Technical annex to the consultation document

Annual updates to New Zealand Emissions Trading Scheme limits and price control settings for units 2025

Ngā whakahou ā-tau ki ngā tepe me ngā tautuhinga whakatau utu mō ngā wae mō te Kaupapa Hokohoko Tukunga o Aotearoa 2025

Ministry for the Environment
Manatū Mō Te Taiao

Te Kāwanatanga o Aotearoa
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Contents

Figures

Introduction

This technical annex provides further detail on the modelling used in the consultation document *Annual updates to New Zealand Emissions Trading Scheme limits and price control settings for units 2025*.

It focuses on the analysis made using the New Zealand Emissions Trading Scheme (NZ ETS) market model. Other settings analysis, particularly the seven-step approach, is described more fully in appendix 1 of the consultation document.

The **first section** of this annex describes:

- technical updates to the model since its last release in February 2025
- the main model assumptions used in this analysis.

This section is intended to provide transparency on technical modelling details.

The **second section** outlines additional modelling results. It gives further detail about the main insights in the consultation document, followed by a range of sensitivity analysis.

NZ ETS market model updates and calibration

Updates since February

The Ministry for the Environment published updates to the market model in February 2025. These aligned to the second emissions reduction plan (ERP2), released in December 2024.

There are two main data updates since the February release.

- As noted under the seven-step methodology, industrial allocation forecasts have been revised further. This accounts for the latest actual allocation data (for 2023) and for updated assumptions about business output.
- A revised surplus stockpile estimate and related total stockpile data for the December 2024 quarter. The model now refers to this 2024 estimate as the starting point (it previously referred to the 2023 estimate).

The latest (May 2025) version of the market model incorporating these updates is available on request from the Ministry for the Environment – please contact etsconsultation@mfe.govt.nz. Because the model is a macro-enabled Excel spreadsheet, we cannot make it available directly on our website.

Key model assumptions for 2025 NZ ETS settings analysis

Auction supply

On the 'Model' tab, the 'Status quo' unit settings option refers to status quo settings (ie, as set in regulations in 2024). 'CCC' refers to the settings proposed by He Pou a Rangi | Climate Change Commission (the Commission). This toggles both the unit settings (auction volumes and cost containment reserve volumes) and the price controls, although the latter are the same for both.

Both options include the 'for visibility' estimated auction volumes for 2031–35. For the Commission option, this has been derived by subtracting industrial allocation from the NZ ETS cap in the Commission's settings workbook for those years. Users may wish to test other auction profiles for these years.

Afforestation

We used ERP2 afforestation projections (excluding afforestation on Crown-owned land) as the main assumption for forestry supply. This is set by toggling cell B6 on the 'Model' tab to 'MPI Central'.

Using an exogenous assumption for forestry means that afforestation is not responsive to NZ ETS prices within the model. However, prices are generally projected to be around or above the estimated breakeven levels for forestry. They follow a similar price path as in ERP2, making these exogenous assumptions broadly consistent. Finally, the ERP2 afforestation projections are consistent with the policy to constrain conversion of farmland to exotic afforestation registered in the ETS.

As forestry plays such a significant role in the scheme, we also did sensitivity analysis using endogenous forestry projections. These are derived using a simplified version of the 'Manley' formula, which relates afforestation rates to prices. The main limitation of this approach is that the 'Manley' formula was derived based on analysis of data up to 2018, when prices were comparatively low, and therefore predicts relatively high rates of afforestation at current and expected price levels. To compensate for this known bias, we use the more conservative 'low' specification of the formula. We discuss the results of the analysis in this document.

Users can combine the 'Manley' endogenous response with an overall annual limit on afforestation if desired. This is set by cell B18. To disable this functionality, simply set the parameter value very high (>100,000).

Stockpile

The behaviour of holders of both 'surplus' and 'other' (non-surplus) stockpile units is a key source of uncertainty for NZ ETS market dynamics.

The total stockpile of New Zealand Units (NZUs) refers to all NZUs held in private accounts. The surplus stockpile is based on the updated methodology discussed in the consultation document. These variables are inputted for 2024 and then vary based on model outcomes in subsequent years.

The model assumes that surplus stockpile NZUs are drawn down first, and therefore the magnitude of the surplus influences the dynamics.

The other stockpile can also be made available to meet NZU demand. This key modelling choice is determined by the parameter controlling the transfer of stockpiled units to the surplus (liquid) stockpile (cell B13). It can be varied according to expectations of the stockpile's liquidity. For this analysis, we used 10% +/-1% for most scenarios. The exception was some of the 'no 2025 auction' scenarios. For these, a more liquid stockpile parameter (14 per cent) would be consistent with observed market dynamics that would lead to these auction outcomes.

We recommend using different values for this parameter as part of sensitivity analysis. Values between 5 and 20 per cent usually generate plausible results. The market model is quite sensitive to the liquidity parameter, which is not empirically testable. Therefore the recent practice has been to set it at a value that generates a broadly stable ratio of other stockpile units to compliance demand in the near term (up to 2035).

In April 2025, the Ministry for the Environment conducted a survey to better understand NZU private holdings (commonly referred to as the 'stockpile'). The survey was aimed at improving understanding of the distribution of NZUs across different types of participants, better understanding the hedging and holding behaviour of participants with surrender and compliance obligations and exploring the intentions for use of NZUs not tied to obligations. Insights from the survey, which were still being collated at the start of the ETS settings consultation, will help improve our understanding of stockpile dynamics in the future. Specifically, it may help us refine some of the assumptions and approaches above.

NZU demand response to price

The aggregate demand response to prices in the model is derived from Emissions in New Zealand (ENZ) model.[1] It is an autoregressive function that incorporates both a change element (response to annual price changes) and a momentum element (longer-run impacts, eg, from investment).

To test sensitivity and to construct error ranges, particularly for total net emissions projections, we used the standard errors of the coefficients. This includes applying +/- one standard error for smaller changes in responsiveness, or using the 95 per cent confidence intervals (ie, +/- 1.96 standard error) for larger changes.

Simulating 2025 auctions not clearing

Some scenarios note that we exogenously set the 2025 price to simulate current secondary market prices and 2025 auctions not clearing. To simulate this, go to cell C10 in the 'Prices' sheet, and set it as desired. We used either:

- $60.00 in 2023 dollar terms, equivalent to about $63.50 in 2025 nominal terms (the average price up to the March auction) or
- $47.30 in 2023 dollar terms, equivalent to about $50 in 2025 nominal terms (the prevailing spot price in late April/early May).

[1] See the ERP2 technical annex for further information on the ENZ Model.

Set at any level below $63.65 (the auction price floor of $68 converted to 2023 dollars) means that the:

- 2025 auction volume is not sold in the model
- endogenously determined price change applies from this year forward.

An alternative approach is to set the 2025 auction volume in the 'Govt supply' sheet (to zero, or a volume representing partial clearance). However, this may not have an internally consistent price.

To simulate unsold auction volumes re-entering the market in later years, the unsold volume must be manually added on to the later years in the 'Govt supply' sheet. We typically assigned all this volume to 2029 and 2030.

Methodology for estimating total net emissions

The market model was not designed to estimate total net emissions – its focus is on net emissions covered by the scheme. However, the projections can be combined with other information to make a high-level projection of total net emissions. This can help with assessing whether a given combination of unit and price control settings accords with emissions budgets. Two additional sources of information/assumptions are needed:

1. **An estimate of emissions outside the NZ ETS (mostly agriculture)**
   ERP2 projections are primarily used to estimate non-ETS sector emissions. These projections also capture estimates of the impact on removals of afforestation on Crown-owned land policy.
2. **A conversion of 'low-risk' forestry NZUs to total 'target' accounting removals**[2]
   Not all emissions removals are within the scheme, and the accounting treatment for some forestry units differs between the NZ ETS and 'target' accounting used for emissions budgets. This means the market model projections of 'low-risk' forestry NZUs usually underestimate removals that contribute towards the budgets. To adjust for this, an estimate of total removals is made by scaling up projected low-risk forestry units. The scaling factor has been set by comparing MPI's low-risk forestry removals projections with total removals projections (which are calculated with consistent information).

Net emissions are calculated as the total demand for NZUs (ie, gross emissions in NZ ETS sectors) plus non-ETS sector emissions less total removals.

These point estimates are subject to a high degree of uncertainty. They should be tested together with sensitivity tests. Varying the stockpile liquidity or the price responsiveness parameters are good ways of doing this.

In advice to support final decisions, we intend to estimate net emissions impacts using both the market model and the broader-based ENZ model (which was used to support ERP2).

[2] We acknowledge that this approach has limitations, and are working on ways to more accurately translate the model afforestation projections into removals projections.

2025 NZ ETS unit and price controls analysis

Scenarios for consultation document analysis

We used selected scenarios in the consultation document (see section on 'Implications of the options for market dynamics and emissions budgets') to highlight the implications and trade-offs of the two options. We outline the scenarios here, with figures.

Proposed options

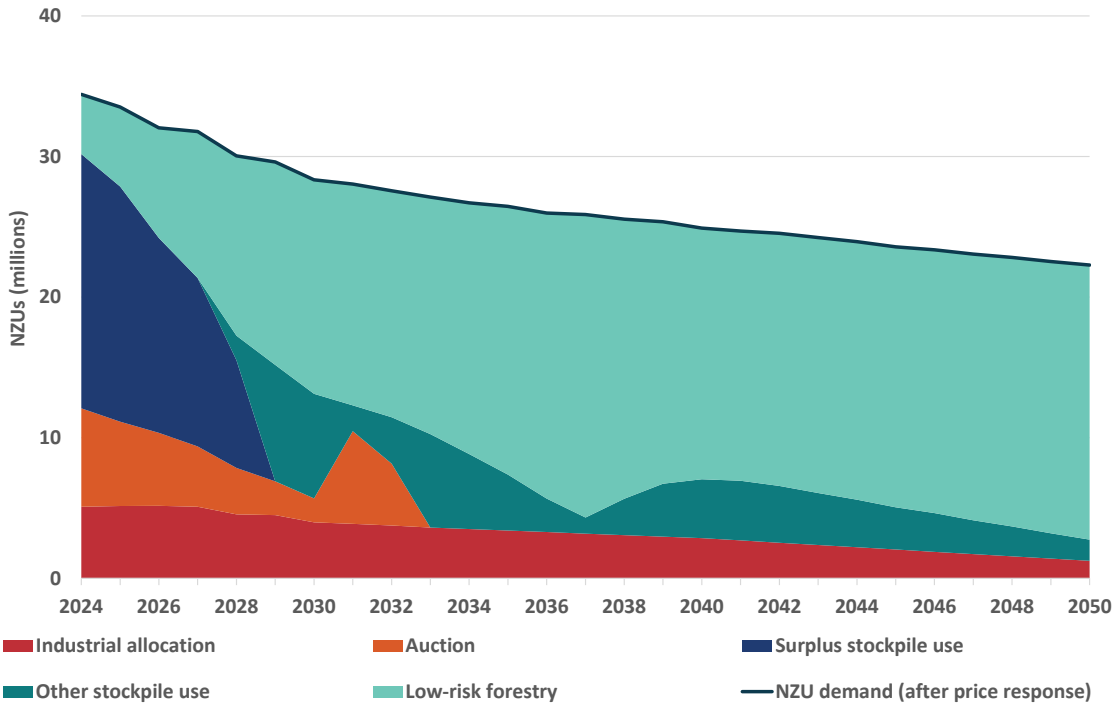
The options in the consultation document are:

- option 1: Status quo auction volumes.
- option 2: Commission-recommended auction volumes (ie, higher volumes).

Projected sources of NZU supply

Figure 4 in the consultation document (replicated below as figure A) showed projected sources of supply under **option 1 (status quo unit and price control settings**). This scenario assumed that 2025 auctions would clear with a starting price just above the price floor and used the ERP2 afforestation projections. We used the central surplus estimate and the slightly higher other stockpile liquidity parameter of 11 per cent.

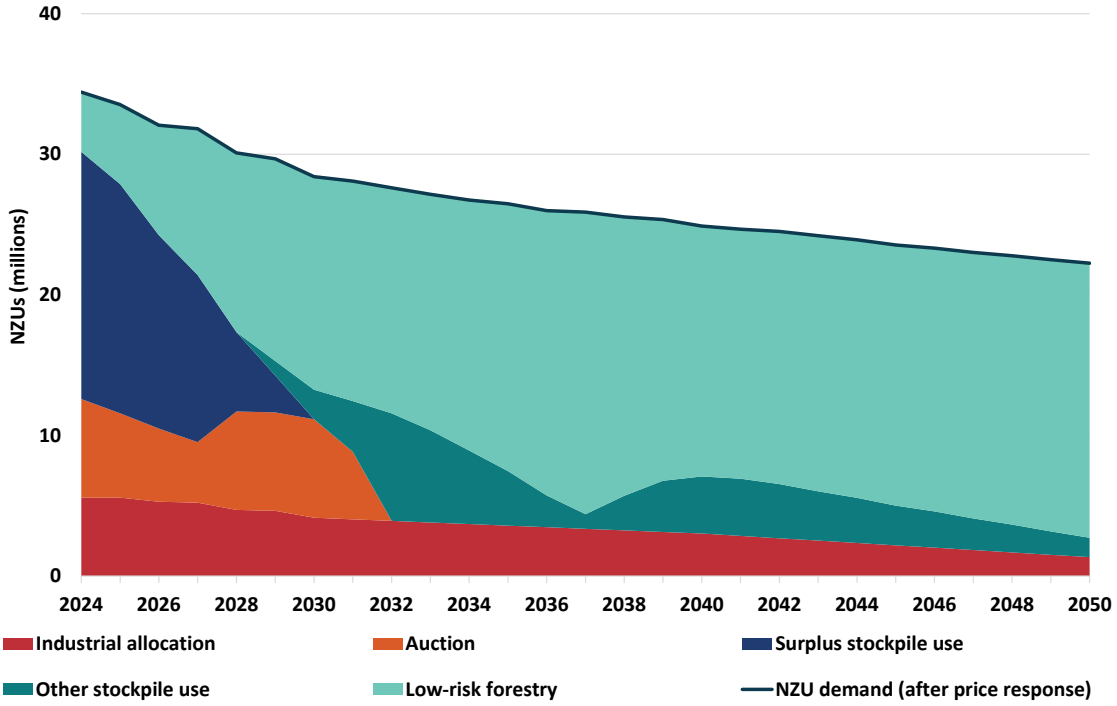
Figure A: Projected dynamics under option 1 (status quo) unit and price control settings



Source: Ministry for the Environment

Figure B below shows the equivalent sources of supply for **option 2 (Commission recommendation)**, using the same assumptions as above. The key difference is that the higher auction volume in 2028–30 replaces some of the 'other stockpile' use under option 1. This reduces upward pressure on prices relative to option 1.

Figure B: Projected dynamics under option 2 (Commission recommended) unit and price control settings



Source: Ministry for the Environment

Implications for projected prices

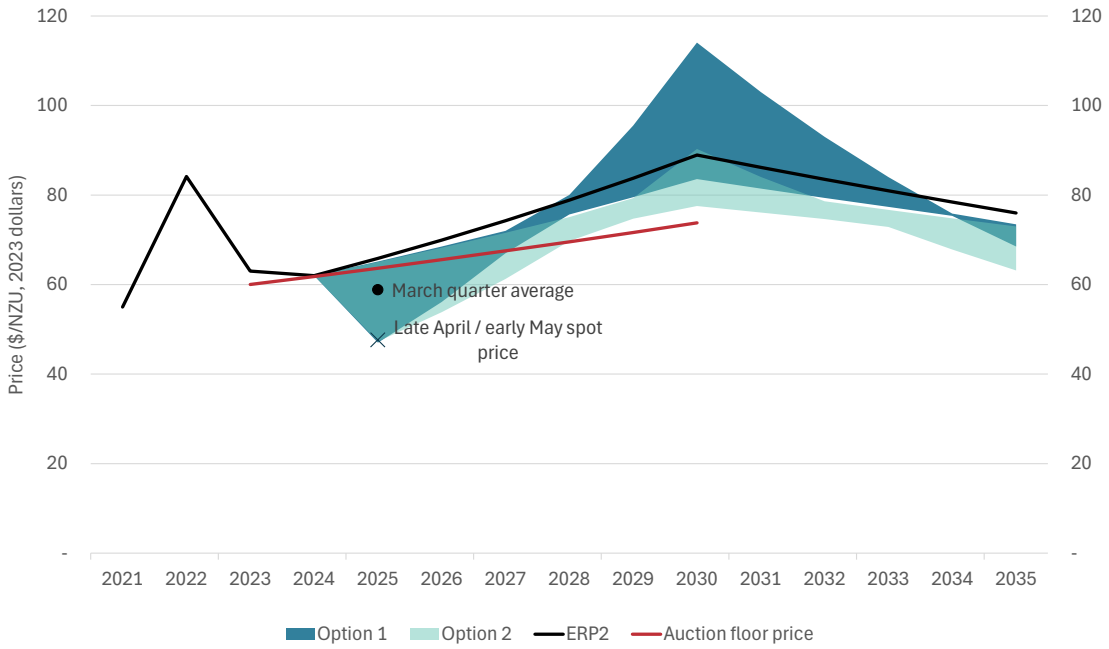
The consultation document then shows implications for projected prices of different scenarios (see section on 'Implications for projected prices'). In addition to the two scenarios described above, the price ranges also include additional scenarios for both option 1 and 2. In these additional scenarios, the 2025 price was set at the spot price prevailing in late April/early May of around $50 ($47.30 in 2023 dollar terms) and therefore 2025 auctions do not clear.

These additional scenarios have low prices in the near term but a higher peak price in 2030. This is particularly high under option 1, largely because of the different treatment of unsold 2025 auction volume. Under option 2, the unsold auction volume in early years is added back to 2029 and 2030, similar to the treatment of 2024 unsold auction volumes in the Commission's advice. This dampens the price response because overall supply volumes are largely unchanged. Under option 1, the unsold 2025 auction volume is assumed to be permanently lost,[3] which in turn puts upward pressure on prices.

[3] This is a modelling assumption rather than a policy position. However, treating the unsold auction volume as permanently lost is consistent with keeping status quo auction volumes.

Figures 5 and 6 in the consultation document then smooth the price ranges to avoid spurious accuracy. For transparency figure C below shows the unsmoothed ranges. Note the ranges of the two options overlap (the teal area).

Figure C: Projected price paths under option 1 (status quo) and option 2 (Commission recommendation)



Source: Ministry for the Environment

Implications for total net emissions projections

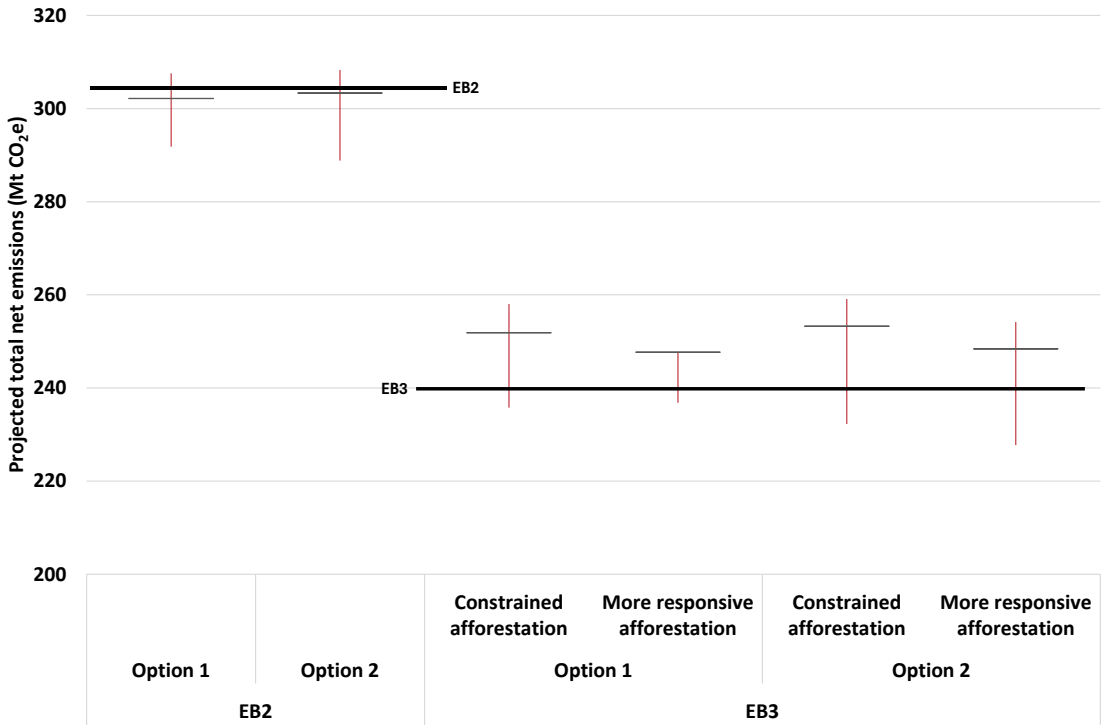
The section on 'Implications for total net emissions projections' in the consultation document outlines estimates of total net emissions. As in the section on methodology, these estimates are subject to a high degree of uncertainty. They are communicated within ranges constructed from sensitivity analysis based on the price responsiveness ranges.

There is little variation in projections of emissions in the second emissions budget (EB2) across almost all scenarios (although the risk posed by the stockpile varies significantly). For emissions in the third emissions budget (EB3), the responsiveness of forestry to prices causes more material variation in the projections. We describe forestry responsiveness further in the 'Sensitivity analysis' section. To illustrate this impact, the scenarios used to show potential implications are:

- option 1 and 2 with 2025 price set to the prevailing spot price (ie, 2025 auctions do not clear), and using **ERP2 afforestation projections**. These are the same scenarios as in the previous section on the price range.
- option 1 and 2 with 2025 price set to the prevailing spot price (ie, 2025 auctions do not clear), and using **endogenous and unconstrained afforestation projections**.

To simplify figure 7 in the consultation document (replicated below as figure D), the net emissions projections of the second pair of scenarios is only shown for EB3. EB2 emissions for these scenarios are similar to those using ERP2 afforestation projections (left side of figure).

Figure D: Projected total net emissions in the second and third emissions budgets



Source: Ministry for the Environment

Sensitivity analysis

The section on model assumptions highlights some of the areas where sensitivity analysis is appropriate. This section focuses on four sensitivities.

2025 starting conditions and auction clearance

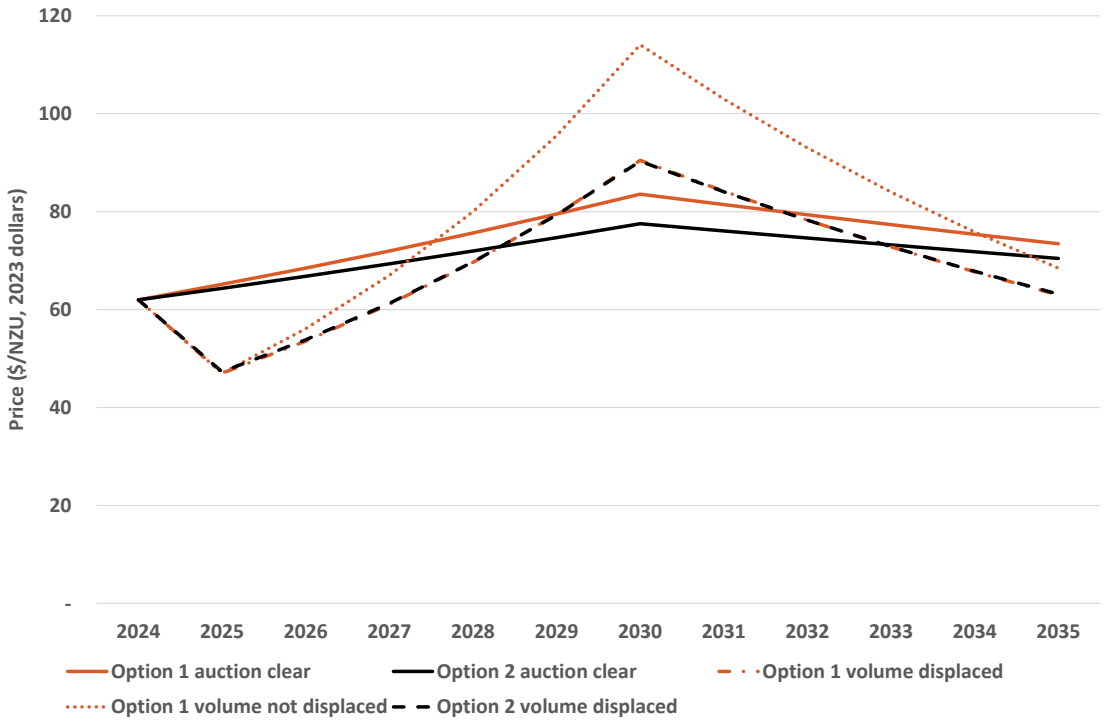
After a period of stability, secondary market NZU spot prices declined to around $50 in early May. If prices remain around these levels, auctions in 2025 are unlikely to clear.

To test the sensitivity of the settings options to this uncertainty, we simulated the market model using exogenous price assumptions for 2025, and different treatment of the unsold auction volumes. In the latter, unsold auction volumes are either displaced to later years of the settings period or are assumed to be removed permanently (option 1 only).

In these scenarios, prices are projected to be lower in the near term but higher in the longer term (figure E). The unsold volume treatment makes a material difference. If unsold auction volume is displaced to later years, the projected mix of supply changes over time, with greater stockpile drawdown in early years of the settings period, followed by increased auction supply in later years. The expected impact on prices is relatively modest, as the overall quantum of supply is largely unaffected.

By contrast, if unsold auction volumes are permanently removed, this tightens supply and puts greater upward pressure on prices, especially if there is no or limited offsetting afforestation response.

Figure E: Projected price paths with 2025 price set to current spot prices



Source: Ministry for the Environment
Note: 'Option 1 volume displaced' and 'Option 2 volumed displaced' overlap each other

Surplus stockpile estimate and stockpile liquidity

Surplus stockpile estimate

The initial surplus stockpile provides a source of NZUs for market participants to meet their emissions obligations. As a result it can influence projected NZ ETS dynamics and price paths. A larger surplus stockpile puts downward pressure on prices. A reverse effect is expected for a smaller surplus.

We tested the sensitivity of modelled outputs for two lower and two upper bound surplus stockpile estimates. These took the outer bounds of the estimate (28.4 million (M) and 67.7M) plus two intermediate estimates halfway between the central and outer bounds (39.3M and 58.9M).

- Status quo settings (option 1) are more sensitive to both lower and upper bound estimates. Together, lower auction volumes than option 2 and a lower initial surplus drive relatively higher prices. Conversely, a high initial surplus lessens the upward pressure on prices.
- Settings option 2 is less sensitive to the estimates. Price paths under all estimates except the extreme lower bound estimate stabilise around the price path of the central estimate.

Stockpile liquidity

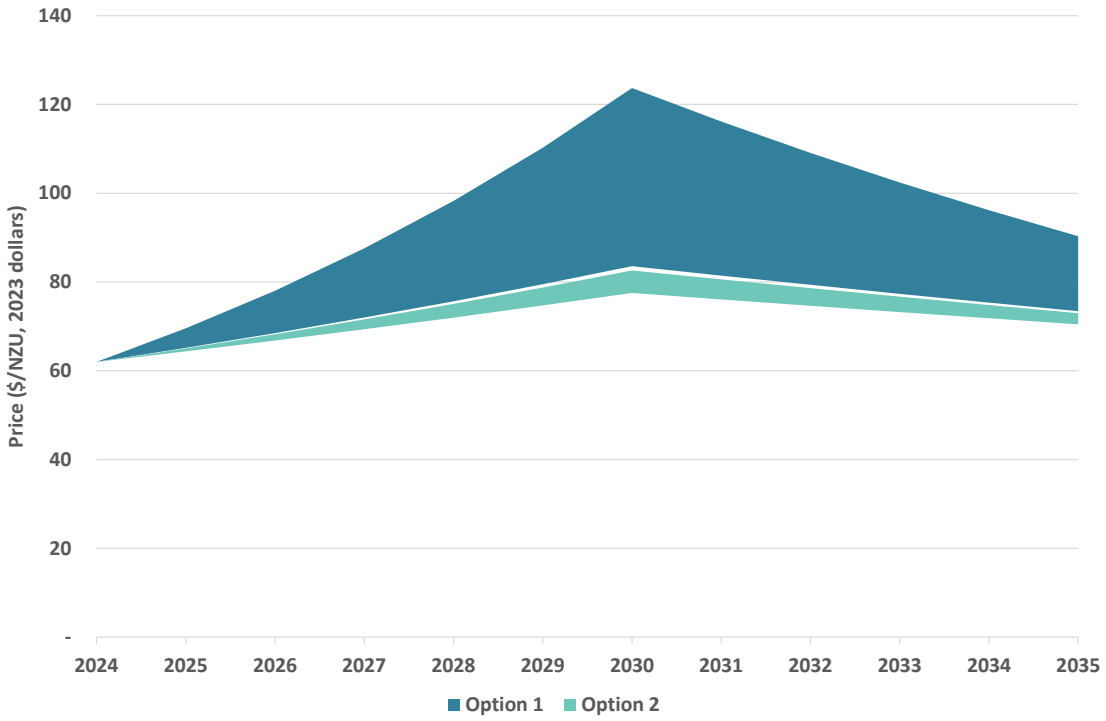
Impacts of the settings are partly conditional on participants' decisions to use stockpiled units to meet their annual emissions obligations. Participants choose to do this to maximise their current and future benefits, using information available to them including the expected NZU price.

If participants expect prices to increase at a slower rate than the cost of capital, both foresters and compliance participants have less incentive to hedge their future requirements, and there is less incentive to hold NZUs as a financial asset. There will be some limits to this – the compliance penalties are sufficiently stringent that participants are unlikely to be fully unhedged. But on balance, some units in the stockpile are likely to become available to the market if prices are not trending steadily higher.

As there will be a spectrum of liquidity in the stockpile, we tested the sensitivity of settings options to this issue by using different liquidity parameters. Figure F below shows the projected price path from the central and higher liquidity scenarios.

- Status quo settings show a wide gap between high and low liquidity price paths, and higher sensitivity to the stockpile liquidity parameter. Together, lower auction supply under the status quo and lower liquidity of surplus stockpile drive higher prices to draw from the other stockpile, to meet outstanding demand for NZUs.
- Option 2 shows less sensitivity. This is apparent from the observed narrow gap between low and high liquidity price paths. Greater supply from auctions, irrespective of stockpile liquidity, gives rise to moderate changes in price.

Figure F: Price path scenarios under high and low liquidity



Source: Ministry for the Environment

Most of the modelling in this document shares a common assumption that prices will stay (or return to) above the floor price to release some auction volume to the market. However, latest secondary market spot prices and the corresponding forward and futures curves are sitting

considerably lower than the auction price floor. Taken at face value, this would indicate that expected forestry supply, stockpile use and industrial allocation would be sufficient to match compliance demand with no further auctioned units. This can be approximated in the market model by setting a very high liquidity parameter such that the price does not lift above the auction floor. These conditions imply a very large drawdown of the total stockpile, to under 30M NZUs from the 2030s onwards, unless there was additional forestry supply and/or faster reductions in compliance demand than anticipated.

The responsiveness of afforestation to price signals

Afforestation has historically been quite responsive to NZ ETS prices. The policy to restrict the conversion of farmland to exotic forestry registered in the scheme may curb this responsiveness. As noted earlier, this is one factor behind using the ERP2 central afforestation projections as the main forestry assumption.

To test the implications of afforestation being more responsive to price signals, we ran the market model with the endogenous forestry response based on the 'Manley' formula.[4] Because projected prices are generally above the levels needed to incentivise afforestation, these scenarios result, on average, in higher afforestation rates than the ERP2 central projections, although lower than the upper projections.

This has two main implications.

1. Higher future forestry supply puts greater downward pressure on prices (relative to comparable scenarios where afforestation is constrained) and reduces the need for stockpile drawdown.
2. Faster afforestation leads to increased removals, particularly from EB3 onwards. This effect is potentially quite material – amounting to 4–5Mt CO_2e in EB3 in the scenarios modelled.

Cyclical versus constant price path

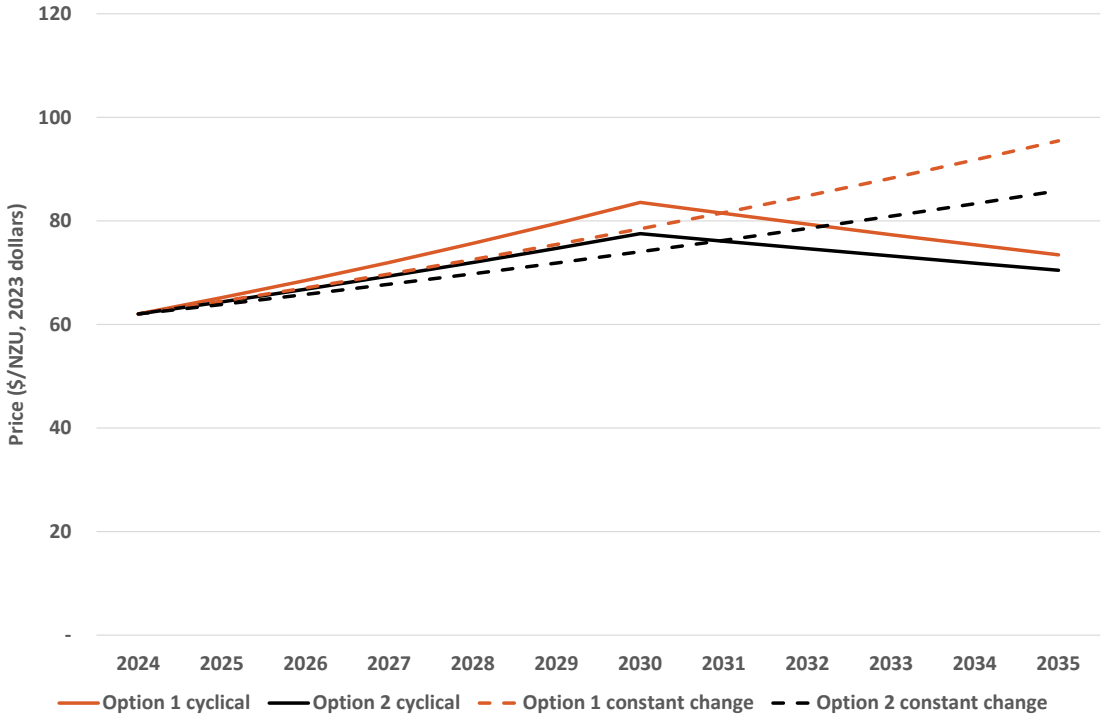
Most of the scenarios assume that prices will be generally increasing over the 2020s, then falling from the 2030s onwards. This reflects a view that prices must be high enough in the shorter term to release auction volumes and to induce enough stockpile drawdown in order to meet compliance demand while forestry supply is relatively low. Over the longer term, growing forestry supply will exert downward pressure on prices. The timing of this turning point is imposed on the model (i.e. the magnitude of the peak is endogenously determined).

An alternative approach is to allow the model to endogenously determine a price path based on a constant price change assumption (figure G). This may be feasible if the policy restricting exotic forestry registering in the scheme acts as an enduring and binding cap on afforestation, preventing additional afforestation from curbing prices. Total net emissions projections for EB2 and EB3 are relatively insensitive to this alternative approach. This is because modelled gross emissions are relatively inelastic and respond slowly to price signals, and afforestation has

[4] The 'Manley' model was developed by Professor Bruce Manley of University of Canterbury to relate afforestation rates to ETS prices and a range of other relevant factors such as land and log prices. The market model uses a simplified version of the formula to estimate the afforestation response. See the Afforestation section under key model assumptions for further details.

been exogenously imposed to reflect policy constraints, preventing afforestation and therefore removals from responding to the price signal.

Figure G: Cyclical vs constant price change paths



Source: Ministry for the Environment