Modelling and data analysis to inform new waste strategy

Prepared for:
NSW Environment Protection Authority

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Contents

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1. Introduction

1.1. Background and context

Waste recycling and recovery in New South Wales (NSW) is addressed in the Waste Avoidance and Resource Recovery Strategy (the 'Waste Strategy'). It is based on the principles of maximising conservation of resources and minimising environmental harm from waste. Developed under the Waste Avoidance and Resource Recovery Act 2001 (the WARR Act), the Waste Strategy is required to be reviewed at least every five years. The first Waste Strategy was developed in 2003, and this was replaced with the current version in 2007. The Waste Strategy 2007 contains targets and outcomes in four key areas which were retained from the Waste Strategy 2003:

- *Preventing and avoiding waste*
    - To hold level the total waste generated for 5 years from the release of Waste Strategy 2003
- *Increased recovery and use of secondary resources by 2014 to:*
    - Increase recovery and use of materials from the municipal waste stream, from 26% (in 2000) to 66%
    - Increase recovery and use of materials from the commercial and industrial waste stream, from 28% (in 2000) to 63%
    - Increase recovery and use of materials from the construction and demolition sector, from 65% (in 2000) to 76%
- *Reducing toxic substances in products and materials by 2014 or earlier:*
    - To phase out priority substances in identified products as a first choice or, if not possible, to achieve maximum recovery for re-use
- *Reduce litter and illegal dumping:*
    - Reduce total amount of litter reported annually
    - Reduce total tonnages of illegally dumped material reported by regulatory agencies and RID squads annually

The 2014 recycling rate targets have also been taken up in the NSW Government's *NSW 2021: A plan to make NSW number one* (NSW 2021) document.

The NSW Environment Protection Authority (EPA) is reviewing the 2007 Strategy as required by the WARR Act and preparing a new Strategy for public consultation. Important input to the review is being provided by:

- the Waste Strategy Progress Report 2012, which reports progress against the Waste Strategy 2007 targets and programme outcomes, based on 2010-11 data
- the review of the NSW waste and environment levy conducted by independent consultants KPMG for the NSW Government in 2012 (report was not released during the period this project was conducted)
- an International Waste Strategy Benchmarking Report prepared by Sinclair Knight Merz, which surveys global practice across 20 comparable jurisdictions to provide a benchmark for the NSW Waste Strategy
- this Modelling and Data Analysis Report, which models a number of future scenarios in relation to potential recycling rates.

This Modelling Report focuses on one measurement of waste outcomes – the amount of material recovered and recycled from the waste stream, called the 'recycling rate'. That is, it focuses on one of the key result areas in the current Waste Strategy 2007 – *"Increased recovery and use of secondary resources*". There are other means of measuring waste outcomes and other focus areas some of which are included in the 2007 Strategy; however these are not considered in this Modelling Report. Additional waste outcomes are outlined in the International Waste Strategy Benchmarking Report.

The term 'recycling rate' has been chosen for consistency with the current NSW waste targets. It is also a measure that is understood and accepted in NSW.

The modelling in this report fleshes out a framework of ten modelled scenarios that were agreed in a workshop with the EPA. The scenarios represent feasible, best practice technologies that are available in other countries and which could be considered for NSW in the future. The focus of these ten scenarios is on Municipal Solid Waste (MSW) and Commercial and Industrial Waste (C&I) as these were identified as streams in which the greatest gains could be made in recycling outcomes. The Construction and Demolition Waste (C&D) sector was included but with less focus.

A separate report was subsequently prepared by SKM, for the EPA, which models further performance improvements in the C&D sector. The report, entitled-*Modelling and data analysis to inform new Waste Strategy – construction and demolition waste* is provided at Appendix E and the key findings are reproduced in Chapter 12 of this report. The Summary and Conclusions (Chapter 13) includes the finds from the C&D sector report.

This report compares future projections for waste and resource volumes to the current policy situation (the 'business as usual' scenario). The scenarios cover a range of potential focus areas for improved performance in recycling rates. The scenarios are either based on individual outcomes (scenarios A to F, and K) or built upon other scenarios to provide a cumulative appreciation of potential outcomes (scenarios G to J, L and M). Scenarios B to M assume investment by councils, businesses and the NSW Government to implement the programmes and new infrastructure to drive further recycling or diversion from landfills. The scenarios are summarised in Table 1.

Table 1: Summary of scenarios

Scenario	Description
Scenario A	Business as usual (for all waste streams) – minimal changes on current performance in future years
Scenario B	Waste prevention and avoidance (MSW and C&I)
Scenario C	Kerbside recycling improvement – dry recyclables (MSW)
Scenario D	Food and garden organics diversion improvement (MSW and C&I)
Scenario E	Alternative Waste Treatment (MSW) – increased use of AWT for the treatment of residual waste
Scenario F	Alternative Waste Treatment (C&I) – as for Scenario E but focussing on the C&I stream
Scenario G	C&I source segregation. Building on Scenario F, but including a greater level of source-segregation for C&I waste
Scenario H	Energy from Waste: Scenarios E & G plus EfW
Scenario I	Combination option (Scenarios A to H excluding F)
Scenario J	'Holistic' stretch scenario (Scenario I stretched further)
Scenario K*	Improvements in C&D sector

Scenario L*	Combined option I – including scenario K
Scenario M*	'Holistic' stretch scenario J - including Scenario K

* These scenarios were carried out subsequent to the 10 main scenarios and are discussed in Chapter 12.

1.2. Modelling method

The modelling has been carried out in a spreadsheet-based mass-flow model. The modelling draws on a range of data sources provided by the EPA and as far as possible keeps separate four geographical areas in NSW:

- Sydney Metropolitan Area (SMA)
- Extended Regulated Area (ERA) comprises the Hunter, Central Coast and Illawarra regions
- Regional Regulated Area (RRA) comprises of coastal councils north of Port Stephens to the Queensland border, and includes the Blue Mountains, Wollondilly and upper Hunter regions
- Non-Regulated Area (NRA)[1] comprises the rest of the state.

The model also keeps separate the three main waste streams:

- Municipal Solid Waste (MSW), which includes domestic (kerbside recycling, organics and residual collections, drop-off and clean-up services) and non-domestic elements (e.g. clean-up of municipal parks and gardens, street sweepings, council tidy bins, etc.)
- Commercial and Industrial Waste (C&I), which is waste generated by businesses and industries (including shopping centres, restaurants and offices) and institutions (such as schools, hospitals and government offices), excluding construction and demolition waste and municipal waste
- Construction and Demolition Waste (C&D), which is waste sourced from construction and demolition works and includes building and demolition waste, asphalt waste and excavated natural material

[1] Note that in some of the sources of data the RRA and NRA were combined, so as described in the course of this document assumptions were used where necessary to split these out.

The best available data (on current tonnages, composition, destinations of material etc.) is for the domestic element of MSW. Much less information is available on the non-domestic element of MSW; it will be noted that for many of the scenarios the proposed changes relate to the domestic element of the MSW (e.g. changes to kerbside collections) and so the non-domestic element was kept separate in the model (and recycling rate improvements were not assumed). The domestic element of MSW has been defined as kerbside refuse, recycling and organic collections, drop-off tonnages and clean-up. Information on C&I and C&D generated is of mixed detail and quality and, as is described in the sections on the scenarios, a range of assumptions therefore needed to be made to support the modelling.

The model was intended primarily to cover the years 2014-15 to 2021-22, but since the majority of data used to form the baseline inputs to the model is for 2010-11 the model started from this year and results are presented from this year.

The model allowed for the manipulation of a number of variables, including for example waste growth rates, waste composition, percentage diversion to recycling, different treatment options (including Alternative Waste Treatment (AWT) or Energy from Waste (EfW)). Baseline data for the model have been drawn from a variety of reports and other sources provided by the EPA. Assumptions used in the development of the different scenarios also drew on these sources. Given the quality and availability of supporting data, there is a degree of uncertainty in the scenarios' projections, but assumptions were as far as possible intended to be conservative (except in those scenarios where it is made clear that the assumptions are deliberately stretching). For many of the assumptions, reference is made to the source data by number (e.g. 'source 33'). A list of these numbers and the corresponding reference is provided in Appendix C.

The model's inputs and assumptions are combined in a series of data and calculation tables within the model. The outputs from the model show recycling performance, based on the assumptions made for each scenario, by stream (MSW, C&I and C&D) and for NSW as a whole across all three streams.[2]

In the sections which follow, each scenario is described along with a summary of the assumptions developed to support it, followed by the outputs from the modelling. For each of the ten scenarios a description of the aim of the scenario is provided, followed by

[2] Recycling performance calculations in the model take into account assumed rejections from material recycling facilities (MRFs) – i.e. although material might be collected for recycling, rejections made at a MRF when the material is sorted would not count towards the recycling rate.

information on the underlying assumptions made and the results in terms of the percentage recycled for each of the three key material streams.

Appendix B provides further figures from the modelling, broken down by stream, year and area for each scenario.

Appendix E is a subsequent report carried out for the EPA that focuses on the C&D sector alone. The key findings are summarised in Chapter 12.

A Glossary of terms used in this report is also provided at Appendix F.

2. Scenario A – Business as usual

2.1. Scenario description

This is the baseline scenario that underpins all others modelled. Essentially, this scenario represents the current level of waste management performance, with no additional actions from the EPA or elsewhere in terms of programmes and with rates of diversion and treatment broadly at their 2010-11 levels; however, it is assumed that the carbon pricing mechanism and planned waste levy increases to 2015-16[3] will continue to drive an increase in waste diversion from landfill and this is reflected in the assumptions set out in section 2.2 below.

2.2. Scenario assumptions

Table 2 and Table 3 summarise the total tonnages by area and stream for the baseline year and the current recycling performance by stream. These figures have been used as inputs to the baseline model for this scenario, and Table 4 lists the source of these figures and other assumptions used in this scenario. Where noted below, Appendix A also contains further detail on key assumptions.

- **Table 2: Baseline year (2010-11) tonnages by area and stream**

Stream	2010-11 tonnage generated – SMA	2010-11 tonnage generated – ERA	2010-11 tonnage generated – RRA	2010-11 tonnage generated – NRA	Total
MSW (domestic)	1,703,882	660,666	392,327	433,215	**3,190,091**
MSW (non-domestic)	750,539	359,074	216,601	239,175	**1,565,388**
C&I	3,358,439	953,291	319,775	820,024	**5,451,529**
C&D	4,652,803	1,773,718	138,846	339,933	**6,905,300**

[3] It is to be noted that ongoing changes would be expected after the end of the levy escalation in 2015-16, but these are not modelled.

- **Table 3: Baseline year (2010-11) recycling performance by stream**

Stream	Total disposed (tonnes)	Total recycled (tonnes)	Total (tonnes)	% recycled
MSW[4]	2,298,148	2,457,331	**4,755,479**	52%
C&I	2,352,021	3,099,508	**5,451,529**	57%
C&D	1,749,406	5,155,893	**6,905,300**	75%

- **Table 4: Assumptions for Scenario A**

Description of element	Applies to stream	Assumption or supporting source
Generated tonnages – MSW	MSW	As shown in Table 2. For domestic MSW: 2010-11 local government survey data provided by EPA (source 33); 2010-11 collected and AWT tonnages from EPA (source 47). For non-domestic MSW: 2010-11 generation data provided by EPA (source 38); no detail is available on the non-domestic element so this has been split out separately from the domestic element for which the data are more detailed. Table 1 In Appendix A shows the estimated non-domestic tonnages and performance based on currently available data.
Generated tonnages – C&I	C&I	As shown in Table 2. 2010-11 generation data provided by EPA (source 38).
Generated tonnages – C&D	C&D	As shown in Table 2. 2010-11 generation data provided by EPA (source 38).
Composition – domestic MSW	MSW (domestic)	2010-11 audit data and tonnages by region were provided by the EPA (sources 32 and 33) and were used as the basis for the composition of domestic MSW. Table 2 in Appendix A provides summary figures on

[4] Figures and performance for MSW include domestic and non-domestic elements. For domestic MSW, the recycling performance is achieved by kerbside dry recyclable and organics collections, clean-up and drop-off services, and some councils sending residual waste to AWT.

Description of element	Applies to stream	Assumption or supporting source
		composition.
Composition	C&I	The available information on C&I composition is less detailed than that available for MSW. Overall composition data from 2010-11 (source 58) was used; see Table 3 in Appendix A. Tonnage data for 2010-11 (source 38) was combined with this to estimate the current overall capture rates.
Composition	C&D	As with C&I data, the available information on C&D was less detailed than that for MSW. To estimate the composition of total waste generated and current diversion, data were combined from sources 38 (2010-11 total generation), 9 (composition of material reprocessed, 2010-11), and 40 (composition of material to landfill, 2004-5). Table 4 in Appendix A shows the assumed overall composition which resulted.
Growth rates	MSW, C&I, C&D	Calculated from background data in the 2011 Infrastructure Needs Analysis (source 28) – these are waste growth projections which take into account projected population changes. Table 5 in Appendix A provides a summary of these figures.
Waste levy effect	MSW, C&I, C&D	The waste levy is expected to have mixed effects on recyclers (e.g. source 13, page 74) but overall the waste levy will continue to drive material from landfill to recycling. It is legislated to increase until 2015-16, and whilst drivers such as CPI will add a small increase to it each year beyond this, for modelling purposes the influence of the waste levy plateaus after 2015-16, retaining the momentum gained to that point but without any further increase in diversion. For MSW (domestic and non-domestic), quantified information on the effect is not available; however a 0.5 percentage point increase in diversion is assumed per year to 2015-16 for each material currently diverted (no increase for those not diverted). This leads to

Description of element	Applies to stream	Assumption or supporting source
		approximately a 1% increase in overall diversion per year. Research into the impact of the levy on C&I waste (source 14) suggests there is some expected effect of the levy on C&I (some increased source separation), therefore a 0.5 percentage point increase in diversion for each material is assumed per year to 2015-16. For C&D, a small increase in recycling rates is assumed, given likely trends to recycle this material, and this is set at a 0.5 percentage point increase in diversion per year to 2015-16 for each material currently diverted.
Diversion of E-waste	MSW, C&I	An E-waste collection service (Product Stewardship Scheme) commenced on 1 July 2012. The scheme targets householders and small businesses, providing these groups with a free service. The EPA has projections on the increased diversion of E-waste resulting from this scheme (source 56) and this increased diversion was included in this baseline scenario.
Diversion, including material to AWT and recovery rate	MSW	For domestic MSW: calculated by area from 2010-11 collected and AWT tonnages from EPA (source 47). For non-domestic MSW: very limited data on composition and diversion were available. Using the reported current overall MSW diversion rate, the diversion rate for non-domestic MSW that must be assumed to be occurring was calculated. The resulting figures suggest significant variation in the different areas' current diversion of non-domestic MSW (19% for the combined RRA and NRA, 62% for the ERA and 80% for the SMA – as stated above, see Table 1 in Appendix A) but in the absence of other information these figures have been used.
Diversion	C&I	Current tonnes to landfill were obtained from source 58, with current diversion calculated using these figures and

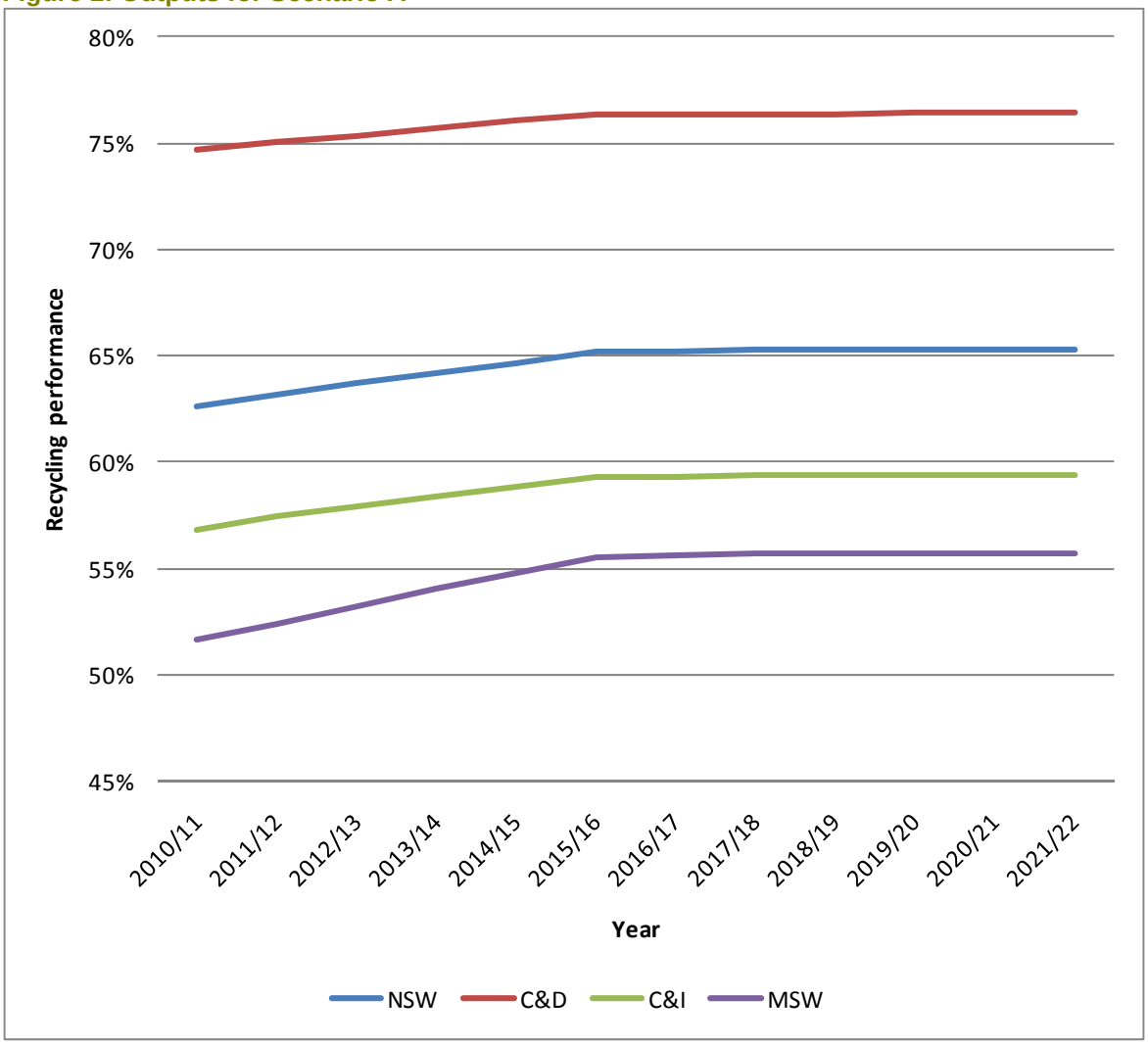
Description of element	Applies to stream	Assumption or supporting source
		the overall waste generated.
MRF rejection rates	MSW	Calculated from data from the EPA on material collected by councils (source 50); the calculations give an overall MRF rejection rate across the four areas of 8% (or 7% (SMA), 7% (ERA), 9% (RRA), 12% (NRA)). It is assumed that this applies to dry kerbside and drop-off services. It is assumed there is 0% rejection of collected organics as any rejections are likely to occur "beyond the gate" of the reprocessor (also, the rejection rate of organics at a reprocessor is typically very low so this can be expected to have minimal impact).
MRF rejection rates	C&I, C&D	Given the nature of the source data, no additional assumptions on rejection rates have been applied (rejection rates are already counted in the source data as the material is processed at the landfill site).

2.3. Modelling outputs

Figure 1 shows the outputs from Scenario A. As described above, the improvement in performance up to 2015-16 for the different waste streams (and therefore overall) is driven by the assumed impact of the waste levy and carbon pricing mechanism (CPM) continuing to drive an increase in recycling. No detailed data are available on what the effect of the CPM might be and economic modelling of its possible effects are beyond the scope of this report; however the waste levy is expected to have a stronger effect than the CPM in increasing recycling (due to the expected relative price difference) and the changes in recycling noted in the assumptions in Table 4 are intended to cover the effects of the waste levy and the CPM combined. Beyond 2015/16, the levels of performance shown in Figure 1 level off as a result of the waste levy increases reverting to increasing in line with consumer price inflation, fixing the driver for further change.

As mentioned previously, Appendix B provides supporting figures on performance for this and other scenarios, broken down by stream, area and year; see Table 6 in the appendix for the detail of this scenario.

Figure 1: Outputs for Scenario A



3. Scenario B – Waste prevention and avoidance

3.1. Scenario description

This scenario models the effect of waste prevention and avoidance programmes. For example, there are likely to be small reductions in total NSW food waste due to the Love Food Hate Waste (LFHW) campaign, and other reductions due to policies such as the Australian Packaging Covenant and other campaigns. The possible reductions are hard to quantify, and in discussion with the EPA it has been agreed that the effect of these may be very small (or it may be too early to tell or measure the difference caused by these programmes), but nonetheless an assumed effect of these programmes is taken into account. Research into other programmes has led to assumed changes in individual material streams and these are applied to the figures in Scenario A, with assumptions as set out in Table 5.

3.2. Scenario assumptions

This scenario takes Scenario A as its starting-point, to which the changes set out below are applied.

Table 5: Assumptions for Scenario B

Description of element	Applies to stream	Assumption or supporting source
Waste prevention and avoidance – effect on materials	MSW (domestic)	As above, NSW has currently adopted two main reduction schemes; LFHW and Product Stewardship. To increase the modelling scope for this scenario, an additional scheme is suggested, targeting home composting. As there is currently a gap in data relating to the effect of such schemes in NSW, UK research has been used to estimate the possible effect as discussed below. All changes are assumed to take effect from 2012-13 with a linear year-on-year increase in their impact.[5]

[5] The potential effects of the National Product Stewardship Campaign are not considered here as it is too early to quantify these. It is suggested that packaging material streams such as plastics and cardboard could be the ones most affected by this policy if it were to be established in a similar way to the UK, with manufacturers developing light-weighting systems.

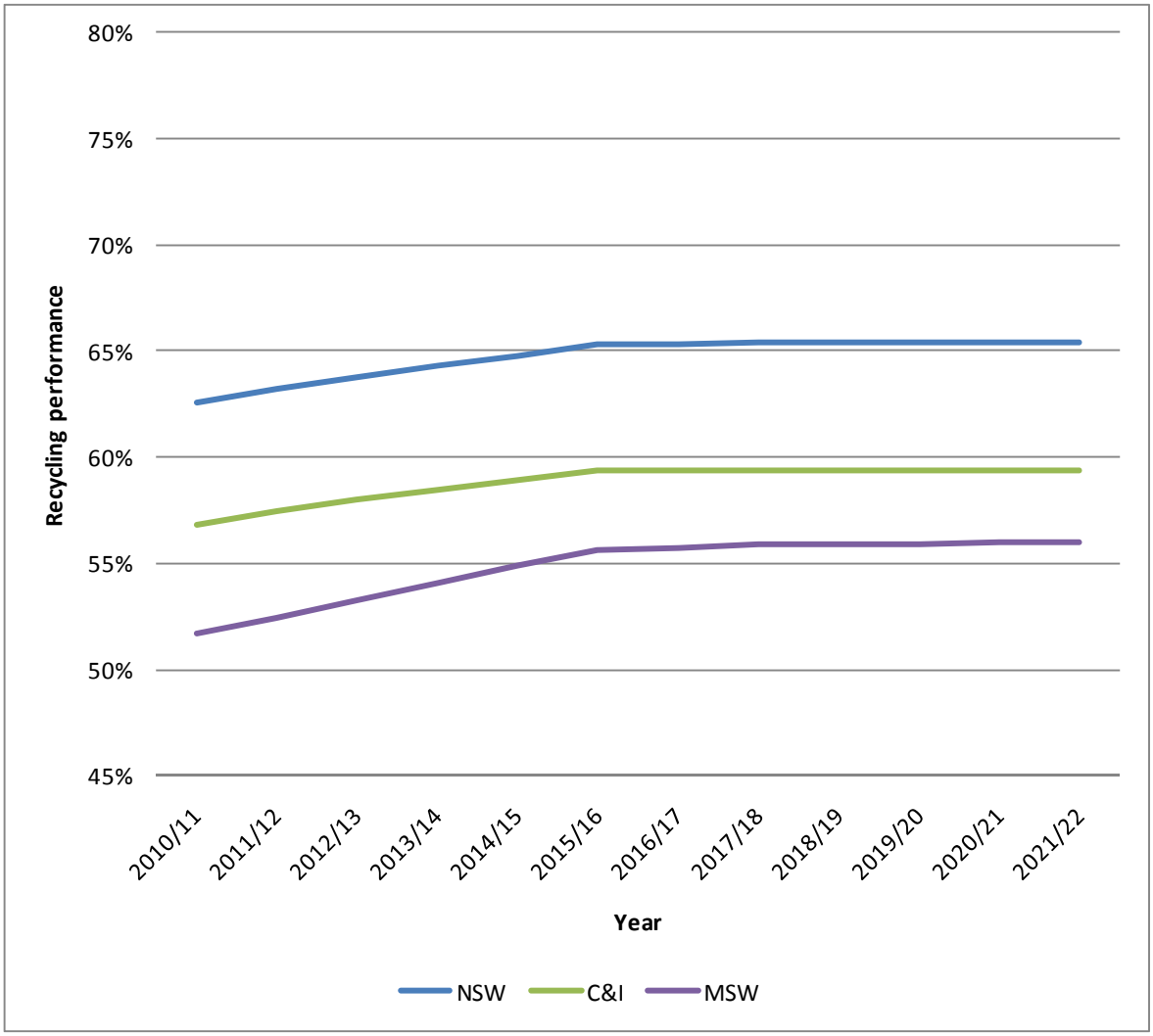
Description of element	Applies to stream	Assumption or supporting source
Love Food Hate Waste	MSW (domestic)	Data gathered by the UK's Waste and Resources Action Programme (WRAP) suggest that households committed to reducing food waste can reduce generation by 1.5kg/hhld/wk (78kg/hhld/yr). In the UK 17% of households are on average classified as committed food waste reducers. By way of setting conservative estimates, it is assumed that 15% of households in NSW would achieve an average reduction of 60kg/hhld/yr, (1.2kg/hhld/wk) by 2016/17, avoiding in the region of 25,000t between 2012/13 and 2016/17. Household projections have been based on data provided in source 33.
Home composting	MSW (domestic)	UK WRAP research suggests that home composter users can divert on average 150kg/hhld/yr of organic waste from their collections with sales of composting bins reaching ~5% of households over a 10-year period. Home composting is actually expected to have a very small effect in NSW, so for this scenario a conservative projected reduction in waste generation of 100kg/hhld/yr has been used with year-on-year sales of composting bins of 0.5% of households per year between 2012-13 and 2021-22. By 2020-21 it is estimated that approximately 12,200t of organic material could be diverted from collections.
Other food recycling (not related to Love Food Hate Waste)	C&I	Figures from the EPA suggest that C&I food waste avoidance of 20,000 tonnes per year is possible across NSW. This includes food recovery by charities. In agreement with the EPA, the impact of this avoidance initiative is introduced as a reduction in food waste generation in 2012-13 with the effect of reducing food waste levels by 20,000t per year throughout the life of the model.
Industrial ecology programmes	C&I	Figures from the EPA suggest that 36,000 tonnes per annum of non-food waste can be diverted from landfill by businesses across NSW through industrial ecology

Description of element	Applies to stream	Assumption or supporting source
		programmes. This diversion is expected to start from 2013-14 and continue for five years (to 2016-17), is assumed to occur across all four areas and is spread across different non-food materials.
Waste prevention and avoidance – other effects	C&I	No other reductions in C&I waste arising are currently modelled. Some impacts are expected through the work of the Australian Packaging Covenant, which has Sustainable Packaging Guidelines that include strategies such as light-weighting and the NSW EPA's Sustainability Advantage (Resource Efficiency) Programme. However, no suitable data have been found to support assumptions on this and none have been applied.
Waste prevention and avoidance – effect on materials	C&D	No changes from BAU in Scenario A – it is assumed that the majority of C&D waste (which is already well recycled) will continue to be recycled at current rates.

3.3. Modelling outputs

As expected, the overall effect of the waste prevention and avoidance schemes is very small, hence the outputs in Figure 2 and the supporting tables are very similar to those for Scenario A (and in the tables may appear the same due to rounding). See Table 7 in Appendix B for output figures for this scenario.

- **Figure 2: Outputs for Scenario B**



4. Scenario C – Kerbside recycling improvement (dry recyclables)

4.1. Scenario description

This scenario focuses on what could be achieved with better performance of kerbside services for dry recycling i.e. paper, cardboard, glass, plastics, and ferrous and non-ferrous metals (not organics). Current figures from the EPA suggest that around a third of the total recyclable tonnage of these materials present in the domestic waste stream is not diverted from the residual. Measures which would improve performance could include:

- Expanding the number of materials offered for collection by all councils (this does not necessarily mean increasing the materials targeted beyond the core materials of paper, cardboard, glass, plastics, and ferrous and non-ferrous metals, but increasing the number of councils that collect these core materials)
- Improvement in the capture rate of materials already collected (i.e. leaving less of the potentially recyclable material in the residual stream)
- Decreasing the rejection rate from MRF processing facilities (i.e. ensuring that the quality of collected recyclables is improved and contaminants (non-recyclable materials) are reduced, so that the rejections made during sorting at the MRF are minimised)

This scenario takes Scenario A as its starting-point, to which the changes set out in Table 6 are applied. This scenario does not model any changes for C&I and C&D, so these remain as in Scenario A.

4.2. Scenario assumptions

Table 6: Assumptions for Scenario C

Description of element	Applies to stream	Assumption or supporting source
Diversion of dry recyclables at the kerbside	MSW (domestic)	For the SMA and ERA: calculations using data provided on material collected by councils (source 50) have been carried out to estimate the proportion of councils collecting each of the dry recyclable materials (e.g. paper, cardboard, glass, plastics and metal). These figures have been used to model the effect of all councils expanding their collections to include those of these core

Description of element	Applies to stream	Assumption or supporting source
		materials which they do not currently collect. In addition, some adjustment has been made to increase the capture of a material within an area where the figures suggest this would be possible. In some cases, the estimated possible expansion of the collection of a material within an area has led to a suggested over-capture (potentially as a result of inaccurate composition data). In these cases the performance has been kept to a high-performing maximum. Changes are assumed to take effect from 2014-15 and increase to their maximum by 2021-22 (i.e. reaching their maximum increased diversion), in recognition of the time needed to put education campaigns and infrastructure in place. For the RRA and NRA: potential changes have been estimated as described above but maximum capture rates kept to a much more conservative estimate, due to the distance to market in these areas which is an obstacle to increased recycling.
MRF rejection rate	MSW (domestic)	To model the effect of less contaminated collections, a decrease in the MRF rejection rate of 1 percentage point has been assumed, reached gradually over three years starting from 2014-15 (such an effect would need to be achieved through improved communications to householders to educate them about the correct use of recycling services and improved MRF processes).

4.3. Modelling outputs

The assumptions described above for the SMA and ERA councils' expansion of collected materials provide an approximate estimate of the effect of expansion because:

(a) A council may currently collect a material from some households only, not all

(b) In collapsing the original list of detailed materials to the model's list of materials some over-statement of collection will have occurred (e.g. a council will have been flagged as collecting plastics even though it collects only one or two types of plastic).

(c) Combined, this effect may slightly underestimate the potential in this area.

Table 7 shows the maximum capture rate[6] reached for each of the core materials by area. Note that these rates are as applied to the recyclable element of the material only (i.e. there will be, for example, additional non-recyclable paper to which these capture rates are not applied). This method for calculating 'capture' rate was chosen to be consistent with that used in NSW. These figures are calculated using kerbside residual waste and recycling only (i.e. they do not include drop-off tonnages). The rates shown in Table 7 are based on audit data (from source 32) which provides a compositional breakdown of the residual and recycling tonnages in 2010-11, Note also that data limitations means there is a level of uncertainty around the figures, particularly for the NRA and the RRA.

Table 7: Kerbside capture rates (recyclable element of material only) in 2021-22[7]

Material	SMA	ERA	RRA	NRA
Paper and paper products - recyclable				
Capture rate according to baseline data (2010-11)	75%	72%	76%	68%
Maximum capture rate (reached in 2021-22)	96%	86%	97%	90%
Glass - recyclable				
Capture rate according to baseline data (2010-11)	82%	78%	81%	74%
Maximum capture rate (reached in 2021-22)	93%	88%	97%	97%
Plastics - recyclable				
Capture rate according to baseline data (2010-11)	27%	26%	33%	24%
Maximum capture rate (reached in 2021-22)	45%	45%	40%	40%
Ferrous - recyclable				
Capture rate according to baseline data (2010-11)	37%	36%	46%	36%
Maximum capture rate (reached in 2021-22)	54%	56%	60%	50%
Non-ferrous - recyclable				
Capture rate according to baseline data (2010-11)	35%	39%	36%	27%
Maximum capture rate (reached in 2021-22)	52%	59%	53%	44%

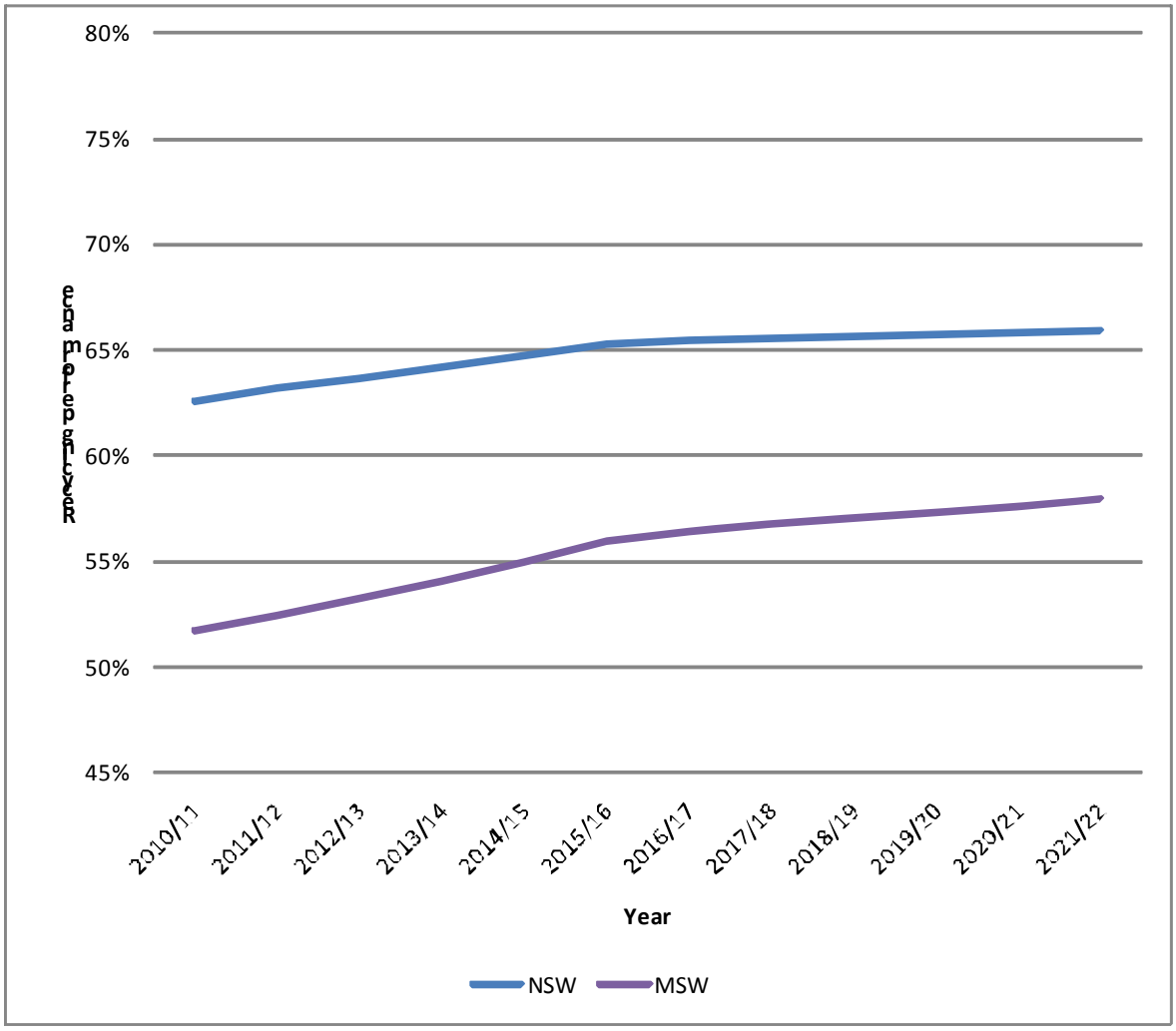
[6] That is, the proportion of the available material which is separated for recycling by householders; a glossary of terms is provided in Appendix F.

[7] The capture rates vary because of, as described in the text above, the areas' different starting compositions and capture rates (e.g. for some materials the base data suggest a higher starting capture rate in the RRA than the SMA) and the estimated possible expansion of the collection of a material within an area.

Figure 3 shows the result of the modelling of this scenario. C&I and C&D do not vary from the baseline (Scenario A); the principal change in MSW occurs from 2013-14 to the end of the modelled period due to the assumed roll-out of increased kerbside provision, improved capture and reduced contamination rates. In the SMA and ERA in the baseline year (2010-11), the domestic residual waste contains around one third of the core recyclable materials available at the kerbside, i.e. not including drop-off (34% and 36% respectively). In 2021-22, by which time the increases to kerbside capture are assumed to have taken effect, this proportion has reduced to 16% for the SMA and ERA combined.

See Table 8 in Appendix B for output figures for this scenario.

- **Figure 3: Outputs for Scenario C**



5. Scenario D – Food and garden organics

5.1. Scenario description

This scenario models the increased diversion of food and garden organics in the MSW and C&I streams. For MSW, this would be achieved through the collection of food waste from households (and garden organics where not already collected); the assumed arrangement, based on discussion with the EPA, is a weekly collection of commingled food and garden organics and a fortnightly collection of residual waste. Table 8 summarises the assumptions used in this scenario. As well as showing the performance outputs for the scenario, section 5.3 provides some information on the size of treatment facilities likely to be used for this material.

This scenario does not impact on C&D waste. It takes Scenario A (business as usual) as its starting point.

5.2. Scenario assumptions

- **Table 8: Assumptions for Scenario D**

Description of element	Applies to stream	Assumption or supporting source
Garden organics	MSW (domestic)	Based on diversion rates provided (source 47) and the composition calculated for modelling, garden organics diversion rates from domestic MSW are already high, at 79% diversion across all domestic collections (including drop-off tonnages). This is even the case in areas such as NRA, where a lower kerbside diversion due to lower service provision is offset by a greater diversion rate through drop-off schemes. Garden organics generation is often more complicated to project than streams such as paper or plastics, as generation is closely linked to service provision. Tonnages can increase as services are created and householders move from methods such as home composting to use the new schemes and therefore introduce new material into the collection system. A full analysis of this is not possible within the timeframes of this study. For example only 14% of NRA councils currently receive a kerbside collection of garden organics, meaning a greater than seven-fold

Description of element	Applies to stream	Assumption or supporting source
		increase in provision is theoretically possible. However even at the current 14% provision a kerbside diversion of 45% is achieved, increasing to 76% when combined with drop-off diversion. It is therefore not possible simply to suggest that a seven-fold increase in provision would be met with a similar increase in diversion rate, with further analysis on council size, impacts on drop-off schemes and potential changes in generation all requiring investigation. The EPA has provided information (source 59) listing councils which may introduce new garden waste collection services in the coming years. The resulting increases in tonnages were estimated on a per-household basis (using an assumed generation figure of 5.8kg per household per week). A number of the listed councils may provide the new service by 2015-16 and the rest of those listed are assumed to provide the service by 2018-19. The appropriate increases in tonnages are therefore introduced evenly from the start of the model to 2015-16 and then from 2015-16 to 2018-19. From 2018-19 to the end of the modelled period there are no further increases in the tonnages apart from those associated with the assumed growth rates.
Food waste	MSW (domestic)	As described above for garden organics, information provided by the EPA (source 59) listed the councils that may introduce food waste collections, some by 2015-16 and some by 2018-19. Discussions with the EPA led to an assumed potential food waste yield of 2.6 kg/hh/wk[8] and this figure was used in estimating the tonnages resulting from these increased collections. The timescales for these increases to take effect are therefore as described for garden organics above.

[8] Calculated as for all households which have access to a food waste collection service, not for all households participating in the service.

Description of element	Applies to stream	Assumption or supporting source
		By the end of the modelled period (2021-22) the food element of the scheme accounts for around an additional 140,000 tonnes of diverted material.
Dry recycling	MSW (domestic)	The proposed change from a weekly to fortnightly residual collection will also have an effect on dry recycling diversion rates as the reduced availability is likely to encourage a greater use of recycling options. UK research suggested the increases in diversion rates as follows: • Paper & cardboard – 115% of diversion rate achieved with weekly residual • Cans – 135% of diversion rate achieved with weekly residual • Glass – 102% of diversion rate achieved with weekly residual • Plastic – 136% of diversion rate achieved with weekly residual These increases in diversion have been applied to the same timescale as the food waste changes described above in order to mirror the proposed service switch to fortnightly residual collections. In the case of the RRA for paper and plastics and the NRA for paper, no increase in diversion of these materials is applied as diversion rates would rise above 100% when starting from a baseline based on source 47 and the assumed modelling composition.
Food waste	C&I	No data on potential rates from new services is available. Supplied figures suggest that current food waste diversion stands at 14% for SMA, 38% for ERA, 7% for RRA and 4% for NRA. It is suggested that C&I would be a harder stream to tackle; report 30 *"The C&I waste stream continues to be the hardest stream to tackle as it has so many players of different sizes and across different areas, with often diverse and ad hoc recycling systems."* As a result it has

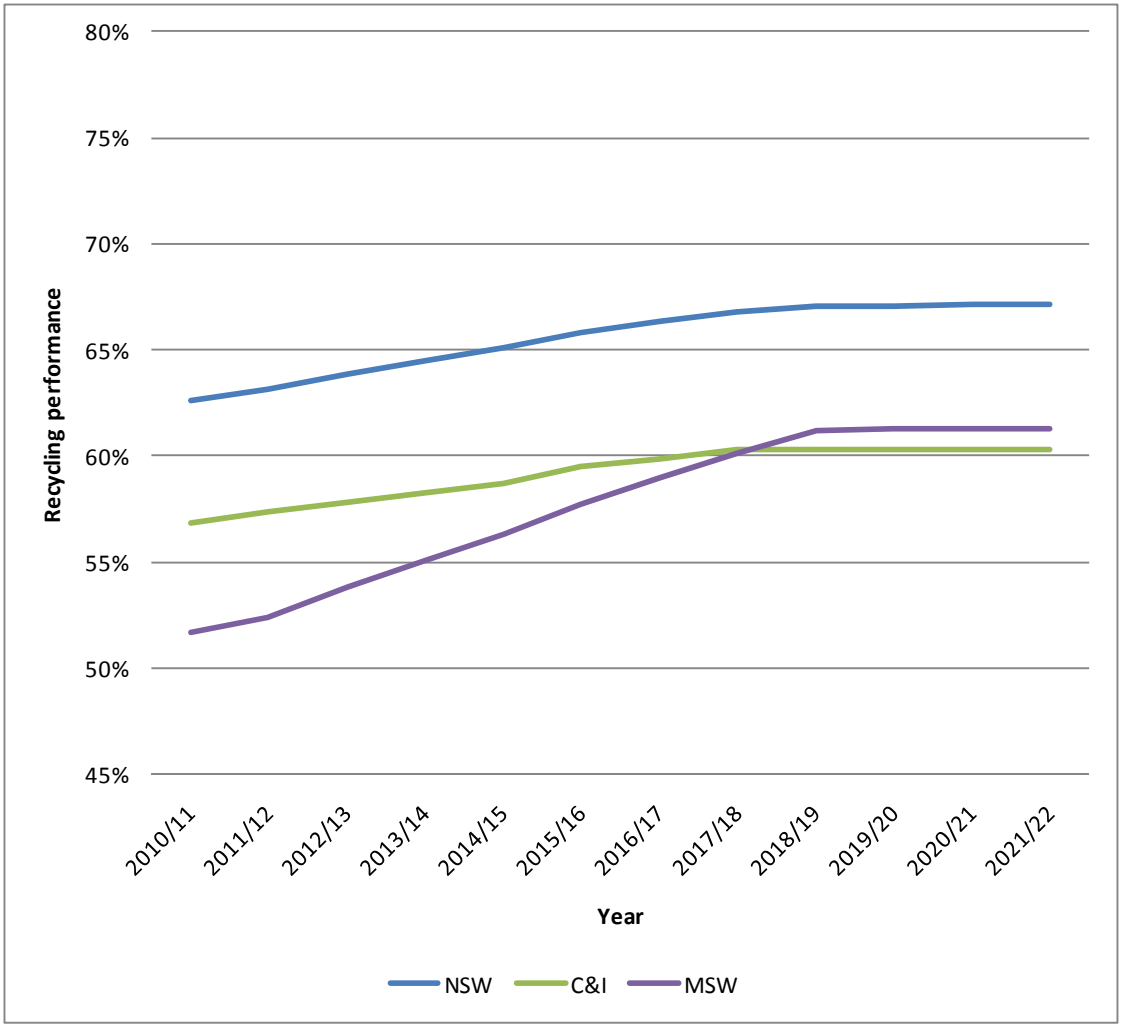
Description of element	Applies to stream	Assumption or supporting source
		been assumed that diversion rates will reach 30% in SMA, 50% in ERA, 20% in RRA and 15% in NRA by 2016-17. By 2021-22, these changes result in an estimated 94,000 tonnes per annum of extra C&I waste diverted. No change is assumed for the C&I dry recycling rates.
Food waste	C&D	No changes are assumed from BAU (Scenario A).

5.3. Modelling outputs

Figure 4 shows the cumulative effect of the scenario's assumptions. As discussed above, the impact of this scenario is conservative because of the difficulty of proposing a substantial improvement in the recycling of garden organics where this material is reportedly relatively well captured even where coverage of services is relatively low. Non-domestic MSW (which will include waste from municipal parks and grounds) might have further scope for the diversion of garden organics, but in the absence of information on the composition and destination of this material no assumption has been made on additional diversion of this material.

Collected organic material can be expected to be treated in enclosed composting or in windrow composting. Enclosed composting is needed in the SMA and ERA, but in the RRA and NRA the remoteness of sites means that the use of enclosed composting may be required to a lesser degree, and windrow facilities, which are quicker to roll out, could be developed. Source 12 (Infrastructure Needs Analysis) gives the capacity of likely future organics facilities (up to 2036) by area. The average size of these facilities is summarised in Table 9; given these sizes, and the tonnages described in the assumptions above, it appears that the increased diversion modelled would require only a small number of additional facilities.

- **Figure 4: Outputs for Scenario D**



- **Table 9: Effect of scenario on number of organics facilities required by 2016-17**

Area	Average size (tonnes per annum) of projected new organics facilities up to 2036	Additional annual tonnage of organics (food and garden) diverted by 2021-22	Approximate number of new facilities required
SMA	78,000	131,000	2
ERA	105,000	104,000	1
RRA	68,000	26,000	0
NRA	14,000	39,000	3

See Table 9 in Appendix B for output figures for this scenario.

6. Scenario E – Alternative Waste Treatment (MSW)

6.1. Scenario description

This scenario models an increase in the proportion of MSW treated through Alternative Waste Treatment (AWT). It is assumed that the additional diversion of waste to this treatment route will occur in the SMA gradually over the period 2015-16 to 2019-20, from a starting point of business as usual (Scenario A).

The diversion rates achieved by these facilities are based on similar facilities currently operating in the SMA and therefore will take into account the composition of residual waste being delivered to the facilities.[9] Table 10 provides further detail on the assumptions.

This scenario does not affect C&I or C&D waste.

6.2. Scenario assumptions

Table 10: Assumptions for Scenario E

Description of element	Applies to stream	Assumption or supporting source
Diversion of MSW to AWT	MSW (domestic)	The increased use of AWT is assumed for the SMA, for domestic MSW. The EPA has figures on AWT facilities[10] that are in planning in NSW along with the projected tonnage throughput, which are as follows: 1. A new facility proposed in the SMA – assumed to be operational in 2015-16. For MSW, the facility would consist of an organic waste composting facility capable of processing up to 50,000 tonnes per year of source-

[9] The majority of councils in the SMA and ERA offer a three-bin collection service. In the SMA, 34 of the 38 councils offer a 3-bin collection service, with the remainder offering a two-bin service (no organics). In the ERA, 6 of the 13 councils offer a 3-bin collection service, with the remainder offering a two-bin service (no organics).

[10] Some facilities are expected to focus on specific waste streams rather than mixed residual waste; although multiple facilities of different types are listed here, the focus of this scenario is on the treatment of residual waste.

Description of element	Applies to stream	Assumption or supporting source
		separated organic material from metropolitan kerbside collections.[11] 2. New AWT facility – assumed operational in the SMA in 2017-18. This facility is expected to process up to 100,000 tonnes per year of both mixed residual waste and source-separated food and garden organics. It is assumed that for modelling purposes there is a 50:50 split between residual and organics. 3. Site expansion (SMA) – increase in capacity, assumed effective from 2019-20. This facility currently has a capacity of 134,000 tpa for both organics and residual waste which is expected to increase to 220,000 tpa. It is assumed that for modelling purposes there is a 50:50 split between residual and organics. 4. New facility (SMA) Operational from 2017/18 with a 100,000 tpa capacity. As above it is assumed to have a 50:50 split between residual and organics for modelling purposes. 5. Site expansion (SMA) operational by 2019/20 with a total capacity of 240,000tpa, assumed to be split 50:50 between residual and organics for modelling purposes. 6. One facility outside Greater Sydney area (RRA/NRA) – operational by 2021/22 – assumed 100,000t capacity for residual waste. These step-changes in AWT throughput (in 2015-16, 2017-18 and 2019-20) lead to a maximum area proportion of residual waste going to AWT of 64% in the SMA. The assumed diversion of material by the AWT process is based on EPA proposed diversion rates of 60%. This is applied in 2015-16, with existing rates being maintained to

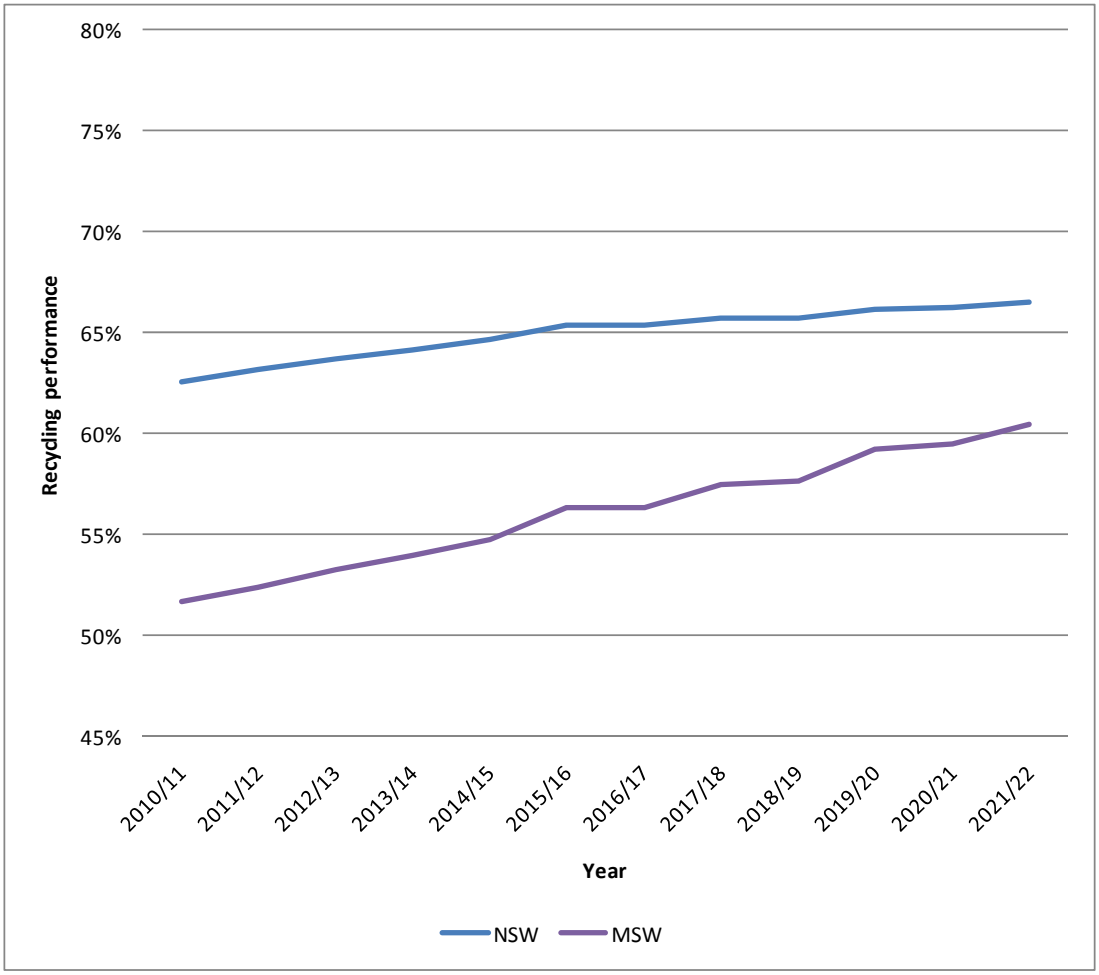
[11] C&I and C&D tonnages will also be handled at the facility, but are not included in this scenario.

Description of element	Applies to stream	Assumption or supporting source
		that point, (e.g. currently 52% in SMA). It is usual that AWT will undergo a commissioning period prior to a facility's full capacity being utilised. This usually takes the form of a period of 3-4 months, during which the facility will operate at approximately 30-40% capacity, before then moving to 100% operational capacity. The modelling has therefore been set up so as to represent 85% of a facility's capacity being utilised in its first year, with the total capacity used from year two onwards.

6.3. Modelling outputs

The step-changes in recycling of MSW from the use of additional AWT facilities are shown in Figure 5. C&I and C&D performance remain as for Scenario A and are not shown.

Figure 5: Outputs for Scenario E



See Table 10 in Appendix B for output figures for this scenario.

7. Scenario F – Alternative Waste Treatment (C&I)

7.1. Scenario description

This scenario is similar to Scenario E but focuses on C&I rather than MSW. It therefore examines the possible impact of the additional diversion of material from the C&I stream through the use of AWT. Information from the EPA suggests that there are three facilities that will be built and ready to accept material from 2017/18 onwards, as detailed in Table 11.

The diversion assumed for this scenario is based on EPA recommendations which suggest a 60% diversion rate, which in the case of this scenario, leaves the remaining 40% to be sent to landfill. In practice it might be possible to find non-landfill destinations for the compost-like output produced by the treatment process, but this scenario assumes the worst-case situation: that the non-diverted outputs are sent to landfill (the next scenario, Scenario H examines the effect of the outputs of AWT being sent to Energy from Waste).

This scenario does not affect MSW or C&D waste. It uses Scenario A (business as usual) as a starting point.

7.2. Scenario assumptions

Table 11: Assumptions for Scenario F

Description of element	Applies to stream	Assumption or supporting source
Diversion of C&I – treatment capacity	C&I	The diversion is applied incrementally from 2017-18 onwards, in recognition of the time needed for the infrastructure to be put in place. In terms of capacity, the following are assumed: • An integrated recycling park is proposed in the SMA in 2015-16, which would feature the construction and operation of an alternative waste treatment facility. For C&I waste this would equate to 150,000 tonnes per annum of capacity in the SMA with commissioning in 2017-18. • Two facilities (with a combined capacity of 100,000

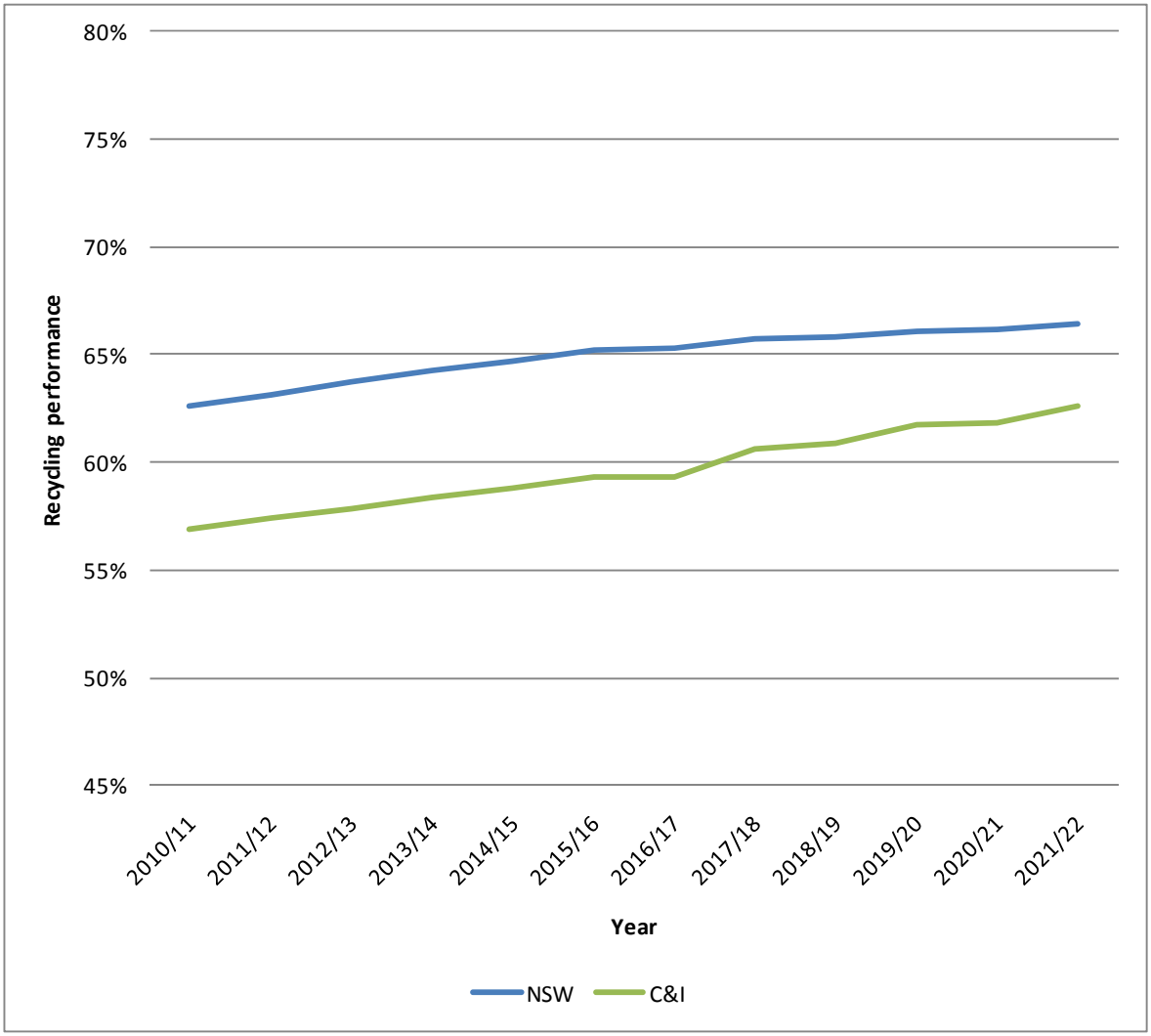
Description of element	Applies to stream	Assumption or supporting source
		tonnes per annum) in the SMA/ERA area in 2019-20 and 2021-22. It is usual that AWT will undergo a commissioning period prior to the full capacity of the facility being utilised. This usually takes the form of a period of 3-4 months, during which the facility will operate at approximately 30-40% capacity, before then moving to 100% beyond this. Therefore the modelling has been set up so to represent 85% of facility capacity being utilised in its first year, before the total capacity is used from year two onwards.
Diversion of C&I – diversion of materials	C&I	A combined diversion rate of 60% of input has been assumed, based on internal EPA forecasts.

7.3. Modelling outputs

The outputs for the assumptions made for this scenario are shown in Figure 6. The step-changes in the performance of the C&I stream occur in the years in which facilities are assumed to become available.

See Table 11 in Appendix B for output figures for this scenario.

Figure 6: Outputs for Scenario F



8. Scenario G – C&I source segregation

8.1. Scenario description

This scenario was designed to build on Scenario F, but to include a greater level of segregation of C&I waste at source. The key assumption is that both dry recyclables (e.g. paper, cardboard, glass, wood) and organics are segregated at source with residual waste sent to AWT as in Scenario F.

The scenario does not include changes to the MSW or C&D waste streams. It uses Scenario A as its baseline and the assumptions underlying it are outlined in Table 12.

8.2. Scenario assumptions

Table 12: Assumptions for Scenario G

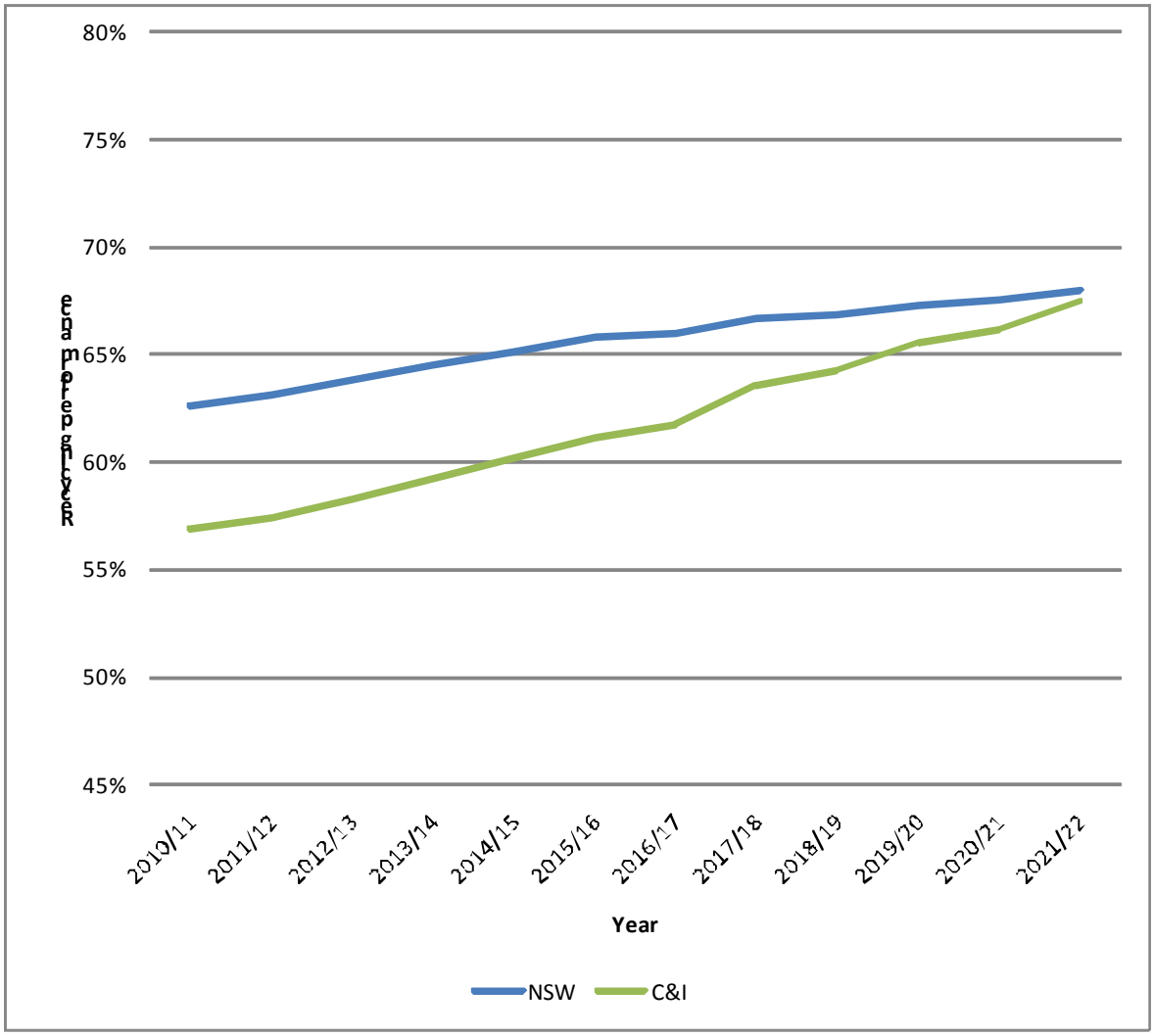
Description of element	Applies to stream	Assumption or supporting source
Source-segregated materials	C&I	Material as described in the sections that follow is assumed to be diverted at source. The quantities of residual waste going to AWT have been assumed to remain as in Scenario F.
Source-segregated dry recycling	C&I	Glass, paper and cardboard: An increase in capture (on top of the already assumed baseline change for the waste levy influence etc.) of 5 percentage points over the ten years from 2012-13 to 2021-22 is assumed across all areas to indicate a modest increase in performance and to maintain regional differences currently suggested by the data. Timber: current capture rates in the SMA and ERA are apparently very low, despite relatively high generation, particularly in the SMA. Therefore a rapid increase in this rate is projected: SMA and ERA diversion is set to increase by around 2 percentage points per year from 2012/13 until a rate of ~40% is reached by 2021-22. In the RRA and NRA rates are assumed to increase by 5 percentage points above an effect assumed from the waste levy over the 10 years from 2012/13. Plastics: According to the 2010/11 base data, the capture rate of plastics ranges between only 5 and 16% leaving a lot

Description of element	Applies to stream	Assumption or supporting source
		of potential for improvement. Therefore the capture rates in all areas are set to increase by 15 percentage points above the effect of the waste levy between 2012/13 and 2021/22.
Source-segregated organics	C&I	Food waste: the capture rate is increased by 10 percentage points in each area over the period from 2012-13 to 2021-22, This leads to the ERA having the highest capture rate (around 51%), the SMA around 27% and the RRA and NRA at 20% and 17%, respectively. Garden organics: the capture rate is increased by 10 percentage points in each area over the ten-year period from 2012-13 to 2021-22. Other organics: no change has been assumed for the capture rate of this stream.

8.3. Modelling outputs

The outputs for Scenario G are shown in Figure 7.

- **Figure 7: Outputs for Scenario G**



See Table 12 in Appendix B for output figures for this scenario.

9. Scenario H – Energy from Waste: Scenarios E & G plus EfW

9.1. Scenario description

This scenario does **not** represent current government policy but examines potential and feasible technology that is available in other comparable countries to Australia and which could be considered for NSW in the future.

A draft Policy Statement on Energy from Waste (EfW) is currently under consideration in NSW and this scenario examines its potential effects on resource recovery. The assumptions made for this scenario are that an EfW policy would not undermine recycling efforts and would require a minimum level of recycling to be achieved before residual waste can be sent to an EfW facility. For example, only councils that have a 'three-bin system' separately collecting dry recyclable material and food and garden material could send residual waste directly to EfW. Scenario H builds on the modelling carried out for scenarios E and G. It proposes the use of EfW on collected residual waste and the rejections or residues created as part of other treatment methods, in order to reduce the tonnage of material sent to landfill.

The lead-in times for construction of EfW facilities can be expected to be several years, and significant EfW capacity is likely to be sourced from the SMA. These considerations are therefore reflected in the assumptions set out in Table 13.

Similar to AWT it is usual that EfW will undergo a commissioning period prior to the full capacity of a facility being utilised. This usually takes the form of a period of 3-4 months, during which the facility will operate at approximately 30-40%, before then moving to 100% beyond this. Therefore the modelling assumes that 85% of facility capacity is utilised in the first year of operation, and the total capacity is used from year two onwards.

9.2. Scenario assumptions

- **Table 13: Assumptions for Scenario H**

Description of element	Applies to stream	Assumption or supporting source
EfW capacity	MSW, C&I & C&D	It is assumed that 200,000 tpa of EfW capacity for MSW and 200,000 tpa of EfW capacity for C&I will become available in the SMA in 2019-20 (reflecting the long lead-in time and likely location of such facilities). In addition to this it is anticipated that an existing facility may be expanded in

Description of element	Applies to stream	Assumption or supporting source
		order to allow it to handle 100,000t of C&D from 2019/20.
EfW and AWT inputs	Domestic MSW	In line with the draft EfW policy, those councils which operate a three-bin kerbside collection including food (i.e. recycling, organics and residual) will be able to send their residual waste directly to EfW (while those with a one-, two- or three-bin system, without food, will need to send the material through AWT first, with the residue then being sent to EfW). Data on councils' collections (source 33) shows the level of provision of three-bin services. According to these figures, whilst 84% of SMA households are in councils which currently have a three-bin system, only 35% will also have a food waste collection in place by 2018/19 (source 59) and so have residual waste suitable for going to EfW. In 2019-20, taking AWT residues into consideration (as in Scenario E), this amounts to a sufficient tonnage to fill the assumed total capacity available described above. From a modelling perspective, rejections from dry recycling MRFs are assumed to be landfilled. EfW input is assumed to be sourced solely from the residual stream as the eventual diversion rate is identical, however it is noted that the high calorific value of the MRF rejection stream would make it a likely target for diversion to EfW. EfW bottom ash is considered to be landfilled, although it might be that recycling outlets could be found for a proportion of this material. In line with UK averages 90% of the input mass is considered to be lost from combustion, leaving the remaining 10% as incinerator bottom ash (IBA).
MRF and AWT residues	C&I	The draft EfW policy allows for residual waste from MRFs or organics processing facilities to be sent to EfW. Building on the increases in recycling assumed by Scenario G, it is considered likely that there will be a sufficient tonnage of such residual waste to fill the assumed C&I capacity described above.
Combustible	C&D	The draft EfW policy allows for residuals from C&D resource

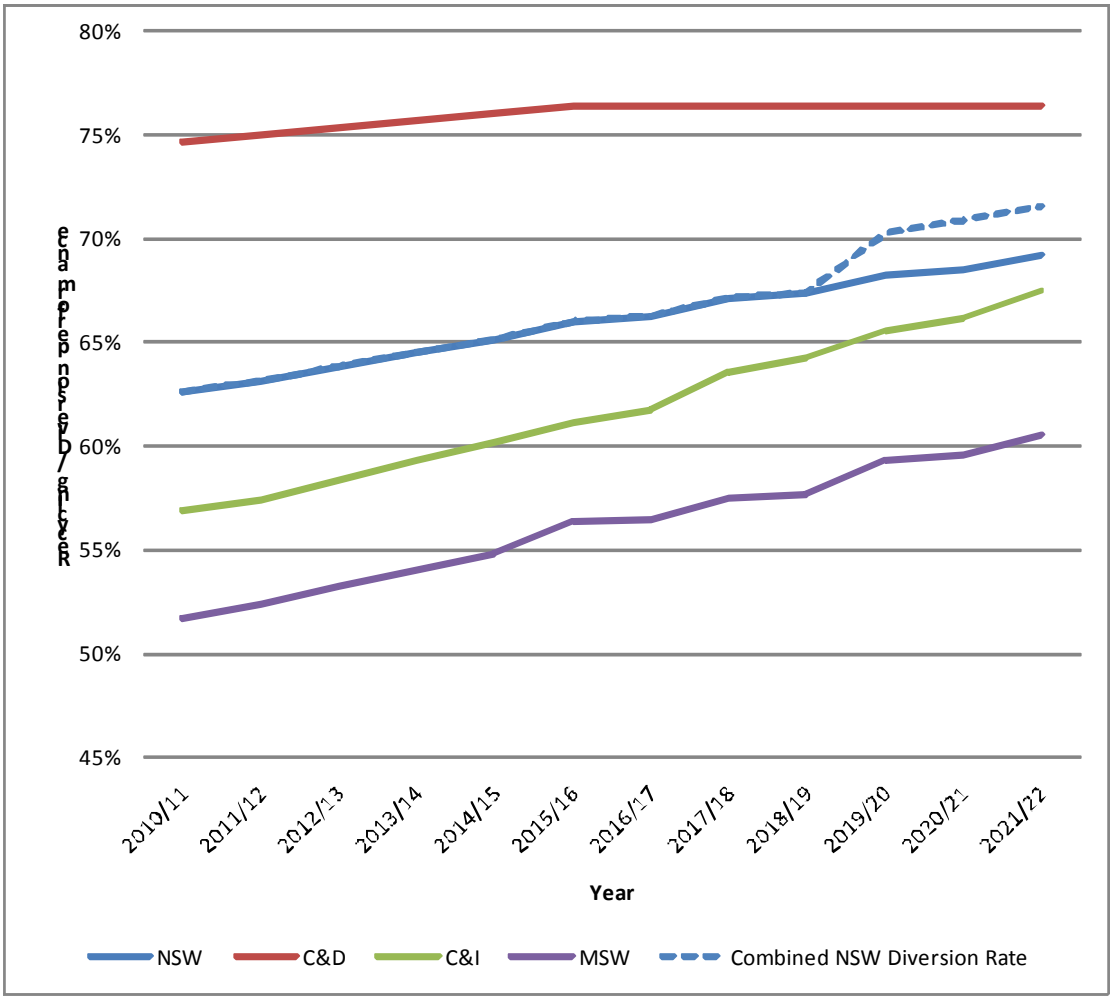
Description of element	Applies to stream	Assumption or supporting source
elements		recovery facilities to be sent to EfW. Therefore one site with a capacity of 100,000t is modelled from 2019/20 to accept C&D sourced refuse derived fuel.

9.3. Modelling outputs

Previous scenarios have shown changes in performance due to increases to the recycling rate. This scenario shows an increase in diversion from landfill being achieved not just through increased recycling but through the use of EfW. For example if there were 100t to begin with and 50t were recycled with the remaining 50t being landfilled, a 50% recycling rate would be achieved; as well as 50% of the material would have been diverted from landfill. If the situation were then changed so that from the 100t, 50t was recycled, but the remaining 50t was split equally between EfW, (25t input with 2.5t output as IBA to landfill), and direct landfill (25t). This would result in the same 50t of the original 100t being recycled, and therefore the same 50% recycling rate, but only 27.5t of the 100 ending up in landfill, so the rate of diversion from landfill would increase from 50% to 72.5%. This concept has been applied to the outputs below (as shown on Figure 8 with a dashed line).

Table 14 therefore shows the calculated overall diversion from landfill across the years which results from this scenario: it can be seen that this rate is higher than the recycling rate shown in Figure 8.

- **Figure 8: Outputs for Scenario H**



Once the Energy from Waste technology is introduced to the waste management system, the recycling rate figures need to be considered alongside the figures relating to diversion of materials from landfill. These figures are shown in the table below.

- **Table 14: Diversion from landfill (overall effect of EfW and Recycling, across all streams and areas)**

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Total waste generated (t)	17,765,014	17,904,505	18,045,621	18,219,598	18,407,721	18,595,542	18,783,556	18,971,388
Remaining to landfill (t)	6,113,323	5,977,088	5,916,511	5,714,284	5,681,067	5,183,728	5,111,084	5,022,271
Diversion from landfill	66%	67%	67%	69%	69%	72%	73%	74%

See Table 13 in Appendix B for output figures for this scenario.

10. Scenario I (MSW & C&I) – Combination option (Scenarios A to H excluding F)

10.1. Scenario description

This scenario takes the base business-as-usual situation of Scenario A and then applies all of the changes proposed by Scenarios A to E plus G and H. This includes the effect of waste prevention activities; increases in dry recycling as a result of expanded domestic MSW kerbside collections; moving to a weekly mixed food and garden collection and fortnightly residual collection for all households; the provision of domestic and commercial food waste collections; the treatment of collected tonnages with an increased use of AWT and the introduction of EfW. It combines the effects of implementing a range of good practice options for achieving improvements in recycling and recovery performance across NSW. The assumptions for the scenario are detailed in Table 15.

10.2. Scenario assumptions

- **Table 15: Assumptions for Scenario I**

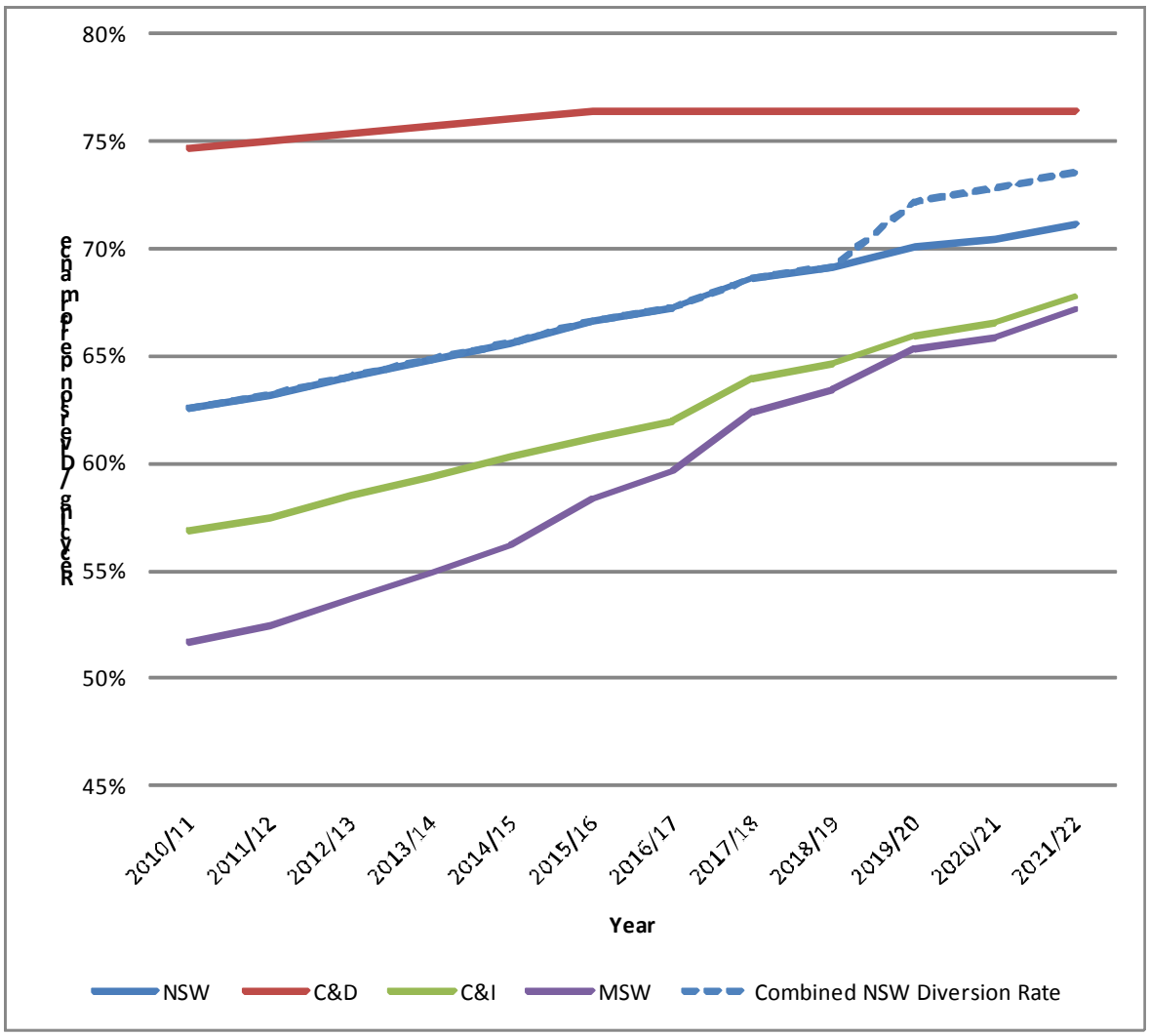
Description of element	Applies to stream	Assumption or supporting source
The application of assumptions from Scenarios A to H (excluding F)	All	The combined application of the assumptions in the individual Scenarios A to E plus G and H. The increased dry recycling diversion assumed in Scenario D as a result of moving to a fortnightly residual bin collection has not been included. This is because both Scenario C; through the enhancement of dry recycling service provision and scope, and Scenario D; through the reduction in residual service frequency, proposed an increase in dry recycling diversion rates. Based on the assumed composition and initial diversion rates reported (source 47), if both of these individual increases were applied the domestic MSW material diversion rate would exceed 100% for some areas. Therefore, for Scenario I dry recycling rates are only increased in line with the rates proposed in Scenario C.

10.3. Modelling outputs

Figure 9 summarises the outputs of Scenario I. As expected when combining all previous scenarios, recycling rates across all three streams increase well above their starting points. By 2021-22 the recycling rates for MSW and C&I have increased respectively to 14% and 10% above the business-as-usual levels in Scenario A.

The outputs of scenario I shown as solid lines in Figure 9 (and in Table 14 in Appendix B) represent the recycling performance expected without EfW. Table 16 shows the potential increase in diversion of waste from landfill disposal when EfW is included as a waste recovery treatment option. This is shown as a dotted line in Figure 9.

- **Figure 9: Outputs for Scenario I**



- **Table 16: Diversion from landfill (overall, across all streams and areas)**

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Total waste generated (t)	17,765,014	17,904,505	18,045,621	18,219,598	18,407,721	18,595,542	18,783,556	18,971,388
Remaining to landfill (t)	6,113,323	5,977,088	5,916,511	5,714,284	5,681,067	5,183,728	5,111,084	5,022,271
Diversion from landfill	66%	67%	67%	69%	69%	72%	73%	74%

Table 16 shows how the diversion rate is increased as a result of the EfW treating waste from 2019-20. As covered in the glossary, diversion rate differs from recycling rate in that it measures the amount of material which does not end up in landfill, rather than how much is recycled or composted. The addition of the EfW capacity has the effect of increasing diversion rates by ~5 percentage points; a value which could be increased further if more EfW capacity were to be made available.

See Table 14 in Appendix B for output figures for this scenario.

11. Scenario J (MSW and C&I) – Stretch Scenario

11.1. Scenario description

This scenario takes Scenario I, which itself was a combination of the preceding scenarios, and highlights a number of areas (as set out in Table 17) identified as being where further gains could be made by way of stretch targets. In order not to diverge from previous reports on disposal infrastructure and to take into consideration the timescales needed to put these facilities into place, no further residual treatment has been projected within the timescale considered by this report. However, the outputs of Scenario I would suggest that there is scope for further development here (i.e. further facilities to deal with the tonnages which are still going to landfill), particularly outside the SMA, where currently proposed developments are focused.

Scenario J therefore investigates the potential for reducing MRF rejection rates, whilst increasing the capture of a number of material streams where diversion could potentially be increased.

11.2. Scenario assumptions

- **Table 17: Assumptions for Scenario J**

Description of element	Applies to stream	Assumption or supporting source
Application of assumptions from Scenario J	All	The combined application of the assumptions from the individual Scenarios A to H (excluding F), as for Scenario I.
Material diversion	Domestic MSW	Scenario D suggested a 'medium' level yield from food waste collections of 2.6kg/hhld/wk, which was based on draft figures available from the EPA. The same draft figures suggest that a 'high' level yield could reach as much as 3.4kg/hhld/wk. Scenario J therefore assumes that a high yield of 3.4kg/hhld/wk be achieved across NSW's domestic properties. Plastics are identified as a stream where significant tonnages remain in the residual stream in most areas. It is therefore suggested that focus could be given to increasing

Description of element	Applies to stream	Assumption or supporting source
		awareness of the collection of these and potentially allowing for the widespread collection of plastic wrapping and rigid plastics which may not be currently recycled. For the purposes of modelling this has been represented by an increase of ten percentage points or to a capture rate of at least 50% by 2019-20 from the currently modelled position.
Material diversion	C&I	As with the domestic MSW stream, food waste and plastics can be identified as streams where there is definite scope to increase diversion rates above those already proposed in earlier scenarios. In addition to this the paper and cardboard stream also appears to offer an opportunity to increase diversion. Scenario J therefore models double the increase in diversion rate as was assumed for scenario G for paper and cardboard and food waste[i]; whilst plastics will be assumed to reach a 40% diversion rate in each area by 2021-22. N.B. in the ERA the food waste rate increase is not doubled as a rate of 51% is already reached in 2021/22.
MRF Rejection rate	Domestic MSW	From the assumption made in scenario C, that MRF rejection rates would decrease by 1 percentage point as a result of the greater awareness created through promotion of improved kerbside recycling services; initial rejection rates in 2015-16 are projected to be: ▪ SMA & ERA 6% ▪ RRA 8% ▪ NRA 11%. Optimised segregation methods and improved resident awareness could potentially lower these rejection rates; Scenario J therefore assumes that rejection rates across all areas will continue to reduce to 2.5% by 2021-22 (an ambitious improvement).
Combustible element	C&D	As noted in the scenario description H, above residual treatment expansions have been proposed in this scenario (EfW). However the modelling outputs suggest there is

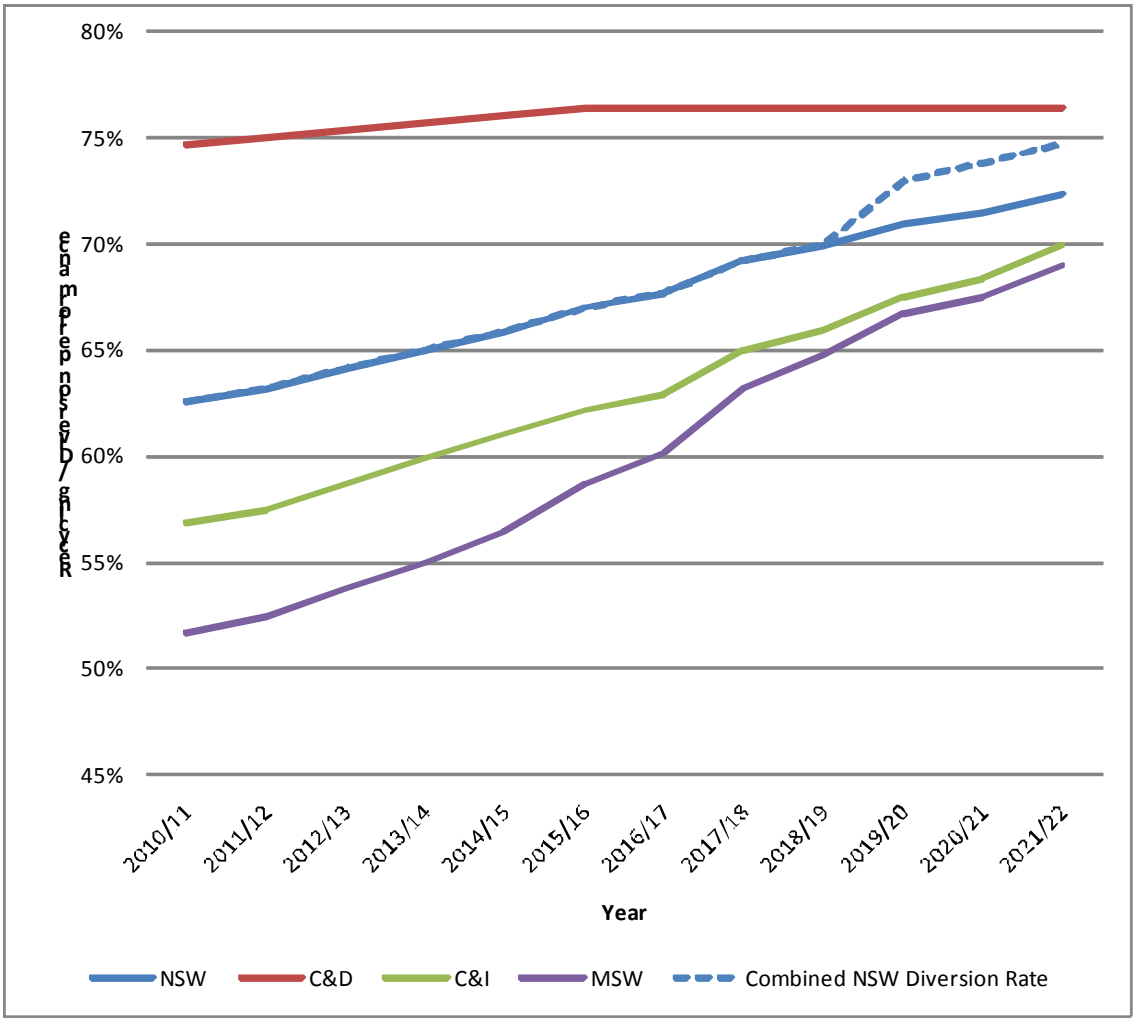
Description of element	Applies to stream	Assumption or supporting source
		potentially scope for further treatment of this stream ~50,000t additional capacity, (i.e. material going to landfill which could be treated by EfW for example).

11.3. Modelling outputs

The outputs from Scenario J are shown in Figure 10. It can be seen that the MSW, C&I and therefore the overall NSW recycling rate are lifted several percentage points above the figures from the outputs of Scenario I. For MSW and C&I, this means that the 2021-22 recycling rates are respectively 17% and 13% above the levels in the business-as-usual Scenario A.

The outputs of scenario J shown as solid lines in Figure 10 (and Table 15 in Appendix B) represent the recycling performance expected without EfW. Table 18 shows the potential increase in diversion of waste from landfill disposal when EfW is included as a waste recovery treatment option. This is shown as a dotted line in Figure 10.

- **Figure 10: Outputs for Scenario J**



- **Table 18: Diversion from landfill (overall, across all streams and areas)**

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Total waste generated (t)	17,765,014	17,904,505	18,045,621	18,219,598	18,407,721	18,595,542	18,783,556	18,971,388
Remaining to landfill (t)	6,063,656	5,909,445	5,836,155	5,614,814	5,538,468	5,024,222	4,925,783	4,813,638
Diversion from landfill	66%	67%	68%	69%	70%	73%	74%	75%

Table 18 shows that the inclusion of EfW increases diversion rates by ~5 percentage points. See Table 15 in Appendix B for output figures for this scenario.

12. Scenarios K, L and M - C&D sector

A separate report was subsequently prepared by SKM that focuses on further performance improvements in the C&D sector. The full report is at Appendix E and provides details of the assumptions made in modelling additional potential improvements for this sector. A summary of those findings are provided in this section for ease of reference. Scenario K modelled potential improvements in the C&D sector and these effects were then added to the combination scenarios I and J which represented the cumulative effects of the previous scenarios, that were focused on MSW and C&I waste.

The modelling outputs for scenario K alone are shown in Figure 11 and illustrate the C&D recycling performance across each of the four NSW areas, as well as a combined performance for NSW. For this scenario, the main materials identified for potential improvements were: aggregates and soil based wastes; timber; garden and vegetation waste; and plasterboard.

The improvements modelled in scenario K increases C&D recycling from 75% in 2010/11 to 79% by 2021/22. While a number of individual material streams were modelled to increase recycling rates quite significantly; the relative size of these streams is quite small when compared to the already well performing materials or those such as asbestos which will continue to require landfill.

- **Figure 11: Scenario K - C&D recycling rate by area and combined recycling for NSW**

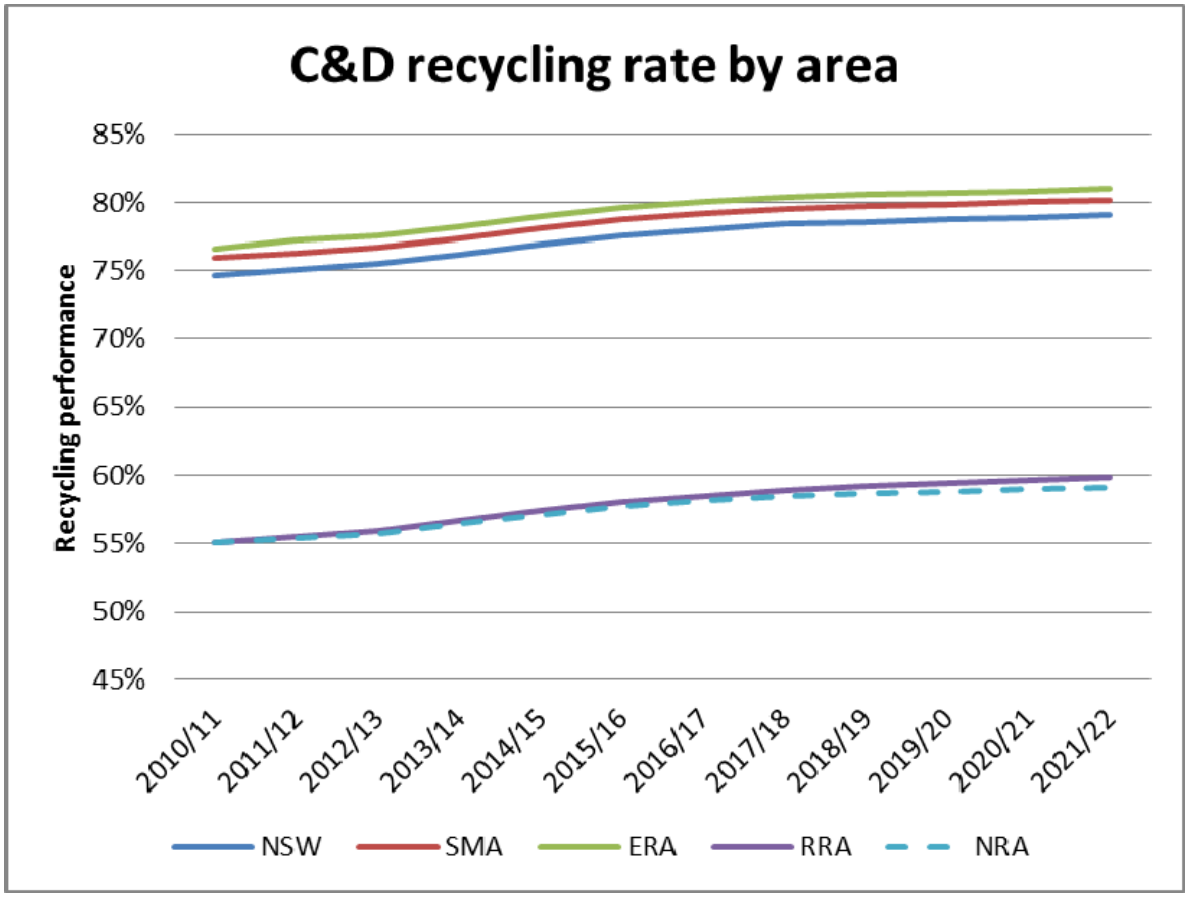


Figure 12 shows the effect of the additional modelled improvements in the C&D sector when added to scenario I (combination option - scenarios A to H, excluding F). The effect of the C&D improvements on the overall NSW combined recycling rate in scenario I in 2021-22 increases the rate from 71% to 72% while the diversion rate is increased from 74% to 75%.

See Tables 5, 6 and 7 of Appendix E for output figures for recycling and diversion rates shown in Figure 12.

- **Figure 12: Scenario L (combined I and K) Recycling and diversion rates across all steams including additional C&D improvements**

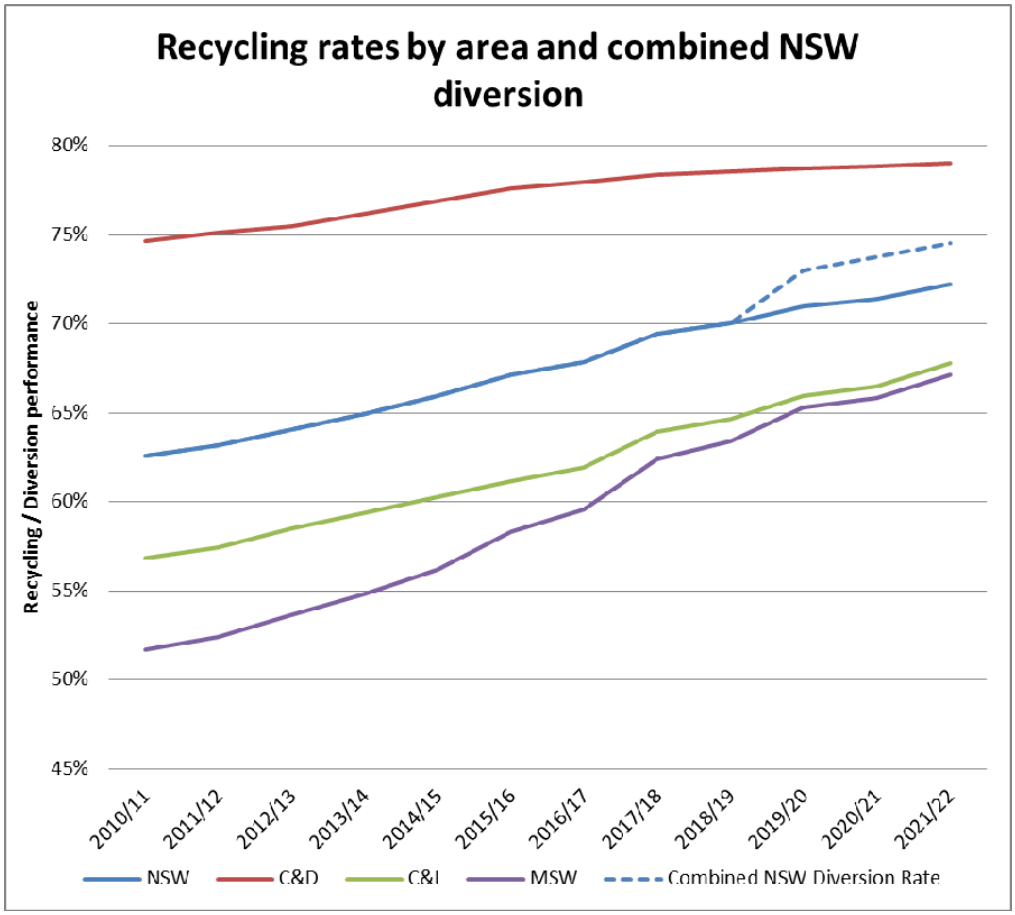
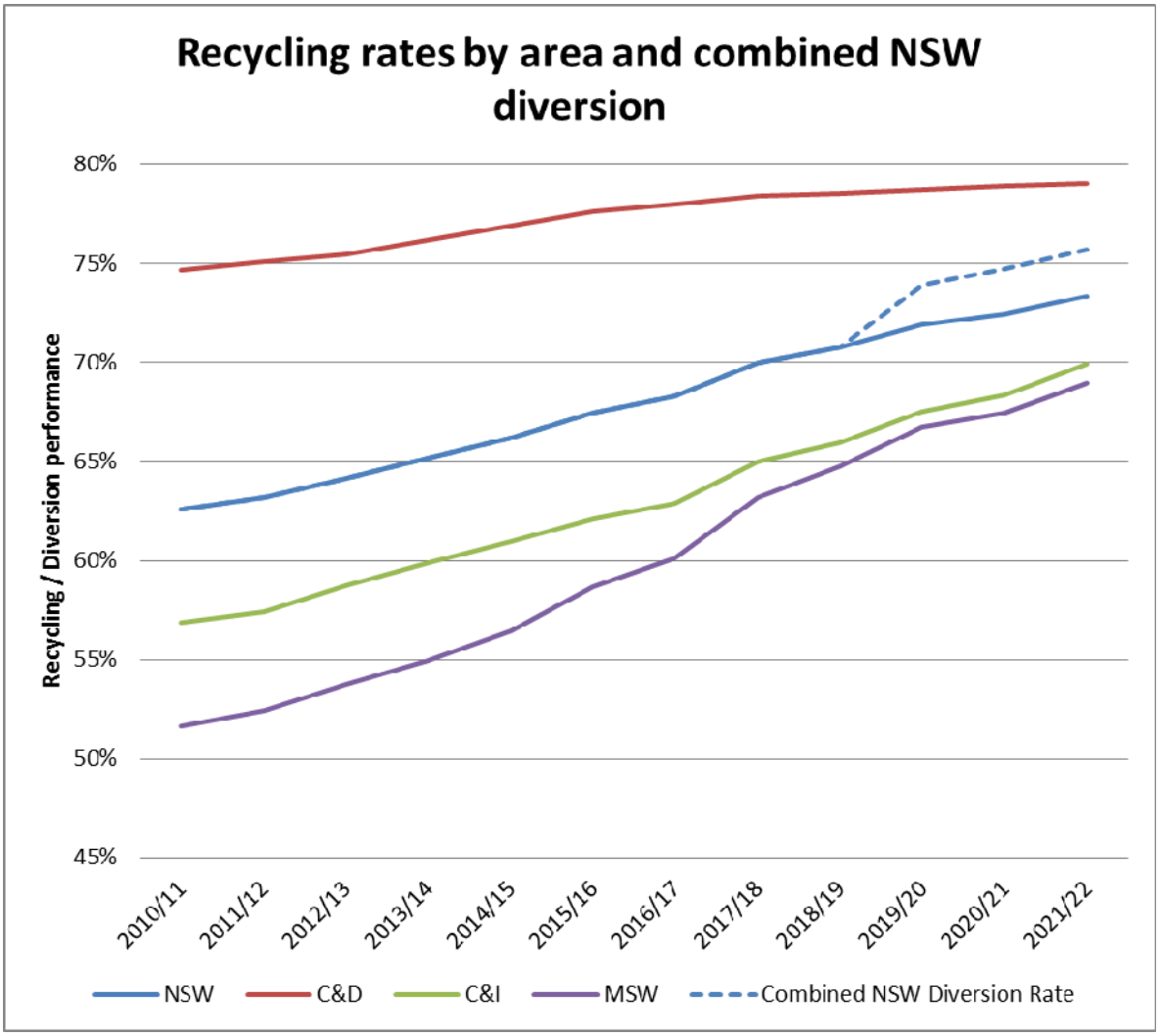


Figure 13 shows the modelled outcomes from scenario M which assesses the impact of adding the C&D modelling changes in scenario K to Scenario J ("stretch" scenario). The effect is to take the overall NSW recycling rate across all streams in 2021-22 from 72% to 73% while the diversion rate is increased from 75% to 76%.

See Tables 5, 6 and 7 of C&D report at Appendix E for output figures for recycling and diversion rates shown in Figure 13.

- **Figure 13: Scenario M (combined J and K) "Stretch" recycling and diversion rates across all steams including additional C&D improvements**

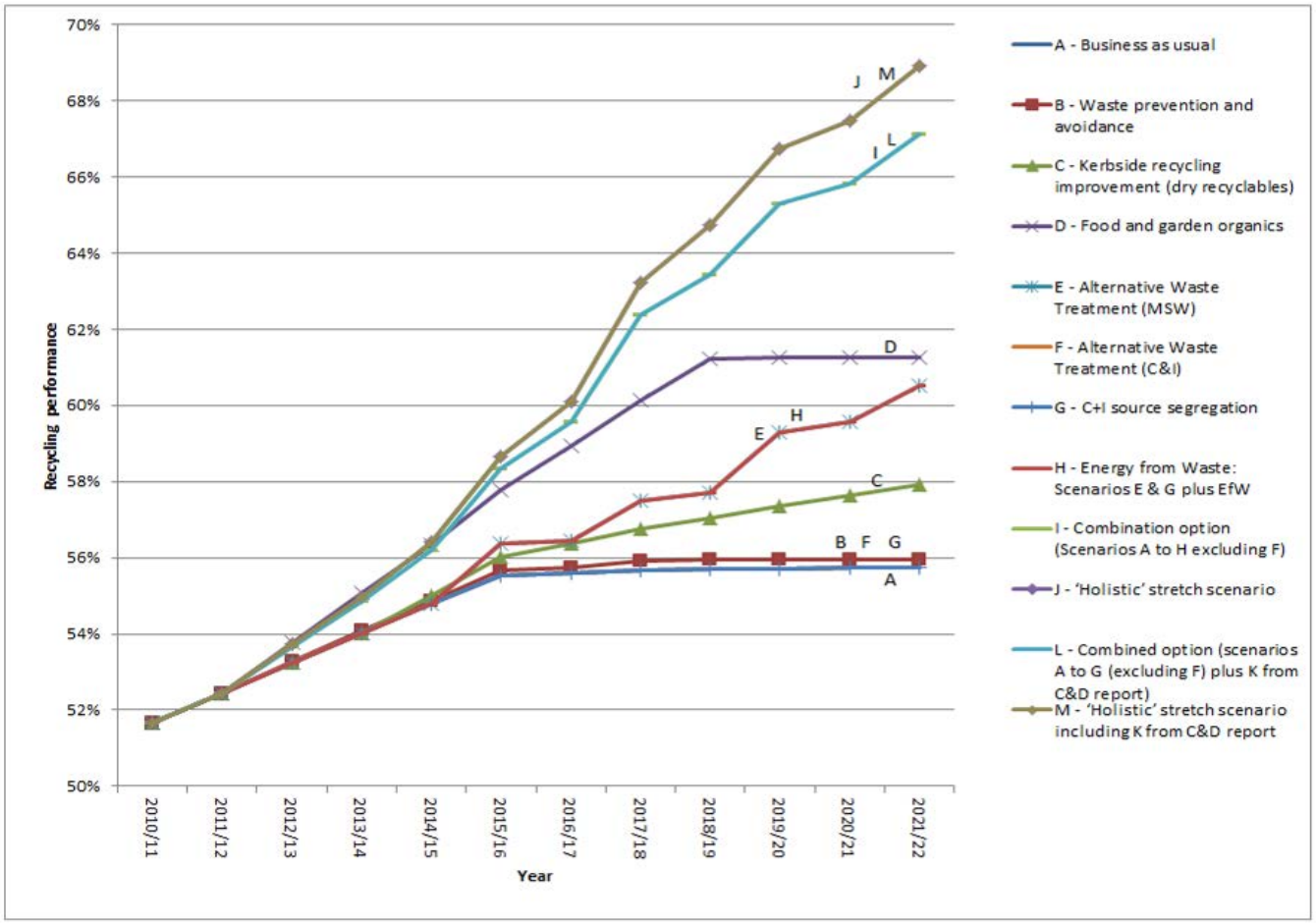


13. Summary and conclusions

This section draws together results from across the scenarios described in the previous sections. The scenarios modelled projected recycling rates to 2021, for the purpose of developing a new Waste Strategy that establishes longer term benchmarks. The focus is not on the modelling of performance against the current recycling targets which stretch to 2014. Information on performance against these targets can be found in biennial Progress Reports on the NSW EPA's website at http://www.environment.nsw.gov.au/warr/index.htm

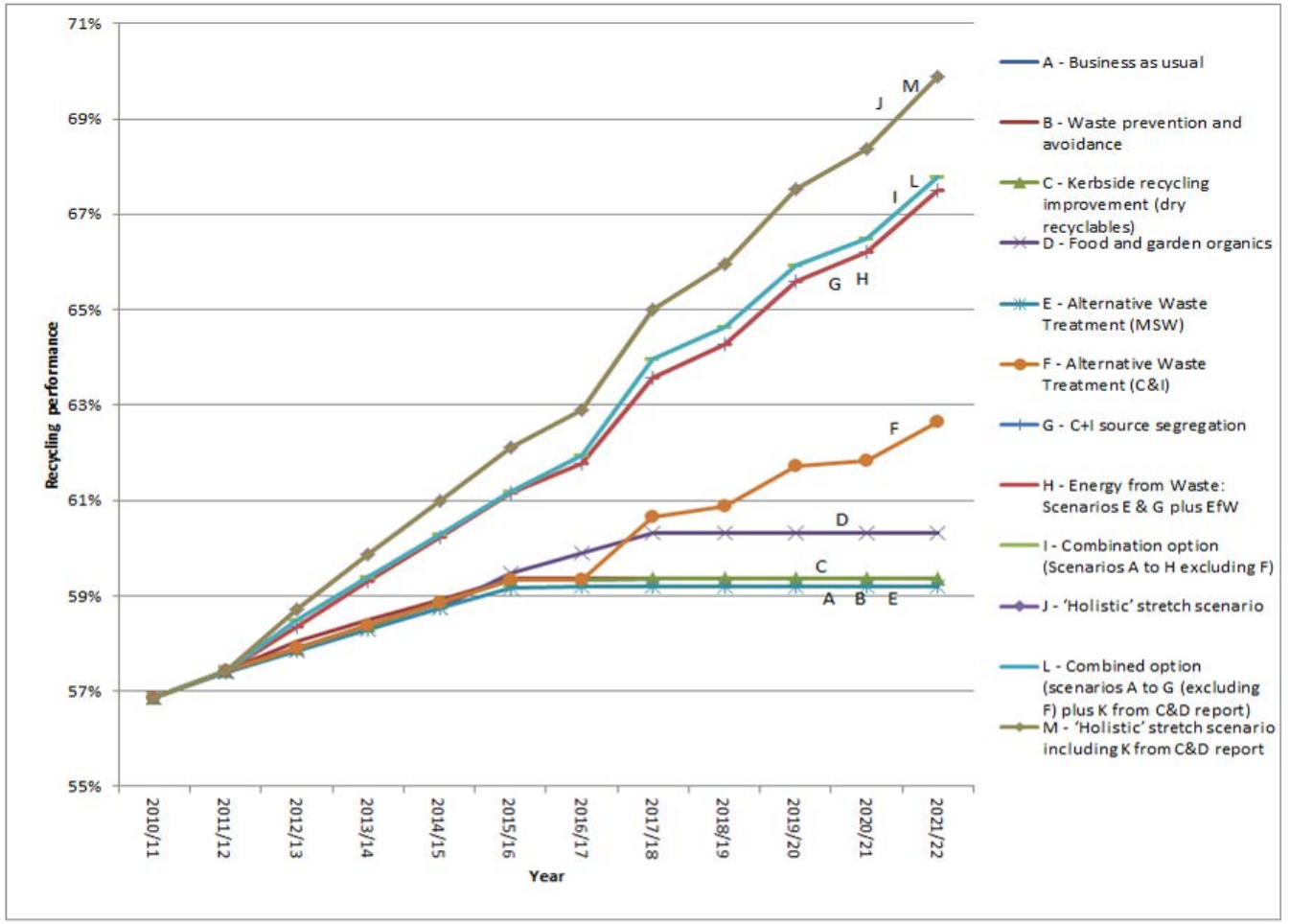
The MSW, C&I and C&D recycling performances across the scenarios are shown in Figures14, 15 and 16, respectively.

- **Figure 14: MSW recycling performance by scenario**[12]



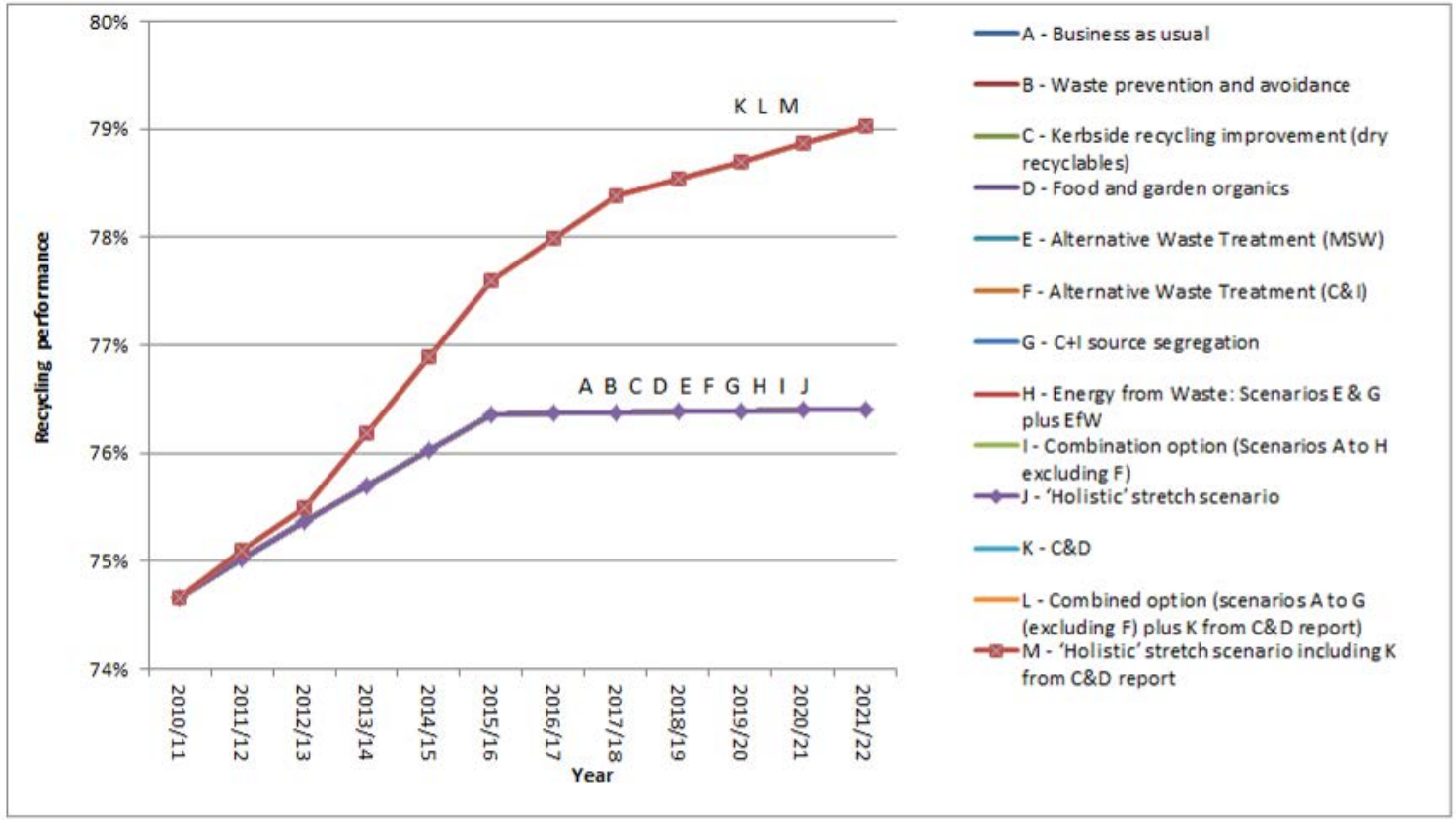
[12] NB: Scenarios E and H; B, F and G; I and L; and J and M have the same performance profiles for this stream and so the individual lines are overlaid.

- **Figure 15: C&I recycling performance by scenario[13]**



[13] NB: Scenarios G and H; A, B and E; I and L; J and M have the same performance profiles for this stream and so the individual lines are overlaid.

- **Figure 16: C&D recycling performance by scenario[14] including outcomes from scenario K (reported in Appendix E)**



[14] NB: All scenarios have the same performance profile for this stream and so the individual lines are overlaid.

These charts therefore show, for each stream, the range of recycling performance from business-as-usual (Scenario A) at the bottom end to the “combination” and “stretch” options (Scenarios L and M) at the best-performing end.

For the sake of consistency these charts show *recycling* performance for the scenarios, but (as discussed in the course of this report) those scenarios which introduce EfW will also have tonnages diverted from landfill which are not recycled but used to generate energy. In considering future targets, it may be important therefore for the EPA to consider targets relating to *diversion from landfill* rates as well as recycling rates (i.e. the overall rate of diversion from landfill that will occur due to recycling and other resource recovery).

In meeting any targets set on the basis of this Modelling Report, key points to note are:

- The modelling suggests targets will not be achieved by single measures alone, but it is a combination of measures which will help to achieve the targets.

- Modelled changes to MSW performance have focussed on domestic MSW rather than non-domestic MSW because there is very limited information (composition, current performance etc.) relating to the latter. The 2010-11 data suggests that non-domestic material is 33% of total MSW – the lack of modelled performance improvement to this stream therefore greatly restricts the overall change to MSW recycling rates. If the levels of performance improvement considered for domestic MSW were replicable for non-domestic MSW then clearly the overall MSW performance could be greatly improved.

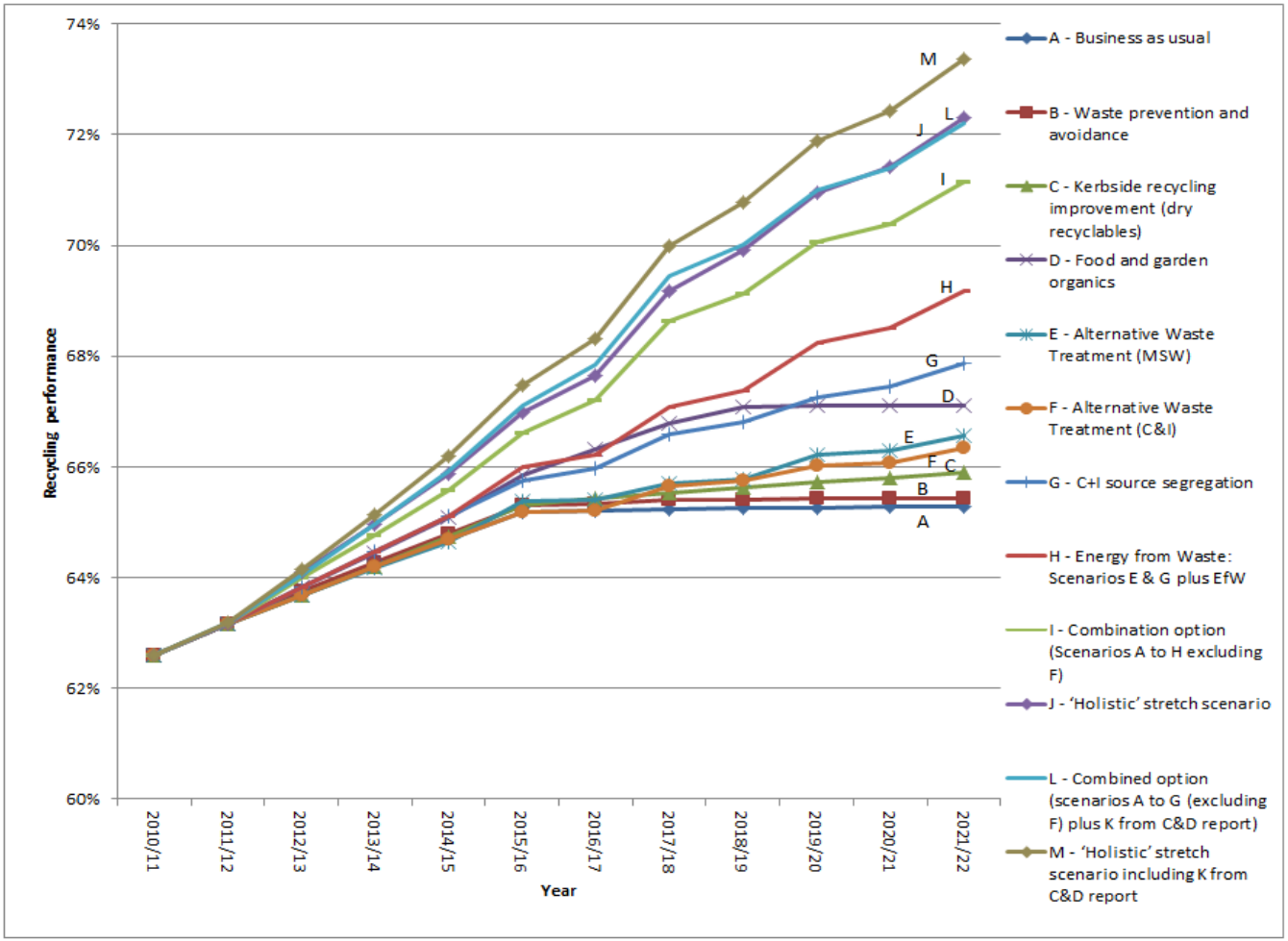
- Performance improvements for C&I have been modelled in accordance with the available information on composition etc. but as described earlier in this report, available data are of mixed quality and come from a variety of sources and it may be that further performance improvement is possible but the available data are not sufficient to support this (for example, updated composition data might show that the overall C&I stream contains more recyclables than it has been appropriate to assume in the course of this piece of work).

- Potential performance improvements for the C&D sector (in a separate report at Appendix E) were identified for some material waste streams in particular: aggregates and soil based wastes; timber; garden and vegetation waste; and plasterboard. While these materials were modelled to increase recycling rates quite significantly; the relative size of these streams is quite small when compared to the already well performing materials or those such as asbestos which will continue to require landfill.

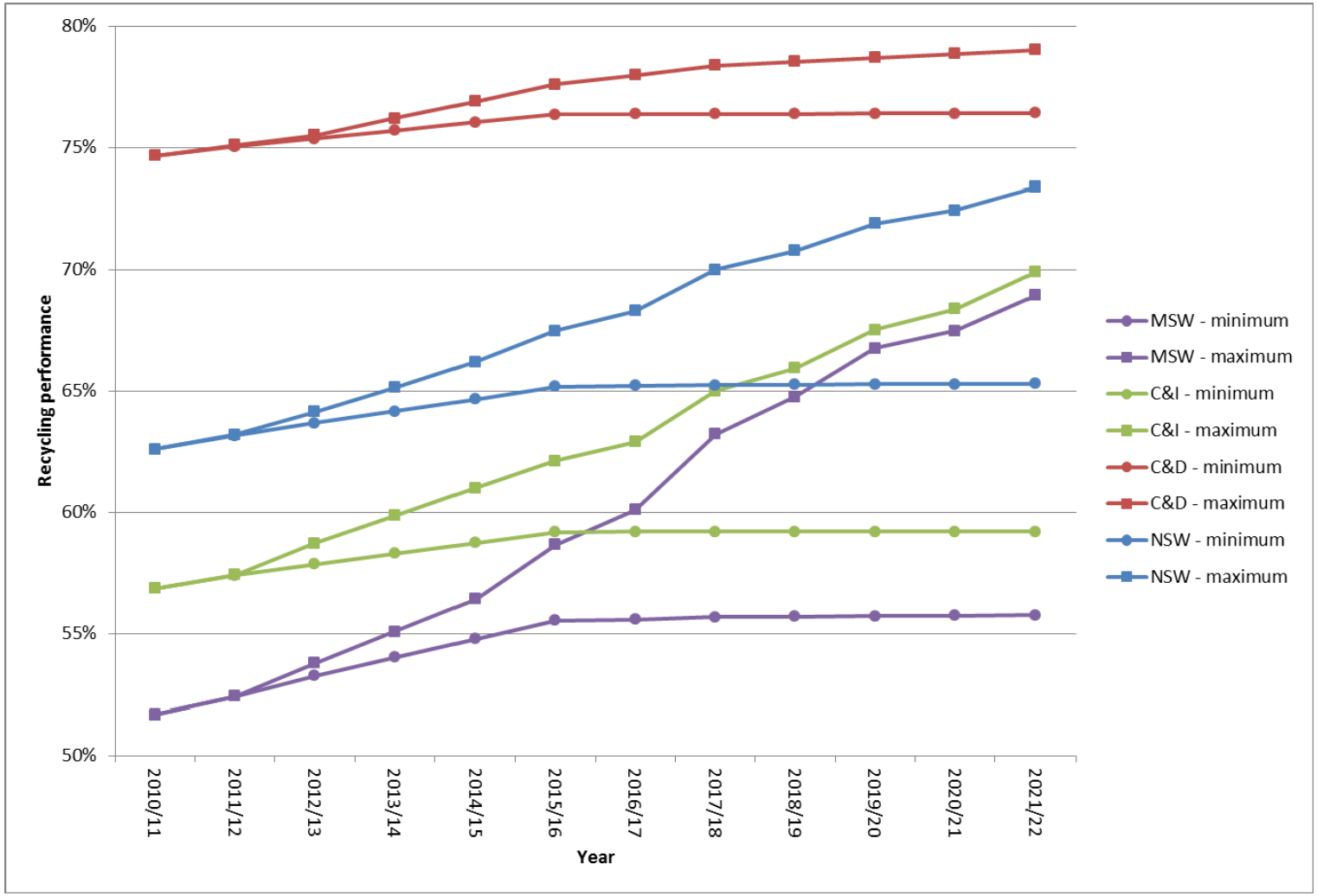
The bullet points listed above identify a key general point about the modelling: that the changes have as far as possible been kept within the realms of what is considered possible according to available data, but improved and more accurate data might reveal that assumptions have been too conservative and further improvements in performance are possible.

Figure17 shows the level of recycling performance for each scenario for NSW as a whole (i.e. the combined effect of changes in MSW, C&I and C&D) and Figure 18 shows, for each stream and overall, the minimum and maximum recycling performances across scenarios (i.e. the worst- and best-performing of the MSW scenarios, the worst- and best-performing of the C&I scenarios, etc.) to summarise the range of achievement of the modelled scenarios.

- **Figure 17: NSW recycling performance (all waste sectors combined) by scenario**



- **Figure 18: Minimum and maximum recycling performances across scenarios by stream and overall**



The modelled scenarios and the supporting assumptions and data used for them, together with the caveats above, therefore suggest that an appropriate stretching but achievable recycling target for C&I in 2021-22 would be 70%, for MSW approximately 69% (depending on what can be achieved with non-domestic MSW), and with C&D able to reach a recycling target of 79%. However, as has already been commented, more ambitious targets could be set but would need appropriate data to support their assessment – one possibility, therefore, could be to consider setting separate domestic and non-domestic MSW targets since more robust data appear to be available for the former than the latter. As noted above, it may also be appropriate to accompany targets on recycling performance with targets for overall diversion from landfill, taking into account the potential impacts of the draft EfW policy.