the resource security issue for the facility operator but involves yet another layer of administration.

The fundamental issue is for councils or regions to understand that RRPs cannot be developed without some assurance about the volumes of wastes to be processed and the time over which the operators can expect a return on their investment.

9. Outcomes and Options

What are the realistic options for delivering cost-effective improvements to waste-management problems? Perhaps there are not as many as people think.

9.1 Summary of the debate so far

In the previous chapters, we have reached the following conclusions:

I There is a genuine demand from the community for radically better waste management to produce a net improvement for the environment, including the conservation of resources.

II As the same community that is demanding the improvements will ultimately pay for the new services as either ratepayers, taxpayers or as consumers, there is an obligation to deliver the results at the least cost.

III The avoidance of producing wastes in the first place (waste minimisation) is the top priority and is essentially an industry responsibility.

IV Wastes that have not been or cannot be "minimised" can safely, beneficially and cost effectively be "processed", stored and disposed of at an actively managed landfill.

V Resource recovery should be specifically focused on the demands of the market, and undertaken only if the recovered resources can sustainably achieve some quantitatively higher value than landfill.

VI Multiple market outlets should be encouraged and developed to limit the current dependence on certain single-industry responses or closed shops.

VII Getting the right target—cost effective resource recovery should be the objective rather than an arbitrary percentage reduction in wastes to landfill.

The role of local/regional/state governments should be as clients who set the rules and have ultimate accountability. Private enterprise would then fund the investment, take the risks, and manage the operations.

For all this to happen, roles for most of the main stakeholders will have to change.

9.2 Probable roles for the key players

Local government

- Main service provider to the community.
- Most politically accountable level of government.
- Provider of initial collection services.
- Provider of resource security assurances to resource recovery park operations either individually or grouped as regions.

State government

- Implementer of environmental standards universally enforced to promote better results.
- Possible cooperative role in developing regional approaches.

Federal government

- Facilitation of standards setting and performance monitoring.
- Harmonisation of approaches (by states/regions) to avoid costly inconsistent requirements.

Primary producers of energy, new materials etc.

- Plan strategically. With such a wealth of materials now recoverable from existing stocks, investment in new mines, plantations and oil wells may be redirected as more domestic demand is met from already existing "secondary" resources.

Materials converters

- The availability of "secondary" resources will progressively increase to supplement or even replace some virgin supplies of raw materials.

Traditional waste industry

- Waste producers, public or private, will increasingly specify the destination or processing facility required to meet their needs.

- The collection and transport business will always be an essential service but adding value will be increasingly difficult if the full needs of the waste producer are not met.

Potential resource recovery operators

- Will ideally be large, well-capitalised companies that have specific expertise in "manufacturing" products to satisfy and sustain markets.
- They may have access to internal markets (within their own businesses), initially for such products as energy, building materials or manufacturing ingredients.
- They may have commodity trading expertise nationally or internationally for certain materials.

Of all these roles, the greatest challenges will be for local government as it moves from being a sole operator to a team player.

9.3 The options

The way forward from here could be:

- **The legislative approach**

Governments, anxious to respond to what they feel is a clear community demand for improvement, could begin to introduce regulations and legislation. Such actions could impose targets, prescribe methodology or strategies, impose taxes and charges or ban certain activities.

Such an approach, as in Germany, can be made to achieve the prime objective, but always at a disproportionately high cost to the community and without solving the underlying problems.

■ *Result*—inflexible, high cost and dislocating action.

- **The technological approach**

Proponents of advanced technologies convince a frustrated community that the answer is a better incinerator or compost plant or a new landfill technique. Sign here, please, and your problems will be solved, or will they?

The US is littered with closed plants. Sometimes the technology was faulty, but mostly the management system, the strategy or the inequitable risk-sharing caused schemes to fail. Technology is a vital tool but it cannot be a cure-all. What is needed is an attack on the fundamentals of collection and management efficiency.

■ *Result*—narrow, inflexible, 'islands of technology' that cannot deliver effective, sustainable environmental improvements.

- **The cooperative integrated approach**

Everything that has been discussed in the preceding chapters points to the fact that no one party, technology or system can deliver the changes the community expects. A successful program has to be inclusive of all the main stakeholders and based on a common understanding of the problems, needs and issues.

With all the main stakeholders included and playing their appropriate roles, the tangible outcome will be the development and operation of the sustainable systems and infrastructure to complete the task.

The next step should be for a council or region to seek a suitable resource recovery park operator or an operator to approach a group of councils. In either case, each party should now fully understand the other's position, and constructive and cooperative negotiations can begin to develop the contracts and service agreements that would record the results.

■ *Result—*

- Investment in a range of resource recovery technologies allows the maximum value of recovered materials to be realised, and the flexibility to provide alternative recovery/disposal paths depending on market demand, which will produce best practice waste management and resource recovery.
- Efficient, market-oriented operation of waste collection, resource recovery and disposal facilities.
- Responsible standards and client accountability from local/state governments.
- A community which receives improved environmental management that is cost effective, sustainable and emphasises minimisation and recovery of recyclable materials.

9.4 The vision

We need to take a long, hard look at our waste management priorities. Instead of putting all our efforts into reducing waste to landfill by 50 percent by the year 2000, we should also be actively working to end the recycling deadlock—a recovery rate of only 15 percent after five years—and achieve meaningful resource recovery from the waste stream.

Since landfill will always play a role in waste management, we should re-examine the role of landfill and make it a more positive one for the environment.

Whether a waste is dispatched to landfill or not should depend on whether or not it has a higher environmental and market value than landfill disposal. It is just as unsustainable to divert waste from landfill at any price as it is to continue to throw away potentially reusable resources.

There are many technologies offering an alternative to landfill, including composting and waste-to-energy conversion, and we should not exclude any of them. The right solution depends on circumstances, costs and the nature of the individual waste stream.

The quickest and surest way to achieve these outcomes is to establish partnerships with reputable private sector companies which already possess the management and marketing skills, can utilise recovered raw materials within their existing operations, and are prepared to capitalise the infrastructure required.

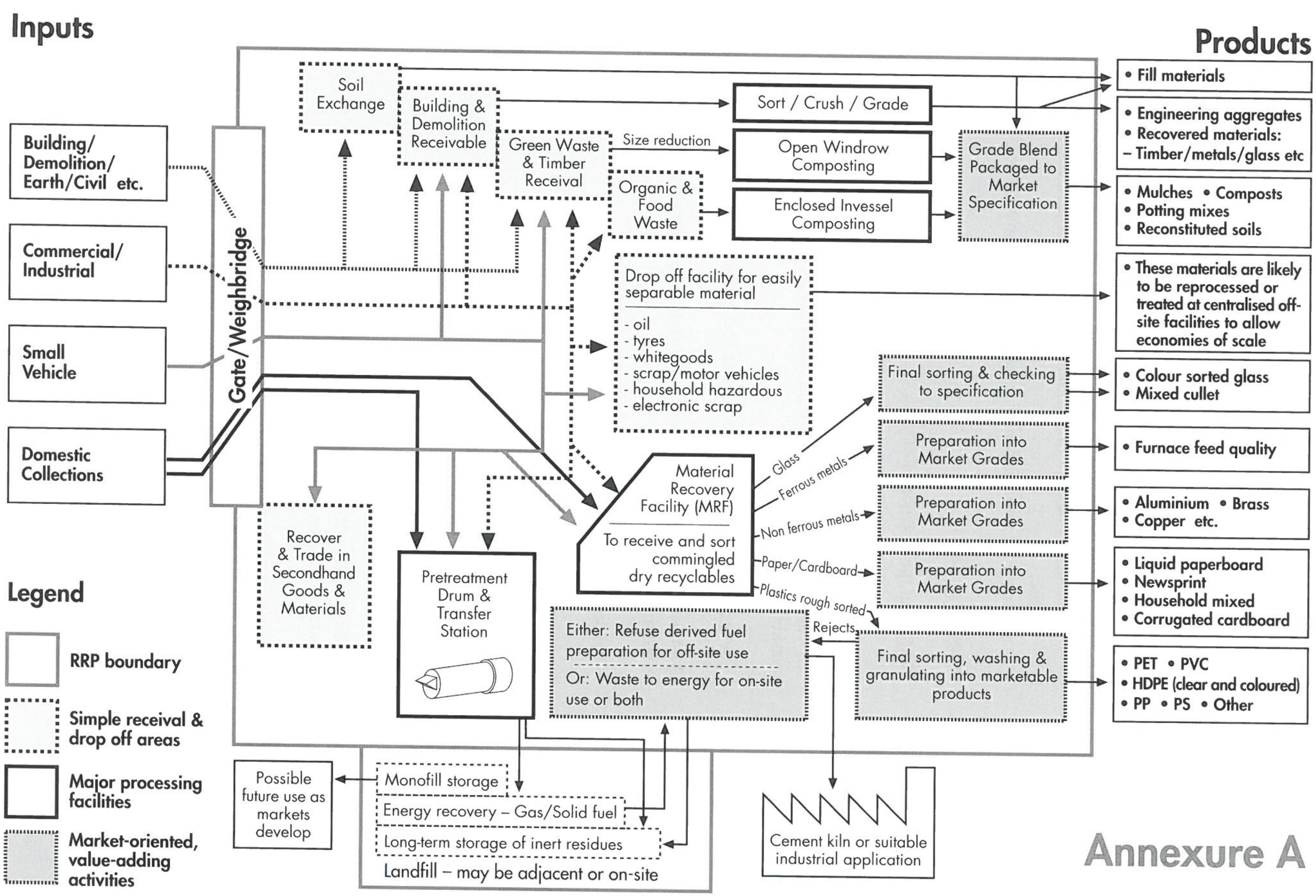
9.5 SWID ongoing role

We must take a "big picture" view of waste management, accept the need for change and develop solutions that ensure the efficient recovery of value from the waste stream and the safe disposal of materials of lower value.

GMA members are committed to the development of environmentally effective and responsible waste management practice in Australia. "Best Practice" solid waste management will require that the community, governments and industry accept new roles in the development of sustainable (affordable) resource recovery and recycling practices.

The SWID group of the GMA will continue to work with government and other interested parties to further the establishment of solid waste management guidelines and infrastructure based on sound business practice, appropriate to local conditions.

In this way, our customers will continue to enjoy good value for money products and Australia will achieve a sustainable competitive advantage.


Inputs
Products
Building/ Demolition/ Earth/Civil etc.
Commercial/ Industrial
Small Vehicle
Domestic Collections
Gate/Weighbridge
Soil Exchange
Building & Demolition Receivable
Green Waste & Timber Receival
Size reduction
Organic & Food Waste
Sort / Crush / Grade
Open Windrow Composting
Enclosed Invessel Composting
Grade Blend Packaged to Market Specification
Drop off facility for easily separable material
- oil
- tyres
- whitegoods
- scrap/motor vehicles
- household hazardous
- electronic scrap
Material Recovery Facility (MRF)
To receive and sort commingled dry recyclables
Glass
Ferrous metals
Non ferrous metals
Paper/Cardboard
Plastics rough sorted
Rejects
Final sorting & checking to specification
Preparation into Market Grades
Preparation into Market Grades
Preparation into Market Grades
Final sorting, washing & granulating into marketable products
Recover & Trade in Secondhand Goods & Materials
Pretreatment Drum & Transfer Station
Either: Refuse derived fuel preparation for off-site use
Or: Waste to energy for on-site use or both
Monofill storage
Energy recovery – Gas/Solid fuel
Long-term storage of inert residues
Landfill – may be adjacent or on-site
Possible future use as markets develop
Cement kiln or suitable industrial application
• Fill materials
• Engineering aggregates
• Recovered materials:
– Timber/metals/glass etc
• Mulches • Composts
• Potting mixes
• Reconstituted soils
• These materials are likely to be reprocessed or treated at centralised off-site facilities to allow economies of scale
• Colour sorted glass
• Mixed cullet
• Furnace feed quality
• Aluminium • Brass
• Copper etc.
• Liquid paperboard
• Newsprint
• Household mixed
• Corrugated cardboard
• PET • PVC
• HDPE (clear and coloured)
• PP • PS • Other
Legend
RRP boundary
Simple receival & drop off areas
Major processing facilities
Market-oriented, value-adding activities
Annexure A

Annexure B

Glossary of Terms

Actively managed landfill	Landfill disposal facility that provides a range of management options for the different incoming materials e.g.: - long-term storage for inert materials; - a monofill function for homogenous materials that have a low current value; - short-term stabilisation of putrescible or reactive wastes.
Aerobic	Requiring oxygen.
Anaerobic	Requiring the absence of oxygen.
ANZECC	Australia and New Zealand Environment Conservation Council.
Beneficiation	To value add or refine recovered materials to improve their subsequent marketing possibilities.
Biodegradation	The breakdown of materials as a result of the action of biological organisms.
Biomass	Materials of immediate biological origin (e.g. wood, paper and plant materials).
C:N	Carbon to Nitrogen ratio.
Carbonaceous	Consisting of or containing carbon.
Commingled collection	Mixed recyclables separated from the waste stream by householders into a dedicated container for separate collection.
Cullet	Broken glass.
Drop-off centre	Dedicated area for the public to deposit recyclables generally in source separated manner.
Feedstock	Raw material for processing.
G.M.A.	Grocery Manufacturers of Australia.
HDPE	High density polyethylene.
Half by 2000	A 50 percent reduction in total waste going to landfill by the year 2000 measured by weight per capita based on 1990 levels.

Halogenated organic compounds	Organic compounds containing any of the non-metallic elements of the halogen group (chlorine, iodine etc.).
Home composting	Disposal of household organic waste by aerobic decomposition at home.
Hydrolysis	The process of decomposing cellulosic materials into fermentable sugars.
ISW	Industrial solid waste.
Inventory risk	The responsibility to maintain the availability of a reliable quantity of feedstocks for an industrial process.
Kerbside collection	Collection of recyclable materials placed at roadside by householders.
LDPE	Low density polyethylene.
Leachate	The solution which is the result of liquid seeping through a landfill and, by so doing, extracts substances from the deposited wastes.
Lightweighting	Minimising the amount of materials needed to manufacture an item or container.
LPB	Liquid paper board
Ligno-cellulosic materials	Wood or vegetative materials such as timber, paper and straw.
MGB	Mobile garbage bin ("wheelie bin").
MRF	Materials recovery facility for sorting and processing recyclable materials such as plastics, ferrous, paper and glass which have been delivered in a commingled and/or source separated form.
MSW	Municipal solid wastes.
Methanogenic	Methane producing microbial reaction.
Monofill	Specific storage of homogenous materials.
ONP	Old newsprint.
PAH	Polycyclic aromatic hydrocarbons.
PET	Polyethylene terephthalate.

Putrescible wastes	Wet, organic material that can be broken down by the action of microbes.
RDF	Refuse derived fuel in pellet or fluff form.
RRP/cluster park	Resource recovery park.
Resource recovery	The recovery of valuable materials or energy from the waste stream including such processes as reuse, recycling and reprocessing.
SWID	Solid Waste Infrastructure Group of Companies formed under the auspices of the GMA.
Source separation	The sorting and separation of garbage streams at source, e.g. the household or workplace.
Trilaminate or three layer bottles	Plastic containers made with a core of recycled plastic sandwiched between two layers of virgin polymer, generally HDPE or PET.
UHT	Ultra high-temperature treatment (e.g. pasteurisation of milk).
Vector	Carrier of disease.
WTE	Waste to energy.
Waste minimisation	The avoidance of materials or waste being produced in the first place.
Windrow	Elongated horizontal piles of organic materials set out for composting.

Annexure C

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