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**WASTE MINIMISATION REPORT -CHAPTERS 2, 11 & 15**

# SCENARIO 2 - WASTE ELIMINATION

Philip Sutton. Version 3.b. 16 April 1996 (First version: October 1995).

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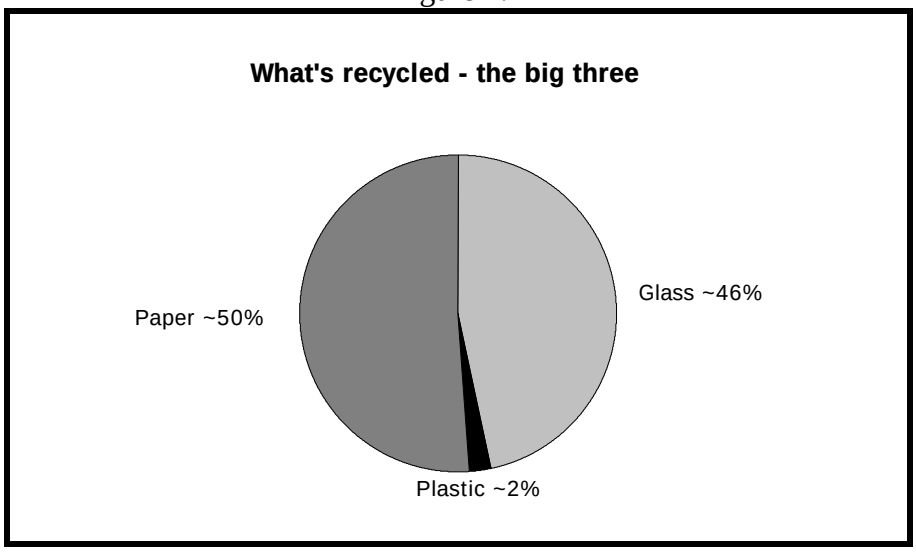
**This paper is a <u>modified</u> extract of work done by Philip Sutton for a multi-authored report on waste minimisation prepared by the Centre for Innovation in Waste Management for the Western Regional Waste Management Authority.**

# Chapter 2 The need for action

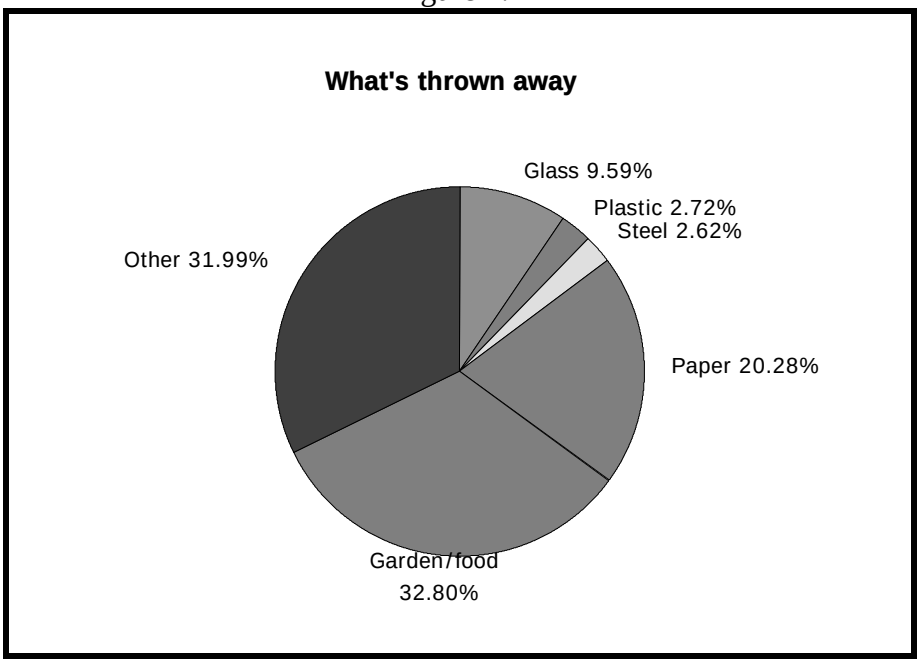
Australians produced approximately 1 tonne of post-consumer waste per capita[1] in 1994. Paper and cardboard was the largest single component of the waste, followed by non-fibre biodegradable waste (eg. kitchen and garden waste) and then by glass containers. While large physical quantities of post-consumer waste are being recycled, they represent only a third of the total post-consumer waste. Paper, cardboard and glass containers make up the bulk of the recycled material. The non-recycled post-consumer waste makes up about a third of the material going to landfill. About half the non-recycled post-consumer waste is biodegradable.

Figure 2.1




Synthesised very roughly from Victorian RRRC 1994 data.

Figure 2.2




Synthesised very roughly from Victorian RRRC 1994 data.

[1] In this report building and demolition waste is not counted as part of post-consumer waste.

In 1992 the Commonwealth government committed itself to the goal of reducing total wastes going to landfill by 50% per capita by the year 2000. This target was also adopted by most state governments and many local governments. However a range of recent studies have shown that, on current trends, the target will not be met by a wide margin.

Maunsell Pty. Ltd., consultants who undertook a study for the national EPA in 1994 to report on the achievement of the 50% waste reduction target, concluded that there is no evidence that the target would be met. Maunsell Pty. Ltd. also reported that, in response to a nationwide survey of councils conducted by them, "there were more councils reporting increases in total waste than there were reporting decreases". Of the capital, Sydney, Darwin, Adelaide and Brisbane had made some progress, but Melbourne and Canberra had recorded increases. (EPA/Maunsell Pty. Ltd., 1994)

The high probability that the 50% target will not be achieved if current trends continue raises two important questions. One is what new things can be done to meet or exceed the original target and the other is why should government, industry and the community make the effort to achieve this goal in any case? The bulk of this report and in particular Chapter 14 is devoted to answering the first question and this chapter answers the second.

**2.1 Why make a special effort?**

There are strong economic and environmental reasons for Australia to energetically pursue levels of waste minimisation which would meet or even exceed the government 50% reduction target. The economic incentives are the potential :

- to boost the competitiveness of Australian manufactures and services
- for cost savings
- to avoid cost escalations in the future.

Almost all of the countries which import or compete with Australian elaborately transformed manufactures and services have higher population densities than Australia. These countries will increasingly have to develop or import products that enable them to save on tip space, reduce pollution, reduce waste at its source and conserve energy. This trend is well established in Europe and north America and is emerging in the more developed Asian countries. Government waste reduction targets at least as demanding as those in Australia are now common in the US and Europe. These countries however, unlike Australia, are in many cases well on the way to fulfilling their targets.

Australia cannot afford to create products that are limited to the Australian market as a consequence of being designed for a high waste society. The imperative to gear Australian products to meet international best practice in waste minimisation will become stronger and stronger as extended product responsibility or take-back regulatory regimes spread. Extended product responsibility will become a favoured policy measure as countries search for the means to meet their treaty obligations in relation to the international protocols on greenhouse and biodiversity. In countries where extended product responsibility and other related policies apply, it is unlikely to be economic to offer products that are not expressly designed for extended life, repair, easy disassembly and take-back.

Not only will Australian elaborately transformed manufactures have to change but so will our services. Existing services will need to be redesigned to achieve waste minimisation and entirely new services will also be needed to help industry and consumers minimise their wastes. It will be easier to develop these new products if they are in demand in the Australian market as well.

While in the short term the production of wastes in the manufacturing, commercial and post-consumer sectors might save money, in the longer term it represents a lost economic opportunity. These wastes are derived from materials that had to be purchased in the first place. As the methods of cleaner production are adopted more widely, companies are finding that they can introduce cost effective innovations that prevent the production of waste or that allow wastes to be used as raw materials for further production processes.

The depletion of high quality tip space, pollution impacts on human health, agricultural and natural systems, the depletion of high quality non-renewable resources and excessive demand on renewable resources will all lead to mounting future costs. All these future costs can be avoided if waste is avoided too.

On top of this there is a strong probability that Australia will eventually have to adopt a highly resource conserving economy (approaching a closed cycle) in order to meet its international obligations under treaties such as the Greenhouse Convention. The transitional costs of a forced jump to such an economy at the last minute would be very high. On the other hand if all the available time is taken advantage of the net costs could be very low and indeed there could be a net benefit if the change is handled skilfully.

The non-economic aspects of the environmental impact of post-consumer waste generation are discussed in the next section.

### 2.2 Why pay attention to post-consumer waste when there are larger waste volumes elsewhere in the economy?

Even when considered together, post-consumer wastes and the wastes from the construction, commercial, and downstream manufacturing sectors are totally overwhelmed by the wastes from the domestic share of the mining, agriculture, forestry and basic resource processing sectors (see Figure 1)[2]. This pattern of wastes is likely to be exaggerated even further as high quality resources are depleted and lower and lower grades of ore and other resources have to be used.

While mining and processing wastes can undoubtedly be reduced directly through better extraction and processing technologies, the most effective method of cutting wastes at the resource production end of the economy is to cut the amount of material thrown out at the post-consumer end of the economy. For every tonne of metal removed from the post-consumer waste stream, as a result of source reduction or materials recycling, there may be reduction of anywhere between 50-100 tonnes in mining and ore processing wastes that will no longer be produced because the need for the primary metal resource has fallen. When it is realised how much waste and pollution could be avoided, it becomes clear why post-consumer waste minimisation is so significant environmentally.

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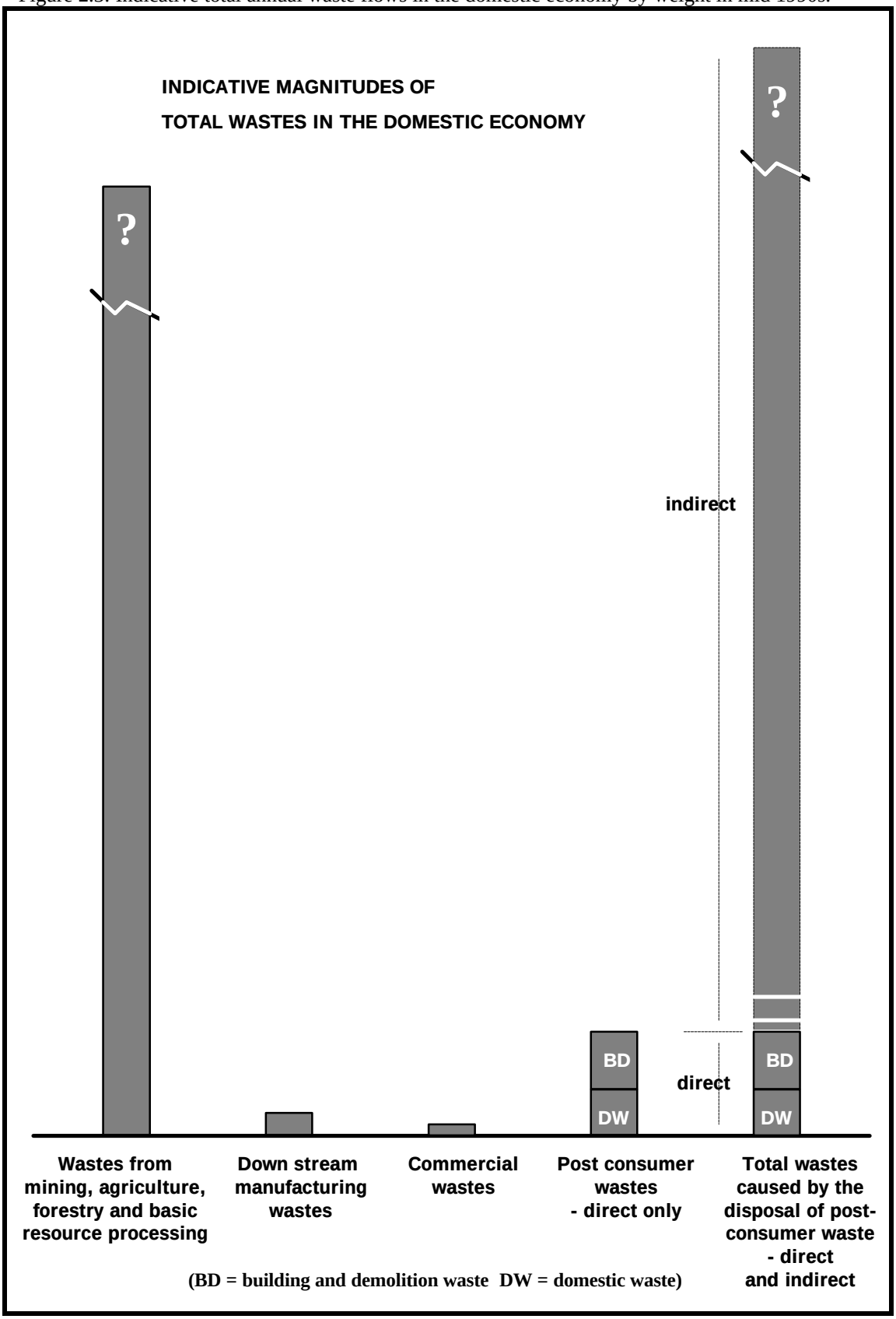
[2] See the 1995 report "Waste flows in the Australian economy" by Connor, Evans and Hurse of the Department of Chemical Engineering, University of Melbourne prepared for the Australian Liquidpaperboard Association Inc.

Figure 2.3: Indicative total annual waste flows in the domestic economy by weight in mid 1990s.




The magnitudes in this figure are synthesised roughly from data from the Recycling and Resource Recovery Council (1994) and the Association of Liquidpaperboard Carton Manufacturers Inc (1995). They are adjusted to deduct wastes associated with exports (eg. mining wastes) and products that do not result in wastes that could go to landfill (eg. consumer services).

Managers of post-consumer waste therefore need to think not only about the wastes that are produced directly by consumers, but also about the wastes that consumers indirectly generate because they use products containing primary resources, that is, the wastes from the resource supply industry. The indicative magnitudes of direct and indirect wastes are illustrated in Figure 2.3.

## Section 11 Generating the scenarios and the options

The method that used to analyse problems and generate scenarios and options is a hybrid of the Opportunity Multiplying method developed by the author (Sutton, 1992) and the Theory of Constraints method developed by Eliyahu Goldratt (Anon, 1994; Goldratt, 1994).

Step 1. The project team's first step was to define the initial field of interest of the study. This was "*to substantially boost source reduction and the recycling of post-consumer waste*". The issue of how to specify "*substantially*" was picked up a little further on in the process.

Step 2. The practical focus was principally to find appropriate "*legal and financial measures*". It was decided that other measures would be identified or recommended where there was a strong reason.

Step 3. The project team's next step was to identify some important core underlying values that should help the team decide how substantially the source reduction and recycling of post-consumer waste should be boosted. Three key sets of values emerged: (a) to meet community expectations, (b) to cut costs and reduce immediate environmental impact and (c) to achieve ecological sustainability and high levels of economic welfare.

Step 4. The project team then decided that there were two logical targets to aim for in boosting post-consumer waste minimisation. The first target was "*a 50% reduction in waste going to landfill, through source reduction and recycling*" and the second, more ambitious, target was "*the achievement of a viable, closed-cycle, ecologically sustainable economy*".

Step 5. The project team then began to explore the problems that stood in the way of "*substantially boosting source reduction and the market for recycled products made from post-consumer waste*". The project team used a brainstorm technique to identify as many blocking problems as possible. The most significant ones are summarised in Chapter 10.

Step 6. Then the problems were linked into a complex cause-effect web. Missing links and new problems were added along the way to make the analysis complete. It then became possible to identify a small number of problems that seemed to lie at the heart of most of the others. Some of these key problems were 'focal' problems, contributed to by disparate causes but giving rise to a powerful and common set of subsidiary problems. A more limited number were root-cause problems, lying at the very start of the cause-effect chain.

The key problems are described in Table 15.1 below. They are presented in a series of levels, starting from the most immediate and ranging through to the most fundamental, that is, the root causes. This ordering is important because the inverse sequence will be used later when attempting to develop and implement solutions. Solutions will, if possible, be developed for the most fundamental goals first.

Table 11.1.

| | |
|---|---|
| **Focal problems - level 1** | |
| **1** | **Too large a supply of post-consumer wastes in the waste stream** |
| **2** | **Lack of market for reusables and recyclables** |
| **Focal problems - level 2** | |
| **3** | **Lack of product design favouring waste minimisation**. |
| **4** | **Lack of consumer behaviour favouring waste minimisation** |
| **5** | **Lack of government follow-through** |
| **6** | **Lack of innovation** |
| **7** | **Lack of action to retain or regain the quality of materials or to retain the quality of energy** |
| **Focal problems - level 3** | |
| **8** | **Lack of *any* overall system for source reduction** |
| **9** | **Lack of an *integrated* system for waste minimisation** |
| **Focal problem - all levels** | |
| **10** | **Vested interests in the unsustainable present are more effective than the vested interests in the sustainable future**[3] |
| **Root cause problems** | |
| **11** | **The business cycle** |
| **12** | **Non-cyclic supply surges** |
| **13** | **Long-run factor prices** |
| **14** | **Lack of commitment to create a closed-cycle economy** |

Step 7. The project team then documented each of these key problems so that their central relationship was made explicit.

Step 8. Once the key problems had been identified the next job was to translate each problem into its opposite - a positive goal that should be pursued actively. These goals then drove the search for solutions.

[3] This concept was developed by Dr Peter Ellyard of Preferred Futures Pty Ltd., Melbourne, Australia.

Figure 11.2.

| Key problems | Problem solving goals |
|---|---|
| **Too large a supply of post-consumer wastes in the waste stream** | To reduce the supply of post-consumer wastes at the source |
| **Lack of market for reusables and recyclables** | To improve the marketability of durables, reusables and recyclables |
| **Lack of product design favouring waste minimisation** | To foster waste minimisation through product conception and design |
| **Lack of consumer behaviour favouring waste minimisation** | To favour waste minimisation through consumer behaviour |
| **Lack of government follow-through** | To ensure effective government follow through |
| **Lack of innovation** | To foster effective innovation in waste minimisation |
| **Lack of action to retain or regain the quality of materials or to retain the quality of energy** | To take effective action to retain (first priority) or regain (second priority) the quality of materials or to retain the quality of energy |
| **Lack of *any* overall system for source reduction** | To create an overall system for source reduction |
| **Lack of an *integrated* system for waste minimisation** | To foster waste minimisation through a well integrated system (including source reduction aspects) |
| **Vested interests in the unsustainable present are more effective than the vested interests in the sustainable future** | To foster the situation where the vested interests in the sustainable future are more effective than the vested interests in the unsustainable present |
| **The business cycle** | To manage the effects of the business cycle |
| **Non-cyclic supply surges** | To minimise non-cyclic supply surges |
| **Long-run factor prices** | To create a pattern of long-run factor prices that favours waste minimisation |
| **Lack of commitment to create a closed-cycle economy** | To create commitment to the concept of a closed-cycle economy and the action needed to achieve it |

Step 9. After creating a problem-solving goal to match each of the key problems, the project team created two scenarios to provide a coherent framework around which to develop packages of internally consistent recommendations. A scenario was built around each of the targets identified in Step 4. Scenario 1 had the target of "*a 50% reduction*[4] *in waste going to landfill, through source reduction and recycling*" and Scenario 2 had the target of "*achieving a viable, closed-cycle, ecologically sustainable economy*".

It was decided that both the scenarios should reflect the three key sets of values (see Step 3) but to different extents. Both scenarios would be compatible with the eventual emergence of a closed-cycle economy. Scenario 1 would pragmatically work 'towards' a closed cycle economy as a distant ideal. Its practical action

[4] Specifically the target is: a 50% reduction from 1992 levels by the year 2000

however would be directed at achieving a 50% reduction in post-consumer waste as a practical symbol of the longer term ideal. Scenario 2, on the other hand, would aim from the outset to actually achieve a true closed-cycle economy. Scenario 2 would nevertheless have to be practical. Every immediate step would have to be technically, socially and economically feasible in the short term as well as being able to deliver the desired long-term benefits.

Step 10. Equipped with the two Scenarios the project team then identified measures or options that would make a strategic contribution to the achievement of each Scenario's goal. The team was especially interested in measures that would be catalytic. Often the most powerful measures required the resolution of some apparent paradox.

## Section 15.1 Two scenarios

Scenario 1 (not described in this paper) aims to **do what is immediately feasible** to move **towards** a closed-cycle economy, whereas Scenario 2 is aimed at **making it feasible,** beginning now, to eventually **achieve** a closed-cycle economy[5].

## Section 15.2 The goal of Scenario 2

Scenario 2 is based on a long-term commitment to the achievement of a true closed-cycle economy[6].

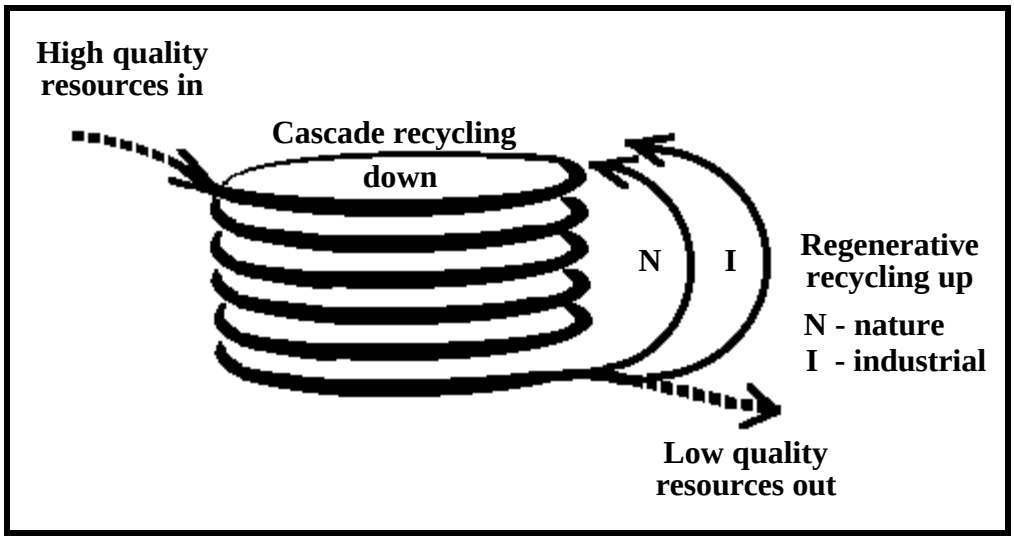



Figure 15.1. The true closed-cycle economy.

This economic structure is the one that is best suited to the simultaneous achievement of ecological sustainability and economic viability.

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5 Scenario 1 moves **towards** a closed-cycle economy, whereas Scenario 2 moves **to** it.

6 The concept of a true closed-cycle economy is described towards the end of Chapter 11.

## Section 15.3 Principles

*Beneficiaries across space and time*
Under this scenario policies would be designed to simultaneously benefit:

- the local community
- people globally
- future generations, and
- nature.

*The precautionary principle*
The precautionary principle would be rigorously adhered to.

*A strong commitment to ecological sustainability*
As a consequence there would be a very strong commitment to:

- the conservation of natural biodiversity
- the conservation of life support systems (eg. the climate system and natural eco-cycles including the soil and the water cycle)
- the conservation of physical resources, and
- reliance on naturally or industrially renewed resources.

*Both short term and long term practicality*
The scenario would be premised on the simultaneous pursuit of short and long term practicality. All actions must be feasible in the short term but must be capable of delivering desired long term pay-offs.

*Continuous improvement and long term stretch goals*
Policies would be framed to achieve goal-directed continuous improvement aimed at the achievement of challenging future-state goals. It is now becoming increasingly common for major industrial companies to set very ambitious environmental stretch goals. For instance, Du Pont has set zero waste and pollution targets in Australia (Warburton, 1992; ), Bristol-Myers Squibb also has a zero pollution target (Bristol-Myers Squibb Company, 1995), while Portland Aluminium in Victoria has a policy of zero waste to landfill[7] (Portland Aluminium, 1994). These goals drive the respective companies' innovation programs. Their immediate performance however is judged against more familiar targets such as a 20% reduction in pollution type 'X' within 2 years.

Appropriate **long-term** stretch goals for an ecologically sound and financially viable closed-cycle economy would be to:

- aim for the maximum source reduction;
- aim for the maximum possible conservation of the quality of physical resources (eg. purity, strength, colour);

[7] Portland Aluminium expects to actually achieve this target by 1995. During 1993 they cut waste to landfill by 50% compared to the 1992 level.

- aim for 100% recycling[8];
- aim for 0% pollution and 0% waste;
- aim for 100% regenerative recycling of all lowest quality materials;
- aim for 100% of materials used in industry to fall into one of two management regimes:
  - where materials can be safely[9] cycled at some point through the natural environment because they are totally biodegradable, with no toxic breakdown products, and
  - where materials of synthetic or natural origin are permanently contained and cycled within the industrial system because they are toxic (have disruptive side-effects) and persistent (cannot be metabolised by the natural system) or are not naturally occurring and are persistent[10];
- aim to use 100% recycled materials in every product[11] and to maximise the substitution of waste energy from other processes for newly produced energy;
- aim to localise materials flows, to the extent that it is environmentally beneficial;
- aim for 'complete' reliance on naturally or industrially renewed energy and materials;
- aim for zero loss of native species and ecological communities, and
- aim for at least a ¾ reduction in material and energy flows through the domestic economy[12].

*Commitment to a true closed-cycle economy and the retention and regeneration of the quality of resources*

There would be a major commitment to conserve resources and to retain and regenerate the quality of resources[13] so that a true closed-cycle economy could operate. As a consequence, the waste minimisation strategy of source reduction would be pushed to the limit first and then the recycling strategy would be applied to all the remaining wastes.

*Economic instruments to set the basic structure of the economy*

Economic and other incentive structures would be changed to favour a closed-cycle economy that could deliver a high standard of living. Regulatory levies and subsidies, rather than detailed regulations, would be used to set the basic structure of the economy. Revenues from regulatory levies would either be spent on solving the problems they were introduced to deal with, thereby increasing the responsiveness of the economy to the levy itself, or they would be rebated to people's income via a negative or reverse pay-roll tax mechanism. Regulatory levies would not be used as revenue generators for general government expenditure.

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8 Including composting and fermentation, with a possible return to nature via agricultural systems.

9 The whole industrial system needs to be managed so that, overall, the flows of natural materials (and energy) into and out of the environment leave the stocks in the natural system within "natural" limits and the rates of flow do not cause stresses outside the "natural" range.

10 Materials that are not naturally occurring but are apparently non-toxic and persistent should be sequestered as a precaution since it is possible they have unknown toxic or ecodisruptive effects.

11 While individual products could use 100% recycled material, thermodynamic limits mean that **over the whole economy** the use of recycled products must fall a little short of 100%. Setting a 95% target for the use of recycled materials over the whole economy would be reasonable.

12 This is needed to deal with the greenhouse issue and the loss of biodiversity.

13 The laws of thermodynamics mean that **overall** the quality of energy cannot be regenerated. The quality of materials can be regenerated with a sufficient expenditure of energy.

*Policies designed to affect the agents with the greatest capacity to change*
Policy measures, including regulatory levies, would be designed wherever possible to affect the agents that had the greatest capacity to change the system in ways that achieved the desired policy outcome. Since consumers cannot respond effectively unless there are appropriate products in the market place, priority would be given to policies that affected product offerings.

*Products designed for a closed-cycle economy*
Products would be designed to fit into a true closed-cycle economy. In particular, they would be designed to maximise their post-use market.

## Section 15.4 How things might look under scenario 2

The creation of an economy that comes close to the closed-cycle ideal would take many decades to achieve. However, with appropriate policies in place, substantial restructuring and more than a 50% reduction in post-consumer waste could be achieved in 10 years.

Eventually everything in the economy would be recycled but the quantity of material to be recycled would be brought down as far as possible by a vigorous and continuing application of source reduction strategies.

Unlike Scenario 1, **all** sectors of the economy would make an active contribution to the achievement of the closed-cycle economy regardless of how small a part of the economy they represented. Nevertheless, special emphasis would be placed in the shorter term on converting those sectors of the economy that currently generate large quantities of one-use, short life products to product strategies that involve product reuse. In this way markets would be automatically available for the next use of the material/product. Also doing this would reduce the amount of waste material that would have to be 'shoe-horned' into other uses in the economy as a way of closing the materials loop.

The quality of materials and energy would be consciously conserved and where possible regenerated. Rigorous efforts would be made to prevent materials and energy from being used for low grade purposes until they had unavoidably degraded to a matching level. This approach would be referred to as a materials-quality stewardship program.

In a closed-cycle economy there would eventually be no need for tips. Wastes would either be used as raw materials within the economy, or they would be stored until a use could be found or, if materials quality stewardship principles allowed, they might be converted to biodegradable wastes and discharged carefully and safely to the environment as nutrients. There would be major industries developed around product hiring, maintenance, repair, and regenerative and cascade recycling. Electronic shopping, telecommuting and home delivery would become common place. Junk mail would only be allowed to be delivered in electronic form. To complement the kerbside recycling system a 'parcel post' style return system would be instituted to send complex products back to the manufacturer at the end of each use cycle. Reusable containers would once again dominate the market and refilling would be done in decentralised multi-company washing and refilling operations. This arrangement would be cost competitive with the current system of national filling and distribution. Use of primary minerals within the

domestic economy would plummet and most materials processing would occur near cities as part of the recycling system.

## Section 15.5 Firm recommendations

Because a commitment to a closed-cycle economy has such major ramifications, it is not appropriate in this report to make a large number of detailed, hard and fast recommendations. Instead, the general direction is recommended and a procedure for fleshing out the detailed actions is proposed. Detailed proposals for further examination, equivalent to those in Scenario 1, are included in Section 15.4.

The firm recommendations are:

1. That all governments and all other organisations adopt the concept of an ecologically sustainable closed-cycle economy as an ideal to work towards.

2. That a government/industry/community working group (with regional sub-groups) be established to examine how a true closed-cycle economy could operate and what steps can be taken to create a high level and effective commitment to the creation of such an economy.

## Section 15.6 Scenario 2 proposals for further examination

Options that are central to this Scenario are spelled out below, grouped under the key goals.

The key goals have been reordered from Chapters 11 and 14 to put the most fundamental first (ie. root cause goals ahead of focal goals and goals related to source reduction ahead of those related to materials recycling). As a general rule it will be most effective to try to act on the fundamental causes first. If for some reason this is not possible then two other strategies should be applied. The first preference is to devise actions that, as rapidly as possible, will create the conditions in which it is possible to address the fundamental causes. The second preference is to move on to address the less fundamental causes of the problem.

Most options recommended in Scenario 1 are relevant here although the order of execution and their detailed form is different.

### 1. To create commitment to the concept of a closed-cycle economy and the action needed to achieve it

A closed-cycle economy will not emerge spontaneously because it cannot be created solely through incremental action. Some system level actions will be required too.

Actions of this latter sort will require commitment, initially from effective advocates and then from society as a whole. This commitment must be built on awareness at both a general level and at a deeper technical and institutional/social level. Organisations and individuals with an interest in catalysing the emergence of a social commitment to a closed-cycle economy need to

develop a program of research, vision building, awareness raising, policy advocacy and opportunities for learning-by-doing. Commitment-building work of this sort could be done through existing channels or through newly formed organisations or networks.

Once sufficient awareness and commitment has been generated then a number of the options canvassed in this report can be considered as ways to extend and deepen the level of social commitment to a closed-cycle economy. These options include mandatory life cycle analysis for all products (Option #44), mandatory design for the environment (Option #83) and mandatory product stewardship (Option #82), resources for community and lobby groups (Option #55).

## 2. To foster the situation where the vested interests in the sustainable future are more effective than the vested interests in the unsustainable present[14]

Improving the effectiveness of the 'vested interests in the sustainable future' versus the 'vested interests in the unsustainable present' is a dynamic process. It is not a once-off exercise. In Chapter 11 a series of focal and root cause problems were identified. Ideally action should be focused on the root cause problems. However, if the status quo is too strongly locked in such action may not be possible. Less fundamental actions may need to be taken first to create the pre-conditions for the more fundamental actions later. So in this scenario actions to deal with the balance of vested interests are split into two action phases.

Actions to improve the effectiveness of vested interests in the sustainable future fall into four groups:

- actions to ensure that those who help to create a closed-cycle economy will gain while those that perpetuate the throughput economy do not benefit from doing so
- actions that help potential beneficiaries of a closed-cycle economy to recognise the possibilities
- actions that foster the emergence of advocates and that help them to reach those who would gain from a closed-cycle economy
- actions to help those whose present activities will be disadvantaged to adjust with the least loss and perhaps with a long term gain.

Actions to help advocates could include measures deepen the level of community awareness of the why, what and how of the closed-cycle economy; that enhance the capacity of advocates eg. through improved resources, skills and access to communications channels; and that increase their legitimacy.

### Phase 1 actions

*Creating incentives:*
Early in the piece while people are having to make major adjustments it is advantageous to provide incentives, often involving subsidised information or direct financial assistance. The following options are examples of what could be done: incentives for waste minimisation design (Option #14), buy recycled campaign (Option #7) or preferential purchasing (Option #8).

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[14] See footnote 3.

*Benefit recognition:*
Vision building, research, education/promotion all play a part here. A sample of relevant options include: a clear vision of a source reduction system (Option #47), incentives for design for waste minimisation (Option #14), government money for packaging system research (Option #15), mandatory waste management plans for firms (Option #18) and mandatory life-cycle analysis for all products (Option #44). In addition it might be worthwhile to promote the adoption, by all firms, of Environmental Management Systems with a policy commitment to contribute to the emergence of a closed-cycle economy and to run a major community education program about the notion of a closed-cycle economy.

*Fostering green entrepreneurialism:*
Green entrepreneurialism will help to create the vested interests in the sustainable future and evidence of active and successful green entrepreneurialism will spark opportunistic entrepreneurs into action faster than almost anything else. Green entrepreneurialism could be promoted by bringing green product development skills together with strong commercial skills.

*Fostering advocacy:*
Action should be taken to foster the emergence of advocates. This could be done by publicising the nature and benefits of a closed-cycle economy and then encouraging people to take up an advocacy role. Specifically action could be taken to create special advisory groups on waste minimisation (Option #58) and an industry network to promote the creation of a closed-cycle economy.

Some of the options that would assist advocates to be more effective are: the provision of resources for community groups (Option #55) and lobby groups, the establishment of consumer waste minimisation boards (Option #54), public reporting on progress (Option #36), third party rights for review (Option #37), planning and review forum (Option #50), local government lobby body (Option #52), union body (Option #56). Assistance might be given to the pro-closed-cycle economy industry network proposed above.

*Structural adjustment:*
One way to promote structural adjustment in the early stages would be for all levels of government to help build the community skills base for waste elimination programs (Option #38).

**Phase 2 actions**

*Creating incentives and disincentives:*
In phase 2 the incentive and disincentive structure needs to be strengthened. Options discussed under Goals 4 (the factor price package) and 6 (mandatory product stewardship/extended product responsibility) are the most relevant.

*Benefit recognition:*
On top of the measures introduced in Phase 1, it would be advantageous to add measures that help firms to systematically uncover the benefits of moving to a closed-cycle economy, eg. mandatory design for the environment (Option #83) and mandatory product stewardship (Option #82).

*Fostering green entrepreneurialism:*
The measures introduced in phase 1 would be continued.

*Fostering advocacy:*
The measures introduced in phase 1 would be continued.

*Structural adjustment:*
A review of the success of the phase 1 measures may reveal further needs.

## 3. To ensure effective government follow through

The consistency and vigour with which governments follow through on policies is influenced by the amount of active public pressure, the degree of internal commitment and the effectiveness of the bureaucratic machinery that is put in place. Until the balance of vested interests has tipped decisively in favour of a closed-cycle economy, effective follow through will have to rely on internal commitment and good bureaucratic machinery.

Governments' internal commitment can be demonstrated and institutionalised by incorporating policy into legislation. Legislation of this sort would need to be enacted by the national and state/territory governments and municipal councils would need to pass complementary local laws. This legislation could also set up the basic bureaucratic machinery (Option #34). A relevant part of the machinery would be a system for carefully integrating waste minimisation into all other government policies and programs (Option #46). This is, in effect, an environment management system as described under the ISO 14000 series standard. Follow though will be enhanced if the monitoring of government progress (Option #35) and the reporting of results (Option #36) are mandatory . This approach is strengthened further if there are third party rights to have progress reviewed judicially or by the national or state Administrative Appeals Tribunals (Option #37).

## 4. To create a pattern of long-run factor prices that favours waste minimisation

For more than 100 years, primary materials prices have fallen (Barnett and Morse, 1963) relative to labour and labour intensive goods, by at least 0.5% per year (Grilli and Yang, 1988). This long run trend in factor prices, that is, the prices of labour, materials, equipment and so on, has made the emergence of a throughput economy almost unavoidable. Many waste minimisation techniques are relatively labour-intensive, and, hence, they are undermined by any relative fall in primary materials costs. Waste minimisation programs tend to flourish for a while for special reasons then begin to flag as long run price changes eat away at their viability. The good times for waste minimisation are when public support surges and subsidies can be provided, during economic booms when raw materials are in short supply and at times when major new technologies are introduced that reduce the labour intensity of source reduction or recycling systems. *However any attempt to promote high levels of waste minimisation will eventually fail or be very heavy-handed if the long-run factor price trend is ignored.*

The reduction of primary materials prices relative to labour-intensive products has been caused by the conjunction of five conditions (Sutton, 1995):

- the occurrence of economic growth,

- the existence of a relatively stable share of national income going to labour,
- the fact that most people gain their income via wages,
- the fact that resource royalties or severance charges have not been indexed to the growth of the economy, and
- the greater ease of increasing labour productivity in the resource sector compared to most other sectors of the economy.

However, if different institutional arrangements applied, then the dynamic pattern of relative prices would be different. With the right mix of environmental levies and expenditures, a long-run relative price pattern that favoured waste minimisation could be developed.

Since it appears that there is economic as well as environmental benefit to be had from creating such an alternative price pattern, that is, a higher rate of improvement in long-run economic productivity (Brinner et al, 1991; Repetto, 1992; DRI et al., 1994; Jacobs, 1994; Sutton, 1994), it makes sense to carefully consider making the change.

To create a true closed cycle economy, the levies and the related expenditure of revenues arising from the levies need to be structured to achieve the following objectives:

- to close the escape routes for waste
- to drive materials back up the quality scale
- to ensure the efficient use of non-renewable energy
- to prevent environmental damage
- to prevent inflation
- to improve responsiveness and productivity of the economy.

The escape routes for waste out of the economy would be gradually closed off using:

- land disposal levies (Option #66)
- sewer disposal levies (Option #67)
- incineration levies (Option #68)
- export levies.

These levies would, in time, make disposal to the local environment (via landfill, sewer, incinerator, pollution) and to the environments of other countries (via export) unviable. The levies should start at the regulatory equivalent of the new New South Wales $7.20 per tonne landfill levy and escalate to the point where they are high enough to make waste avoidance, recycling[15] or the payment of temporary waste storage rentals the preferable options.

In a closed-cycle economy there would be virtually no need for landfill tips to service urban areas. Instead when there was a need to store wastes, for example,

- during the down swings of the business cycle, or
- to build up a sufficient volume to make reprocessing economically viable, or
- until a viable recycling option was developed,

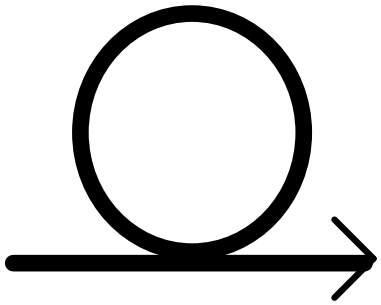
temporary waste storages would be used (related to Option 65). Rather than paying a once-off fee for permanent dumping as is done presently, the organisation responsible for the waste would pay a waste storage rental for as long as the waste was storaged. Waste storage fees

[15] The reprocessing could occur in another country provided the recycled material or it equivalent in quantity and quality was returned to Australia for use.

would need to be high enough to provide an incentive to take the waste out of storage eventually.

**MEASURES TO TRANSFORM THE MARKET**
**TO CREATE A CLOSED-CYCLE GREEN ECONOMY**

***Subsidise and invest in:*** **VB 1.b**
**Regenerative recycling**
***Revenue recycling:***
**Via negative payroll taxes, and pensions**



| *Levy on the way in:* | *Levy to stop side effects* | *Levy to block escape routes from the economy:* |
|---|---|---|
| **Depletable energy**<br>**Primary production waste** | **Pollution**<br>**Alienation from the natural state** | **Waste to industrial or municipal tip**<br>**Waste to incinerator**<br>**Waste to sewer/sea**<br>**Waste to export (to prevent physical dumping)** |
| | | ***User fees:***<br>**Waste storage rentals** |

***All disposal charges would reflect the extent to which disposal lowers the quality and accessibility of the waste for eventual reprocessing.***

***Disposal charges on post-consumer waste would be split between waste disposers and manufacturers/importers to affect both product design and disposal behaviour.***

***All levies and the waste storage rentals would be indexed to the growth of the economy.***

**MEASURES TO FURTHER IMPROVE THE DYNAMICS**

***Invest in or subsidise:***
**R&D, infrastructure, structural adjustment and education (in relation to waste elimination, renewed resource use and environment protection).**
**An economy wide life-cycle analysis system.**

Fig. 15.2. Measures required to create an economically viable and ecologically sound closed-cycle economy.

'Waste' dumps associated with minerals extraction and processing would be subject to land disposal levies to the extent that the method of storage used reduced the quality and accessibility of the material for later use. They would be subject to waste storage rentals to cover the cost of on-going management for pollution control etc.

The disposal levies (to land, sewer, incinerator or export) would eventually be split 50:50 and charged equally to the direct disposer and, through advance disposal fees (Option #40), to the manufacturer/importer. The idea behind this is to ensure that not only are waste generators

encouraged to reduce their waste output but also those with control over products are encouraged to design and market them in a way that makes waste reduction easy for users.

A user-pays system (Option #22) would be introduced to feed the disposal levies back from the agent doing the disposing to the person or organisation who initiated the disposal of the 'waste'.

Advance disposal fees would be imposed on all manufacturers and importers of physical products[16]. The fees would be based on either general estimates of the amount of the supplier's product that finds its way to final disposal or on precise figures generated by life-cycle assessments (Option #44). While the data-gathering and administration costs of the advance disposal fee system would be high, the benefit is that it would accelerate the widespread introduction of life-cycle assessment. The administrative infrastructure for the advance disposal fees could be used as part of the data gathering and tracking system for life-cycle assessment thus improving the productivity of the administrative system.

To prevent waste producers using exports as a way of bypassing measures designed to create a closed-cycled economy, an export levy would be needed. It would apply where wastes were permanently exported. Wastes reprocessed overseas and reimported for use in Australia would be either subject to a rebate or exempted. Australia would need to comply with the Basle Convention and would need to ensure that the export of waste for recycling was not pursued as a means of exporting pollution.

The levies discussed so far are designed to gradually close off the escape routes for waste out of the economy. But if a true closed-cycle economy is to be created, materials that cannot be recycled at their current quality must be restored to high quality, that is, they must go through a regeneration recycling process.

In the absence of any eco-levies, regeneration recycling of non-biodegradable materials is likely to be more expensive, economically and energy-wise, than cascade recycling and considerably more expensive than the production of virgin materials. Given that the disposal levies would need to be phased in to avoid a major shock to the economy, it might be quite some time before regeneration recycling became economically viable.

It would be desirable to accelerate the introduction of regeneration recycling. This could be done by investing in research and development and by introducing subsidies for the regeneration recycling of non-biodegradable materials. So that there was an incentive to improve the cost-effectiveness of regeneration recycling, contracts to undertake this activity could be put out to competitive tender. This would avoid the temptation to rort the system that can arise with straight cost-plus subsidies. The economic and innovation risks of complete monopolisation could be avoided by putting wastes to tender in sufficient parcels to ensure that a number of players were active in the area over the long term. However measures to foster competition shouldn't be pushed so far that regeneration recyclers were not able to achieve or maintain necessary levels of technical competence nor achieve desirable economies of scale.

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16 Given that manufacturers and importers often sell to other manufacturers, the most effective assignment of the advance deposit fees would need to be worked out using the principles of product stewardship. The assignment process would begin with importers and the major manufacturers and would work out from there.

A non-renewable energy levy (covering coal, gas, & oil[17]) would be necessary to ensure that recycling doesn't lead to wastage of non-renewable energy (Option #69). Such a levy would encourage demand reduction as well as a shift to renewable energy sources.

Two levies would be needed to prevent possible environmental side-effects.

Pollution levies (Option #71) would be needed to ensure that:

- the closed-cycle economy does not lead to increased damage to the environment compared to the throughput economy, and
- materials are not lost from the economy through direct discharge to the environment as a way of avoiding tips, sewers and incinerators and their attendant levies.

The pollution levies would need to be based on the quantity of physical output and be weighted to reflect the risk posed to the environment and the responsiveness of the economy to the regulatory intent of the particular levy. A greenhouse gas levy (a modified version of Option #70) would be part of the package and would need to be integrated with the non-renewable energy levy.

To ensure that renewable energy is not substituted for non-renewable energy at the expense of the viability of the natural environment and to ensure that the natural environment is not used as a dumping ground for materials to be 'recycled by nature'[18] a land-use transformation levy[19] would need to be introduced (Option #74). The land-use transformation levy would be related to the land's degree of transformation from its natural ecosystem state, rather than to its intensity of human use. This levy would be paid by land managers and passed on through the cost of products to users.

All of the levies mentioned above would be indexed to the growth of the economy so that their regulatory power is maintained in the face of growing income levels and an expanded economy.

Taken together the non-renewable energy levy and the land-use transformation levy would set an economic limit on the energy available for recycling, with the result that waste avoidance would be progressively favoured as the economy grows.

If this suite of levies is not introduced as a package, waste avoidance may not be favoured, energy wasteful recycling might proliferate and there might be strong pressure to use natural areas to produce renewable energy to power recycling.

In the early stages of the introduction of the eco-levy package the non-renewable energy levy and the carbon component of the pollution levies would be rebated when energy intensive products were exported to allow for more gradual structural adjustment by export industries. This modification is particularly important for Australia because energy intensive products make

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[17] It is not relevant in Australia, but the non-renewable energy taxes should cover nuclear energy where it is used.

[18] Materials to be recycled 'by nature' should be reintroduced into the natural cycles through agricultural not natural/wild ecosystems.

[19] The land-use transformation tax would be set using a sliding scale. Areas that were in a fully natural condition would have a tax rate of zero. Areas that had virtually no native species would be subject to the highest tax rate. The tax would be graded, in intermediate cases, to reflect the extent to which native species and ecological communities had been displaced. In contrast to land taxes proposed by Henry George and his supporters, the land-use transformation tax would not directly reflect the monetary value of the land.

up such a large percentage of its exports. It is probable that the non-renewable energy levy and the carbon component of the pollution levies would not be fully applied to energy intensive exports until an international agreement was operating.

Other nations would be encouraged to introduce similar eco-levy packages so that cross border distortions are minimised. If a sufficient number of other nations did not introduce this levy/expenditure package within a reasonable time, then border adjustments (green tariffs) would be needed (Option #79).

The eco-levy package will raise progressively larger amounts of money over time. Traditional economic thinking holds that changes of this magnitude will 'distort' the economy and reduce GNP from its expected rate. However, econometric modelling work over the last 5 years in Europe and the US (Brinner et al., 1991; DRI et al., 1994; Jacobs, 1994) and in Australia (Common and Hamilton (1994) shows that economic growth can equal or exceed the present rate if the revenue from eco-levies is used appropriately.

The revenues need to be recycled into the economy in such a way that:
- inflation is avoided
- investment levels are maintained or increased
- the responsiveness of the economy to the eco-levies is enhanced
- the innovation dynamics and hence the productivity growth of the economy are maintained or enhanced.

These objectives can be met in this case by:
- recycling the bulk of revenue from the eco-levies (once the revenues have reached a noticeable level) back to people's income through the phased elimination of payroll tax and the gradual introduction of wages subsidies. In this way, while the levies increase business costs in one area the revenue is used to reduce costs in another area.
- identifying major opportunities for business development in areas that fit with the new environmental direction.
- by spending money on education, R&D, infrastructure and structural adjustment assistance so that the economy is highly responsive to the eco-levies (Option #76).
- by even more actively building strengths in the information sector to offset the reduced productivity in the virgin resources sector.

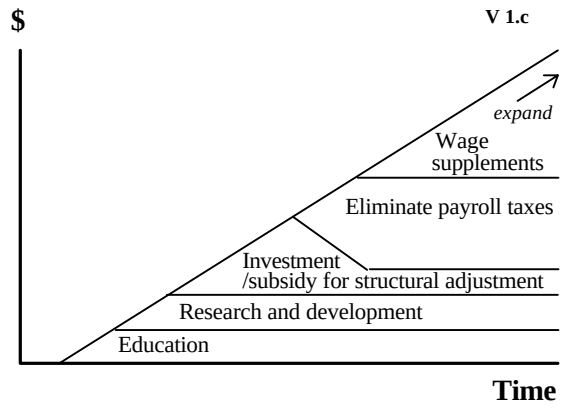



Fig. 15.3 The uses of the growing revenues from the eco-levies.

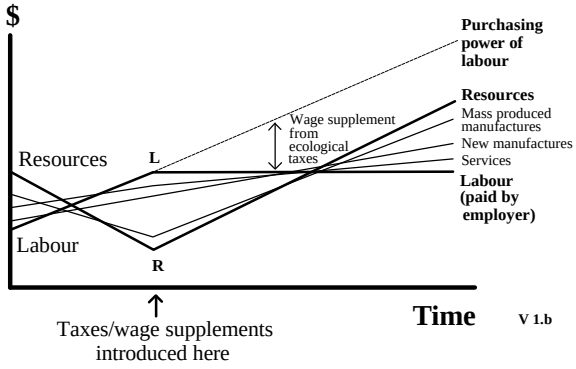



Fig. 15.4 Changes in relative factor prices after the introduction of the recommended eco-levy and revenue package.

It is unlikely that such a fundamental levy/expenditure package will be introduced immediately or that the dimensions of the levies, subsidies and other expenditures will be large during the early stages of their gradual introduction. During this early period, a range of relatively ad hoc tax/subsidy and law-based regulatory measures would be used to anticipate the industrial pattern that would emerge in due course as a result of the slow working-through of the fundamental levy/expenditure package.

To minimise the distortions that could be introduced by the ad hoc measures, modelling work should be done to show the changes expected in the long term, thus revealing the long-run structure that should be emulated by the ad hoc measures. For example, the modelling could guide the interim use of sales tax measures.

## 5. To create an overall system for source reduction

Waste minimisation is made up of two components: source reduction and materials recycling. Even though source reduction is recognised as being at the top of the materials policy hierarchy[20] almost all the attention has focused on materials recycling. This is because long-run declining resource prices have favoured resource intensive product strategies, goods producers (as opposed to service providers) have dominated product offerings and their commercial strategies favour maximising sales of material products, and waste management professionals are used to 'getting rid of waste' after it has been produced rather than beforehand, so recycling seems logical. Also source reduction involves influencing product offerings from predominantly national manufacturers, whereas the waste management professionals are mainly located in decentralised organisations with geographically limited briefs.

As a consequence there is virtually no systematic awareness of how to undertake or facilitate source reduction. This deficiency must be overcome.

There are six aspects to look at to find source reduction opportunities. They are:

- **efficient service concept** (principles include: 'avoidance of frivolous planned obsolescence', 'non-material needs should be met non-materially', 'material needs should be met most efficiently', 'consider multi-function products ie. more user values for the one physical platform').
- **long life design** (principles include: 'the whole product or the maximum number of components should be designed for long life', 'software upgrading is preferred to hardware upgrading', 'design for efficient maintenance, including repair', 'design for reuse')
- **efficient production and reprocessing**
- **efficient use** of the product
- **efficient maintenance** (including repair)
- **efficient reuse.**

Some of these aspects require a little explanation. The most powerful strategy for source reduction is to rethink all products, even goods, in terms of the services they provide. Doing this opens up the greatest number of possibilities for stripping physical resources out of the

[20] The materials policy hierarchy is 'reduce, reuse, recycle'. Source reduction covers reduction and reuse.

product or service delivery process. A useful illustration is the case of a General Motors plant in the United States. This plant had traditionally bought a large variety and quantity of chemicals from a plethora of suppliers. These suppliers being in the business of selling goods wanted to maximise the volume of chemicals sold and so that is where they concentrated their effort. This however was costly for GM and it wasted materials. GM then decided to appoint one supplier and to reconceptualise their role as a 'supplier of chemical services'. The contract with the supplier was written in terms of the outcomes that GM wanted as a result of using the chemicals rather than focusing on the physical quantities of chemicals. The result was that the chemical services provider had an incentive to deliver the specified outcomes with the least practical quantity of chemicals since they could increase their profit in that way. Over time GM was able to reduce the cost of their chemical services as the supplier became more efficient and in addition there was a large saving of physical resources. (Pers. comm., Michael Overcash)

The concept of products as services can be taken further. It is useful to think of material objects as providing a physical platform for the delivery of services. Source reduction strategies can then concentrate on either increasing the level of service delivered using a platform of certain physical dimensions, or effort can be put into reducing the physical platform needed to deliver a given level of service. The combined phone/answering machine/fax/photocopier is an example of the former strategy, while the delivery of junk mail via multi-media computer (Option #42) is an example of the latter.

Building on these ideas it is possible to frame a program to foster source reduction. It could contain these elements:

- a program to develop visions (Option #47) and strategies for source reduction
- research into methods for conceptualising and designing for source reduction and research into particular source reduction initiatives (Options #15 and #53)
- promotion and education programs and institutions to spread source reduction visions, strategies, skills and solutions (see discussion of Goal 1)
- a legal requirement that all organisations prepare source reduction plans (Option #18)
- initiatives to encourage the introduction of long-life, reusable products (Option #45)
- adoption of the extended product responsibility concept (Options #44, #83 and #82)
- a lifestyles program to encourage the use of services that maximise source reduction and to encourage the efficient use, maintenance and disposal of products
- temporary financial measures to provide special incentives in the short term to pursue source reduction. (Options #59, #13 and #14 should be adapted to be used as structural adjustment and infant industry incentives.)
- an ecological levies and expenditure package that creates factor prices and economic and social responsiveness leading to effective source reduction. (See the discussion under Goal 4.)

These initiatives should be integrated into the machinery for waste minimisation as a whole. However there is a need to place the spotlight on source reduction for some time until the approach becomes second nature. For this reason it might be desirable to have a stand alone strategy for source reduction and have a specially promoted short-term incentive package.

## 6. To foster waste minimisation through a well integrated system (including source reduction aspects)

A true closed-cycle economy requires a careful coordination of resource flows so that desired economic and environmental outcomes can be achieved at both the micro and the macro level. This physical coordination can only succeed if the policies of all the major players are also coordinated, that is, there is an integration of the policies of businesses, governments, consumers, etc.

We are however a very long way from this ideal. There is, as yet, virtually no conscious commitment to a closed-cycle economy. Even the main players in the waste minimisation area tend to have their own non-complementary strategies. Furthermore, those responsible for waste minimisation frequently do not have the power to take effective action while those with the power to take key actions often do not have sufficient responsibility or motivation. There is little connecting the **indirect** environmental and social effects of economic activities, no matter how profound these indirect effects are, with the economic activities themselves or with those who are responsible. And finally there is the sheer complexity of how and when to source reduce or recycle in the absence of a set of simple principles. At present neoclassical economic principles of cost-benefit analysis are used to decide how far to internalise externalities. And this then guides source reduction and recycling decisions. However this method undervalues costs to future generations and nature and therefore results in too low a level of source reduction and recycling.

However, as contradictory as it may seem, if an integrated approach is to work it must allow for and draw strength from the spontaneity of the market.

An integrated system depends on both motivation and coordination. In the case of a market based system the motivators include:

- economic gains or losses
- customer service
- the need for legal compliance
- political impacts
- ethical concerns.

Coordination can be achieved through:

- market demand
- the factor price pattern
- infrastructure provision
- general investment planning
- law-based planning and regulation
- community pressure
- shared visions, rules-of-thumb and a sense of what's appropriate (culture / knowledge base).

An essential support for a coordinated approach is a good supply of information about the economic/environmental/social system.

How do these coordination mechanisms work? While businesses often make strenuous efforts to shape market demand to suit their product offerings, if consumers have a strong, articulated preference that is followed through in purchasing behaviour then this will force businesses to

change their offerings. The underlying price structure in the economy will change the way that businesses go about producing and delivering their products and it will, over time, change consumer culture so that people can 'maximise their utility', that is get value-for-money, in the prevailing circumstances. The available infrastructure, for example the product design, maintenance, repair and product return services in the case of source reduction and the collection, processing and marketing systems in the case of materials recycling, determines to a large extent what is feasible for people to do. Investment planning in its turn determines what infrastructure will be there. Law based regulation directly sets a pattern of what can or cannot be done while community pressure creates a pattern of what is easy or hard to do. Shared visions are very powerful despite their ethereal nature because they shape all the other coordinating mechanisms, especially if they represent a consensus among powerful but usually conflicting parties.

Coordination and integration can either be a centralised process of conscious control or it can emerge spontaneously because of the incentive structure experienced by each of the players or because of the rules-of-thumb that they operate by. Each of these forms of coordination have a role to play in achieving a closed-cycle economy. The 'emergent' coordination strategy is particularly compatible with the spontaneous character of the market. Emergent coordination will work best when as many of the forces for coordination are driving things in the same direction, for example education programs, laws and pricing policies have similar implications.

When promoting 'emergent' coordination it should not be forgotten that this approach requires an underlying incentive structure that will have to be established using conscious centralised control, for example, a suite of levies and subsidies to shape prices or a formal policy to shape educational programs.

A number of initiatives to promote a well integrated and coordinated waste minimisation system are offered for consideration:

- The centrepiece is a national multipartite Deliberation Council with regional sub-groupings. (This corresponds to the second firm recommendation for this Scenario in Section 15.5. It is similar to the recommendation in Scenario 1 on establishing an integrated system for waste minimisation which combines Options #49, #50 and #47.) The primary purpose of this body would be to develop a shared vision of the dynamic path to a true closed-cycle economy. It would be an advisory body only. Organisations that, between them, are the key players affecting all the coordination channels described above would be represented, for example, businesses, all three levels of government and relevant government agencies, professional bodies and environmental and other community groups. The Deliberation Council's terms of reference and the weighting of representation would need to be structured so that a commitment to an ecologically sustainable, economically viable closed-cycle economy was consistently maintained.

  The Deliberation Council's role would be review the waste minimisation system of the day and assist its member organisations to develop a consensual vision of how to take additional effective steps to create a viable closed-cycle economy.

  Although acting purely as an advisory body, the Deliberation Council would have two phases of operation. Firstly it would seek to develop a consensus between the parties about how to generally achieve a closed-cycle economy. This consensus would deal specifically with the formal plans, incentive structures, education programs and decision making rules-

of-thumb that each of the parties intended to develop. Once a consensus was reached on the broad vision, the parties would be asked to put in place real commitments based on the consensus. After that the parties would be reconvened to consider how these commitments might fit together as a functioning system. This cycle would be repeated at intervals, possibly with different focuses in each cycle.

- Building on the work of the Deliberation Council, standard setting bodies such as governments and Standards Australia would prepare 'standardised sub-systems' into which all products would be expected to fit. (Option #17) For an elaboration of this concept see Appendix B.
- National and State/Territory governments would legislate for extended product responsibility or product stewardship (Option #82). Australian based product managers, that is manufacturer/marketers or importers, would be required to adopt (a) design-for-the-environment covering all major environmental issues (eg. waste minimisation, pollution prevention, the conservation of energy, materials and biodiversity, ecologically sustainable urban form etc., amenity and heritage conservation), (b) product stewardship covering management of the total life cycle and (c) they would be required to take responsibility for the product at the end of its life either arranging for reuse or, if that is not possible, materials recycling.
- The establishment of a national register of supply and demand for waste materials and energy, and products and components for recycling or reuse would enable firms to more effectively integrate their inputs and outputs. Such a register should also record the quality of the material or product so that it can be matched as far as possible with a subsequent use that doesn't result in a decline in its quality. Locational details will also be needed. (A related national waste minimisation database is being established by the CRC for Waste Management and Pollution Control.)
- Grants, for say a 5-10 year period, would assist firms to put in place life-cycle tracking systems so that they could trace materials and energy as they came into the system, passed through cascade recycling loops and then, in the case of materials, were finally regeneratively recycled (Option #44).
- To assist firms to plan within the context of a closed-cycle economy it would be necessary to create a model of the materials stocks and flows economy. This model should deal with both physical and economic parameters. It should be available for use by all interested parties and for that reason is best developed by a national government agency with input from all the other key players.

## 7. To manage the effects of the business cycle

As discussed in Section 10.14 materials recycling companies often do well in the booms when materials demand and hence prices are high but they have great difficulties in the downturns when primary materials suppliers maintain production and sell at marginal cost. There are three measures that could help materials recyclers manage the business cycle. As is done in Seattle (see Section 9.12.10) waste management bodies could contract for a fixed, long-term price that is higher than the spot price in the downturns and lower than the spot price in the booms (Option #64). If the spot price during the booms is only just high enough to make recycling viable, then averaging the price may simply make recycling non-viable all the time. Recycling would be made viable for many resources if the levies/expenditure package described under Goal 4 were introduced thereby allowing the price of secondary materials to rise without losing competitiveness against primary materials.

The third measure relevant to the management of the business cycle is the introduction of temporary waste storage facilities. Demand for material for recycling will fluctuate during the business cycle. When demand is down wastes should be stored and then released later when the market improves.

## 8. To minimise non-cyclic supply surges

In many countries around the world there has been a surge of supply of recyclables as collection systems have been improved, tipping costs have risen in response to new policies to discourage waste dumping and as extended product responsibility regimes have been introduced.

These supply surges are very disruptive to markets for recyclables around the world, causing suddenly depressed prices and the displacement of existing suppliers.

Internationally the problem could be dealt with by lobbying the European Community, the United States, Japan etc. to manage their recycling programs to smooth out supply increases and to cooperate to increase source reduction. This could be followed by the creation of an international treaty to govern recycling programs so that there are no significant supply surges. A treaty of this sort may well be necessary to establish GATT compatible environmental levy and expenditure packages. (See Goal 4.)

The problem of supply surges can probably be solved by ensuring that in each country, including Australia, the primary resource levies of various sorts and incentives for source reduction and recycling bear down faster than the disposal levies. If this is done then the demand for recyclables should keep just ahead of supply. This could be supplemented by a system of international trading quotas for recyclable materials.

## 9. To take effective action to retain (first priority) or regain (second priority) the quality of materials or to retain the quality of energy

If a true closed-cycle economy is to be created then the greatest possible care must be taken to slow down the decline in quality of materials and energy through long product life and careful matching of subsequent uses to recycled material. Care must also be taken to regeneratively recycle all materials so that they once again are available for use by the economy or nature.

Techniques need to be developed so that this can be done, training needs to occur in relation to the what, why and how of materials quality stewardship and a formal duty of care needs to be established through legislation (Option #39) and though Environmental Management Systems. Information systems to track materials quality will be needed.

## 10. To foster waste minimisation through product conception and design

Unless appropriate services and goods are available consumers cannot exercise any discretion. This means that product conception, design and re-design play a central role in making effective source reduction and materials recycling possible. It is therefore most important to provide

plenty of resources to ensure that the conceptualisation and design processes are of the highest standard (Option #14). At least part of the resources needed can come from the revenues of the source reduction and recycling assistance levy. (See Goal 4).

Assistance could take the form of full or part public funding for:

- research and development of conceptualisation and design skills
- the specification of standardised sub-systems. (See Goal 6)
- education and training of both professionals and clients
- promotion of the benefits
- the creation of a best practice database and the dissemination of its contents
- pilot projects.

Design-for-waste minimisation, as part of design-for-the-environment, could also be required by legislation (Option #83).

## 11. To favour waste minimisation through consumer behaviour

While design-for-waste minimisation is important to make a closed-cycle economy possible, in many cases it is consumer behaviour that decides finally whether a closed-cycle economy actually happens.

At present there is little financial feedback to consumers about the wastes that they generate. The introduction of user-pays schemes would correct this (Option #22). Also further encouragement could be given to waste separation by consumers as this increases the potential for materials quality maintenance (Option #29).

At present consumers are relatively active supporters of waste collection for reprocessing, but they are not so keen to purchase products with recycled content. There is a need for a very active education and promotion program, that is, a buy-recycled program, to reinforce the idea that if people are not 'buying recycled' they are not actually recycling (Option #9).

With the increased emphasis that this Scenario places on source reduction there is a need for programs to help people design and adopt relevant new lifestyle variations. This could be catalysed by individuals, community groups, councils or even service companies that 'sell' the ways of living green. Whichever way it is done, there needs to be good feedback to service and goods suppliers about existing and potential products that would make it easy to live in a closed-cycle economy. Consumer waste minimisation boards organised through local government are one way this could be done (Option #54).

Given the reluctance of many businesses to take action until they have seen a working model, the importation of good green products from overseas could be an effective way of gingering up local suppliers. This would need to be accompanied by an active import replacement program if negative balance of payments problems are to be avoided.

## 12. To foster effective innovation in waste minimisation

There are two key reasons why it is essential that innovation in waste minimisation is fostered. The first is that in the absence of a corrective package of levies and expenditures, primary raw material cost will continue to decline, despite the depletion of resources. The only way that secondary materials suppliers or source reduction option providers can compete is to maintain an even more effective cost reduction program, largely through actively and continuously reducing the labour intensity of their products.

The second reason why innovation is essential is that the creation of a closed-cycle economy will require enormous structural changes. Many things will need to be done in new ways, especially if they are to be cost-competitive with the present ways of doing things.

At present the waste minimisation industry is too small and too poorly resourced to maintain innovation on the required scale. This might be corrected by injecting public funds or it might be overcome if existing industries are required by law to support waste minimisation through programs such as extended product responsibility.

Infant industry support programs are appropriate where rates of innovation need to be significantly increased above the previous rate. Sales tax exemptions operating for some years can be a useful stimulus to create new products as has been demonstrated by the sales tax exemption on recycled paper products (Options #6 and #11).

Further support would be appropriate for initiatives such as:
- R&D
- pilot and demonstration projects
- dissemination of best practice.

**13. To reduce the supply of post-consumer wastes at the source**

**14. To improve the marketability of durables, reusables and recyclables**

These last two goals are catch-all topics to consider when the initiatives for the other goals have been determined and committed to as part of a practical program of action. If it appears that the committed initiatives are not sufficient to achieve a true closed-cycle then further initiatives will have to be developed to achieve Goals 13 and 14.

## Section 15.7 How it might be achieved

Such an economy might be introduced through a sequence of measures such as the following:

- organisations and individuals committed to the creation of a closed-cycle economy initiate an advocacy program.
- the three levels of government release a discussion paper on the concept of the closed-cycle economy as a national goal. The benefits of such a transformation to Australia's efforts to boost exports of elaborately transformed manufactures and services are spelled out in the discussion paper.
- a general education program is launched explaining the why, what and how of the closed-cycle economy.

- a range of appropriate advocacy groups are identified and funded.
- the three levels of government commit themselves to complementary legislation to promote a closed-cycle economy and a multipartite Deliberation Council is formed to negotiate the form the legislation should take.
- a major assistance program is introduced giving grants and partial subsidies for training, plan development, R&D and feasibility studies related to activities contributing to the closed-cycle economy.
- legislation is introduced that requires industry, within say 4 years, to take back their products at the end of their life and that establishes the ecological levy/expenditure package described in Goal 4.
- independent auditing of progress towards a closed cycle economy is introduced.

## Appendix A: Standardised sub-systems

It is only possible to judge the contribution that a firm, a product or a project might make to sustainability once the context has been defined. However there are, in theory, an infinite number of ways of defining the context of any firm, product or project. To make context sensitive management, design and assessment a practical proposition, it is necessary to create a finite number of publicly recognised and specified contexts (standardised sub-systems) into which specific initiatives can fit.

This approach is now being used in software development where systems are reaching such high levels of complexity that no one person can comprehend the software system in totality. That is, it is not possible for one person to know the detailed structure and behaviour of **all** the components and the overall system as well. The same problem of complexity applies to the construction of very large office towers, sophisticated aircraft, and to the coordination of inter-related product offerings from a range of independent companies. In the latter case a shared standard is developed, or adopted defacto, so that designers know what is required if their products are to fit in with other related products. This is a very common strategy in the information industry.

To make it possible for many people to work together on these products or projects, despite the fact that the complexity is too much for any one person to comprehend, it is necessary to treat the components of the products or indeed whole products as modules of a larger system. The components or products can then be designed and fabricated semi-independently and yet still work together finally.

Standardised sub-systems developed to facilitate the achievement of sustainability would vary from:

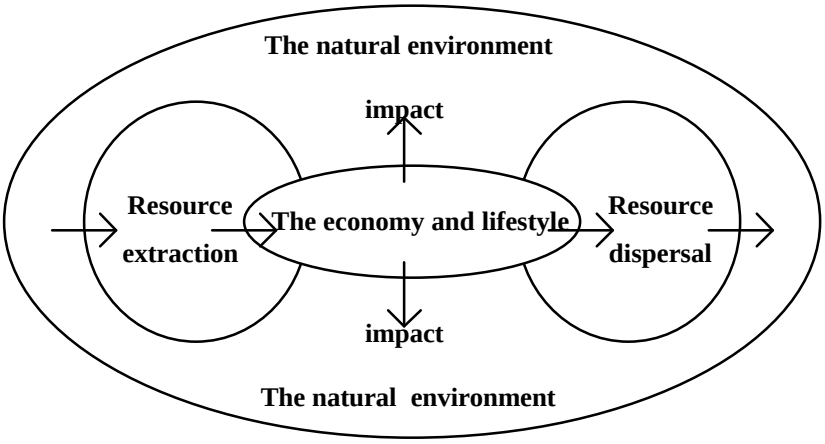
- generalised **conceptual frameworks** for particular sub-systems or for collections of sub-systems[21], through to-

[21] At the more abstract framework level it might be more useful to think of standardised sub-systems as ‘standardised contexts’ for analysis or design. For example visions or green scenarios for a sustainable society and economy would be very important high level ‘standardised contexts’. Exploration of these high level contexts would lead very well into the design of tangible standardised sub-systems.

- highly specified **real systems** for handling specific problems eg. kerbside collection systems for high volume/low money value/low material diversity wastes for recycling or 'parcel post' collection of medium volume/high money value/high materials diversity products and components.

In order to make sustainability an achievable goal, the natural environment and human systems needs to be grouped into conceptual or real modules (standardised sub-systems). Some of the systems that need to be modularised to produce a standardised sub-system include:

- geographical areas (urban, rural, natural)
- processes of resource extraction from the natural environment
- the production of goods and services
- waste management
- transport
- lifestyle elements.




To create standardised sub-systems for the achievement of sustainability, it is necessary to develop widely held consensuses[22] on:

- the nature of the threat to sustainability
- the application of the precautionary principle in practice
- the best options for achieving sustainability given each society's or localities social, cultural and physical circumstances.

To take a practical example, a series of standardised sub-systems might be generated for domestic waste management as follows.

The domestic waste management system would need to be structured so that it built up into a system that was sustainable overall. To do this it would be necessary to:

- approximate a closed cycle system (100% recycling and zero pollution discharge) for all non-natural materials and chemicals and for most natural materials and chemicals
- modify human production systems so that, overall, they mimic nature where wastes from one process become feed stock for another
- dissipate into the environment only those materials that natural systems can metabolise safely

[22] The Swedish program, the Natural Step, has created a movement for sustainability focused on a similar consensus building process. This program is now being established in Australia.

- hold as stocks in the human economy all materials that natural systems cannot metabolise safely
- shift to powering the system with solar energy.

If these changes were to be made, then the traditional dumping of waste would no longer be an option. Once an appropriate suite of standardised sub-systems for waste handling and processing had been determined and approved, all products would be designed so that they could be handled by one or more of the available options. If a manufacturer did not want to fit into any of the available standardised sub-systems for waste handling or processing, they would have to ensure that a new, preferred standardised sub-system was developed and approved. The combination of the new standardised sub-system plus the existing ones would still have to add up to a total system that was sustainable.

The handling modules for domestically used products might be selected bearing in mind the following characteristics of the waste:

- handling weight
- the bulk of items
- the total volume to be handled
- $ value
- physical state (solid, liquid, gas)
- biodegradability
- hazard level.

Waste removal and management modes might narrow down to the options in the following tables:

| **Removal mode** | |
|---|---|
| **Standardised sub-system** | **Wastes handled** |
| Regular kerbside collection | Easily separable high volume solids with low material diversity and low unit value |
| Infrequent kerbside collection | High bulk or weight solids with low value |
| 'Parcel post' collection[23] | Low to medium weight or bulky objects with high value and high materials/object diversity |
| Special collections | Hazardous, bulky, heavy or especially high value objects |
| Sewer | Waterborne biodegradable wastes |
| Drainage system | Clean water (rainfall run off; garden watering seepage) (No pesticide or fertiliser seepage) |
| Air discharge | Natural gases only within atmospheric management limits |
| Not removed | Material composted on-site; domestically repaired and reused objects. |

[23] This system does not yet exist. The concept is that people would get rid of certain unneeded products or components by 'posting' them. The goods would be contained in a bar-coded bag or box. Returned goods would be sorted electronically at central depots and despatched from time to time in lots to users on an as-needed basis. This system is designed to cope with the huge range of products that are produced in smallish numbers (compared with newspapers and beverage containers). This system would only be economical for goods that were to be reused or remanufactured. It would not be economical for materials destined to be reprocessed into basic recycled raw materials.

| Processing mode | |
|---|---|
| **Standardised sub-system** | **From collection system** |
| Reuse in current form | Regular kerbside collection, parcel post collection |
| Remanufacture - reconditioning/repair of whole product | Parcel post collection; special collections |
| Remanufacture - disassembly/reassembly - use of components) | Parcel post collection; special collections |
| Reprocess (non-biodegradable) | Regular kerbside collection; infrequent kerbside collection |
| Reprocess (biodegradable) - compost or ferment | Infrequent kerbside collection; sewer |
| Direct return to the environment for **use** by the biological system | Drainage system; air discharge |
| Warehouse, awaiting processing opportunity | Parcel post collection; special collections; infrequent kerbside collection |

Not every standardised sub-system would be available in every locality. But the standardised sub-systems that were present would have to combine to form part of the overall sustainable system. All wastes in the locality would therefore be able to be handled or processed through the approved standardised sub-systems that did exist locally.

## Appendix B.1: Glossary

| | |
|---|---|
| Cascade recycling | Recycling of materials or energy where the resources are used again for lower grade uses. |
| Closed-cycle recycling system or closed-cycle economy | A recycling system where industrially or naturally renewed resources dominate resource supply, and where degraded resources that have been through an optimum amount of cascade recycling are regenerated industrially or through ecological processes to produce high quality resources yet again. |
| Cradle-to-grave | The progress of the materials and energy that go to make up a product, from their initial production or extraction from the environment to their ultimate disposal. |
| Factor price pattern | The pattern of prices, at a particular time or over a period of time, of the inputs to production. Traditionally the 'factors' were considered to be land, labour and capital. For the purpose of environmental/economic analysis they can be usefully thought of as materials, energy, land & environmental services, labour, plant & equipment and information. |

| | |
|---|---|
| Post-consumer wastes | Products and materials which have been discarded by their ultimate consumers. The category can cover products or materials disposed of in municipal tips. |
| Recycling | The use of raw materials or energy recovered from old products to make new products (the third approach in the waste minimisation hierarchy). This often involves the reprocessing of the recovered materials or energy[24]. Recycling has not occurred if recovered materials have not been reused. |
| Regenerative recycling | Recycling where low grade materials are reprocessed and purified to a higher grade. |
| Re-use | Re-use of products and materials without reprocessing them (the second approach in the waste minimisation hierarchy). |
| Source reduction | Reduction of waste at its source, ie. not producing it in the first place(the first approach in the waste minimisation hierarchy). |
| Throughput recycling system | A recycling system where the production of primary resources to top up the resource supply, and the disposal to landfill or incineration of materials that no longer have recycling potential, is still occurring on a large scale. |
| Waste minimisation | A hierarchy of approaches to reduce waste based on the quantity of resources saved: first, reduction of waste at its source; second, re-use; third, recycling; fourth, treatment; fifth; disposal. The main waste reducing components are source reduction (including re-use of products and materials without reprocessing) and recycling (meaning reprocessing of materials). |

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