GHG Emissions

in Australia's Waste and Recycling Sector

NWRIC

National Waste and Recycling Industry Council

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Executive Summary

The National Waste and Recycling Industry Council (NWRIC) works to advance Australia's waste and resource recovery industry, committing to high standards in policy development, industry representation and transparency.

NWRIC engaged Ricardo Energy Environment and Planning (Ricardo) to measure the carbon footprint of Australia's waste and recycling industry, as represented by NWRIC's members including Cleanaway, Infrabuild, LMS Energy, JJ's Waste & Recycling, ResourceCo, Sell & Parker Group, Sims Metal Management, Solo Resource Recovery and Veolia.

Australia's waste and recycling industry is contributing to Australia's Greenhouse Gas (GHG) emissions reduction target of net zero by 2050 and has seen a 45% decrease in GHG emissions over the past 30 years. The sector is actively pursuing low emissions options and replacing virgin resources with recycled materials. Today the sector contributes 2.9% or approximately 10 Mt CO_2-e to Australia's GHG emissions profile per year. The majority of emissions are from the decomposition of organic material in landfills.

The reductions to date are mainly due to increases in landfill methane recovery and the decline of total waste disposed as alternative waste treatment options have become operational. GHG emissions will continue to decline due to increases in organics recovery and the separation and recycling of waste streams. Although total volumes of waste generated and disposed across Australia remain steady, the intensity of emissions per tonne of waste recycled will reduce over time. This is attributed to waste and recycling management facilities using decarbonised energy sources and the future of Australia's grid-connected renewable energy production.

Landfills continue to play an important role to capture methane gas which has a significant short-term effect on climate, where approximately 50% of all landfill gas has been captured across Australia. Whilst this figure will increase significantly into the future, it will not achieve 100% due to the way organic matter is transferred and decomposed over long periods of time, and the practicalities of even the best constructed and managed landfills. Diverting organic material from landfill will be key to reducing emissions, as well as sustained improvement of landfill gas capture systems as key critical infrastructure.

NWRIC members represent 65% of Australia's waste operations and have quantified their emissions from operations in landfills, resource recovery and recycling facilities, and other collections and processing to understand their collective contribution to GHG emission reductions and forecast their future path to net zero emissions and track progress.

Avoided emissions generated from operations and activities can be quantified from the diversion of material from landfill and the displacement of virgin materials, including fossil fuels. These are attributed to:

- Alternative fuel production
- Provision of recycled materials to manufacturing, locally and internationally
- Provision of recycled oils, solvents, aggregates
- Production of nutrients from recycled organics.

By 2030, GHG emissions from Australia's waste and recycling industry are projected to reduce to around 4 Mt CO_2-e from 10 Mt per annum today and will likely continue trending down towards zero by 2050. Today Australia's waste and recycling sector recovers 63% of the total waste generated. Fast tracking and sacling local technical solutions and innovations, government support and partnerships with other industries and supply chains will see an increase in recovery and avoided emissions for the waste and recycling sector to achieve a net zero balance before 2050. Many industry members have adopted net zero emissions targets, mainly by decarbonising their energy sources and investing significantly into circular economy projects.

NWRIC is committed to monitor and identify more opportunities to avoid emissions and reach a negative net carbon emission balance before 2050.

CASE STUDY

LMS Energy is reducing over 4 million tonnes of GHG emissions every year

LMS Energy's Seaford Bioenergy Facility, South Australia.

LMS Energy is the nation's largest landfill biogas methane destruction company, using innovative methods of methane capture to achieve significant emission reductions.

Landfills with organic waste produce biogas which is approximately 50% methane. This methane is a valuable energy resource that LMS uses as fuel in engines to produce renewable energy that is exported to the electricity grid and used by homes and businesses. With 56 Australian biogas projects, LMS Energy are leaders in methane destruction and bioenergy, generating 600,000 gigawatt hours (Gwh) of baseload renewable energy – enough to power 100,000 homes each day. Collectively across Australia, LMS reduces more than 4 million tonnes of greenhouse gases from being emitted into the atmosphere each year. This carbon abatement is equivalent to planting 68 million trees. Methane abatement varies from site to site with larger scale sites such as the Wollert Bioenergy Facility in Victoria abating more than 4.5 million tonnes of carbon dioxide equivalent (CO_2-e) over the past 17 years.

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Background

2.1 Australian waste and recycling sector overview

The recovery and processing of materials is an essential function of the economy providing services to almost all households, businesses and government entities either directly or indirectly. Australia generates approximately 75.8 Mt of solid waste, over half is recycled (38.5 Mt), while 27% (20.5 Mt) is sent to landfill for disposal.[1] The remaining is exported 6%, recovered for energy 3%, or treated for other disposal.

The waste and resource recovery sector continues to expand operations in response to the growing volume of waste generated due to population and economic activity. Most of the waste is produced from commercial and industrial streams 43%, followed by construction and demolition 38% and households and local government activities 18%[2].

Recovered waste materials are sent for recycling, used for energy production or exported. Higher recovery rates represent more reusable materials and a more circular economy. Approximately 63% of total waste is recovered[2] - dominated by construction materials, metals and paper, whilst 6% is currently exported – mainly scrap metal and paper.

The 2019 National Waste Policy Action Plan[3] outlines ambitious targets to achieve by 2030, including an 80% resource recovery target, which means an extra 15 Mt of material needs to be recovered each year.

Recycling of food and garden waste is growing at pace, aligned to government targets to significantly reduce the volumes landfilled, as organic material is the main greenhouse gas (GHG) emission source from waste disposal. The organics recycling industry processes at least 7.5 Mt of waste to produce materials, e.g. compost, and energy, e.g. biogas, from anaerobic digestion, for further reuse across the Australian economy, significantly reducing emissions and recovering valuable nutrients from being landfilled.

The introduction of export regulations for plastics, glass, tyres, paper and cardboard is driving the greater need for additional local reprocessing capacity in these areas, to refine quality and produce higher value materials, as markets for low grade commodities are not reliable.

Reprocessed waste has many uses as a resource, with economic and environmental benefits. It can be used as an input in manufacturing, construction, soil improvement and energy generation, thereby value-adding inputs to create the circular economy.

2.2 Waste and recycling's economic contribution

The Australian recycling industry has grown significantly in economic terms over the past decade, where the value-add in current prices was 117% - higher than Australia's gross domestic product increase of 46%[4]. Industry employment has grown by 68% compared to Australia's nationwide employment growth of 17% over the same period.

Combining all benefits, the industry contributes $18.9 billion in value add to the Australian economy and provided 94,235 jobs in 2021–22. It has been estimated that $465 in net economic activity is created for every one tonne of material recycled; and one job is supported for every 431 tonnes of material recycled in Australia[4].

Moving towards a circular economy supports more sustainable jobs and supply chains and improves how we manage our resources.

2.3 National waste and recycling industry council

The National Waste and Recycling Industry Council (NWRIC) represents all aspects of the sector, including major landfills, transfer stations, resource recovery facilities (including advanced manufacturing), firming power facilities, collection services and secondary reprocessing operations across Australia.

NWRIC is composed of national waste and recycling companies and representatives from affiliated associations who together represent the interests of more than 450 small, medium, national and global businesses in Australia. NWRIC members and its affiliates are the principal contractors servicing more than 80% of all Australian households and business with waste and recycling services.

NWRIC members have and continue to invest in new capacity to add value to the commodities recovered and are focussing on developing local markets and resilient supply chains for recycled materials. NWRIC members' quest to reach net-zero carbon involves scaling investments in technologies to both avoid the generation and reduce the release of GHG emissions.

CASE STUDY

Sell & Parker recycling metal for wind turbine anchor cages using 50% recycled parts

Allthread Industries

Sell & Parker Metal Recycling Services is an Australian owned and operated company, buying and selling ferrous and non-ferrous metals, including suppling scrap metal to Bluescope Steel.

Sell & Parker have been partnering with manufacturers since 1966 to increase recycling. Since 2013, Sell & Parker has serviced Nespresso's nationwide recycling program, where they pioneered the process to recover aluminium and used coffee grounds to ensure they are sustainable recycled.

Allthread Industries, a subsidiary of Sell and Parker, manufacturer and assemble parts for wind turbines, such as anchor cages, using Australian raw materials with 50% recycled content. Steel production is energy and resource intensive, so the manufacturing of anchor cages with 50% recycled metal results in a 48% reduction in GHG Emissions.

By manufacturing these anchor cages in Australia with Australian recycled parts, reduces the transport of imported materials, and the assembly of the parts, reducing installation times from 2 days to 2 hours, saving a considerable amount of energy used in cranes and installation gears.

Since beginning to supply the Australian market, Allthread has shipped more than 1200 anchor cages, with current contracts for another 332 anchor cages.

2.4 National greenhouse and energy reporting scheme

The National Greenhouse and Energy Reporting (NGER) scheme, established by the National Greenhouse and Energy Reporting Act (NGER Act)[5], is the framework for reporting and disseminating corporate and national information about greenhouse gas (GHG) emissions. Companies who trigger the GHG emissions threshold must report annually. Most NWRIC members are required to report their scope 1 and 2 emissions under the NGER scheme (see Table 2-1).

Scope 1 GHG emissions are those released to the atmosphere as a direct result of activities at a facility level; Scope 2 GHG emissions are those released to the atmosphere from the indirect consumption of an energy commodity, i.e. 'indirect emissions' from the use of electricity produced by the burning of coal in another facility.

GHG reported emissions include carbon dioxide CO_2, methane CH_4, nitrous oxide N_2O, sulphur hexafluoride SF_6 and specified kinds of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). GHG emissions are measured as kilotonnes of carbon dioxide equivalence i.e. kt CO_2-e.

There are two types of thresholds that determine which companies have an obligation to report - facility and corporate group thresholds. The facility threshold is >25kt CO_2-e per annum (combined scope 1 and 2 emissions), or production or consumption of >100 Tj energy. The corporate group threshold is >50kt CO_2-e per annum (combined scope 1 and 2 emissions), or production or consumptions of 200 Tj of energy.

Other waste and resource recovery companies also trigger the thresholds, and together the total GHG emissions are reported annually in National Inventory Reports[6]. The whole waste and recycling sector as a portion of total national emissions is reported to be 2.9%. Total estimated waste emissions have decreased since 1989–90 from 17 Mt CO_2 -e to 10 Mt CO_2 -e (2020-21).

Table 2-1 NWRIC Members reporting under NGERs

Source: National Greenhouse and Energy Register 2020-21.

Member	NGER scheme reporting
Cleanaway	Yes
Infrabuild	Yes
JJ's Waste & Recycling	Yes
LMS Energy Pty Ltd	Yes
ResourceCo	Yes
Sell & Parker	No
SIMS Metals	Yes
Solo Resource Recovery	No
Veolia	Yes

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Overview

3.1 Introduction

NWRIC engaged Ricardo to quantify the current level of direct (scope 1), indirect (scope 2), and avoided GHG emissions associated with the waste and recycling sector in Australia. This work will help establish the current waste sector's baseline and trajectory to support actions required to meet the Australian Government's target of net zero GHG emissions by 2050.

This waste emissions assessment is designed to demonstrate how the sector has been contributing to significant GHG emissions reductions for many years and continues to reduce emissions, based on voluntary action and investment growth in recycling capacity and circular economy projects to avoid emissions to meet the national targets.

In order to quantify the level of GHG emissions associated with the recycling and waste management sector, the past and current GHG emissions associated with the NWRIC members, and the waste and recycling sector as a whole were evaluated, based on data provided by NWRIC members and Australia's National Greenhouse Accounts. Projected emissions to 2050 were modelled on the most likely future scenario. The methodology is described in further detail below.

The final stage was to collate case studies from NWRIC members on avoided emissions to estimate the total GHG balance today for the whole sector and help forecast future estimates. This includes projects underpinned by circular economy where products are made from recycled materials, reducing GHG emissions primarily by decreasing the amount of energy used compared with using virgin raw materials. Avoided emissions can be summed to offset total emissions and help predict a path towards a net zero balance.

3.2 Emissions targets progress

Australia has committed to the goal of achieving net zero emissions by 2050. In 2022, the Government updated its Nationally Determined Contribution under the Paris Agreement, by increasing the 2030 target to 43% below 2005 emission levels. Both 2030 and 2050 targets were updated in the Climate Change Act 2022.

In 2022, the Climate Change Authority (CCA) published its first Annual Progress Report on how Australia will achieve its targets by sustaining a decarbonisation rate of at least 17 Mt CO_2-e per year[7]. Whilst this is a significant challenge, the waste sector has played an important role in helping achieve these targets, with a 45% decrease over the past 30 years and currently contributes 2.9% of Australia's total net GHG emissions.

While all levels of government have economy-wide emissions reduction targets and policy interventions to drive down emissions, efforts have largely been focused on the land and electricity sectors, with limited or no targets for other sectors. The waste and resource recovery sector has relied on voluntary action and high-level emissions inventory data. NWRIC wishes to track the progress of the waste and recycling sector with more up-to-date information, including the assessment of investments into projects that significantly reduce emissions, which is forging their pathway towards a net zero balance or better (net negative).

While all levels of government have economy-wide emissions reduction targets and policy interventions to drive down emissions, efforts have largely been focused on the land and electricity sectors, with limited or no targets for other sectors.

3.3 Waste quantities and targets

In 2018, the Australian Government, State and Territory governments and the Australian Local Government Association released the updated National Waste Policy. The policy aims to help Australia move closer to a circular economy that eliminates waste and improves economic, social and environmental outcomes.

The 2019 National Waste Action Plan includes targets and actions to guide Australia's investment and efforts, including halving the amount of organic waste sent to landfill by 2030, and other actions such as export bans on waste plastics, paper glass and tyres. These actions are also supported and implemented by State and Territory governments, local government, business and industry.

The National Waste Report 2022[8] provides ongoing performance data for the national targets. Australia's resource recovery rate target is 80% by 2030. In 2020-21 our performance was 63% and this has remained relatively steady, even though waste generation has been increasing slightly over previous years. Total waste generation in 2020-21 was 75.8 Mt, including 25.2 Mt of building and demolition materials, 14.4 Mt of organics, 12 Mt of ash, 7.4 Mt of hazardous waste (mainly contaminated soil), 5.8 Mt of paper and cardboard, 5.7 Mt of metals and 2.6 Mt of plastics. Ash is a residue of coal-fired electricity generated in the commercial and industrial stream. This material is not managed by the waste and resource recovery sector but is included in reporting due to the large quantities produced.

Achieving the 80% resource recovery target by 2030 requires recovering an extra 15 Mt pa of waste. Significant investment has been made into increasing the capacity of recycling infrastructure, with the support of all levels of government and industry. The Australian Government's Recycling Modernisation Fund[9] projects announced in 2022 are expected to recycle an extra 1.1 Mt from July 2024.

Halving the amount of organic waste sent to landfill by 2030 means 2.7 Mt less organic waste will go to landfill every year, thereby reducing the methane gas generated from the breakdown of organic material under anaerobic conditions (in the absence of oxygen) in a landfill. Methane is 26 times more potent GHG than carbon dioxide. Decomposition of organic waste via composting reduces methane compared to landfill due to the aerobic process of composting where methane producing microbes are not active in the presence of oxygen.

Municipal kerbside collection of food organics and garden organics has seen a significant diversion of food waste in recent years and is driving a need for growth in organics processing capacity. In 2018-19, 7.5 Mt of organic material was processed from composting operations, which has grown 3.4% each year. The total GHG savings, due to diverting recovered materials from landfills, was estimated to be 3.8 Mt CO_2-e that year.[10]

Of the 14.4Mt of organic waste generated, kerbside organics collections account for 1.9 Mt (13%), therefore food waste and other organics recovery from the commercial sector, cafes and restaurants, and multi-unit dwellings is the next greatest opportunity and challenge.

The National Waste Policy was updated in October 2022, pushing back the target for FOGO collection to metropolitan households and businesses by 5 years to 2030.Removing FOGO from the municipal stream and food waste from the commercial sectors will be the key driver to achieve a greater than 75% diversion rate from landfill.

CASE STUDY

Veolia's Organics Recovery

Veolia Organic In-vessel Composting Facility, Bulla Victoria.

Veolia operates a comprehensive range of technologies including a number of in-vessel composting facilities as well as an anaerobic digestion facility which produces both electricity and fertiliser.

Across Veolia's facilities, up to 120,000 tonnes per year of organic material from kerbside food and garden organics, commercial and industrial wastes are processed and converted into high quality composts and soil conditioners. Composted products are beneficially reused across urban and agricultural applications across the country, returning carbon back into the soil to improve soil health and grow everyday foods.

Diverting organic resources for recycling, significantly reduces emissions and recovers valuable nutrients from being landfilled that improves sustainability and provides benefit to our community. Compost plays a critical role in improving soils carbon and crop productivity, and keeps the materials valued through a circular economy.

3.4 Recycling Commodity Exports

The export of certain wastes from Australia became regulated under the *Recycling and Waste Reduction Act 2020*. Since 2021, the export of glass, plastics and tyres has been regulated, and paper and cardboard will come under the export rules from 1 July 2024. The National Waste Report 2022 showed how the new rules, together with the import controls imposed by key trading partners have significantly reduced the quantities of the regulated wastes.

The waste and recycling sector values a centralised system to licence exported materials to agreed quality standards, and the strategy to build Australia's capability to process and remanufacture waste as a major circular economy opportunity for Australia. However, there are significant shortfalls in recycling infrastructure and underdeveloped growth in markets for locally produced recycled content. Until there is capacity, there is a need to continue to export the excess commodities that are unable to be recycled locally, or the alternative is to landfill.

In Australia, there has been limited growth in the market for recycled materials and little incentive for manufacturers to prioritise locally produced recycled materials over imported virgin materials, mostly due to costs. Australia imports and exports waste materials, and it will take longer for sufficient internal capacity to reuse the total quantities of recyclable commodities it recovers.

In Australia, there has been limited growth in the market for recycled materials and little incentive for manufacturers to prioritise locally produced recycled materials over imported virgin materials, mostly due to costs.

CASE STUDY

Cleanaway set to recycle 50,000t plastic bottles every year

Circular Plastics Australia

Cleanaway has partnered with Circular Plastics Australia to return used plastic feedstock (PET bottles and containers) to the market by recycling the equivalent of approximately 1 billion 600ml PET plastic bottles every year.

The Albury plant creates food-grade recycled polyethylene terephthalate or 'rPET' that is used to produce new beverage bottles. Around 30,000 tonnes of rPET are created to service big brands for their consumer goods to be reused again and again, lessening the reliance on virgin PET plastic. Comparably, rPET has a carbon footprint of 0.45kg CO_2-e per kg of rPET, while virgin PET accounts for 2.15kg CO_2-e per kg. Ultimately, this corresponds to 79% lower GHG emissions for rPET.

The Laverton plant at capacity will be able to process more than 20,000 tonnes of plastic into food grade rHDPE and rPP resin. Recycled HDPE has a carbon footprint of around 0.24kg CO_2-e /kg, which is 88% less GHG emissions than virgin HDPE which has a footprint of 1.92kg CO_2-e /kg. Whilst rPP is 0.53kg CO_2-e /kg in comparison to virgin PP of 1.84Kg CO_2-e /kg.

The plastic recycling facility brings the circular economy on-shore to Australia, with Cleanaway supplying the plant with the plastic after sorting and bundling comingled recyclables from municipal and commercial sources. Appropriate PET stock is then transported to the Albury site to produce the plastic resin for use in manufacturing overseas and in Australia.

3.5 Scope & methodology

To establish an emissions profile for the waste and recycling sector, reporting must be consistent with the established international reporting protocols, such as the GHG Protocol for reporting net emissions, the UN Framework Convention on Climate Change and Paris Agreement, and the National Greenhouse and Energy Reporting Scheme (NGERS) which aligns with these frameworks.

Ricardo modelled historical data from various data sources, the 2 key sources were the National Greenhouse Accounts and the National Waste Data Report. Data was also verified with supplementary data provided by NWRIC members. All historic figures and forecasts are representative of Australia's entire waste sector, apart from the avoided emissions that are discussed later (Section 3.3 Avoided GHG emissions).

3.5.1 Data sources

The quantification of the GHG emissions associated with Australia's waste and resource recovery activities was conducted through baseline and forecast modelling from a range of data sources, where each was reviewed for specificity, quality and types of data available, from the following data sources:

- NWRIC member data including NGER scheme reporting
- NWRIC and non-NWRIC members annual and sustainability reports
- NWRIC member forecasts – new infrastructure and plans
- National Greenhouse Accounts Factors 2022
- National Greenhouse and Energy Reporting (Measurement) Determination 2008
- Australian Greenhouse and Energy Information System AGEIS
- Industry reports
- Environmental approval applications

The analysis looked at the waste industry process and transport emissions for the baseline year 2005 and projected to 2050 to assess the ambition of the 2050 net zero target. The data was assessed from current day baseline data to ensure that the historical data back to 2005 is accurately represented and consistent with more recent information.

Infrastructure forecasts from NWRIC members combined with population and GDP projections and committed government and industry targets, enabled forecasting of emissions to 2050.

Avoided emissions were based on case studies and recorded separately, representing the positive benefit associated with recycling waste into products in place of raw materials.

3.5.2 Assumptions and Validation

Quantifying GHG direct and indirect emissions of companies relies on existing reporting requirements under NGERs, verified by data provided by member companies and their waste and recycling business activities. All assumptions reported by the two key data sources – the National Waste Reporting Tools and NGERs, also apply to this report.

Other assumptions included the need to fill data gaps during historic time periods where no data was reported. These gaps were filled with proportionate values to the adjacent time period. All other assumptions associated with projections are outlined in the sections below.

3.5.3 Results and Interpretation

The quantified results presented below account for the whole waste and recycling sector in Australia and not limited to just NWRIC members. A systematic approach was used to organise the waste and emissions data to cover the same time periods as completely as possible to ensure the forecast is conservative and defines the potential for the sector to continue to contribute to national emission target reductions.

CASE STUDY

Solo Resource Recovery is reducing emissions with hydrogen technology

Solo Resource Recovery

Solo has over 90 years of experience in the waste collection and recycling sector, servicing over 1 million bins per month. Solo is teaming up with Hydi Hydrogen to roll-out 'hydrogen-on-demand' technology to save fuel and cut emissions down from their waste collection trucks.

The technology uses distilled water and low-voltage electricity from the electrical system of the vehicle to produce hydrogen used to supplement fuel and enable more efficient combustion process, reducing diesel particulate matter and up to 80% GHG emissions.

An initial rollout of the HYDI device has begun on waste collection vehicles in South Australia, while Solo has committed to fitting the system to its trucks in WA and NSW.

Solo found a significant and immediate contribution to reducing GHG emissions attributed to transport with the retrofit unit, which pays for itself via reduced fuel consumption.

04

Quantifying GHG emissions

4.1 Current GHG emissions

The Australian Government tracks the nation's GHG emissions through the National Greenhouse Gas Inventory. Australia's net GHG emissions from all sectors was 464.8 Mt CO_2-e in 2020–21. Energy sector emissions accounted for the largest proportion, followed by the agricultural sector and industrial processes and product use sectors (Figure 4-1). The waste sector emissions accounted for 2.9% (10.1 Mt CO_2-e) of Australia's net inventory emissions in 2020–21. This was a decrease in contribution from 3.7% in 1989–90.

The majority of emissions from the waste sector were from solid waste disposal (Figure 4-2), contributing 8.5 Mt CO_2-e (72.6%). Wastewater treatment contributed a further 2.9 Mt CO_2-e (24.7%), while waste incineration and biological treatment of solid waste contributed 0.03 Mt CO_2-e (0.3%) and 0.3 Mt CO_2-e (2.4%) respectively. Waste emissions are predominantly methane-generated from anaerobic decomposition of organic matter.

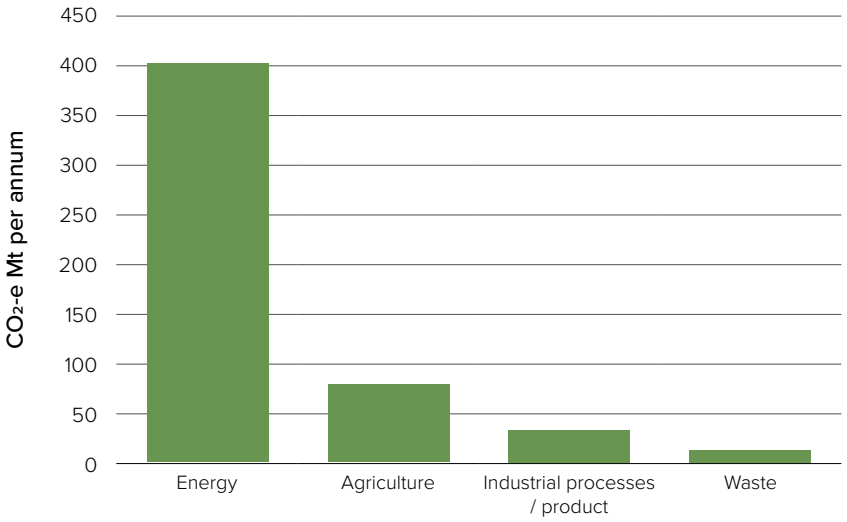


Figure 4-1 Australia's net GHG emissions by key sectors 2020-21

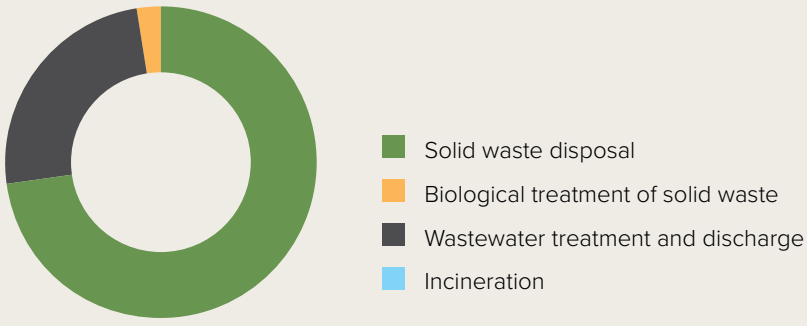


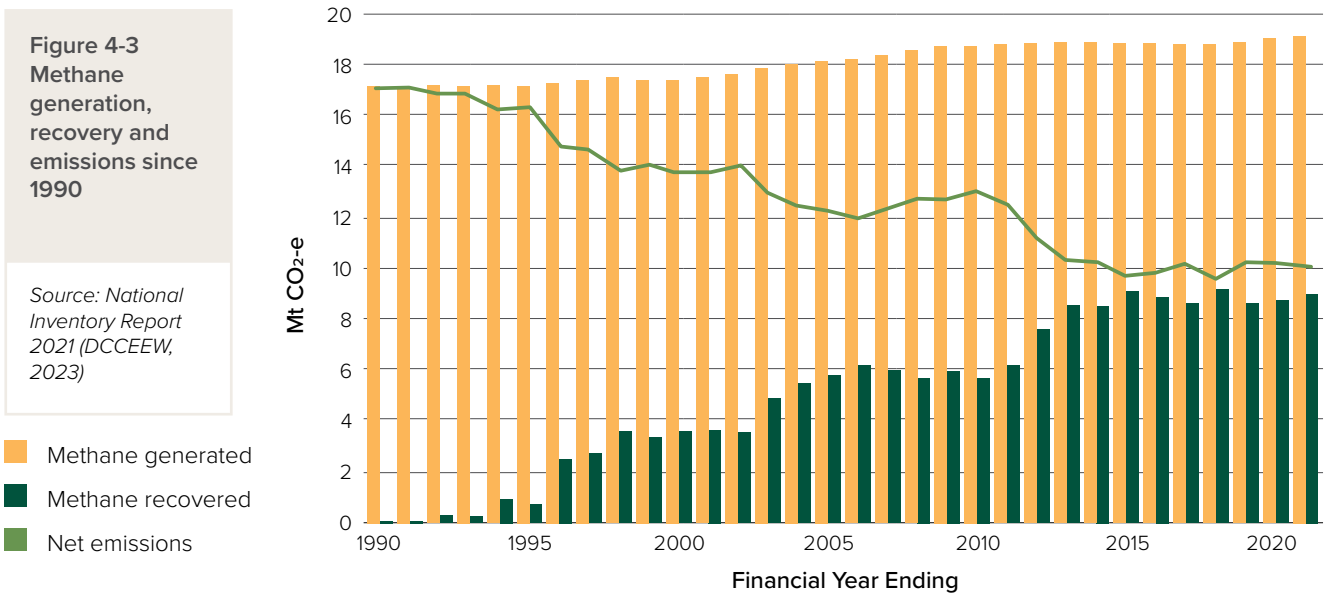
Figure 4-2 GHG net emissions by waste sub-sector 2020-21

The waste sector has significantly reduced GHG emissions by 45% (7.2 Mt CO_2-e) over the past 30 years (see Figure 4-3). Rates of methane recovery from solid waste have improved substantially, increasing from a negligible amount in 1990 to recovering almost half of the total methane generated today. Hence the attention has been mainly focussed on reduction of methane emissions from landfills.

Total waste disposal has also declined in recent years as rates of recycling have increased and alternative waste treatment options are becoming operational. It is possible to capture >90% at a landfill, but naturally not all landfills will achieve that. Even a theoretical 100% capture does not eliminate emissions due to the way organic matter is transferred and decomposed, and how landfills are constructed even in the most efficient way. Over the long-term, diverting organic material from landfill is the main mechanism to reduce GHG emissions, as well as maintaining landfill gas capture systems as key critical infrastructure.

Figure 4-3 Methane generation, recovery and emissions since 1990

Source: National Inventory Report 2021 (DCCEEW, 2023)



4.2 Forecasting GHG emissions

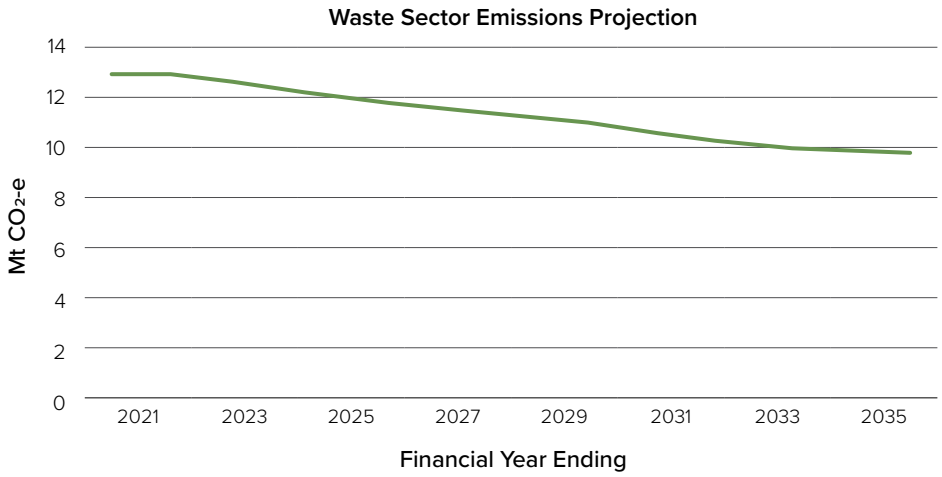
Australia's National Greenhouse Accounts (ANGA) prepares emissions projections using the latest production and activity levels, commodity prices and macroeconomic assumptions data. Figure 4-4 shows Australia's emissions projections for the waste sector including wastewater treatment, as a baseline scenario which is an estimate of projected future emissions under today's policies and measures. The projections do not attempt to account for unknown future changes in technology, energy demand, and supply and the economy.

By 2035 emissions are projected to decrease by a further 25% from 13 Mt CO_2-e (2021) to 9.75 Mt CO_2-e. ANGA projects to 2030 only; however if this trend were to continue on a similar trajectory, the estimated projection would see a reduction to approximately 7 Mt CO_2-e by 2050.

ANGA reports that the decline in emissions in the baseline scenario is projected to come from the strong uptake of renewables which is supported by all levels of government. Many of the larger waste and recycling companies operating in Australia have also committed to emission reduction targets by 2030 and 2050 that align with government targets or better.

Figure 4-4 Emissions projected to 2035 for the baseline scenario

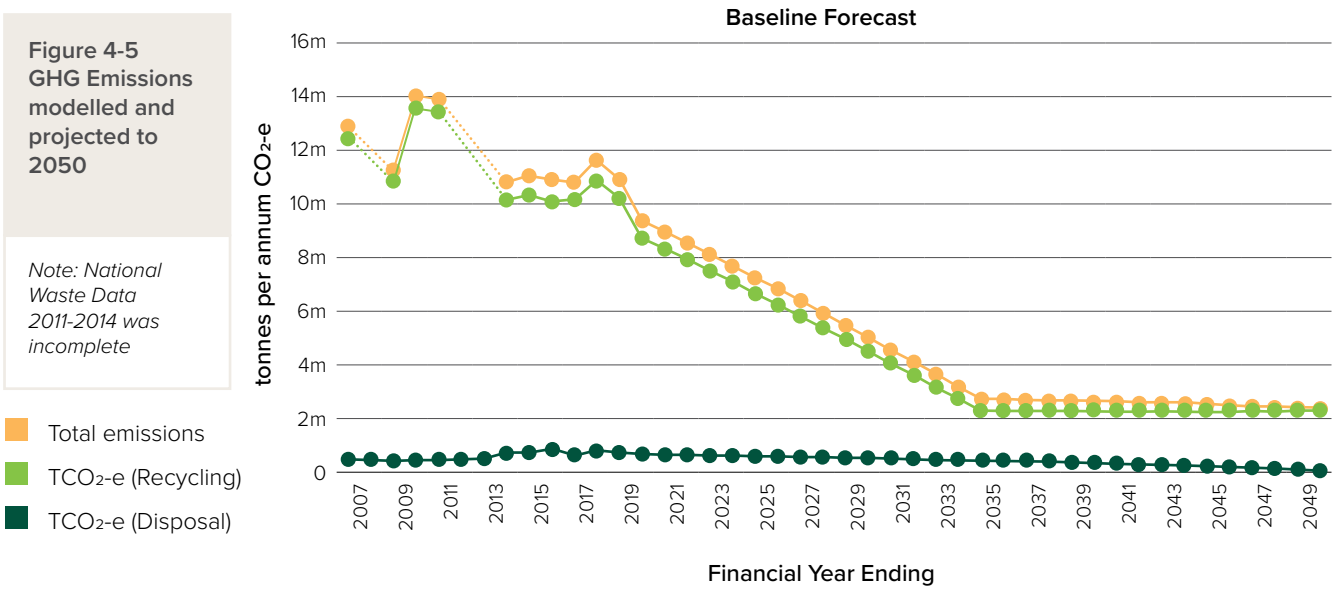
Source: Baseline scenario Australia's National Greenhouse Accounts (DCCEEW, 2023)



Ricardo modelled and projected emissions for the solid waste sector from 2007 to 2050 on the most likely scenario (see Figure 4-5). Based on the modelling, projected emissions dropped to around 2.3 Mt by 2050, which is significantly better than the baseline scenario of 7 Mt by 2050 extrapolated from the National Inventory projection.

Figure 4-5 GHG Emissions modelled and projected to 2050

Note: National Waste Data 2011-2014 was incomplete



The likely scenario is based on a more refined dataset, where the key factors contributing to these further reductions are:

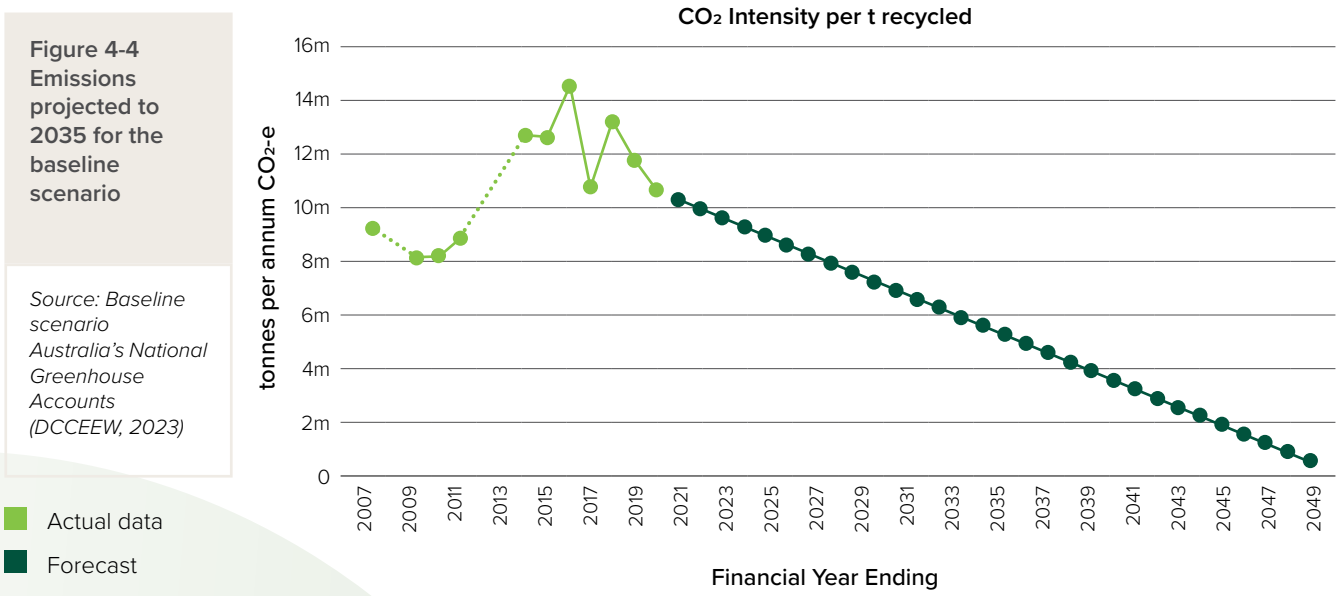
- Diversion of organics from landfill
- Decarbonisation of the energy grid
- Increase in renewable energy use for recycling activities.

Recycling is becoming more energy efficient (see Figure 4-6), where the emissions intensity of recycling will decrease over time, although the volumes recycled will increase. Intensity of emissions per tonne of waste recycled will reduce, which is attributed to waste and recycling management facilities using decarbonised energy sources and the future of Australia's grid-connected renewable energy production. Total emissions will reduce as the reduction of organic material disposed to landfill is diverted. Even though volumes generated and disposed (landfill or WtE) remain steady.

Waste transport emissions is considered a relatively small portion of the total emissions. The adoption of alternative fuels and the transition of the sector to a localised circular economy will see reductions in long haul transport of waste materials interstate and overseas.

Figure 4-4 Emissions projected to 2035 for the baseline scenario

Source: Baseline scenario Australia's National Greenhouse Accounts (DCCEEW, 2023)



The key findings are:

- Recycling rates are increasing, whilst emissions are decreasing
- Intensity of emissions per tonne of waste recycled will reduce over time, due to decarbonisation of the electricity grid and facilities installing renewable energy sources
- Total emissions will reduce as the reduction of organic material disposed to landfill is diverted
- Whilst GHG emissions are declining, volumes generated and disposed remain steady.

CASE STUDY

ResourceCo & Cleanaway joint venture to produce alternative fuels

Source: Cleanaway ResourceCo Resource Recovery Facility (RRF) Wetherill Park, NSW.

ResourceCo's eight different locations across Australia and Asia make them one of the country's largest recycling businesses by accepting and processing over 2 million tonnes of waste per year. A core component is in the production of alternative Fuels from waste materials.

In a joint venture with Cleanaway, ResourceCo converts up to 250,000t of raw waste material into approximately 150,000t of Processed Engineered Fuel (PEF) each year. The state-of-the-art facility initially screens and recovers metals and aggregates for reuse, which means more than 90% of all incoming material is diverted from landfill.

The PEF is used as an alternative to fossil fuels for major cement kilns, reducing greenhouse gas production per tonne of cement produced. Based on current production levels, use of ResourceCo fuels has been independently calculated to avoid over 370,000 tonnes of carbon dioxide equivalent per annum.

4.3 Avoided GHG emissions

Avoided emissions generated from operations and activities can be quantified from the diversion of materials from landfill and the displacement of virgin materials (including fossil fuels) due to:

- Alternative fuel production
- Provision of recycled materials to manufacturing, locally and internationally
- Recycled products such as oils, solvents, aggregates
- Production of nutrients from recycled organics.

Avoided emissions are important because they are not accounted for in scope 1 and 2 emissions and can only be quantified on a project or case basis on any given year. It was assumed the activity avoiding emissions continues at the same rate for the foreseeable future. By collating the figures as an annualised emissions offset, it can be estimated when the sector will reach net zero carbon.

Considering the waste sector currently produces around 10 Mt CO_2-e today and this is forecast to reduce to 2.3 Mt CO_2-e by 2035, any offsets by avoided emissions over these figures will result in a net negative balance. Collectively, it was estimated that NWRIC members are avoiding 4.8 Mt CO_2-e per annum based on the cases collated to date (see Table 4-1).

Table 4-1 NWRIC Members estimated avoided GHG emissions per annum

Avoided emissions	Estimated avoided CO_2-e t pa
Alternative fuel production	370,000
Bioenergy facilities currently destroy >4 Mt CO_2-e pa as methane to produce 550 MWh pa. The estimated avoided emissions based on the renewable energy generated.	379,500
Extraction and refinement of waste oil for reuse	200,600
Compost operations, where conversion is based on AORA 2021 figures of avoided emissions per tonne of compost per annum	285,000
Reprocessing facilities replacing virgin raw materials	51,000
Scrap metal recycling, where global avoided emissions were extrapolated for local metals processing	3,501,500
TOTAL	4,787,600

If NWRIC members maintain these rates of avoided emissions every year, theoretically, carbon neutrality will be reached by 2031, as the projected total emissions by 2031 is approximately 4.5 Mt (see Figure 4-5) which is less than the avoided emissions combined.

Reported offsets by other sector participants (non-NWRIC members) are also significant, so the total figure for the whole sector will be greater, and therefore carbon neutrality could be reached earlier than 2031.

Many industry members have adopted net zero emissions targets, mainly by decarbonising their energy sources with the installation of renewable energy on site and investing in lower fleet emission technologies. Significant investment in recycling infrastructure is also increasing the capacity to divert more waste from landfill and implement circular economy projects.

By replacing virgin raw materials with recycled ones, which is at the heart of the recycling industry, forges the pathway towards net zero emission. Australia's waste and recycling sector are well on track to achieve a net zero emissions target by 2030, and a net negative balance by 2050.

CASE STUDY

Infrabuild is repurposing Australia's used steel onshore

Infrabuild

Infrabuild, Australia's largest processor and distributor of steel long products are committed to keeping Australia's used steel on shore for repurpose and to be remanufactured into new products with less reliance on the production of virgin steel.

Every year Infrabuild's domestic recycling facilities recover about 1.4 million tonnes of recycled metals for their Electric Arc Furnaces to manufacture the steel needed for residential and commercial construction. For every tonne of ferrous scrap metal that is recycled 1.5 tonnes of CO_2-e is saved.

Ferrous scrap material remaining onshore enhances Australia's feedstock of recyclable materials as well as eliminating overseas exportation and the GHG emissions associated with transportation. About 1 million tonne of unprocessed ferrous scrap metal is exported from Australia per year.

If all ferrous scrap metal was recycled in Australia instead of exporting to countries with lesser environmental standards, the reduction in transport alone would see the CO_2-e emissions almost halved.

05

Future opportunities

Australia's waste and recycling industry is preparing for the additional tonnes of plastic, paper, glass and tyres that will need to be re-processed and recycled when the full extent of the waste export regulations come into effect. Major investments in increasing capacity and infrastructure to produce 'input ready' recovered materials for reuse into manufacturing or agriculture are creating greater local demand. Industry will continue to be reliant on government to successfully establish the necessary infrastructure capabilities and ensure planning and environmental approvals are supported.

Opportunities for further GHG reductions in the waste sector are primarily associated with process improvements (less energy consumption), improved technologies and use of renewables during the reprocessing of materials like metals, plastic, and cardboard/paper.

Metal recycling is a key feature of the industry which contributes significant emissions reductions as it requires less energy and resource consumption. All scrap that is collected across Australia is recycled on shore or exported. Every tonne of scrap used for steel production avoids the emission of 1.5 t of carbon dioxide[12]. There is greater potential for the steel industry to use more recyclable materials as feedstock. It was estimated that further recycling of the exported 802,975 tonnes of ferrous scrap metal would save 1.2 million in Australian greenhouse gas emissions[13].

Increased separation of organics in commercial operations, especially in retail and hospitality is required to divert more organic material from landfill. Recovering organics and food waste as compost or energy will further reduce emissions and provide valuable soil carbon to regenerate the land. Recovering energy from non-recyclable materials that otherwise will end up in landfill will be a major contributor to emissions offsets in the short to medium term, by providing baseload power to the existing power grid.

The modelling demonstrates that removing organic material from residual waste will reduce the GHG impact from landfill emissions dramatically. In a thermal Waste to Energy (WtE) facility, if the emissions from combusting food count as renewable energy, there is less GHG impact as carbon dioxide is produced instead of methane. So, when food waste is removed from the residual stream entering a thermal WtE facility, there is little to no impact on emissions, except for the degree of energy produced.

Currently GHG emissions from WtE facilities are lower than landfills due to the energy grid's reliance on fossil fuels. The electricity produced by thermal WtE facilities have an emissions intensity that is lower than the National Electricity Market (except for Tasmania and possibly South Australia). Once FOGO collections are rolled out to all households, GHG emissions will be on par in a best practice landfill and in a WtE Facility for managing municipal waste.

Although no analysis or modelling has been attempted for this report to compare WtE with landfill, it would be reasonable to expect that in the longer term, and by 2050, with FOGO collections in place and the electricity grid on a positive path to decarbonisation, the emissions intensity of thermal WtE could be higher than the average electricity market, meaning that there will be no emissions offset available for electricity.

The long term future of WtE will be as a technique to treat waste and reduce landfill volumes which has wider environmental benefits, rather than just a GHG reduction measure. Total sector emissions will continue to decrease as the modelling shows, and net emissions will also be much lower than today, but the case for thermal WtE will need to be based on different drivers.[12]

CASE STUDY

SIMS Limited is a global leader in metals recycling

Sims Limited is an Australian success story. Founded more than 100 years ago in Sydney as a scrap metal business, today Sims Limited is a global leader in metal recycling and circular solutions for technology.

Sims Metal provides high-quality recycled metals in place of virgin materials, which enables the avoidance of emissions, including those associated with extraction and refining of virgin materials, and the production of steel products. When Sims Metal processes discarded metal, it is transformed from waste to a resource that can go directly to a smelter without further processing, ready to be made into new steel. Low-carbon steel is essential for the renewable infrastructure of the future: solar panels, wind turbines, dams and electric vehicles all require steel, along with non-ferrous materials like copper and aluminium that Sims Metal also recovers.

In FY21, Sims Metal recycled 8.3 Mt of ferrous metal, which globally, has the potential to avoid 13.4 Mt of CO_2-e emissions compared to producing the same amount of steel from raw materials. This equates to more than 100 times the carbon footprint of Sims Metal's direct operations annually. For scale, 13.4 Mt of CO_2-e is comparable to the annual emissions of some of Australia's largest coal-fired power plants.

Sims Lifecycle Services (SLS) plays a critical role in helping enterprises and data centres manage the end-of-life stage of the technology lifecycle, including refurbishing, reselling, parts harvesting, as well as recycling. In an industry first, in 2022 SLS launched a calculator that quantifies carbon avoidance from recycling, as well as from the reuse of whole IT assets and components. Detailed dashboards show volumes of equipment processed, disposition routes and the carbon-equivalent emissions avoided, powered by equipment manufacturing data and our own lab-based asset data. For FY22, the total avoided emissions impact was 439 kilotonnes of CO_2-e – that's equivalent to taking more than 90,000 cars off the road for one year.

Sims Metal Kwinana ©Salty Dingo

Sims Limited has also committed to reducing emissions from its own operations, including committing to using 100% renewable electricity in all operations by 2025. Since FY20, Sims Limited has reduced emissions by 21%, equivalent to the energy use of more than 3000 homes. Sims Limited has laid out its direct decarbonisation plan in a report endorsed by shareholders at its 2022 AGM.

06

Conclusions and recommendations

Australia's waste and recycling industry is contributing to Australia's GHG emissions reduction target of net zero by 2050 and has seen a 45% decrease in GHG emissions over the past 30 years. The sector is actively pursuing low emissions options and replacing virgin resources with recycled materials. Today the sector contributes 2.9% or approximately 10 Mt CO_2-e to Australia's GHG emissions profile per year.

Avoided emissions from operations and activities, including the diversion of material from landfill and the displacement of virgin materials including fossil fuels, was quantified. By 2030, GHG emissions are projected to reduce to around 4 Mt CO_2-e (from 10 Mt per annum today) and will likely continue trending down towards zero by 2050.

Today Australia's waste and recycling sector recovers 63% of the total waste generated, whilst also increasing the circularity and value of waste materials. More local options and solutions, government support and partnerships with other industries and supply chains will see further reductions in emissions to help Australia reach its net zero balance before 2050.

A growing market for recycled products needs development, and a regulatory environment that supports harmonisation of State policies and drivers will further incentivise investment into recycling and recovery infrastructure creating more opportunities to be able to shift to a circular economy.

NWRIC is committed to monitor and identify more opportunities to avoid emissions and reach negative net carbon emissions before 2050.

CASE STUDY

JJs Waste and Recycling recovering nearly 99% lube oil from collected waste oil

JJ's Waste and Recycling provide waste management services and are committed to providing best possible solutions to waste management problems in order to minimise their environmental footprint.

JJ's have partnered with Southern Oil Refining to recycle waste lube oil back into base lube oil that is used to manufacture new engine and hydraulic oils. About 350 million litres of waste lube is collected in Australia every year, much of which, before re-refining infrastructure was developed, was burned as a cheap fuel.

The JJ's / Southern Oil partnership operates two refineries in Wagga Wagga and Gladstone. The Gladstone facility is the newest waste oil refinery in Australia, commissioned in 2014 with a capacity to refine over 100 million litres of waste lube oil per year, producing about 65 million litres of base oil. This 'cradle to cradle' treatment of waste oil is the highest form of recycling that keeps lube oil in productive use, lowering carbon emissions by avoiding the extraction and refining of virgin lube oil from crude oil, as well as through the avoidance of importations.

At capacity 200,000 tonnes of CO_2-e emissions are avoided each year through waste diversion and the enhancement of circular economy practices at the two refineries.

The Southern Oil re-refining process produces no waste and with 99% of the lube oil component in the waste oil being recovered as high-quality lube oil. This creates a near perpetual cycle of use and re-use within a limited resource.

07 References

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08 Glossary

CCA	Climate Change Authority
kt CO_2-e	Kilotonne of carbon dioxide equivalent
GHG	Greenhouse Gas
NGER	National Greenhouse and Energy Reporting
NWRIC	National Waste and Recycling Industry Council (NWRIC)

NWRIC

National Waste and Recycling Industry Council