Civil Works and Recycled Content

Economic assessment of options for increasing the use of recycled content in Western Australia

Prepared for Department of Environment and Conservation

June 2008

ACIL Tasman
Economics Policy Strategy
# Contents

**Report Summary**
- Options evaluated  vii
- Evaluation criteria  vii
- Assessment summary  viii

**Recommendations**
- Stage one actions  xi
- Review results  xi
- Other possible actions  xii

1 **Introduction**
   - 1.1 Recycling and reuse in Western Australia  1
   - 1.2 Report focus  1
   - 1.3 Terms of reference  2
   - 1.4 Report structure  2

2 **Formal assessment framework**
   - 2.1 Efficiency criteria  4
   - 2.2 Equity criteria  6
   - 2.3 Simplicity criteria  6
   - 2.4 Development criteria  7
   - 2.5 Issues relating to market failure  9
     - 2.5.1 Allocation methodologies  10
     - 2.5.2 Implications for efficiency  11
     - 2.5.3 Implications for equity  11

3 **A review of other jurisdictions**
   - 3.1 New South Wales  12
     - 3.1.1 Landfill levy in New South Wales  12
     - 3.1.2 Waste and Resource recovery framework  13
     - 3.1.3 Market review for New South Wales  13
   - 3.2 South Australia  16
   - 3.3 Productivity Commission report  18
   - 3.4 International evidence  19
     - 3.4.1 Landfill taxes and virgin materials taxes  20
     - 3.4.2 Price responsiveness studies  23
     - 3.4.3 Long-run responses versus short-run responses  24
   - 3.5 Case study details  26
     - 3.5.1 Case study- Merton local council  26
     - 3.5.2 Case study Essex local government  27
Civil Works and Recycled Content

3.5.3 Case study - San Diego and Chicago 28
3.5.4 Case study Durham local government 29
3.5.5 Case study Gloucestershire local government 29
3.5.6 Summary 30

4 Market overview 30
4.1 Current flow to landfill 30
  4.1.1 Landfill and recycling rates for C&D waste 33
  4.1.2 Landfill site regulation 34
  4.1.3 The landfill levy in WA 34
  4.1.4 Clean fill and C&D waste 35
  4.1.5 Summary comments 36
4.2 Current use activity summary 37
  4.2.1 Recyclers 37
  4.2.2 Main Roads (WA) 38
  4.2.3 WALGA involvement 40
  4.2.4 Individual local government 41
  4.2.5 Department of Housing and Works 45
4.3 Extractive industries in WA 48
  4.3.1 Metropolitan and outer metropolitan operations 49
  4.3.2 Extractive industries and environmental policy 50

5 Options for increasing the use of recycled material 51
5.1 Modified status quo model 52
  5.1.1 Changes to the landfill levy 52
  5.1.2 Removing explicit barriers to use of recycled products 52
  5.1.3 Education and information campaign 54
  5.1.4 Variant based on incentives 54
5.2 Modified status quo assessment 55
  5.2.1 Assessment against efficiency criteria 56
  5.2.2 Assessment against equity criteria 60
  5.2.3 Assessment against simplicity criteria 62
  5.2.4 Assessment against development criteria 63
  5.2.5 Externality issues 64
5.3 Regulation based option 64
  5.3.1 Setting the initial targets and updating regulations 65
5.4 Regulation based option assessment 66
  5.4.1 Assessment against efficiency criteria 67
  5.4.2 Assessment against equity criteria 69
  5.4.3 Assessment against simplicity criteria 70
  5.4.4 Assessment against development criteria 72
  5.4.5 Externality comments 72
5.5 Overall outcomes approach 72
Civil Works and Recycled Content

5.5.1 Establishing the basic design of the approach 73
5.5.2 A framework for roads 74
5.6 Overall outcomes approach assessment 75
5.6.1 Assessment against efficiency criteria 75
5.6.2 Assessment against equity criteria 76
5.6.3 Assessment against simplicity criteria 77
5.6.4 Assessment against development criteria 79
5.6.5 Externality issues 79
5.7 Price based options 79
5.7.1 The three arms of the price based approach 80
5.8 Price based approach assessment 81
5.8.1 Assessment against efficiency criteria 81
5.8.2 Assessment against equity criteria 83
5.8.3 Assessment against simplicity criteria 84
5.8.4 Assessment against development criteria 85
5.8.5 Externality issues 86

6 Option overview 86
6.1 Revised status quo summary assessment 87
6.2 Regulation based approaches summary assessment 88
6.3 Outcomes based approaches summary assessment 89
6.4 Price based options summary assessment 91

A Appendix: Main Roads WA Technical Specifications for materials A-1
B Industry Cost structure examples B-1
C Partial adjustment model C-1
D Bibliography D-1

Boxes, figures and tables

Box 1 RTA annual report 2007 extract 15
Box 2 Recommendations from South Australian review process 17
Box 3 Productivity Commission Policy Assessment Criteria 19
Box 4 Elasticity concepts explained 24
Box 5 Tender extract on recycled material 44
Box 6 Extract of crushed recycled concrete Sub-Base requirements A-1
Box 7 Extract of crushed recycled concrete Basecourse requirements A-2

Figure 1 Typical cost structure for an industrial single location firm 9
Figure 2 Tipping rates at various locations in 2003-04 33
Figure 3 Tipping rate and recycling rate correlation 34
Figure 4 Inert landfill levy rate in Western Australia 35
Civil Works and Recycled Content

Figure 5  Main Roads WA: checklist for relationship contracting 40
Figure 6  State government contribution to local government roads 42
Figure 7  Materials sub-section for Education Green Star 46
Figure 8  Green Star summary for education 47
Figure 9  Different possible long-run industry supply curves 59
Figure 10  Constant cost industry: individual firm and market B-2
Figure 11  Increasing cost industry: individual firm and market B-3
Figure 12  Decreasing cost industry: individual firm and market B-4

Table 1  Aggregate production in 2005 20
Table 2  Estimates of the price elasticity of demand for landfill 23
Table 3  Long-run vs. short-run effects: the case of oil demand 25
Table 4  Merton recycled content targets 27
Table 5  Recycling content targets 28
Table 6  Incentive arrangements for projects 30
Table 7  C&D waste by category 31
Table 8  Construction and demolition waste by generating sector 31
Table 9  Construction and demolition waste and recycling in 2002-03 32
Table 10  Basic raw material forecasts for urban WA 36
Table 11  Main Roads WA tender process evolution 39
Table 12  Local government expenditure on roads: 2005-06 41
Table 13  Road funding by source: 2005-06 42
Table 14  Approved operation in metropolitan and outer metropolitan region 49
Table 15  Overall option assessment summary table 90
Civil Works and Recycled Content

Report Summary

The report evaluates a range of different policy options that could be used to increase the amount of recycled content in civil construction projects. The specific options evaluated are briefly outlined below.

Options evaluated

- **Revised status quo option**
  - The revised status quo, which:
    - Maintains the current landfill levy structure, but introduces indexation for the landfill levy
    - Removes explicit barriers at the local government level to the use of recycled material as road base
    - Works to overcome information asymmetry in the government sector by way of an education campaign, and
    - Includes a variant that provides a financial rebate to LGAs that use recycled content material in construction projects, where the rebate fund operates for a limited number of years.

- **Regulation based options**
  - Regulation based regime, which:
    - Is based on a target mandatory percentage level of recycled content for all government civil construction projects and mandatory diversion targets for waste for all government demolition projects
    - Includes different targets for different regions, and
    - Considers a variant that involves additional regulations/legislation for material used as clean fill.

- **Overall outcomes based options**
  - Project outcomes based approach, where:
    - The objective is to achieve the best possible overall environmental outcome, and where the recycled content component of the project is just one assessment element, and
    - Includes a variant where there is a financial reward programme for projects that achieve excellent environmental outcomes.

- **Pricing based options**
  - Price based approaches, which involve the three distinct sub-options of:
    - A substantially higher landfill levy
    - The introduction of a virgin aggregates tax
    - Implementation of a bond system for building and demolition projects.

Evaluation criteria

So that consistent comparisons could be made across the different options, each option was evaluated against a common set of criteria. The evaluation
criteria considered issues of efficiency, equity, simplicity, and market development.

**Efficiency criteria**

There are three separate aspects of efficiency that are considered. The first, *allocative efficiency*, requires that the price of goods and services be set so that society’s scarce resources are put to the best possible use. The second, *productive efficiency*, requires goods and services to be produced in the most cost effective manner. The third, *dynamic efficiency*, considers incentives. Specifically, the incentive to invest and the incentive to keep prices low.

**Equity criteria**

The equity assessment considered:

- issues of ability to pay and potential disadvantage to government departments, government agencies, and LGAs
- the relative treatment of potential suppliers of virgin material and recycled content material
- the extent to which the costs of any change are borne by different contractors/agencies/departments
- the possibility for there to be distributional effects across contractors of different size, or across LGAs in different locations.

**Simplicity criteria**

The simplicity criteria considered both operational issues and implementation issues. Specific operational issues considered included whether or not the approach was transparent and understandable, and what monitoring and auditing costs were involved. Specific implementation issues considered included the new institutional arrangements required under the approach and the capacity of organisations to cope with additional responsibilities.

**Market development criteria**

The final area of assessment considered how the option would assist with the development of the market for recycled goods.

**Assessment summary**

Under the efficiency assessment the best performing option was the outcomes based approach, followed closely by the revised status quo option. For the outcomes based approach, the financial incentive variant did not change the assessment. For the revised status quo approach, the rebate scheme lowered the efficiency assessment slightly. The demolition bond approach performs moderately well in terms of efficiency, but significantly less well than either the revised status quo option or the outcomes based approach. The regulation based approach, the levy approach, and the aggregates tax approach, all perform poorly against the efficiency criteria.

Under the equity assessment the revised status quo option and the outcomes based option perform equally well. For both options the financial incentive variant has the potential to introduce distributional effects. The demolition
bond approach has a medium assessment for all three equity sub-criteria. The regulation based approach and the levy approach both perform relatively poorly against the equity criteria. The worst performing approach in terms of equity, given the specific operational assumption made about each option, is the aggregates tax approach.

The best performing options under the simplicity assessment are the levy approach and the revised status quo approach. The aggregates tax approach and the demolition bond approach perform moderately well in terms of operational simplicity, but perform poorly in terms of the new institutional arrangements required, and implementation impacts. The regulation approach performs poorly in terms of ongoing administration cost, and moderately poorly in terms of new institutional arrangements and implementation impacts. The outcomes based approach performs poorly on all aspects of the simplicity assessment.

The regulation based approach, the levy approach, the aggregates tax approach, the standard outcomes based approach, and the outcomes based approach with financial incentive, are the approaches that would stimulate market development the most. The demolition bond approach and the revised status quo with a financial rebate scheme would have a slightly lesser impact on market development. The revised status quo without a financial incentive would have the smallest impact on market development, but the approach would still have a strong positive impact.

A summary assessment table is shown below. In the table the row headings describe the assessment criteria and the column headings describe the option being assessed.
<table>
<thead>
<tr>
<th>Efficiency criteria</th>
<th>Revised status quo</th>
<th>Regulation approaches</th>
<th>Outcomes based approaches</th>
<th>Price based options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic revised status quo</td>
<td>Variant: recycled content rebate</td>
<td>Content and diversion regulations</td>
<td>Variant: new clean fill regulations</td>
</tr>
<tr>
<td>Allocative efficiency</td>
<td>Good</td>
<td>Good/medium</td>
<td>Poor</td>
<td>Medium</td>
</tr>
<tr>
<td>Productive efficiency</td>
<td>Good</td>
<td>Good/medium</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Incentives for investment</td>
<td>Medium</td>
<td>Good/medium</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Incentives for cost discipline</td>
<td>Good</td>
<td>Medium</td>
<td>Poor</td>
<td>Poor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equity criteria</th>
<th>Revised status quo</th>
<th>Regulation approaches</th>
<th>Outcomes based approaches</th>
<th>Price based options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to pay and disadvantage</td>
<td>Good</td>
<td>Good</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Horizontal equity</td>
<td>Good</td>
<td>Good</td>
<td>Medium/poor</td>
<td>Medium/poor</td>
</tr>
<tr>
<td>Incidence and distributional effects</td>
<td>Good</td>
<td>Good/medium</td>
<td>Medium/poor</td>
<td>Medium/poor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Simplicity</th>
<th>Revised status quo</th>
<th>Regulation approaches</th>
<th>Outcomes based approaches</th>
<th>Price based options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transparent and understandable</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Low ongoing administrative burden</td>
<td>Good</td>
<td>Medium</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>New institutional infrastructure required</td>
<td>Good</td>
<td>Medium</td>
<td>Medium/poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Implementation impacts</td>
<td>Good</td>
<td>Good/medium</td>
<td>Medium/poor</td>
<td>Medium/poor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development</th>
<th>Revised status quo</th>
<th>Regulation approaches</th>
<th>Outcomes based approaches</th>
<th>Price based options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market development effect</td>
<td>Medium</td>
<td>Good/medium</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>
Recommendations

The revised status quo option, without a rebate scheme, provides a path for positive steps to be taken that performs well against all of the assessment criteria, and should also have a strong positive impact on market development.

Stage one actions

At the end of the current schedule of levy increases, the landfill levy will, in broad terms capture the externality impacts of landfill. The current levy structure does not however have an allowance for indexation. The levy should be indexed to the Perth CPI, or other appropriate index.

All tenders for road construction material should be based on technical specifications. This could be achieved either by way of a communication strategy aimed at LGAs, and LGA engineers especially, or by making State road funding contingent on using technical specifications in roads tenders rather than specifying virgin material only.

There should be a continuing and sustained effort to communicate the potential benefits of using recycled C&D material to LGA engineering departments. There should also be a focused effort to explain tendering approaches that can deliver savings to LGAs and at the same time involve the use of recycled content products in civil construction projects.

Environmental offsets are an appropriate means of capturing the externality impact of extractive industry activities. The use of environmental offsets should be continued.

Review results

These actions should assist with the uptake of recycled content in civil construction projects, without detracting from market efficiency. It would however be appropriate to review the progress that had been made in three or four years. At this point in time the landfill levy would be at a level that captures the full Productivity Commission estimated externality impact, and it would be possible to evaluate the impact of the education campaign, and the impact of the change in tender processes. Part of the review would be to reconsider and update the estimate of the landfill externality cost.

If the review found substantial progress had not been made, the outcomes based approach would provide an option that could be further developed.
Other possible actions

Additional to the revised status quo actions outlined above, there are a range of other actions that could also be considered to promote market development and material uptake.

Clean fill regulations

As the landfill levy increases there is potential for significant quantities of C&D waste to be used as clean fill rather than in the production of specified recycled products. Such activity represents a significant prospective issue for the long term development of the recycling industry, and appropriate changes to regulations and or legislation to prevent this occurring could be developed.

Asbestos contamination

Excessively cautious testing procedures for asbestos contamination have the potential to raise dramatically costs for suppliers of recycled C&D waste material. Acceptable risk assessment and testing procedures that are not prohibitively expensive need to be agreed between industry and government regulating bodies.

Project assessment tools

An appropriate action could be to conduct a detailed investigation into the cost of developing and operating outcomes based templates for road projects and other civil construction projects that could be used in Western Australia.

Overall targets

Notwithstanding the Zero waste vision, explicit targets for the amount of C&D waste recycled should be set for the metropolitan area and Western Australia as a whole. The targets should be realistic and annual performance against the target should be documented. The NSW target would represent a realistic upper bound for the WA target.
1 Introduction

This section of the report provides some introductory remarks, explains the scope of works, and outlines the report structure.

1.1 Recycling and reuse in Western Australia

The political environment in Western Australia with respect to recycling and waste management has evolved substantially in recent years. In particular the imposition of a landfill levy and the creation of the Waste Management and Recycling Fund has meant that it has been possible for the Waste Management Board to support a wide range of activities and new initiatives.

With the passing of the Waste Avoidance and Resource Recovery (WARR) Bill and the creation, in late 2007, of the new statutory Waste Authority, further significant developments in recycling activity and waste strategy can be expected in the coming years. With respect to the current report the comments of the Hon. David Templeman -- the relevant Minister in the current government -- regarding the priorities of the new Waste Authority are especially noteworthy.

The Waste Authority’s first priority will be to set out a comprehensive strategic five to 10-year plan on how we [Western Australia] can achieve a major reduction in waste going to landfill across Western Australia.¹

1.2 Report focus

The passing of the WARR bill means that in Western Australia there will be an increased focus on waste reduction and recycling across the whole of government at the highest levels. The current report does not address high level issues relating to recycling policy and waste minimisation. Rather, the current report focuses on assessing a range of practical options that may be used to achieve an increase in the amount of recycled content in government civil works projects.

The purpose of this report is to develop and evaluate the options available for achieving an increase in the use of recycled content in civil construction projects. The approach to the task involved:

– Establishing a clear set of assessment criteria
– Characterising the nature and features of each option

¹ Minister for the Environment; Climate Change Media Statement, 10 December 2007. WA Embarks on WARR on Waste.
Civil Works and Recycled Content

- Examining the experience of other jurisdictions, both in Australia and internationally
- Consulting with industry participants, government departments, and relevant agencies
- Assessing, discussing, and evaluating each option.

1.3 Terms of reference

The terms of reference asked for an economic assessment of at least the following two options:

1. Mandated recycled content levels in all civil construction projects
2. A policy based on principles of:
   a) Maximum use of recycled content and on-site recycling and reuse
   b) Only not using recycled material where it can be demonstrated that recycled material is not available or there is some technical limitation to using recycled material
   c) Requiring contractors to demonstrate how they followed the policy
   d) Flexibility in pricing to ensure where there are cost increases associated with using recycled material contractors are not disadvantaged.

Following discussion and the review of other jurisdictions several further possible options were also identified. These additional options are also presented and evaluated in the report.

The specific issues to be addressed during the economic evaluation and assessment process were listed as:

- Availability and cost comparison of using virgin and recycled materials now and in the future
- Barriers to use of recycled content
- Experience of other Australian jurisdictions
- Impact on the market demand and market supply for recyclables
- Geographical considerations.

These specific aspects of the evaluation process were incorporated into a formal assessment framework based on the general economic criteria of efficiency, equity, simplicity. Additionally, market development issues are also considered.

1.4 Report structure

The remainder of the report is structured as follows. First the assessment criteria used to evaluate each option are explained. The existence of externalities plays a role in motivating and justifying a role for government
Civil Works and Recycled Content

action. As such details relating to the concept of market failure are also presented.

Next, the experience in other jurisdictions is commented upon. Although the circumstances are not necessarily the same -- with respect to landfill levy rates, availability of virgin material etc -- the experience of NSW is illustrative and so is discussed in some detail. Consideration is also given over to the view of the Productivity Commission articulated in the 2006 Waste Management report. The UK is a jurisdiction that has made significant progress in the area of increasing the use of recycled content in civil construction works, and so the experience of the UK is also documented. The material on the UK is largely presented by way of a series of case study summaries, although the international case study summaries are not exclusively from the UK.

As the UK, Denmark, and Sweden have all had experience with virgin material taxes, details on their experiences are also reported.

Before moving to a review of the current situation in Western Australia, details on own-price elasticity estimates for waste are presented, along with a discussion about long-run and short-run responses. The discussion of the current situation with respect to recycling in WA draws on information obtained during the interview and consultation process.

The next chapter sets out the details of each option, along with variants to the basic option in some cases. Each of the different options identified is then assessed against the evaluation criteria specified in chapter 2 of the report. The assessments and related discussion is quite detailed, and so as a way of summing up the detailed information into an easily understandable format, the report concludes with a summary chapter.

The summary chapter includes a colour coded summary evaluation table. The table provides an easy to read comparative assessment of the relative strengths of each option against each of the criteria.

The various options described perform differently against each of the criteria and so the option deemed most appropriate will depend on the weight given to the various assessment criteria. The conclusions drawn are based on a first approximation weighting that the assessment criteria are all equally important.

It is important to note that while the elements included in each option are grouped together in a logical fashion, the specific combinations are somewhat arbitrary. The deciding factor in categorising each option was that each option had to represent something distinct from other options, and the discussion of the option could be kept tractable. As such, it is not strictly necessary to treat each option in isolation, and it would be possible to implement more than one option. Particular elements of different options could also be combined to
form a new option. Further, some options are more suited to the long-term and some the short-term. As such, implementation of some option combinations may be seen as complementary. This is recognised in the actions set out in the Recommendation section of the report.

2 Formal assessment framework

When evaluating alternative options it is important to be clear regarding the assessment objectives. Some assessment criteria are unlikely to be controversial. It is for example usually seen as desirable that any government policy option pursued: encourages outcomes which involve the lowest possible costs to society; is regarded as equitable by market participants; and does not have an excessively high administrative burden. Depending on the specific context a range of other assessment criteria may also be appropriate. It is therefore necessary to set out a clear framework for assessment against which each option can be evaluated.

The brief called for an assessment of each policy option against a range of very specific criteria. The very specific areas of assessment have been incorporated into a formal framework that assesses each policy option in terms of efficiency, equity, simplicity, and economic development. Establishing clear general principles of assessment ensures consistency in the assessment of each option, and also allows the complete set of relevant factors to be considered in a systematic manner.

2.1 Efficiency criteria

An economic assessment of policy efficiency is generally taken to mean an assessment of efficiency from three separate perspectives. The three economic efficiency criteria, or perspectives, generally considered are: allocative efficiency, productive efficiency, and dynamic efficiency.

Allocative efficiency requires that prices be set in a way that ensures the best use of society’s scarce resources. In the case of goods with externalities defining the true full price is not always an easy task, especially once uncertainty regarding the extent of externalities is introduced. Placing a value on things such as extending the life of a landfill site is also difficult.

In terms of intergenerational externalities, this is largely an issue relating to the stock of natural capital bequeathed to future generations. One view is that what one generation needs to leave the next generation is a general wealth creating capacity not a specific set of assets. Central to this position is acceptance of the view that ways can be made to make resources, in a broadly defined sense, substitutable.
The alternate view is that some environmental damage may be irreversible and that substitutes will not always be found; which, when coupled with uncertainty about the future and a general acceptance of risk aversion means that great care should be taken with the stock of natural resources. The implication is that it is not just a generalised capacity that matters, but the specific stock of natural assets.

It should be noted that regardless of the view taken about natural resource depletion, in the Australian context any position on intergenerational externalities would need to be consistent with the National Strategy for Ecologically Sustainable Development.

There are substitute products for virgin aggregates and so in terms of resource depletion the issue of intergenerational externalities may be thought of applying to any explicit environmental impacts on biodiversity from specific quarrying activities only. Issues relating to the environmental impacts of a quarry development are largely localised and are addressed at the time of the establishment of the quarry. Depletion of quarry material in itself is not a threat to biodiversity.

Regarding the issue of future landfill space, the view taken in developing the assessments in the report is consistent with the view put forward in Productivity Commission (2006) that as landfill tipping rates should reflect the scarcity value of landfill space, there is no external scarcity cost to consider. Future scarcity of space does not therefore impact on allocative efficiency.

With respect to energy use costs and associated greenhouse emissions, it has become clear during 2008, with the progressively more detailed announcements of Professor Garnaut, that the externalities associated with energy are to be fully priced. As such explicit consideration of energy related emissions does not feature in the assessment.

Productive efficiency requires that demand be met at least cost. Where externalities are involved, or the time horizon under consideration is long, accurately capturing the total cost of an activity can be difficult. The potential for economies of scale to exist in recycling industries adds complexity to the issue of assessing productive efficiency over the long term.

Dynamic efficiency involves consideration of the incentives for investment and innovation, and assessing whether or not the incentives provided under the option are appropriate. For example, an approach that requires a large capital investment that can only be recovered over decades reduces the incentive for existing firms to peruse research and development on innovative new approaches. This is because any new disruptive technological advance or innovative breakthrough may result in the company’s existing significant
investment in capital becoming redundant and the company failing to receive an appropriate return on their initial investment.

It is under the various efficiency criteria that the specific brief requirements of assessing the cost of using recycled materials relative to the use of virgin materials in public civil works projects are covered.

### 2.2 Equity criteria

In general terms equity is understood to encompass concepts such as fairness and support for the disadvantaged. In economic applications the most commonly cited references to equity are those seen in the public finance literature that relate to vertical equity and horizontal equity. In the public finance literature it is understood that vertical equity involves those with greater capacity to pay making a larger contribution, in either absolute terms or as a proportion of income, than those with limited capacity to pay, and horizontal equity involves treating people in similar circumstances equally.

Outside the specific area of public finance there can be many differing concepts as to what is fair. For example in the way contractors of different sizes should be treated. Consideration of inter-generational equity adds further complexity to assessing the equity implications of any given policy but is something that cannot just be ignored. In this instance as the inter-generational effects are central to the assessment of allocative efficiency, the inter-generational impacts are assessed under the efficiency assessment.

In the context of assessing options for increasing the amount of recycled content used in government civil construction projects, equity could be seen as relating to recognition of ability to pay and potential disadvantage to departments and government agencies; equity of treatment across potential contractors and source suppliers of both virgin and recycled content; and the extent to which the costs of any change are borne by different contractors/agencies/departments.

Where there are significant incidence effects it is particularly important to ensure that the rationale for change is seen by those affected as fair. Incidence effects are sometimes considered as part on the implementation processes and so seen as an element of the simplicity criteria.

### 2.3 Simplicity criteria

2 A discussion of the issues involved in discounting the future adds complexity to any assessment, but in the current context the issue of discounting is not considered as it is thought such considerations will add complexity but not value to the report.
Civil Works and Recycled Content

Simplicity recognises that an excessively complicated approach will increase administrative costs, both for firms and government, and potentially blunt the impact of any policy change. The policy approach also needs to be transparent and understandable to commercial firms, government departments and agencies, and the wider public. More generally, the principle to apply is that, subject to meeting the policy objective, the approach taken should be as simple as possible.

An assessment of simplicity is central to the consideration of the monitoring requirements incorporated within each option. Options that, for example, have embedded within them the need to demonstrate, via a technical report, why recycled material has not been used, are less simple, and hence more costly, than options that rely on an assessment of firm decision processes only.

Simplicity also relates to the future development and refinement of each option. For example, consider an option that has a specified recycled content requirement. The assessment of what an appropriate minimum recycled content requirement might be will change through time. The mechanism that is used to adjust the rate into the future is therefore also an important consideration when evaluating the overall simplicity of the option.

The final area of assessment under simplicity relates to implementation. The implementation evaluation considers a range of matters: the extent of new institutional infrastructure, arrangements, and legislative change required for each option; the capacity of the various relevant industry players to meet any new requirements; and the internal capacity of contracting organisations to assess potential new tender clauses.

Implementation changes will also generate incidence effects, but such effects are considered under the equity criteria.

2.4 Development criteria

Development criteria do not necessarily always form part of a general economic assessment of policy options, but are explicitly required as part of the project brief.

In the current context explicit consideration of a development criterion is useful as it allows the various efficiency criteria to be revisited in light of the potential for market development. Should there be, for example, significant economies of scale in the provision of recycled crushed concrete as road base, then it is possible that strict adherence to least cost approaches in the short-run may not allow the recycling industry to develop the scale it needs to offer a lower cost product over the longer term.
In light of the potential opportunities for market development it may turn out to be the case that best practice in terms of short-run market outcomes is not consistent with best practice in terms of long-term economic development outcomes. In particular, the existence of external effects flowing from firm entry to a market could potentially justify a deviation from strict least cost tendering in the present period so that savings could be realised over the longer term.

Regarding individual firm size, as a general rule the standard economic position is that there is an optimal size for a firm, found as the minimum of the long-run average cost curve, which, as Viner established in the 1930s, is found as the envelope of the short-run firm cost curves.

Typical cost curve shapes

In such a scenario the long-run cost curve initially falls, reaches a minimum point and then rises. Regardless of whether the fall and rise is gentle or steep, the implication is that the long-run cost curve as a U-shape. The specific shape of the cost curve does however have implications for what size firm is required to catch most of the benefits. If the fall in costs is dramatic, it implies that relatively small increases in plant size can achieve substantial cost savings.

Firm size and plant size

Although when first discussed it may have made sense to consider the firm and an individual plant as one in the same, in a modern economy it is easy to imagine that an entrepreneur may, having determined the optimal size of plant, then set about establishing multiple plants. With such a strategy the size of the firm can continue to expand while individual plant size is kept at the optimal level. In the recycling industry, where transport costs associated with sending material to a recycling facility are an important cost, it is possible to conceive of a multi-plant operation developing in the future.
Market interactions and complexity mean that not only are the representative cost functions typically used by economists, such as the translog cost function, indecipherable to anyone without a mathematics degree, but they also still fail to capture many salient features of the market. As such, the assessments made under the development criteria rest more on the business environment created under the different scenarios considered.

To develop and grow businesses require clear price signals, certainty, and the removal of explicit impediments to competition. The specific assessments made will therefore consider the implications in these areas. Long term, businesses need to be viable in their own right and not reliant on recurrent subsidy funding.

### 2.5 Issues relating to market failure

In general, when evaluating policy options of any kind, an important set of issues arises where there is a case of market failure. It is clear from both economic theory and real world market experience that markets will allocate resources efficiently when property rights over resources are well-specified and defined, exclusive, enforceable, and transferable. Where property rights are not fully defined, or are costly to enforce, the decisions made by individuals within the market will generally result in outcomes that are not socially optimal.
Market failure can occur when:

- A good or service is a ‘public good’ in that once it is provided to one individual, it is provided to all; and enjoyment of the service by one individual does not reduce the benefits available to others
- There is information asymmetry between market participants, or
- Externalities arise whereby the actions of one individual result in costs or benefits that affect others but are not borne by the individual creating the costs or benefits.

With respect to waste management, externalities can be further decomposed into upstream externalities and downstream externalities. Upstream externalities refer to the potential externalities associated with the mining and quarrying of virgin materials. Downstream externalities refer to things such as greenhouse gas emissions from landfill and emissions associated with transport of material etc. As the main greenhouse gas emissions of concern -- methane and carbon dioxide -- are generated by the decomposition of organic matter, in the current context downstream externalities are not as pronounced as in the case of waste in general.

Where there is a market failure, some approach to the allocation of costs needs to be identified. In broad terms there are two approaches to managing the assignment of costs where market failure exists. The two approaches are the impactor pays approach and the beneficiary pays approach.

### 2.5.1 Allocation methodologies

#### Impactor pays approach

In the market failure literature an impactor is defined as any individual or group of individuals whose activities generate the costs or the need to incur the costs that are to be allocated. Under the impactor or polluter pays principle, costs are allocated to individuals or groups in proportion to the contribution that each makes to the creation of the cost in question. The economic rationale of the approach is that it effectively internalises the cost of the externality. The resource impacts that were previously not fully priced are now priced, and the resource users are forced to face the full costs of their actions.

#### Beneficiary pays approach

A beneficiary is defined in the market failure literature as an individual or group of individuals who derive benefits from the activities for which costs are to be allocated. The benefits that accrue to a beneficiary may be direct, in terms of a service provided, or alternatively they may be in terms of costs and damage avoided. The beneficiary pays principle says that costs should be allocated to individuals or groups in proportion to the benefits that each individual or group stands to derive.

Since activities can often generate both private and broader public benefits, the beneficiary pays approach is often characterised by two component principles:
• A user pays principle whereby individuals or groups pay for the direct private benefits arising from the activity. For example, payments collected from landholders in potential landfill regions that will benefit from improved land amenity value when potential future landfill sites are no longer required; and

• A beneficiary compensates principle whereby those who benefit indirectly from an activity (including government on behalf of the general community in the case of broader public benefits, or local government where benefits are localised) contribute to costs.

It is worth making a further distinction between the costs that arise from the ongoing activities of an impactor, and the costs that arise from past activities when attitudes and standards of environmental protection may have been different. It is impractical to recover such costs from past impactors, and neither fair nor efficient to recover them from current impactors. This suggests that should legacy cost issues be faced, a beneficiary pays approach, whereby these costs are funded by government on behalf of the broader community, is more appropriate.

2.5.2 Implications for efficiency

Under the impactor pays approach service users are required to pay for the costs of the adverse impacts arising from their actions. The impactor pays approach can therefore, in principle, provide strong incentives for users to reduce the environmental impact of their actions. In practice such an outcome requires that the impactors be identified, that an appropriate charging mechanism can be designed, and that alternative courses of action are available to impactors.

The beneficiary pays principle is generally seen as providing less incentive for efficiency as it tends to subsidise activities that generate adverse environmental or other impacts, and may not encourage users to change their practices. In addition there is an incentive for users to seek the beneficiary pays approach in order to gain public funding.

2.5.3 Implications for equity

The impactor pays approach is often seen as equitable in the sense that those whose activities cause adverse impacts should be required to pay for the costs of addressing these impacts, rather than requiring those on whom the costs fall, or the broader community, to pay. Yet this is not necessarily the case. For example, in the case of traditionally allowed usages impacts may have been capitalised into the value of property. In effect, the seller of the asset, rather than the purchaser, may have captured most of the benefits -- and a purchaser
who then faces a set of new imposts to reflect the cost of their impacts could well see the outcome as unfair.

There may, moreover, be concerns about the effect of a new cost impost on impactors and their ability to pay. One response is for the government to adjust cost shares in favour of impactors, at least in the short term. An alternative is to phase in impactor charges over time to provide time for those affected to adjust.

Views on whether a beneficiary pays approach is equitable can vary considerably. For example, it may be seen as fair that local communities that benefit from a reduction in waste flows to landfill contribute to any extra cost associated with achieving this reduction. On the other hand, some may see it as inequitable to require a local community to make a contribution to such costs when the source waste was not generated in the local region.

3 A review of other jurisdictions

Some jurisdictions have made greater progress than Western Australia in terms of general waste management processes and outcomes. By considering the developments in these jurisdictions, and the policies and practices that have been implemented, useful insight can be gained regarding the likely impact of different policies.

The Productivity Commission report into Waste Management is an important reference. As such the key arguments of the report are also briefly discussed in this section of the report.

3.1 New South Wales

New South Wales has had experience with a landfill levy for a long time and has also had experience with Waste and Resource Recovery legislation since 2001. As such the experience of New South Wales is worth reviewing in some detail.

3.1.1 Landfill levy in New South Wales

A landfill levy has operated in New South Wales for decades, and details of the operation of the levy are described in the various editions of the *Protection of the Environment Operations (Waste) Regulations*. The levy was first introduced in 1971. In 1997, for the Sydney Metropolitan Area (SMA), the levy was increased from $7.20 per tonne of waste to $17 per tonne. As of 1 July 2002, for the SMA the levy was set at $18.20 per tonne, and for the Extended Regulated Area (ERA), which encompasses the Illawarra and Hunter regions, the levy was set at $9.60...
Landfill levy is high in NSW

Levy promotes waste diversion

WARR act since 2001

Key targets for resource recovery have been established

C&D waste recycling rates in NSW of 62 percent

per tonne. The levy rate was then indexed to the Consumer Price Index (CPI) to ensure that the real value of the levy was not eroded overtime by inflation.

In addition to the annual CPI increases, new regulations in 2006 provided for a series of substantial increases in the landfill levy in both the SMA and the ERA. For the 2007-08 year the levy for the SMA was set at $38.60. Annual increases in the levy in the SMA, in addition to the annual CPI increase, will be $7 for both the 2008-09 year and the 2009-10 year, and $6 for the 2010-11 year. The levy in 2007-08 for the ERA was set at $31.60, and for the ERA the annual increases in addition to the CPI increases are set to be $7.50 each year for the next three years, followed by two additional annual increases of $1.50.

The landfill levy in NSW encourages waste diversion and recycling. Not only does the levy impose an additional cost on material sent to landfill, but it also provides a source of funds that can be used to assist local government, and generally encourage innovation in the area of waste management. Even at the lower rates for the levy that have historically been charged in NSW, the levy has been particularly successful at encouraging diversion of C&D waste (DECC 2007b, p. 22).

3.1.2 Waste and Resource recovery framework

In New South Wales, until 2001, the waste management framework was governed by provisions contained in the Waste Management and Minimisation Act 1995. In 2001 the Waste Avoidance and Resource Recovery Act 2001 (WARR Act) was put in place.

Regarding waste recovery and recycling, the key objectives in NSW were set out in the Waste Avoidance and Resource Recovery Strategy 2003. Specifically, the relevant objectives from the review were to:

- Increase recovery and utilisation of materials from the municipal sector from the current 26 percent to 66 percent
- Increase recovery and utilisation of materials from the commercial & industrial sector from the current 28 percent to 63 percent
- Increase recovery and utilisation of materials from the construction & demolition sector from the current 65 percent to 76 percent (Resource NSW 2003).

The most recent strategy document for NSW is the NSW Waste Avoidance and Resource Recovery Strategy 2007. The current targets for recycling and waste reuse have not been revised from those originally set.

3.1.3 Market review for New South Wales

The actual recycling and reuse rates for C&D waste in NSW for 2004-05 were 62 percent for NSW as a whole, 66 percent for the SMA, and 65 percent for
the ERA (DECC 2007b, p. 13). These rates are substantially higher than in Western Australia, but give an indication of what is achievable in terms of recycling rates. In 2003-04 more than three million tonnes of recycled C&D waste was sold as product in the NSW market.

Market developments in NSW for recycled content products have been assisted by state government agencies and local councils. The purchase decisions of these groups are based on the principles outlined in *Waste Reduction and Purchasing Plans* (WRAPP) and the *Council Sustainable Choice Program* (DECC 2007b, p. 22).

Despite a policy framework that encourages the purchase of recycled content products, price and performance remain the primary drivers of the purchase decision. A reluctance to change practice, unless clear economic benefit can be demonstrated, has also been noted as a feature of the recycled content market. Unless recycling operations can achieve appropriate scale, competing on price can be challenging. A lack of information, especially technical information on product performance, also slows adoption of new recycled content products.

For an illustration of the role State government agencies can have in the promotion of recycled content products, consider the extract from the RTA annual report shown in Box 1.
Box 1  RTA annual report 2007 extract

Construction and maintenance

The RTA continues to beneficially use waste materials in its construction and maintenance activities. Examples of major construction related waste re-use projects during 2006–07 include:

- Approximately 170,000 tonnes of crushed steel slag was used in the subsurface pavement during construction of the North Kiama Bypass. An additional 70,000 tonnes of steel slag aggregate was incorporated into the asphalt surface layer. Slag is a waste product that is produced during the steel making process and for this project it was sourced from the steelworks at Port Kembla located approximately 35 kilometres from the construction site.

- About 1,500 tonnes of fly ash were incorporated into the 12,000 cubic metres of concrete used in the construction of the Sea Cliff Bridge at Stanwell Park. Power station fly ash is commonly added to concrete mixtures as it has cement like properties. Re-use of this common industrial waste material reduced greenhouse gas emissions that would otherwise have been produced by the increase in cement use.

- Upgrading works of the Pacific Highway at Bonville set an environmental example by recycling trees that were cleared. Logs of milling quality were sent to saw mills for processing or turned into fence posts on site. Poorer quality logs were used to make fauna friendly structures like koala and glider refuge poles, or sold as firewood. Tree roots were given to the NSW Riverbank Program for stream bank rehabilitation projects. The remaining tree limbs, roots and mulch were laid across exposed soil to help stop erosion and provide a surface for revegetation.

- Upgrading works on Cowpasture Road, Hoxton Park involved the use of a commercially produced recycled product made of recycled concrete and quarry scalps or crushed bricks. This product was used in the base layer of the road pavement and has been found to be particularly beneficial in situations where a more flexible pavement is required.

- Spoil-sandstone recovered from the Lane Cove Tunnel projects was re-used as the base layer in the widening of the southbound lanes on the M5 Motorway. In the north bound lanes, existing pavement was milled and augmented with other materials before being re-used in the upper road layers.

Future challenges of managing natural resources and waste

The challenge for the RTA is to continue to increase the use of recycled materials in its construction and maintenance projects.

During the coming year the RTA will be developing recycled material guidelines and training programs to better educate road designers, project managers and others on the environmental and economic benefits of using recycled materials.

The RTA is also partnering with the DECC and private companies to trial the use of materials such as waste crushed glass in road pavements.

while aggregate suitable for use in road base applications was generally cheaper than virgin products the:

use of recycled materials of this type did not increase significantly prior to the introduction of the waste levy and better landfill controls. In other words, the mere fact that it was cheaper to recycle did not stimulate investment to exploit the opportunity. A policy ‘jolt’ was required.

Importantly, the landfill levy was not the only tool used to achieve improvements in NSW. For example, the Local Government Waste Performance Improvement Payment, a payment aimed at helping local governments achieve better management practice and resource recovery outcomes had funding worth $80M over five years (DECC 2006).

With respect to road base, details from the DECC suggest that 20 percent of the road base used in Sydney is derived from recycled concrete, or recycled bricks and tiles.

### 3.2 South Australia

In 2001 the South Australian Environmental Protection Agency commissioned Nolan-ITU to prepare the report *Re-use and Recycling of Clean Fill and Building and Demolition Waste*.

In summary the report identified the following as barriers to the development of the C&D recycling industry:

- Illegal landfilling of C&D waste
- Low levels of enforcement by the EPA of landfill sites
- Failure of local and state governments to specify a preference for recycled material
- Low commitment and investment from government for product testing and development
- Low tipping fees at landfill sites
- Reluctance of industry to engage in on-site separation of materials
- Public perception that recycled products were inferior to virgin materials.

For the Western Australian context some of the report recommendations are more relevant than others. For completeness all of the specific recommendations of the report are reproduced in Box 2 below.
Box 2  
**Recommendations from South Australian review process**

- The EPA develop a State strategy for the upgrading or closure of inadequate or inferior licensed facilities that specialise in the disposal of B&D waste. The strategy should also include the identification and closure of any illegal disposal sites in the metropolitan area and metropolitan fringe.

- The EPA review all existing licences for operations treating/landfilling B&D waste with the aim of standardising terms and conditions including operational management, environmental control and monitoring programs and closure/post closure requirements. To eliminate the potential for ambiguity, licences should clearly specify waste materials approved for treatment/disposal at the waste depot.

- The EPA develop standard definitions for clean fill and B&D wastes. Definitions should address the issue of the recovery, reuse and recycling of materials not covered by EPA Technical Bulletin No. 5 on Disposal Criteria for Contaminated Soil, which fundamentally deals with disposal to landfill.

- In consultation with relevant stakeholders the EPA facilitate the development of a Waste Management Code of Practice for the building and construction industry with emphasis on waste avoidance, reduction, recycling and reuse. The Code of Practice should be to the requirements of the Environment Protection Authority and be included within the proposed Environment Protection Policy for Waste.

- Tenders or terms of reference for Local Government and State Government contracts require tenderers for building and demolition projects to provide waste minimisation plans. The waste minimisation plans should include, but not be limited to, the quantities and types of wastes likely to be generated, and the strategies to be implemented to avoid, reduce, re-use, recycle, recover and dispose of the waste.

- A decision on the awarding of any contract by Local and State Government take into consideration the capacity of the developer, and its contractors to implement a waste management program in accordance with the principles of the waste hierarchy.

- The EPA work with the State Supply Board and the Department of Administrative and Information Services to review the SA Government Procurement Reform Strategy and the Environmental Impact Policy.

- The EPA liaise with the Northern Adelaide and Barossa Catchment Management Board re issues relating to the landfills adjacent to the Gawler River, as there are common issues outlined in the Catchment Management Plan.

- Communication tools, such as a series of fact sheets and a publicly accessible website should be developed, and include information such as a listing of recycling and waste companies that offer recycling services, guidelines on environmentally responsible waste management practices and information to facilitate the exchange of construction and demolition waste materials.

- The building and construction industry should be informed of actions being initiated by the EPA to address uncontrolled landfilling practices for B&D wastes.

*Data source: Nolan-ITU (2001).*
3.3 Productivity Commission report

The view of the Productivity Commission relating to waste management policies can be expressed as follows:

Because there are market incentives to reduce waste and undertake recycling, the scope for effective government intervention is limited mainly to circumstances where these incentives do not reflect the true costs and benefits to the community that are associated with waste. That is, where there is market failure (Productivity Commission 2006, p. 94).

Regarding upstream externalities the Productivity Commission strongly expresses the view that as the relationship between upstream externalities and waste is indirect, waste management policy should not target such externalities. The Commission does not suggest that these externalities be ignored, rather the Commission suggests that these costs should be tackled directly. Relevant examples cited by the Productivity Commission of the direct approach include the regulation of environmental standards and mandatory environmental offsets (Productivity Commission 2006, p. 96).

The benefits of using direct policies with regard to potential upstream externalities, as identified by the Productivity Commission, are that they can:

- Vary as appropriate to the specific location
- Vary in light of the specific operation
- Minimise the risk of realising unforseen outcomes
- Address environmental impact irrespective of whether the ultimate destination for use for the product is domestic or international
- Allow a negotiation process whereby mutually beneficial outcomes can be achieved.

More generally the Productivity Commission expressed the view that market forces work in the market for waste. The logic of the Productivity Commission is based around the idea that gate tipping fees reflect costs -- including any intergenerational costs -- and so when landfill space becomes scare, tipping rates increase, and so incentives for reuse and waste avoidance are introduced into the system naturally.

Regarding specific policy options, such as the inclusion of a specified recycled content requirement, the Productivity Commission (2006, p. 165):

does not support recycled-content standards. Likewise, the Commission does not support policies that require products to be made with 100 per cent virgin materials. Instead, the amount of recycled content or virgin material in a product should be based on cost, availability and performance. If including recycled content adds to a product’s performance at a reasonable cost, it is likely to be included by a manufacturer with no need for regulation. For example, the newsprint industry in
Civil Works and Recycled Content

Australia has found it commercially worthwhile to recycle a large amount of newsprint without the need for recycled content-standards to be imposed.

A final point that should be considered is the view of the Productivity Commission regarding policy assessment. The suggested policy assessment criteria developed are a useful reference and so have been reproduced below in Box 3.

**Box 3**

**Productivity Commission Policy Assessment Criteria**

1. **Does the policy directly target a market failure?** — As government intervention is not costless, it is important that there is a valid reason for it. The existence of market failure indicates there may be a role for government action. Measures that directly target the problem are generally preferable. If a measure is indirect, the reason for not using more direct policy should be made explicit and rigorously tested.

2. **Is there a clear objective?** — The objective should be clear, concise and as specific as possible, but specified broadly enough to allow consideration of all relevant solutions.

3. **How effective is the policy likely to be?** — This involves assessing the extent to which the policy is likely to achieve its objective. Reviews of past performance of the policy, or similar measures, in Australia and internationally can be useful in making this assessment.

4. **Is the policy likely to deliver net benefits?** — This requires comprehensively assessing the costs and benefits from a community-wide perspective (including private and external costs and benefits, both short and long term). Costs to the community include those to government, firms and consumers. In the first instance, costs and benefits must be estimated before the policy is introduced and some uncertainty is inevitable. However, this uncertainty can be reduced over time by conducting ex post policy evaluations. Such evaluations are critical to the ongoing improvement of policy.

5. **Are the distributional outcomes acceptable?** — Policies have different impacts on different groups and some may be left worse off. Costs and benefits accruing to particular groups in society should therefore be assessed and considered by policymakers. The acceptability of outcomes from an intergenerational equity perspective may also need to be considered to ensure consistency with the National Strategy for Ecologically Sustainable Development. However, taking a net community benefits approach greatly assists in achieving the objectives of ecologically sustainable development and

*Data source: Productivity Commission (2006).*

**3.4 International evidence**

Outside Australia several countries have had success in achieving substantial reductions in waste flows to landfill. For example, Denmark set a policy goal of achieving a recycling rate for C&D waste of 64 percent by 2004. The actual recycling rate achieved for C&D waste in Denmark in 2003 was 94 percent.
Civil Works and Recycled Content

(DECC 2007b). New Zealand set a target of a 50 percent reduction in C&D waste to landfill by 2005, and appears to have met this objective (DECC 2007b). In Scotland, of the 10.8M tonnes of construction and excavation waste produced each year, approximately 45 percent is recycled (WAE 2006). In the UK as a whole, road work material specifications include specifications for recycled materials, and 25 percent of the market for aggregates is met with product from recycled and secondary sources.

Summary details relating to aggregate use in European countries is shown below in Table 1, and as can be seen, the Netherlands and the UK are the two countries that standout as big users of recycled aggregates.

Table 1 Aggregate production in 2005

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Aggregate Production</th>
<th>Recycled Aggregate</th>
<th>Recycled and Artificial Aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tonnes (M)</td>
<td>(%)</td>
<td>(%)</td>
</tr>
<tr>
<td>Austria</td>
<td>104.5</td>
<td>3.3</td>
<td>6.2</td>
</tr>
<tr>
<td>Belgium</td>
<td>57.4</td>
<td>7.5</td>
<td>9.5</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>67.2</td>
<td>5.1</td>
<td>5.5</td>
</tr>
<tr>
<td>Denmark</td>
<td>58.3</td>
<td>n.a</td>
<td>n.a</td>
</tr>
<tr>
<td>Finland</td>
<td>107.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>France</td>
<td>410.0</td>
<td>2.4</td>
<td>4.1</td>
</tr>
<tr>
<td>Germany</td>
<td>513.0</td>
<td>9.0</td>
<td>14.8</td>
</tr>
<tr>
<td>Ireland*</td>
<td>101.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Italy</td>
<td>377.5</td>
<td>1.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Netherlands</td>
<td>48.2</td>
<td>41.9</td>
<td>41.9</td>
</tr>
<tr>
<td>Norway</td>
<td>53.2</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Poland</td>
<td>150.8</td>
<td>4.8</td>
<td>5.8</td>
</tr>
<tr>
<td>Portugal**</td>
<td>88.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Slovakia</td>
<td>26.3</td>
<td>0.8</td>
<td>1.9</td>
</tr>
<tr>
<td>Spain</td>
<td>460.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Sweden</td>
<td>80.1</td>
<td>9.9</td>
<td>10.1</td>
</tr>
<tr>
<td>Switzerland</td>
<td>57.1</td>
<td>9.3</td>
<td>9.3</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>277.0</td>
<td>20.2</td>
<td>24.5</td>
</tr>
</tbody>
</table>

Note: * Ireland is for 2004; ** Portugal is for 2003.

3.4.1 Landfill taxes and virgin materials taxes

In the Netherlands the landfill tax is the highest in the European Union and is €85 per tonne. With such a high landfill tax rate it is not surprising that the

---

Netherlands recycles a significant amount of C&D waste into aggregate products.

Originally the UK landfill tax was introduced in 1996 so that the externalities associates with landfill would be captured in the total price paid by those disposing of product to landfill. The aim was not to achieve specific behaviour changes or specific recycling and re-use targets.

Given the policy objective the tax rates were set at different levels for inert waste and active waste. The specific rates were set at £7 per tonne for active waste and £2 per tonne for inert waste, and were not indexed for inflation. Since 2002 there has also been a virgin aggregates tax of £1.60 per tonne that has been applied to sand, gravel, and crushed rock materials quarried in the UK or imported into the UK.

Although the landfill tax rate charged in the UK for inert waste is low, it has been estimated that it increased the landfill cost for inert waste by as much as 200 percent. The UK government has estimated that between 1997-98 and 2003-04, the volume of inert waste going to landfill fell by 60 percent (Bartelings, et al. 2005, p. 10). It is possibly worth noting that a 60 percent reduction in quantity to landfill following an increase in price of 200 percent implies an own-price elasticity of minus 0.3.

The experience of the UK with regard to the introduction of the landfill tax in 1996 suggests that while municipal waste flows might be relatively insensitive to price changes, small increases in the cost of dumping C&D waste to landfill can result in relatively significant changes in behaviour.

The UK aggregates tax was introduced to address the externalities associated with quarrying operations. It has been argued that as the tax is a flat tax, and as externalities are specific to each quarrying operation and are localised, the aggregates tax is an inappropriate means of addressing quarrying externalities. It has also been noted that a uniform tax only achieves environmental improvements via reducing demand for quarried product and provides no incentive to change polluting behaviour (Soderholm 2006).

Details on the Swedish experience with an aggregates tax can be found in Soderholm (2006). Sweden introduced a tax on naturally occurring gravel in 1996 of SEK 5 per tonne, which on current market exchange rates is the equivalent of about $1 per tonne. The tax was motivated by a desire to conserve natural gravel and encourage substitution away from gravel into alternative materials including recycled crushed concrete. At the time the tax represented an increase in price of about 10 percent. Demand for material being relatively inelastic, it is estimated that about 90 percent of the tax was
difficult to establish tax impact

A tax on one product does not imply an increase in the use of C&D waste

Danish aggregates tax is $1.10 per cubic metre

Waste tax in Denmark is €45 per tonne

passed thought to consumers\(^4\). In 2003 the aggregates tax was increased to SEK 10 per tonne.

Although the use of gravel in Sweden has fallen since the tax was introduced, the use of gravel had been falling since the mid 1980s anyway. The Swedish national road authority also introduced, in 1994, a bonus in the tender process for tenders that made use of crushed rock rather than gravel. It is therefore difficult to isolate the effect of the aggregates tax in the reduction in the use of gravel. Certainly in the case of the UK, the extractive industries lobby has argued that improvements were caused by the landfill tax and not the aggregates tax.

The specific substitution or cross-price relationships are important factors in any analysis. In 2001 recycled material made up less than 10 percent of the aggregates market in Sweden. The main substitution that took place during the 1980s and 1990s was in fact away from gravel to crushed rock rather than to crushed recycled material. In the case of aggregates in Sweden, crushing rock for aggregate is between 60 and 80 percent more energy intensive than quarrying natural gravel. As such, the net environmental benefits that have arisen from the tax are ambiguous. Although it could be argue that this is more grounds for the extension of the tax to other virgin aggregates rather than a specific failing of the tax concept itself.

Soderholm (2006) also contains details on the Danish experience with a virgin materials tax. Although a raw materials extraction tax existed in Denmark between 1987 and 1990, the rate was very low. In 1990 the Danes introduced a new aggregates tax set at DKK 5 (approximately $1.10) per cubic metre, which, in conjunction with the waste disposal tax, was focused on encouraging substitution away from virgin material aggregates and encouraging the use of C&D waste.

As the tax is relatively low, and demand relatively inelastic, it is thought that improvements in recycling activity in Denmark have been mainly driven by the waste disposal tax rather than the virgin aggregates tax.

Denmark introduced a waste tax in 1987, and introduced different tax rates for different types of disposal in 1993. In 1997 the tax rate for landfill was increased to €45 per tonne. In the summary of Anderson (1998), reported in Bartelings, et al. (2005, p. 11), it is noted that much of the reduction in waste flows realised in Denmark was from the construction materials sector and the

\(^4\) Tax pass through rates to consumers are generally reported as depending on the own-price elasticity of the good; with the pass through rate increasing with more inelastic demand. Depending on the specification of the demand function, tax pass through rates can be more than 100 percent.
garden waste sector, and that the waste tax may have been important in promoting recovery and reuse.

### 3.4.2 Price responsiveness studies

There have been numerous studies investigating the own-price elasticity of demand for landfill and related waste services. The details shown in Table 2 are based primarily on the information reported in Bartelings et al. (2005, pp. 6-8). As can be seen the values are generally close to zero which suggests price changes to waste services have little impact on demand.

<table>
<thead>
<tr>
<th>Source</th>
<th>Location</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wertz (1976)</td>
<td>US (San Francisco)</td>
<td>-0.15</td>
</tr>
<tr>
<td>Hong et al. (1993)</td>
<td>US (Portland)</td>
<td>-0.03</td>
</tr>
<tr>
<td>Jenkins (1993)</td>
<td>US (14 municipalities)</td>
<td>-0.12</td>
</tr>
<tr>
<td>Sedee et al. (2000)</td>
<td>Denmark</td>
<td>-0.07</td>
</tr>
<tr>
<td>Strathman et al. (1995)</td>
<td>US (Portland)</td>
<td>-0.45</td>
</tr>
<tr>
<td>Morris and Holthausen (1994)</td>
<td>US (Perkasie)</td>
<td>-0.51 to -0.61</td>
</tr>
<tr>
<td>Sterner and Bartelings (1999)</td>
<td>Sweden</td>
<td>-0.35</td>
</tr>
</tbody>
</table>


Estimates of the own-price elasticity of the more generally defined good environmental quality are also generally relatively close to zero. For example, Brasington and Hite (2005), using a spatial hedonic approach, estimate that the implied own-price elasticity of demand for environmental quality is minus .12, which is broadly in line with the estimates for waste disposal. The authors further note that:

A relatively inelastic demand curve [for environmental quality] may suggest that people are not very sensitive to changes in the price of environmental quality. Another interpretation is that individuals cannot easily respond to changes in environmental quality; they can only change environmental quality through collective action or moving. Cleanup is likely to require significant time to achieve, while moving presents a large fixed cost.

The above reference to options available to consumers is an important point as it hints at the key determinant of the own-price elasticity of a good; the availability of substitutes.

The price responsiveness of any good or service is determined by the number of substitute products available for that good. With respect to waste stream flows, it could reasonably be argued that for the C&D waste stream there are more viable alternatives to sending material to landfill than exist for household waste. As there are a greater number of alternatives available for the C&D waste stream, demand homogeneity requires that the C&D waste stream be
more price responsive to changes in the price of landfill than the other waste streams.

Studies that consider the waste flow quantity response to an increase in price have typically been concerned with municipal waste flows rather than C&D waste flows. As such it is possible that the measures reported in the literature understate price responsiveness as it applies to C&D waste.

Box 4  Elasticity concepts explained

The formal economic measure of the change in consumer behaviour following a price change is referred to as the own-price elasticity of demand for the good. The own-price elasticity of demand for landfill is defined as the percentage change in the quantity of landfill demanded as a result of a one percent change in the price of landfill. Thus, if the own-price elasticity of demand for landfill is minus 0.1, this means that if the price of landfill were to increase by one percent, the quantity demanded would decrease by 0.1 percent. The formal result for the own-price elasticity of demand for landfill is shown directly below.

\[
\frac{\partial Q_L}{\partial P_L} \cdot \frac{P_L}{Q_L} = \frac{\partial Q_L}{\partial Q_L} \cdot \frac{P_L}{P_L} \quad \text{percentage change in quantity of Landfill} \\
\frac{\partial Q_L}{\partial P_L} \cdot \frac{P_L}{Q_L} = \frac{\partial Q_L}{\partial Q_L} \cdot \frac{P_L}{P_L} \quad \text{percentage change in price of Landfill}
\]

The cross-price elasticity of a good measures the percentage change in the quantity of a good -- say recycled crushed concrete -- demanded as a result of a one percent change in the price of a different but related good, say the price of landfill. If the cross-price elasticity of demand for landfill and recycled crushed concrete is 0.1, it implies that if the price of landfill were to increase by one percent, the quantity of recycled crushed concrete demanded would increase by 0.1 per cent. Where the cross-price elasticity is positive, the goods are referred to as substitutes, and where the cross price elasticity is negative, the goods are referred to as complements. The formal result for the cross-price elasticity of demand between landfill and recycled crushed concrete is shown directly below.

\[
\frac{\partial Q_{RC}}{\partial P_L} \cdot \frac{P_L}{Q_{RC}} = \frac{\partial Q_{RC}}{\partial Q_{RC}} \cdot \frac{P_L}{P_L} \quad \text{percentage change in quantity of Recycled concrete sold} \\
\frac{\partial Q_{RC}}{\partial P_L} \cdot \frac{P_L}{Q_{RC}} = \frac{\partial Q_{RC}}{\partial Q_{RC}} \cdot \frac{P_L}{P_L} \quad \text{percentage change in price of Landfill}
\]

The fundamental economic theorem of demand homogeneity requires that the (Hicksian) own-price elasticity of a good, plus all the relevant cross-price elasticities, must sum to zero. Demand homogeneity implies that the fundamental determinants of the own-price elasticity of a good are:

(i) the number of substitutes, and

(ii) the extent to which products are substitutable.

Data source: ACIL Tasman

3.4.3  Long-run responses versus short-run responses

When evaluating the effectiveness of any price based policy a key reference metric will be the own-price elasticity of demand. Where the own-price
elasticiy is close to zero price based policies are not a good means of achieving change.

Care must however be taken with regard to estimating the own-price elasticity of demand where it is thought that there may be some limit to the ability of organisations or individuals to respond to price changes in a timely manner. In such circumstances it is possible that the short-run demand response may be substantially different to the long-run demand response. In such cases measuring only the short run response will lead to a significant underestimation of the true extent of price responsiveness. A classic example of where this is clearly the case is petroleum consumption, where in the short-run options for change are very limited and so the short-run own-price elasticity is very close to zero, while in the long-run consumption is much more price responsive. Failure to recognise the possibility that there can be a lag in the demand response can therefore result in a substantial underestimate of the effectiveness of price based policies.

Consideration of a partial adjustment process is not just a theoretical consideration, but something that has practical implications for the assessment of how effective different policy approaches might be. By way of example of how important such considerations can be, details on the short-run and long-run own-price elasticity for petroleum in select countries, obtained using a partial adjustment approach, are shown below in Table 3.

<table>
<thead>
<tr>
<th>Country</th>
<th>Price Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short-run</td>
</tr>
<tr>
<td>United States</td>
<td>-0.06</td>
</tr>
<tr>
<td>Japan</td>
<td>-0.07</td>
</tr>
<tr>
<td>Germany</td>
<td>-0.02</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>-0.07</td>
</tr>
<tr>
<td>France</td>
<td>-0.07</td>
</tr>
<tr>
<td>Italy</td>
<td>-0.04</td>
</tr>
</tbody>
</table>

Data source: Cooper (2003).

The way elasticity estimates for waste have been reported in the existing literature suggests that the possibility of partial adjustment through time may not have been considered. Should partial adjustment be a reality, reported estimates will have understated the price responsiveness of the demand response to price changes as the parameter estimates reported will represent the short-run partial effect only.
Details on the partial adjustment model and how it is possible to obtain estimates of the long-run demand response for observable short run information are set out in an appendix.

The possibility of partial adjustment means that the true price responsiveness for C&D waste could be greater than the international empirical evidence regarding responsiveness to price suggests.

### 3.5 Case study details

There is a considerable literature on increasing the use of recycled products in civil construction projects. Below, summary details on case studies are presented that illustrate some examples of how progress has been achieved.

At a general level a desktop review of tender documents for roads materials for LGAs on the East Coast revealed that where recycled material was considered it was generally not the only material considered. That is, supply contracts generally allowed for the LGA to approve more than one aggregate material supplier. Where multiple suppliers were considered as preferred suppliers, the suppliers were likely to include suppliers of virgin aggregate and suppliers of recycled material.

#### 3.5.1 Case study - Merton local council

The Merton council, a UK LGA, sought to formalise arrangements for using recycled content in roads by means of a panel contract arrangement for large projects, and term partner contracts for small and medium works.

**Panel contract arrangements**

Tenders from those on the panel are evaluated as follows:

- 60 percent weight to price and 40 percent weight to quality, with a recycling component worth at least 10 percent of the quality score. Other quality components relate to such things as completion time, number of truck movements etc.

- To encourage continuous high performance for each new project, within the quality score a weight of 50 percent is given to the quality score in the previous project.

**Term partner contracts**

Term partner contracts are long-term contract arrangement, and in the case of Merton council are set at five years with a two year option for extension. The

---

Civil Works and Recycled Content

Contracts are designed to allow a deep relationship to develop with the contractor.

**KPI for recycling in contracts**

Recycling is specified as a direct KPI in the contract, and assessment of recycled product used is regularly assessed. The position with regard to recycling and the value the council places on achieving high use of recycled content was clearly indicated to potential contracting firms at the project outset.

**Targets periodically revised**

Best practice is determined by periodically reviewing the usage rates for recycled material achieved by other local governments. An illustrative example is shown below in Table 4 of the kind of targets specified.

### Table 4  Merton recycled content targets

<table>
<thead>
<tr>
<th>Material</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-base</td>
<td>80</td>
</tr>
<tr>
<td>Base</td>
<td>40</td>
</tr>
<tr>
<td>Binder course</td>
<td>30</td>
</tr>
<tr>
<td>Surface course</td>
<td>5</td>
</tr>
<tr>
<td>All concrete mixes</td>
<td>20</td>
</tr>
<tr>
<td>Bedding sand</td>
<td>20</td>
</tr>
</tbody>
</table>

Data source: Wrap Case Study 1: London Borough of Merton

**Collaborative approach to conflict resolution**

Although performance against benchmarks is assessed, in keeping with the spirit of developing a relationship with the contracting organisation, rather than use a financial penalty programme, a collaborative co-operative approach is used to correct shortfalls in performance.

**3.5.2 Case study Essex local government**

The local government has a high level objective relating to sustainability, but also has a higher order priority to ensure public funds are not wasted, and in the case of roads the additional requirement that the travelling public are not put at risk. At Essex a partnership agreement was developed with contractors that allowed the development of phased targets for recycling. The initial contract period was for three years with four one year options for extension. Importantly, given the requirement for local governments to use funds efficiently, using recycled material for roads was shown to be a cost effective option. Transparency in accounting was therefore central in the assessment of outcomes.

---

Civil Works and Recycled Content

Recycled material targets were expressed as a proportion of total materials used. By way of illustration the phased targets are shown below in Table 5.

<table>
<thead>
<tr>
<th>Target year</th>
<th>Target (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
<td>5</td>
</tr>
<tr>
<td>2nd Year</td>
<td>12</td>
</tr>
<tr>
<td>3rd year</td>
<td>20</td>
</tr>
<tr>
<td>4th year</td>
<td>28</td>
</tr>
<tr>
<td>5th year</td>
<td>35</td>
</tr>
<tr>
<td>6th year</td>
<td>43</td>
</tr>
<tr>
<td>7th year</td>
<td>50</td>
</tr>
</tbody>
</table>

*Data source: Wrap Case Study 4: Essex County Council*

As the contract arrangements are specified for several years, the arrangements provide the stability needed to help deliver sustained improved use of recycled content.

### 3.5.3 Case study - San Diego and Chicago

Faced with pressure on landfill sites, and with C&D waste accounting for approximately 30 percent of the waste going to landfill, the San Diego City Council placed conditions on building permits relating to waste. When a building demolition permit is issued a bond is paid. The bond is then returned depending on the amount of material diverted from landfill. The exact targets for diversion from landfill that have to be met are indexed to actual best practice so that as the diversion rates achieved at waste and recovery facilities rise over time, the diversion rate required for the full return of the bond also rises (Ursery 2005).

In Chicago a similar approach has been adopted. As of 1 January 2006 a contractor issued with a building permit has been required to recycle at least 25 percent (measured by weight) of the C&D waste produced at the site. The requirement was raised to 50 percent on 1 January 2007. For small projects contractors face fines of $2,000 per percentage point below the recycling benchmark, and for large projects fines of $5,000 per percentage point. Prior to introducing the scheme, investment was made in an education campaign (Fickes 2005).

In both examples the approach taken is based largely on the impactor pays idea.
3.5.4 Case study Durham local government

Frustrated at regular cost over-runs with traditional tendering contracts awarded on a least-cost basis, the local government created a strategic alliance with private sector partners to deliver road and highway projects. The alliance structure also meant working with a local waste company and allowed trust to be developed over time between all parties.

Rather than the traditional adversarial approach to contract management it became possible to develop processes incorporating a target cost, an agreed maximum cost, and a process for sharing any contract savings. As contract management arrangements included activates such as best practice workshops, it became increasingly possible to incorporate the use of recycled content into contract specifications. In Durham assessments of tenders are no longer made on a least-cost approach, but incorporate a 70 percent weight to price and 30 percent weight to quality in the evaluation process.

The basic specification relating to KPIs for recycled material are the percent of material excavated from roads which is subsequently reused or recycled and the percent of secondary and recycled aggregates in the material imported for use at the site.

3.5.5 Case study Gloucestershire local government

A multi-year partnership arrangement was established by the council with a contractor and a design consultancy. Regarding recycled content, it was indicated at the outset that the partnership objective would be to reuse and recycle as much as possible subject to keeping any cost increase caused by such an approach to a minimum. As recycled material such as aggregates has in practice been cheaper than virgin material, overall project savings have been possible.

In terms of pricing for contracts where recycled material was used, the payment value was made as if virgin material was used. Any resulting surplus was then shared between the local government authority, the contractor and the consultancy. For the consultancy and contractor this meant higher profits. For the local government it meant that funds were available to invest in new works and new environmental initiatives.

---

### 3.5.6 Summary

Some of the key themes that emerge from the case study material are as follows:

- Improvements in usage rates for recycled material are achieved, and further progress is made, where recycling and reuse objectives are specified in local government strategic documents, and details are communicated to tendering organisations at an early stage of the tender process.

- Developing long-term relationships with contractors allows trust to build-up and relationships to develop. In such an environment it is easier for innovation in the area of material use to take place.

- While there may be price advantages to using a recycled product, this alone is not always enough to stimulate interest in using the product.

- Raising the price of disposing of C&D waste, either by placing conditions on building permits or by way of a landfill levy encourages material to be put to alternative uses.

- Government road authorities can play an important part in supporting the development of markets for recycled products.

- When recycling is set as an explicit KPI progress is more likely.

### 4 Market overview

This chapter provides an overview of the current market situation, and details the views of some relevant market participants. Although the experience in other jurisdiction was discussed in the previous chapter, comparative performance details for other states are presented here.

#### 4.1 Current flow to landfill

It is understood that of waste disposed to landfill in the metropolitan region of Perth, approximately 20-25 percent is from the municipal waste stream, 20-25 percent is from the commercial and industrial waste stream and that 50-55 percent is from the construction and demolition waste stream.

To obtain a better understanding of the material flow to landfill for the construction and demolition waste stream and commercial and industrial waste stream, DEC commissioned a disposal based audit project that took place.
Civil Works and Recycled Content

during February and March 2007. The audit included two commercial and industrial landfill sites, three construction and demolition landfill sites, and one commercial and industrial transfer station. During the audit 1,561 vehicles were logged at the various gatehouses.

Summary details relating to the type of C&D waste disposed of to landfill are shown in Table 7. As can be seen from the detail shown in the table, measured by weight, rocks/bricks, soil, and concrete account for approximately 80 percent of all C&D waste going to landfill.

Table 7  
C&D waste by category

<table>
<thead>
<tr>
<th>Category</th>
<th>Tonnes</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rocks/Bricks</td>
<td>935</td>
<td>29.9</td>
</tr>
<tr>
<td>Soil</td>
<td>885</td>
<td>28.3</td>
</tr>
<tr>
<td>Concrete</td>
<td>650</td>
<td>20.8</td>
</tr>
<tr>
<td>Rubble</td>
<td>419</td>
<td>13.4</td>
</tr>
<tr>
<td>Wood/Timber</td>
<td>49</td>
<td>1.6</td>
</tr>
<tr>
<td>Metal - Ferrous</td>
<td>43</td>
<td>1.4</td>
</tr>
<tr>
<td>Plasterboard</td>
<td>19</td>
<td>0.6</td>
</tr>
<tr>
<td>Misc other</td>
<td>125</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3125</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Note: The total tonnes of C & D waste value is not the same in all tables of the report.


The report audit also collected details on the industry sectors that were responsible for the generation of the waste. Summary details on C&D waste by waste generating sector are shown in Table 8, and residential development, demolition, and construction activity account for almost 70 percent of the overall C&D waste flow to metropolitan landfill.

Table 8  
Construction and demolition waste by generating sector

<table>
<thead>
<tr>
<th>Category</th>
<th>Tonnes</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential development</td>
<td>849</td>
<td>25.6</td>
</tr>
<tr>
<td>Residential demolition</td>
<td>764</td>
<td>23.1</td>
</tr>
<tr>
<td>Residential construction and demolition</td>
<td>653</td>
<td>19.7</td>
</tr>
<tr>
<td>Commercial demolition</td>
<td>334</td>
<td>10.1</td>
</tr>
<tr>
<td>Landscaping construction and demolition</td>
<td>212</td>
<td>6.4</td>
</tr>
<tr>
<td>Other</td>
<td>501</td>
<td>15.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3313</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Note: The total tonnes of C & D waste value is not the same in all tables of the report.

Data source: WACS and Golder (2007, P. 28)
The proportion of C&D waste in the total waste stream varies significantly between different Australian jurisdictions. Details reported in Productivity Commission (2006) for 2002-03 suggest that C&D waste makes up approximately 29 percent of the waste in Queensland, 37 percent in the ACT, 38 percent in New South Wales, 41 percent in Victoria, 55 percent in Western Australia and 63 percent in South Australia. The reasons for the differences relate not only to difference in the level of construction and demolition activity across the business cycle in different States, but also to differences in the policy approach to waste of each jurisdiction.

Recycling rates for C&D waste are also highly variable across Australia. As can be seen from Table 9, the highest recycling rates for C&D waste are in the ACT (89 percent) and New South Wales (71 percent), while Western Australia, with a recycling rate for C&D waste of only 21 percent is clearly the worst performing jurisdiction.

Table 9  Construction and demolition waste and recycling in 2002-03

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Total waste (kT)</th>
<th>Per capita waste (kg)</th>
<th>Recycle rate (%)</th>
<th>Recycle per capita (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New South Wales</td>
<td>4649</td>
<td>693.8</td>
<td>71</td>
<td>492.6</td>
</tr>
<tr>
<td>Victoria</td>
<td>3575</td>
<td>724.2</td>
<td>54</td>
<td>391.0</td>
</tr>
<tr>
<td>Queensland</td>
<td>1166</td>
<td>303.1</td>
<td>42</td>
<td>127.3</td>
</tr>
<tr>
<td>Western Australia</td>
<td>1945</td>
<td>990.2</td>
<td>21</td>
<td>208.0</td>
</tr>
<tr>
<td>South Australia</td>
<td>2156</td>
<td>1409.2</td>
<td>67</td>
<td>944.2</td>
</tr>
<tr>
<td>Australian Capital Territory</td>
<td>250</td>
<td>773.6</td>
<td>89</td>
<td>688.5</td>
</tr>
</tbody>
</table>

Note: Population is for 2003. Details for the Northern Territory and Tasmania are incomplete.

Data source: Productivity Commission (2006); ABS (2006), catalogue number 3105.0.65.001

Average tipping rates, exclusive of GST and landfill levies, are shown in Figure 2. The rates shown are not the specific rates for C&D waste, but are illustrative as they show Perth, at the time of the study, had the lowest average tipping fees. Comparing the detail in Table 9 with that in Figure 2 it can be seen that there is a general positive relationship between tipping rates and recycling rates. This relationship is explored further below.
**Civil Works and Recycled Content**

Figure 2  **Tipping rates at various locations in 2003-04**

![Diagram showing tipping rates at various locations.](image)

Note: Rates are exclusive of any possible landfill levy charges and GST.

*Data source:* Productivity Commission (2004, p. 69)

### 4.1.1 Landfill and recycling rates for C&D waste

Figure 3 shows a plot that has average tipping fees on the vertical axis and recycling rates for C&D waste on the horizontal axis. When interpreting the information caution is required as critical factors that influence overall landfill costs, such as transport distances and landfill levy charges, are not considered in the plot.

A least squares regression line has been fitted to the data to emphasise the positive correlation between the cost of sending waste to landfill and recycling rates. The implied slope coefficient of the regression does not have an interpretation as an elasticity, but rather informs on the percentage change in recycling rates likely following a $1 increase in tipping charges.

As indicated in the figure, the regression slope coefficient indicates that a one dollar per tonne increase in the cost of sending C&D waste to landfill is associated with a 0.35 percent increase in the C&D recycling rate. While the figure should be interpreted with caution, it is notable that Kinnaman and Fullerton (2000) cited in Bartelings, et al. (2005) have calculated a cross-price elasticity with respect to landfill and recycling and estimate it to be 0.22. Such an estimate is not inconsistent with the indicative semi-elasticity value shown in Figure 3.
4.1.2 Landfill site regulation

One concern regarding the sustainability of waste disposal relates to landfill regulation compliance. The Productivity Commission (2006, p. 156) found that compliance with landfill license conditions was generally poor, and enforcement variable. The target should be full compliance with regulations for landfill. To the extent that license conditions are not met and operators are able to save on costs, landfill operators are potentially able to lower tipping fees, and so disadvantage recyclers.

At this stage it is worth distinguishing between landfill for putrescibles and landfill for inert waste. In Western Australia discussion with representatives from DEC enforcement indicated that while there had in the past been some problems with putrescibles, there had been no significant problems with inert waste.

4.1.3 The landfill levy in WA

Details relating to the landfill levy in Western Australia are set out in the Landfill Levy Regulation Administration Policy. There are a range of detailed provisions in the regulations, but broadly speaking, for inert waste the landfill levy is calculated based on the volume of waste. Specifically, the levy is calculated based on the volume of waste, measured in terms of cubic metres, delivered during the return period, multiplied by the levy rate, minus an allowance for compliances costs to a maximum of $2,000. The levy rate for inert waste prior to 1 July 2008 is $3; the rate after 1 July 2008 and before 1
Civil Works and Recycled Content

July 2009 is $5; the rate after 1 July 2009 and before 1 July 2010 is $7; and the on or after 1 July 2010 is $9.

By way of an illustrative example, assume that a landfill accepts 10,000 cubic metres of inert waste during the return period and incurs $500 worth of compliance costs in preparing the return. The total amount payable in April 2008 is then \(10,000 \times 3\) - $500 = $29,500. At the end of the scheduled series of levy increases, the levy payable for the same volume of inert waste, with the same level of compliance costs, will have increased to \(10,000 \times 9\) - $500 = $89,500. So while the scheduled increases will bring the levy to a rate that is still substantially lower than in some other jurisdictions, the scheduled increases are set to change substantially the economics of sending C&D waste to landfill.

**Figure 4  Inert landfill levy rate in Western Australia**

Data source: DEC 2006 Landfill Levy Regulation Administration Policy.

**4.1.4 Clean fill and C&D waste**

Clean fill is defined under the *Landfill Waste Classification and Waste Definitions 1996* as:

Material that will have no harmful effects on the environment and which consists of rocks or soil arising from the excavation of undisturbed material.

For material not from clean excavation, it must be validated to have contaminants below relevant ecological investigation levels (as defined in the document Assessment Levels for Soil, Sediment and Water, Department of Environment, 2003).

As a practical matter, clean fill can consist of inert material that is no greater than 75 mm in diameter, and so can consist of crushed C&D waste.
The main residential developments that require clean fill are in many cases located on former market garden land, or are urban renewal projects on sites that previously had activity of some sort on them. As such, it would be a requirement at these sites to demonstrate that any clean fill had been tested appropriately and was in a technical sense clean.

To the extent that clean fill must be asbestos free, a certain degree of attention to source separation is required by demolition companies that want to provide clean fill. Although, as clean fill can contain small amounts of timber and other miscellaneous products, the extent of source separation required is minimal, and relates only to potentially hazardous material.

Crushing demolition waste to a size so that it can be used as clean fill is a lower value use than crushing material for use as aggregate for roads projects. As the total landfill tipping rate increases there will be an increase in the amount of material crushed for use as clean fill by demolition companies. This activity limits the amount of source material available for the recycling industry.

The potential for C&D waste to be used as clean fill can be seen by considering demand for material in the residential sector. Details on the forecast demand for different basic raw materials as a whole, and for the housing sector specifically, for the period 2006 to 2011, and the period 2006 to 2036, are shown below in Table 10.

**Table 10  Basic raw material forecasts for urban WA**

<table>
<thead>
<tr>
<th>Description</th>
<th>2006 – 11 in ('000) tonnes</th>
<th>2006 – 36 in ('000) tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sand</td>
<td>Limestone</td>
</tr>
<tr>
<td>Residential</td>
<td>19,734</td>
<td>14,564</td>
</tr>
<tr>
<td>Total</td>
<td>32,877</td>
<td>22,406</td>
</tr>
</tbody>
</table>

*Note: For the Perth metropolitan region and Peel sector only.*

*Data source: CCI (2007, pp. 37-8)*

### 4.1.5  Summary comments

C&D recycling rates vary significantly across the different jurisdictions of Australia. While remaining cautious, it seems reasonable to suggest that where recycling rates are high, total landfill tipping rates are high, and where recycling rates are low, total tipping rates are low. Further, it is possible that reported estimates of the own-price elasticity of demand for landfill underestimate price responsiveness when it comes to the C&D waste stream. Finally, it is notable that in NSW, the state that has made the most progress in the area or recycling for C&D waste, there is a clear high level stated goal for the target recycling rate for C&D waste.
4.2 Current use activity summary

This section of the report provides some perspective on the current arrangements in Western Australia.

4.2.1 Recyclers

The most pressing concern from current market participants relates to the restrictions in local government tenders and local government regulations about the use of material. Market participants believe in their product, and are capable of delivering cost effective product into the market. However, current practice at most local governments locks them out of much of the potential market.

The key barrier is that the tender contracts for road materials are generally specified to require virgin material, and are not based on technical specifications. As such recycled products are excluded from the market. In many cases restrictions also apply to low traffic uses such as cross-overs.

Provided they are allowed access to the market, the recycling companies will pursue business opportunities.

There was some concern about regulations and debris free status. A particular issue, and one that potentially has major implications, relates to asbestos contamination in material. Testing requirements to prove asbestos free status could be such that they price recyclers out of business. Asbestos testing procedures are an area of concern for the industry. The regime for asbestos testing needs to be flexible enough so that operators can put forward whole of business environmental and safety plans that minimise explicit costs to operators while at the same time address any potential health concerns.

There was also a feeling that the properties of the material were not well understood by those not directly involved in the industry and that there needs to be education of engineers in general, and local government engineers in particular, about the material’s properties and uses.

As to be viable it is necessary to have a clean supply of source material, on-site separation of waste is good for business. Methods that would assist with source separation on-site would therefore help with business viability. Although should new markets become available to operators from the removal of existing barriers, the entrepreneurial spirit and the profit motive of operators could be relied upon to motivate them to secure supply of raw material.

There was a view expressed by some that the tipping rates for landfill were too low. Although it must be noted that actual tipping rates are not the only part...
of the demolition equation, and transport costs to a tipping site may represent a more important determinate of where material is sent.

Labelling was noted by some as an issue in that if a firm says it is a recycler it should have to produce a specified recycled product. If material is simply crushed and then sent to landfill or used as clean fill, there exists the possibility for ambiguity in the market regarding the service provided.

For C&D waste the options for disposal are: dump the material illegally, take the material to a landfill site, supply a recycler with the material for reprocessing, or crush the material for use as clean fill. To the extent that unprocessed C&D waste can be supplied as clean fill, such an option represents a potential low cost arrangement for those in the demolition industry. The use of C&D waste as clean fill has the potential to limit supply of raw material to recyclers.

4.2.2 Main Roads (WA)

Main Roads WA has developed a standard for the use of recycled crushed concrete as sub-base or base course. The technical specifications for material to be used as sub-base are reproduced in an appendix (Box 6) as are the specifications for base course (Box 7). Any organisation issuing a tender for the supply of material can insert these provisions into their tender documentation.

In 2003 Main Roads WA, in conjunction with the local council, trialled the use of crushed concrete on Gilmore Avenue in Kwinana. The results of the trial were broadly positive. Main Road WA will also be trialling the use of recycled crushed concrete in a section of the new Bunbury to Perth highway.

The potential for asbestos contamination in recycled crushed concrete is a matter that has recently been highlighted as an issue of concern. Main Roads WA is currently working through how potential contamination issues will be resolved.

In general Main Roads WA has a positive view of recycled material as aggregate. Current barriers to use relate to asbestos and the quantity of material that can be supplied. Main Roads WA typically has a need for large quantities of product that current suppliers would not be capable of meeting.

Another limiting factor over the longer term regarding up-take by Main Roads WA relates to the increasing focus on full depth asphalt. For the high volume roads that Main Roads are responsible for, current industry trends favour full depth asphalt over roads that have a granular -- virgin or recycled -- base course. This suggests Main Roads will have a decreasing need for all types of aggregate.
As an operational matter, large road construction works are contracted on a design and construct basis. To pre-qualify with Main Roads WA, civil engineering and construction companies must have policies in place to deal with:

• Quality Management
• Occupational Safety and Health
• Environmental Management
• Worksite Traffic Management.

Regarding environmental management policies, contractors must have a policy that meets the requirements of an environmental management system as specified under Australian Standard 14001, which is in fact an ISO standard.

As with all Government contracts, Main Roads WA has a buy local weighting in the assessment process for local content, and the ability to make additional value-for-money assessments.

As shown in Table 11, tending processes for Main Roads WA have evolved through time. The most recent shift in tendering practice has been towards relationship tendering, which as noted in the case studies has been identified as an approach that is well suited to achieving environmental outcomes. The Main Roads WA checklist for considering whether relationship contracting is appropriate is shown in Figure 5.

<table>
<thead>
<tr>
<th>Year</th>
<th>Driver</th>
<th>Contracting Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960’s to 1970’s</td>
<td>Rapid expansion of network</td>
<td>Day labour</td>
</tr>
<tr>
<td></td>
<td>National highway requirements</td>
<td>Works contracts</td>
</tr>
<tr>
<td>1993</td>
<td>Rapid cost escalation, vfm, alignment of objectives</td>
<td>Partnering</td>
</tr>
<tr>
<td>1995</td>
<td>McCarrey Hilmer report</td>
<td>Design and Construct</td>
</tr>
<tr>
<td></td>
<td>WA Government Guidelines for Competitive Tendering</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>National competition policy, State Supply Policies</td>
<td>Prequalification</td>
</tr>
<tr>
<td>2002</td>
<td>Contracting environment</td>
<td>Relationship contracting</td>
</tr>
</tbody>
</table>

Data source: Menno Henneveld 7 August 2007, Relationship Contracting The Main Roads Experience
Civil Works and Recycled Content

The final point to note with respect to Main Roads WA relates to reporting. Currently Main Roads WA is involved with, and reports on, a range of sustainability related programmes. These programmes range from labour related programmes such as the Regional Education and Careers in Highways Foundation, through to environment programmes.

Within the Environment section of its annual report, it is noted that Main Roads is ISO 14001:2004 compliant, and details are reported for a significant range of environment activities within Main Roads WA. It is however notable that use of recycled material in construction projects is not a performance indicator reported against.

### 4.2.3 WALGA involvement

WALGA is committed to developing policy that will minimise waste flows to landfill, and encourage individual local governments to use recycled content in civil works, especially in respect of footpaths, cycle paths, and local roads.

WALGA is currently working through a process of setting a framework that will identify the drivers for local government to use recycled content materials and will also identify the inhibitors to product uptake at the LGA level.

In the general area of roads, communication channels from WALGA to individual LGAs are well established. In terms of procurement arrangements, WALGA offers a service for those LGAs that do not have sufficient scale to run their own procurement processes, or who have chosen to outsource procurement for efficiency reasons.
4.2.4 Individual local government

Local government expenditure on roads in Western Australia is substantial. For example, in 2005-06 local government expenditure on road maintenance, renewal, upgrades and expansions was $412M, and the replacement value of local government road assets stood at $14.62B (WALGA 2007).

WALGA collates details on local government roads expenditure across the different regions, and details for both total roads expenditure and the amount sourced from local government own-source revenue are shown in Table 12.

<table>
<thead>
<tr>
<th>Regional Road Group</th>
<th>Total Exp. ($'000)</th>
<th>LGA Exp. ($'000)</th>
<th>LGA Exp. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gascoyne</td>
<td>7,970</td>
<td>1,143</td>
<td>14.3</td>
</tr>
<tr>
<td>Goldfields-Esperance</td>
<td>26,904</td>
<td>11,406</td>
<td>42.4</td>
</tr>
<tr>
<td>Great Southern</td>
<td>27,120</td>
<td>10,399</td>
<td>38.3</td>
</tr>
<tr>
<td>Kimberley</td>
<td>13,556</td>
<td>4,727</td>
<td>34.9</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>189,693</td>
<td>134,424</td>
<td>70.9</td>
</tr>
<tr>
<td>Mid West</td>
<td>27,556</td>
<td>8,964</td>
<td>32.5</td>
</tr>
<tr>
<td>Pilbara</td>
<td>12,440</td>
<td>3,868</td>
<td>31.1</td>
</tr>
<tr>
<td>South West</td>
<td>44,496</td>
<td>19,560</td>
<td>44.0</td>
</tr>
<tr>
<td>Wheatbelt North</td>
<td>37,546</td>
<td>10,617</td>
<td>28.3</td>
</tr>
<tr>
<td>Wheatbelt South</td>
<td>24,881</td>
<td>6,349</td>
<td>25.5</td>
</tr>
<tr>
<td>Total</td>
<td>412,162</td>
<td>211,458</td>
<td>51.3</td>
</tr>
</tbody>
</table>

*Data source: WALGA (2007, p. 26)*

As can be seen from the detail in the table, while the sector as a whole contributes approximately half the funds for local road works, in the metropolitan area local governments contribute approximately 70 percent of the funds for local roads works. Specifically, for metropolitan local governments the remaining funds are sourced from the Federal government (15.8 percent), State government (10.6 percent), and Private sources (2.7 percent). Details for all the regional road group regions are shown in Table 13, and the relative importance of State government funding for each region is shown in Figure 6.
## Civil Works and Recycled Content

### Table 13  Road funding by source: 2005-06

<table>
<thead>
<tr>
<th>Regional road group</th>
<th>Federal ($'000)</th>
<th>State ($'000)</th>
<th>Private ($'000)</th>
<th>LGAs ($'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gascoyne</td>
<td>3,144</td>
<td>3,659</td>
<td>24</td>
<td>1,143</td>
</tr>
<tr>
<td>Goldfields-Esperance</td>
<td>10,275</td>
<td>4,962</td>
<td>261</td>
<td>11,406</td>
</tr>
<tr>
<td>Great Southern</td>
<td>9,445</td>
<td>7,276</td>
<td>-</td>
<td>10,399</td>
</tr>
<tr>
<td>Kimberley</td>
<td>3,977</td>
<td>4,829</td>
<td>23</td>
<td>4,727</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>30,064</td>
<td>20,066</td>
<td>5,139</td>
<td>134,424</td>
</tr>
<tr>
<td>Mid West</td>
<td>12,947</td>
<td>5,588</td>
<td>57</td>
<td>8,964</td>
</tr>
<tr>
<td>Pilbara</td>
<td>5,721</td>
<td>2,701</td>
<td>150</td>
<td>3,868</td>
</tr>
<tr>
<td>South West</td>
<td>16,002</td>
<td>8,837</td>
<td>97</td>
<td>19,560</td>
</tr>
<tr>
<td>Wheatbelt North</td>
<td>18,455</td>
<td>8,111</td>
<td>362</td>
<td>10,618</td>
</tr>
<tr>
<td>Wheatbelt South</td>
<td>12,572</td>
<td>5,950</td>
<td>10</td>
<td>6,349</td>
</tr>
<tr>
<td>Total</td>
<td>122,602</td>
<td>71,979</td>
<td>6,123</td>
<td>211,458</td>
</tr>
</tbody>
</table>

*Data source: WALGA (2007, p. 22)*

### Figure 6  State government contribution to local government roads

Currently there is very limited use of recycled content in road works projects by individual local governments. Acceptance at a specific local council of recycled material as a suitable aggregate material appears to be associated with past experience so that there is a greater chance of acceptance of recycled material where the person responsible for procurement of road materials has had previous experience with recycled products.

At the individual local government level there is, in many cases, substantial resistance to change. Specifically, rather than rely on a technical specification that would allow the use of any product that met the required technical...
standard, many LGAs continue to specify in their tender documents for road material the provision of virgin quarried product only. So although recycled crushed concrete may be a suitable product that is cheaper than virgin material, in many cases recycled material is explicitly excluded from consideration. Further, not only is recycled material explicitly excluded from consideration for roads, in some cases it is also excluded as a product that can be used in other areas such as cross-overs.

In summary, there appears to be a strong disconnect between the vision for waste and increasing the use of recycled product as articulated by WALGA, and current practice at the individual LGA level.

**Shire of Augusta and Margaret River**

In 2007 the Shire tender for road aggregate was specification based, and included the specifications required for the provision of recycled products as base course and sub-base. The only tenders received related to the supply of virgin products. Tenders are assessed on the basis of ability to deliver the required amount of product and price. A willingness to consider recycled content was driven by a particular staff member that had experience working with recycled products.

**City of Canning**

Like many LGAs the City of Canning tender documents historically specified the provision of virgin crushed rock as a road base product. As such, recycled material was explicitly excluded from consideration in the tender process. The explicit restriction relating to recycled material was then removed, and Canning moved to a tender approach that allowed recycled material to be considered. An extract from the revised tender document is shown in Box 5, and importantly the tender document notes the City’s commitment to recycling at the outset. Also, by allowing for the possibility of awarding concurrent tenders, the tender document foreshadows an appropriately practical approach to the use of recycled materials in road works.
Box 5  **Tender extract on recycled material**

The City of Canning is supportive of the use of recycled materials and will consider materials sourced from crushed building rubble provided it meets the specification.

The City will not commit to sole use of recycled road base until its performance has been proven, and may award two tenders, one for fully recycled material and one for material sourced from a hard rock quarry.

Should the City award two concurrent tenders, the Superintending Officer shall decide which material source is applicable to specific projects, but will not allow the use of recycled road base on major roads until its suitability has been assessed on trials in minor roads and confirmed by rigorous testing.

*Data source: City of Canning Supply and Delivery of Crushed Road Base Tender No. 6/2007*

The City of Canning is now using recycled material in road projects. A current project to widen 780 lineal metres of Welshpool Road involved the use of 1,800 cubic metres of recycled material as sub-base. For a 160 metre section 100 percent recycled material has been used with no virgin material in the upper layer.

Regarding the economics of the project it has been noted that:

- Once delivery costs were considered recycled material was cheaper than virgin product
- The council was able to save by backloading recyclable material such as kerbs and pavements to be recycled
- There was a reduction in material sent to landfill
- The total number of road trip required for the project was reduced.

The City of Canning is involved in a further project aimed at increasing the use of recycled material in concrete that will see concrete path construction that uses some or all recycled material.

**Kwinana Shire**

Through an association with Waste Stream Management (WSM), the Town of Kwinana was involved in an early test road project that made use of recycled concrete aggregate. WSM has since ceased recycled material operations.
4.2.5 Department of Housing and Works

For large works the Department of Housing and Works (DHW) takes an overall project based approach that is centred on the green star building program. Although following the approach, formal accreditation for works is not necessarily sought.\(^9\)

The green star program is an example of the overall project approach. In the case of green star there are nine broad assessment categories: Management, Indoor Environment Quality, Energy, Transport, Water, Materials, Land Use and Ecology, Emissions, and Innovation.

Within each of these categories there are a number of sub-categories, and depending on the performance achieved in each category points are awarded. By way of illustration the material category for a new school project is shown in Figure 7. As can be seen there are a total of 25 points available in the building materials assessment. The complete point allocation for a new school is shown in Figure 8.

In some areas green start assessments can be relatively straight forward. For example under the management assessment points will be awarded where it can be demonstrated that the contractor both has and implements a waste management plan. The specific number of points then depends on providing evidence of the extent of material recycled (measured by weight). In other areas, such as assessments of potable water use, the evaluation process is somewhat more complicated.

The scores in each assessment category are then summed, and an overall assessment of the project made. In the case of green star there are currently three ratings. A building that achieves a rating of four stars is deemed to be a building of best practice; a rating of five stars indicates Australian excellence; and a six star rating indicates the building is a world leader.

In terms of economic efficiency the green star approach has much to commend it. It is not always practicable to achieve best practice outcomes in every area of a project. The green star approach allows the project management team to start with the most cost effective areas for improvement. That is, the approach allows for the development of the most efficient strategies for each project.

---

\(^9\) There are currently 51 certified Green Star projects in Australia, and in WA only 167 Westralia Plaza has Green Star certification (4 Star – Office Design).
### Materials sub-section for Education Green Star

<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Title</th>
<th>Aim of Credit</th>
<th>Credit Criteria Summary</th>
<th>Related Credits (in other categories)</th>
<th>No. of Points Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mat-1</td>
<td>Recycling Waste Storage</td>
<td>To encourage and recognise the inclusion of storage space that facilitates the recycling of resources utilised within offices to reduce waste going to landfill.</td>
<td>One point is awarded where it is demonstrated that a dedicated storage area is provided for the collection, collection and recycling of office consumables with good access for all building occupants and for collection by recycling companies. The storage area shall be adequately sized to allow for recycling of, as a minimum, paper, glass, plastics, metals, and organic (compost) materials.</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Mat-2</td>
<td>Reuse of Façade</td>
<td>To encourage and recognise the reuse of existing façades to reduce new material consumption.</td>
<td>Two points are awarded where it is demonstrated that at least 50% of the total façade of the building area comprises reused building façades.</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Mat-3</td>
<td>Reuse of Structure</td>
<td>To encourage and recognise the reuse of existing structures to reduce new material consumption.</td>
<td>Up to three points are awarded where it is demonstrated that a design allows for the reuse of a significant proportion of an existing major structure by gross building volume and where the reused structure comprises at least 50% of the total final structure by building volume. Points are awarded as follows:</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Mat-4</td>
<td>Recycled Content of Concrete</td>
<td>To encourage and recognise the reduction of embodied energy and resource depletion due to the use of concrete.</td>
<td>Up to three points are awarded where it is demonstrated that the concrete to be used in the building construction or refurbishment has a significant recycled content. One point is awarded where 20% of all aggregate used is recycled aggregate. Up to two points are also awarded, as follows:</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Mat-5</td>
<td>Recycled Content of Steel</td>
<td>To encourage and recognise the reduction in embodied energy and resource depletion due to the use of recycled steel.</td>
<td>Up to two points are awarded where it is demonstrated that the percentage of steel in the design has a post-consumer recycled content greater than 50%, as follows:</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Mat-6</td>
<td>PVC Minimisation</td>
<td>To encourage and recognise the reduction of Poly Vinyl Chloride (PVC) products in Australian buildings.</td>
<td>Up to two points are awarded where it is demonstrated that the total PVC content cost for major services elements (pipes, conduits, wire and cable sheathing, and flooring) is reduced by replacing with alternative materials, as follows:</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Mat-7</td>
<td>Sustainable Timber</td>
<td>To encourage and recognise the specification of reused timber products or timber that has certified environmentally responsible forest management practices.</td>
<td>Two points are awarded where it is demonstrated that all timber and composite timber products used in the building and construction works are required to be sourced from either or a combination of the following:</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Mat-8</td>
<td>Flooring</td>
<td>Encourage and recognise the selection of flooring that reduce environmental impact relative to available alternatives.</td>
<td>Up to three points are awarded where it is demonstrated that the flooring used in the project has a reduced environmental impact as determined by the Flooring Calculator.</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Mat-9</td>
<td>Joinery</td>
<td>To encourage and recognise the installation of reused joinery or joinery designed for reuse.</td>
<td>Up to two points are awarded as follows:</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Mat-10</td>
<td>Loose Furniture</td>
<td>To encourage and recognise the selection of loose furniture that has a reduced environmental impact relative to available alternatives.</td>
<td>Up to three points are awarded where it is demonstrated that the loose furniture (defined as chairs, tables and storage only) used in the project has a reduced environmental impact as determined by the Loose Furniture Calculator. All chair, table and storage items must be listed in the Calculator and complete documentation must be provided for at least 80% of entries to make the project eligible for full points.</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Mat-11</td>
<td>Recycled-Content &amp; Reused Products and Materials</td>
<td>To encourage and recognise design initiatives that increase the market demand for building materials with recycled content and for reused building materials.</td>
<td>One point is awarded where it is demonstrated that materials selected for building construction representing at least 2% of the project’s total contract value meet the following criteria:</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Mat-12</td>
<td>Dis-assembly &amp; Deconstruct.</td>
<td>To encourage and recognise designs that minimise the loss of embodied energy and resources associated with demolition.</td>
<td>One point is awarded where it is demonstrated that 50% (by area) of the structural framing, roofing, and façade cladding systems are designed for disassembly:</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Total Points = 25
Figure 8  Green Star summary for education

Credit Summary for:

<table>
<thead>
<tr>
<th>Category</th>
<th>Title</th>
<th>Credit No.</th>
<th>Points Available</th>
<th>Points Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Green Star Accredited Professional</td>
<td>Man-1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Commissioning - Clauses</td>
<td>Man-2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Commissioning - Building Tuning</td>
<td>Man-3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Commissioning - Commissioning Agent</td>
<td>Man-4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Building Users' Guide</td>
<td>Man-5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Environmental Management</td>
<td>Man-6</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Waste Management</td>
<td>Man-7</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Learning Resource</td>
<td>Man-8</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Maintainability</td>
<td>Man-9</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td><strong>Indoor Environment Quality</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ventilation Rates</td>
<td>IEO-1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Air Change Effectiveness</td>
<td>IEO-2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Carbon Dioxide and VOC Monitoring and Control</td>
<td>IEO-3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Daylight</td>
<td>IEO-4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Daylight Glare Control</td>
<td>IEO-5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>High Frequency Ballasts</td>
<td>IEO-6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Electric Lighting Levels</td>
<td>IEO-7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>External Views</td>
<td>IEO-8</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Thermal Comfort</td>
<td>IEO-9</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Hazardous Materials</td>
<td>IEO-10</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Internal Noise Levels</td>
<td>IEO-11</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Volatile Organic Compounds</td>
<td>IEO-12</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Formaldehyde Minimisation</td>
<td>IEO-13</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mould Prevention</td>
<td>IEO-14</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ene-Conditional Requirement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy Improvement</td>
<td>Ene-1</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Electrical Sub-metering</td>
<td>Ene-2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Peak Energy Demand Reduction</td>
<td>Ene-3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Stairs</td>
<td>Ene-4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Unoccupied Areas</td>
<td>Ene-5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Lighting Zoning and Control</td>
<td>Ene-6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Efficient External Lighting</td>
<td>Ene-7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Car Park Ventilation</td>
<td>Ene-8</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Centralised Energy Systems</td>
<td>Ene-9</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td><strong>Transport</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Car Park Minimisation</td>
<td>Tra-1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Fuel Efficient Transport</td>
<td>Tra-2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Cyclist Facilities</td>
<td>Tra-3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Commuting Mass Transport</td>
<td>Tra-4</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Pedestrian Routes</td>
<td>Tra-5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Occupant Amenity Potable Water Efficiency</td>
<td>Wat-1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Water Meters</td>
<td>Wat-2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Landscape Irrigation Water Efficiency</td>
<td>Wat-3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Heat Rejection Water Consumption</td>
<td>Wat-4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Fire System Water Consumption</td>
<td>Wat-5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Potable Water Use in Laboratories</td>
<td>Wat-6</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td>16</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: Green Star tool can be downloaded from the Green Building Council Australia website: www.gbcaus.org
Data source: Green star Education Pilot Tool [accessed 5 February 2008].

Market overview
Civil Works and Recycled Content

Figure 2 (continued)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Mat-1</th>
<th>Mat-2</th>
<th>Mat-3</th>
<th>Mat-4</th>
<th>Mat-5</th>
<th>Mat-6</th>
<th>Mat-7</th>
<th>Mat-8</th>
<th>Mat-9</th>
<th>Mat-10</th>
<th>Mat-11</th>
<th>Mat-12</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycling Waste Storage</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Reuse of Façade</td>
<td>0</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Reuse of Structure</td>
<td>0</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Recycled Content of Concrete</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Recycled Content of Steel</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PVC Minimisation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sustainable Timber</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Flooring</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Joinery</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Loose Furniture</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Recycled Content &amp; Reused Products and Materials</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Disassembly / Deconstruction</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Land Use & Ecology**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Eco-1</th>
<th>Eco-2</th>
<th>Eco-3</th>
<th>Eco-4</th>
<th>Eco-5</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecological Value of Site</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Reuse of Land</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Reclaimed Contaminated Land</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Change of Ecological Value</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Topsoil and Fill Removal from Site</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

**Emissions**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Emi-1</th>
<th>Emi-2</th>
<th>Emi-3</th>
<th>Emi-4</th>
<th>Emi-5</th>
<th>Emi-6</th>
<th>Emi-7</th>
<th>Emi-8</th>
<th>Emi-9</th>
<th>Emi-10</th>
<th>Emi-11</th>
<th>Emi-12</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone Depletion Potential</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Refrigerant GWP</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Refrigerant Leak Detection and Recovery</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Watercourse Pollution</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Reduced Flow to Sewer</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Light Pollution</td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Legionella</td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

**Sub-total weighted points:** 0

**Innovation**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Inn-1</th>
<th>Inn-2</th>
<th>Inn-3</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovative Strategies &amp; Technologies</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Exceeding Green Star Benchmarks</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Environmental Design Initiatives</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total weighted points:** 0

Minimal standards for Green Star accreditation not met.

The GBCA does not endorse any self-assessed rating achieved by the use of Green Star - Education PILOT. The GBCA offers a formal certification process for ratings of Four Stars and above; this service provides for independent third party review of points claimed to ensure all points can be demonstrated to be achieved by the provision of the necessary documentary evidence. The use of Green Star - Education PILOT without formal certification by the GBCA does not entitle the user or any other party to promote the Green Star rating achieved.

Note: Green Star tool can be downloaded from the Green Building Council Australia website: www.gbcaus.org

Data source: Green star Education Pilot Tool accessed [5 February 2008]

### 4.3 Extractive industries in WA

The main quarrying or extractive industries in WA are concerned with: sand, gravel, limestone, clay, and hard rock. In December 2007 the Western Australian Chamber of Commerce and Industry prepared the *Basic Raw Materials Access and Availability 1996-08* report which covers all of the extractive industries other than gravel.

As an interesting aside the report comments on the experience of New South Wales in terms of recycling. In relation to the experience of NSW the report notes the key drivers for the development of the C&D recycling industry as:
Civil Works and Recycled Content

- increases in the landfill levy
- scarcity of raw material, and
- well developed and enforced recycled product standards (CCI 2007, p. 34).

4.3.1 Metropolitan and outer metropolitan operations

In addition to its use in concrete and building applications, and in glass production, sand is used as clean fill. Limestone has uses including as an aggregate for road-base, and hard rock (granite and dolerite) is used as aggregate. These three products therefore compete directly with recycled product and clean fill sourced from C&D waste.

As can be seen from the detail in Table 14, quarrying operations are distributed throughout the metropolitan and outer metropolitan region.

Table 14 Approved operation in metropolitan and outer metropolitan region

<table>
<thead>
<tr>
<th>Location</th>
<th>Sand</th>
<th>Limestone</th>
<th>Rock</th>
</tr>
</thead>
<tbody>
<tr>
<td>North West</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wanneroo</td>
<td>6</td>
<td>23</td>
<td>-</td>
</tr>
<tr>
<td>Gingin</td>
<td>11</td>
<td>29</td>
<td>-</td>
</tr>
<tr>
<td>North East</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swan</td>
<td>11</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Chittering</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Toodyay</td>
<td>6</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Northam</td>
<td>8</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>South East</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gosnells</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Serpentine-Jarrahdale</td>
<td>6</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>South West</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cockburn</td>
<td>11</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>Kwinana</td>
<td>4</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>Rockingham</td>
<td>3</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Mandurah</td>
<td>-</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Murray</td>
<td>8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>79</td>
<td>91</td>
<td>14</td>
</tr>
</tbody>
</table>

Data source: CCI (2007, p. 25)

Given the variety of uses for different virgin materials, aggregate figure do not reveal the complete picture. Nevertheless, aggregate output figures for the various industries do give some idea of the scale of the extractive industries. In 2006 some 7.6M tonnes of sand were extracted and sold, 4.8M tonnes of limestone were extracted and sold, and 6.7M tonnes of hard rock were
Civil Works and Recycled Content

extracted and sold (CCI 2007, p. 28). Demand for products is expected to remain strong into the future.

The CCI assessment of future supply is that the supply of hard rock is relatively secure, but there are potential issues with regard to limestone and sand supply. In the case of sand this is because much of the available supply in the south metropolitan region is zoned for urban development. With respect to limestone the issues are less pronounced, for while future sources are currently planned to be industrial areas, the sites are controlled by LandCorp. Naturally the challenges for the extractive industry represent opportunities for the recycling industry.

4.3.2 Extractive industries and environmental policy

The activities of the extractive industries involve clearing native vegetation and so involve environmental regulation. In particular, a permit is required from DEC before clearing of native vegetation can take place. The offsets approach, and in particular the Bush Forever programme, appears to be of some concern to the extractive industry. The offsets approach is used where environmental damage is deemed certain, and rather than restricting the activity entirely the proponent of the project is required to make an appropriate contribution elsewhere.

Examples [of offsets] for extractive industry have included the requirement to cede Bush Forever land free of cost into conservation estate, the need to fence native bush, and the need to undertake restoration of previously cleared areas. These offsets can involve considerable cost but have been undertaken by the proponent without compensation (CCI 2007, p. 53).

The offset approach does impose costs on the extractive industry. The offset approach could however been seen as consistent with an impactor pays approach to dealing with the localised externality issues associated with the clearing of native vegetation for new quarries, and so be seen as an appropriate and legitimate policy tool. Offsets are recognised as a valid tool for addressing upstream externalities in Productivity Commission (2006).

---

10 Exemptions exist for activities such as firebreak clearing, areas governed by a State Agreement Act, and actions taken under various other pieces of legislation.
5 Options for increasing the use of recycled material

This section describes the central characteristics of each option and assesses each against the criteria that have been set out previously. As a practical matter it has been necessary to group the options together under separate headings. The elements that comprise an option are however not necessarily mutually exclusive and it may be possible to combine elements from the different options to arrive at a new option. In some cases the options discussed are in fact complementary.

The discussion and review of material suggests the following options for consideration:

- **Revised status quo option**
  - The revised status quo, which
    - Maintains the current landfill levy structure, but introduces indexation for the levy
    - Removes barriers at the local government level to the use of recycled material as road-base
    - Works to overcome information asymmetry in the government, and
    - Includes a variant that allows for a positive incentive for use of recycled material in terms of a fund that reimburses local governments that use recycled material where the fund operates for a limited number of years.

- **Regulation based options**
  - Regulation based regime, which
    - Is based on a target mandatory percentage level of recycled content for all government civil construction projects and mandatory diversion targets for waste for all government demolition projects
      - Includes different targets for different regions, and
      - Considers a variant that involves additional restrictions on material used as general fill.

- **Overall outcomes based options**
  - Project outcomes based approach\(^\text{11}\), where
    - The objective is to achieve the best possible environmental outcome, and where the recycled content component of the project is just one assessment element, and
    - Includes a variant where there is a financial incentive programme.

- **Pricing based options**
  - Price based approaches, which involve
    - Higher real landfill levy rates
    - The introduction a virgin aggregates tax
    - Implementation of a bond system for demolition sites.

---

\(^{11}\) The outcomes based approach subsumes the principle of maximum use approach.
5.1 Modified status quo model

The modified status quo option is included as a reference benchmark. It seeks to establish what is likely for the future if the basic features of the current approach are maintained with some minor modifications.

5.1.1 Changes to the landfill levy

The landfill levy is set to increase substantially over the coming years and as noted in Martin and Scott (2003), relatively small increases in a landfill levy have been shown to have a substantial impact on recycling and diversion rates for inert material. The current levy structure does not have an allowance for indexation; in contrast, the levy in NSW is indexed. Without indexation, over time the relative price of landfill will fall. This will naturally encourage use of landfill at the expense of recycling. As such, once the current cycle of staged increases in the levy is complete, the levy rate should be indexed to the Perth CPI, or other appropriate index.

The current arrangements in NSW provide a ready template for incorporating indexation into the levy.

5.1.2 Removing explicit barriers to use of recycled products

Although Main Roads WA have established a technical specification for the use of recycled material as road-base and sub-base, in many instances recycled product is explicitly excluded from consideration as a supply material due to the way tender documents are drafted. To unnecessarily restrict the range of products considered is inefficient.

In the jargon of economic analysis, the decision about which products to use as road-base and sub-base represents a constrained optimisation problem. The problem could be framed as one where the objective is to minimise expenditure on roads materials subject to the constraint of completing the scheduled programme of works. By restricting the supply of materials for road-base and sub-base to only virgin quarried products, an additional constraint is placed on the optimisation problem. In the current context, the imposition of an additional constraint on the optimisation problem will result in an outcome that requires a higher level of spending if the constraint is binding, or no increase in the level of spending if the constraint is not binding. It therefore follows that removing clauses in tender documents that exclude recycled material from consideration as a suitable product can result in only two possible outcomes; no increase in roads material costs, or a reduction in roads material costs.
Civil Works and Recycled Content

All local government tenders for roads material should be based on the principle that material be fit for use and should not be based on specific products. That is, reference should be made to the relevant technical specifications provided by Main Roads WA, or other appropriate specifications, and products that meet the relevant technical specifications considered for use.

Importantly, removing a restriction does not compel anyone to use recycled material, it merely allows for consideration of the material. Removing the restriction on consideration of recycled aggregates is also consistent with the recommendations of the Productivity Commission.

There are several approaches that could be considered as appropriate for achieving such a change. One approach would be to require as a condition of eligibility for state government road funding that tenders be based on material being fit for purpose, i.e., the material meets the appropriate technical standard. Such an approach would be effective in achieving the desired outcome but may cause some resentment at the individual local government level. The relative contributions of the state government to road funding, especially in the metropolitan region, must be kept in mind (see Figure 6).

The extent of resentment caused is something that could be managed with appropriate provision of educational material and information to local governments. Working in partnership with WALGA during the implementation phase of any change would further reduce the potential for unease within individual local governments.

It can be further noted that there exists precedent in the waste management area for making funding eligibility contingent on meeting certain requirements. It has for example been indicated that LGAs that do not have a Strategic Waste Management Plan will not be eligible for Strategic Waste Initiate Scheme funds.

An alternative approach would be to rely solely on an information campaign explaining the benefits of removing such clauses in tender documents. WALGA’s ability to communicate with local governments would need to be utilised in any information programme.

The approach implicitly assumes recycled material would also be approved for lower level uses such as cross-overs. Although the exact tool to achieve this is unclear, it logically follows that if a material is suitable for a higher traffic use then it is also suitable for lower traffic uses.
5.1.3 Education and information campaign

There is a technical standard for the use of recycled material as road-base; there exist numerous cases studies that demonstrate the cost saving that can be achieved from using recycled material, not just a road material but also in concrete product applications; and there are several willing suppliers of product in Western Australia. Yet despite this there has been only very limited use of recycled C&D product in Western Australia.

In the case of Main Roads WA it is unlikely that the current market participants could supply the amount of material required, and going forward there is an increasing focus on full depth asphalt for high volume roads. In the case of local government it is unclear why they have not embraced the product, although it has been suggested that quality control issues in earlier times may have resulted in negative perceptions of recycled aggregate.

A targeted information and education campaign focused on local government civil works departments could do much to change views about the product. Such a programme would need to involve WALGA (via the Municipal Waste Advisory Council and WasteNet), and could also involve Recyclers and the City of Canning. The programme could draw on material such as the WRAP Opportunities to use Recycled Materials in Preliminary Building Works and Civil Engineering Quick Wins Guide.

Regarding on-site source separation, it is thought that demolition companies will respond to price signals, but may be unresponsive to an education campaign highlighting the benefits of source separation. The modified status quo option therefore does not envisage an extension of an advertising campaign to demolition companies.

5.1.4 Variant based on incentives

Funds from the landfill levy are placed in the Waste Management Recycling Account. These funds are used to assist with the achievement of the objectives of the Waste Management Board, and a number of programmes and activities have been funded. One use of funds, until June 2006, was the Resource Recovery Rebate Scheme (RRRS). Regarding the RRRS, some of the programme limitations noted in MWAA (2005) were that:

- Initially payment process times were excessive
- Monies provided under the programme were not hypothecated for waste programmes
- The programme did not focus on behaviour change
- Reporting protocols were complex.
In 2007 the two-phase Zero Waste Plan Development Scheme was determined to be an appropriate use for Funds from the Waste Management Recycling Account. Zero Waste Plans are due to be completed by the end of September 2008.

A modified version of the RSSS could be used to help encourage uptake of recycled material in road works. A key limitation regarding the adoption of recycled material in road works relates to resistance to change. The provision to local governments of a relatively modest financial incentive, for a limited period of time, would help them make the step change in thinking required to consider the use of recycled products. A natural period for such a programme may be to end the programme either at the same time, or one-year after, the current planned series of increases to the land fill levy. Such a timetable would imply an end date for any such programme of 2010 or 2011. Alternatively, a simple schedule could be developed whereby local governments receive a payment of say $1.50 per cubic metre of recycled material used in road works in 2009, a payment of $1.00 per cubic metre in 2010, and a payment of $0.50 per cubic metre in 2011; possibly subject to some system-wide fund cap on funds distributed each year.

As local governments gain experience with using recycled material the need for an extra financial incentive will disappear because the applications in which the product has advantages over virgin material will become apparent.

Although the market in Western Australia is not currently over-crowded with potential suppliers of recycled road-base and sub-base, anecdotal evidence suggests there is significant competition between industry participants. There is also the threat of an established east coast operator opening a recycling operation in Western Australia, plus competition from virgin materials suppliers.

A final consideration in any such programme would relate to the level of involvement regional LGAs would have in any programme. Current market arrangements suggest that the ability of Shires to participate in any such programme would be limited.

## 5.2 Modified status quo assessment

The modified status quo option, including the variant, as described above, is assessed against each of the criteria. The assessment order follows that established in Section 2, where the formal assessment criteria were set out.
5.2.1 Assessment against efficiency criteria

In general, as they apply to every unit of material, taxes perform well in terms of allocative efficiency. A central issue in achieving allocative efficiency relates to understanding the value of the externality associated with inert landfill. For landfill as a whole, the single biggest contributing factor to the overall externality cost relates to greenhouse gas emissions. Relative to the level of emissions from municipal waste and commercial and industrial waste, the level of greenhouse gas emissions from C&D waste is low. The externality cost associated with C&D waste is therefore lower than that associated with either municipal waste or commercial and industrial waste.

The externality cost associated with the C&D waste stream in Productivity Commission (2006, p. 76) for a properly-located, engineered and managed landfill are between $1 and $7 per tonne, and for properly-located, engineered and managed landfill with efficient methane capture and electricity generation less than $4 per tonne. The landfill tax rate in the UK was originally set to reflect the cost of externalities and was set at £2 per tonne for inert waste.

The landfill levy in Western Australia is calculated in terms of cubic metres and if we assume a conversion factor of 1 cubic metre of C&D waste equals approximately 1.5 tonnes, the range for externality costs, as estimated by the Productivity Commission, falls within the band $1.50 to $10.50 per cubic metre. Using an exchange rate of one Australian dollar equals 40 pence,$^{12}$ and using the same multiple for conversion of tonnes of waste to cubic metres, the UK estimate for externalities implies a charge of $7.50 per cubic metre. As the projections schedule for the landfill levy has the charge reaching $9 per cubic metre in 2010, the current policy is moving in the direction of allocative efficiency. The current levy rate, as shown in Figure 4 is too low.

The value of the externality is determined by valuations for leachate, greenhouse gas, amenity etc. All such valuations are nominal valuations. As such the nominal value of the externality cost associated with landfill will increase through time. Indexation of the levy would ensure that the levy continued to reflect the cost of externalities associated with landfill into the future.

To the extent that there exists localised upstream externalities from the quarrying of virgin material for aggregates, and these externalities are not addressed appropriately under the offsets approach, there is the potential for source suppliers of virgin material to be treated more favourably than suppliers...

---

12 Actual exchange rates fluctuate substantially through time. Over the longer term economists prefer to use purchasing power parity (PPP) exchange rates. The exchange rate used for the conversion represents a reasonable approximation to an appropriate PPP exchange rate.
of recycled material. If the offsets approach is working properly, which is assumed, there should be no intergeneration externality issue.

The implication of local government roads material tenders that explicitly exclude recycled material from consideration is that under current practice productive efficiency may not be achieved. Requiring the removal of such restrictions will allow a shift towards productive efficiency. Given the overwhelming commitment of LGAs to delivering value for money in all the services they provide, the simple removal of the restriction all but ensures an improvement in terms of productive efficiency relative to current practice.

For similar reasons to those set out under allocative efficiency, taxes perform well in terms of dynamic efficiency. As the levy applies to all C&D waste going to landfill there is a continuous incentive for demolition firms to divert waste from landfill to other uses where the levy is not payable. For recycling firms, the knowledge that the volume of material is not limited by some quota or mandatory regulation means that such firms can feel positive about the opportunities for growing their business. As a general principle a levy or tax will perform better than mandatory regulations or content requirements and targets in terms of dynamic efficiency. This is because the tax or levy imposes a continuous incentive whereas other approaches only impose an incentive to achieve the minimum regulated standard.

In terms of geography, as actions are not mandated but rather rely on price signals and information, there is no spatial inefficiency generated with the approach.

On the whole the modified status quo approach performs well in terms of efficiency. It results in obvious impediments to growth in the use of recycled material being removed, appropriate price signals, and strong incentives for investment. To the extent that an education campaign will remove information asymmetry in the market, it will have a positive effect on efficiency.

The additional value of a temporary recycled road material rebate scheme is difficult to assess. While such a fund would decrease the relative price of using recycled material versus virgin aggregate, currently the missing price elements in the recycled material use equation relate to the externalities associated with inert landfill that are currently not fully priced. As such, in terms of allocative efficiency, it could be argued that the focus should be on appropriately pricing the externality via the landfill levy rather than on decreasing the price of recycled material via a rebate scheme to local government.
If such a fund were to greatly speed up experimentation by local governments with recycled material it could be seen as valuable. If, however, having removed explicit restrictions on the use of recycled material from tender contracts, local governments would have moved rapidly to using recycled material anyway, then the value of such a fund in terms of assisting allocative efficiency would be limited.

A subsidy fund that draws monies from the Waste Management and Recycling Account would also need to be evaluated in light of the other opportunities and priorities that the Waste Management Board has for these funds. That is to say the opportunity cost of establishing the rebate programme must be considered.

Productive efficiency requires that demand be met at least cost. A subsidy based on the per unit cost of a tonne of material would decrease the effective price paid by purchasers for recycled material, and so from the point of view of supplier firms result in an increase in the effective demand curve they face. In the short-run prices received by supplier firms would rise and so profits would increase. In a pure theory setting the increase in profitability encourages new firms to enter the market. It is however worth testing the reasonableness of such a proposition in practice.

In the case of recycling material for use as aggregates, significant investment in plant and machinery is required. This represents a clear barrier to entry. There are however firms currently based on the east coast that could expand operations to Western Australia. So while there are barriers to entry, in response to higher prices there is potential for new local firms to enter the market, and potential for existing firms based on the east coast to establish a branch operation in Western Australia.

Having established that it is not implausible for new players to enter the market, the next question becomes what happens when new firms enter the market. In particular, the question to answer is what happens to the long-run industry supply curve. In a stylised sense three basic outcomes are possible, and the outcome depends on whether the industry is a(n):

- **Constant cost industry** where the entry of new firms does not impact upon other firm input prices
- **Increasing cost industry** where firm entry increases average input prices for existing firms, or
- **Decreasing cost industry** where firm entry results in decreasing average costs for firms.

Generally speaking, a change in the size of an industry has the potential to impact upon existing firms due to pecuniary effects and technical effects. *Pecuniary* effects relates to the impact on factor prices when industry output
varies, where as Technical effects relate to the amount of output that can be produced with any given set of inputs.

**Pecuniary and technical effect examples**

An example of a pecuniary effect would be the wages of miners rising as mining activity increases due to the need to attract new workers to the industry. An example of a technical effect would be increasing average transport times (and hence transport costs) for the mining industry as output expands and the relevant road, rail, and port infrastructure becomes congested.

**Short-run supply curve**

Regardless of the type of industry, the short-run market supply curve is up-sloping. This is because it is found as the sum of individual firm marginal cost curves, which by definition are up-sloping.

- **Constant cost industry**

  When there are no pecuniary or technical effects firms can enter and leave the market with no implication for individual firm costs. In such a case the industry long run supply curve will be a horizontal line and the long-run supply elasticity will be infinite.

- **Increasing cost industry**

  When there are negative external pecuniary or technical effects following the entry of new firms, average industry costs rise for all existing firms. In such a situation the industry long run supply curve will be up-sloping and the long-run supply elasticity will be positive.

- **Decreasing cost industry**

  For the case of positive external pecuniary or technical effects, following the entry of new firms, average industry costs are driven lower for all existing firms. In this case the industry long run supply curve will be down-sloping and the long-run supply elasticity will be negative.

Details of the three possible cases for the shape of the long-run industry supply curve are shown below in Figure 9. Supporting detail on how the curves are derived is contained in an appendix.

**Figure 9 Different possible long-run industry supply curves**

<table>
<thead>
<tr>
<th>Price</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS₀</td>
<td></td>
</tr>
</tbody>
</table>

**Data source:** ACIL Tasman

**Infant industry argument**

Options for increasing the use of recycled material
Although the arguments developed in the international trade literature are slightly more nuanced, it is essentially the possibility of a down-sloping long-run supply curve driven by positive external economies from new firms entering the market that underpins the infant industry argument for supporting new industries. Should there be a down-sloping long-run supply curve, it would justify government intervention.

With respect to time limited interventions such as the one envisaged under the variant described above, it is generally assumed that the benefits from the development in the infant industry (in this case recyclers) will accrue to a wider group (the whole economy) rather than just the specific infant industry. This is required because the cost of the government intervention must be recovered, with interest, for the whole of society. The intervention could not be justified, in purely economic terms, if the benefits were simply captured by the entrepreneurs involved in the infant (recycling) industry.

Empirical studies generally find little support for the idea of a down-sloping long-run supply curve. Summary estimates reported in Nicholson (2005, p. 302) for agricultural goods, commodities, and housing are all positive, although in the case of aluminium it is noted that the long-run supply curve is almost horizontal.\(^\text{13}\)

Without compelling evidence that supports the existence of positive external economies in the recycling industry where benefits accrue to those outside the industry, it is difficult to see the rebate variant improving performance in terms of productive efficiency.

The dynamic efficiency assessment involves consideration of the incentives for investment and innovation, and their appropriateness. To the extent that the subsidy signal intent on the part of government and stimulates demand it provides additional incentives for investment.

### 5.2.2 Assessment against equity criteria

The modified status quo option performs well in terms of equity considerations, as defined. Specifically, it was suggested that in the current context equity could be seen as relating to:

- any issues of ability to pay and potential disadvantage to departments and government agencies
- horizontal equity in terms of the equitable treatment across potential contractors and source suppliers of both virgin and recycled content products, and

\(^{13}\) A review of standard databases did not reveal any long-run supply estimates that might be more closely associated with the recycling industry.
Civil Works and Recycled Content

Ability to pay and disadvantage

Under the revised status quo approach there is no disadvantage or additional cost imposed on departments and government agencies. There is no mandatory requirement to take action, rather only a requirement to not exclude from consideration recycled materials.

Horizontal equity

As currently suppliers of recycled material are explicitly discriminated against in many local government tender documents, and the modified status option has these discriminatory provisions removed, the option makes a substantial improvement on current practice in terms of equity across suppliers. The move toward appropriately pricing the externality arising from landfill further improves horizontal equity.

Incidence effects

Landfill tipping charges rise to appropriately capture the externality cost and so additional costs are borne by demolition companies that send C&D waste to landfill. Those demolition companies that engage in source separation and so can supply recyclers with material face no additional costs. Regardless of geographic location there are no additional incidence implications for government agencies or departments.

Rebate variant

As the shape of the long-run supply curve is unknown, the impact on local government and other purchasing organisations is unclear.

Horizontal equity

The variant discussed sees the provision of a rebate for the use of recycled aggregates for a specific period of time and so represents a favourable treatment of recyclers relative to suppliers of virgin material. Again appropriateness of this rests on whether offsets are appropriately capturing the up-stream externality effects of quarrying. Here we assume they are appropriately captured.

Incidence and distributional effects

Although the specific funding program is unknown, it is understood that funds from the Waste Management and Recycling Account will continue to be made available to the local government sector to assist the sector with waste reduction and recycling activities and programmes. To the extent that the rebate received at any given local government under a recycled content rebate scheme would be different to the funding they would receive under some other programme, there are distributional/incidence effects. Although the sector as

---

14 Some assessments would define and assess distribution effects and incidence effects separately. As it made the overall assessment process easier, in the current assessment process they are treated as a single grouping.
a whole would not be disadvantaged, some individual local governments would be better off and others would be worse off.

The supply of recycled aggregate material is more likely to take place in urban areas than in rural areas. As such it is likely that rural councils would be clear losers with a rebate system compared to some other possible funding approach. Other than this very general characterisation it is difficult to say more about the distributional/incidence effects across the local government sector.

5.2.3 Assessment against simplicity criteria

The modified status quo represents a simple approach and performs very well in terms of simplicity. The changes required under the modified status quo option are uncomplicated, transparent, and easily understandable. Further, the approach does not require updating and revision procedures. The on-going work that is implied under the option relates to the indexation of the levy and such a process is not burdensome.

The option envisages a change to road funding arrangements whereby local governments must not explicitly exclude recycled material which would require a one-off simple change to road funding arrangements.

As templates for tenders that allow for recycled material as an aggregate already exist and could be distributed via WALGA, no new documentation need be prepared. Further, given WALGA is committed to minimising waste, the default road material tender document that will need to be developed at some point by the fledgling central tender service of WALGA could simply be distributed to all LGAs.

The modified status quo option requires no new institutional architecture and places no new demands on industry participants. No additional strain is placed on industry participants and so the question of whether capacity matches new requirements and responsibilities does not arise.

Regarding any education programme, DEC has both the skills and ready access to the basic information required for such a programme. WALGA represents a ready distribution network. Existing capacity and institution arrangements are therefore well suited to such activities.

Rebate variant

The proposed variant of a rebate scheme would require new institutional infrastructure, although previous schemes provide a ready template from which to work. The proposed variant also imposes additional administration costs on local government in terms of reporting. In this regard it is worth
recalling that one of the criticisms of the previous recycling rebate programme was the complexity of reporting requirements. Although the level of complexity and burden added under the rebate variant could in no way be thought of as excessive, it is a less simple system than the straight modified status quo option.

### 5.2.4 Assessment against development criteria

The modified status quo approach performs reasonably well in terms of providing incentives for the development and expansion of the recycling industry in Western Australia.

**Discrimination removed**

The single biggest barrier to development -- explicit exclusion from tender contracts for road base at the local government level -- is removed. This should have a very positive stimulatory effect on market development.

**Strong positive price signals**

The scheduled increases in the landfill levy, combined with indexation of the levy, send a strong and continuing price signal for C&D waste to be diverted from landfill to recyclers. An increase in the relative price of tipping rates at landfill makes supplying material to recyclers more attractive. To the extent that there are potential entrants into the market it is likely competitive pressure will ensure that tipping rates at recycling facilities do not rise. The positive effect of the landfill tipping rate increases will be strong, and indexation ensures the effect is not eroded by inflation.

**Source material supply relies on recycling firm initiative**

The option does not directly address the issue of on-site source separation, a key issue with respect to the supply of base material. Rather, the approach relies on demolition firms responding to price signals to change behaviour and engage in source separation, combined with the entrepreneurship of existing and future recyclers to source base material for crushing. Given the opportunity to compete on a level playing field with virgin aggregates, it is reasonable to believe the profit motive will be sufficient for recycling firms to ensure an adequate supply of source material.

**Clean fill market**

A potential issue regarding market development with the modified status quo option is that changes to the landfill levy could simply see material crushed for use as clean fill rather than sent to a recycler for transformation into a more valuable product. The potential for the clean fill market to expand and limit the supply of material to recyclers therefore exists under the revised status quo option.

**Educating government engineers will help**

The education and awareness campaign targeted at local government engineers should further increase adoption rates at the local government level, and so encourage development in the sector.
Rebate variant

Rebate and opportunity cost
The rebate variant would further encourage local government uptake of recycled aggregates. The rebate programme, as outlined would be temporary in nature. The logic is that once engineers become familiar with using recycled aggregates they will want to continue using the product as it will remain a cost effective product after the removal of the subsidy in later years. In this respect a rebate programme should assist with market development. The caveat that must be mentioned is that with a rebate scheme there is an opportunity cost regarding the use the funds from the Waste Management and Recycling Account. In the aggregate the effect of a rebate scheme on the recycling industry is therefore indeterminate.

5.2.5 Externality issues

Landfill externalities
The approach sees the externality cost associated with C&D waste, as estimated in Productivity Commission (2006) appropriately covered. As those depositing the waste at landfill sites pay the landfill charge, the method of allocation is an impactor pays approach.

Quarrying externalities
Potential upstream externalities associated with quarrying activity are assumed to be dealt with by way of offsets that are appropriate to each site, and so again are impactor based and appropriately captured.

5.3 Regulation based option

Practical matters for the assessment
The basic design of the regulation based approach is that a target level is set for the percentage of recycled content used in civil construction projects and the amount of demolition material diverted from landfill. As a practical matter it is difficult to discuss such an approach as it might apply across all possible government civil construction projects. Without limiting the generality of the approach, and to make the discussion tractable, it is helpful to limit the discussion to how such an approach might apply to the case of government road works only. As such, the discussion presented here focuses on roads applications only. While such an approach has a cost in terms of a loss of generality in the discussion, this cost is more than compensated for by the ability to discuss the operation of the approach in detail.

The regulation option defined
The discussion therefore assesses an option based on a mandatory percentage level of recycled content for all government road projects and mandatory diversion targets for waste for all government construction and demolition tenders. The variant discussed involves placing new regulations on the composition of clean fill.
5.3.1 Setting the initial targets and updating regulations

There are numerous components to the overall road construction process, and the option could set a target for each aspect of the process, or only for some aspects of the construction process, such as the sub-base and road-base components. It is assumed as part of the assessment process that wherever a content target is set, appropriate technical specifications for the product exist.

Initially it will be necessary to set targets for both recycled content and diversion rates, and then establish a review mechanism for updating the targets. Prudence suggests setting the initial diversion and content targets at conservative levels, and in a simple manner, say expressed as a percentage of total weight. In the case of diversion target these would be specified as applying to all government projects and would be a clearly stated requirement in the tender documents. In the case of road works the targets could be set for each project, or based on an annual assessment of materials used and each organisation issuing roads tenders. As it would give greater scope for alternative approaches and assessment of local conditions, an assessment based on annual usage would be the least restrictive approach.

Such an approach would however not stop individual LGAs or Main Roads WA from specifying a target for each project if they wanted to, it just would not mandate such an approach.

Initial targets, both for diversion rates and recycled content, would need to be set following an assessment of industry capacity to produce and process material, and following consultation with WALGA and individual LGA representatives, Main Roads WA, Construction and Demolition industry representatives, and Recyclers. In the initial years, an annual review of how the targets are working would be appropriate.

Experience shows that what can be achieved in terms of recycling rates and recycled content use improves over time. Notwithstanding the need to be conservative in setting the initial targets, realist aspirational forward looking targets could also be set. These targets would need to be set so as to match the practical limits of industry capacity.

It is assumed that targets will be set according to geographic boundaries that take into consideration the practical limits to the cost effective use of recycled content material in different locations, as well as the practical limits to achieving diversion from landfill for C&D waste. How finely divided the boundaries are for assessment is a matter for judgement. At a minimum there could be a simple separation that establishes a target for the metropolitan region and a target for rural regions. At the most finely disaggregated level the targets could be specified for each local government area.
The trade off involved with setting the number of different assessment zones is straightforward. The greater the number of specific target areas the greater the flexibility. The more target areas, the greater the administrative complexity. For assessment purposes it is assumed that rural areas represent one area, and that there are up to four separate zones in the metropolitan area. For assessment purposes the metropolitan regions will be defined as inner metropolitan, south metropolitan, east metropolitan, and north metropolitan.

**Clean fill variant**

Largely unseparated C&D waste can be crushed and used as clean fill. Using C&D waste as clean fill means that although the material is not sent to landfill, a specified recycled product is not produced. The use of unseparated C&D waste as clean fill also places limits on the supply of raw material to recyclers that wish to produce specified recycled products. To the extent that the objective of the regulations are to encourage the use of specified recycled products in civil construction projects and encourage market development, using crushed C&D waste as clean fill is an issue.

The aim of the additional regulation on clean fill would be to ensure that C&D waste is put to its highest value use. There are many potential ways additional regulations on clean fill could be implemented. The simplest approach would be to follow the approach used in NSW where clean fill cannot contain C&D material. Such an approach may however be too aggressive for the WA market, and would also appear to restrict the ability of recyclers to supply clean fill into the market. As such, for the purposes of assessment it is assumed that the regulations are based around the content of general fill. That is to say, regulations are set on the level of timber, gyp rock, plastics and other miscellaneous materials that can be contained in general fill. Specifically, it is assumed that the regulations are set to ensure that the clean fill material that is sourced from the C&D waste stream must have come from material that has been source separated before crushing.

The specific regulations could be set after consultation with industry representatives. There will be some uncertainty about the specific level that content regulations should be set at for clean fill. As such the regulations will need to be reviewed periodically, at least in the initial years, to ensure they are working appropriately and that there had been no unforeseen negative impacts of the regulations on the recycling industry as a whole.

### 5.4 Regulation based option assessment

The discussion below sets out the assessment of the regulation based option against each of the criteria. At the end of each assessment the impact of the variant is discussed.
5.4.1 Assessment against efficiency criteria

It was established above that the landfill levy, once the current series of increases are complete, will be broadly appropriate for the level of externalities established for inert waste by the Productivity Commission.

The regulation based approach for content in new constructions does not consider whether or not resources are devoted to their best use. A central target is set by the regulator that must be met. The possibility for a significant deviation from allocative efficiency in new construction projects therefore exists.

Currently source separation of material is not standard industry practice. To the extent that the failure of demolition companies to source separate material results in material not being put to its best use -- and the evidence that source separation can be undertaken in a cost neutral fashion -- there is currently a deviation from allocative efficiency. Depending on the rates set, there is the potential for regulation in this area to either increase or decrease allocative efficiency.

In a general sense, as the requirement is to reach the target level for content and diversion, and the target only, a regulation based approach will perform less well than an appropriately structured price or tax based approach. This is because once the target is reached there is no longer any economic incentive to pursue further improvements.

Where there is an enforceable target for content with financial consequences for failing to meet that target, demand is met subject to the constraint and not subject to least cost. Where the market is functioning properly, and externalities are priced appropriately, theory suggests that least cost approaches will be followed by market participants. If the regulation is binding, then the least cost approach is not met. If the regulation is not binding, then the regulation has no impact on overall content use.

The current practice in local government of not considering recycled material as a possible product limits market competition. Mandatory targets for content will, to a greater or lesser degree, limit competition. Where tenders are designed so that there are multiple tender offers from both suppliers of virgin material and recycled material there remains the potential to achieve competitive bidding from both suppliers of virgin material and recycled material. The extent to which this is possible will vary spatially.

As demolition companies are required to divert material away from landfill and to recyclers, the need for price competition among recyclers for source material is reduced, and so the potential for least cost outcomes to be achieved is potentially also reduced.
Civil Works and Recycled Content

Unintended consequences

The detail reported in Cassidy (2007) for California’s carpet market provides a cautionary lesson about the unintended consequences of mandatory targets. In California carpet is required to include a 10 percent post-consumer component. To meet this requirement it has been reported that some manufactures are now adding glass into the carpet backing. The addition of glass to the backing means that when the carpet reaches the end of its useful life, it will be very difficult to recycle.

Dynamic efficiency

A well constructed timetable for the mandatory targets should provide some certainty regarding both the minimum level of demand for material and the likely supply of material for recyclers. This certainty regarding market conditions would support investment and expansion planning. Although as the basic business model is underpinned not by competitiveness, but by government regulation, and to the extent that government regulation can change, there would remain a certain level of uncertainty that may cause operators to be cautious regarding expansion plans.

The diversion targets mean that supply to recyclers is likely to be forthcoming regardless of the level of investment in new cost reduction technology and capital. With supply underwritten in this way, there is potential for a diminution of the incentive to innovate and invest in new cost reduction technology.

Clean fill variant

Allocative efficiency

Allocative efficiency requires that society’s scarce resources be put to best use. If the best use of C&D waste is not as clean fill but rather as a specified recycled product, then the additional regulations should assist in terms of allocative efficiency.

Productive efficiency

The additional restrictions placed on what constitutes clean fill would limit the supply of clean fill material for residential developments and so in the clean fill market demand would not necessarily be met at least cost. Recyclers that produce clean fill after source separation would however be able to supply product into the market, as would existing virgin materials suppliers.

Dynamic efficiency

The possibility for unseparated C&D waste to be crushed in a rudimentary fashion and then used as clean fill has been identified by industry participants as a reason for not investing in recycling capacity in Western Australia. The additional regulations on clean fill would therefore improve the incentive to invest in recycling capacity in Western Australia.

In more general terms, the diversion of C&D waste away from recyclers that transform the material into a specified recycled product and into clean fill has
the potential to dramatically restrict the supply of raw material to recyclers, and limit development.

5.4.2 Assessment against equity criteria

To keep the discussion tractable the regulation option considers mandatory targets for all government demolition works and content targets that apply to road works only. It is therefore the implications for LGAs and Main Roads WA that are discussed here. Under an expanded regulation programme that covered all civil construction, the general conclusions discussed would apply to other agencies.

Given flexibility in terms of the specific contracting approach taken by each agency, it is not certain that targets would necessarily raise overall project construction costs. Again this assumes that the targets are set at conservative levels in the initial years; and consider geography, transport distances, etc. There would however be an increase in compliance and reporting costs compared to current practice.

In the event that targets did result in higher construction costs there would be a reduction in total quantity of road works undertaken. In an environment where current road expenditure is not covering costs -- WALGA (2007) estimate the shortfall in expenditure maintaining the network was $120M in 2005-06 -- any further reduction in spending would be a concern. Ultimately these additional costs would be borne by the wider community.

Regarding demolition works, other than in terms of compliance, it is not clear that such a requirement would raise overall project costs. With competitive tendering and initial conservative targets that consider geography, impacts could be kept relatively low.

In terms of demolition works, as the requirement applies across all potential contractors, they are treated equally. Regarding suppliers of virgin and recycled material, the purpose of the regulation is to discriminate against virgin material suppliers in favour of suppliers of recycled product.

The approach compels a move away from virgin aggregates in favour of recycled material and so the extractive industries are clearly impacted negatively and recyclers positively. The extractive industry would see the approach as unfair. There is no information available on the extent to which additional compliance costs in demolition work would be passed on to government agencies. Where overall project costs are higher as a result of the regulation

---

As a general rule, the more inelastic the demand, the greater the pass through rate of additional costs to the final user. Depending on the nature of demand, pass through rates can be more than 100 percent.
approach, these costs will be ultimately be met by the wider community in terms of higher rates of taxation and rates.

Without additional resources it is likely that Main Roads WA and LGAs would view the additional costs they face in terms of compliance as unfair. The existence of zones where mandatory targets may differ across zones may create issues at the zone borders. These should not be substantial issues though.

**Clean fill variant**

The crushing of C&D waste to generate clean fill is not yet a substantive widespread activity. As the landfill levy rises in the coming years there is however a strong potential for the activity to grow in importance. The residential development sector, as a key destination for clean fill, is therefore likely to be disadvantaged by the change.

The regulation applies to all demolition companies equally, and so in this sense they are all treated equally.

The change would not have large incidence effects in the sense that it would stunt the potential development of an activity rather than cause a dramatic change in current activities. As it removes a potential business development opportunity for demolition companies there are however still incidence effects. Extinguishing an option, even if it is only an option, does have a real economic cost.

**5.4.3 Assessment against simplicity criteria**

A regulation based approach could be made to be simple, for example by setting a single target for diversion rates and a single target for content. Such an approach would however be a disaster in terms of efficiency. As such the assessment was based on the existence of about four metropolitan zones for targets and one regional zone, and the idea that the targets were well considered. The approach is therefore not simple.

To set meaningful initial targets requires details on the capacity of recyclers and their investment plans, and consultation with LGAs and Main Roads WA. The targets also need to be supported by substantial documentation and evidence so that the process is completely transparent. This could be a process that is not only costly, but also complex and lengthy.

There would be monitoring costs under the regulation based option. In terms of demolition activity, a condition of payment would be the provision of documentation outlining the volumes of material removed and where these volumes of material were sent. For road projects, contractors to both LGAs and Main Roads WA would need to provide evidence of both the total
quantity of aggregates purchased and the quantity of recycled material purchased. Such processes should not be especially costly to implement.

In the initial years, to ensure compliance, it would be necessary to establish rigorous and meaningful auditing processes. These costs could turn out to be a moderate expense.

The assessment of what an appropriate minimum recycled content requirement might be, for each zone, will change through time. There will therefore need to be a committee that considers what represents current best practice, and what is achievable in Western Australia. So that the process is transparent, the committee will have to weigh up the potential costs of any changes with their assessment of the benefits and set out the reasons for the changes. This could be a moderately cumbersome process.

A regulation based option would need to be supported by substantial new institutional architecture in terms of a body to set targets, revise targets, assess capacity, determine current best practice, conduct audits, and enforce compliance. Administrative capacity of market participants is however likely to be sufficient to deal with the extra requirements in tenders and the provision of suitable documentation on use and disposal.

Clean fill variant

The imposition of additional regulations that change the definition of clean fill so that it is only C&D waste that has been through a source separation process that can be used as clean fill would be relatively simple. Establishment costs for setting out such regulations would not be great.

For much large scale residential development in Western Australia the contaminated sites branch of DEC is already involved in monitoring clean fill material. As such, for large residential developments there would be few additional monitoring and auditing costs associated with the additional regulations. For smaller local developments such as sub-divisions, the contaminated sites branch is not necessarily involved. There would be additional costs involved to monitor clean fill at this level.

To ensure the regulation is serving the intended purpose, there would need to be periodic review of the regulations. Periodic review is however not likely to be an especially frequent or burdensome processes.

There would not need to be substantial changes to implement the regulation. As a practical matter there would need to be an education programme informing people of what can and can’t be included in clean fill, and what documentation they need to ask for before allowing material on to a site. In terms of penalties for non-compliance, these would need to be legislated. The
finances system that operates in NSW could however serve as a template for enforcement provisions.

### 5.4.4 Assessment against development criteria

The requirement for diversion ensures a minimum level of source material for the sector. The minimum content requirements ensure a minimum level of demand for material. As such the regulation option would appear to provide the basic conditions for industry growth and development. To a certain extent this is true. With the regulation option, provided regulation is maintained, there will be an industry based around the provision of recycled content materials for civil construction in Western Australia.

The sustainability of the industry is however completely dependent on regulation, which is a form of protection. In general, protection results in inefficient practices that hinder long-term development and productivity growth in the protected sector. With carefully designed tenders the potential negative impacts can be limited, but not entirely eliminated.

#### Clean fill variant

The clean fill variant would see a limit placed on the ability of demolition companies to develop businesses selling clean fill from C&D waste that has not been source separated. If would however ensure that suppliers producing specified recycled products would not be starved of source material. The potential for lightly crushed C&D waste to be used as clean fill has been explicitly identified as a factor limiting market expansion in WA by industry participants. The regulation will therefore be positive for market development.

### 5.4.5 Externality comments

The externality assessment is the same as under the modified status quo option. The landfill levy is assumed to appropriately capture the externality associated with inert waste going to landfill and site specific offsets are assumed to capture the externalities associated with quarrying. In both cases the cost of externalities are allocated using an impactor pays approach.

### 5.5 Overall outcomes approach

The project brief called for an assessment of an option based on the idea of maximum use of recycled content in civil construction projects and a policy of maximum on-site recycling and reuse, subject to a large number of caveats. The intent of the option as described in the brief can be captured much more succinctly and efficiently by considering the outcomes based assessment.
approach to projects. The outcomes based approach is set out and assessed below.

### 5.5.1 Establishing the basic design of the approach

**Basis of assessment**

Under the project outcomes based approach each construction project would be assessed against a range of criteria, not just the amount of recycled content material used or the proportion of material diverted from landfill. In the case of large civil works projects such as schools and hospitals, the pilot green star evaluation tools provide a ready template that could be adapted to form the basis of an assessment template for civil works. For roads projects, although there is no green star template to inform the development of a State assessment template, there is substantial material readily available from other sources that could be used.

**Assessment implications**

There would be a State-wide commitment to assess all civil construction projects greater than some threshold value using the assessment tools developed, where the stated objective is to receive the highest rating possible. There would not be a financial incentive or penalty relating to the assessment, but rather a process of disseminating information about projects that have achieved a high overall score. A central part of the information dissemination process would be a dedicated website that was updated regularly with details on the most recent projects completed, the tender processed used, and the results achieved. Although there would be no explicit financial implications relating to performance, the achievement of each LGA, government department, and agency would be a KPI that they reported against in their annual report.

**Green star ratings**

For the green star programme the assessments are out of 100, and there are effectively four bands of assessment. Less than 45 points and the project does not get a rating; 45 to 59 points and the project gets a best practice rating; 60 to 74 points and the project gets an Australian excellence rating; and 75+ points and the project gets a world leadership rating. It would make sense to use a similar approach for the assessment templates developed for WA.

**Updating benchmarks**

Over time the standards of achievement that represent world leadership, Australian excellence, and best practice will change. It will therefore be necessary to have an appropriate body review and update the targets from time-to-time to ensure that they remain meaningful.

**Audit process**

While it is not considered necessary to go to the same extent of audit as undertaken in the green star programme, to ensure integrity of the system a process of random audits would need to be part of the overall approach. The actual number of audits conducted could be determined with reference to the
total number of projects, appropriate statistical tables, and the level of certainty about compliance that the government wanted to establish.

5.5.2 A framework for roads

To understand how the system might work it is worth developing an illustrative case for roads. For road construction assessments, activities could be grouped together into several broad areas such as:

- Management
- Materials used
- Onsite recycling and reuse
- Energy, and
- Transport.

Within each broad grouping there would be potential for sub-groupings. In the case of the materials group the sub-groupings would probably be something like: steel, concrete, hot mix asphalt, and aggregates. In the case of the transport assessment the sub-groupings could be based around considering onsite transport and offsite transport separately, and could allow for such things as whether or not back loading trucks following materials delivery had been achieved at the site.

Although a 100 point scale is assumed, the specific scale for the total number of points available is largely irrelevant. The weighting given to different groups, sub-groups and the achievement of different targets within each sub-group, is however important. If the initial objective of the programme is to achieve increases in the use of recycled material, then the materials grouping can be given a relatively large weight.

The points allocated for achieving different targets within a specific sub-group do not have to increase linearly. For example, when considering the use of aggregates it might be possible to allocate 20 assessment points for achieving more than 90 percent use of recycled aggregates on a project, 10 points for achieving 70 percent use of aggregates, 5 points for achieving 50 percent usage, and no points for anything less than 50 percent.

It is assumed that over time the standards would be reviewed. During the review process it would be possible to adjust the weighting structure to emphasise different aspects.

Financial incentive variant

The variant considered is one based around the provision of funds to organisations that achieve the best outcomes overall, or excellence in a particular area. The basic elements and issues with such a programme would
not be dissimilar to the details outlined earlier for the rebate scheme in the modified status quo section. In brief the essential features of such a programme could as follows:

- The source of funds would be the Waste Management Recycling Account
- Funds awarded would be untied funds
- The programme would consider regional and urban projects separately
- The total amount available each year would be several million
- There would be multiple awards each year.

5.6 Overall outcomes approach assessment

The below discussion sets out the assessment of the outcomes based approach against each of the criteria

5.6.1 Assessment against efficiency criteria

In terms of allocative efficiency the assessment is similar to that outlined under the modified status quo assessment where the externality associated with landfill and the extraction of virgin materials is captured by the landfill levy and site specific offsets. Additionally, it is worth recalling that all the assessments assume that other key externality costs, such as those associated with energy consumption, will be priced appropriately in the near future. These assumptions mean that in all cases the assessments are made on the understanding that the social cost equals the private cost.

The outcomes approach involves considering each aspect of the project and assessing whether or not there are alternative approaches. If there is an alternative approach, then comparisons about the benefit of each outcome must be made. The approach therefore encourages constant consideration of whether or not resources are being allocated in a way that maximises society welfare. The question of allocative efficiency is therefore one that is constantly assessed with such an approach.

Unlike the case with mandatory targets, there is no explicit interference regarding the pursuit of a least cost approach at any organisation. Each project is assessed and evaluated in light of the latest information available. If progress is made in some specific area at one LGA, this information will be distributed to others via the website. Each organisation will then have the freedom to act and make changes in that specific area of assessment. The constant provision of information and posting of latest assessments will provide constant information on a range of issues including options that generated savings. The outcomes based approach, as defined in this assessment, therefore performs well in terms of productive efficiency.
In terms of dynamic efficiency the outcomes based approach performs well. Under the approach each construction project is assessed and details of the project assessment and processes used in the call for tenders are publicised. Details relating to current best practice will therefore spread quickly. As those issuing tenders are assumed to be constantly looking for improvements so that they can achieve higher ratings, recyclers know that if they are able to innovate they will be rewarded with new business. Furthermore, as details of what was achieved by a particular recycling company spread, these innovations will be adopted by others. Because the approach involves the provision of more information it encourages a more competitive market. Competition in turn encourages innovation.

**Financial incentive variant**

In terms of allocative efficiency, similar to the discussion under the modified status quo assessment, the impact of the financial incentive rests on assumptions about the up-take of new practicies by LGAs and other agencies. As outcomes are reportable, even without a financial incentive, uptake of new methods and practices should be strong. The financial incentive option is therefore unlikely to have a significant impact on allocative efficiency.

As with any financial programme that uses funds from the Waste Management and Recycling Account, the opportunity cost must be explicitly considered. It is clearly possible for there to exist higher value uses for the funds.

Within an outcomes based approach, it is unlikely that any agency or LGA would deviate from the approach they would have otherwise taken simply because of the chance they may receive additional funds from a specific award pool of funds, unless the pool was especially large. As it is assumed the fund is not especially large, the variant has no implication for the assessment under productive efficiency.

The incentives for innovation and investment would be fundamentally unchanged under the financial awards variant, and so again there is no change to the assessment under dynamic efficiency under the financial incentive variant.

**5.6.2 Assessment against equity criteria**

There would be additional costs in terms of reporting under the option, and without recognition of the additional costs imposed to administer the system, departments, government agencies, and LGAs may face financial difficulties meeting the reporting and assessment costs. As action is not mandated, there are no further ability to pay related issues.
Issues related to horizontal equity consider the treatment of potential contractors and source suppliers of virgin and recycled content material. The outcomes based approach is flexible and allows for a great many strategies, including targets, relationship contracting, dual tender processes etc., to be considered. It is therefore difficult to evaluate the option in terms of horizontal equity. What can be said about the approach is that a common reference framework is established and that all market participants know and work within that framework.

As the approach sets an overall framework of assessment, a dramatic sudden change in behaviour is unlikely. Rather, as information is disseminated, change will be gradual. To the extent that change is gradual, and associated with well publicised examples, incidence effects should be muted. Compliance cost could however be substantial. Placing additional compliance costs on departments, agencies and LGAs without providing additional resources will be seen as unfair by those affected.

5.6.3 Assessment against simplicity criteria

Developing the assessment templates and carrying out the evaluations, even if they are less rigorous than the current green star evaluations, is unlikely to be a simple process. To be meaningful the assessments must be appropriately constructed. Considerable detail on what constitutes a best practice rating, an Australian excellence rating, and a world leadership rating will therefore need to be collected and documented prior to establishing the scheme.

Substantial effort and resources will also need to be devoted to both explaining the assessment process and training staff in how to conduct an evaluation.

Project monitoring costs are directly related to the audit process established. The more rigorous the audit process, the higher the acceptance of the ratings, but the higher the cost. There are also substantial evaluation costs associated
with completing an assessment of each project and lodging that information centrally.

The passage of time

As what constitutes best practice, excellence, and world leadership will be constantly evolving, the scores for performance in each area of assessment will need to be adjusted periodically. A biennial process would probably be appropriate. Each review would need to consider a substantial amount of information, but the database of assessed projects would mean that much of the material needed for the review would be at hand.

Implementation

The approach implies a substantial deviation from current practice, and the need for a wide range of new institutional arrangements. Notwithstanding that some government department follow the green star approach, it is far from clear that LGAs, departments, and government agencies would have the capacity to perform all the new tasks required of them without substantial transitional funding. The co-ordination of the implementation of a comprehensive outcomes based approach would be a substantial undertaking, requiring extensive communication and consultation across all those impacted by the change.

Financial incentive variant

To introduce a financial incentive scheme would add a further complexity to the approach. Although given the scale of change implied by the approach, the additional complications with an award fund would not be that great.

Simplicity

With the award of funds comes a greater need for certainty and audit. Projects that were acknowledged under the funding programme would need to be assessed to a high level, and so monitoring costs would be higher under the proposed variant.

Monitoring cost

The relevance of the programme, the appropriateness of the funding level, and the impact of the programme would need to be evaluated periodically. To the extent that additional decisions need to be made about funding, complexity is added. The complexity added is however not especially large.

Simplicity and time

The process would be more involved than the simple rebate scheme described in the modified status quo assessment and past schemes would not provide a ready template for the programme. The assessment process and subsequent awards would not necessarily be based simply on the projects that received the highest score, but could involve acknowledging excellence in a particular area. The effect of the variant is therefore to further increase the implementation burden.
5.6.4 Assessment against development criteria

The outcomes based approach performs well in terms of the incentives it provides for business. Although it does not compel the removal of barriers to the provision of recycled products in civil construction it does require all those involved in issuing tenders for works to assess options for increasing their use of recycled products. There is no explicit interference with price signals and so where businesses are able to establish themselves they are likely to be viable businesses long term.

Unlike other approaches, the comprehensive nature of the assessment process means that no matter where the opportunity for improvement in using recycled products arises, entrepreneurs can fully pursue the opportunity safe in the knowledge that market participants are conditioned to consider innovative new processes and products. The option therefore creates an environment that encourages investment, innovation, and development.

The website, as a means of information distribution about practices and innovation should lead to a continual re-evaluation of what can be achieved, and so should add to competitive pressures to innovate.

Financial incentive variant

Under the financial incentive variant there is no change to the dynamic efficiency assessment.

5.6.5 Externality issues

For both the basic overall project outcomes based approach, and the proposed variant of providing a financial reward for achieving excellence, the cost of externalities are allocated under an impactor pays approach. The landfill levy captures the externality associated with inert waste going to landfill; and site specific offsets capture the externalities associated with quarrying.

5.7 Price based options

Regarding price based options, in the context of waste management more generally, the Productivity Commission (2006, p. 227) concluded that:

…the current practices of using (and increasing) landfill levies to generate revenue, and the pursuit of selected landfill diversion targets, are likely to impose net costs on the community. They also may have some perverse consequences, such as increased illegal disposal and costly evasion behaviour.

It is however important to note that the Commission was considering all waste streams, and while the usefulness of a landfill levy is questionable when considering the municipal waste stream, the Productivity Commission
Civil Works and Recycled Content

acknowledges the success of the UK landfill levy in terms of increasing diversion rates for inert waste reported in Martin and Scott (2003) and discussed previously in this report.

Without entering into a substantial discussion about taxation, it can be noted that taxes can be levied to:

- raise revenue to fund the agreed functions of the state
- address circumstances of market failure, and
- change behaviour.

In this instance we are concerned with taxes aimed at changing behaviour.

5.7.1 The three arms of the price based approach

While grouping the three price based approaches together, they actually represent three different, but related options. The specific price based approaches assessed are:

- Additional increases in the landfill levy
- The introduction of a virgin aggregates tax
- Implementation of a bond system for all demolition works.

To conduct an assessment of each option it has been necessary to make some assumptions about how each approach will work. The assumptions for each approach are set out below.

To be worth consideration as an option the assumed increase in the levy must be substantially greater than the level that captures the externality costs associated with landfill. As an indicative range the assessment assumes a total levy of between $15 and $20 per cubic meter of inert waste sent to landfill. As is current practice the levy funds would be hypothecated and go to the Waste Management Recycling Account.

As with the landfill levy, to make the option of a virgin materials tax worth considering as a standalone option, the rate the tax is set at must be non-trivial. Here it is assumed that the tax is set at a rate of between $2 and $4 per tonne of material. An additional question relates to the materials the tax would apply to. The tax could potentially apply to sand, gravel, limestone, clay, and hard rock. Here we assume the tax does not apply to clay, but does apply to sand, gravel, limestone, and hard rock. With respect to limestone it is assumed that there are exemptions from the tax for higher value uses such as limestone used in the production of cement and limestone blocks used for paving or retaining walls etc. It is assumed that the liability for the tax arises at the point the product is sold. Rather than go to consolidated revenue it is thought that the
funds generated by way of the tax would flow into the Waste Management Recycling Account.

The bond approach requires a financial bond to be lodged at the time planning approval is given for demolition works. It is assumed that there are two basic bond sizes, one applying to small building/demolition works, and another applying to all other building/demolition works. While there are only two bond amounts, it would be possible to use multiple zones when setting diversion rate targets. At a minimum it would be necessary to set different targets for urban and non-urban, but there could be as many urban zones as there are LGAs. As indicative figures for the size of bonds payable $2,000 might be an appropriate figure for small works, and $10,000 for large works.

So that the bond did not turn into simply another charge it is expected that there would be a role for a central planning agency in setting the diversion rates. To receive a full refund of the bond demolition and building companies would need to provide evidence in the form or receipts from registered recyclers of the volume of material disposed of by different means. Failure to meet the required target would involve forfeiting part or all of the bond, depending on actual performance. A simple sliding scale could apply up to some threshold where the entire bond would be lost. As with the other price based options, it is assumed the funds generated from the system are directed to the Waste Management Recycling Account.

Across all three approaches it is assumed that the charges apply only in the metropolitan area, at least initially.

### 5.8 Price based approach assessment

The below discussion sets out the assessment of each aspect of the price based options against each of the criteria. To make the comparisons across the different price based approaches easier, for each element of the assessment each option is assessed sequentially. For example, under efficiency the levy option is assessed in terms of allocative efficiency, productive efficiency, and dynamic efficiency before moving on to the aggregates tax and assessing the tax on each element etc.

In the sidenote sub-headings, levy is used to indicate discussion of the higher landfill levy option; tax is used to indicate discussion of the virgin aggregates tax; and bond is used to indicate discussion of the diversion bond approach.

#### 5.8.1 Assessment against efficiency criteria

Where the marginal social cost is equal to the private cost, provided the market is competitive, market forces will result in prices being set so that resources are
devoted as consumers would wish. Raising the levy substantially above the level that captures the externality impacts therefore results in a deviation from allocative efficiency. The higher the levy the greater the deviation from allocative efficiency.

**Productive efficiency – levy**

The levy represents a wedge between the full market price of landfill (including the externality effect) and the price faced by those wanting to send material to landfill. Demand will therefore not be met at least cost. A substantial increase in the landfill levy also has the potential to reduce the price competition among recyclers in terms of tipping fees.

**Dynamic efficiency – levy**

The levy is high and applies to all material sent to landfill. There is therefore a strong and constant incentive to divert material away from landfill and to recyclers. A high levy also provides a strong incentive for recycling firms to invest in new plant.

**Allocative efficiency – tax**

A general criticism of a uniform tax such as this is that unless external environmental impacts from quarrying are directly proportional to scale, which is not likely, the tax is not well suited to capturing the impacts of externalities. Here it is assumed that local site specific offsets are used to deal with the externality issues associated extractive industries. A virgin material tax would not be able to reflect localised conditions and impacts, but it is not meant to do this. The tax is aimed at altering behaviour not dealing with market failure. As is the case with the levy, the higher the virgin materials tax, the greater the overall deviation from allocative efficiency.

**Productive efficiency – tax**

The effect of a virgin material tax would be more wide-spread than for the levy. The tax would not affect just civil construction but would also impact upon residential construction costs.

**Dynamic efficiency – tax**

The tax would increase the cost of virgin aggregates relative to recycled aggregate products. This is positive for the recycling industry and so would provide a signal to invest.

**Allocative efficiency – bond**

As discussed in a limited way with respect to the regulation assessment, to the extent that demolition sites currently do not source separate and send material to recyclers, resources are potentially not put to their best use. If it is correct that source separation can be undertaken at either no or a very low extra cost, then the bond will result in source separation and material being recycled. The bond system therefore holds out the possibility of an improvement in allocative efficiency. Impractically high targets could however result in a reduction in allocative efficiency. Unlike the regulation option the extent of this potential reduction in allocative efficiency is capped by the level of the bond.
Under the regulation option it was assumed that some level of diversion was made mandatory in government tenders. Under the regulation assessment it was noted that mandatory diversion may reduce the price competition among the various recyclers, and so reduce the possibility of achieving least cost outcomes. The assessment of the bond system is similar, except that the size of the bond places a limit to any relaxation in competition.

The bond would increase the flow of material to recyclers and provide them with some certainty regarding supply. The bond system alone does not however address the issue of who will purchase the products produced by recyclers. The incentive to invest ultimately rests on being able to sell product, while competition is the driver for innovation. The bond system therefore performs less well than the other two price approaches in terms the incentive to invest and innovate.

### 5.8.2 Assessment against equity criteria

**Ability to pay – levy**

The increase in the cost of landfill has the potential to raise the cost of projects involving demolition works, where the most cost effective arrangement is to send the material to landfill. Ability to pay and potential disadvantage to departments and government agencies is however unlikely to be significant.

**Horizontal equity – levy**

The levy is set at a rate above the externality cost of sending material to landfill. This favours recyclers and disadvantages suppliers of virgin products. The extent of the advantage is directly proportional to the size of the levy, but the discrimination against suppliers of virgin material suppliers is indirect and opaque.

**Incidence – levy**

The additional costs associated with landfill will be shared between the demolition companies and the all users of their services. Some demolition companies will, in the face of higher charges, move to source separation and supply material to recyclers rather than pay the higher cost of sending material to landfill. To the extent that source separation is not a significant additional expense the total incidence related costs to share may not be that great.

**Ability to pay – tax**

A virgin material tax will impact all users of virgin material in construction projects, and there is the potential for the tax to create noticeable ability to pay problems in the residential housing sector. Across the government sector, given the large scale nature of purchases, and competition from recycled material suppliers, ability to pay issues are not always going to be significant.

It is however worth noting that the volume of aggregate used in some large road works projects will not be able to be met from recycled sources. As such, some users of aggregate, such as Main Roads WA, are likely to have no option...
but to continue to source material from virgin sources and so face higher costs regardless of whether or not they want to change suppliers.

**Horizontal equity – tax**

Under the virgin material option the discrimination is explicit and direct. As with the levy, the deviation in terms of horizontal equity across suppliers of material is directly related to the size of the tax.

**Incidence – tax**

Firms operating in the extractive industries are undoubtedly the firms most affected by the change, and will see the additional tax as unfair. The other area that would potentially face significant additional costs would be residential development sector. Across individual firms it is also likely that larger firms would be better equipped to deal with the implementation issues than small and medium sized firms.

**Ability to pay – bond**

Lodgement of a bond would place an additional financial strain on demolition companies. Depending on the volume of work undertaken, the amount of working capital tied up in bonds could be large. Even if firms separate material on-site and supply recyclers so that they receive the full bond at the completion of each project, holding money with LGAs as bonds is an additional business cost.

**Horizontal equity – bond**

All demolition companies are treated equally. Those with a relatively strong balance sheet may however gain an advantage.

**Incidence – bond**

It is building and demolition companies that face additional costs and they will see the imposition of the bonds as unfair. To the extent that under a bond system companies can change their behaviour and receive a full refund of the bond, the wider community may see the bond system as a reasonable approach.

### 5.8.3 Assessment against simplicity criteria

**The levy is simple to implement**

As it is an adjustment to an existing levy, the approach is simple to implement. No complex new arrangements or institutions are required, and only regulations would need to be varied. To ensure the impact of the levy is maintained indexation would be required, but this too is a simple process. All other process relating to monitoring and audit are already established.

**Simplicity – tax**

The virgin materials tax could be structured so that the actual operation and monitoring aspects of the tax are relatively straightforward. Firms would presumably be required to register and then they would lodge (quarterly) returns on volumes sold.

**Implementation - tax**

Unlike during the operation phase, the actual introduction of the tax would be a relatively complex and expensive matter. Negotiation would be required with participants in the extractive industry, and care would need to be taken in
drafting appropriate exemptions for relatively high value uses of virgin products.

Unlike the situation for the levy, new legislation would be required. New tax collection architecture and processes would need to be developed and put in place. So, although once set up the process might work relatively smoothly, establishment costs for the approach would be substantial. The British aggregates industry has argued that the establishment costs imposed on industry were substantial following the introduction of a similar tax in the UK. It is however necessary to be cautious in accepting at face value the view of British industry representatives on this matter.

Monitoring and audit – bond

Under the bond approach monitoring and audit cost would exist, but would not seem to be excessive.

Implementation - bond

Local government planning approval and building license fees are regulated by the Town Planning (Local Government Planning Fees) Regulations 2000 and Building Regulations 1989 (Part 6 – Fees).

In addition to its own fees, each local government is required to collect the following levies as part of the building licence approval process:
- Building and Construction Industry Training Levy Regulations 2001 training levy
- Builders Registration Act 1939 (Section 4B Building License Fee).

The bond system would need to be embedded into the existing legislation governing buildings, and this could be a somewhat involved process.

In addition to the legislative change required, the option places additional requirements on demolition contractors and LGAs. Although the additional responsibilities are not excessive, the additional cost imposed on local governments would need to be recognised.

5.8.4 Assessment against development criteria

A substantial increase in the landfill levy would send a strong price signal that material should be diverted from landfill to recyclers. Indexation would ensure the price signal was not diminished through time. In NSW the charge for landfill is significantly above that required to cover externality costs and in NSW the recycling market is well developed. On balance it therefore seems reasonable to suggest that with a landfill levy set at a rate significantly higher than that required to cover the cost of the externality associated with landfill, the market for recycled material in WA would develop strongly.

The tax would affect all construction projects. As such it is not just the civil construction sector that would be looking at the source of basic materials but all construction sectors. The British aggregate industry argues that the UK tax
has not seen a significant move towards greater use of recycled products, and that the shift towards recycled aggregate use that has taken place in the UK followed the earlier introduction of the landfill charge in 1997. Overall, the international evidence discussed earlier in the report indicated that virgin aggregates taxes have not been especially successful in encouraging market development.

**Bond development summary**

The contribution the bond system would make to development of the recycling industry in Western Australia is in part similar to that outlined in the regulation assessment. It would encourage building and demolition companies to source separate material and send this material to recyclers which would in turn help them grow their businesses.

**Revenue advantage**

A final consideration relating to all three approaches concerns revenue. The amount of revenue collected under the different options would not be the same, but to the extent that additional revenue is generated under each approach, and that this revenue is hypothecated, the price based options generate revenue that can be used to further encourage the use of recycled material in construction projects.

**5.8.5 Externality issues**

All three price based options consider charges in excess of those required to cover the externalities associated with the extraction of raw materials and sending material to landfill. With the landfill levy and the virgin aggregates tax the impactor pays more than the cost of the externality. With the bond approach, impactors potentially may pay more than the cost of the externality.

**6 Option overview**

The assessment of each option presented in the previous chapter was relatively detailed. It is therefore worth stepping back from the detail and comparing the overall performance of the different options. As a means of summarising the detail presented in the previous chapter a comparison table has been prepared. In the table good assessments are shaded in a light aqua colour; medium assessments are shaded a medium blue; and poor assessments are shaded a dark blue. The assessments are based on a qualitative consideration of the issues involved, as discussed in the previous section.

In the table no consideration is given over to the relative importance of each of the criteria. It is therefore not possible to read down the table and make a determination regarding which approach is best based simply on which option has the greatest number of light blue squares. Nor is it possible to simply take an average across cells and say a score of good against one criteria and a score of poor on another criteria gives an average of a medium score. Ultimately, the
choice between the options and their variants will reflect the weight attached to individual criteria, and the timeframe under consideration.

The criteria sub-headings in the summary table generally match closely with the headings and descriptions used throughout the report. The dynamic efficiency assessment has however been presented under two heading, incentives for investment, and incentives for cost discipline.

The final point to recall about the assessments is that assumptions have to be made, and that alternative assumptions would lead to different assessment scores. For example, under a regulation based approach, if the mandatory recycled content target was set at a high level, and without consideration of geography, there would be significant ability to pay issues, and so the assessment for ability to pay for the regulation options would necessarily be poor. It is however assumed that care is taken in setting the targets; that the targets are set at conservative levels in the initial years; and that geography is an explicit consideration when setting targets. Under these assumptions the actual assessment under ability to pay and disadvantage for the regulation option is medium.

6.1 Revised status quo summary assessment

In general the revised status quo option performs well across the various efficiency criteria. The incentives for investment under the option are appropriate, but as the incentive is not as strong as under some of the other scenarios, the rating is medium rather than good. The rebate option has a mild negative impact across all aspects of the efficiency assessments, except the incentive for investment, where it is thought to have a mild positive impact.

The option performs well in terms of the equity assessment. This is because the only compulsion that forms part of the approach is the removal of explicit restrictions on product use across LGAs. The rebate programme changes the assessment little. The lower rating for incidence and distributional effects with the rebate scheme flows from the potential for distributional effects in terms of potential disadvantage for rural LGAs. With specific compensating programmes for rural LGAs these effects could be made small.

As the approach involves minimal change to existing arrangements it is a simple approach. No new institutions are required and the only ongoing monitoring cost relates to the indexation of the levy. Implementation issues are not a problem. The rebate variant adds a layer of administration, and requires new arrangements to be established for the scheme to operate. Past experience with similar systems means that these costs are not likely to be overwhelming; hence the assessment of medium for both new institutions
required and administration burden, and good/medium for implementation impacts.

The revised status quo is positive for market development, and this needs to be recognised. The increase in the levy and the removal of explicit barriers will see the market for recycled content material grow. Other options do however provide more explicit incentives for market development, and so the assessment under market development is set at medium. To the extent that the rebate scheme would signal government intent and may increase LGA experimentation with recycled aggregate products, it improves the assessment under market development.

### 6.2 Regulation based approaches summary assessment

The regulation approach introduces the possibility of substantial deviations from both allocative efficiency and productive efficiency, and so has a poor assessment under these assessments. The clean fill variant has the potential to improve allocative efficiency, and so partly offset some of the negative impacts of the other regulations. Under both options there are strong incentives for investment by recyclers, but poor incentives for cost discipline.

Issues relating to ability to pay and disadvantage could be significant. The assessment assumes that care is taken in setting the initial targets and so while there will be higher reporting and administration costs, additional construction costs should be modest. Although all demolition companies are treated equally, the intent is to discriminate against virgin material suppliers. Any additional costs faced by LGAs and Main Roads WA would be seen as unfair by these organisations. Relative to some of the other options the assessment in terms of horizontal equity and incidence and distribution effects is therefore not especially positive.

The approach is less simple than some other options, and potential for geographic boundaries to cause confusion was noted as a potential issue. The impact of boundary issues are however unlikely to be significant enough to detract from an assessment of good under transparency and understandability. Provided there is an education campaign about the new clean fill regulations, these additional regulations would not impact on the assessment under transparency and understandability. The approach would require significant new institutional infrastructure and also involve significant monitoring and auditing costs. The clean fill variant would require additional legislation for fines and related matters, and so receives a lower assessment than the basic option under new institutions. The approach would place additional demands
on the capacity of organisations to implement the approach and some organisation will be better equipped than others to meet these challenges.

The content requirement would underpin demand for product and the diversion requirement would underpin the supply of new material. The additional regulations on clean fill would be a further positive for market development. Both options would see strong market development. It is however necessary to point out that in such a scenario the industry is underpinned not by competitiveness, but by regulation.

6.3 Outcomes based approaches summary assessment

Both the basic outcomes approach and the financial incentive variant perform very well in terms of all the efficiency criteria. Those involved in each construction project are encouraged to consider allocative efficiency for each stage of the project. There is no compulsion to take a specific approach, and so productive efficiency can also be achieved. The environment created in terms of constantly considering new approaches within a framework of minimising the environmental impact is an environment that encourages firms to invest in new products. As there is no regulated or mandated approach, competition is not reduced, and so incentives for cost discipline are maintained.

The approach is not based on compulsion and so there are no substantial equity issues. The slightly lower assessment for the financial incentive variant under incidence and distributional effects reflects the possibility for regional LGAs to be disadvantaged. The design of the financial rewards could be such that this impact is minimised.

The approach would represent a substantial shift in thinking and approach from current practice. Project assessments are involved, and as they concern all aspects of the construction process they are not simple and easily understood. Not only does the approach require significant new institutional infrastructure, but ongoing assessments are also required. The capacity at organisations to implement the approach is also likely to be lacking. Both the standard option and the financial incentive option are therefore rated as poor under all of the simplicity criteria.

The approach would be very positive for market development. The approach would see a step change in attitude whereby issues such as recycled content are a constant consideration in all government civil construction projects. In such an environment innovation and market development would be strongly encouraged.
### Overall option assessment summary table

<table>
<thead>
<tr>
<th></th>
<th>Revised status quo</th>
<th>Regulation approaches</th>
<th>Outcomes based approaches</th>
<th>Price based options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic revised status quo</td>
<td>Variant: recycled content rebate</td>
<td>Content and diversion regulations</td>
<td>Variant: new clean fill regulations</td>
</tr>
<tr>
<td><strong>Efficiency criteria</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allocative efficiency</td>
<td>Good</td>
<td>Good/medium</td>
<td>Poor</td>
<td>Medium</td>
</tr>
<tr>
<td>Productive efficiency</td>
<td>Good</td>
<td>Good/medium</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Incentives for investment</td>
<td>Medium</td>
<td>Good/medium</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Incentives for cost discipline</td>
<td>Good</td>
<td>Medium</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Equity criteria</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability to pay and disadvantage</td>
<td>Good</td>
<td>Good</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Horizontal equity</td>
<td>Good</td>
<td>Good</td>
<td>Medium/poor</td>
<td>Medium/poor</td>
</tr>
<tr>
<td>Incidence and distributional effects</td>
<td>Good</td>
<td>Good/medium</td>
<td>Medium/poor</td>
<td>Medium/poor</td>
</tr>
<tr>
<td><strong>Simplicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transparent and understandable</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Low ongoing administrative burden</td>
<td>Good</td>
<td>Medium</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>New institutional infrastructure required</td>
<td>Good</td>
<td>Medium</td>
<td>Medium/poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Implementation impacts</td>
<td>Good</td>
<td>Good/medium</td>
<td>Medium/poor</td>
<td>Medium/poor</td>
</tr>
<tr>
<td><strong>Development</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market development effect</td>
<td>Medium</td>
<td>Good/medium</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>
6.4 Price based options summary assessment

Both the tax and the levy, because they are set so as to be above the externality cost, perform poorly in terms of allocative and productive efficiency. They also perform relatively poorly in terms of the incentive for cost discipline. Under such arrangement there would however be a strong incentive for recyclers to invest in new plant and equipment.

The bond system assessment is slightly different. In terms of allocative efficiency, depending on the target diversion rate, there is potential for a wide range of outcomes. Given the assumption that care is taken when setting the targets, the assessment is set at medium. The bond dollar amount puts a limit on the extent of the diversion from productive efficiency possible, and so caps the reduction in the incentive for cost discipline. As such, the approach scores better than the other price options in these two areas. The incentive for investment is however less direct and less strong under the approach.

Ability to pay issues are likely to be modest under both the bond approach and the levy system. The aggregates tax impacts all construction activity and so has much greater potential to impact total construction costs than the other approaches. The assessment scores reflect that the extent of discrimination against suppliers of virgin material is greatest under the aggregates tax, followed by the levy, and then the bond system. Those impacted are all likely to view the approach as unfair. Under the aggregates tax approach there are however likely to be added distributional impacts across firms of different size.

Either a levy or a tax, where they are based on weight, is simple to understand. The demolition bond system, where targets vary across regions, is readily comprehensible, but less so than a straight per unit tax or levy. The levy would build on existing institutions and arrangements, and so also performs well on the remaining simplicity assessments. Once established, the bond system and the tax system both involve modest extra administration processes. The establishment costs for both the tax and the bond system would be substantial, and this is reflected in the assessment score.

The stimulus to the market for recycled material is strong under both the levy and tax option. As the bond system works more indirectly than the other price based options, the impact of the demolition bond is less pronounced, but still a strong positive.
Appendix: Main Roads WA Technical Specifications for materials

Box 6  
Extract of crushed recycled concrete Sub-Base requirements

501.92 CRUSHED RECYCLED CONCRETE SUB-BASE

501.92.01 GENERAL

1. The material shall consist of a uniformly blended mixture of coarse and fine aggregate resulting from the crushing of recycled concrete from construction and demolition waste. This material shall be used as sub-base material only.

2. Coarse aggregate (retained on 4.75mm sieve) shall consist of hard durable angular fragments and shall not break up after wetting and drying. Foreign material content shall be limited to the values shown in Table 501.05.

<table>
<thead>
<tr>
<th>Material</th>
<th>Maximum % Retained by Mass on 4.75mm Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Density Materials (brick, glass, etc)</td>
<td>15</td>
</tr>
<tr>
<td>Low Density Materials (plastic, plaster, etc)</td>
<td>3</td>
</tr>
<tr>
<td>Wood and other vegetable matter</td>
<td>1</td>
</tr>
</tbody>
</table>

3. Fine aggregate (passing 4.75mm sieve) shall consist of crushed material or crushed material and sand with similar durability properties to that of the coarse aggregate.

501.92.02 PARTICLE SIZE DISTRIBUTION

1. The particle size distribution shall be determined in accordance with Test Method WA 115.1, and shall conform to the limits given in Table 501.06. The grading of material passing the 37.5mm sieve shall vary from coarse to fine in a uniform and consistent manner. It shall not be subject to extreme or near extreme percentages of gradation represented by the maximum and minimum limits from the various sieve sizes.

<table>
<thead>
<tr>
<th>AS Sieve Size(mm)</th>
<th>% Passing by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5</td>
<td>100</td>
</tr>
<tr>
<td>19.0</td>
<td>71 – 100</td>
</tr>
<tr>
<td>4.75</td>
<td>36 – 65</td>
</tr>
<tr>
<td>0.075</td>
<td>2 – 14</td>
</tr>
</tbody>
</table>

501.92.03 OTHER ACCEPTANCE LIMITS

5. The material shall also conform to the following limits given in Table 501.07 when tested in accordance with the listed Test Methods:

<table>
<thead>
<tr>
<th></th>
<th>% Passing by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>Limits</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Los Angeles Abrasion Value</td>
<td>45.0% Maximum</td>
</tr>
<tr>
<td>Liquid Limit (Cone Penetrometer)</td>
<td>45% Maximum</td>
</tr>
<tr>
<td>Linear Shrinkage</td>
<td>4.0 Maximum</td>
</tr>
<tr>
<td>California Bearing Ratio (CBR)</td>
<td>50% Minimum</td>
</tr>
</tbody>
</table>

501.92.04 STOCKPILING AND MOISTURE CONTENT

1. Crushed recycled concrete sub-base material shall be pre-wet to within 95% to 110% of the optimum moisture content as determined from Test Method WA 133.1 or WA 133.2 as appropriate. The moisture content shall be determined in accordance with Test Methods WA 110.1.

2. Crushed recycled concrete sub-base material and water shall be thoroughly mixed using a pugmill or any other alternative approved method to produce a homogeneous product suitable for placement in the final position.

Data source: Main Roads WA Specification 501 Pavements [last revisions 25 January 2008]

Box 7 Extract of crushed recycled concrete Basecourse requirements

501.94 CRUSHED RECYCLED CONCRETE BASECOURSE

501.94.01 GENERAL

1. The material shall consist of a uniformly blended mixture of coarse and fine aggregate resulting from the crushing of recycled concrete from construction and demolition waste.

2. Coarse aggregate (retained on 4.75mm sieve) shall consist of hard durable angular fragments and shall not break up after wetting and drying. Foreign material content shall be limited to the values shown in Table 501.23.

3. Fine aggregate (passing 4.75mm sieve) shall consist of crushed material or crushed material and sand with similar durability properties to that of the coarse aggregate.

<table>
<thead>
<tr>
<th>TABLE 501.23 LIMITS OF FOREIGN MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
</tr>
<tr>
<td>High Density Materials (brick, glass, etc.)</td>
</tr>
<tr>
<td>Low Density Materials (plastic, plaster, etc.)</td>
</tr>
<tr>
<td>Wood and other vegetable matter</td>
</tr>
<tr>
<td>Asbestos</td>
</tr>
</tbody>
</table>

501.94.02 PARTICLE SIZE DISTRIBUTION

1. The particle size distribution shall be determined in accordance with Test Method WA 115.1 and shall conform to the limits given in 501.24. The grading of material passing the 26.5mm sieve shall vary from coarse to fine in a uniform and
consistent manner. It shall not be subject to extreme or near extreme percentages of gradation represented by the maximum and minimum limits from the various sieve sizes.

501.24 PARTICLE SIZE DISTRIBUTION (CRUSHED RECYCLED CONCRETE FOR BASECOURSE)

<table>
<thead>
<tr>
<th>AS 1152 Sieve Size (mm)</th>
<th>% Passing by Mass Target Grading</th>
<th>% Passing by Mass Target Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.5</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>19.0</td>
<td>100</td>
<td>95 – 100</td>
</tr>
<tr>
<td>9.5</td>
<td>70</td>
<td>59 – 80</td>
</tr>
<tr>
<td>4.75</td>
<td>50</td>
<td>41 – 60</td>
</tr>
<tr>
<td>2.36</td>
<td>37</td>
<td>29 – 45</td>
</tr>
<tr>
<td>1.18</td>
<td>26</td>
<td>20 – 35</td>
</tr>
<tr>
<td>0.600</td>
<td>19</td>
<td>13 – 27</td>
</tr>
<tr>
<td>0.425</td>
<td>16</td>
<td>10 – 23</td>
</tr>
<tr>
<td>0.300</td>
<td>13</td>
<td>8 – 20</td>
</tr>
<tr>
<td>0.150</td>
<td>10</td>
<td>5 – 14</td>
</tr>
<tr>
<td>0.075</td>
<td>8</td>
<td>3 – 11</td>
</tr>
</tbody>
</table>

501.94.03 OTHER ACCEPTANCE LIMITS

1. The material shall also conform to the following limits given in Table 501.25.

<table>
<thead>
<tr>
<th>Test</th>
<th>Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid limit</td>
<td>35.0% Maximum</td>
<td>WA 120.2</td>
</tr>
<tr>
<td>Linear Shrinkage</td>
<td>3.0% Maximum</td>
<td>WA 123.1</td>
</tr>
<tr>
<td>LA Abrasion</td>
<td>40% Maximum</td>
<td>WA 220.1</td>
</tr>
<tr>
<td>Maximum Dry Compressive Strength</td>
<td>1.7MPa Minimum</td>
<td>WA 140.1</td>
</tr>
<tr>
<td>California Bearing Ratio (Soaked 4 days) at 98% of MDD and 100% of OMC</td>
<td>100% Minimum</td>
<td>WA 141.1</td>
</tr>
<tr>
<td>Unconfined Compressive Strength (UCS- 7 days cured and 4 hours immersed)</td>
<td>0.6MPa to 1.0MPa</td>
<td>WA 143.1</td>
</tr>
</tbody>
</table>

501.94.04 STOCKPILING AND MOISTURE CONTENT

1. Crushed recycled concrete basecourse material shall be pre-wet to within 95% to 110% of the optimum moisture content as determined from Test Method WA 133.1 or WA 133.2 as appropriate. The moisture content shall be determined in accordance with Test Methods WA 110.1.

2. Crushed recycled concrete basecourse material and water shall be thoroughly mixed using a pugmill or any other alternative method approved by the Superintendent to produce a homogeneous product suitable for placement in the final position.

Data source: Main Roads WA Specification 501 Pavements [last revisions 25 January 2008]
**B  Industry cost structure examples**

In discussing the value of a subsidy the report discusses the possibility that the long-run supply curve could be up-sloping, a horizontal line, or down sloping, and presents the three cases without explaining in much detail how the curves are derived. This appendix provided details on how the different long-run supply curves discussed in the report are found.

To illustrate the issues involved it is helpful to include only the essential elements that characterise each case and to avoid unnecessary complications and details. As such the below discussion uses a relatively stylised representation for firm cost structures, but nevertheless conveys the main message rather well.

Let us first consider the case where there are no pecuniary or technical effects so that entry and exit of firms has no external scale effects on other firms – ie the industry is a constant cost industry. In such a case the industry long run supply curve will be a horizontal line and the long-run supply elasticity will be infinite.

The case of a constant cost industry is shown in Figure 10. In the figure the left-hand diagram describes the case for the individual firm and the right-hand diagram describes the case for the market as a whole. The original market equilibrium is at found by equating the market short-run supply curve -- found as the sum of the individual firm marginal cost curves -- and the market demand curve. For simplicity it is assumed that at the individual firm level price equals marginal cost equals average cost so that the firm is making a normal profit, including an appropriate return on capital and owner entrepreneurship. As drawn the market equilibrium is an output of $Q_0$ with price $p_0$. For the individual firms, equilibrium output is $q_0$ with price $p_0$. As we are implicitly assuming the same cost structure for each firm, $q_0 = Q_0/n$, where $n$ is the number of firms.

A subsidy or rebate to local government for recycled material results in an increase in demand, which is represented by the shift in the market demand curve from $D_0$ to $D_1$, an increase in price from $p_0$ to $p_1$, and an increase in the equilibrium market output from $Q_0$ to $Q_1$. With the price for material now at $p_1$, individual firms increase output to $q_1$. At this point price is greater than average costs so new firms are encouraged to enter the market. As new firms enter the market the short-run market supply curve, being the sum of the individual firm marginal cost curves, expands and prices fall. As new firms enter the market there are no external scale effects and so individual firm cost curves remain unchanged.
For a constant cost industry firms will continue to enter the market until prices reach $p_0$, and once more price equals marginal cost equals average cost. For the individual firm the level of output post-subsidy will be the same as pre-subsidy, so that $q_2 = q_0$, and the price will be the same so that $p_2 = p_0$. There are however more firms in the market so market supply, $Q_2$, is greater than prior to the subsidy/rebate. For a constant cost industry the long-run supply curve is horizontal, and in Figure 10 the long-run supply curve is represented by the red line labelled $LS_0$.

**Figure 10  Constant cost industry: individual firm and market**

![Diagram](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAPAAABfRXkAAAAuAAAAKgACAgIEBAAA...)

**Data source:** Adapted from material in Layard and Walters (1978) and Nicholson (2005).

The second scenario to consider is the case of an increasing cost industry where for some reason entry of new firms drives up average costs for existing firms. Illustrative details for an increasing cost industry are shown in Figure 11.

The initial starting point is the same as was discussed for the constant cost industry, and again the rebate results in an increase in demand, which is represented by the shift in the market demand curve from $D_0$ to $D_1$, an increase in price from $p_0$ to $p_1$, and an increase in the equilibrium market output from $Q_0$ to $Q_1$. At the individual firm level the price level is $p_1$ and output is $q_1$. At this price-quantity output level average costs for the firm are below price and so the individual firms in the market are now making supranormal profit and new firms enter the industry.

Unlike the case for a constant cost industry, for an increasing cost industry, when new firms enter the market, average costs for all existing firms are driven higher. This is shown in the individual firm diagram with $AC_1$ and $MC_1$ greater than $AC_0$ and $MC_0$. In the long-run market output expands from $Q_1$ to $Q_2$, prices fall from $p_1$ to $p_2$, and individual firm output falls from $q_1$ to $q_2$. Importantly, in the long-run the new equilibrium price, $p_2$, is greater than the original pre-rebate price of $p_1$, and the long-run supply curve labelled $LS_0$ is up-sloping so that the long-run supply elasticity is positive.
The final scenario to consider is the case of a decreasing cost industry where for some reason, such as spread of new techniques and information the entry of new firms drives average costs for existing firms lower. Illustrative details for a decreasing cost industry are shown in Figure 12.

As in the two previous scenarios, the rebate scheme initially results in an increase in demand and an expansion of individual firm output from $q_0$ to $q_1$, an increase in the market output from $Q_0$ to $Q_1$, and an increase in price from $p_0$ to $p_1$. For individual firms, at output level $q_1$ with price $p_1$ because price is greater than average cost they make supranormal profits and so new firms are attracted into the market. The entry of these new firms into the market has the effect of driving down average costs for all firms in the market so that a new equilibrium is reached for firms where prices are $p_2$ and output is $q_2$.

Importantly, the new equilibrium price, $p_2$, is lower than the pre-rebate price of $p_0$, and market supply is higher with $Q_2$ greater than $Q_1$, which in turn is greater than $Q_0$. The long-run supply is found, as previously, as the locus of points connecting the intersection of the respective short-run supply curve and associated demand curve. In the case of a decreasing cost industry the long-run supply is downward sloping and so the long-run supply elasticity is negative. Should there be a down-sloping long-run supply curve, it would justify government intervention.
Figure 12  **Decreasing cost industry: individual firm and market**

Although the arguments developed in the international trade literature are slightly more nuanced, it is essentially the possibility of a down-sloping long-run supply curve driven by positive external economies from new firms entering the market that underpins the infant industry argument for supporting new industries.

With respect to time limited interventions such as the one envisaged under the variant described above, it is generally assumed that the benefits from the development in the infant industry (in this case recyclers) will accrue to a wider group (the whole economy) rather than just the specific infant industry. This is required because the cost of the government intervention must be recovered, with interest, for the whole of society. The intervention could not be justified, in purely economic terms, if the benefits were simply captured by the entrepreneurs involved in the infant (recycling) industry.
C Partial adjustment model

The discussion in the body of the report suggests that the failure to consider the possibility that there is a partial adjustment process with respect to the realised demand for recycled material may have lead to existing studies underestimating price responsiveness. The following appendix shows how both the long-run and short-run price elasticity can be retrieved from observable data.

With respect to the uptake of recycled material in civil construction projects, let us assume that there is some limit or restriction, possibly of a technical nature, that means in any one period it is not possible to achieve the total desired change in use of material in response to a price change. This means that in response to a price change there will be only partial adjustment in each time period. Should this be a fair characterisation of the market for recycled material, then there is a very real problem in assessing the impact of price based policies. What is required is a measure of the long-run demand response; what is observed every period is the short-run demand response.

The basic partial adjustment framework of Nerlove does however provide a means of obtaining an estimate of the long-run demand response from short-run observable information. Let the long-run (or target) demand response at time $t$ be represented as:

$$D_{tL} = a P_t^b Y_t^c,$$

where $D_{tL}$ is the long-run or target level of demand for recycled material use at time period $t$, $P_t$ is the (relative) price of recycled material at time $t$, $Y_t$ is the real wealth of the local government sector at time $t$, and $a$, $b$, and $c$ are arbitrary parameters. Such a representation is convenient as by taking the natural log of both sides of the demand equation we have:

$$log D_{tL} = log a + b log P_t + c log Y_t,$$

where as shown below, the $b$ parameter can be interpreted as the long-run own-price elasticity.

Regarding the extent of the partial adjustment that takes place in each period, a standard representation would be to relate the partial adjustment to the difference between the target long-run level of demand and the actual short-run demand in the previous period. One such representation of such a
situation is shown below where the $d$ parameter describes the speed of adjustment, and where $D_{tS}$ is the short-run observed level of demand for recycled material at time period $t$.

\[
\frac{D_{tL}}{D_{tS}} = \left[ \frac{D_{tL}}{D_{t-1S}} \right]^d, \text{ where } 0 < d \leq 1
\]

Solving the partial adjustment condition in terms of long-run demand we have:

\[
D_{tL} = \left[ \frac{D_{tS}}{D_{t-1S}^d} \right]^{\frac{1}{1-d}},
\]

which can be substituted directly into the long-run demand equation so that we have an expression for the long-run demand for recycled material in terms of short-run observables. Specifically, we have:

\[
D_{tL} = \left[ \frac{D_{tS}}{D_{t-1S}^d} \right]^{\frac{1}{1-d}} = aP_t^bY_t^c,
\]

which can be rearranged to give:

\[
D_{tS} = a(1-d)P_t^{b(1-d)}Y_t^{c(1-d)}D_{t-1S}^d,
\]

which when we take the natural log of both sides gives:

\[
logD_{tS} = (1-d)loga + (1-d)blogP_t + (1-d)clogY_t + dD_{t-1S}.
\]

Importantly, the above form of demand equation can be readily estimated via a least squares regression using observable data. Recall that the value we are interested in is $b$, the long-run elasticity of demand. Given the above partial adjustment framework, the long-run elasticity value can be retrieved from the observable data by dividing the estimated least squares coefficient associated with the price term by one minus the estimated coefficient associated with the one period lagged demand term, $(1-d)b)/(1-d) = b$. The interpretation of the estimated least squares coefficient associated with the price term, $(1-d)b$, is as a short-run elasticity.
Civil Works and Recycled Content

**Bibliography**


