Abatement cost methodology for assessing co-funding applications

Government Investment in Decarbonising Industry Fund

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Abatement cost methodology for assessing co-funding applications: Government Investment in Decarbonising Industry Fund

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Foreword

The Government Investment in Decarbonising Industry (GIDI) Fund seeks to accelerate the reduction of New Zealand's energy-related carbon emissions through energy efficiency and fuel switching. The co-funding eases the burden of the energy transition by promoting cost-effective decarbonisation options.

This paper presents a methodology used by EECA to assess potential GIDI projects in order to deliver the maximum benefit to New Zealanders. The methodology is focused on the project's abatement cost, and highlights GIDI's role as a bridge between the public benefits of decarbonisation and the private costs of investment.

True progress requires working together across the public and private spheres. International evidence shows that complementary levers, like co-investment and proactive industrial policy, alongside carbon pricing, gives us the best chance to avoid the worst of climate change and accelerate the transition to a low emissions economy.

This paper is a formal expression of EECA's existing approach to analysing abatement cost. It highlights that GIDI requires a clear understanding of the benefit a given project provides, who realises the benefit, what the cost of alternative options is for a GIDI project, and whether a project may already be sufficiently incentivised by carbon pricing through the NZ ETS.

The key measure of a GIDI project's impact is the carbon dioxide emissions abatement it achieves.
The gaps between public and private incentives to decarbonise therefore form the basis of our analysis.
The methodology addresses three questions: will New Zealand benefit from the project taking place, is the project unlikely to happen in the timeframes required without the requested level of GIDI co-funding, and is the project an efficient use of public good funding to deliver abatement to the Crown.

The methodology covered in this paper helps provide clarity on one factor of the many used for assessing potential GIDI recipients. EECA's investments also consider broader investment principles, including beyond direct abatement cost. This is because many important considerations that play into decisions about decarbonisation investment cannot be straightforwardly captured in this way.

The paper has been through extensive peer review within Government and among private experts, and at every stage EECA has sought to stress test and improve our approach and assumptions.

EECA remains committed to the effective deployment of GIDI funding for the good of all New Zealanders.

Murray Bell
Group Manager Strategy, Insights and Regulations, EECA

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Glossary

Term (abbreviation)	Definition (unit)
Abatement	The pollution (here CO_2 emissions) avoided because of an intervention. In GIDI's case, the intervention in question would be EECA's co-funding support for a project. (tCO_2e)
Abatement cost	The amount of pollution (here CO_2 emissions) avoided by an intervention, per dollar spent ($\$/tCO_2e$ or $/t).
Decision threshold	A level that needs to be met for a particular action to be taken, such as the decision to make an investment.
Direct resource cost	Cost of the raw inputs (capital and operational) necessary for production.
Emissions factor	The amount of carbon released per unit of fuel consumed. (tCO_2e/unit)
Emissions Reduction Plan (ERP)	New Zealand's policy package aimed at meeting our 2050 net zero target by meeting emissions budgets set for five-year periods.
GIDI	New Zealand's Government Investing in Decarbonising Industry Fund.
Hurdle rate	The minimum rate of return on a project or investment required by an investor.
Internal rate of return	The discount rate at which the net present value (NPV) of an investment would become zero.
Levelised abatement cost	The abatement cost of a project, considering the time value of money at a social or private discount rate. It can be defined as the constant price of carbon at which the net present value (NPV) of the abatement project would be zero.
Market failure	An inefficient distribution of goods and services in the free market.
Net present value (NPV)	A financial metric for assessing expected financial inflows and outflows, accounting for the time value of money.
New Zealand Emissions Trading Scheme (NZ ETS)	New Zealand's Emissions Trading Scheme, the primary policy for achieving net zero in the emissions reduction plan.
New Zealand Unit (NZU)	A permit to emit one tonne of carbon under the New Zealand Emissions Trading Scheme.
Shadow price of carbon	The dollar value assigned to a tonne of carbon for the purpose of cost-benefit analysis. The Treasury shadow price is an estimate of the marginal cost of abatement consistent with meeting the climate change commission pathway. (NZ$/$tCO_2e$)
Weighted average cost of capital (WACC)	The average after-tax cost of capital from all sources. This can be at an individual firm level or sector level. (%)

1 Introduction

The Government Investment in Decarbonising Industry (GIDI) Fund is a co-funding programme that seeks to reduce New Zealand's carbon emissions. GIDI is part of the New Zealand Government's Emissions Reduction Plan (ERP) and is a complementary measure to the primary emissions reduction tool, the New Zealand Emissions Trading Scheme (NZ ETS). GIDI's goals are to:

- Accelerate the adoption of energy efficiency and emissions-reducing projects.
- Reduce carbon dioxide (CO_2) emissions from energy use in the first three national emission budget periods (2025, 2030, 2035).

To do this, GIDI co-funds private investment in industrial and commercial equipment and process changes to reduce energy consumption and reduce carbon emissions. Because GIDI leverages private capital and know-how, it has the potential to achieve emissions reduction at a comparatively low price to the Crown. By addressing barriers to private sector decarbonisation, GIDI can bring abatement forward and help New Zealand achieve its domestic and international emissions reduction targets.

In line with the principles of open government, it is important that EECA demonstrates transparency and consistency in the way GIDI co-funding decisions are made. The purpose of this document is to:

- Explain how abatement cost fits, among the wider matters for consideration, within EECA's co-funding decision-making process.
- Describe the inputs and formulae used to calculate the abatement and abatement costs of projects being considered for GIDI co-funding.
- Indicate how the abatement cost assessment is used to support EECA's co-funding decisions.
- Explain the rationale behind the varying levels of control that EECA exerts over these inputs.

2 GIDI's goals: cost vs benefit

Well-targeted GIDI co-funding benefits New Zealand as a whole. However, GIDI is at risk of co-funding either projects that are too expensive for the abatement return they provide, or projects that would most likely occur anyway. To realise GIDI's potential and minimise these risks, the GIDI co-funding decision process needs a robust, transparent, appropriate, and consistent abatement cost methodology that allows EECA to:

- Identify projects with abatement costs that are so high that compelling reasons would need to be provided to show that co-funding them is in the national interest (see Section 4, New Zealand's perspective).
- Identify projects with abatement costs that are so low that compelling reasons would need to be provided to show why they would not be likely to happen anyway, or would not happen within the timeframes needed to meet New Zealand's Emissions Budgets (see Section 5, The applicant's perspective).
- Provide appropriate levels of co-funding to enable applicants to implement the proposed energy efficiency and emissions reduction projects (see Section 6, Co-funding and distribution), prioritising projects that deliver maximum value to the Crown, and ensuring that outcomes are consistent with GIDI's budget and decarbonisation targets.

To achieve the points above, EECA analyses GIDI applications through a present-value economic lens that is comparable to a lightweight cost benefit analysis. Ideally, GIDI projects provide a good public return on investment and are unlikely to occur without government support. At a high level, our analysis of any GIDI project is as follows:

- Its economic benefit to New Zealand is the avoided cost of finding the same amount of abatement elsewhere.[1]
- Its economic cost to New Zealand is approximately the direct resource cost, or the total amount of spending required for the project – be that operational or capital expense.[2]
- If our comparison suggests that the project would provide value to New Zealand, we then work to determine how much co-funding the applicant firm requires to make the project happen.[3]
- If the project already appears well incentivised for the applicant given its financial and abatement details, EECA will tend not to fund it or fund it at a low level. This is to avoid co-funding projects that will most likely occur without government support.

[1] In other words, for the purposes of assessing an individual GIDI project, we compare to a counterfactual case – in which the project is not supported – where the same abatement is found elsewhere to meet national decarbonisation targets. This method of valuing the economic benefit of decarbonisation aligns our approach with the analysis presented in Denne T (2020), The Social Cost of Carbon and the basis for its estimation in New Zealand. This analysis allows us to value GIDI projects at the individual project level; it should not be taken to imply that the GIDI programme does not alter abatement outcomes. In our assessment, the ERP as currently envisioned would not be able to meet New Zealand's ERP emissions budgets at palatable ETS prices without the help of GIDI in overcoming the market failures identified in this paper.

[2] We note that this estimate of cost is focused on carbon accounting and does not include multiplier effects from investment in New Zealand industry or other co-benefits from investment. GIDI's primary focus is accelerating decarbonisation; we have 'right-sized' our evaluation of GIDI applications, and do not attempt to do a full macroeconomic cost-benefit analysis which would include analysis of macroeconomic effects (e.g. trade) and wider economic costs and benefits. Indirect decarbonisation co-benefits are considered alongside the abatement cost in a qualitative manner.

[3] Whereas national cost and benefit should be modelled using an appropriate social discount rate, modelling private behavioural changes requires analysis using private discount rates, as discussed in Circular A-4, p75.

Note that this framework is used by EECA as a tool for analysing projects and identifying when further information is needed to demonstrate a project's merit. It is considered in combination with GIDI's investment principles, such as supporting a fair transition, contributing to wider government outcomes, supporting the long-term efficiency of the energy system, and encouraging innovation. A project that falls outside of the envelope identified in this paper may still be supported - but would need to provide robust evidence that it provides a benefit to New Zealand and would not occur without GIDI co-funding or would occur much sooner with GIDI support. Within the abatement cost framework, an application for co-funding is approached as follows:

- **An applicant identifies a project that would reduce emissions but does not meet its investment hurdle rate at the estimated NZU price.**
- **EECA estimates the levelised abatement cost of emission reduction for the project using a social discount rate (e.g. 5%). EECA will consider co-funding if the levelised cost is lower than a decision threshold derived from the Treasury shadow price using the social discount rate.**
- **EECA is willing to pay an amount that makes the project viable for the applicant, generally limited to 50% of the total capital expense.**
- **EECA will prioritise projects that deliver the largest decarbonisation per dollar of GIDI co-funding, i.e. the lowest abatement cost to the government.**

3 Abatement and abatement cost

The key measure of a GIDI project's impact is the carbon dioxide emissions abatement it achieves. We quantify this in tonnes of carbon dioxide equivalent (tCO_2e) abated. This section describes how carbon abatement is defined, beginning with the concept of additionality, which underpins abatement.

In economic decision making, decisions are valued in terms of opportunity cost – how a decision compares to the next-best alternative it rules out. The 'additionality' criterion brings this logic into a carbon-emissions context. In project-based carbon accounting, carbon abatement is defined as the additional reduction in carbon emissions resulting from the project compared to the most likely alternative scenario – known as the base case or counterfactual.

The abatement of a GIDI project is therefore the amount of carbon the project prevents from being emitted – compared to the most likely scenario without EECA co-funding.

For a worked example of carbon abatement, please see Appendix A.

We compare the lifetime abatement of a given project to its cost, to get a figure known as the abatement cost. The lower an abatement cost, the more tonnes of CO_2 abated per dollar. When calculating abatement cost, we exclude the effect of the price of carbon in the New Zealand Emissions Trading Scheme (NZ ETS) impacting fuel prices – this allows us to meaningfully compare abatement cost with anticipated future NZ ETS carbon prices. Because GIDI projects affect outcomes for years into the future, EECA uses a 'levelised' abatement cost, which discounts the future benefits and costs of a given project. We compare this to a similarly levelised NZ ETS carbon price to summarise the total future value-for-money of a project in present terms.[4]

As stated above, abatement is the difference in emissions between the project scenario and the most likely counterfactual. Likewise, all project costs in our levelised abatement cost methodology are the incremental cost of the project compared to the counterfactual.

Written as a formula, the levelised abatement cost is as follows:

$$\textit{Project levelised abatement cost} = \frac{PV(\textit{Incremental Costs})}{PV(\textit{Emissions Reduced})} = \frac{\sum C_t/(1+r)^t}{\sum ER_t/(1+r)^t}$$

For more details and a worked example of this calculation, please see Appendix B.

The abatement cost of a given project can differ greatly depending on who is calculating it and what their assumptions are – especially because of the influence of discount rates. In this paper, we consider two views: the New Zealand view and the applicant business view. EECA uses these two views (1) to estimate the public return of a project, (2) to assess whether EECA's intervention is needed, and (3) to estimate how much co-funding is needed to make a project happen.

[4] Appendix B includes a discussion of this approach, including (1) the fact that emissions reductions are frequently not discounted in abatement cost calculations, and (2) an explanation of the analogy between levelised abatement cost and the levelised cost of energy (LCOE), which is a widely adopted concept in the energy industry. Putting aside technical details, the main justification for our use of levelised abatement cost is that it aligns our decision-making process with the cost-benefit analysis sketched in Section 1. Appendix C explains how to calculate a levelised cost of alternatives; the levelised ETS carbon price is calculated in this way.

4 New Zealand's perspective

This section discusses the method by which EECA reviews potential GIDI projects from a 'New Zealand Inc' point of view.

To consider the merit of a project, we need to determine whether we could get the same benefits at a lower cost. The chart below shows four theoretical projects applying for GIDI co-funding, compared to a readily available alternative. In Figure 1 below, project A is more expensive over its lifetime than the alternative, so co-funding it would result in a net loss for New Zealand: this project may be inappropriate for GIDI co-funding. Projects B, C and D provide abatement at a lower cost than the alternative and therefore provide a net gain for New Zealand; in fact, project D would provide benefit irrespective of emissions considerations.

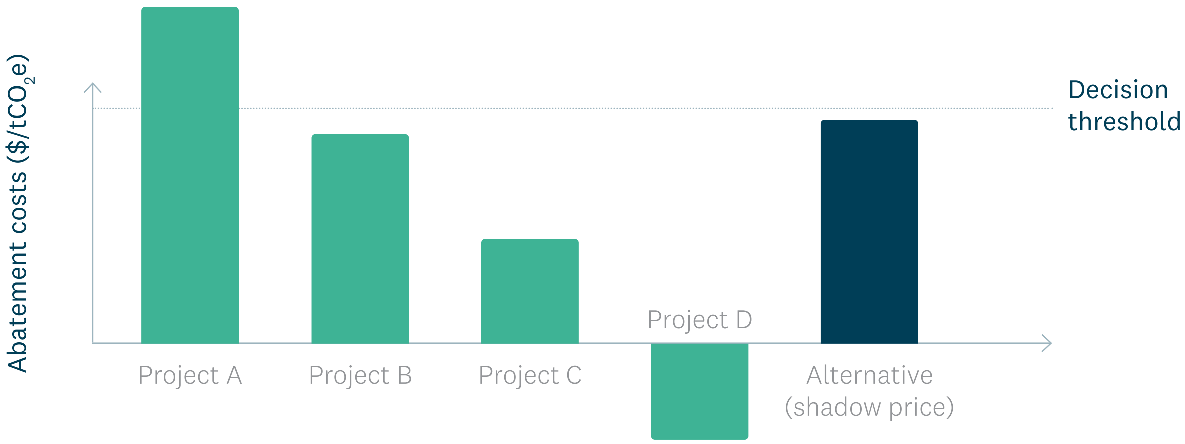

Figure 1: New Zealand Inc project view

For GIDI co-funding, EECA uses the Treasury's shadow emissions values projection (central path) over the lifetime of the project as a proxy for the cost of alternatives. The shadow emissions values reflect estimates of the anticipated future costs of abatement required to reach New Zealand's domestic emissions targets. Non-carbon and indirect decarbonisaton benefits cannot be easily priced into this method, so they need to be considered and valued separately in a qualitative manner.

The appropriate way to use the shadow price depends on our model of when the alternative decarbonisation would need to be purchased. For the purposes of determining whether a project makes economic sense, our standard approach is to consider the cost of paying for an equivalent quantity of decarbonisation in each year, to match the project abatement that the project would provide that year. We discount this cost at the Treasury-recommended social discount rate of 5% to account for the time value of money.

Acknowledging uncertainty in the inputs, EECA also uses a 2% discount rate and the high path projection for the Treasury shadow price for sensitivity analysis of marginal projects. Projects which meet this more lenient standard may be approved if the EECA co-funding per tonne is low, there is evidence of flow-on benefits for decarbonisation of the New Zealand economy, or the project otherwise contributes to a portfolio of projects that aligns with EECA's investment principles.

Whichever rate is used, EECA derives a decision threshold based on the Treasury shadow price over the lifetime of the project. For a worked example, please see Appendix C at the end of this document.

After examining a project from the New Zealand perspective, we know whether we see it as a good investment for New Zealand or not. If a project costs less than the decision threshold we have derived from the Treasury shadow price, it is likely to provide value to New Zealand. The next question is: does GIDI need to fund it?

5 The applicant's perspective

In this section, we will explore the applicant's viewpoint and how it is used in GIDI co-funding decisions. The applicant's perspective differs from New Zealand Inc's in two main ways:

1. The applicant makes decisions based on expectations of the Emissions Trading Scheme price, which may not align with the Treasury Shadow Price.

2. Applicants face higher borrowing costs than the government and calculate their costs and benefits using a higher (frequently much higher) discount rate than EECA would.

The consequence of these two points is typically that abatement projects look less attractive to applicants than they do to New Zealand Inc. The project's benefits may look lower both because NZ ETS price expectations are lower than the Treasury shadow price path and because the long-term benefits of emissions reductions are more discounted. Meanwhile, up front capital costs are broadly unchanged. Although EECA uses the applicant perspective to assess additionality in light of real-world firm incentives, the appropriate lens for valuing cost and benefit is always the New Zealand Inc one (refer to Circular A-4, p75). To determine an appropriate discount rate to use for the applicant view, EECA will consider both typical industry WACC and the hurdle rate that the applicant uses to assess projects of this type.

For GIDI projects, EECA uses the applicant's view to screen projects which already seem well incentivised without co-funding. The chart below shows a set of potential projects for four different applicants. In each case, the project alternative is that the applicant emits the amount of carbon the project would abate and purchases NZ ETS credits for the right to do so.[5] For simplicity's sake we have assumed the same alternative cost for all four projects, but note that the 'alternative (NZ ETS price)', presented as the blue bar in Figure 2 below, is calculated as the net present value of future NZ ETS purchases required if the applicant does not do the project, as described in Appendix C. In general, this alternative cost (as perceived by each applicant) will depend upon when the abatement would occur, and on the applicant's specific cost of capital. Based on the figures below, we would expect projects C and D to proceed without any GIDI co-funding (though there could be relevant reasons why this may not arise and GIDI co-funding may be appropriate), while projects A and B appear more likely to need GIDI co-funding to bridge a financial gap.

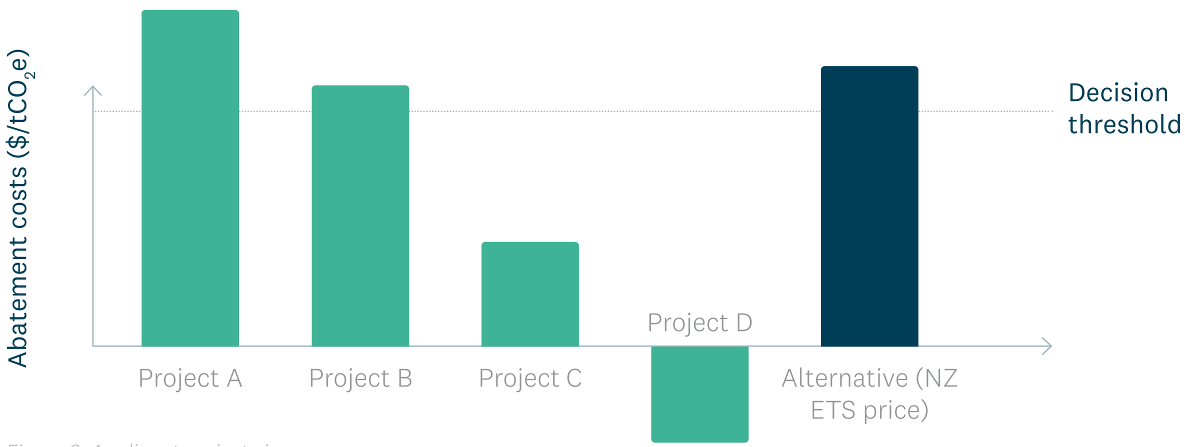

Figure 2: Applicant project view

[5] If the applicant is not fully exposed to NZ ETS prices, then EECA will consider what carbon price signals they face and construct a cost of the alternative based on their circumstances.

The applicant perspective provides EECA with insight on the additionality and real abatement of a project. As discussed above, the abatement of a project is the difference between the CO_2 emissions in the project scenario, and the CO_2 emissions in the best option available to the firm without co-funding. If doing the project already appears to be the best option for an applicant without co-funding, then co-funding the project looks like a non-additional intervention for EECA. In the graph above, project D looks non-additional as it has a negative abatement cost without support. EECA would not co-fund the project unless able to identify barriers preventing the project from occurring in a timely fashion, such as robust evidence that the applicant would not fund the project without EECA support. Such evidence could be based on internal capital competition (due to competing projects), debt covenant constraints, or limited access to private funding, among other barriers.

In the following section, we will work through an imaginary GIDI application, examining it from the New Zealand perspective and the applicant view.

6 Co-funding and distribution

Suppose that an applicant requests co-funding from EECA. This amounts to a proposal to split the project's abatement cost into two parts, which will respectively be funded by EECA and by the applicant. These two pieces are illustrated as the bars labelled 'EECA' and 'Residual' in Figure 3 below, a waterfall chart which depicts the co-funding proposal from the 'New Zealand Inc' view, with a 5% social discount rate.

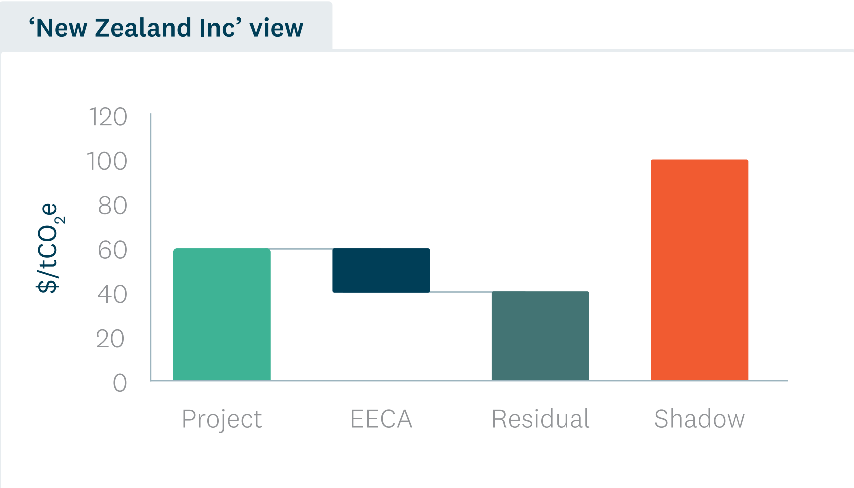

Figure 3: 'New Zealand Inc' waterfall

From the 'New Zealand Inc' perspective, the project cost is far lower than the cost of alternatives (the orange shadow bar above) – therefore this project looks like a clear net positive for New Zealand. Because EECA is mobilising private sector capital, the abatement cost to the taxpayer is only a fraction of the total project cost and is lower than other decarbonisation options available to government. However, if the project already appears attractive (compared with the shadow price alternative) prior to co-funding, this raises the question, why is co-funding necessary to support the project?

The answer may potentially include a whole host of non-price factors[6], but we restrict ourselves here to an analysis of the applicant's carbon-accounting view of the project.

From the applicant's point of view, the alternative to doing the project would be to continue to purchase emission credits under the New Zealand Emissions Trading Scheme. In addition, the applicant is likely to choose to use a higher discount rate than the social discount rate.[7]

[6] EECA's investment principles include factors in addition to abatement cost, building on the findings of the 2021 EECA/MAFIC report Accelerating the decarbonisation of process heat.

[7] While the higher borrowing costs faced by firms reflect higher risks due to market exposure, this risk does not necessarily attach to the decarbonisation impact of a given project. Decarbonising New Zealand's industrial base does not depend on the continued existence of a given firm – only the continued use of low emissions assets. EECA is working on a risk management framework in a separate workstream, aimed at supporting portfolio management.

Treasury's advice on discount rates indicates that the best economic outcomes for New Zealand will be achieved when the Government uses a relatively low discount rate for its investment decisions. However, this is unlikely to be an option for a company facing high borrowing costs and operating in a competitive environment. A standard practice is for an applicant to use its weighted average cost of capital (WACC) as its discount rate. According to the PwC New Zealand Cost of Capital Report 2022, companies across a range of industries face a nominal cost of capital ranging up to between 10% and 15%, suggesting an upper bound of around 12% for real WACC. In an uncertain environment, it is reasonable to expect that hurdle rates being used by companies are higher still.

Figure 4 below depicts the same project, as viewed by the applicant.[8] The analysis that has been used to produce the chart is the same as described above, but we have assumed that the applicant applies a discount rate of 12% and has used a lower forecast of future NZ ETS prices than the Treasury shadow carbon values. EECA collects information on applicant expectations of future NZ ETS prices in order to understand perceived emissions prices. Uncertainty about future NZ ETS policy settings can act as a disincentive to action. As discussed above, the company's shorter-term perspective leads to a very different picture of the same project. From the company's point of view, the abatement cost of the project looks higher, and the cost of the alternative looks smaller. Because of the effect of discounting, each of the costs looks different between the applicant and New Zealand Inc views.

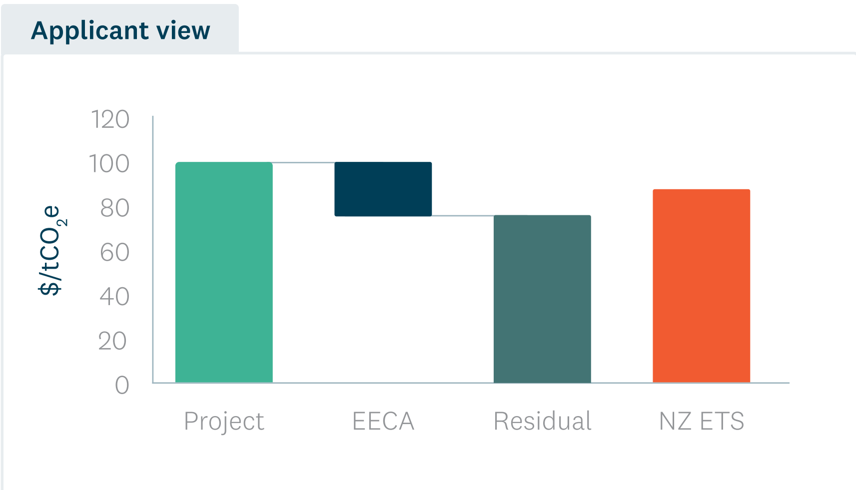

Figure 4: Applicant waterfall

[8] To determine whether funding has overcome an internal decision threshold or barrier, the project can also be visualised in terms of IRR or payback period, before and after co-funding, compared to an applicant's hurdle rate or maximum payback period. Here we restrict ourselves to the 'waterfall' breakdown of abatement cost and focus on a comparison of the EECA and applicant views.

The applicant sees the project (prior to EECA co-funding) as more expensive than the alternative, meaning that without GIDI co-funding they would not implement the project, and would instead continue to emit and purchase NZ ETS credits. In this instance, we are confident that the project is additional and a good candidate for GIDI support. We note that there may also be instances where, prior to GIDI support, the project appears cheaper than the NZ ETS alternative but is nevertheless unlikely to go ahead without co-funding support. This could be the case, for instance, when a firm is considering allocating its limited pool of available capital to other investments which offer a better expected return than the decarbonisation project.

After EECA co-funding, the 'Residual' cost of the project is less than the NZ ETS price, showing that co-funding has successfully altered the business's economic calculus, aligning the applicant's incentives with those of 'New Zealand Inc'. However, the co-funding has been selected to avoid going further than necessary to achieve this outcome: the level of co-funding has been selected to deliver its outcome in a cost-effective manner for the New Zealand Government.

To summarise, we place the 'New Zealand Inc' view alongside the applicant view in Figure 5, below.

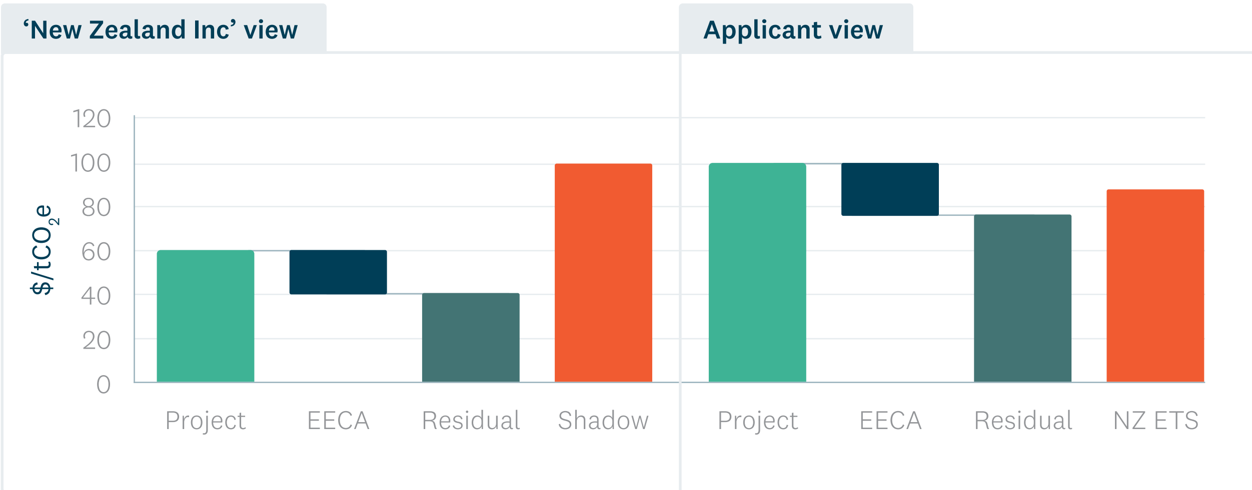

Figure 5: Dual waterfall

In each plot, the project's levelised abatement cost is split out into the portion that EECA will co-fund and the residual cost to the applicant. Each can be compared with the cost of the relevant alternative. From New Zealand's point of view the cost of the alternative is the net present value of future abatement alternatives required if the project does not occur, as described in Appendix C. From the applicant's point of view the cost of the alternative is the net present value of future NZ ETS purchases required if the applicant does not do the project.

When considering return on investment, EECA compares both the total project cost and EECA's co-funding cost ('New Zealand Inc' view) to the relevant alternative (left orange bar), while the applicant compares their residual cost (Applicant view) to the relevant alternative (right orange bar).

The plots show the following for our hypothetical project:

- **The project cost (New Zealand Inc view) is less than the estimated cost of finding the same abatement elsewhere in the economy (Shadow): the project is likely to make New Zealand better off.**
- **The project cost (Applicant view) exceeds the NZ ETS cost: this supports the claim that the project won't go ahead without co-funding, i.e. the project is not already incentivised by the NZ ETS. In addition, the EECA co-funding is a material percentage of the overall project cost (Applicant view), which supports the idea that co-funding would be a decisive factor in enabling the project.**
- **After co-funding, the applicant share of the abatement cost isn't vastly smaller than the NZ ETS price, confirming that the proposed co-funding level is set appropriately to incentivise the project.**
- **The EECA co-funding impact (New Zealand view) is much lower than the estimated cost of finding the same abatement elsewhere (Shadow), suggesting that taxpayers are well served by the project. The EECA co-funding impact can also be compared to GIDI abatement cost targets and to rank projects in terms of their cost-effectiveness to government.**

Again, note that the only difference between the side-by-side view above is the discount rate used, and anticipated NZ-ETS prices versus shadow carbon values. This demonstrates the impact of two key inputs on both the New Zealand view, and that of the applicant. Ensuring the validity and accuracy of the inputs is the key challenge in determining the abatement, abatement cost, and co-funding level of a GIDI project. The section below outlines the inputs needed for a GIDI project, and the level of control EECA puts on them.

7 How EECA controls input assumptions

In this section we describe the methodology that EECA has adopted for controlling the inputs to its abatement cost calculations, and the reasons for this. The methodology is adopted in our 'financial assessment template' spreadsheet, where cost calculation inputs are either a) hard-coded, b) given 'acceptable ranges', or c) provided by applicants and vetted by technical experts.

As Appendix B shows, the information that goes into the calculation of a project's abatement cost is wide-ranging, and includes physical properties (of fuels), engineering estimates of project costs, forecasts of future fuel prices, future carbon prices and carbon abatement costs, qualitative information such as environmental policy settings, and appropriate discount rates for the country and for the applicant.

Much of this information will be subject to a large amount of uncertainty: this is an inevitable aspect of long-term decisions. Some of it will be better known by the applicant, while some of it is more appropriate to be sourced from government data sets.

We are guided by the following principles, presented in the order of their ranking:

1. **Inputs must be internally consistent and consistent with standard practice for carbon accounting, as laid out in The GHG Protocol for Project Accounting.**
2. **To ensure consistent treatment of different GIDI applications, EECA uses standardised values for inputs that are common, such as fuel emission factors (except in cases where exceptions are justified), future NZ ETS and shadow carbon prices, and relative fuel price changes over time.**
3. **Applicants are incentivised to make a strong case for co-funding. Therefore, inputs that strongly influence the calculated abatement cost, and potentially the level of EECA co-funding, should receive extra scrutiny and justification to ensure that projects receive appropriate co-funding**

The aforementioned principles provide a straightforward framework for determining where inputs should come from. The inputs can be divided into three categories, in increasing order of EECA control:

Applicant-sourced:

- Incremental capital expenditure
- Incremental operational and maintenance expenditure
- Incremental fuel use

Collaboratively sourced:

- Fuel price track
- Applicant discount rate (WACC and hurdle rate for the project)

EECA-sourced:

- NZ ETS price future values
- Shadow carbon price future values
- Social discount rate
- Fuel emissions intensity

To ensure consistency with The GHG Protocol for Project Accounting, even the inputs labelled as *'applicant-sourced'* will typically be produced via the iterative process described at the end of *Section 3.*

8 Summary

The GIDI Fund plays a crucial role in accelerating decarbonisation in New Zealand by promoting energy-efficient and emissions-reducing projects that contribute to CO_2 abatement. GIDI accelerates the energy transition by promoting cost-effective decarbonisation projects.

This paper has described the methodology by which EECA assesses projects to deliver the maximum benefit to New Zealanders via the GIDI co-funding mechanism. This boils down to three questions:

1. Will New Zealand benefit from the project taking place?
2. Is the project unlikely to happen without the requested level of GIDI co-funding?
3. Is the project an efficient use of government funding to deliver abatement to the crown?

It is important that EECA demonstrates transparency and consistency in its decision making. As this paper has outlined, EECA aims to maximise GIDI's impact by analysing GIDI projects through a present-value economic lens, comparing the benefits and costs of a project to determine the value it could provide to New Zealand. To ensure the most effective use of public funds, EECA also examines potential projects from the applicant firm perspective to determine whether and how much the project requires co-funding support, and ranks projects in terms of the abatement impact that they provide per dollar of Crown funding. This process is an important input into assessing GIDI applications, alongside EECA's wider investment principles.

References

Accelerating the decarbonisation of process heat. EECA/MAFIC, August 2021. https://www.eeca.govt.nz/assets/EECA-Resources/Research-papers-guides/Accelerating-the-decarbonisation-of-Process-Heat.pdf

Advice on New Zealand ETS unit limits and price control settings for 2024-2028. Climate Change Commission, March 2023. https://www.climatecommission.govt.nz/public/ETS-advice/2023/2023-advice-on-NZ-ETS-unit-limit-and-price-control-settings.pdf

CBAx Tool User Guidance: Guide for departments and agencies using Treasury's CBAx tool for cost benefit analysis. October 2022. https://www.treasury.govt.nz/sites/default/files/2022-10/cbax-guide-oct22.pdf

Cost of Capital Report for June 2022. PwC New Zealand. https://www.pwc.co.nz/pdfs/2022/cost-of-capital-report-2022.pdf

Ināia tonu nei: a low emissions future for Aotearoa Advice to the New Zealand Government on its first three emissions budgets and direction for its emissions reduction plan 2022-2025. Climate Change Commission, 31 May 2021. https://www.climatecommission.govt.nz/public/Inaia-tonu-nei-a-low-emissions-future-for-Aotearoa/Inaia-tonu-nei-a-low-emissions-future-for-Aotearoa.pdf

A General Equilibrium Analysis of Options for New Zealand's post-2020 Climate Change Contribution, for Ministry for the Environment. Infometrics, 13 April 2015. https://environment.govt.nz/assets/Publications/Files/general-equilibrium-analysis_0.pdf

The levelised cost of carbon: a practical, if imperfect, method to compare CO2 abatement projects, Climate Policy. Erin D. Baker & Seyedeh Nazanin Khatami, 2019. ÝOI: 10.1080/14693062.2019.1634508

Marginal Abatement Costs: Should tonnes be Discounted? Note to Ministry for the Environment, 19th August 2019. Resource Economics. Denne T, 2019.

Office of Management and Budget Circular A-4 – DRAFT FOR PUBLIC REVIEW https://www.whitehouse.gov/wp-content/uploads/2023/04/DraftCircularA-4.pdf

Report of the High-Level Commission on Carbon Prices. Stiglitz, Joseph & Stern, Nicholas & Duan, Maosheng & Edenhofer, Ottmar & Giraud, Gaël & Heal, Geoffrey & La Rovere, Emilio & Morris, Adele & Elisabeth, Moyer & Pangestu, Mari & Shukla, Priyadarshi & Sokona, Youba & Winkler, Harald, 2017.

The Social Cost of Carbon and the basis for its estimation in New Zealand. Treasury OIA document, 30 August 2021. Denne T, 2020. https://www.treasury.govt.nz/sites/default/files/2022-03/oia-20210278.pdf

Study: Levelised Cost of Electricity- Renewable Energy Technologies. Fraunhofer ISE, June 2021. https://www.ise.fraunhofer.de/content/dam/ise/en/documents/publications/studies/EN2021_Fraunhofer-ISE_LCOE_Renewable_Energy_Technologies.pdf

Update to New Zealand Emissions Trading Scheme limits and price control settings for units. Office of the Minister of Climate Change, 2022. https://environment.govt.nz/assets/publications/nz-ets-settings-2022-cabinet-paper_redacted.pdf

Appendix A - Abatement worked example

An abatement calculation is illustrated in the table below. We imagine a simplified GIDI application with a project scenario and an alternative scenario called the base case. The base case represents the likely outcome if there were no co-funding. In our example, in the base case, the applicant would continue to produce 20 tCO_2e of emissions from coal per year for the next 10 years, before switching to a biomass boiler (due to the coal boiler reaching the end of life, and a decision to switch to biomass in response to an increased NZ ETS carbon price, say). In the project scenario, the applicant will immediately replace their coal boiler with a biomass one, because GIDI co-funding makes this decision consistent with their hurdle rate today.

		0	1	2	3	4	5	6	7	8	9	10	Total tCO_2e
Base Case	Coal until year 9	20	20	20	20	20	20	20	20	20	20	0.2	**200.2**
Project	Biomass from year 0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	**2.2**
Abatement		19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	0	**198**

The switch to a biomass boiler will reduce the applicant's annual emissions by 19.8 tCO_2e per annum for 10 years. Therefore, the total tCO_2e impact of the project is 198 tonnes of CO_2e avoided. This is the additional lifetime tCO_2e abatement of the project.

In the final year of the above table, both scenarios have the same CO_2 emissions – from year 10 onwards, we consider the project to provide no additional carbon abatement. This is true even if the new equipment installed by the project has an expected lifetime of 20 years. The base case scenario reflects an expectation that in later years the NZ ETS would send a strong enough signal to trigger the project without support from GIDI.

This section has emphasised that quantifying tCO_2e abatement involves comparison against a counterfactual base case scenario. Selection of the appropriate base case is not a straightforward task. Guidelines for determining an appropriate base case are described in The GHG Protocol for Project Accounting. The base case should aim to be as realistic as possible. It should be consistent with a net benefit analysis, and with known barriers ruling out alternative scenarios. For example, if an end-of-life coal boiler must be replaced within the project timeframe, the base case cannot involve continuing to run it indefinitely. In general, the base case should reflect realities that will inevitably be specific to the applicant and will need to be provided by the applicant.

The selected base case also should be consistent with the assumptions used in cross-government modelling. For instance, RMA legislation changes phase out coal use by 2037: therefore, the base case should not assume coal use beyond 2037. Ensuring consistent input assumptions is essential for EECA to assess projects on a level playing-field and in a way that is consistent with cross-government modelling and monitoring efforts. Defining the appropriate base case for a project will typically be an iterative process drawing on input both from the applicant and from EECA. The resulting base case scenario will inevitably remain uncertain, but it will allow us to calculate our best estimate of the project's impact.

Appendix B - Levelised abatement cost worked example

In this section we describe how an abatement cost is calculated for each project, so that we can determine whether the project makes economic sense in terms of its emissions impacts. EECA uses a 'levelised' abatement cost, as will be explained below.[9]

Calculating the abatement cost requires a forecast over the project lifetime of:

- Incremental CAPEX.
- Incremental OPEX (both non-fuel and fuel, excluding the effect of NZ ETS).
- Incremental emissions, or abatement, as calculated in the previous section.

Here the word 'incremental' means what is required is a difference between the project scenario and the base case scenario for each quantity. In practice this means that we need two forecasts of CAPEX, OPEX and emissions, one for the project scenario and one for the base case, to allow comparison between the two. The two forecasts must be consistent with one another. For instance, they should draw on consistent forecasts of future fuel prices and fuel emission intensities in both scenarios. OPEX related to fuel consumption needs to be consistent with the derived tCO_2e emissions. The base case should be consistent with the guidelines described in The GHG Protocol for Project Accounting.

From the incremental CAPEX, OPEX and emissions, we can compute an incremental cost associated with the project. We must ensure the dollar values are in real terms in a consistent base year, and we use cashflow discounting to account for the time value of money. For instance, suppose our hypothetical project has the following incremental costs associated with it. The following table is a view of the project cost calculated using a discount rate of 5%. Treasury guidelines (CBAx Tool User Guidance, October 2022) recommend that government entities use this discount rate, in addition to a test rate of 2%, for assessing the economic impact of their decisions.

Year	0	1	2	3	4	5	6	7	8	9	10	Total
Incremental project CAPEX	($10k)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$10k	
Incremental project OPEX excl. NZ ETS	($800)	($800)	($800)	($800)	($800)	($800)	($800)	($800)	($800)	($800)	$0	
Incremental cost in each year excl. NZ ETS	($10.8k)	($800)	($800)	($800)	($800)	($800)	($800)	($800)	($800)	($800)	$10k	
Incremental present value cost (excl. NZ ETS)	($10.8k)	($762)	($726)	($691)	($658)	($626)	($596)	($569)	($541)	($516)	$6139	**($10,347)**

[9] For a discussion of the merits of discounting emissions volumes in the calculation of marginal abatement cost, see Marginal Abatement Costs: Should tonnes be Discounted? Note to Ministry for the Environment (Denne, T), 19th August 2019. Resource Economics.

Note that net incremental costs to the applicant are shown as negative here. In year zero the incremental project CAPEX is negative at ($10k) because, in the project scenario (in which a new biomass boiler is installed to replace the coal boiler), $10k more CAPEX occurs than in the baseline scenario. In year 10 the upgrade happens in the baseline scenario, but not in the project scenario – the boiler already having been upgraded in year zero – so the incremental CAPEX is positive: $10k. An incremental project OPEX excluding NZ ETS of ($800) reflects higher costs in the project scenario than in the base case, e.g. biomass costing more than coal, when the associated NZ ETS costs are excluded.

Adding up the present values of the incremental project cost in each year, we obtain a net present value cost of the project, excluding the cost of its carbon emissions, of ($10.3k). To be able to talk about an effective price that we would pay per tonne CO_2e of abatement, we need to divide the total (present value) cost by a quantity of abatement obtained. The most obvious thing to do here would be to divide $17,293 by the 198 tCO_2e lifetime emissions abatement that the project achieves. However, the result of this calculation would not be directly comparable to an equivalent price paid for carbon throughout the lifetime of the project. Instead, EECA uses a 'levelised cost' of the abatement. To calculate this, the annual abatements are discounted at the same rate (here 5%) as the financial numbers:

Year	0	1	2	3	4	5	6	7	8	9	10	Total
Discounted abatement	19.8 t	18.9 t	18.0 t	17.1 t	16.3 t	15.5 t	14.8 t	14.1 t	13.4 t	12.8 t	0 t	**161 tCO_2e**

The levelised abatement cost is then calculated as net present value cost of the project, divided by the total discounted abatement:

$$\textit{Project levelised abatement cost } (5\% \textit{ discount rate}) = \frac{\$10{,}347}{161\ \text{tCO2e}} = \$64.5/\ \text{tCO2e}$$

This is the constant carbon cost at which the net present value of the project would be zero. Written as a formula, the levelised abatement cost can be written:

$$\textit{Project levelised abatement cost} = \frac{PV(Costs)}{PV(Emissions\ Reduced)} = \frac{\sum C_t/(1+r)^t}{\sum ER_t/(1+r)^t}$$

The use of discounting in the denominator of this formula can lead to confusion. It is important to emphasise that although a 'discounted abatement' is being used here to calculate a levelised cost, discounted abatement is not meaningful outside of this context and would never be quoted as an abatement figure – the correct lifetime abatement figure to quote in this example would be 198 tCO_2e.

While it is common for abatement costs to be calculated on a non-levelised basis, there are good arguments that the ‘levelised’ abatement cost can provide a more financially meaningful measure than the ‘non-levelised’ alternative. These include that:

- It distinguishes between projects that have different abatement timing.
- It makes it straightforward to compare derived abatement costs with a carbon price.

Although non-levelised abatement costs are widely used, this practice treats avoided emissions identically no matter when they are expected to happen, and it doesn’t acknowledge our preference for projects that can give deep cuts immediately over other projects that will take longer to yield benefits. If tonnes are not discounted but costs are, the same project delayed by five years with the same in-year costs appears to have a lower abatement cost.

Faster projects will avoid more carbon costs in the short term and are more valuable in present value terms. The use of levelised abatement cost aligns with the widespread use of levelised cost of energy to evaluate energy production cost (see for example the June 2021 Fraunhofer ISE Study). Above all, the use of levelised abatement cost aligns our decision making with the economic analysis sketched in Section 2. GIDI’s goals: cost vs benefit.

For more discussion, see *Marginal Abatement Costs: Should tonnes be Discounted?* and *The levelised cost of carbon: a practical, if imperfect, method to compare CO2 abatement projects*.

Appendix C - Cost of alternatives worked example

The following table illustrates the calculation of the cost of alternatives, from the New Zealand perspective, for the hypothetical fuel-switching project described in Appendices 1 and 2. With a 5% discount rate, the present value of alternative decarbonisation equivalent to the abatement that would be delivered by the project is a net cost of ($17,500).

Year	0	1	2	3	4	5	6	7	8	9	10	Total
Abatement	19.8 t	19.8 t	19.8 t	19.8 t	19.8 t	19.8 t	19.8 t	19.8 t	19.8 t	19.8 t	0 t	**198 tCO_2e**
Shadow price	$72/t	$81/t	$90/t	$99/t	$108/t	$118/t	$127/t	$136/t	$145/t	$150/t	$156/t	
Cost in year	($1426)	($1604)	($1782)	($1960)	($2138)	($2336)	($2515)	($2693)	($2871)	($2970)	$0	
Present value	($1426)	($1527)	($1616)	($1693)	($1759)	($1831)	($1876)	($1914)	($1943)	($1914)	$0	**($17,500)**

The levelised cost of alternative decarbonisation avoided is then calculated as the total discounted cost of the decarbonisation, divided by the total discounted abatement:

$$\text{Levelised cost threshold} = \frac{\$17{,}500}{161\ \text{tCO2e}} = \$109/\text{tCO2e}$$

As was mentioned in Appendix B, one benefit of using levelised costs is that they provide an effective average price paid for the decarbonisation, making them comparable with the market price. To illustrate this, suppose the carbon shadow price were forecast to remain constant at $100/$tCO_2e$. In this case the levelised cost of alternatives would also evaluate to $100/$tCO_2e$. The levelised cost gives a weighted average of the price paid at different times during the project lifetime, with each year receiving a weighting that is determined both by the amount of carbon abated and by the discount factor for that year. It is the answer to the question, "what constant price per tCO_2e, over the period during which the project is considered additional, would end up costing the same amount in present value terms as the forecast shadow price?"

To summarise, we have calculated a price of $109/$tCO_2e$ as the effective cost per tonne that we would pay to abate these emissions without undertaking our hypothetical project, by paying for alternative decarbonisation in each year in lieu of the project's carbon abatement. For the project to make economic sense as a recipient of government co-funding, its total cost per tonne should be less than this alternative, unless it has other identifiable co-benefits.

In the previous section we computed the abatement cost of the project as $64.5/ tCO_2e. This is less than the levelised cost threshold of $109/$tCO_2e$. In other words, the project is expected to provide decarbonisation at lower cost than alternative decarbonisation options. Note that comparing the levelised abatement cost with the levelised cost of alternatives is equivalent to checking whether the project has a positive NPV, because the discounted abatement cancels from both sides of the comparison. In this case, we have found that the project has a positive NPV from an 'New Zealand Inc' perspective, and will likely make New Zealand better off if it goes ahead.

An analogous calculation can be used by a business to determine the cost of the alternative to a decarbonisation project from that business's perspective. This calculation is identical to the one outlined above but uses anticipated NZ ETS prices in place of the shadow carbon price, and the appropriate discount rate for the business. This provides a levelised NZ ETS carbon price, which can serve as a decision threshold for the business. If the levelised abatement cost of the project is less than the levelised NZ ETS price, it is rational for the business to pursue the project.

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