# Waste generation and resource efficiency:

## Social conciousness or valued commodities?

A report submitted to the Productivity Commission

M2W2 Professional Services.

# Contents

## SUMMARY

Waste is very big business. The Australian Bureau of Statistics estimates the cost of waste to landfill or Materials Recycling Facility alone at 0.2% of Gross Domestic Product (>$3b 2006 est.). Further, revenues from recycled or second-run materials as saleable commodities command multiples of this figure (corrugated box market alone at $2b pa).

The Commission may consider this Inquiry as an opportunity to:

- refocus waste management within its manufacturing environment,
- acknowledge local government's role as Australia's clean-up agent,
- move the waste debate on from its stranglehold by laudable, but largely self-serving community entities and public policyfollowers;

and set about placing the waste management industry on a competitive and productive path.

> Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: *Taking sustainable use of resources forward: A Thematic Strategy on the prevention and recycling of waste.*
>
> Although waste prevention has been the paramount objective of both national and EU waste management policies for many years, limited progress has been made so far in transforming this objective into practical action. Neither the Community nor the national targets set in the past have been satisfactorily met.
>
> P5 Brussels, 21.12.2005
> COM (2005) 666 final

# 1. Optimising resource recovery: benefits and costs

## 1.1 A Resource Recovery facility

Fifteen years ago, the Public Transport Corporation in Victoria was staving off a series of stakeholders all of whom were bent on absorption of V/Line Freight's lucrative short- and mid-range haulage. They succeeded.

Before this, the V/Line Freight's Marketing Group was investigating high-bulk freight haulage opportunities. One may be of interest to the Commission.

**The proposal for a Resource Recovery Facility to manage Melbourne's municipal waste stream.**

Plant Audit Australia proposed an integrated domestic waste handling system and a fully-mechanised resource recovery plant of one million tonnes per annum. The proposal had the following components:

1. Resource transfer station.

   The resource transfer stations were to be located adjacent to rail spurs. The waste was transferred from the garbage trucks, larger pieces ground to a certain size and the waste flow was screw fed into rail containers. This process occurred in a controlled environment. The containers were stored in a race that fed on to noise-dampened rail wagons and the resultant containerised and sealed waste was transported to a mid-Victorian municipality – again with railway access. The municipality had no objections to the resource recovery facility and the jobs and potential business in manufacturing, and education that it would attract.

   At that time, three transfer stations could handle all Melbourne's domestic waste.

2. Resource Renewal facility.

   The trains unloaded their freight containers at the regional facility and picked up cleaned containers and lids for the return journey. The containers were emptied, and in a series of processes the heavy components such as rocks, glass and metal were removed first – Feedstock A. Lighter materials - Feedstock B – paper, plastic and fibres were also removed, leaving Feedstock C – the putrescibles and any contaminants.

   Feedstock A is now routinely removed from waste streams.

   In Resource Renewal, Feedstock B was also sorted according to density on principles derived from flour-making and now being introduced in automated materials recovery facilities. The Resource Renewal process is robust and quite efficient, cleaning and sorting particle-sized plastics by type, paper and cardboard by fibre length, plus cleaning and sorting fabric-based fibres.

   Feedstock C became slurry that was mechanically processed, again using food technology principles. From this stream any remaining plastics or fibres were

removed, dried and returned to Feedstock B. The remaining compostable stream, subject to contamination from household chemicals, was continuously subject to chemical analyses and any suspect flow could be diverted and containerised for off-site treatment.

On the plans, the Resource Renewal facility produced baled colour-sorted glass, paper and cardboard fibres, named plastics and long lines of covered compostables (to prevent drying out) turning into very rich compost – graded and certified.

Due to the scale of the fully-operational facility, these products were removed continuously, as the trains only stopped running once or twice a year and the quantities were very large and seasonal. Also, the compost stream was off-site, although it may have been in conveyor-belt range. The facility's process water was recycled, and the financial numbers stacked up very well for councils against landfill prices, i.e. free at the transfer station.

As the Chinese say, everything about the duck was used except the quack. Resource Renewal, being containerised, was even quieter.

## 1.2 Post-Resource Recovery facility

The aftermath of the proposal:

First, V/Line Freight was very interested in the proposal and invited representatives from the relevant emerging industries to study the schematics.

Second, V/Line Freight vigorously lobbied the Victorian Government to set up a pilot plant in the selected town to produce enough feedstock to allow the emerging industries to assess the output.

Third, that was the time of turmoil in the waste collection industry, with proven allegations of overseas criminal elements involved in the Australian waste collection and landfill industries.

On the first point, the then-emerging resource industries have now settled down into an Australian duopoly, partly and incompletely using the schematics provided by Plant Audit Australia to sort contaminated recyclables. It is not hard to imagine why their processes are suboptimal; Plant Audit is still waiting to hear from them about their final decisions on paper fibre/plastics retrieval from Resource Renewal, whereupon they can get the complete plans. V/Line Freight was sold off.

On the second point, the lobbying was unsuccessful due to some political blood-letting and the PTC's champion (and Minister) deciding to take a position in London.

On the third point, timing was against V/Line Freight as the waste collection industry was under investigation, as were officers from several Councils. Some were dismissed for bribery.

*Quote 1. ACCC commences proceedings against Visy group for cartel activities*

**Proceedings instituted against Visy group, senior executives for alleged cartel in the corrugated fibreboard container market**

The Australian Competition and Consumer Commission has instituted proceedings in the Federal Court, Melbourne against Visy Industries Holdings Pty Ltd, Visy Industries Australia Pty Ltd and Visy Board Pty Ltd.

Proceedings have also been taken against Mr Richard Pratt, Chairman of the Visy Group; Mr Harry Debney, the Chief Executive Officer of the Visy Group; and Mr Rod Carroll, the former General Manager of Visy Board; for allegedly being knowingly concerned in or party to the contravening conduct by the Visy respondents.The ACCC alleges that the above respondents engaged in conduct in the corrugated fibreboard container industry that was anti-competitive, including engaging in price-fixing and market sharing, in contravention of section 45 of the *Trade Practices Act 1974*.

The ACCC alleges that between 2000 and late 2004 the Visy respondents entered into and gave effect to anti-competitive arrangements with its principal competitor Amcor Ltd in the supply, throughout Australia, of corrugated fibreboard containers. . .

Amcor Ltd and its former senior executives have to date received immunity from legal proceedings by the ACCC after the company came forward with information about the alleged conduct. The immunity was granted under the ACCC's 2003 Leniency Policy and is conditional upon continuing full cooperation from the company and executives in providing information to the ACCC about the alleged cartel. Ref. ACCC 2005.

# 2. Australian waste services.

## 2.1 Brief history of recycling in Australia

The use of recycled materials within manufacturing depends on many factors. One lesson from the Resource Renewal story is that would-be entrants with new feedstock supplies and new technology must deal with the current industry structures. At that time there were few organisations that could cope with more than a few extra tonnes of feedstock or a few extra input types. That means that it must be in the financial and strategic interests of the various sectors of manufacturing to accept or reject a new feedstock and that is still the case.

## 2.2 Traditional recycling industries

*Glass.* For years glass was recycled from hotels, restaurants, bottle drives and basic recycling at landfill. It was sorted by hand according to white (clear), green and brown, with brown then being some 30 per cent below the value of white, and green only slightly better.

*Paper*. Only long fibre office paper and cartons – especially imported kraft cartons – were of interest to paper recyclers. They on-sold the actual cartons and quality paper to Visy and (now) Amcor and these firms pre-processed the items for inclusion with their virgin fibre feedstock.

*Metal*. Aluminium (drink) and steel (foodstuffs) cans were always recycled if transport costs permitted. Metals were, and are still, collected as off cuts and recycled within each factory or industry, or collected in scrap as cars, whitegoods and from demolition, for steel and aluminium recycling. Both these feedstock streams are vital in the production of first-run metals.

*Specialist recycling*. This was the province of SMEs. From used clothing, used curtains, furniture and jewellery to 200 litre drums, oil, cars and car parts, tools, machinery...

At that time no one thought of *charging* to accept recycling feedstock streams – much of it was purchased, or removed as a service.

## 2.3 1980s restructure of the waste industry.

The embryonic environmental concerns of the public about plastics – packaging that was vital for large-scale food protection and handling – became the driver for an integrated plan for separation of waste at source, combined with a new waste collection system. This initiated a new funds-based approach to recycling, a precursor of the so-called fees factories in finance.

In this scenario, the ratepayer pre-processed the recyclables by sorting household waste (after being supplied with a ‘free’ recycled plastic bin) and then paid for separate collections for waste and reuse materials. On the recycling side, the plastics in particular are then in an acceptable condition for a Materials Recovery Facility, i.e., to be picked out often by hand, reprocessed and sold back to the consumer via government purchasing policies.

But plastic recycling is still inefficient compared with recycling of other materials such as paper fibres and metals. The recycled plastics industry generates poor quality products because the plastic breaks down when it is subjected to contamination, overuse and inefficient reprocessing (PACIA)[1]. So, local governments buy the residual-based products such as wheelie bins, park benches and road markers and Australians pay through rates, taxes and littering fines.

[1] Plastics and Chemical Industries Recycling 2006 accessed 10/01/06 at http://www.pacia.org.au/index.cfm?menuaction=mem&mmid=009&mid=009.003

# 3. The economic, environmental and social benefits and costs of resource efficiency in Australia (Item 1 of the Inquiry's scope)

Resource efficiency, or the management of municipal and construction waste in Australia, involves recycling or landfill. Landfill initiatives to minimise and use its waste have included on-site recycling through separation of non-putrescibles, toxic substances and garden refuse; energy recovery through methane extraction, and management techniques for waste compression and littering.

Consequently, this section discusses waste recycling matters.

## 3.1 The revenues from and costs of recycling

As discussed in a later section, Australia has an intermittent record on regards to waste data collection.

Whilst the Australian Bureau of Statistics has made a grudging response to measuring waste (Quote 2) by stopping firmly at recycling facilities or landfill, no Australian entity has attempted a systematic examination of the total cost of the recycling regime.

The Europeans have tracked assumed costs of recycling particular waste streams as shown in the tables under Quote 3. Incineration and landfill with energy recovery show far better economic returns thus highlighting the cost to the public purse of the current 'acceptable' recycling patterns.

*Quote 2 – Counting the cost of Australian waste transport, recycling and landfill*

> At $2,700 million (m), the income generated by Australia's waste management services businesses in 2002-03 was equivalent to 0.2% of Australia's Gross Domestic Product (GDP), according to figures released today by the Australian Bureau of Statistics.
>
> More than half (59% or $1,600m) of the income generated by private and public trading sector waste management services businesses was from the collection and transportation of waste. Most (91% or $1,400m) of this income related to the collection of solid waste. Less than a quarter (20% or $500m) of the total income generated in 2002-03 was accrued from the treatment/processing and/or disposal of waste.
>
> ABS Cat 8698. Accessed 7/02/06 from http://www.abs.gov.au/Ausstats/abs@.nsf/0/1BF8B711320E1094CA256EAC007879AC?Open

*Quote 3 Counting the cost of recycling in Europe*

> **Costs of recycling unknown:**
> As a general case the cost functions of recycling activities are very poorly described in the literature. The data points that do exist point to wide variation in the material collection, transport and processing costs incurred in different locations.
> EPEC (2005) p.50

**Table 6.11 Summary of the assumed costs of recycling by waste stream[32]**

| | Collection | Sorting | Processing | Transport | Income | Total |
|---|---|---|---|---|---|---|
| Bottle recycling | -195 | -195 | -225 | -25 | 98 | -542 |
| Other household plastic packaging | -195 | -292.5 | -337.5 | -25 | 98 | -752 |
| Industrial plastic packaging | -52 | | -65 | | | -117 |
| End-of-life vehicles | | -2000 | -200 | -275 | 400 | -2075 |
| WEEE | -145 | | -240 / -1855* | | | -385/-2000 |
| Construction waste – PVC pipes | -100 | | -500 | | | -600 |
| Agricultural film | -120 | -220 | | | | -340 |

*Note: Processing costs assumed to be net of income from sale or payment for collected & reprocessed product where no data provided, and net of residue disposal costs. * Low case and high case tested for WEEE.*

(WEEE: Waste electric and electronic equipment)

**Table 6.12 Summary of the assumed costs and externalities of disposal**

| | Avoided waste collection cost[4] (€/t) | Avoided waste management costs (€/t) | Avoided externalities of disposal (€/t) |
|---|---|---|---|
| Incineration with electricity generation[1] | 70 | 69 | 37 |
| 'Standard+' compliant landfill[2] | 70 | 51 | 11 |
| 'Standard' landfill[3] | 70 | 45 | 11 |

*Notes & sources: 1: Incinerator assumed to be equivalent to option I2 in COWI (2000) – i.e. compliant with Directive 89/369/EEC, generating electricity only and achieving 25% energy recovery. 2: Landfill assumed to*

EPEC p68. NB – No copy available for Table 6.12 Notes and sources '2'.

Given the European 'assumed public cost' allocated to their recycling industry, it would be useful to identify Australia's revenue streams generated by the funds-flow model:

For the public sector:

- revenue from ratepayers for relevant waste collection (the States have this information)
- revenue from sale or disposal of recyclables (Councils)
- revenue from relevant fine structures by State and local governments.

For the private sector:

- revenue from public sector for waste-derived contracts, including advertising
- revenue from 'cottage-level' recycling
- revenue from waste products as replacement of virgin feedstock.

For the taxpayer:

- warm feelings.

## 3.2 Recycling systems and members

The European Union counsels a materials-based approach to recycling rather than by each manufactured item, to pursue suitable long term objectives for waste management.

*Quote 4. A materials approach is preferable to product-based recycling*

> Thematic Strategy on the Prevention and Recycling of Waste - Final Report submitted by EPEC
>
> Overall Conclusion
>
> A materials approach is more cost effective than a product-based approach based on existing regulated products. … Results suggest that the materials-based approach would lead to the inclusion of cheaper recycling activities than would be possible through additional efforts focused on the presently regulated products.
>
> However, given the large share of current and future recyclable volumes already covered by existing Directives, the scope to make a major difference in the costs of given increases in overall recycling rates for a given waste stream is not extensive.
>
> Comparative Impacts
>
> The relatively cheaper social and financial costs of a materials approach indicates that at least as far as paper and plastics are concerned, there are economic benefits to a materials-based approach which arise from exploiting the lower costs per tonne recycled of some applications not currently the subject of a major recycling effort.
>
> For paper, the environmental benefits of a materials- or a product- based approach to recycling would be the same. In contrast, for plastics, a materials approach to recycling has environmental advantages over a product- based approach. This is because a materials- based approach would be more efficient in promoting recycling of homogenous uncontaminated flows that delivers higher environmental benefits than recycling of mixed plastics.
> EPEC (2005) P.48

Current recycling systems are based on the need for waste resources (some paper, some glass, some metals and few plastics) to be pre-sorted by the consumer and separately binned. These mixed recyclables are then sorted manually or rarely, mechanically, at Materials Recovery Facilities to select feedstock-quality items and the remainder go to landfill.

The baled or loose recyclables are then in an acceptable condition for mass processing as minor percentages of feedstock streams in large manufacturing processes, the only possible method for recycling even these quantities.

As members of Australia's cartels, these industries bear high barriers to entry for newcomers. The market is skewed by the dominance of these recycling/reuse cartels that carry little financial risk, have no competitors, no singular performance criteria for recycling (being able to claim feedstock contamination or adverse recycled material prices) and thus can generate enormous cash flows.

An example of this national infrastructure is Visy Recyclables, which accepts and collects about 850,000 tonnes of paper and cardboard every year and sorts it, prepares it and uses it in Visy Board's recycled paper mills to manufacture recycled cardboard boxes. Visy, as part of Australia's waste management structure, is selective in its feedstock streams, as shown in Quote 5.

*Quote 5. Non-recyclable materials for Visy Recycling*

| | |
|---|---|
| Category: | Visy Recycling |
| Question: | What is not Visy Recyclable? |
| Answer: | Polystyrene<br>Crockery<br>Ceramics<br>Carbon Paper<br>Food Scraps<br>Food Wrappers<br>Rubber<br>Waxed Boxes<br>Code 4,5,6,7 Plastics[2]* |

* Code 4 – low density polyethylene (Lids of icecream containers, garbage bags, garbage bins, black plastic sheet)
Code 5 – polypropylene (Icecream containers, potato crisp bags, drinking straws, hinged lunch boxes)
Code 6 – polystyrene (as above) and expanded polystyrene (the former including yoghurt containers, plastic cutlery, imitation crystal "glassware"; the latter, hot drink cups, takeaway food containers, meat trays, packaging)
Code 7 – other plastics, including acrylic and nylon, plus of course, plastic bags [3]

Changes in product recycling in thirty years? Polyvinylchloride is now recycled.

### 3.2.1 Paper recycling

Whilst commercial collection and recycling of white paper is advanced in the larger population centres, newsprint is fragile and easily contaminated by moisture.

The main opportunity to increase the volume of paper recycling is to make newsprint using old newspapers and magazines. New de-inking and recycling plants have been established, but they won't help paper recycling much outside the east coast of Australia.

About a third of waste newsprint recovered in Australia is exported for recycling overseas, and remains the preferred disposal outlet for some supplies. There has been a small but increasing quantity of high quality paper being used in the manufacture of printing and writing papers.[4]

[2] Visy website accessed 08/01/06: http://www.visy.com.au/about/about_faqs.aspx
[3] Gould League website accessed 08/01/06: http://www.gould.edu.au/waste_stop/act_06.htm
[4] Southern Cross University accessed 15/01/06
http://www.scu.edu.au/staff_pages/mcullen/wt_lec6.html

### 3.2.2 Plastics recycling stats from separate viewpoints

*Quote 6. European plastic recycling.*

Within the plastics packaging category, recycling efforts have probably progressed furthest in relation to plastic bottles where there is some prospect of a relatively homogenous flow of material – most bottles being manufactured either from PET or HDPE.
It has been estimated that 612,000t of PET bottles were recycled in 2003, equivalent to a 30% recycling rate given that approximately 2 million tonne of PET are used for PET bottles.

Exemplar costs of PET bottle recycling are shown in Table 6.3.

**Table 6.3 Plastic Bottle Recycling – Exemplar Costs, €/t**

| | Collection | Sorting | Processing | Transport | Total |
|---|---|---|---|---|---|
| Fost-Plus (BE) PET Bottles | 186-190 | 195-200 | | | |
| RECOUP (UK) | 188 | 135 | | 27 | |
| PETCORE EU Average | 350 | 150 | 225 | | 350-800 |

*Source: Good Practices Guide on Waste Plastics Recycling: A Guide by and for local and regional authorities. ACCR / APME / ECVM / EUPR / EUPC.2004.*

**Table 6.4 UK Recovered Plastic Bottle Prices, €/t**

| | Range | |
|---|---|---|
| Clear & light blue PET | 98 | 140 |
| Coloured PET | 49 | 84 |
| HDPE single colour | 98 | 140 |
| HDPE mixed colour | 84 | 112 |
| PVC | 14 | 35 |
| Mixed | 14 | 42 |

*Source: www.letsrecycle.com. Figures represent price on product delivered to a reprocessor in UK or*

On the basis of these costs and prices, avoided disposal costs of €140-€20/t and avoided externalities of disposal of -€43-€20/t, the calculated net average economic benefit per tonne for bottle recycling is –€450/t to –€500/t, before consideration of the avoided externalities of virgin plastic production.

In the scenario testing the required increase in recycling of household packaging plastics is significant (in the product based scenario) and beyond that which could be delivered from bottles alone. For the purposes of the scenario testing it is assumed that sorting and processing costs for plastic packaging other than bottles are 50% higher than for the bottle waste stream. Collection and transport costs are assumed to be the same as for bottles.

Industrial packaging plastics are recycled at a higher rate than household packaging. Major applications include polyethylene films and reusable polypropylene packaging crates. Polyethylene films account for the larger part of the plastics recycled, with crates, trays and EPS packaging also contributing. Industrial plastics recycling is essentially a private sector activity where prices are internalised within commercial contracts and many different arrangements exist according to sector, polymer, volume etc.

Determining a single price or price function for the purposes of the current assignment is thus highly problematic. Data for mixed commercial plastics collection from a 2001 TNO study on the eco-efficiency of plastics packaging recovery have been used, as summarised in Table 6.7, with no adjustment for inflation.

**Table 6.7 Examples of industrial plastics packaging recycling costs, €/t**

| | Collection | Separation & upgrading | Total |
|---|---|---|---|
| Commercial film | 30 | 105 | 135 |
| Crates & pallets | 30 | 80 | 110 |
| Mixed commercial plastics | 52 | 65 | 117 |

*Source: TNO for APME. 2001. Eco-efficiency of recovery scenarios of plastic packaging.*

EPEC (2005) pp62 – 63

Europe's dilemma with plastics recycling at Quote 6 is reflected here in Australia. PACIA Recycling[5] is as equally blunt about its recycling limitations as Visy is with its acceptances:

- All plastics packaging is recyclable, but not all of it is recycled through the kerbside recycling scheme. PET (Category 1) soft drink bottles, (clear bottles used by Coca-Cola, Cadbury Schweppes, etc.), HDPE (Category 2) milk bottles, cream bottles and orange juice bottles are collected. Many councils collect PVC (Category 3) bottles, the ones often used for cordial. Some councils now collect the whole range of rigid plastic packaging.
- Other plastics such as margarine tubs, yoghurt tubs and detergent bottles may be taken by some local government councils that take all plastics, but the majority of these items are not currently processed for recycling.
- Plastics are collected, hand and mechanically sorted and baled into like materials, washed, shredded, pelletised into granules, but the plastic loses strength/stability. It can be recycled back into the same items (Note, not for contact with food), but it often needs the help of some virgin materials to achieve a quality result.
- About 376,000 tonnes per year of plastic is used in packaging in Australia (Note Visy's claims below). The recycling figure for this amount (including imported packaging) is growing annually and at the end of 1997 the figure for kerbside recycling was 37,357 tonnes and industrial and post consumer industrial was approximately 55,000 tonnes.

[5] Plastics and Chemical Industries Australia – PACIA -Recycling Accessed 10/01/06: http://www.pacia.org.au/index.cfm?menuaction=mem&mmid=009&mid=009.003

- Items made from recycled plastic include wheelie bins, outdoor furniture, timber substitute planking used in jetties and walking tracks, pipes, mud flaps, traffic calming equipment, water meter covers, pots for plants, crates, pallets, garden edging, bags, worm farms, compost bins and a developing stream of goods as more recycled material becomes available.
- Biodegradable plastics are available, but require aerobic composting to degrade, not available in landfill. Biodegradable plastics are not appropriate for all packaging uses. They are also more expensive than traditional plastics. There are different types of degradable plastics.

Visy, on the other hand, claims Australia produces more than 1.3 million tonnes of plastics every year, including 50,000 tonnes of soft drink bottles, 30,000 tonnes of milk bottles and more than 10,000 tonnes of detergent and shampoo bottles, the rest made up of shrink-wrap, film, shopping bags and other types of plastics. Visy processes about 20,000 tonnes of bottles and other plastic containers and produces a recycled plastic resin that manufacturers use to make a range of new plastic products (ibid)

The Gould League website nominates products which could be made out of the 'no-go' plastics *if* they are successfully separated:

- low density polyethylene: film for builders, industry, packaging and plant nurseries, bags
- polypropylene: compost bins, kerbside recycling crates, worm factories
- polystyrene: clothes pegs, coat hangers, office accessories, spools, rulers, video/CD boxes.

### 3.2.3 Recycled plastics and paper cannot be used with food

The National Food Authority notes that relatively little work has been undertaken on chemical changes that occur when plastic and paper materials are recycled. Recycling of in-house scrap materials has been practised by the packaging industry for many years, but these have never been used as food packaging.

However, the use of recycled consumer packaging materials, other than metals and glass, is potentially a problem because of contamination, since there are no controls on the treatment procedures or the uses to which these materials are put. It is inevitable that some recycled materials would not be acceptable for use in many food packaging applications.

The National Food Authority, through the food regulations, has the role of determining when and how recycled materials could be used.

*Consumers should be aware that recycled materials are second-hand. Products packaged in recycled packaging materials should be labelled as such. This is especially important with imported packaging materials and foods packaged in imported materials. The public should be conscious that there are potential problems especially since the European Economic Community seems to have started exporting used packaging materials to Developing Countries following the introduction of regulations designed to reduce land fill demand in Europe.*

Until the situation is clarified it is advisable not to use recycled materials in food contact situations.[6]

Recycled cardboard is, however, frequently used as a holder for take-away drinks, eggs and other foods.

## 3.3. Opportunities for SMEs

There is little available profit left for Small to Medium Enterprises (SMEs) at the current level of recycling. Exceptions may be landfill site operators and the waste transport collectors that have restructured and merged in the last decade to provide standardised services to feed the behemoths.

Used tyres is one of the few environmental benefit stories that have arisen, through their new use as a product additive in cement kilns, but this is a peripheral funds-flow.

Recycled oil, too, is a SME success story, although not necessarily for the environment, due to the fact that the acid-clay process for rerefining waste oil has resulted in the residual sludge contaminating land[7].

Plastic-based molding is a route for SMEs – outdoor materials for use by local government and consumer garden items.

Short-term, start-up products based on recycled greeting cards or beverage cartons make the environmental news 'headlines'. Other products are generated from the manufacturing industry.

### 3.3.1 Green waste recycling

Whilst local government collects and processes green waste and makes it available to the public as large scale, it requires equipment, time and effort for ratepayers to collect it. The consumer prefers Bunnings' homogenised and bagged (vinyl) versions for pot plants and garden beds.

Although the majority of 'green' recyclables were very usefully employed combating erosion on roadside verges and replacing grass in Council parks, there is now a burgeoning compost market in Melbourne for the courtyard professionals and the landscapers. Both Baxter and Twigg Groups relieve councils of their green bin waste and compost it at landfill sites.

### 3.3.2 In-house manufacturing recycling

There has been minimal change over the last few decades to the bulk of Australia's traditional recycling – aluminium, copper, cars, whitegoods, electrical/electronics, household goods and clothing, which all take traditional routes. Manufacturing and commercial waste of off cuts and packaging is usually accepted back into the system.

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[6] Food Science Australia Fact Sheet Accessed 10/01/06: http://www.foodscience.afisc.csiro.au/migpac.htm

[7] Soutthern Cross University, accessed5/01/06: http://www.scu.edu.au/staff_pages/mcullen/wt_lec6.html

Recently, briquetting manufacturing dust, shavings, off cuts, and the like for feedstock streams from metals to polystyrene is enabling a greater return from these materials. An example is Boral Hancock Plywood at Ipswich, where briquetting sawdust has removed 120 m³ from landfill each week for use for fuel.[8]

### 3.3.3 Construction and demolition recycling

Waste from construction sites was used in landfill sites as overburden to assist in the compaction and due coverage of putrescible waste. In most parts of Australia, it presumably still fulfills this function.

However, such waste is now sorted on building sites and used by the Alex Fraser Group as base materials in civil projects, thereby relieving landfill of millions of cubic metres of fill.

*Quote 7. Recycling: latest and greatest effect for removing tonnage from landfill.*

Construction and Demolition Recycling

In the early 1980's, Alex Fraser pioneered recycling construction and demolition waste, which was one of the main contributors to landfill in Australia.

Today, the Company processes this material into a range of high quality, specification products that match – and in many cases, out-perform virgin quarried materials. In the not too distant future, Alex Fraser will have recycled and sold over 10 million cubic metres of CandD material. This material is used for a broad variety of road building, municipal and civil works projects. Many of Australia's latest freeway, highway and civil landmarks utilise Alex Fraser recycled products.

The idea of dumping concrete, brick and masonry rubble into landfill is a thing of the past in many areas of Australia. Recycling these materials into a range of approved, specification construction products, has established Alex Fraser as the Australian leader and an international authority in CandD materials recycling systems and technology.

Fraser's RecycleBin™ Service is a new best practice recycling initiative that redirects waste CandD materials at the source. It allows construction contractors to efficiently handle their mixed waste materials on site, offering savings in cost and time, as well as dramatically enhancing recycling targets.

Ref. Alex Fraser Group. 2005

## 3.4 Environmental impact of recycling.

The impact on the environment from recycling is diffused as part of human consumption activity. The Scope of this Inquiry, as is pointed out, seeks only to look at solid waste, and focus on significant issues that arise from its use or disposal.

[8] Waste Streams website, accessed 15/01/06: http://www.buynet.com.au/ws/white_papers/paper_042005a.asp

Environmental impact can be discussed either from a viewpoint of littering – wrong piece in the wrong place, to misquote the definition of a weed; or of use through energy or redistribution of material destined for landfill.

On environmental impact policymaking for littering, state and local governments have jurisdiction. On policies aimed at removal of tonnage from landfill, constraints to be addressed include the distance of potential recyclables from MRFs and construction and demolition materials from appropriate processors, and usage of contaminated and compostable materials.

Contaminated materials are, to use the previous 'weed' example, wrong materials in the wrong places. Cross-contamination, usage of different materials on packaging (different plastics, paper, inks, wax and glue) and moisture content eliminate these potential feedstock streams from potential reuse.

Unless, of course, a holistic approach is taken to waste and the Committee decides that optional 'downstream' treatment of the entirety of municipal waste such as through Resource Recovery-type systems should be pursued. Then cross-contamination becomes a number of feedstock streams, not landfill.

## 3.5 Social impact of recycling

Over the years, the public sectors of Australia have constructed a recycling belief system that the private sector can exploit.

The *social impact of waste management in Australia* stems mainly from a well-entrenched public sector response that manifests itself in a hybrid of cross-pollinating programs. These programs are based on a continuum of subjective rationale starting at the selfishness of individuals and households and the consequent need to teach thoughtfulness and self-restraint, reach the milestone of *The Environment*, then progress sometimes via an underlying antipathy to Big Business.

Waste management awareness programs are aimed at pre-teenage children at a fun level, teenagers for a community-spirit level and the public for a financial response. Taken in moderation, the strategies are a harmless and virtuous attempt to mitigate environmental damage – reject packaging and don't litter.

But the recycling programs have proliferated over the decades and become increasingly bureaucratic and non-productive through over-simplification and repetition. Each council and each state have numerous 'Don'ts' written into their regulations, under an umbrella commonwealth code. As details are left to each jurisdiction, and the regulations become increasingly layered and Byzantine in interpretation, the objective has been lost. *Recycle* is now the end, not the means.

### 3.5.1 Social conscious outcomes – waste not, want not

This closed-loop result is borne out by the European Union regarding its December 2005 recycled waste strategy. Its Frequently Asked Questions page explained the benefits of the strategy's business-as-usual findings:

> **Citizens** will benefit because the strategy will trigger national, regional and local prevention policies that help citizens understand how they can contribute to preventing waste and using resources more efficiently. The strategy also specifies a renewed push to

implement the rules in areas that are important for the citizen, such as illegal landfills that are a nuisance and an environmental threat.[9]

Without undertaking a sociological thesis on the implications of recycling for recycling's sake, the following examples may illustrate some fallout from what could be viewed as circular reasoning:

*Quote 8. Recycling impacts unequally on Australians*

> Pensioner, Coles Supermarket check-out, Bentleigh Vic., 6/1/06*: 'I forgot to bring my green bag. I feel so guilty taking a plastic bag….But the green bags are so heavy as they put so much into them. You have to pay for them and the first one I bought broke within a week*.'

The second example is the writer's attempt to identify items in household cupboards for recycling through Bayside City Council's recycling program for plastic packaging:

*Quote 9. A rummage through cupboards for plastic containers*

| Item | Brand | Plastic type | Recyclable Yes-No |
|---|---|---|---|
| Meat tray | Home brand | 6 | No |
| Salad container tub (with lid) | Home brand | 5 | No |
| Fresh fruit tubs (lids) | Various | 3 | Yes |
| Margarine container (lid) | Bertolli | 5 | No |
| Deli tubs (lids) | Home | 5 | No |
| Cheese container (lid) | Cracker Barrel | 1 | Yes |
| Yoghurt container (lid) | Dairy Farmers | unmarked | No |
| Milk bottle | Pura | 2 | *Yes |
| Orange juice bottle | Golden Circle | 2 | *Yes |
| Sauce bottle | Simply Seafood | 1 | Yes |
| Vitamin tablet screw top containers | Nature's Way | 2, unmarked | Yes and no. |
| Dishwashing liquid squeeze bottle | Morning Fresh | 2 | Yes |
| Kitchen/bathroom cleaners pump bottles | Pine O Cleen | 2 | Yes |
| Floor cleaner | Pledge | 2 | Yes |
| Window cleaner in bottle with pump | Windex | 1 | Yes |
| Dishwasher powder | Finish | 2 | Yes |
| Dishwasher rinse bottle | Finish | 1 | Yes |
| Toilet cleaner squeeze bottle | Harpic | 2 | Yes |
| Fertiliser container (lid) | Bunnings | 5 | No |
| Fertiliser container (lid) | Debco | 5 | No |
| Fertiliser bottle | Multicrop | 2 | Yes |

* Actually recyclable through BaysideCouncil's collection system.

[9] European Union press releases. Accessed 12/01/06: http://europa.eu.int/rapid/pressReleasesAction.do?reference=MEMO/05/496&format=HTML&aged=0&language=EN&guiLanguage=en

Whilst all these items are dutifully 'blue-binned' as part of Bayside's recycling program, a further contact with Council representatives was enlightening:

- all Bayside households are charged $115 (or $105 for smaller bins for flats) for environmental matters (garbage removal, recycling, hard waste collection, street cleaning and beautification of the area)
- of this charge, some $24 relates to blue bin collection
- although Bayside residents pay for blue bin *collection*, blue bin contents are accepted free at the Council contractor Baxter/Visy Springvale's site
- only milk and juice bottles and water and soft drink bottles are actually recycled (plus the old faithfuls - paper, steel, aluminium and glass)
- garbage was delivered to the same site and cost $49 per weighed tonne for landfill
- green waste was accepted at that site for composting (cost unknown).

*Quote 10. A conundrum – waste or recycling?*

> Question to Bayside Council.
>
> Are the contaminated household recyclables and non recyclables from blue bin collections that are dumped to landfill counted as household or industrial waste?
>
> Answer:
>
> Don't know.

# 4. Waste data gaps (Item 3 of the Scope)

The Commission may consider waste as an occurrence from human activities.

Each public entity concerned with usage of goods has its own definition of waste and its own regulations to define and measure its version of waste. The target for these measurements/regulations is usually local government, even when such manifestos are self-imposed by the councils. So responsibility for such measurements may appropriately be placed on the regulator, rather than someone else.

Data are difficult to pinpoint, particularly in the messy world of waste. These data morph into waste statistics which tend to build off each other in a GIGO[10] environment. In the waste 'industry', there is no way to compare like for like.

## 4.1 Tonnage v volume = hybrid measurement

Victoria proudly recycles more than 50 per cent of its *solid* waste. In pursuit of further recycling 'goals', the government has produced *Towards Zero Waste,* a management plan that seeks to attain new technologies and further reduce waste going to landfill. The Victorian Government has set up an interdepartmental board, comprising regional waste management authorities and others, charged with reaching the magic figure by 2014.

> *In 2003-04, Victoria produced over 9.5 million tonnes of solid waste. Just under half was sent to landfill. Through strategic planning and our Waste Wise approach, we assist business, the community and government to reduce waste, use resources more efficiently and send waste to landfill only as a last resort.* (Ecorecycle, 2005)

First, waste must be defined to be allocated a measurement tool. Victoria recycles 50 per cent of its solid waste *tonnage*, not Municipal Solid Waste, whilst Alex Fraser, for example, recycles *volumes* (cubic metres) of construction and demolition (solid) waste.

Also, guesstimating is the rule of waste management. Landfill or waste transfer sites may or may not have a weighbridge. This creates a dual system for measuring municipal waste, weight and volume. Volume is converted to weight [number of trucks x volume of filled truck x conversion factor (0.55) = tonnage]. But municipal waste - light industrial, commercial and household – applies only to certain receiving sites; and heavy industrial wastes, non-municipal regions, and waste that does not reach the system are not included.

## 4.2 Data, measurement Ψ solution.

It is difficult to imagine what purpose, other than for fine-tuning direct and fair fee waste collection charges, collecting more data on waste generation may achieve. The two quotes following illustrate the level of detail that local government is expected, and sometimes does, pursue.

The first relates to a federal policymaker, the National Environment Protection (Used Packaging Materials) Measure as varied July 2005, which asks the largely

[10] Garbage in, garbage out.

unanswerable questions of participation rates in kerbside recycling (every week? twice per year?), weight of each material collected, weight of material recovered used for energy recovery. On the other hand, City of Sydney actually audited the waste their households (not including commercial and other wastes) produces – but this audit did not necessarily produce the data required by the federal body.

If the Commission considers further data are required, perhaps suggesting some coordination of the various enthusiastic entities may assist those undertaking the expensive tasks.

*Quote 11. Measures to count the uncountable – Federal, and City of Sydney.*

National Environment Protection Measure Cl17. Collection and Participation Data

1) Participating jurisdictions shall require each local government of a municipal district (or each grouping of local governments of municipal districts where waste management groups exist) in which a kerbside recycling collection service or other municipal materials recovery system is provided, to provide the following information in relation to the municipal district or group of municipal districts, for a financial year:

(a) what percentage of households is covered by any such service;
(b) participation rate in any such service;
(c) number of tenements covered by the service and whether the tenements are residential tenements or other kinds of tenement;
(d) per tenement fee charged for recycling collection services;
(e) total weight of recyclable material collected at kerbside or by other municipal materials recovery systems by material type;
(f) if the material collected is sorted:
(i) the total weight of each material type sold and/or sent for secondary use, including energy recovery;
(ii) the total weight of the residual fraction disposed of to landfill by material type if practicable.

Reference National Environment Protection (Used Packaging Materials) Measure as varied July 2005. Accessed 09/01/06
http://www.ephc.gov.au/pdf/upm/UPM_NEPM_varied_July_05.pdf

**City of Sydney – Overview - Environment**

During 2004/05, the City conducted a household waste audit to inform our waste services and information programs. Major findings for the southern areas include:

. the average household generates 6.96 kilograms of garbage per week and 2.77 kilograms of recyclables - the Australian average is 12.7 kilograms of garbage and 3.6 kilograms of recyclables)

. garbage comprises 67.8 per cent recyclable materials including 36.7 per cent food, 14.4 per cent paper and cardboard, 11.7 per cent containers and 5 per cent vegetation (**despite a recycling service being provided for paper, containers and green waste)**

. the recycling stream comprises 52 per cent paper and cardboard and 43.2 per cent containers, with just 4.8 per cent non-recyclable contamination

. diversion from landfill is 27.1 per cent, which is in the mid range of Sydney results.

*Major findings for the northern areas include*:

. the average household generates 4.33 kilograms of garbage per week and 3.91 kilograms of recyclables. Garbage comprises 64.9 per cent recyclable materials, including 47.2 per cent food, 5.1 per cent paper and cardboard, 8.6 per cent containers and 4 per cent vegetation (despite a recycling service being provided for paper and containers)

. the recycling stream comprises 53 per cent paper and cardboard and 45.1 per cent containers, with just 1.9 per cent non-recyclable contamination

. diversion from landfill is 46.6 per cent which is at the higher end of Sydney results. City of Sydney (2005)

*Quote 12. Some data on waste generation in Victoria*

Solid waste in Victoria is categorised by its source, according to Sustainability Victoria.

The three sources are:
. municipal, which includes household and public place waste
. commercial and industrial, waste from business, government operations and schools
. construction and demolition waste

Waste going to landfill across Victoria is composed of 36 per cent municipal waste, 24 per cent commercial and industrial waste and 40 per cent of construction and demolition waste.

In 2002/3 Victoria:
. generated 1.65 million tonnes of household waste, an average of 885 kg per household per year. Garbage accounted for 65 per cent of this amount and recyclables for 28 per cent*
. spent almost **$178.5 million** on kerbside collection services, approximately 4 per cent of all local government expenditure
. paper (newspaper, cardboard, magazines and office paper) accounted for 55 per cent by weight of all household materials collected. Other containers, such as glass, steel, aluminium and liquid paperboard made up 31 per cent and plastic containers 8 per cent
. food and green waste make up over 47 per cent of municipal waste sent to landfill.[11]

*So how does Victoria recycle over 50 per cent of its hard waste (defined similarly to local government's periodic hard waste collections) as its government claims? It is through inclusion of construction and demolition waste, recycled by the Alex Fraser Group.

[11] Accessed on 6 January 2006 from Sustainability Victoria: http://www.ecorecycle.sustainability.vic.gov.au/resources/documents/Info_2_-_Waste_Facts.doc

# 5 Strategies to improve outcomes in regard to waste management. (Item 5 of the Scope)

## 5.1 Social rethink

*Quote 13. Europe is adverse to further regulation.*

**Support in the drafting of an ExIA (Impact Statement) on the Thematic Strategy on the Prevention and Recycling of Waste (TSPRW) Final Report submitted by EPEC**

The complexities and difficulties of defining the environmental impacts from the use of different materials in different products, used in different ways, is compounded by the fact that these impacts differ between Member States(MS) (reflecting different cultural, economic and social activities, and different physical environments). Moreover, where impacts are local rather than global, different MS will accord different weights to the significance of the impacts, again reflecting different economic, social and environmental conditions.
It therefore follows that the Strategy can not seek to introduce common EU prevention or recycling targets or (in the case of economic instruments) common tax rates, **without the risk of introducing perverse incentives which increase, rather than reduce environmental impacts**. EPEC (2005) P42.

Quote 13 highlights the fact that Europe and Australia have arrived at the same crossroad from different directions. They say that there is no common ground in their three-tier jurisdictional system (four for Germany) for targeted intervention, no common ground for systems efficiencies or environmental impact; nor recycling targets or financing arrangements. The outcome from this investigation is to look at the matter again in a few years.

Whilst this 'waste environment' is true for Australia, we will continue to down our resource recovery road and further away from that taken by the catatonic Europeans. But the warning against 'perverse incentives' is a strong reminder for care in a regulatory environment we find is more used to imposing 'sin taxes' than strategy.

Australia could create a 'can do' recycling economy rather than the current 'can't do'. After decades of extracting more money and more effort from more people, the point of exhaustion and no further real return has been reached socially and economically – certainly not environmentally, where the damage continues to mount.

A strategy review including possible 'mergers and acquisitions' of federally-funded waste, recycling, littering and allied environmental entities should be undertaken, whilst also reviewing the sum of their effects on the population (for children, community-mindedness).

Point out the effect of one-size-fits-all directives that unfairly focus on population strata. The pensioner's day out was ruined as she considered herself 'socially undesirable' because she had not intended to visit the supermarket and did not take her green bag. She agreed that an old-fashioned string shopper would be simpler (and cleaner) and thought she might still have one...

## 5.2 Industry rethink

Audit productivity and reward traditional recycling industries, SMEs and micro businesses through tax concessions and perhaps infrastructure finance, not through more regulatory ‘advice’.

These businesses, some generational, have an incredible amount of initiative and flexibility in their operations. They survive by continually adjusting to new suppliers, new customers and new products within the manufacturing environment, but are removed from the giant recycling enterprises that utilise the consumer environment. Many of their ‘tricks of the trade’ (systems), adapted equipment (technologies), and bartering (trading practices) support and enhance a viable Australian manufacturing sector.

Excluding the use of an occasional illegality, this traditional ingenuity can be adapted to the new recycling streams diverted from the cartels. Encourage and show this ‘Aussie know-how’ sector through local hands-on resource exhibitions, short conferences, and a guarantee that they will suffer no ’advice’ or forms to fill.

‘Encourage’ big business to wean itself off its *free ride* by building an infrastructure that allows local government to either collect its own recyclables, or to invite tenders for such collection.

Initially, an additional cost for collection can arise if the local government authority does not have access to small manufacturing businesses that can take advantage of the feedstock streams provided by the concept of resource renewal (if not the system itself) rather than individual product recycling.

Further, new export legislation is necessary to utilise resources not wanted by highly specified manufacturing processes that use recycled fibres and shredded plastics as part of their feedstock streams. Recycling industries outside the cartels’ catchment areas may be further encouraged to pre-process such second-run materials to direct them toward genuine export manufacturers if exploitation of minority groups is a consideration.

There is a problem, too, with few recycling technology leads coming from overseas, due to the OECD countries’ penchant for incineration. Australia does not now produce waste management equipment and it is sourced either from recycled manufacturing equipment of northern hemisphere suppliers, often Germany. International design does not cater for a feedstock that is not available and most likely will never be in high-density living, cold climate environments. In fact, Australia is exporting its waste-handling technology.

## 5.3 Resource Renewal rethink

Considering its Issues paper, the eminent Productivity Commission is somehow brought off economic efficiency with recycle/d philosophies and programs.

It would be advantageous for the Commission to rethink second-run resources from an economic viewpoint instead of the unwieldy structure of the various recycling factions. This will treat waste as a potential part of the manufacturing cycle rather than it is currently viewed - an environmental factor, a social charter square peg trying to fit into a manufacturing round hole.

What about the economic effect of billions of dollars of skewed and inefficient markets on our economy? Corrugated cartons alone contribute a couple of billion dollars to Australia's economy - and the 'waste' is efficiently recycled (apart from the duopoly).

Steel and aluminium are efficiently recycled. Glass is recycled, somewhat inefficiently. Paper fibre in the eastern states is efficiently recycled. What do these manufactured items contribute to our economy?

## 5.4 Where to from here?

Despite excellent research on the economic benefits inherent in waste management practices, the recent European Thematic Strategy on the prevention and recycling of waste [12] maintains a status quo approach until 2010. It confines its attention to highlighting disparities among Member States in generation of waste, notes available statistics, and considers legislative streamlining and simplification using common definitions and terminology. It is an inward-looking document. There are no proposals, apart from a new slogan for promotional purposes, and no economic considerations for waste other than to remove some recycled products from the concept of recycling. This attitude returns the European Union to a traditional (pre funds-flow) waste management concept.

Given the quiet response from the lead sources on waste management, Australia is on its own for the foreseeable future to benefit from the economic opportunities inherent in this industry. And we are already moving in this direction.

We are currently mining possibilities. For example, both Visy and Alex Fraser have worked with Singapore's SembCorp to transfer materials recovery facility and construction and demolition recycling technology.[13]

Cleanevent from Melbourne won the contract for cleaning up after the Athens Olympics - $80 million. They now operate in USA, UK and Australia.

New South Wales' Global Renewables won a contract to design, build and operate a $6 billion materials recovery plus landfill/methane facility in Lancashire, UK.

The Commission is urged to consider rethinking waste management as industry opportunity rather than social embarrassment.

We have a fractured waste industry, with the greater proportion of public waste payments directed to the duopolies that can easily afford to pre-process their own feedstock, but won't; a post-cottage-level waste collection and disposal industry that can't progress; and a dire need to get the whole creaky structure on to some sensible footing and allow those who can, to gain resource efficiency.

Can you help, please?

[12] European Union Environment accessed 12/01/06: http://europa.eu.int/comm/environment/waste/strategy.htm
[13] SembCorp Industries accessed 11/01/06: http://www.sembcorp.com.sg/env_engineering.htm

## Bibliography


ABS *Year Book 2003 Population Distribution.* Accessed 12 December 2005 http://www.abs.gov.au/Ausstats/abs@.nsf/Lookup/361F400BCE3AB8ACCA256CAE00053FA4

Alex Fraser Group. (2005) *Construction and Demolition Recycling*. Accessed 22 December 2005: http://www.alexfraser.com.au/recycling1.htm

Answers.com(2005) – Herring. *Dictionary.* Accessed 23 December 2005: http://www.answers.com/topic/herring

Association of Victorian Regional Waste Management Groups. (2005). *News Metropolitan Waste Management Region.* Accessed 21 December 2005 from: http://www.vicregions.asn.au/geninfo/news/news.html

*Australia State of the Environment Report 2001 (Theme Report)*
Lead Author: Professor Peter W. Newton, CSIRO Building, Construction and Engineering, CSIRO Publishing on behalf of the Department of the Environment and Heritage. Accessed 12 December 2005
http://www.deh.gov.au/soe/settlements/index.html

Australian Competition and Consumer Commission (2005). *Proceedings instituted against Visy group, senior executives for alleged cartel in the corrugated fibreboard container market*. Release # MR 327/05. Issued: 21st December 2005. Accessed 22 December 2005 :
http://www.accc.gov.au/content/index.phtml/itemId/719891/fromItemId/142

Australian Competition and Consumer Commission (2005). *Pyramid selling schemes.* Accessed 22 December 2005:
http://www.accc.gov.au/content/index.phtml/itemId/8137/fromItemId/3667

Australian Financial Review (22 December 2005), Infrastructure spin-off does Alinta proud. *Street Talk* (p.16). John Fairfax Publications, Sydney.

City of Sydney (2005) *Residential Waste and Recycling.* Accessed 23 December 2005:
http://www.cityofsydney.nsw.gov.au/Environment/Waste/CurrentStatus/WasteVolumes.asp

Ecorecycle, Towards Zero Waste. Accessed 21 December 2005 from
http://www.ecorecycle.sustainability.vic.gov.au/www/html/253-towards-zero-waste.asp

European Policy Evaluation Consortium. (2005) Support in the drafting of an ExIA (Imact Statement) on the Thematic Strategy on the Prevention and Recycling of Waste (TSPRW). Final Report submitted by EPEC, London. Author.

OECD (2000) OECD Environmental Data Compendium. Accessed 22 December 2005: http://www.oecd.org/dataoecd/11/15/24111692.PDF

The Quotations Page (2005). *Quote details, Abraham Lincoln*. Accessed 22 December 2005: http://www.quotationspage.com/quote/27074.html

Tiscali Reference: Country facts. Accessed 12 December 2005:http://www.tiscali.co.uk/reference/encyclopaedia/countryfacts/italy.html

UK Environment Agency: Waste Incineration in Waste Management Strategies: Position Statement. Accessed 12 December 2005. http://www.environment-agency.gov.uk/aboutus/512398/289428/653535/?lang=_e

Waste Online (UK) What you can do. Accessed 12 December 2005 http://www.wasteonline.org.uk/resources/InformationSheets/WasteDisposal.htm