Investing in minimising waste: An impact assessment

Final report

22 August 2025
Commercial in confidence

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Contents

Appendices

Tables

Figures

Preface

This report has been prepared for the Ministry for the Environment by Chelsea Steen-Jones, Jason Webber, Aaron Gabbie, Stephen Knuckey, and Donella Bellett from MartinJenkins (Martin, Jenkins & Associates Ltd).

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Summary

This review identifies and quantifies the impacts of investing in waste minimisation

The Ministry for the Environment (MfE) asked MartinJenkins to identify and quantify the economic, environmental, and wellbeing impacts from its investments in minimising waste. Our review covered programme funds distributed to date, covering more than 350 projects from July 2015 to June 2025, including work on contaminated sites and vulnerable landfills.

MfE will use the findings to improve its reporting to ministers and the public on the impacts and benefits of investing in minimising waste.

Our review built on the 2024 review by Sapere,[1] which had quantified two key impacts, avoided landfill costs and avoided emissions, and also identified, but didn't quantify, several other impacts. The list of outcomes and impacts that we developed for this review aligns well with the impacts identified by Sapere.

We developed a re-usable intervention logic and quantification approach, which can then be used for future investments in minimising waste. This report presents that intervention logic, with its four intended outcomes, and it then shows and quantifies the different tiers of impacts flowing from those four outcomes. Finally, we present our estimate of the overall return on investment from the programme funds distributed so far.

We estimate that the investments deliver a positive return to society of around $500 million with a benefit-cost ratio of 3.11

These return-on-investment results bolster Sapere's initial assessment with further quantified benefits. We found that Sapere's calculated benefit-cost ratio (BCR) of **1.42** (from two key impacts, avoided landfill costs and avoided emissions) increased to **3.11** in our assessment (from 14 quantified impacts across four outcome areas).

The results of our assessment are broadly consistent with what one would expect from environmental or social investments: a significant positive return, but over a lengthy payback period. Up-front costs are high, and the return for society is negative for at least the first 10 years, with benefits only delivering a significant positive social return after some 11 years.

Table 1: Summary of incremental costs and benefits (rounded to nearest $000) over 30 years

High-level summary	Total present value
Costs	$236,622,000
Benefits	$736,424,000
Net present value (NPV) in 2025 dollars with 2% discount rate	$499,802,000
Benefit-cost ratio (BCR)	3.11
Payback period	11.09 years

[1] Sapere, "Waste levy review: an assessment of outcomes and recent performance of waste levy investments", October 2024.

The results of our analysis are highly sensitive to some key assumptions

This analysis, although relying on a significant amount of data from MfE and other participants, rests on a range of assumptions. The results we got were highly sensitive to some key assumptions:

- Our analysis applied the "social rate of time preference" (SRTP) discount rate of 2% for both costs and benefits after 2025, with costs and benefits from 2015 to 2024 adjusted by CPI into 2025 dollars. If instead we use a discount rate based on the social opportunity cost of capital (SOC) (the "commercial" rate), which is 8%, the BCR drops to 2.14.
- Our analysis included quantifiable environmental benefits, particularly biodiversity protection, quantified on the basis of a willingness-to-pay (WTP) assessment from the Treasury's CBAx toolkit. If those benefits are excluded, the BCR drops to 1.44.
- If both of those two changes are combined – that is, an 8% discount rate along with removing the willingness-to-pay measures for environmental benefits – then the BCR is only 1.04.
- We assessed costs and benefits over 30 years, from July 2015 to June 2045. Shortening the assessment period would reduce the BCR: an assessment period of 10 years gives a BCR of less than 1.0, at 0.69.
- If we include only high-quality evidence, the value of the impacts is then less than the total costs. However, if we include medium- and high-quality evidence (excluding only low-quality evidence), the BCR is 2.47.

Some important qualitative benefits also result from the investments in minimising waste

A strict value-for-money assessment on a quantitative economic basis will naturally favour those waste-minimisation activities that improve efficiency and operations for waste-management operators over the short term. However, those activities may not be where dollars would best deliver a return for society overall. There are a range of qualitative benefits that, although harder to quantify, clearly result from the investments in waste minimisation.

Those qualitative benefits include innovation and advances in the waste-management sector that could result in significant improvements for outcomes identified in this report. The type of impact will depend on the project's focus.

Introduction

About this review

This review identifies and quantifies the impacts of investing in waste minimisation

The Ministry for the Environment (MfE) asked MartinJenkins to identify and quantify the economic, environmental, and wellbeing impacts from investing in waste minimisation, which includes funding for work on contaminated sites and vulnerable landfills.

The findings will be used by MfE to improve its reporting to ministers and the public on the impacts and benefits of investing in minimising waste.

Our review involved building a re-usable intervention logic and quantification approach, which can then be used to assess future investments in minimising waste.

Our review builds on Sapere's review from 2024

Our review builds on Sapere's October 2024 report "Waste levy review: an assessment of outcomes and recent performance of waste levy investments". Sapere identified a range of waste investment impacts and quantified two key impacts:

- **avoided landfill costs**, calculated based on the volume of organic waste diverted from landfills, and
- **avoided emissions**, calculated based on the volume of CO2 emissions avoided.

Sapere's report identified the following additional impacts and considered them qualitatively:

- employment opportunities
- value of recovered material
- reduced imports
- knowledge gained from feasibility studies
- improved management behaviour and attitudes
- increased public awareness
- social cohesion and community engagement, and
- "warm glow" effects.

For our review we identified the outcomes and impacts in scope by reviewing the list of impacts that Sapere had identified, alongside monitoring and reporting data from MfE's Waste Team on the investments, and a review of relevant literature.

Our final list of outcomes and impacts is well-aligned with Sapere's. We expanded some impacts to provide more detail, and combined or removed some to avoid double counting. A summary of how our work aligns with the work done by Sapere and MfE is in **Appendix 1**.

This report presents the intervention logic we built, our quantitative assessment of each impact, and our estimate of the return on investment

This report presents:

- an intervention logic for investing in waste minimisation, showing the inputs in scope (the investments), the activities the investments are used for, the outputs, and the four intended outcomes
- the impacts that flow from the four intended outcomes, broken down into first-, second-, and third-order impacts, and
- the overall return on investment from the programme funds distributed to date on over 350 projects.

Where it was possible to quantify an impact, our assessment of the return on investment included assessing the quality of the evidence base and assessing the assumptions we used to quantify the identified impacts. Where it wasn't possible to quantify impacts, we note how the impact links to other benefits that are generated downstream.

Where both benefits and disbenefits are associated with an impact, we noted that a net zero value is assumed, meaning that the advantages and disadvantages are expected to offset each other or result overall in a very small positive benefit that wouldn't be practical to measure.

Our waste-management sector and the shape of government investment

Government invests in minimising waste as a catalyst for reducing waste and recovering more resources

Central government is investing in minimising waste through local government, businesses, and communities, in order to strengthen New Zealand's solid-waste management sector, reduce waste exports, and preserve our natural environment and public health.

Government invested over $200 million in waste minimisation from 2010 to February 2025. This is across three funds:

- **Waste Minimisation Fund** – $173.7 million in investment that is funded through a portion of the National Waste Disposal Levy, and which varies each year based on the actual waste sent to landfill.
- **COVID-19 Response and Recovery Fund for Waste and Resource Recovery Initiatives** – a one-off fund that came to an end in 2024, covering $40.9 million of investment. This included funding for resource recovery infrastructure to help increase jobs and incomes from waste reduction, recycling, and waste management.
- **Plastics Innovation Fund** – the Fund started in November 2021 and is now closed, with investment continuing via the Waste Minimisation Fund. The Fund invested $24.3 million across 24 projects.

Further investment is planned through the National Waste Disposal Levy, as set out in the Waste Minimisation Act 2008. Half of the levy money goes to territorial authorities (city and district councils) to spend on carrying out or promoting the waste-minimisation activities set out in their waste-management and minimisation plans.

Sections 30 and 38 of the Waste Minimisation Act 2008 outline what the remaining levy money (minus administration costs) must be used for, including projects to achieve wate minimisation or to remediate contaminated sites. Budget 2025 has allocated $30 million per year for the Waste Minimisation Fund and $20 million per year for the Contaminated Sites and Vulnerable Landfills Fund to invest in new initiatives.

The Ministry's investment in waste minimisation has attracted a further $212 million in third-party funding to date, and $1.135 billion of potential co-investment over the life of the projects.

Without new investment in minimising waste, there will be a range of significant costs to New Zealanders

Reducing and recycling organic, plastic, and construction and demolition waste provides financial and non-financial benefits for people, the environment, and the economy.

Overall, without new investment in minimising waste there is a burden on councils to maintain and upgrade a financially unsustainable waste and recycling system, which results in overall higher costs for New Zealanders. The financial, environmental, and social costs to New Zealanders would include:

- recyclable waste continuing to be exported for processing overseas
- deferred improvements to resource recovery, meaning we wouldn't be maximising the value of recyclable materials
- landfills reaching capacity sooner with less waste diverted, and more landfills needed as a result
- hazardous waste being stockpiled, leading to significant clean-up and monitoring costs
- landfills having severely limited end-of-life use
- more emissions being generated from waste going to landfill and recyclable materials being transported overseas, and
- more negative public perceptions of the environmental and health impacts from landfills, making it more difficult to get resource consents to open new landfills when needed.

Our solid-waste management sector faces high volumes of waste and low recycling rates

Construction and demolition is the largest source of waste in New Zealand, including waste generated from property damage caused by natural events such as Cyclone Gabrielle and the Canterbury Earthquakes. One estimate is that half of all municipal landfill waste comes from construction and demolition, a third comes from business, industry, farming, and rural sources, and the rest comes from household waste and other sources.[2] It's estimated that across all levied landfills (municipal landfills, construction and demolition fills, and controlled/managed landfills), construction and demolition accounts for nearly 70% of all waste disposed.[3]

2 https://tewaihanga.govt.nz/the-strategy/issues/how-do-we-stop-throwing-so-much-away

3 https://environment.govt.nz/assets/publications/Waste/New-Zealand-Construction-and-Demolition-Waste-Baseline-and-Tracking-Methodology-Report.pdf

In 2019, Sensoneo's first Global Waste Index found New Zealand was the third-worst waste management country out of the 36 reviewed, behind Turkey and Latvia.[4] This appears to reflect missing recycling data, which is addressed in the 2022 Index update, where New Zealand's overall ranking improved. However, in 2022 New Zealand was ranked fourth out of 38 countries for highest waste generation, producing 781 kg per person, with 727 kg of this going to landfill.[5]

Local councils and businesses manage a range of waste-management facilities

In New Zealand, solid-waste management is done by councils and private businesses who manage a mix of facilities, including sites dedicated to construction and demolition as well as industrial waste.

The Ministry for the Environment classifies waste facilities based on their different uses, including:[6]

- **Class 1, Municipal disposal facilities** (40 total as at 26 May 2025) accept disposal waste that is or includes household, commercial, industrial, or institutional waste, green waste, or waste that is not accepted at other classes of facilities.
- **Class 2, Construction and demolition fill disposal facilities** (16 total) accept waste that is or includes solid waste from construction and demolition activity.
- **Class 3 and 4, Managed or controlled fill disposal facilities** (127 total) accept inert material from construction and demolition activities, or inert waste from earthworks or site remediation.

Facilities that aren't considered to be "disposal facilities" include:

- **Class 5, Clean-fill facilities** (124 total) accept only virgin excavated natural material such as clay, soil, or rock, for disposal.
- **Industrial monofill sites** (24 total) accept disposal waste that discharges or could discharge contaminants or emissions and is generated from a single industrial process (for example, steel or aluminium making, or pulp and paper making).
- **Transfer station sites** (253 total) contain a designated receiving area where waste is received, and from which waste (or any material derived from that waste) is transferred to a final disposal site or elsewhere for further processing. Transfer stations do not provide long-term storage for waste or material derived from that waste.
- **Contaminated land** – These are not intended as waste facilities, but because of the presence of introduced hazardous substances government monitors and manages the sites through regulatory requirements in the Resource Management Act (RMA) 1991 and Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

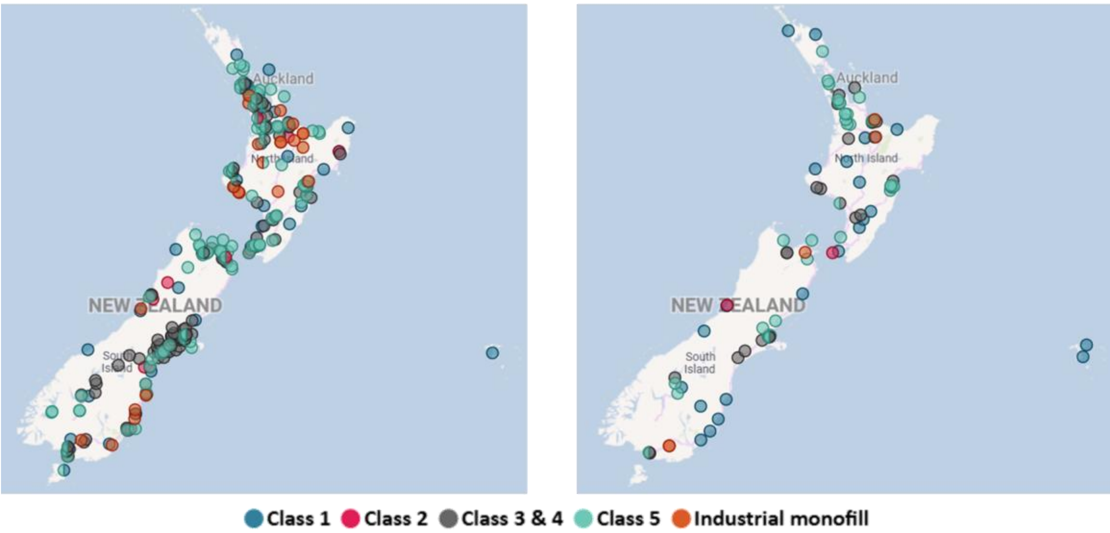
4 https://sensoneo.com/global-waste-index-2019/

5 https://sensoneo.com/global-waste-index/

6 https://environment.govt.nz/what-government-is-doing/areas-of-work/waste/waste-disposal-levy/overview/

Figure 1: Open and closed solid-waste facilities in New Zealand, excluding transfer stations

420 open facilities | **89 closed facilities**



Source: https://environment.govt.nz/facts-and-science/waste/waste-facilities-and-disposal/ last updated 26 May 2025

Notes

1 Closed facilities were sites previously registered with MfE and now listed as closed. There are likely to be other closed facilities not included in the data.

Data from landfills shows both positive and negative trends

In the 2023/24 financial year, 3.6 million tonnes of household and commercial waste was received by Class 1 facilities (municipal disposal facilities), with 9.2% of material being reused, repurposed, or removed from the facility within six months of arriving.[7]

That figure of 3.6 million tonnes represents a 11.7% reduction in waste disposed of compared to the previous year. However, 17.5% less waste was diverted in 2023/24 compared to the previous year.

Research from 2019 also found that New Zealand homes are incorrectly disposing of 178,000 tonnes of material at kerbside each year.[8] Recyclable waste is going straight to landfill or is correctly sorted but is contaminated and so not able to be recycled.

One of the most significant challenges in recycling household waste continues to be the huge variation in the types of materials accepted for recycling throughout the country. Responding to that problem, in February 2024 the Government standardised what can be recycled at kerbside across councils.

Because of our geographically spread population, it has been difficult to justify investing in local recycling infrastructure as there generally is not the scale to allow local recycling operations to be economic and affordable for ratepayers.

As a result of the dispersed nature of operations and processing, and our lack of population density, New Zealand has limited plastic recycling infrastructure and historically has relied on exporting plastic

7 https://environment.govt.nz/facts-and-science/waste/waste-statistics/

8 https://environment.govt.nz/assets/publications/Transforming-recycling-consultation-document.pdf

and other recyclable waste, mainly to Malaysia and Indonesia, where there is scale and low-cost labour, particularly for polyethylene.

However, waste exports have decreased since China's "National Sword" policy came into effect in 2018, and New Zealand is now focussing on local processing and reducing non-recyclable plastic use.[9]

9 https://environment.govt.nz/assets/OIA/Files/Doc3-BRF-3444_Aide_Memoire-Information_on_plastic_waste_exports_out_of_New_Zealand-for_release.pdf

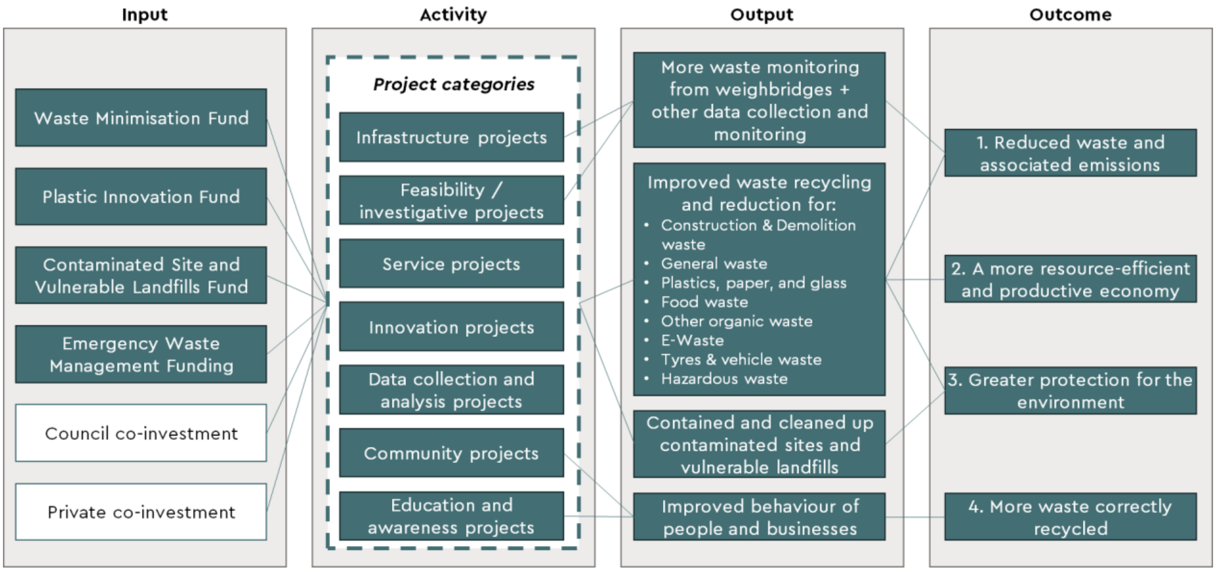
Developing an intervention logic for investing in waste minimisation

As part of our initial work, we developed an evidence-based intervention logic for investing in waste minimisation, drawing on previous work conducted by the Waste Minimisation team and the Ministry for the Environment. The intervention logic provides the foundation for our review by setting out the investments of focus, and the outcomes that are expected from those investments.

In developing the investment logic, we drew on:

- administrative data, to help us understand the flow and purpose of investment at a project level
- a review of MfE's existing programme intervention logic, and
- a review of investment policy documents, and a targeted literature review.

Figure 2: Intervention logic for investing in waste minimisation



Source: MartinJenkins

The parts that make up the intervention logic

Inputs

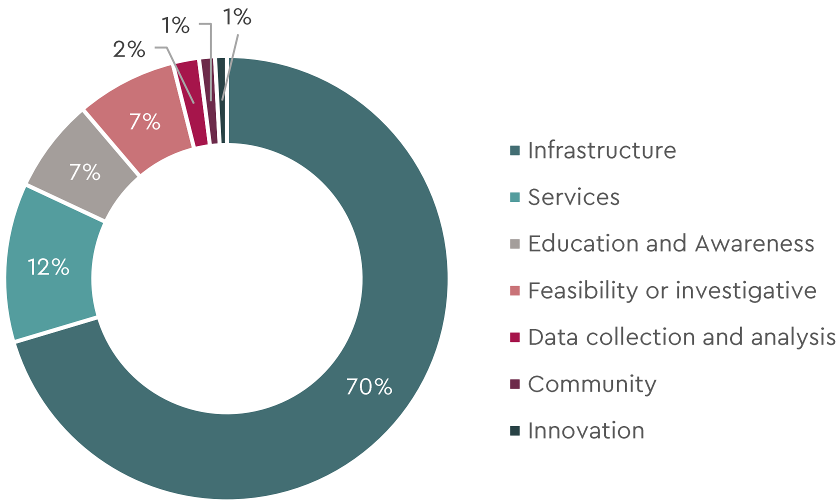
Our review looked at a range of waste minimisation investments, including $214 million of government funding, plus $1.135 billion of estimated third-party co-funding over the life of the projects, from councils and the private sector.

Activity

There are more than 350 waste-minimisation projects now completed or underway that are reported on across seven different project categories, capturing the different approaches each project takes.

The mix of activities depends on which fund applications are successful. To date, most funded projects are for infrastructure, including weighbridges, recycling facilities, and waste-sorting systems.

Figure 3: Proportion of waste-minimisation investments by project type



Source: Ministry for the Environment, Waste investments dashboard accessed 16 February 2025

Outputs

The various activities produce four distinct types of outputs. These are the tangible things produced by the funded projects and are not in themselves quantifiable benefits.

1. **Improved understanding of the waste system.** Infrastructure, data collection, and analysis that informs waste planning and decision making.
2. **Improved waste reduction, reuse, and recycling for a range of different waste types**. The majority of projects are focussed on general waste. To better guide our review, we identified some specific waste types that projects focus on in order to explore any specific impacts, including:
   - construction and demolition waste
   - general waste
   - plastic, paper, and glass
   - food waste (separate to other organic waste as some food can be rescued and redistributed)
   - other organic waste
   - E-waste
   - tyres and vehicle waste, and
   - hazardous waste (which can overlap with some of the above categories).

3. **Contained and cleaned-up contaminated sites and vulnerable landfills.** This includes the contaminated sites work that is in the scope of this review, which is monitored and reported on separately from investments in waste minimisation.
   - Contaminated land is land that has a hazardous substance in or on it that has, or is reasonably likely to have, a significant adverse effect on the environment.[10]
   - Contaminated sites include many things in addition to landfills, such as old service stations, mines, factories, and agricultural land. Landfills that have hazardous substances in them are examples of contaminated land and are included so that their impacts on the environment and on people's health are part of the review.
4. **Improved behaviour of people and businesses.** We have defined this as an output (rather than an outcome) as it does not create a quantifiable impact, but people and businesses understanding what to do and then doing it leads to less waste produced and more waste being correctly recycled.

Outcomes

Through our review of investment policy documents and literature, we found that investing in waste minimisation contributes to four distinct outcomes:

- **Reduced waste and associated emissions**, including the impacts from avoiding landfill costs through more composting and recycling of waste
- **A more resource-efficient and productive economy**, including impacts from diverting waste from landfills through recycling more materials
- **Greater protection for the environment**, including impacts from more sustainable manufacturing and better processing of waste, particularly hazardous waste, which minimise the environmental costs of landfills and contaminated sites, and
- **More waste correctly recycled**, including impacts from better behaviours and practices for creating and disposing of waste.

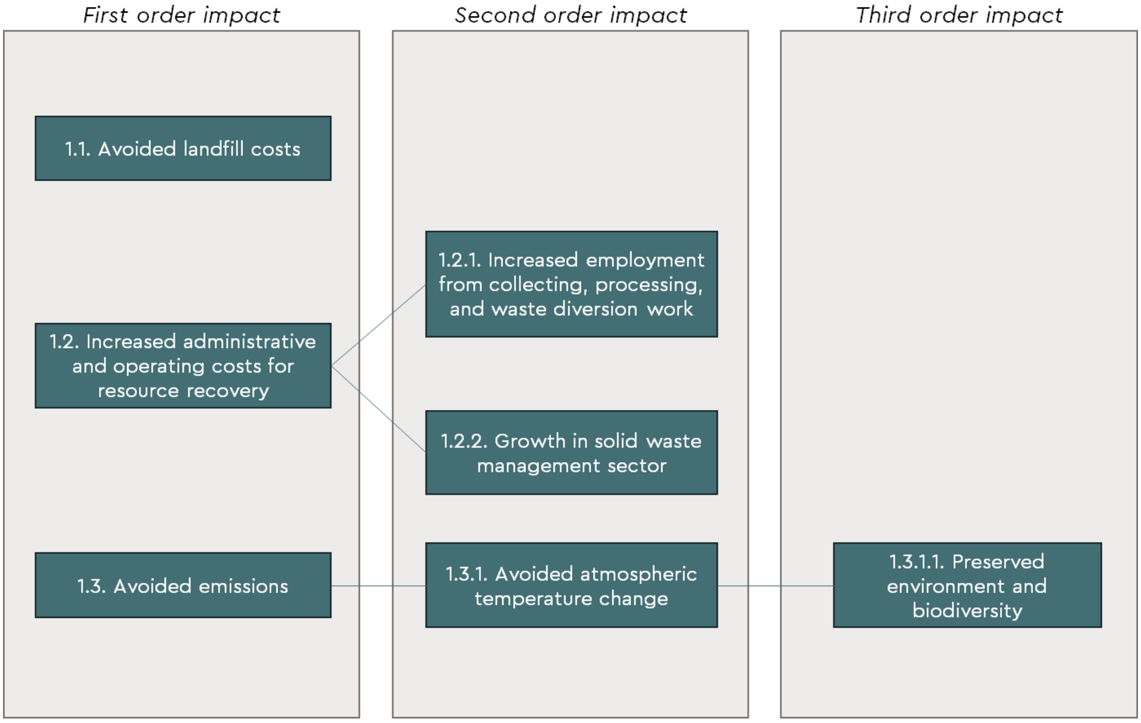
The impacts of investing in waste minimisation

Once the intervention logic was agreed, we used evidence from our literature review and our analysis of waste investment data to identify the impacts that are expected to flow from the four outcomes.

The following four figures map out the flow-on impacts that can be evidenced and quantified for each outcome. These impact maps include first-, second-, and third-order impacts based on the order in which they flow on from these outcomes.

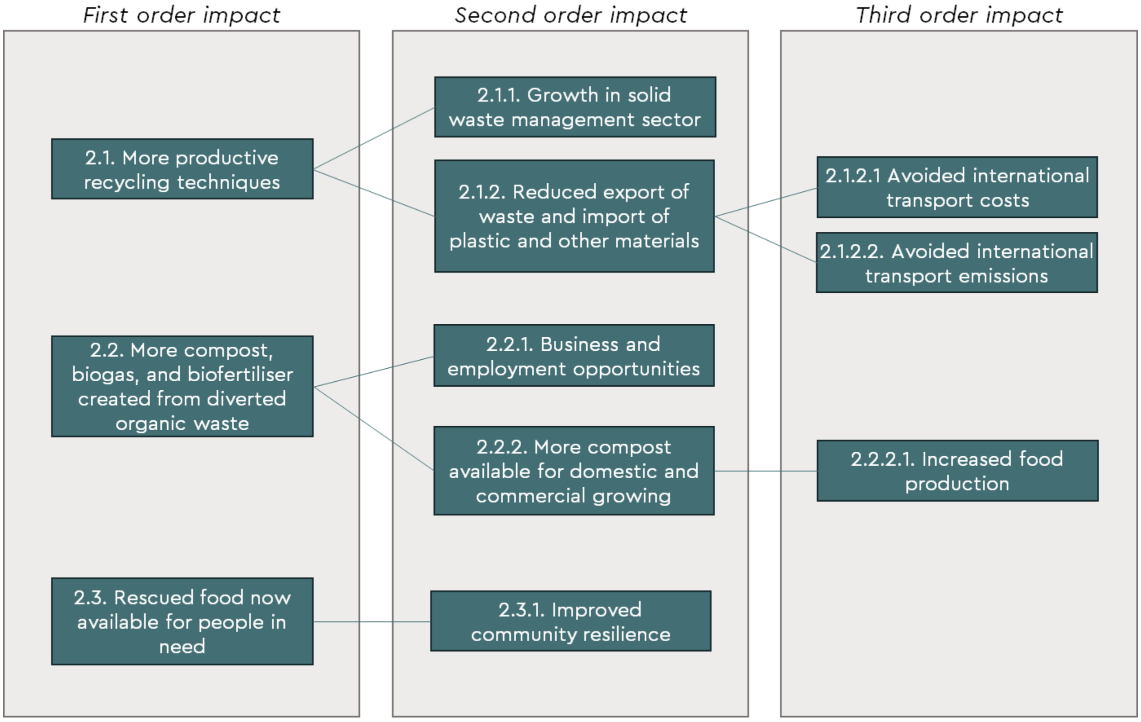
10 https://environment.govt.nz/facts-and-science/land/contaminated-land/

Figure 4: Outcome 1: Reduced waste and associated emissions – impact map



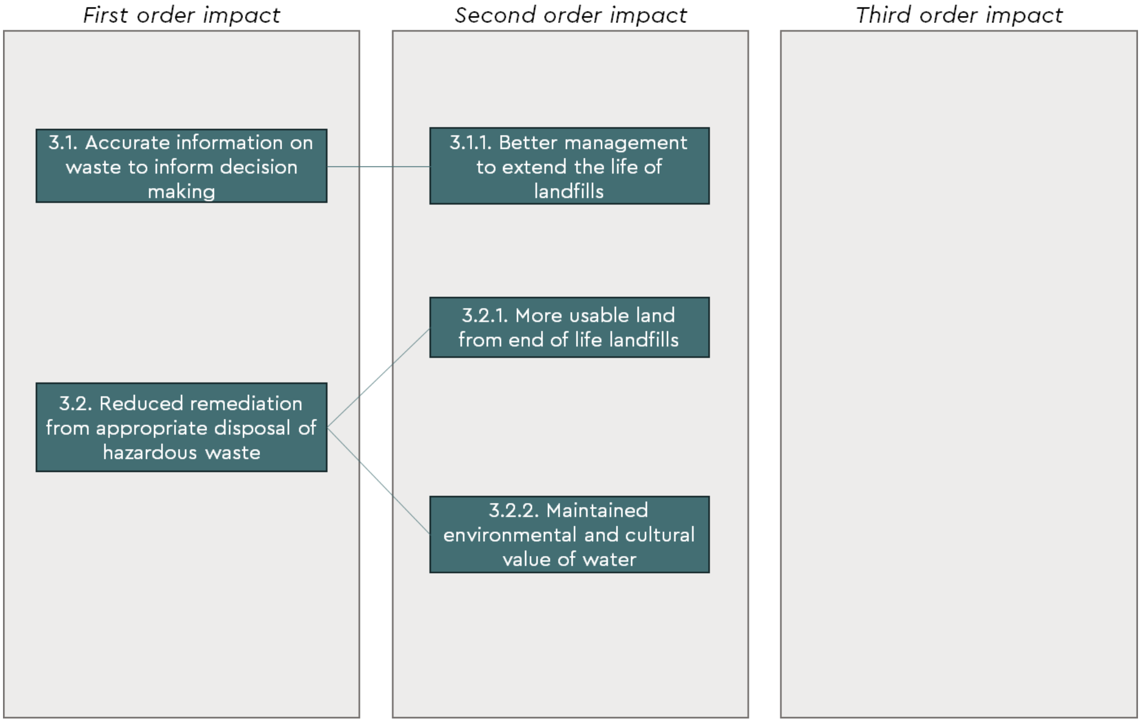
Source: See research summarised in **Impacts of Outcome 1: Reduced waste and associated emissions** on page 15.

Figure 5: Outcome 2: A more resource-efficient and productive economy – impact map



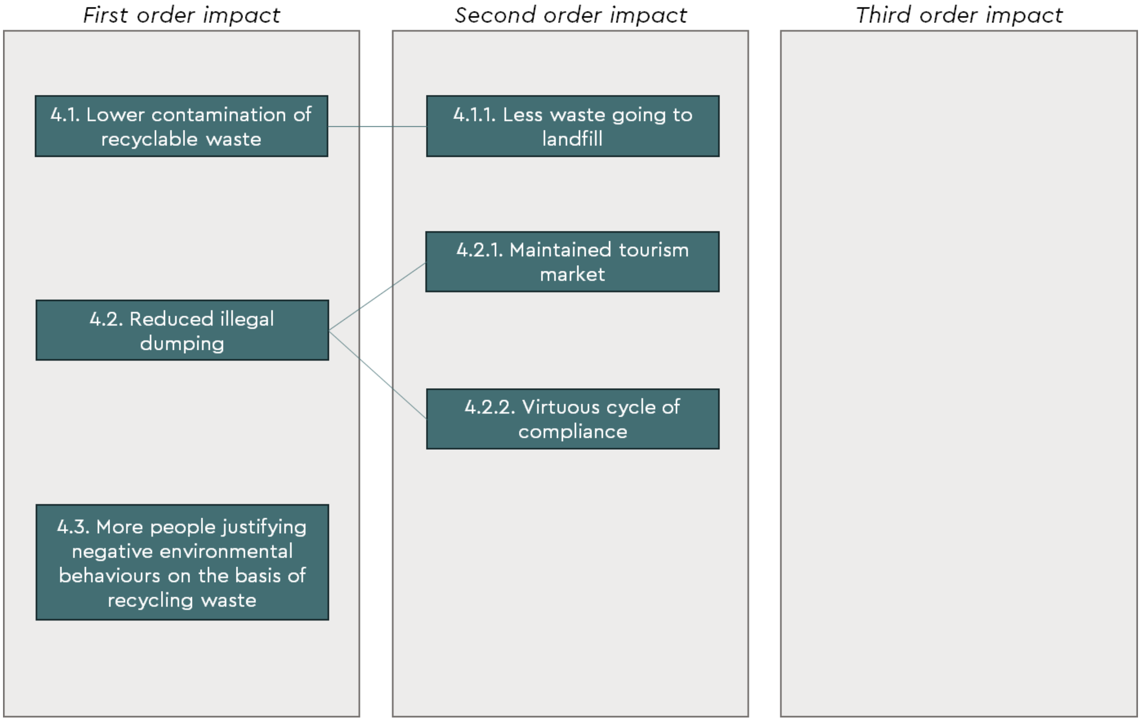
Source: See research summarised in **Impacts of Outcome 2: A more resource-efficient and productive economy** on page 18.

Figure 6: Outcome 3: Greater protection for the environment – impact map



Source: See research summarised in **Impacts of Outcome 3: Greater protection of the environment** on page 22.

Figure 7: Outcome 4: More waste correctly recycled – impact map



Source: See research summarised in **Impacts of Outcome 4: More waste correctly recycled** on page 24.

Quantifying the impacts of investing in waste minimisation

Once we developed the full intervention logic and set of impact maps (see the last section), we then quantified the first-, second- and third-order impacts, where possible.

The following tables set out the evidence base and key assumptions for quantifying the impacts listed in the previous section. The tables include information on:

- **value** – the dollar amount of the benefit. This can be negative if the impact is a disbenefit or additional cost. Disbenefits are shown in **red**.
- **success rate** – the likelihood that the impact value will be realised.
- **duration** – the length of time the value is delivered for. Some impacts are one-offs, and others can continue for many years as a result of the underlying projects.
- **lag** – the length of time until an impact is realised once the project investment has been made. This reflects that it can take some time for benefits to come to fruition.
- **evidence quality** – an indicator of how strong the underlying evidence base and assumptions are for the particular impact. This lets us signal any limitations in the evidence base and assumptions. Ratings include:
  - **high** where there is reporting specific to the investment or a strong evidence base for the value and success rate of the impact.
  - **medium** where there is evidence that can be applied to the investment but that is not based on actual values measured or reported. Assumptions have been used to apply impact values that are supported by relevant evidence.
  - **low** where the value is based largely on assumptions or there is evidence that is not rooted in the same context as the investment. For these, there is an opportunity for MfE to build out the evidence base through its monitoring and reporting, or possibly new research.

The **net present values (NPVs)** show the total value of each quantified impact in the left-hand column.

To be conservative, some impacts are assumed to be zero overall. This assumption is used for impacts that have both a positive and negative element to them and where there may be a net positive impact, but it would be too small to be meaningful or measurable, or there is significant uncertainty in the spread of possible outcomes.

To avoid double counting, some impacts are noted as being measured through another impact. We note in the tables how the quantification of relevant impacts overlaps with other impacts.

The four impact tables below are:

- **Impacts of Outcome 1: Reduced waste and associated emissions** on page 15
- **Impacts of Outcome 2: A more resource-efficient and productive economy** on page 18
- **Impacts of Outcome 3: Greater protection of the environment** on page 22, and
- **Impacts of Outcome 4: More waste correctly recycled** on page 24.

Impacts of Outcome 1: Reduced waste and associated emissions

Table 2: Impacts of reduced waste and associated emissions

Impact (NPV)	Description	Assumptions
1.1. Avoided landfill costs (**NPV:** $125m)	Avoided landfill cost were previously quantified by Sapere using the value in Treasury's CBAx model for class 1, class 2, and class 3 landfills based on estimated proportions of waste types. MfE forecast 285,586 tonnes of diverted organic waste from class 1 landfills through active and completed projects. There will also be diverted inorganic waste including plastics, tyres, e-waste, and other recyclable materials from class 1 landfills. Construction/demolition waste minimisation projects will be reducing the amount of waste going to class 2 and 3 landfills. This analysis considers inorganic materials diverted in "2.1.2. Reduced export of waste and import of plastic and other material" measured below. To avoid double counting these inorganic waste impacts, this impact uses only the class 1 landfill CBAx value of $145 per tonne, and the volume of organic waste diverted from MfE's forecasts.	**Value:** $145/ t of organic waste diverted **Success:** 100% **Duration:** 1 year **Lag:** No lag **Evidence quality:** High
1.2. Increased administrative and operating costs for resource recovery (**NPV:**-$246m)	Waste minimisation activities come at an increased operating cost to councils and businesses. This includes the additional staff and operating expenses to run the new infrastructure that is delivered through the schemes, including weighbridges, recycling plants, collection routes, and other new programmes. These additional costs are covered by the co-funding from investment recipients. This co-funding is estimated at $1.135 billion over the life of the waste minimisation projects funded by MfE. Assuming these costs are over 15 years (to be consistent with MfE's assumptions), this equates to $58,480 per year per project.	**Value:** -$58,480/ project per year **Success:** 100% **Duration:** 15 years **Lag:** No lag **Evidence quality:** Low
1.2.1. Increased employment from collecting, processing, and waste diversion work (**NPV:** $54.5m)	The administrative and operating costs discussed above directly lead to increased employment from collecting, processing, and waste-diversion work. New jobs are created that are accessible for people who are at risk of being unemployed or under-employed. For cost-benefit analysis, increased employment opportunities in the form of new or better jobs, rather than workers being displaced from existing jobs, may divert people off government benefits, while increasing private labour costs. However, there may also be decreased employment opportunities as new infrastructure investment replaces manual work. Self-reporting across the projects shows that 368 out of a targeted 1,453 new FTE positions have been created (with a total of 1,558 of new positions expected by 2030). This indicates a 25% success rate, with fewer than planned new FTE positions being created potentially reflecting some displacement from jobs lost through automation and increased investment in infrastructure.	**Value:** $16,688/project with FTE targets **Success:** 25% **Duration:** 15 years **Lag:** 1 year **Evidence quality:** High

	The value of these additional jobs is assumed to be equal to the Job Seeker Support avoided for each new FTE position, which is valued at $16,688 according to the Treasury's CBAx toolkit.	
1.2.2. Growth in solid waste management sector (**NPV:** N/A)	This is a measure of economic growth, which will be excluded from cost benefit analysis as it is considered to be a transfer, not a newly generated benefit or disbenefit. The uplift in GDP has been quantified based on the $211,089,072 of waste minimisation funding approved to date, using the input-output multiplier for 'Waste collection, treatment, and disposal services'. There will be further economic growth from the co-investment – the amount included here includes only direct impacts from this expenditure, and not indirect or induced impacts.	**Economic growth:** $90m *This will be considered separately to the CBA impacts.*
1.3. Avoided emissions (**NPV:** $20.5m)	While landfill gas includes CO_2, it also includes methane, which is far more effective at trapping heat but with a shorter lifespan than CO_2. One tonne of methane can be considered equivalent to 28 to 36 tonnes of CO_2 in terms of impact over 100 years. The volume of emissions is calculated here is based on assumptions on the type of diverted waste and proportion organic waste. It is not clear how Sapere calculated the emissions avoided based on project data, so this value will be slightly different to their calculated amount. Research suggests 1 tonne of municipal solid waste leads to a total of 70 kg of methane (equivalent to 1,610 kg of CO_2). It also suggests that landfill gas is about half methane and half CO_2, giving a total of 1,680kg of CO_2 equivalent gas produced per tonne of waste. There are also emissions associated with waste minimisation activities that offset some of these gains. When considering this, research found there to be 423kg of CO_2 equivalent per tonne of waste managed, and 133kg per tonne of organic waste diverted. Avoided emissions costs were valued by Sapere using the shadow emissions value of CO_2 for the central price path (present – 2030) in the December 2023 version Treasury's CBAx model. This impact is currently valued at $155 per tonne. With 133kg of CO_2-equivalent emissions avoided per tonne of waste managed, this gives a value of $20.62 per tonne of organic waste diverted.	**Value:** $20.62/t of organic waste diverted **Success:** 100% **Duration:** 1 year **Lag:** 1 year **Evidence quality:** High
1.3.1. Avoided atmospheric temperature change (**NPV:** N/A)	The value of avoided emissions is directly linked to avoided atmospheric temperature change. According to the Intergovernmental Panel on Climate Change (IPCC), the maximum atmospheric temperature rise is a factor of cumulative net CO_2 emissions as well as net non-CO_2 radiative forcing. These anthropogenic forcing agents include methane, nitrous oxide, and other trace gases from landfill sites. In 2022, New Zealand emissions from managed fills, unmanaged fills, and farm fills contributed about three-quarters of total waste-sector emissions. Other sources of waste emissions included composting, open burning, and incineration, which all made smaller methane contributions. The impact of waste minimisation in New Zealand on atmospheric temperature change will be relatively small, so this impact is	Measured through **'Avoided emissions'** and **'Preserved environment and biodiversity'**

	indirectly measured through reduced emissions and preserved biodiversity.	
1.3.1.1. Preserved environment and biodiversity (**NPV:** $396m)	The interconnected nature of the environment means the impacts of our changing climate are cascading through ecosystems, compounding other pressures from human activities, including past land-use choices, habitat fragmentation, and pollution. These compounding pressures are affecting our biodiversity and species ranges and disturbing ecosystem structures, as well as increasing the risk of other threats such as invasive species. Heat extremes have driven local extinctions of species, along with mass mortality on land and in the ocean. Biodiversity loss threatens our ecosystems' ability to absorb carbon and limits their ability to provide protection and resilience against the impacts of climate change. At its most extreme, climate events will impact our built infrastructure; however, this is hard to attribute to waste processing compared to preserved biodiversity, which has a closer link. Biodiversity is typically valued in terms of prevented extinction of species. Species that are already endangered are the most vulnerable to climate change. Within New Zealand, we have 1,127 threatened species, including 533 that are nationally critical and 215 that are nationally endangered. The Treasury's CBAx model uses a "willingness to pay" per person of $64 as the value of preventing extinction of 1–3 susceptible native species. In applying this it may be reasonable to assume a reduction in emissions, combined with improved waste management that preserves habitats as a result of 'Outcome 3: Protecting the environment from harm', and prevents the extinction of at least one species. This is of direct or indirect value to at least 10% of New Zealanders, which are those who are assumed to regularly enjoy recreation outdoors. This is based on the Department of Conservation's research into New Zealanders in the outdoors: it found 40% of people were outdoors at least monthly for sightseeing, and that 25% of people felt that wildlife and connection with nature was a key benefit from being in New Zealand's outdoors.	**Value:** $33/person **Success:** 10% **Duration:** 1 year **Lag:** 10 years **Evidence quality:** Low

Source: See bibliography.

Impacts of Outcome 2: A more resource-efficient and productive economy

Table 3: Impacts of a more resource-efficient and productive economy

Impact (NPV)	Description	Value
2.1. More productive recycling techniques (**NPV:** N/A)	Waste minimisation investment includes funding to buy new recycling plant and equipment, such as automated sorters, as well as supporting the development of new recycling techniques, such as finding new uses for end-of-life food and material scraps. New technology and innovations will lead to increased knowledge in a range of recycling techniques. Training on how to use new technology increases the skill-base of the workforce. Innovations will generate new knowledge that may spill into other sectors and countries. This impact flows into employment opportunities and growth in the solid-waste management sector upstream and downstream from solid-waste management.	Measured through **'2.1.1. Growth in the solid waste management sector'**
2.1.1. Growth in the solid waste management sector (**NPV:** N/A)	This is a measure of economic growth, which is excluded from cost benefit analysis as it is considered to be a transfer of wealth, not a newly generated benefit or disbenefit. This impact is based on the $1.135 billion of estimated co-funding attracted by MfE project investments (whereas the economic growth shown in 'Minimised landfill waste' is based on direct MfE project funding only).	**Economic growth:** $484m[11]
2.1.2. Reduced export of waste and import of plastic and other material (**NPV:** N/A)	Traditionally, New Zealand has exported some waste for recycling as we do not have the scale or density of population to justify investing in local recycling plant and equipment for all the material types we want to recycle. New Zealand exports its plastic waste to Malaysia, Indonesia, Taiwan, China, and other countries. However, exports have decreased since China's "National Sword" policy came into effect in 2018, banning the importing of 24 types of solid waste and imposing stricter contamination limits on recyclable materials, and also as a result of the Basel Convention plastic waste amendment, and new compliance and due-diligence checks that have been imposed by importing countries. The ability to export plastic waste is at risk, with some international shipping companies no longer transporting waste plastics. Investing to be able to recycle plastics in New Zealand reduces the amount of plastic waste we export for recycling and also reduces the amount of plastic we import, as we would use the recycled plastic domestically. Plastic is assumed to be fully recyclable (with no product lost from the recycling process). For example, Flight Plastics in Lower Hutt opened its recycling plant in 2019 and over its first five months saved 1,000 tonnes of new plastics from being	Measured through **'2.1.2.1. Avoided international transport costs'** and **'2.1.2.2. Avoided international transport emissions'**

[11] This is considered separately from the CBA impacts and is not included in the CBA, but reflects the expected overall economic growth that is generated through investment in the solid waste management sector via I/O calculations.

	imported into New Zealand, as well as also saving 1,000 tonnes of waste PET from the traditional waste stream. This ability to offset our plastic imports and exports by recycling ultimately reduces the amount of international transport for plastics. It reduces plastics that cannot be exported, or insufficiently decontaminated plastics going to landfill. It also takes less energy to recycle than to create new materials from scratch. On a global scale, this creates a benefit from less energy being used, and our renewable energy displaces the use overseas of more fossil fuel-based energy to produce plastic and other materials. However, domestically this is hard to quantify separately, as we face higher energy prices, which erodes the value of energy savings. This impact is measured in two parts – the international transport costs avoided from recycling domestically, and the emissions avoided from avoiding international transport.	
2.1.2.1. Avoided international transport costs (**NPV:** $23.2m)	As a result of the reduced exporting of plastic waste and importing of plastic and other material, there are avoided transport costs. Plastic makes up 10% of waste (by weight) going to landfills, with up to 60% of this exported for recycling. Rubber makes up a further 1% of landfilled waste, with up to 40% being recycled overseas. Overall, this means 6% of total waste diverted through the programme reduces the amount of recycling transported overseas. LDPE and HDPE, our most commonly exported plastics, cost on average US$1.17 per kg (NZ$2.04). New Zealand exports 4 t per person, and imports 1 t per person, with a total of 21,000 t of plastic exported in 2022. The cost of transporting a 40 ft container was over USD$10,000 in 2022, but on average around USD$4,000 pre-pandemic (NZ$6,073, inflated to $7,574 in 2024 using the CPI). A 40 ft container has 67m3 of usable capacity, and polyethylene weighs 950kg/m3. With a packing efficiency of 80%, a container can carry 50,920kg of plastics, resulting in a $0.15 shipping cost per kg of plastic transported from New Zealand to Malaysia and other countries, or $148.74 per tonne.	**Value:** $148.74/t of all waste diverted **Success:** 6% **Duration:** 1 year **Lag:** No lag **Evidence quality:** Medium
2.1.2.2. Avoided international transport emissions (**NPV:** $1.8m)	The transport of plastics also creates emissions that can be avoided by recycling domestically. Transporting 21,000t of plastic by sea 8,400km to Malaysia results in 1,558t CO2e of transport emissions. Using the CBAx shadow price of emissions of $155 per tonne, this is equal to $11.50 per tonne of recyclable plastic shipped overseas for recycling. This assumes that the domestic transport emissions to move waste to recycling facilities within New Zealand is the same as it is to transport waste to ports for exporting.	**Value:** $11.50/t of all waste diverted **Success:** 6% **Duration:** 1 year **Lag:** No lag **Evidence quality:** Medium
2.2. More compost, biogas, and biofertiliser created from	Organics makes up a considerable portion of household waste going to landfill – 60% in Wellington and, before kerbside scrap collection, 50% in Auckland and 21% in Christchurch. Diverting organic waste from landfills frees up capacity for non-reusable or	**Value:** $7.70/kg of organic waste diverted

diverted organic waste (**NPV:** $3.8m)	recyclable waste, extending the life of landfills, while producing compost that can be used for agriculture and gardening. Organic waste produces landfill gases, which are also greenhouse gasses contributing to climate change. 9% of New Zealand's biogenic methane emissions and 4% of our total greenhouse gas emissions are from food and organic waste. Composting emissions are 38-84% lower than equivalent landfilling fluxes. It is an effective way of compacting organic waste, as waste is reduced to 30% of its size by decomposing and losing moisture over a seven-month period. For the forecast 285,586t per annum of organic waste diversion from active and completed projects, this equates to up to 85,675t of compost being created. To be conservative, assuming only half of diverted organic waste is used to produce compost, with other diversion techniques being things like food or timber rescue not resulting in compost, the investment may be producing 42,838t of compost that is diverted from landfills each year. Given there are 0.033 kg per litre of compost, and that compost sells for $7 per 30L, each kg of organic waste can generate $7.70 worth of compost. In addition, specialist processing facilities may be able to produce higher value byproducts, such as biogas and biofertiliser, which is assumed to have at least the same sales value as compost. Compost is assumed to supplement, rather than displace, synthetic fertilisers, improving soil drainage, aeration, and moisture retention.	**Success:** 50% **Duration:** 1 year **Lag:** 1 year **Evidence quality:** Medium
2.2.1. Business and employment opportunities (**NPV:** N/A)	There are additional opportunities for business and government to develop schemes that support composting in areas that are currently not served by composting services. For example, people living in medium to high density housing that do not have the outdoor space to compost and that are largely excluded from council waste collection do not have significant opportunities to participate in composting schemes. The waste minimisation fund could test such a scheme through a small-scale project. Private businesses, including NGOs, have an opportunity to run businesses producing and selling compost, creating employment opportunities for collection, production, distribution, and logistics. This impact is valued through the amount of compost that could be produced, as the main output from these business and employment opportunities, assuming other business and employment benefits are equal to their costs.	Measured through **'2.2.2. More compost available for domestic and commercial growing'**
2.2.2. More compost available for domestic and commercial growing (**NPV:** N/A)	Markets for compost typically include farmers, horticulturalists and gardeners, and landscapers. Compost can also be used to help control sediment and erosion in construction projects and along waterways. This impact of this is valued through the resulting increase in food production, as compost doesn't produce any economic benefits until it's being used.	Measured through **'2.2.2.1. Increased food production'**
2.2.2.1. Increased food production	As a result of more compost being available for domestic and commercial growing, there should be a flow on impact to increased food production.	**Value:** $49,976,667/year

(**NPV:** $99.2m)	A 5% increase in organic composting materials in soil quadruples its water-holding capacity, meaning there is less need for irrigation or other external water sources. Research indicates there is an over 10% increase in crop yield with the addition of compost. Using carrots as an example crop that represents the low end of increased yield, the potential 42,838t of compost produced can cover 4,284 hectares and increase yield by 7t per hectare, resulting in 29,986t of additional carrots grown. With an average retail price of $2.50/kg, with an assumed 50% markup on the wholesale price, this equates to $49.98m in increased food production. In practice, any potential increase in food production would be realised over a range of crops, including some with a higher value. Noting not all compost will be used for food production, a conservative success rate of 10% is assumed, with a three-year delay to reflect the time it takes to collect waste, convert it to compost, distribute the compost, and then for it to realise increased crop yield in future growing seasons.	**Success:** 10% **Duration:** 1 year **Lag:** 3 years **Evidence quality:** Medium
2.3. Rescued food now available for people in need (**NPV:** $1.2m)	Rescuing edible food from going to landfill benefits the environment by reducing organic waste that produces landfill gases, which contribute to emissions, as well as improving social outcomes and well-being for the people receiving the food. People receiving food benefit from increased access to a variety of food, increased connection to social services, reduced financial burden, an improved ability to allocate finances towards costs other than food, and reduced stress and anxiety as a result. Increased connection to social services can result in an improved quality of life but comes at the public and private cost of providing these services, and increased waitlists if services are at capacity. The indirect impact of improved community resilience is considered separately. Looking specifically at the value of increased free access to a variety of food, research found this was valued through a social impact assessment at $7.4m from programmes, with a total investment of $2.2m. With an additional 20% deadweight loss and 15% attribution rate, this gives a value of $3.38 per $1 invested in food rescue programmes, with a 12% success rate.	**Value:** $3.38/$1 invested in food rescue programmes **Success:** 12% **Duration:** 1 year **Lag:** No lag **Evidence quality:** Medium
2.3.1. Improved community resilience (**NPV:** $0.06m)	Food rescue has benefits for food donors, food rescue volunteers, recipient organisations, and food recipients. Across the programme, there are 12 community projects focused on rescuing and redistributing food. Overall, it bolsters community resilience, helping those most in need by addressing food insecurity, and providing pathways to other support services and employment opportunities. CBAx features the measure 'member of volunteering group (general population)', valued at $2,971 per year per club which is used to quantitatively estimate the value of this increased community resilience.	**Value:** $2,971/food rescue community programme **Success:** 100% **Duration:** 1 year **Lag:** no lag **Evidence quality:** Medium

Source: See bibliography.

Impacts of Outcome 3: Greater protection of the environment

Table 4: Impacts of greater protection of the environment

Impact (NPV)	Description	Value
3.1. Accurate information on waste to inform decision making (**NPV:** N/A)	Data can play a critical role in making landfills safer and more efficient, and in reducing their emissions. Data can help to understand the scope and source of emissions, track emissions reduction, and identify areas of improvement. Integrated digital tools enable emissions inventories, monitoring and reporting; identification of emission sources; evaluation of technologies; predictive modelling; public health assessments; education and outreach (including streamlining regulatory compliance); and landfill rehabilitation. Knowing what waste is going where supports the recovery of more waste and better matching of it to secondary market materials. Having accurate waste information that is effectively being used bolsters the likelihood of success of all other impacts identified and should therefore result in extending the utilisation and life of existing landfills.	Measured through **'3.1.1. Better management to extend the life of landfills'**
3.1.1. Better management to extend the life of landfills (**NPV:** $254.6m)	In the context of waste minimisation investment, avoided landfill costs should reflect the avoided or delayed cost of constructing new landfills, including the high front-end costs from siting, resource consent applications, and design. There are currently 40 class 1 landfills in New Zealand, which have an average lifespan of 35 years. New class 1 landfills require significant investment. Dunedin's proposed new landfill at Smooth Hill has had its budget grow to $92m. Wellington has proposed a low-cost option for a new $42.5m landfill built on top of the existing landfill, which avoids the cost of land acquisition, but it will only provide space for 15-20 years, opposed to the 35-year average lifespan of new landfills. If it costs on average $90m to set up a new class 1 landfill, extending the life of each landfill by 5 years through waste minimisation will avoid the need for 0.14 new landfills in New Zealand each year, representing $12.86m of avoided cost each year.	**Value:** $12,857,143/year **Success:** 100% **Duration:** 1 year **Lag:** 5 years **Evidence quality:** Medium
3.2. Reduced remediation from appropriate disposal of hazardous waste (**NPV:** $0.06m)	Vulnerable landfills and contaminated sites are costly to remediate. Appropriate disposal of hazardous waste avoids these costs and results in more useable land from end-of-life landfills and otherwise contaminated sites. It also reduces the monitoring and compliance costs associated with sites on the hazardous activities and industries list (HAIL). With appropriate disposal of hazardous waste, HAIL sites are less likely to need a detailed site investigation, assuming the preliminary site investigation finds land development is highly unlikely to pose a risk to human health. A detailed site investigation (DSI), with remedial action plan, and site validation can cost $12,000. This excludes the cost of doing the remedial action, which can be over $1m which would only be done in a free-market environment if remedial work is expected to result in at least $1m of value for the landowner.	**Value:** $12,000/project targeting hazardous substances **Success:** 100% **Duration:** 1 year **Lag:** 15 years **Evidence quality:** Medium

	For each project targeting hazardous waste, it is assumed that one fewer site with HAIL activities needs remedial work at the end of its life. For conservatism, only the additional assessment cost of a DSI is considered.	
3.2.1. More usable land from end-of-life landfills (**NPV:** N/A)	Many closed landfills in urban areas have been converted to reserves/parks (public open space or sports fields) and are managed for recreation. Closed landfills in rural areas have either reverted to the surrounding agricultural use (grazing), been used for forestry, or remain unused. Other recorded uses include car parking, a council yard, a tree nursery, restoration of native vegetation, residential dwellings, a marae, a museum and a school. A challenge with parks on closed landfills is drainage and ground quality, making these sites harder and more costly to maintain than other sites. For land to be usable, there can be significant clean-up work required, and ongoing monitoring of former hazardous waste sites. The investment decisions at a site level are assumed to be based on ongoing costs at least meeting the community value gained from new public amenities. For this reason, we assume that the net benefit of this is zero – that is, the costs associated with mitigation and remediating landfill land are offset by providing more usable land to the community for other purposes.	**Value:** Net zero assumed
3.2.2. Maintained environmental and cultural value of water (**NPV:** N/A)	Given the level of prevention and monitoring work that is required for landfills, there is significant investment made up front to mitigate environmental issues, including iwi input in the resource consent process. There are two main impacts from landfills that appear to cause significant issues: the presence of heavy metals in water, and the perceived pollution of waterways. When contaminants are detected in water, these can lead to bans on swimming and gathering food/kaimoana, which are important to health, leisure, connections, and culture. The cultural value of preventing these impacts is difficult to attribute and measure, particularly with the scale of prevention and mitigation work required. It may be worth baselining displaced water activities due to municipal solid waste and contaminated sites, then monitoring any impact from projects targeting improvements in this space.	**Value:** Qualitatively considered – more programme data needed

Source: See bibliography.

Impacts of Outcome 4: More waste correctly recycled

Table 5: Impacts of more waste correctly recycled

Impact (NPV)	Description	Value
4.1. Lower contamination of recyclable waste (**NPV:** N/A)	Correctly recycling waste results in lower contamination of recyclable waste, improving the volume and value of recycled materials. This is a result of both education projects that teach people proper recycling techniques, as well as recycling infrastructure projects that enable the collection and processing of more recyclables. While this includes using more water to rinse recycling to ensure they are not contaminated with foods or liquids, this increased water use is assumed to be at least offset by the water used in the production of new materials displaced by recycling. Over time, consumers will put pressure on producers to design out waste. It will likely become a competitive advantage, and eventually a minimum requirement, to make recycling waste as easy as possible. Overall, this impact bolsters other impacts quantified – in particular, *"a more resource-efficient and productive economy*" by enabling more productive recycling techniques.	Measured through **'2.1. More productive recycling techniques'**
4.1.1. Less waste going to landfill (**NPV:** N/A)	More waste being correctly recycled because of lower contamination of recyclable waste ultimately results in less waste going to landfill. This is a key impact already considered under "Reduced *landfill waste and associated emissions'*.	Measured through **'1.1. Avoided landfill costs'** under 'Minimised landfill waste and associated emissions'
4.2. Reduced illegal dumping (**NPV:** $2.3m)	Illegal dumping carries a number of costs to communities, including the health and safety risk of sharp objects and hazardous waste, damage to the environment, direct costs of the council having to remove illegally dumped waste, and a decrease in property values or the usability of community spaces. Illegal dumping can be reduced while more circular economies are supported through drop off sites and collection services for reusable items. Within the programme, there are projects focused on collection sites for hard to dispose of waste, such as tyres and e-waste, which may otherwise be illegally dumped. E-waste in particular carries the risk of battery related fires, which can damage property and the environment. Lithium-ion batteries are a key driver of this, leading to at least five fires a day at Queensland recycling plants. If these fires start at unsupervised sites used for illegal dumping, the impact of the fire can be worse. Assuming that, across all projects, there is at least one community of 10 houses that have preserved property values of 1% as a result of the suite of initiatives, this would result in a savings of $772,000 per year, as this this equates to $77,200 per dwelling x 10 dwellings, based on the median house price of $772,000.	**Value:** $772,000/year **Success:** 10% **Duration:** 1 year **Lag:** 1 year **Evidence quality:** Low

4.2.1. Maintained tourism (**NPV:** N/A)	New Zealand's cultural and natural features are significant draw cards for international tourism, which is our second largest export earner. Tourism positively impacts regional economies by directly or indirectly employing 1 in 9 New Zealanders. However, more litter and waste generation is the most prevalent negative impact perceived by New Zealand residents. While the amount of waste attributed to international tourists has not been quantified, for conservatism, the value of maintained tourism is assumed to at least match the direct and indirect cost of increased waste and litter.	**Value:** Net zero assumed
4.2.2. Virtuous cycle of compliance (**NPV:** N/A)	In the case of avoiding illegal dumping, this can create a virtuous cycle. Where public spaces are kept clean and used for recreation purposes, the local environment is protected and property values are maintained, and this can bolster community surveillance and mitigate against illegal dumping. However, there are both positive and negative behaviours that occur as a result of waste minimisation investment. These are described below under 'More people justifying negative environmental behaviours on the basis of recycling waste'.	Assumed to offset **'More people justifying negative environmental behaviours on the basis of recycling waste'**
4.3. More people justifying negative environmental behaviours on the basis of recycling waste (**NPV:** N/A)	Recycling waste does not always translate to other positive impacts. Research shows that people who recycle may use this to justify negative environmental behaviours, such as littering or driving their car more. These negative impacts are assumed to offset gains from the 'Virtuous cycle of compliance' described above.	Assumed to offset **'Virtuous cycle of compliance'**

Source: See bibliography.

Other impacts considered

Our literature review identified some impacts that were expected but not found in the current body of evidence.

Improved community health

Health gains from reducing the waste going to landfills, remediating contaminated sites, and rescuing food for people in need were expected to be key benefits from the investment. However, our analysis of the projects funded and the literature found that these impacts were hard to justify.

Health gains from reducing waste going to landfills

Intuitively, it makes sense that investments in minimising waste would result in considerable health benefits for communities living near landfills because of potentially improved air quality or avoided run-off from hazardous substances. However, for modern landfills, the Resource Management Act sets strong guardrails that prevent environmental impacts that could harm people's health. For new landfill sites, the Act sets up rigorous processes to make sure the location and the facilities have community support and that, once the site is operational, potential negative impacts will be contained, monitored, mitigated, and managed.

To safeguard air quality, municipal landfills work to prevent harmful methane gas being released. There have been cases of residents having problems with the smell coming off landfills, but the negative health impacts from this are rare and relatively immaterial. Advice from Te Whatu Ora for residents living near Spicer Landfill states:

> "Landfill gases are produced when bacteria break down organic waste. Ninety-nine per cent of landfill gas is methane and carbon dioxide. The remaining one per cent is made up of over 500 trace components that produce a distinctive odour. Humans can smell very low levels of these odour producing trace components. Being able to smell odour at such low levels **does not usually cause health effects** [emphasis added]. However, some people can experience physical symptoms such as nausea and headaches from exposure to odour."

In contrast, landfills can also have positive externalities for communities by supporting affordable housing, as property markets price-in the perceived problems with living near landfill sites. As affordable housing supports health outcomes, current research suggests that modern landfills probably have no impact, or a small positive impact, on community health overall.

Health gains from remediating contaminated sites

Contaminated sites pose a potential threat to community health if people are directly exposed through ingestion, inhalation, or skin contact with hazardous materials. However, there isn't strong evidence of large-scale harm in New Zealand from contaminated sites. Most health events have been caused by agricultural activity – for example, sheep faeces contaminating water in Havelock North in 2016.

Our quantification focuses on the economic cost of remediating contaminated sites for landowners. Our analysis assumes that all contaminated sites will need an initial assessment before deciding on what to do next. The remediation work will then only be done if the benefits will at least cover the costs. Here, the landowner may consider health gains for the community when making this decision.

Health gains from rescuing food for people in need

The investments in waste minimisation have supported 12 food rescue projects, which divert food from landfills. Many of these projects focus on enabling work, such as promotion and education, rather than supplying food-insecure households with food directly.

Research found that food-rescue programmes improved health and wellbeing by increasing access to a variety of free food; this impact for food recipients was measured through substitute pricing. However, in the context of the food-rescue projects funded, it was not clear how much free food was being made available as a result or how many individuals were supported to access food.

If monitoring and reporting could be extended to include the number of people supported to access food, it would be possible to quantify the associated health impacts from this.

Avoided leachate pollution into waterways

Initial research identified avoided leachate pollution into waterways as a potential impact. However, our assessment of results in New Zealand found it was hard to quantify the value of this, for two reasons:

1. The Resource Management Act requires modern landfills, where most of the avoided waste would otherwise go to, to be lined with leachate collection systems that avoid pollution into waterways.
2. For older landfills, testing found that agricultural activity was a major source of heavy metals and toxins in waterways, making it hard to attribute waterway pollution to landfills.

Our research found that older landfills can introduce some heavy metals into waterways, but that they may not be the most significant source. We also found that there is a public perception that landfills are a key contributor to pollution. These findings are included in '3.2.2. Maintained environmental and cultural value of water'. However, we were unable to quantify the value of this impact.

Estimating the return on investment

We estimate that the investments deliver a positive return to society of around $500 million with a benefit-cost ratio of 3.11

Table 6: Summary of incremental costs and benefits (rounded to nearest $000) over 30 years

High-level summary	Total present value
Costs	$236,622,000
Benefits	$736,424,000
Net present value (NPV) in 2025 dollars with 2% discount rate	$499,802,000
Benefit-cost ratio (BCR)	3.11
Payback period	11.09 years

Source: MartinJenkins analysis

These results bolster Sapere's initial assessment with further quantified benefits. We found that Sapere's calculated BCR of **1.42** (from two key impacts, avoided landfill costs and avoided emissions), increased to **3.11** (from 14 quantified impacts across four outcome areas).

The analysis is broadly consistent with what one would expect from environmental or social investments: a significant positive return, but over a lengthy payback period. Up-front costs are high, and the return for society is negative for at least the first 10 years, with benefits only delivering a significant positive social return after some 11 years.

The analysis rests on a range of assumptions

This analysis, although relying on a significant amount of data from MfE and other participants, rests on a range of assumptions. These include the impact assumptions set out in the above tables, and also the following further modelling assumptions:

- The analysis covered projects underway between 1 July 2015 and 30 June 2025.
- Costs and benefits were considered over 30 years, from 1 July 2015 to 30 June 2045.
- We applied the "social rate of time preference" (SRTP) discount rate of 2% for both costs and benefits after 2025, with costs and benefits from 2015 to 2024 adjusted by CPI into 2025 dollars.

The results are highly sensitive to some key assumptions, including the discount rate used and whether non-economic benefits are included

As noted above, we used the SRTP discount rate of 2%. However, because significant funding is provided to the commercial waste sector, it could also be appropriate to use the social opportunity cost of capital (SOC), also called the "commercial" rate, of 8%. When an 8% discount rate is applied, the BCR drops to 2.14.

The results are also significantly affected by the extent to which quantifiable values are placed on environmental benefits – particularly on biodiversity protection that results from minimising waste production and reducing emissions associated with waste production and disposal. The biodiversity benefits are quantified on the basis of a willingness-to-pay (WTP) assessment from the Treasury's CBAx toolkit. When these benefits are removed from the quantitative assessment, the BCR drops to 1.44.

If those two changes are combined – that is, if we use an 8% discount rate and remove the willingness-to-pay measures from the assessment – the BCR is only 1.04.

As noted above, it takes a number of years for the benefits to accrue, resulting in a lengthy payback period. Shortening the assessment period from 30 years to just 10 years would result in a BCR of less than 1.0 – at 0.69.

The quality of evidence for the impacts considered also affects the BCR. When only high-quality evidence is included, the value of these impacts is less than the total costs. However, if we include medium- and high-quality evidence (excluding only low-quality evidence), the BCR is 2.47.

These sensitivities are summarised in Table 7 below.

Table 7: Sensitivity analysis of the incremental costs and benefits

Present value - $000s	Costs	Benefits	NPV	BCR
Core analysis	**$237m**	**$737m**	**$500m**	**3.11**
Variable change				
Discount rate – 8%	$232m	$497m	$265m	2.14
Excluding WTP CBAx measures from quantification	$237m	$341m	$104m	1.44
Discount rate 8% and excluding WTP measures	$232m	$242m	$10m	1.04
Assessment period change				
10-year assessment period for all costs and benefits	$198m	$136m	($62m)	0.69
Impact evidence quality				
High-quality evidence only	$237m	$201m	($36m)	0.85
High- and medium-quality evidence only	$237m	$585m	$348m	2.47

Source: MartinJenkins analysis

We quantified incremental costs and benefits

Incremental costs

Table 8: Incremental costs

Costs	Total present value $000s	% of total costs
Waste Minimisation Fund	$166,925	70.5%
COVID-19 Response and Recovery Fund for Waste and Resource Recovery Initiatives	$46,236	10.0%
Plastics Innovation Fund	$23,462	19.5%
Total incremental costs	**$236,622**	**100%**

Source: MartinJenkins analysis

Incremental benefits

Table 9: Incremental benefits by outcome

Outcome	Total present value $000s	% of total benefits
Minimised waste and associated emissions benefits, including biodiversity benefits from reduced emissions	$224,628	36.7%
More resource efficient and productive economy benefits	$129,442	21.2%
Protecting the environment from harm benefits	$254,691	41.7%
More waste correctly recycled benefits	$2,281	0.4%
Total incremental benefits	**$611,042**	**100%**

Source: MartinJenkins analysis

Table 10: Incremental benefits by type

Benefit type	Total present value $000s	% of total benefits
Economic benefits[12]	$318,141	43.2%
Environmental benefits[13]	$418,228	56.8%
Wellbeing benefits[14]	$56	0.0%

Source: MartinJenkins analysis

12 Economic benefits include ten impacts: 1.1; 1.2.; 1.2.1.; 2.1.2.1.; 2.2.; 2.2.2.1; 2.3.; 3.1.1.; 3.2.; and 4.2.

13 Environmental benefits include avoided emission impacts (1.3 and 2.1.2.2), and persevered environment and biodiversity (1.3.1.1.)

14 Wellbeing benefits include improved community resilience (2.3.1.)

Some important qualitative benefits also result from the investments

A strict value-for-money assessment on a quantitative economic basis will naturally favour those waste-minimisation activities that improve efficiency and operations for waste management operators over the short term. However, those activities may not be where dollars would best deliver a return for society overall. There are a range of qualitative benefits that, although harder to quantify, clearly result from the investments in waste minimisation.

Those qualitative benefits include innovation and advances in the waste-management sector that could result in significant improvements for outcomes identified in this report. The type of impact will depend on the project's focus.

Appendix 1: Alignment with other reviews and reporting

Alignment with MfE output categories

To understand the suite of projects that have been invested into, we started our review with a fresh-eyed review of the outputs generated from each project. Our output groups largely matched up with the MfE waste categories used for reporting, with some categories grouped up, and other new categories added. We note that the MfE waste categories are appropriate for waste minimisation reporting. The output categories that we identified are slightly different but are more useful for filling out the intervention logic and to guide the literature review.

Table 11: Waste minimisation output groups identified from our review of funded projects compared to the reporting categories used by MfE

Overarching output category for the intervention logic	Output group from review of funded projects	MfE waste categories used for reporting
Intel for informed decision	Weighbridge	
	Data	
	Emissions	
New approaches to waste management	Innovation	
	Landfills	
Protected environment	Hazardous waste	Hazardous waste
Collecting recyclables	General waste recycling	Multiple waste streams
Organic waste processing	Food waste	Organic waste
	Other organic waste (including untreated timber)	Organic waste Timber Biosolids
Industry materials	Construction and demolition (treated timber, concrete, plaster board)	Construction and demolition
	Tyres and vehicle waste	Tyres
	E-waste	E-waste
Recyclable materials	Plastics (including rubber)	Plastics
	Paper	Organic waste
	Glass	Glass
	Textiles	Fibre
	Oil	
	Metal	
N/A	Various	Commercial and industrial

Source: https://environment.govt.nz/facts-and-science/waste/waste-investments/ (accessed 16 February 2025)

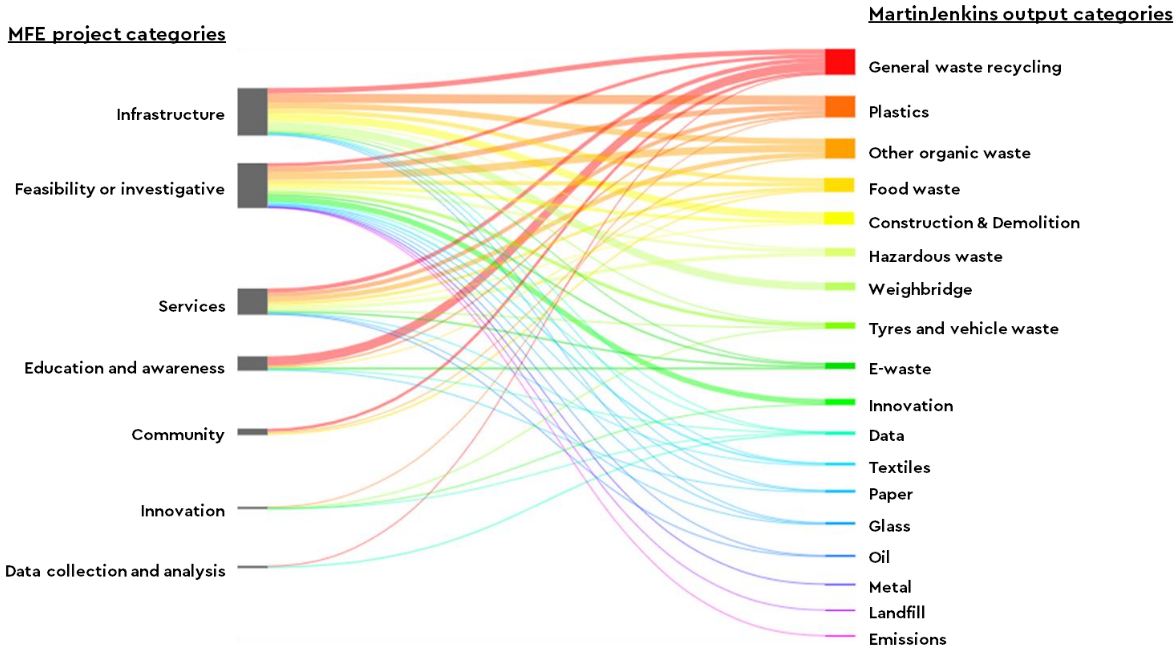
MfE waste categories are included as they are reported here: https://environment.govt.nz/publications/waste-funds-annual-report-2021/

Note: Paper/cardboard is currently treated by MfE as organic waste for its reporting. Research highlights its value as a recyclable material with recycling codes (20 PAP, 21 PAP, and 22 PAP) used to identify different types of cardboard and paper.

Linking MfE project categories to our identified output groups

We also considered the link between output groups and the reported project categories to understand how waste investment is being applied. The links between the project categories and the output groups identified are as follows.

Figure 8: Links between MfE's waste minimisation fund project categories and our identified output groups



Source: Accessed 16 February 2025: https://environment.govt.nz/facts-and-science/waste/waste-investments/

Notes

1 Reduced emissions is an impact sought by most projects. Only one project was focused on emissions as an output area by providing guidance on how best practice for emission rules can be met.

Alignment to Sapere's impacts

Before commencing the literature review, we paused to compare our understanding of the intervention logic with the impacts identified through our review of funded projects discussed above.

Sapere's research identified ten different impacts, with all but avoided landfill costs and avoided emissions being qualitatively considered. The table below explains how these impacts have been considered in this review.

Table 12: Impacts identified by Sapere and the approach we have taken for each

Impacts identified by Sapere's previous research	Research approach being used for the current review, quantification of impacts
Avoided landfill costs (quantified by Sapere)	This is included using Sapere's measurement approach, focusing only on class 1 landfills and organic waste diverted. Other types of waste and flow on impacts have been considered across a number of other impacts, so class 2 and 3 landfill impacts have been excluded here to avoid double counting.
Avoided emissions (quantified by Sapere)	This is included with an update to the shadow value of emissions used to reflect the current CBAx, and the volume updated to the current forecast of organic waste diverted from completed and in-progress projects.
Infrastructure development	This is included as a driver of impacts. Key infrastructure has been identified through a review of the existing and past projects. To refine the ILM, we reviewed the impact of investment in: • Weighbridges • Optical and mechanical sorting technologies.
Employment opportunities	This is included as we have explored employment impacts (both positive and negative) from: • Introducing general waste recycling collections • New infrastructure (weighbridges and sorting) • New innovations • New employment from reducing imports (recycled plastic, salvaged e-waste, etc) • Offset employment from productivity gains.
Improved waste management behaviours and attitudes	This is included as an enabler for more waste being correctly recycled. Considered through '*more waste correctly recycled impacts*' (an outcome) that result from '*improved behaviour of people and businesses*' (an output).
Social cohesion and community engagement	This is included as a downstream impact from more useable land from end-of-life landfill as councils repurpose these for parks, sports fields, and community facilities Considered through '*improved community resilience*' (an impact) that results from a '*more resource efficient and productive economy*' (an outcome).
Reduced imports	This is included as an impact resulting from a more resource efficient and productive economy.
Value of recovered materials	This is excluded, as it was considered as part of the value of reduced imports to avoid double counting and to acknowledge potential displacement effects.
Gained knowledge from feasibility studies	This is partially included. New innovations have been considered as part of a more resource efficient and productive economy. This is otherwise excluded, as there is no guarantee that there is the funding available to invest in viable options to unlock these benefits, or that the knowledge will result in successful investments.

'Warm glow' effects	This is excluded as it may introduce double counting based on how other impacts are quantified, for example, overlapping with improved community resilience or impacts from protecting the environment from harm.

Appendix 2: Identified output areas

About the output areas we identified

Note, there is not a one-to-one relationship between the output areas identified and the outputs summarised on the logic map.

Intel for informed decisions

Weighbridges (21 contributing projects, linked to $2.1m of MfE investment). These projects were specifically adding weighbridges to landfill sites to collect better data on waste to enable more monitoring and management. *Links to 'More waste monitoring from weighbridges + other data collection and monitoring'.*

Data (8 contributing projects, linked to $4.9m of MfE investment). These projects include extending technology platforms, aligning cross-council waste data, setting new strategies, and setting baselines for waste information. *Links to 'More waste monitoring from weighbridges + other data collection and monitoring'.*

Emissions (1 contributing project, linked to $0.1m of MfE investment). This includes a project for providing guidance on best practice for emission rules. *Links to 'More waste monitoring from weighbridges + other data collection and monitoring'.*

New approaches to waste management

Innovation (16 contributing projects, linked to $1.5m of MfE investment). These projects largely overlap with other categories and are focused on investigating and testing possible ways to divert waste from landfill. *Enables outputs, particularly 'Improved waste recycling and reduction'.*

Landfills (1 contributing project, linked to $0.2m of MfE investment). This includes a project to develop a business case to explore if alternatives to landfill, such as an energy and waste plant, are viable. *Enables outputs, particularly 'Contained and cleaned up contaminated sites and vulnerable landfills'.*

Protected environment

Hazardous waste (22 contributing projects, linked to $5.3m of MfE investment). This category overlaps with a number of others. These projects featured collecting, managing and educating people on hazardous waste from construction (such as asbestos), coolants, agrichemicals, batteries, and other hazardous substances. *Links to 'Improved waste recycling and reduction'.*

Collecting recyclables

General waste (68 contributing projects, linked to $37.7m of funding of MfE investment). These projects include adding public recycling bins, kerbside recycling collections, transfer stations, and education and promoting recycling of general waste amount iwi, schools, and rural communities. *Links to 'Improved waste recycling and reduction' and 'Improved behaviour of people and businesses'.*

Organic waste processing

Food waste (36 contributing projects, linked to $10.8m of funding of MfE investment). These projects primarily including food rescue and food waste minimisation projects as well as food specific composting projects. *Links to 'Improved waste recycling and reduction'.*

Other organic waste (53 contributing projects, linked to $26.4m of funding of MfE investment). These projects are largely focused on organic and compostable waste, including untreated wood, sludge and biosolids, organic pollutants, and animal by products. *Links to 'Improved waste recycling and reduction'.*

Industry materials

Construction & Demolition (33 contributing projects, linked to $46.9m of MfE investment). This includes recycling and rescuing construction materials such as concrete, plaster board, paint, treated wood, and plastics. Some projects were particularly focused on cyclone and earthquake related demolition and construction. *Links to 'Improved waste recycling and reduction'.*

Tyres & vehicle waste (17 contributing projects, linked to $23m of MfE investment). These included projects specifically focused on recycling and salvaging tyres as well as other automotive components such as batteries and coolant. *Links to 'Improved waste recycling and reduction'.*

E-waste (17 contributing projects, linked to $6.9m of MfE investment). These included projects specifically focused on recycling and salvaging electronics, such as phones, wires, appliances, and devices. *Links to 'Improved waste recycling and reduction'.*

Recyclable materials

Plastics (57 contributing projects, linked to $56.2m of funding of MfE investment). These projects include improve sorting and recovery of plastics, changing packaging, agricultural product plastics, and recycling more plastics to rescue it from landfills. *Links to 'Improved waste recycling and reduction'.*

Paper (7 contributing projects, linked to $19m of MfE investment). These included projects specifically focused on recycling paper. *Links to 'Improved waste recycling and reduction'.*

Glass (7 contributing projects, linked to $1.4m of MfE investment). These included projects specifically focused on recycling glass. *Links to 'Improved waste recycling and reduction'.*

Textiles (7 contributing projects, linked to $2.7m of MfE investment). These included projects specifically focused on textiles and fibres. *Links to 'Improved waste recycling and reduction'.*

Oil (5 contributing projects, linked to $1m of MfE investment). These included projects specifically focused on better uses and alternatives for oil and fuel. *Links to 'Improved waste recycling and reduction'.*

Metal (1 contributing project, linked to $0.2m of MfE investment). This includes a project focused on reducing shredder floc – it is not clear if this is related to construction or something broader. *Links to 'Improved waste recycling and reduction'.*

Appendix 3: Key search terms

We used the following key words when searching for relevant literature.

Research approach

Search terms

- Waste minimisation impacts
- Circular economy + waste
- Landfill health impacts
- Landfill community impacts
- End of life landfills
- Optimising landfills
- Value of landfill data
- Recycling import reduction
- Illegal dumping
- Waste behaviours
- Waste recycling behaviours
- Food waste
- Plastic waste
- Organic waste
- Value of compost
- Waste emissions
- Landfill leachate
- Contaminated sites
- Heavy metal impacts
- Council responsibilities
- Waste impact on tourism
- Kaupapa Māori services

Geographies of interest

- Australia and Australian states
- UK
- Europe
- USA
- Canada

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Appendix 5: Glossary

Intervention logic terms	
Input	Resources such as time, money, and materials that are invested into waste minimisation efforts.
Activity	Actions taken to achieve waste minimisation, such as recycling programs, and educational campaigns.
Output	The immediate results of the activities, such as the amount of waste recycled or the number of people educated about waste minimisation.
Outcome	The overall change achieved by the intervention.
Impact	The (quantifiable and qualifiable) effects of the intervention over time, including downstream effects that happen as a result of the activities.
Impact measurement terms	
Discount rate	The interest rate used to convert future costs and benefits into present values in economic evaluations.
Social rate of time preference (SRTP)	The rate at which society is willing to trade off present for future consumption, reflecting preferences for immediate benefits over delayed ones. Treasury expects this to be 2% when looking over 1-30 years.
Social opportunity cost of capital (SOC)	The return that could be earned on capital if it were invested in the best alternative use in the economy. Treasury expects this to be 8% when looking over 1-30 years.
Costs	Waste minimisation investment made by MfE.
Benefits	The outcomes resulting from a programme or intervention. This can also include negative disbenefits.
Economic benefits	Monetary impacts resulting from an intervention, such as increased productivity or reduced expenses.
Environmental benefits	Positive impacts on the natural environment, such as avoided emissions, preserved biodiversity, or improved ecosystem health.
Wellbeing benefits	Improvements in quality of life, health, happiness, or social outcomes experienced by individuals or communities.
Net present value	The total present value of benefits minus the total present value of costs; a key indicator of a project's overall value.
Benefit-cost ratio	A ratio of the present value of benefits to the present value of costs; a value greater than 1 indicates a worthwhile investment.
Payback period	The time it takes for the benefits of a project to repay its initial costs.
Willingness to pay	The maximum amount an individual or group is willing to pay for a good, service, or benefit. This is used to work out the monetary value of intrinsic impacts, such as biodiversity.
Value for money	An assessment of whether an intervention delivers the best possible outcomes for the resources invested.

Waste terms	
Biodegradable	Capable of being decomposed by bacteria or other living organisms.
Circular economy	An economic system aimed at eliminating waste and the continual use of resources.
Composting	The process of recycling organic waste into a rich soil amendment.
Contaminated sites	Areas where the soil, water, or air has been polluted by hazardous substances, posing risks to human health and the environment.
E-waste	Discarded electrical or electronic devices.
Emissions	The release of pollutants into the air from waste, contributing to environmental pollution and climate change.
Hazardous waste	Waste that poses substantial or potential threats to public health or the environment.
Landfill	A site for the disposal of waste materials by burial.
Leachate	Contaminated liquid that results from water percolating through waste materials in a landfill, often containing hazardous substances.
Organic waste	Biodegradable material that can decompose naturally, such as food waste and yard trimmings.
Recycling	The action or process of converting waste into reusable material.
Sustainability	The ability to maintain or support an activity or process over the long term.
Waste minimisation	The process of reducing the amount of waste produced by a person or a society.
Weighbridges	Tools for accurately measuring the weight of waste materials transported by vehicles.
Zero waste	A philosophy that encourages the redesign of resource life cycles so that all products are reused.

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