Circular Australia

UTS

Circular Economy Metrics

Case Studies for NSW

NOVEMBER 2022

Table of Contents

About the Project

The NSW government is aiming to drive a circular economy and has released its Circular Economy Policy Statement with a number of key principles and focus areas, including supporting innovation, sustainable procurement, enabling high quality consistent recycling, valuing organics, mainstreaming product stewardship, supporting reuse and repair, and circular design.

Despite being a stated policy objective, currently there is no common measure of NSW's progress towards a circular economy. Additionally, there is a need to extend the measurement of circular economy benchmarks beyond waste and materials, to address varied economic, social and regenerative dimensions. These benchmarks will be critical to drive change, reveal successes and future requirements in order to transition to a circular economy.

Circular Australia plays an important role in driving NSW's circular economy ambitions with a mission to deliver a zero-carbon circular economy in NSW through various initiatives, including: through the provision of data to the market and working collaboratively with businesses, government, researchers and individuals to remove barriers and scale the circular economy.

The Institute for Sustainable Futures at the University of Technology Sydney was commissioned by NSW Circular to research international best practice in circular economy metrics and to develop benchmarks to measure and report on NSW's progress towards a circular economy.

The intention was to consider a wide range of benchmarks including those that relate to: resource use, recycling, energy consumption, carbon emissions, water consumption and jobs. The reviewed metrics spanned a variety of circular economy actions, such as redesign, reducing consumption, use and reuse, repair, remanufacture, recycling, recovery, waste and disposal. The scope of analysis addressed different scales, ranging from local government areas to state and national metrics.

Methodology

The research team undertook a number of steps to scope, identify, assess and short-list metrics for this study. The key steps are set out here.

1. The team started with a framework of three circular economy principles from the Ellen Macarthur Foundation (EMF) to help scope and consider a broad range of metrics. These were:
   - Eliminate waste & pollution
   - Keep products and materials in use
   - Regenerate natural systems
2. The team conducted a comprehensive review of metrics in academic papers and in grey literature with reference to these three circular economy principles, and then mapped them against five key themes as well as the dimensions of the circular economy.

Key themes and dimensions of the circular economy considered in the review:

Key themes	Dimensions of the circular economy
Material use	Redesign
Energy & greenhouse gas emissions	Reducing consumption
Jobs & investment	Use & reuse
Water	Repair
Natural & regenerative environment	Remanufacture
	Recycling
	Recovery

3. The initial search found 47 potentially relevant metrics. An appraisal of these metrics led to the exclusion of some metrics that were less directly relevant to the circular economy, and those that were substantively very similar or duplicative in terms of the whole suite of metrics being considered. The result was a “long list” of 31 metrics for further investigation (See Report 1: 'Circular Economy Metrics - A Review').
4. The team then reviewed each metric on the long list, documenting key information such as current examples of its use, the method of calculation, the scale, availability of data for NSW, and the nature of the metric as modelled, measured, absolute or relative.
5. The team then conducted a traffic light assessment using the gathered information, with regard to the ease of data collection, the circular economy focus, and the alignment of the metric with regards to NSW policy. The criteria used for the traffic light assessment is shown in the table below.
6. Based on this assessment, six metrics were shortlisted for further investigation for application in tracking circular economy progress in NSW. While all six metrics had a strong circular economy focus, they varied widely in scope and ease of application. They were used to highlight both the benefits and some of the challenges in applying metrics at a national, state and precinct level.

Methodology cont.

Updated Criteria used for traffic light assessment of metrics

Criteria & Performance	Grey	Yellow	Green
Ease of data collection	Data is not yet publicly available and future availability is not known, or significant amount of research is required to develop the methodology for data collection	Only some of the data is publicly available, or data is not available but the method for obtaining data is known, or source data is available, but some work is required to arrive at metric.	Data is readily available and published.
Circular economy focus	Metric is relevant to a CE but primarily supports a linear economy (e.g. waste to energy). This can also be an established metric used to report on other environmental outcomes but not directly related to CE.	Metric provides baseline information that supports the circular economy (e.g. waste generation), or adapts an existing metric to link more closely to CE goals and strategies (e.g. waste generation linked to DMC).	New or emerging metric that directly supports circular economy strategies – reduce, redesign, repair, reuse, remanufacture, share, recycle, recover etc.
Alignment with policy	Relevant CE metric but not directly supported by state or national policy.	Implied alignment stated in NSW policies and National Waste Policy CE objectives.	Aligns directly with stated NSW policies and National Waste Policy CE objectives.

1 **Framework for circular economy metrics**	**Three CE principles were adopted:** 1. Eliminate waste & pollution 2. Keep products and materials in use 3. Regenerate natural systems
2 **International literature review**	**Five categories of metrics were examined:** 1. Material use 2. Energy & GHG emissions 3. Jobs and investment 4. Water 5. Natural & regenerative environment
3 **Findings mapped against circular economy actions**	**CE actions:** 1. Redesign 2. Reducing consumption 3. Use & reuse 4. Repair 5. Remanufacture 6. Recycling 7. Recovery
4 **Long list of CE metrics**	1. 47 metrics were collated based on pre-defined criteria 2. Details of metrics were determined in terms of data inputs, method of calculation, scale, circular economy relevance
5 **CE metrics benchmarking for NSW**	1. CE benchmarking criteria established through consultation. 2. 31 CE metrics assessed for NSW with relevance to: data availability, CE focus, and alignment with NSW & national policy. 3. 6 metrics investigated and estimated (where possible) for NSW with next steps

Methodology cont.

Six circular economy metrics were shortlisted for further exploration, for application in tracking circular economy progress in NSW.

The first five metrics were chosen due to strong alignment with NSW and national policy, their scope including the drivers and enablers for recycling (such as investment and procurement), the industrial sector, data availability, and the potential to address objectives including greenhouse gas abatement, jobs and investment. Lastly, the circularity gap index was examined for its uses and limitations, as it is a prominent metric to determine economy wide circular resource use.

The following sections address each of these metrics in turn, and include an overview, details of the methodology for calculation (where this was possible), data sources, results of calculations or methodological assumptions for NSW and some discussion of applicability and next steps required in each case.

METRIC 1:
Carbon dividend of recycling materials

METRIC 2:
Planned new investment in recycling capacity

METRIC 3:
Green public procurement

METRIC 4:
Industrial symbiosis

METRIC 5:
Circular employment for reuse, repair and recycling

METRIC 6:
Circularity gap

CHAPTER ONE

Carbon dividend of recycling materials

1

An important benefit of recycling is that it reduces carbon emissions by avoiding landfill and the manufacture of new raw materials. This metric links progress towards material circularity with carbon reduction goals in NSW's Net Zero Plan.

Metric summary	
Description	Carbon savings from recovery of solid waste through material recycling or organics recycling processes (excludes stockpiles and energy recovery)
Calculation	Quantity of each material recycled (tonnes) multiplied by a carbon reduction factor (tonnes of CO2 equivalent per tonne)
Scale	State and LGA
Already reported for NSW?	Partial. Data is available on quantity recycled but not converted into CO2eq.
Modelled or measured? **Absolute or relative?**	Modelled Absolute
Data source/s	• Life Cycle Assessment (LCA) data in Green Industries SA (2019) • Online calculators for NSW or Victoria
Example(s) of use	**NSW Department of Planning and Environment (2021), Waste and Sustainable Materials Strategy 2041 (p. 15)** Australian Packaging Covenant Organisation (2020), Australian Packaging Consumption & Recycling Data 2018-19, p. 89

Metrics assessment for NSW

Ease of data collection	Circular economy focus	Alignment with policy

Carbon dividend of recycling materials

Introduction

Material recycling is one of the strategies that will help to achieve emission reduction targets including net zero by 2050. Recycling reduces greenhouse gas emissions by diverting materials from landfill and by reducing the need to manufacture new raw materials.

This metric links progress towards material circularity with carbon reduction goals in the NSW Government's Net Zero Plan, which includes a target of net zero emissions from organic waste to landfill by 2030. Diversion of organics to recycling avoids methane emissions from landfill.

The NSW Waste and Sustainable Materials Strategy 2041 notes that:

- emissions from organic waste breaking down in landfill make up more than 2% of total net annual emissions in NSW
- In addition, nearly half of global emissions are attributable to the use and management of materials and products. These emissions can be reduced by producing recycled materials and avoiding production of new materials

Methodology

There are at least two options for measurement:

The simplest, streamlined option is to measure the carbon dividend by multiplying the quantity of each material recycled (tonnes) by a relevant carbon reduction factor, (CO2 reduced/ waste recycled, CO2 tonnes eq) derived from previous LCAs. This is how the metric below was estimated.

A more rigorous approach is to undertake a full LCA to determine both avoided landfill emissions and avoided emissions in the life cycle of virgin materials.

Whichever method is used, one of the most significant carbon dividends is achieved by extracting and processing less raw material to meet a market need with recycled rather than virgin material.

How mature is the methodology?

There is no single method used to estimate avoided carbon emissions from recycling. Calculations vary depending on decisions about methodology, e.g. system boundaries and how the LCA deals with emissions avoided through the replacement of virgin raw materials.[1]

How is this metric being used in Australia?

- The Australian Packaging Covenant Organisation (APCO) measures carbon emissions that could be avoided if packaging that is currently disposed to landfill was recycled.
- In 2015 Sustainability Victoria commissioned an LCA of kerbside recycling which estimated greenhouse gas savings in Victoria.
- Green Industries SA also reports greenhouse gas emissions avoided through recycling.

1 See for example the discussion in Thinkstep (2021), **Life cycle assessment of courier bags on behalf of New Zealand Post** pp. 14-15

Estimated carbon dividend of recycling materials

In 2018-19, NSW avoided 4 million tonnes of GHG emissions from the recycling of non-hazardous solid wastes

How the metric was calculated

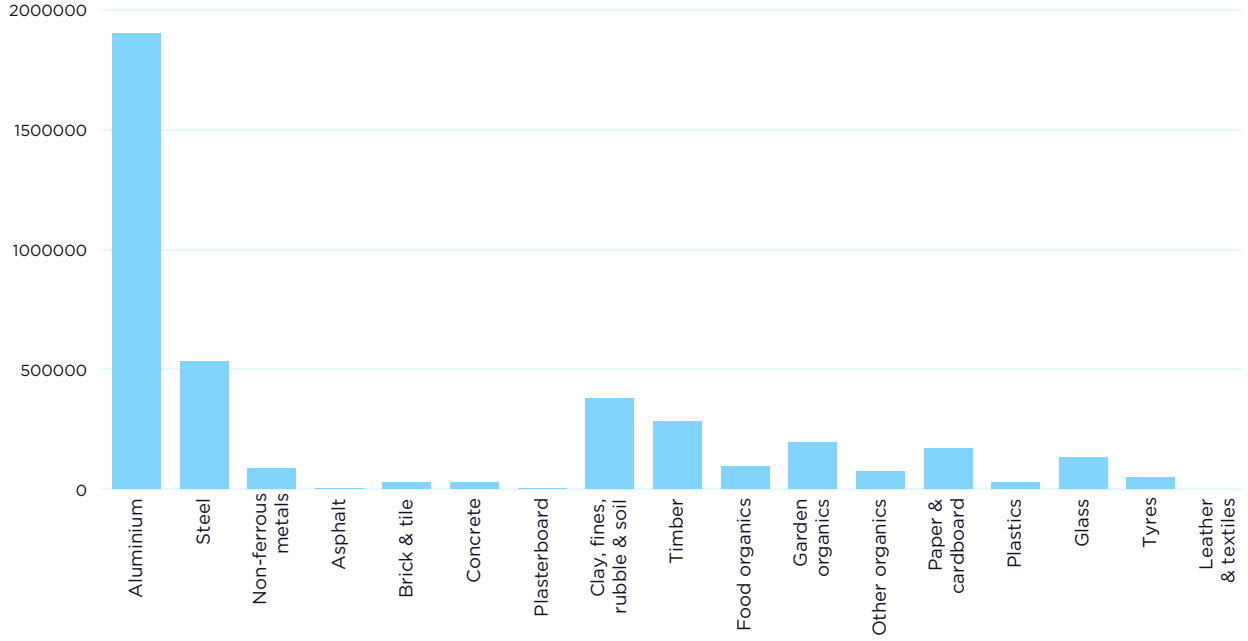
The quantity of non-hazardous materials recycled in NSW was multiplied by public carbon emission factors to estimate the amount of greenhouse gas emissions that were avoided due to recycling. Supporting data is provided in **Appendix 1.**

Discussion

The figure shows avoided carbon emissions (the 'carbon dividend') for materials recycled in NSW in 2018-19. The highest dividend was for aluminium due to its relative energy intensity, followed by steel, building and construction products (clay, fines, rubble and soil), timber and other organics.

The overall saving from recycling is estimated to be around 4 million tonnes. To put this into perspective, NSW greenhouse emissions from waste were estimated to be 5 million tonnes in 2019. This highlights the need to continue pursuing high waste diversion rates to support the NSW goal of net zero emissions by 2020. [2]

Avoided carbon emissions from recycling, NSW, 2018–19



2 NSW Government, NSW Emissions, climatechange.environment.nsw.gov.au/about-climate-change-in-nsw/nsw-emissions.

Next steps for NSW

This metric is recommended for further development by the NSW Government.

The carbon dividend for 2018-19 was estimated using generic emission conversion factors.

The next steps to develop the metric would be to:

- Establish the objectives of the metric and how it would be used by stakeholders, for example to support reporting against the NSW government's Waste and Sustainable Materials Strategy. This will inform a decision on the scope and level of rigour required to estimate the carbon dividend.
- Understand alternative methodologies to measure emissions associated with waste and recycling.
- Undertake research on carbon emissions associated with waste disposal and recycling in NSW to develop more relevant and up to date carbon conversion factors.
- Develop a system to calculate the carbon dividend on an annual basis.

CHAPTER TWO

Planned new investment in recycling capacity

2

Recycling targets and waste export bans are driving significant investments in new recycling capacity. Announcements of increased capacity are a leading indicator for local recycling rates.

Metric summary	
Description	Additional tonnes of recycling capacity arising from announced new investments (not yet operational)
Calculation	A database of announced new capacity for recycling (from the Recycling Modernisation Fund (RMF), other NSW Government grants and industry investments) was used to estimate total additional tonnes by material type. Going forward, this could be an annual or cumulative figure for announced capacity improvements.
Scale	National and State
Already reported for NSW?	Not in this form, although in 2021 the NSW Government estimated planned infrastructure expansions in A Guide to Future Infrastructure Needs.
Modelled or measured? **Absolute or relative?**	Measured Absolute
Data source/s	NSW Government grant announcements, Recycling industry media announcements, Federal Government RMF database

Metrics assessment for NSW

Ease of data collection	Circular economy focus	Alignment with policy

Planned new investment in recycling capacity

Introduction

Recycling targets and waste export bans are driving significant investments in new or expanded recycling infrastructure.

One of the targets in the National Waste Policy Action Plan is to achieve an 80% average recovery rate from all waste streams by 2030. The NSW Waste and Sustainable Materials Strategy 2041 commits to this target.

The Australian Government as well as state and territory governments are investing in new or expanded reprocessing capacity to absorb material that was previously exported. This includes mixed paper and cardboard, mixed plastics and unprocessed tyres, and to increase recovery rates.

This metric, which would enable government agencies to track planned new investments in recycling infrastructure, provides a leading indicator for the capacity of local recycling facilities and material recovery rates. It could be used to evaluate progress and identify gaps for particular materials.

Scope, data and gaps

Purpose

This metric can be used to monitor increased recycling capacity that is expected to come on stream over the next few years. The purpose is twofold:

- to evaluate the extent to which there is capacity to reprocess materials within NSW that would previously have been exported for recycling
- to highlight the increasing level of investment in one of the key circular economy sectors, i.e., material reprocessing.

How it is measured

This could be measured by maintaining a database of announced new or expanded capacity for recycling from NSW grants programs, the RMF and company investments. The aim would be to estimate total additional tonnes of capacity by material type. This could be an annual or cumulative figure for announced capacity improvements.

Data would be collected from public announcements, e.g. from government and industry media releases, as well as government funding programs where data is not publicly available. To provide an indicator of potential impact, the capacity would need to be compared to existing levels of recycling. To do that, the tonnes of new capacity for each material would be added to the most recent data on the quantity of material recycled to estimate future recycling levels.

How is this metric being used in Australia?

This metric is not currently being used, although some related data is published.

The Australian Government publishes high level data on grants received through the RMF, but some of this investment is for quality improvements rather than additional capacity. There is likely to be some double counting as it includes investments in sorting infrastructure as well as reprocessing.

The NSW Government publishes lists of grants approved under Remanufacture NSW, the Product Improvement Program, Major Resource Recovery Infrastructure and other programs but there is no aggregated data available on additional capacity linked to government grants.

Estimated planned new investments in NSW recycling capacity

Between end 2019 and August 2021, more than 400,000 tonnes of additional recycling capacity in NSW received funding through government grants.

How the metric was calculated

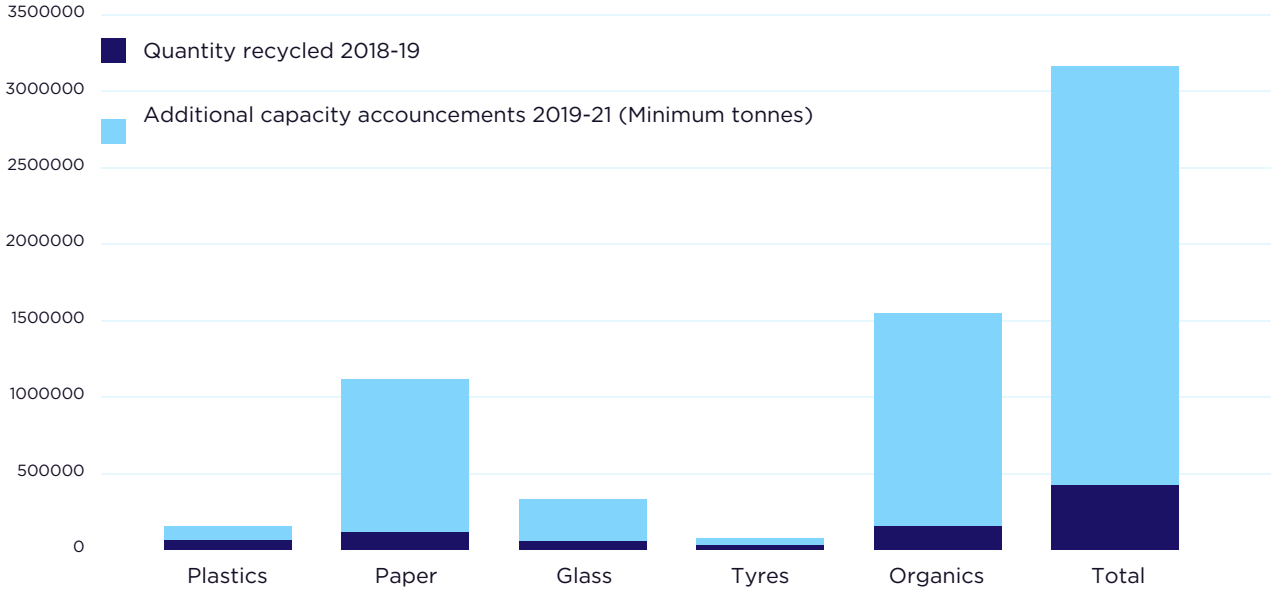
The estimated increases in recycling capacity and total government grants are taken from public lists of grants approved under Remanufacture NSW, the Product Improvement Program, Major Resource Recovery Infrastructure. This data underestimates the additional capacity as it is not always reported for individual grants. These announcements were made between December 2019 and August 2021.

- Recycling data for NSW is from the National Waste Report 2020. [3]
- The additional capacity was added to the quantity recycled in 2018–19 to show the potential impact on recycling levels in future.
- Supporting data is provided in Appendix 2.

Discussion

These announcements suggest an additional 400,000 tonnes of recycling capacity in NSW. Assuming all of the announced capacity is built and fully utilised, this would represent a 14% increase on the level of recycling in 2018-19. The impact on two materials will be particularly significant: an additional 70% capacity for plastics and 64% for tyres.

Announced capacity expansions relative to quantity recycled in NSW (2018-19)



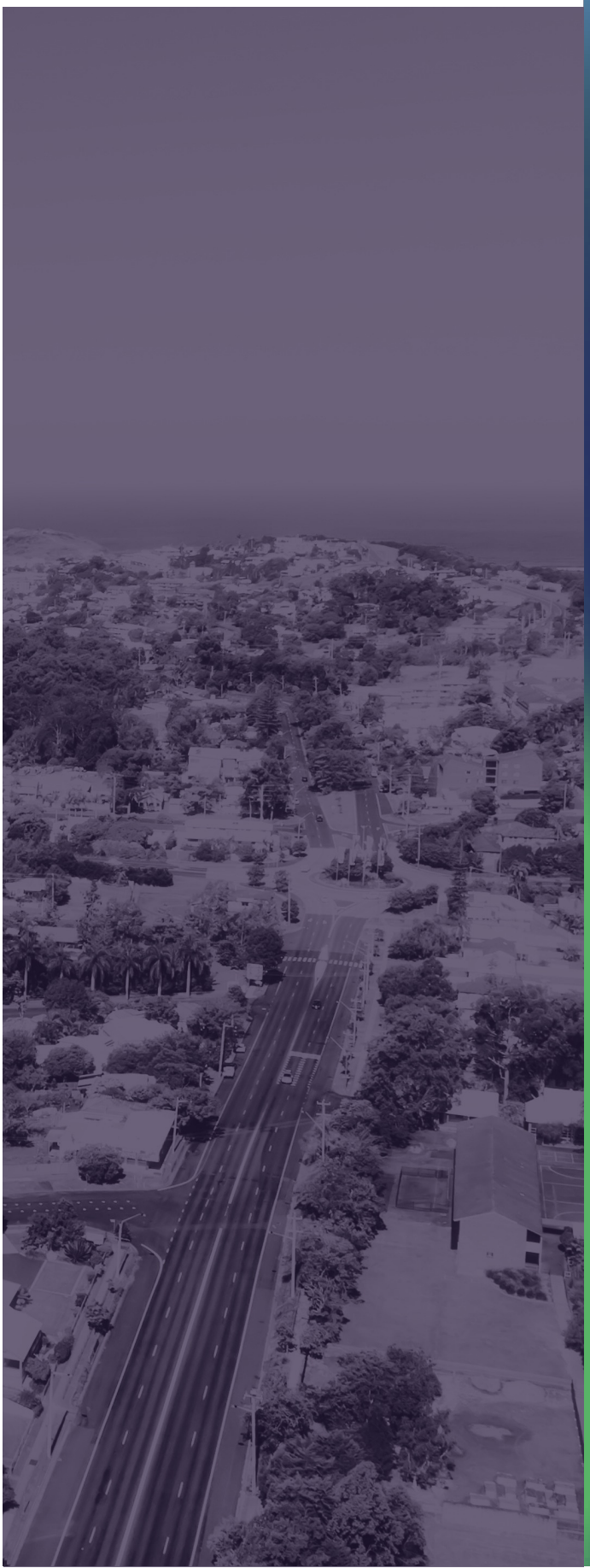
3 Blue Environment (2021) **National Waste Database 2020**, Prepared for Department of Agriculture Water and Environment.

Next steps for NSW

This metric is recommended for further development by the NSW Government.

The next steps to develop the metric would be to:

- Establish the scope, e.g. all infrastructure that adds to recycling capacity in tonnes (i.e. excluding investments in infrastructure that would deliver quality improvements rather than increased capacity) and data points (e.g. additional tonnes by material type, total investment ($), and when it is expected to be fully operational (year))
- Develop a system to aggregate data from several government sources including the Department of Planning and Environment (DPE), EPA, NSW Environmental Trust and the Australian Government's Recycling Modernisation Fund (RMF)



CHAPTER THREE

Green public procurement

Measuring green public procurement (GPP) can reduce government expenditure and waste from purchased goods & services, increase resource efficiency, and stimulate markets for sustainable products and services, owing to the high share of government procurement in the economy.

Metric summary	
Description	This metric is used to measure the share of green procurement by governments. To be effective, GPP requires the inclusion of clear and verifiable sustainability criteria for products and services in the public procurement process.
Calculation	GPP criteria as a ratio of total procurement volume or value. This metric can be reported in % or in absolute figures.
Scale	State (Department level) and LGA (Councils)
Already reported for NSW?	No
Modelled or measured? **Absolute or relative?**	Measured Relative
Data source/s	• NSW Waste and Sustainable Materials Strategy 2041 (2021) • Local Government NSW Sustainable Procurement Guide (2017) • Sustainable Procurement Guide: A practical guide for Commonwealth Entities (2021)
Example(s) of use	EU CE Monitoring Framework

Metrics assessment for NSW

Ease of data collection | Circular economy focus | Alignment with policy

Green public procurement

Introduction

Government expenditure for procurement activities contributes 40.2% for Australia nationally, which is higher than the OECD average at 29.1%. Green or sustainable procurement provides a framework to monitor and consider the whole-of-life impacts on the economy, environment and society for purchase decisions related to products and services. Green public procurement (GPP) is an opportunity for government departments to leverage their considerable purchasing power to reduce public expenditure and waste, increase resource efficiency, and stimulate markets for sustainable products and services. Sustainable procurement guidelines are available for LGNSW, Federal and state governments.

The NSW Waste and Sustainable Materials Strategy 2041 lays out plans for local governments to jointly procure waste services and increase recycled content in government procurement. There are plans to report annually on the use of recycled content and its associated impact on emissions and waste reduction.

Some of the other plans are:

- To publish a directory of recycled material suppliers, along with a register of upcoming government infrastructure and construction projects that will procure recycled materials.
- To develop standards which will be available for local governments to adopt, providing them with more confidence to use recycled content in their own procurement.

Moving from green to circular procurement

An overview

Green or sustainable procurement has been successfully applied in transport, infrastructure and catering sectors, with a strong focus on energy efficiency and greenhouse gas emissions reduction. Material flows through green procurement are often managed through better recycling and use of recycled materials.

Circular procurement is an extension of green procurement, using circular economy principles. The construction industry has examples of circular procurement where recycled materials are repurposed to new products.

The circular procurement of services is an emerging area of focus; examples are leasing of uniforms, car sharing, office stationery and supplies.

The Nordic countries, EU and UK have established targets and methodologies to intensify circular procurement & green public procurement, especially in construction, building fit outs & transportation sectors.

Construction sector: Reuse and recycling of building materials such as concrete, elimination of harmful substances and pollution, energy efficiency and preparing for end-of-life, design for disassembly.

Infrastructure and transport sectors: Road construction, street lighting and procurement for transport, including: cars, car-sharing, e-bikes, biogas buses, ports and ambulances.

Food and catering: Low-carbon approaches, energy efficient transport and equipment, minimising packaging & food waste, organic & local food sources

Textiles: Uniforms and work garments are either organic, made from recycled fibres or procured via leasing.

Office furniture and other equipment: This is the traditional domain of green procurement, focusing on office stationery, cleaning products, IT and office furniture.

Source:

ISF (2018), based on research conducted for NSW EPA

Moving from green to circular procurement cont.

Procurement including GPP based 'circular' criteria	Procurement of new 'circular' products and materials	Precurement of services and new business concepts	Procurement promoting circular ecosystems
Improved products and services are procured by adding more GPP and circular criteria to the tender competition: • Recyclability • Share of recycled materials • Reuse • Packaging materials etc.	**New products are procured and/ or developed by innovative public procurement:** • Products that are significantly better in terms of recy-clability, share of recycled materials, long lifespan, disassembly, etc.	**Product - service systems are procured and new approaches are applied that promote circular aspects:** • Leasing concept • Buy per use • Shared use • Buying and selling back	**Investments are made that stimulate the development of 'circular ecosystems':** • Develop or support closed loops • Create new networks and alliances • 'waste as material'
Examples: • Paper products • ICT devices • Packages • Furniture	**Examples:** • Building components of recycled material • Textiles made of recycled material	**Examples:** • Buying light instead of lamps • Leasing furniture instead of buying it	**Examples:** • Buses running by locally produced biogas • Construction projects with closed material loops
Better quality products →	**New products →**	**New business concepts →**	**Circular ecosystems →**

Source: Alhola et al. (2017)

GPP metrics in the Commonwealth Sustainable Procurement guide

The Commonwealth Sustainable Procurement guide (2020) outlines the following measures for GPP.

The Australian Government will be required to report on progress against the National Waste Policy Action Plan targets, including the target to significantly increase the use of recycled content by governments and industry.

The Department of Agriculture, Water and the Environment is developing guidance for agencies to identify, track, and report progress on the National Waste Policy Action Plan targets. The following sustainability metrics are under consideration:

- Energy consumption
- Greenhouse gas emissions
- Reduction of waste
- Use of recycled products
- Reduction in hazardous substances & packaging
- End-of-life recycling

Entities are encouraged to consider whole-of-life costing, which generally includes the costs of acquisition, maintenance, operation and end of life.

There is an emphasis on expanding the share of recycled content in public procurement as per the Commonwealth guidelines. Product categories with recycled content and commercial availability in Australia can be accessed **here.**

The guide proposes the following types of data to measure and report progress of recycled content procurement:

- contract values (both dollars and percentage of value) of contracts procuring goods with recycled content
- amount of recycled content procured specified in tonnes and type per contract
- report on goods/services/contracts that have procured recycled content to calculate percentage of goods with recycled content purchased by the organisation
- increased diversion of waste from landfill, specified in percentage terms or in tonnes per annum.

CASE STUDY

SSROC's Procure Recycled Paving the Way initiative in NSW

Paving the Way to Sustainable Roads

Southern Sydney Regional Organisation of Councils (SSROC) generates 71,000 tonnes of municipal glass waste annually, of which approximately 65% is recycled locally. Paving the Way is a 16 council-led procurement of asphalt with recycled crushed glass as a substitute for natural sand, creating a local market for kerbside glass and driving regional infrastructural investment.

The initiative has created a local closed-loop market for approximately one-third of participating councils' domestic glass collections (80 million glass bottle equivalents per year), reduced greenhouse gases, and driven essential infrastructural development and job creation through a large-scale procurement of asphalt with recycled crushed glass (RCG) as a substitute for natural sand.

The largest council-led procurement of its kind in NSW, aggregated demand from 16 participating Sydney councils and Transport for NSW, through parallel market approaches, have doubled state-wide demand for RCG. An innovative contract model reports on sustainability KPIs and an innovation clause is facilitating next-generation materials.

The Sustainable Pavements contract resulting from the procurement commenced in 1 July 2021. Some of the anticipated results are:

- A scalable and replicable framework for end-to-end engagement, analysis, procurement, contract and communications.
- Creation of a local market for all remaining recoverable domestic glass in SSROC equivalent to 80 million glass bottles/year.
- Triple bottom line cost-benefit analysis indicates $1.19 of value generated for every $1 invested in the initiative.
- Reduction in greenhouse gas emissions by approximately 1,900 tonnes per annum
- Reduced interstate transportation of used glass.
- Together with TfNSW, doubled state-wide demand for RCG.

PAVING THE WAY

Note: This case study was developed based on documents and information received directly from SSROC.

CASE STUDY

Local Government Association of SA

Buying it Back

LGA Circular Procurement Pilot Project

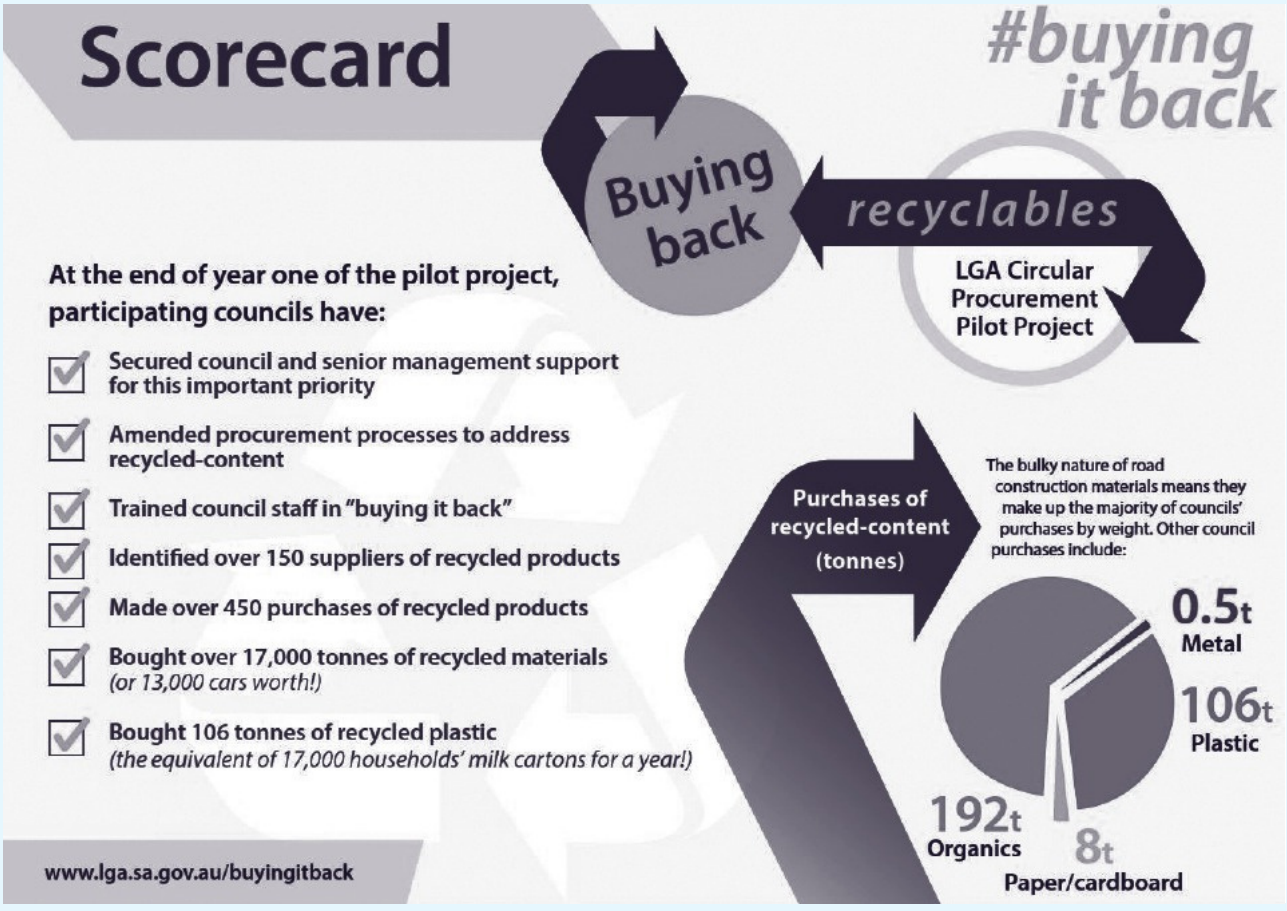
Councils using combined buying-power to increase demand for recyclable materials in South Australia.

Systems & processes established to:

- Prioritise recycled-content through the procurement process
- Track recycled-content by weight
- Publicly report on the amount (number of tonnes) of recycled-content products and materials purchased

Most councils have adopted a target in relation to plastic materials in particular.

Procurement data from January to July 2020 is displayed in the image below.



Source: LGA SA (2020)

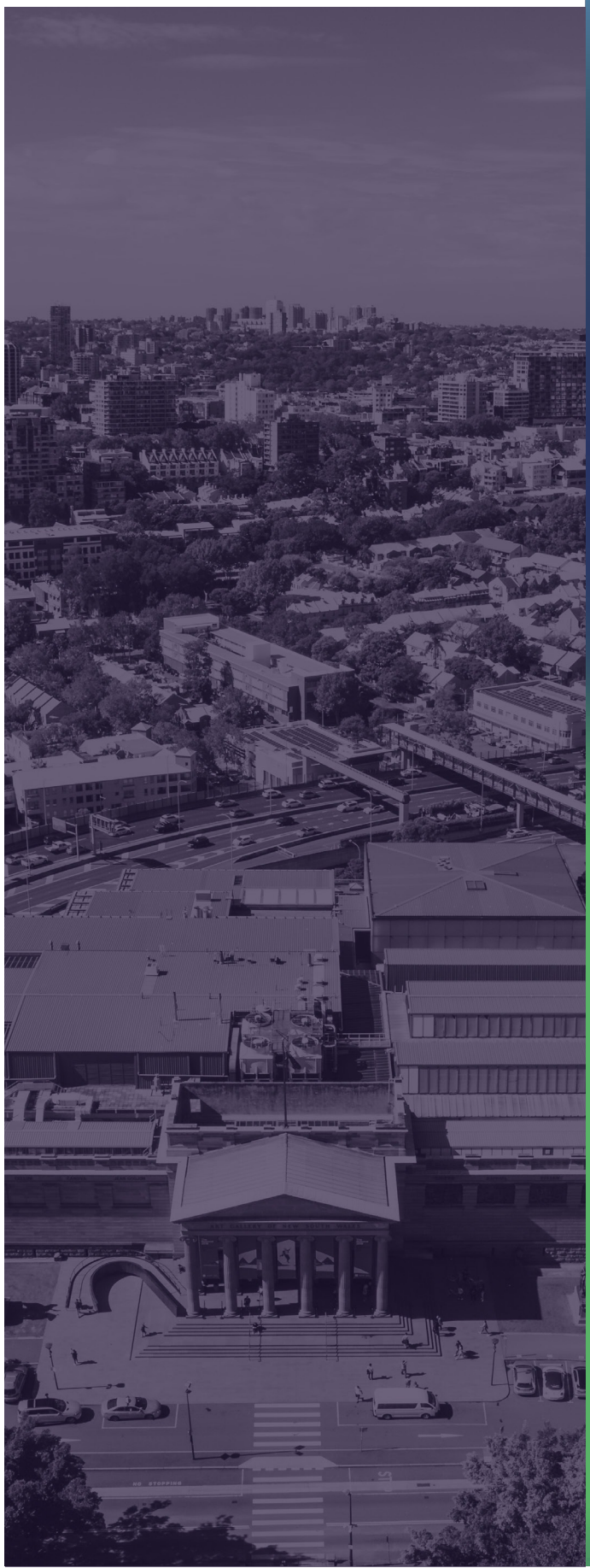
Next steps for NSW

The outcomes of GPP are currently not reported in NSW; however, there are a few a metrics under consideration in NSW's sustainable procurement strategy, such as:

- % recycled content
- % recyclable content
- availability of product lifecycle extension
- % waste diverted from landfill

To be effective, GPP requires clear and verifiable sustainability criteria for products and services in the public procurement process. Under the EU GPP framework, **20 product categories** are prioritised with sector-specific criteria and technical guidance. Although a voluntary instrument in the EU, GPP is expected to stimulate eco-innovation, by creating a critical mass of demand for more sustainable goods and services from public authorities, who are major consumers.

GPP criteria setting, targets and measurement metrics for different product classes are current gaps in NSW. **Appendix 3** offers a methodological overview for criteria setting in NSW, which will be an important step in the development of green public procurement. Additional research is required to evaluate the feasibility of comprehensive GPP metrics for NSW, including criteria development for priority sectors, data requirements, metrics and reporting.



CHAPTER FOUR

Industrial symbiosis

4

UNIDO has developed eight assessment tools to plan, implement & monitor industrial symbiosis activities. These tools are useful for eco-industrial park and circular precinct managers, firms, policy makers & researchers.

Metric summary	
Description	The **UNIDO International Framework for Eco-Industrial Parks** is a useful assessment framework for planning and evaluating industrial symbiosis (IS) progress in existing and new industrial parks and precincts such as Australia's **first UNIDO Eco-Industrial Parks.**
Calculation	• Three tools are shortlisted for this assessment. These are: • **Industrial symbiosis (IS) identification:** to identify IS opportunities and infrastructure planning. • RECP monitoring: a standardized method to calculate and monitor the economic, environmental & social savings from Resource Efficient and Cleaner Production (RECP) activities, in Eco-Industrial Parks (EIPs) and circular precincts. • **Industrial synergies monitoring tool:** to monitor & report resource savings, improvements, and impacts of industrial synergies.
Scale	Eco-industrial park, precinct
Already reported for NSW?	No
Modelled or measured? **Absolute or relative?**	Measured & modelled Absolute & relative
Data source/s	UNIDO (2021)

Metrics assessment for NSW

Ease of data collection | Circular economy focus | Alignment with policy

Industrial symbiosis

Introduction

Industrial symbiosis refers to business-to-business exchanges for materials, water, energy and shared resource use. Industrial symbiosis networks promote the reduction of virgin resource use, longer circulation of materials, water and energy as well as the development of new industry sectors engaged in secondary material recovery, treatment, upcycle and use. Some notable examples of industrial symbiosis networks globally are the Kalundborg Symbiosis in Denmark, Tianjin Economic-Technological Development Area in China and Ulsan in Korea.

Special Activation Precincts are part of the NSW Government's 20 Year Economic Vision for Regional NSW. Regional Growth NSW Development Corporation is designing Special Activation Precincts that will offer investment benefits including government-funded infrastructure, streamlined planning and approvals and business support services. CE principles are expected to be a core focus of the activation precincts. In fact, the Parkes Special Activation Precinct Master Plan, specifically has performance criteria benchmarked against the standards set by UNIDO for eco-industrial parks, as well as other benchmarks for circular economy performance.

Industrial symbioses are one of the means of achieving a circular economy in manufacturing, and thus, are an important facet of industrialisation and globalisation. An expected outcome is the creation of industrial symbiosis networks involving diverse supply chain actors, secondary resource flows and knowledge exchange. Measuring industrial symbiosis progress is complex and often fraught with data unavailability or firm resistance to sharing proprietary or commercially-sensitive information with regards to their resource use, waste and supply chain impacts of production.

This section examines the methodological approaches adopted in UNIDO's Toolbox for EIP assessment, as a potential metric for industrial symbiosis measurement in NSW. [4]

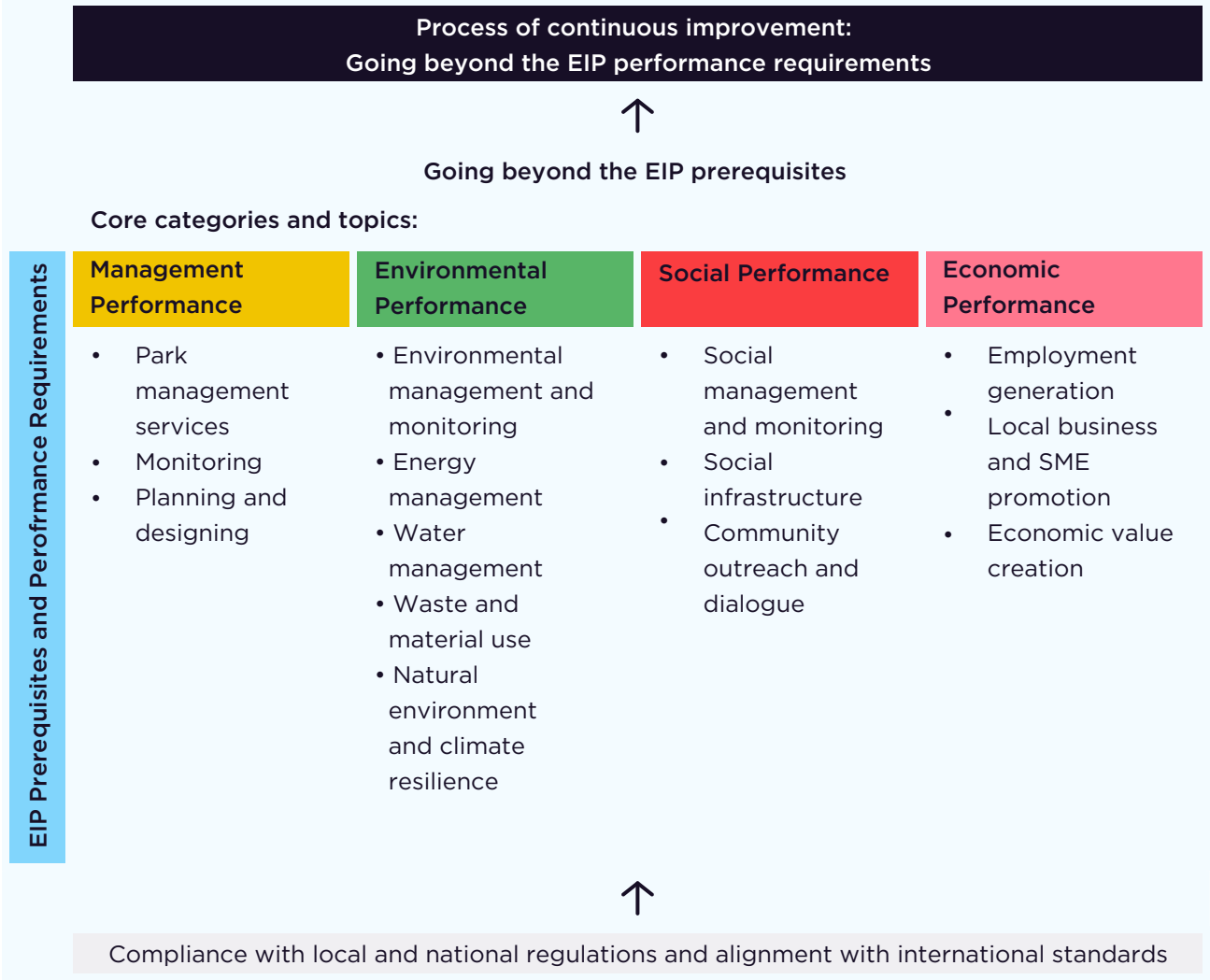
4 Some of the other metrics reviewed in earlier phases of the project included the Industrial symbiosis indicator and the Eco-efficiency indicator. (See Report 1)

Eco-industrial park performance measurement – methodology

UNIDO (2021) designed an international framework for eco-industrial parks which measures Eco-Industrial Parks (EIP) performance based on four key indicators:

1. **Park management performance**
2. **Environmental performance**
3. **Social performance**
4. **Economic performance**

The framework is useful to define prerequisites and performance criteria right from the design stages. It is expected that environmental and social performance of an EIP exceeds minimum regulatory requirements in a country.



Source: UNIDO (2021)

An overview of UNIDO's Toolbox for Eco-Industrial Parks

UNIDO's EIP Toolbox covers all key components of eco-industrial parks, including Resource Efficient and Cleaner Production (RECP), development of industrial synergies, strengthening park management, park selection and scoping EIP interventions, policy support and capacity building.

UNIDO's EIP tools	Scope of the tools: Existing industrial parks (Brownfields)	New industrial parks (Greenfields)	Technical	Organisational and political
EIP Selection Tool	✓	✓	✓	✓
Stakeholder Mapping Tool	✓	✓		✓
EIP Policy Support Tool	✓	✓		✓
EIP Assessment Tool	✓		✓	✓
Industrial Symbiosis Indentification Tool	✓	✓	✓	
RECP Monitoring Tool	✓		✓	
Industrial Synergies Monitoring Tool	✓		✓	

Source: UNIDO (2019)

Selected tools for industrial symbiosis assessment (UNIDO 2019)

The following tools are set out in further detail in the tables below:

Industrial Symbiosis Indentification Tool	
Tool Total objective:	Supports the identification of by-product synergies and waste exchanges (industrial symbiosis).
Steps in tool application:	The tool can be used to identify potential industrial symbiosis: 1. Related to a given material ('Search by product') 2. Related to a given company ('Search by Company'), to generate a list of inputs and outputs related to a specific industry.
Explanatory notes:	This tool can be used in the planning stage of a greenfield industrial park to highlight possible waste exchanges (i.e. industrial symbiosis) between companies. Alternatively, it can be also used in a brownfield EIP to assist in the set-up of industrial symbiosis. It also informs if a similar industrial symbiosis has already been implemented, somewhere. A list of refences (sheet 3) is indicated for more information.

RECP Monitoring	
Tool Total objective:	Monitor and report the resource savings and results of RECP assessments accomplished in industrial parks. It can be used immediately after RECP assessments to inform about expected results, or later to report about implementation and actual results.
Steps in tool application:	1. Fill a form for RECP results per company in industrial park 2. Summary of RECP results at company level 3. Summary of RECP results at industrial park level.
Explanatory notes:	If the project covers multiple industrial parks, additional fill-in forms (worksheets) can be created (one fill-in form per industrial park).

Industrial Synergies Monitoring	
Tool Total objective:	Monitor and report resource savings, improvements and impacts in industrial parks achieved through industrial synergies (e.g. by-product, utility, supply chain, service synergies).
Steps in tool application:	1. Monitoring worksheet to fill in the savings and impacts achieved 2. Summary of savings and impacts of EIP projects, calculations and summary based on completed monitoring worksheet (summary is automatically generated).
Explanatory notes:	If the project covers multiple industrial parks, additional fill-in forms (worksheets) can be created (one fill-in form per industrial park).

CASE STUDY

Industrial symbiosis assessment using RECP tool

Since 2012, UNIDO have expanded the joint global Resource Efficient and Cleaner Production (RECP) program with the United Nations Environment Programme (UNEP), funded by the Swiss State Secretariat of Economic Affairs (SECO).

Under the joint program, Eco-Industrial Parks (EIP) assessments were conducted in 33 industrial parks across 12 developing countries. The following case examines the adoption of the RECP assessment tools in two industrial parks in western India.

In 2016, UNIDO appointed the the Gujarat Cleaner Production Centre to undertake RECP and industrial synergies assessment in two industrial parks in India: Nandesari Industrial Estate (NIE) and Dahej Petroleum, Chemicals and Petrochemicals Investment Region (Dahej PCPIR).

The objectives of the RECP assessments were to attract policy support for eco-industrial parks from the state government, and to identify technical skill requirements for industrial symbiosis exchanges. The process was also used as an opportunity for stakeholder education and capacity building for EIP development.

Some of the results reported from the RECP assessments were:

- At least 20 firms were involved in the RECP assessment process, with opportunity identification for industrial symbiosis.
- Existing and potential new common infrastructure needs were identified, especially in the mature (brownfield) industrial park at Nandesari Industrial Estate.
- The Government of Gujarat extended financial assistance for RECP implementation in its industrial policy.
- An input/output database was developed; for example, data from 25 firms at Dahej PCPIR is being recorded in the I/O database.
- Multi-faceted by-product and material exchanges are underway, in order to reduce waste to landfill and increase inter-firm connectedness as well as co-processing of industrial by-products by diverse industries.

Next steps for NSW

Modelling software and input-output techniques are necessary for industrial symbiosis measurement.

A holistic measure for reporting industrial symbiosis progress and benefits for NSW is lacking, and must be developed for existing industrial parks as well as emerging special activation precincts. Here, we examined potential metrics for consideration in NSW government's plans to set up special activation precincts (akin to eco-industrial parks), designed to facilitate inter-firm resource synergies and shared use.

UNIDO's EIP assessment framework has established tools for industrial symbiosis identification and RECP monitoring, and is being adopted in many operational and planned industrial parks. **We, thereby, recommend adopting UNIDO's EIP assessment framework as a first step to measure industrial symbiosis progress in NSW**, while also testing more advanced indices such as the industrial symbiosis indicator and the eco-efficiency indicator.

It must also be noted that both the industrial symbiosis indicator and the eco-efficiency indicator, while theoretically sound must be validated empirically through pilot testing in live industrial parks, in order to examine their effectiveness to measure industrial symbiosis.

CHAPTER FIVE

Circular employment for repair, reuse and recycling

5

A more circular economy will create jobs in businesses providing repair, reuse and recycling services. While employment in these sectors would be the easiest to track initially, other activities could be added over time e.g. in the sharing economy.

Metric summary	
Description	Number of people employed in selected industries related to the CE, e.g. waste treatment, repair & maintenance, rental & hiring services, charity shops.
Calculation	Employment in selected CE activities Australia-wide could be estimated using a combination of existing data sources (see below) or using a new, specially designed survey for NSW.
Scale	National. Could be used to estimate NSW employment based on share of population or GDP.
Already reported for NSW?	No
Modelled or measured? **Absolute or relative?**	Measured Absolute
Data source/s	ABS, Employment data (rental and hiring services excl. real estate; waste collection, treatment & disposal; repair & maintenance) **Access Economics (2009), Employment in waste and recycling** Charitable Recyclers Australia, 2021 Impact report
Example(s) of use	**KPMG (2020), Potential economic payoff of a circular economy**

Metrics assessment for NSW

Ease of data collection | Circular economy focus | Alignment with policy

Circular employment for repair, reuse and recycling

Introduction

The jobs potential of the circular economy is a key interest for many governments driving a circular economy approach. However, it is often a challenge to define as the variety of circular economy initiatives is still evolving. In addition, standard employment data and classifications can only capture part of the relevant workforce, and further industry research is needed to accurately define and quantify jobs.

For this metric we focus on employment in relation to the recycling, reuse, and repair of materials and products, as some of this data is available in an unrefined form. Further study is needed to identify future employment, including for redesign and remanufacturing. Data sources are discussed in the following slides in relation to their limitations and exclusions. An estimate of current jobs in NSW in relation to recycling, repair and material reuse follows.

Scope, data sources and gaps: Employment data

	Scope	Data sources and gaps
Recycling	Recycling industry jobs – sorting, transfer and trans-formation of recycling materials	Access Economics 2009 *Gap: Industry data needs updating from 2009.* Other potential data sources: ABS waste industry categories *Gap: ABS categories are not suitable to distinguish recycling, and energy recovery from other waste collection, treatment and disposal services* More specific data: Organics industry (AORA data)
Repair	Repair shops as defined by employment statistics in the census	ABS employment data, 2016
Reuse	Second hand shops, using ABS category: Antique and other second-hand sales Rental and sharing platforms	ABS employment data, 2016 *Gaps: ABS data captures rental services broadly, but does not delineate between short-term rental (sharing/reuse) and long-term rental (which may not involve reuse and sharing). Also unclear whether these categories capture online sharing platforms* Other source of specific sub-sector data: Charity shops (with specific data on clothing and furniture reuse, charity shop second-hand sales), these are already included within the ABS data, so they are not added here. **MRA Consulting Group (2021), Measuring the impact of the charitable reuse and recycling sector**

Circular employment for repair, reuse and recycling

Estimated employment in recycling, repair and reuse

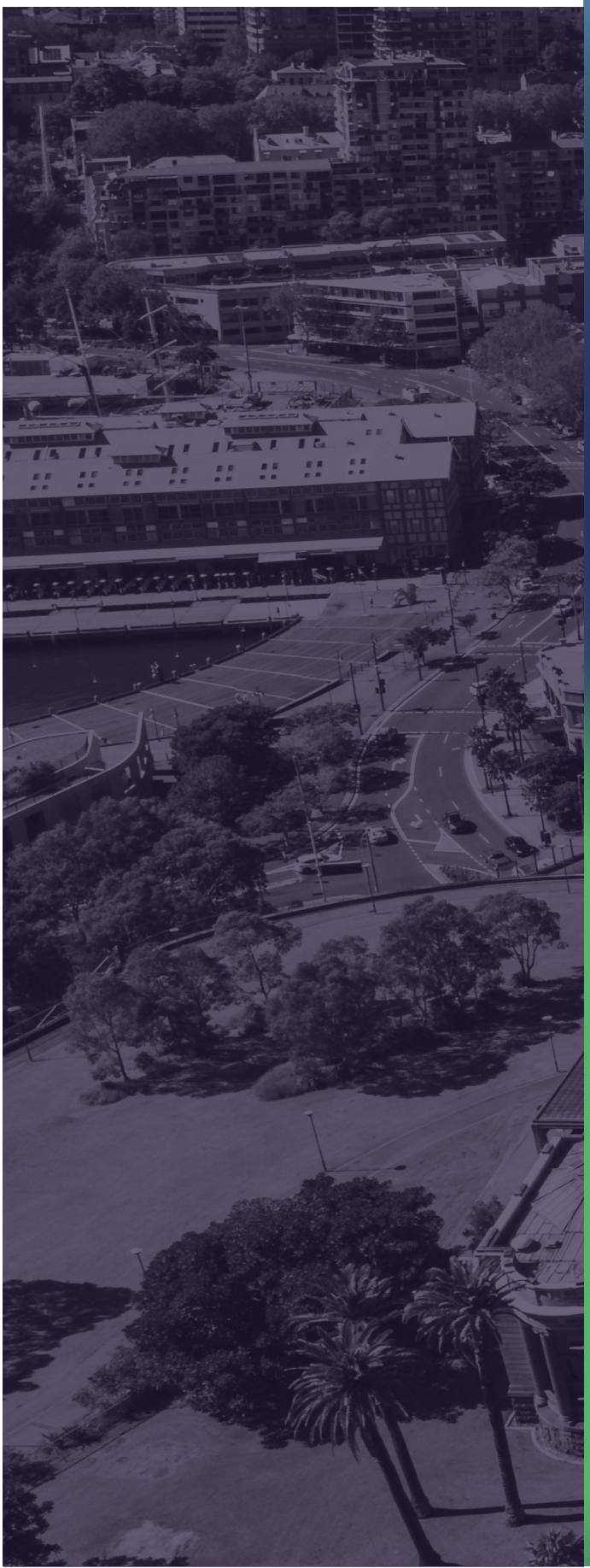
	Estimate # FTE in NSW	Basis
Recycling	12,983	Based on Access Economics 2009 survey of the industry - 9.2 FTE per 10,000 tonnes recycling. 14,112,000 tonnes recycling (2019-20) (NSW EPA, 2021), including MSW, C&I, C&D.
Repair	19,888 (non-automotive repair)	ABS 2016 Census data, in relation to non-automotive repairs, including categories: Machinery and Equipment Repair and Maintenance, nfd; Domestic Appliance Repair and Maintenance; Electronic (except Domestic Appliance) and Precision Equipment Repair and Maintenance; Other Machinery and Equipment Repair and Maintenance; Other Repair and Maintenance, nfd; Clothing and Footwear Repair; Other Repair and Maintenance nec; Repair and Maintenance, nfd
	33,378 (automotive repair)	ABS 2016 Census data, in relation to automotive repairs, including categories: Automotive Repair and Maintenance, nfd; Automotive Body, Paint and Interior Repair; Other Automotive Repair and Maintenance; Automotive Electrical Services
Reuse	1,862 (second-hand retailing)	ABS 2016 Census data, in relation to second-hand sales, category: Antique and other second-hand sales
	15,427 (rental services / goods sharing)	ABS 2016 Census data, in relation to goods sharing and rental services, including categories: Rental and Hiring Services (except Real Estate), nfd; Motor Vehicle and Transport Equipment Rental and Hiring, nfd; Passenger Car Rental and Hiring; Other Motor Vehicle and Transport Equipment Rental and Hiring; Other Goods and Equipment Rental and Hiring, nfd; Heavy Machinery and Scaffolding Rental and Hiring; Video and Other Electronic Media Rental and Hiring; Other Goods and Equipment Rental and Hiring nec; Laundry and Dry-Cleaning Services
Total	83,538	Employment in NSW for recycling, repair and reuse

Next steps for NSW

Steps to improve employment estimates

To refine employment estimates and include a more comprehensive approach to circular economy employment, it will be important to do the following:

- Undertake a survey of the recycling industry to update 2009 estimates and to refine understanding of jobs in relation to recycling collection, treatment and processing, as well as energy and nutrient recovery
- Survey industries to understand future employment trends with regard to other aspects of the circular economy including: research and development, redesign of products, remanufacturing, and to refine estimates in relation to sharing and reusing goods and product-service systems approaches, including online platforms. This approach may also reveal unforeseen categories of employment that relate to circular economy.



CHAPTER SIX

Circularity gap

The circularity gap is the inverse of the circularity metric , which determines what percentage of an economy is driven by circular resource use. The circularity metric is based on economy wide modelling of material flows. In practice the circularity gap metric has primarily focused on recycling. This metric is used by the Circularity Gap reporting initiative (CGRi).

Metric summary	
Description	The circularity gap is based on an economy wide material flow analysis (MFA) which considers the flow of materials from extraction and import, through to processing and consumption, then accumulation as stocks, and finally recycling and waste products and emissions.
Calculation	Economy wide material flow analysis (EW-MFA), which uses an input output database to model stocks and flows of materials through an economy.
Scale	National, based on high level material flows
Already reported for NSW?	No
Modelled or measured? **Absolute or relative?**	Measured Absolute
Data source/s	The international resource panel (IRP)'s Global Material Flow database
Example(s) of use	Circularity Gap Quebec

Metrics assessment for NSW

Ease of data collection | Circular economy focus | Alignment with policy

Circularity Gap

Uses and limitations

How can this metric be used?

Circularity has strong synergies with strategies to reduce carbon emissions. The Circularity Gap Report 2021 estimates that global circularity is currently at 8.6%, and that to limit global heating to below 2 degrees Celsius would require global circularity to reach 17%. As such a circular economy approach can be used to target resource conservation, waste reduction and emissions reductions. It is a useful metric to keep track of the big picture of resource use overall and global efforts to reduce carbon emissions.

Limitations of the metric

The focus of the circularity metric is recycling, as it models stocks and flows, and assumes that materials that accumulate in stock are not part of a circular economy. This means that circular economy activities such as: reuse, sharing, second-hand sales, repairing and remanufacturing are not explicitly accounted for. While this measure aims to keep track of resource inputs and outputs at a high-level, it is less likely to capture progress in circular economy initiatives at the local level and for the full range of circular economy strategies. It is also a relative metric, which means that the percentage circularity can increase while overall resource extraction continues to increase.

Can this metric be used in NSW?

This metric has primarily been used at the global or national level as it relies on national level databases. However, the province of Quebec in Canada has recently undertaken the analysis. Their study noted major data gaps particularly in relation to the end-of-life of materials. The study also noted the challenges in quantifying trade at the provincial level and the need to take either a production or consumption perspective, which yield dierent results.

Similar challenges and gaps in determining the circularity index for NSW are likely.

APPENDIX 1

Supporting data for carbon dividend of recycling materials NSW

The data used to estimate the carbon dividend is shown in the table below.

Material recycled NSW, 2018–19, and avoided carbon emissions.[5]
i.e. Material recycled NSW, 2018-19, and avoided carbon emissions from recycling

Material	Tonnes recycled 2018-19	Emission factor (t C02-e/t)	Avoided emissions (t C02-e)
Aluminium	114,340	16.667	1,905,705
Steel	1,207,808	0.44	531,436
Non-ferrous metals	97,405	0.88	85,716
Asphalt	85,275	0.03	2,558
Brick & tile	1,291,546	0.02	25,831
Concrete	1,291,339	0.02	25,827
Plasterboard	24,554	0.03	737
Clay, fines, rubble & soil	4,309,003	0.088	379,192
Timber	208,986	1.35	282,131
Food organics	383,290	0.25	95,823
Garden organics	868,494	0.224	194,543
Other organics	150,983	0.481	72,623
Paper & cardboard	1,006,748	0.169	170,140
Plastics	87,032	0.313	27,241
Glass	253,194	0.528	133,686
Tyres	45,309	1.07	48,481
Leather & textiles	1,364	NS	
Total	**11,426,670**		**3,981,669**

NS = not specified as insufficient reference data

5 Avoided emissions estimated by ISF based on recycling data from Blue Environment (2020) and emission factors from Trellis Technologies (2019)

APPENDIX 2

Supporting data for planned new investments in recycling capacity

The data used to estimate the change in NSW recycling capacity is shown in the table below.

Additional recycling capacity announcements and relative to amount previously recycled[6]

	Additional capacity announcements 2019-2021 (minimum tonnes)[6]	Government grants[6]	Quantity recycled 2018–19 (tonnes)[7]	Additional capacity as a percentage of quantity recycled[6]
Plastics	61,230	$31,344,408	87,032	70%
Paper	104,000	$7,894,128	1,006,748	10%
Glass	55,000	$6,246,873	253,194	22%
Tyres	28,780	$4,509,946	45,309	64%
Organics	145,000	$7,847,875	1,402,767	10%
Total	**394,010**	**$57,843,230**	**2,795,050**	**14%**

6 Data collated by ISF from various sources

7 Recycling data from Blue Environment (2020)

APPENDIX 3

Methodology overview for Green Public Procurement criteria setting

This section offers a methodological overview for criteria setting, which will be an important step in the development of green public procurement in NSW. The EU GPP framework is considered as a best practice example for the following criteria setting process. Additional research is required to evaluate the feasibility of comprehensive GPP metrics for NSW, including criteria setting for priority sectors, data requirements & reporting.

1. Prioritise sectors for implementing GPP

- The EU GPP framework considered the following criteria to draw up a list of priority sectors for GPP.

› scope for environmental improvement
› public expenditure
› potential impact on suppliers
› best practice in private or corporate consumers
› political sensitivity
› existence of relevant and easy-to-use criteria
› market availability
› economic efficiency

2. **Embedding life-cycle approaches in criteria definition for different sectors**

• Sector specific EU criteria can be accessed **here.**

3. **Identify synergies with existing policy & guidelines**

• Develop links with product-related ecolabeling schemes, product stewardship, circular economy policies.

4. **Undertake participatory processes for criteria development**

• Stakeholder involvement in design, feedback on process and implementation, target-setting, measurement & reporting was instrumental in the design of the EU GPP framework.

5. Setting common criteria

- Common GPP criteria will reduce administrative burdens for economic operators and public administrations implementing GPP.
- Two sets of criteria are developed in the EU GPP framework: core criteria with key environmental performance indicators for a product/service; comprehensive criteria with life cycle costs evaluation along side other sustainability dimensions and innovation.
- Additionally, sector-specific mandatory thresholds were decided, in addition to voluntary adoption


Circular
Australia