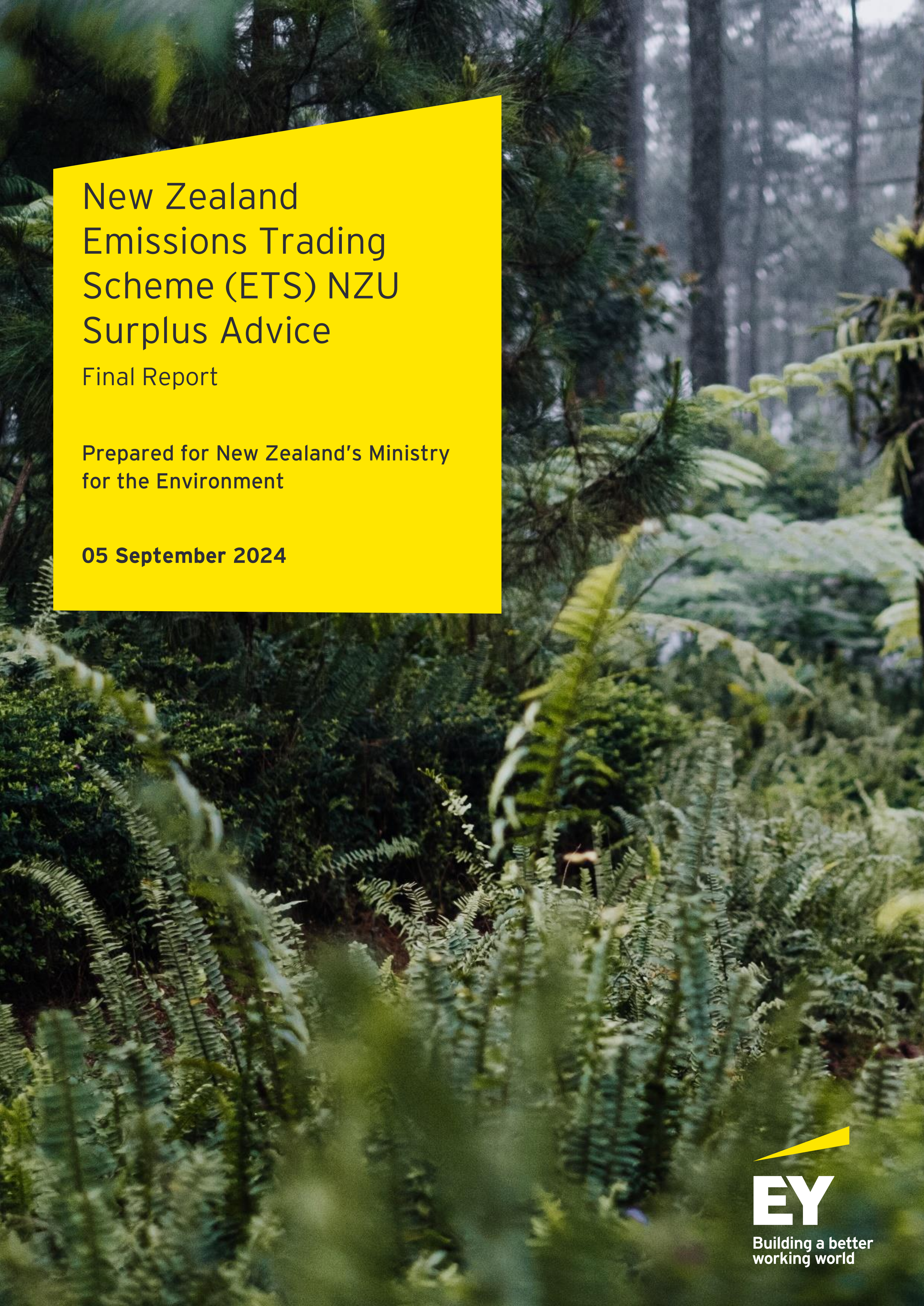

New Zealand Emissions Trading Scheme (ETS) NZU Surplus Advice

Final Report

Prepared for New Zealand's Ministry for the Environment

05 September 2024

Building a better working world

Release Notice

Ernst & Young (EY) New Zealand was engaged on the instructions of Ministry for Environment (MfE) (Client) to assess MfE's analysis of the NZ ETS stockpile 'surplus' ("Project"), in accordance with the Consultancy Services Order dated 24 June 2024.

The results of EY's work, including the assumptions and qualifications made in preparing the report, are set out in this report ("Report"). The Report should be read in its entirety including the transmittal letter, the applicable scope of the work and any limitations. A reference to the Report includes any part of the Report.

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Table of contents

1. Executive summary

1.1 Background and scope

Under the Climate Change Response Act (the Act), the Climate Change Commission (CCC) must provide annual advice to the Minister of Climate Change (Minister) on the settings of the New Zealand Emissions Trading Scheme (NZ ETS), focusing on two areas: adjustments to limits on the number of units in the scheme, and to the auction price control settings.[1] The Minister is then required to recommend NZ ETS settings to Cabinet and these settings must support New Zealand in meeting its emissions budgets, New Zealand's Nationally Determined Contribution (NDC) under the Paris Agreement, and the 2050 emissions reduction target.[2] The Ministry for the Environment (MfE) provides advice to support the Minister in taking these recommendations to Cabinet. The adaptive management framework, which sees these decisions made annually, was established due to the uncertainty inherent in projecting emissions and forecasting unit flows and means that new data can be considered each year to update forecasts and projections.

In February 2024 the CCC released its advice covering the period 2025-2029 and recommended a significant reduction in auction volumes and flagged concerns affecting the ongoing effectiveness of the NZ ETS.[3] A particular focus of their advice was the large volume of NZUs which have built up in private accounts, and the impact of these units on the ability of the scheme to meet its legislative objectives in the future.

As well as considering the CCC advice, MfE have also run a public consultation on proposals for NZ ETS settings.[4] MfE is currently in the process of considering the public consultation feedback, the CCC advice and their own internal analysis in order to advise Ministers about their upcoming NZ ETS settings decision. The Government must make decisions on the NZ ETS unit limits and price control settings in time for the regulations to be updated by 30 September 2024.

MfE sought EY New Zealand's assessment on the analysis of the NZ ETS stockpile 'surplus'. The 'stockpile' of units within the ETS refers to large quantity of units (NZUs) that has accumulated in private registry accounts. Of these stockpiled units, there is a significant 'surplus' of units that are held by participants. All units within this stockpile are considered surplus except for units that are:

- Held for forestry harvest liabilities.
- P90 units held long-term, or
- Held by emitters for hedging purposes.

Surplus units present a risk to achieving emissions budgets as they may enable emissions to exceed these. The Government strives to manage this risk through the NZ ETS unit limit settings, by reducing auction volumes and requiring drawdown of these surplus units to meet surrender obligations.[5]

In engaging EY New Zealand to perform this work, in particular MfE were interested in EY New Zealand's assessment on the:

- Methodology for estimation that MfE is planning to use.
- Assumptions required within this methodology.
- Sensitivity of the stockpile forecast to a range of modelling inputs.

For the avoidance of doubt, EY New Zealand was not involved in discussions with Ministers, nor did EY New Zealand see or assess any advice to Ministers about the NZ ETS settings. Decisions about NZ ETS auction settings will be made by Cabinet and considerations relating to the stockpile 'surplus' will likely form only part of this decision-making process. While MfE shared some updated data points with EY New Zealand and held workshops with EY New Zealand to discuss their methodology, most of the information assessed by EY New Zealand for this project had already been made publicly available by either the CCC and/or MfE.

[1] Climate Change Response Act 2002, s 5ZOA.
[2] Climate Change Response Act 2002, s 30GC.
[3] *Advice on NZ ETS unit limits and price control settings for 2025-2029*, Climate Change Commission, February 2024.
[4] *Annual updates to New Zealand Emissions Trading Scheme limits and price control settings for units 2024 – Consultation Document*, Ministry for the Environment, May 2024.
[5] *Advice on NZ ETS unit limits and price control settings for 2023-2027*, Climate Change Commission, July 2022.

1.2 Method

The EY New Zealand team followed the approach outlined below in carrying out this work:

1. Gained an understanding of the Commission's and MfE's analysis on the stockpile 'surplus' by:

    - Assessing documents provided.
    - Holding interviews and walkthroughs with MfE and the Commission.

2. Interrogated the analysis by each stockpile 'surplus' component. Specifically, we sought answers to the below questions through both qualitative and quantitative means:

    - Are the methodologies applied appropriate?
    - Are there any issues with the methodologies used in the analysis?
    - Are there any more suitable methodologies that could be used?
    - Do the assumptions made make sense?
    - Are the assumptions appropriate?
    - Are the calculations accurate and do they align with the methodologies and assumptions documented?
    - Which methods and assumptions have the biggest impact on the outcomes and how sensitive are the outcomes to changes in these methods and assumptions?

1.3 Summary of findings and implications on decision making

MfE estimate 'surplus' units by subtracting three categories of units off the stockpile total as these units are not considered 'surplus':

- Units held for post-1989 forest harvest liabilities (P89 units).
- Pre-1990 forest allocation units held long term (P90 units).
- Units held for hedging by emitters (Hedging units).

We have classified the findings we have identified in this report as either over-estimating or under-estimating one of the three components listed above. An over-estimation of these components reflects an under-estimation of the 'surplus', all else being equal. Beyond these components there are other drivers of 'surplus' volume.

MfE has made three estimates of 'surplus' units – a small, central and large case. In general, the EY New Zealand team found the methodologies applied to determine the P89, P90 and Hedging unit estimates to be appropriate and calculations can be accurately related back to the methodologies and assumptions. The EY New Zealand Team identified opportunities for future potential enhancements to the methods and assumptions in relation to the P89 and Hedging unit estimates which are outlined in Table 1. If these can be affirmed, tested and potentially further developed by officials, these enhancements could be considered for inclusion within future assessments of the NZ ETS stockpile components. Some further enhancements could include the use of more granular data to support more sophisticated harvest age weighting approaches in relation to P89 units, or including a consideration of intra-year holdings when determining hedging unit volumes. These potential enhancements suggest larger liabilities are possible and therefore, all else being equal, a smaller surplus number.

We note that we have detailed only our view of the consequences of under-estimation for each component because the consequences for the NZU market of over-estimation are similar in each case. Over-estimating the volumes of any/all of these components would reduce the forecast size of the NZU surplus in the secondary market and (again all else being equal) allow greater auction volumes to be made available. Over-estimations for any of these components may therefore suppress NZU prices below where they might otherwise have traded.

The following are considered important points to understand in reading and interpreting this advice:

- Considerations about the surplus volume are just one of a range of important drivers for decisions about the final NZ ETS auction volumes. For example, decisions about auction volumes need to be taken together with auction price control settings.
- There is considerable uncertainty in the NZU surplus volume estimates developed by both MfE and EY. This means that it is critical to consider not only the central case values, but also how the uncertainty will be managed as more information about the stockpile becomes available in the coming years.
- Particular care must be taken in moving auction volumes in the direction suggested by a smaller surplus number. This is because of the one-sided nature of the market influence that the auction platform affords the government. The auction platform cannot remove NZUs from circulation in the secondary market, it can only supply them.
- The annual adaptive management framework provides an opportunity to adjust auction volumes every year. This provides the ability to refine these estimates over time as more information becomes available.

Table 1 Summary of findings and indication of potential implications for future decision-making

Stockpile compo-nent	MfE estimate NZU millions (20 June)	MfE estimate NZU millions (11 July)	The EY New Zealand team's estimate NZU millions	Findings for input into future decision-making processes about NZU surplus estimates	Potential consequences of under-estimating these volumes
P90 units	Large: 5.0 Central: 3.7 Small: 1.4	Large: 12.5 Central: 7.0 Small: 3.9	Large: 12.5 Central: 7.0 Small: 3.9	The EY New Zealand team considered the initial range estimated by MfE as too narrow for the scale of uncertainties that this estimate is exposed to. The initial central case estimated a faster transfer based on a more recent transfer trend. The update to consider a slower earlier trend period for the central case and a larger range of potential outcomes is considered appropriate by the EY New Zealand team.	Under-estimating this volume could lead to slightly higher NZU prices. The price impact of any volume under-estimate would be limited by the relatively small volume of P90 units in the market, as well as the ability of P90 holders to respond to higher prices by selling additional units.
P89 units	Large: 65.0 Central: 58.0 Small: 51.0	Large: 65.0 Central: 58.0 Small: 51.0	Large: 72.0 Central: 66.8 Small: 64.2	The EY New Zealand team considers MfE's general methodology in calculating P89 units to be appropriate. Likewise, the EY New Zealand team did not identify any calculation errors in the Forestry Model that has been used as a basis for MfE's estimate. However, currently, MfE considers only one level of 'safe' carbon in determining its estimation range. Additionally, the method considers a range of harvest age assumptions but does not weight these based on historic average harvest ages in determining the central case or range. The EY New Zealand team's assessment is that these potential enhancements suggest larger liabilities are possible and therefore, all else being equal, a smaller surplus number for each of the small, central and large cases.	Under-estimating this volume could lead to moderately higher NZU prices. The P89 harvest liability is a large proportion of the stockpile volume and so, on a first-order basis, under-estimating its volume could be assumed to produce substantially higher NZU prices. However, if higher NZU prices were to eventuate in the market then some P89 forest owners could change the management of their forests to free up more saleable NZU volume. These changes in management practice could include harvesting at a later date or converting rotational harvest forests into permanent carbon forests. Either of these actions, or a combination of them, would free up more NZU supply and allow NZU prices to soften leading to a moderated overall price impact.
Hedging units	Large: 35.7 Central: 27.7 Small: 19.4	Large: 35.7 Central: 27.7 Small: 19.4	Large: 39.8 Central: 33.7 Small: 27.3	Whilst the EY New Zealand team generally considers MfE's calculation methodology for calculating hedging unit volume appropriate, MfE currently only considers the steady-state hedging units that each emitting sector holds to manage price risks in meeting forward product sale commitments. It does not consider the additional 'holding' volumes built up from January until their surrender in May the following year. The EY New Zealand team's assessment is that the central case steady-state hedging volume could be about 3.8 million units lower than MfE's estimate because of lower hedging demand within the LFF sector. However, this reduction in steady-state hedging volume may be offset by additional demand for intra-year holdings that can vary between 9.8-39.2 million units in different months. The implications of these intra-year holding volumes will be muted when the NZ ETS has ample	Under-estimating this volume could, in the longer term as/if the NZU stockpile is drawn down, lead to substantial spikes in NZ ETS prices. This is because these hedging/holding volumes are key price risk management tools for compliance buyers. Compliance buyers would therefore likely need to be paid high NZU prices before they would consider releasing this volume into the secondary market. For some compliance buyers, it might not be possible to release this volume at any price as doing so would compromise their internal price risk management policies.

Stockpile compo-nent	MfE estimate NZU millions (20 June)	MfE estimate NZU millions (11 July)	The EY New Zealand team's estimate NZU millions	Findings for input into future decision-making processes about NZU surplus estimates	Potential consequences of under-estimating these volumes
				annual volumes of supply, either from auctions and/or saleable forestry NZUs.	

Table 2 Total impact of findings on stockpile units considered surplus.

MfE estimate NZU millions (20 June)	MfE estimate NZU millions (11 July)	The EY New Zealand team's estimate NZU millions	The EY New Zealand team's estimate's variance from MfE (11/07)
Small: 37.4 Central: 53.7 Large: 71.2	Small: 46.8 Central: 67.3 Large: 85.6	Small: 35.6 Central: 52.4 Large: 64.5	Small: -11.1 million NZU / 23.8% Central: -14.9 million NZU / 22.1% Large: -21.1 million NZU / 24.6%

In summary, due to our findings in relation to MfE's calculations for both P89 units and Hedging units, the EY New Zealand team's estimated 'surplus' of stockpile units is smaller than MfE's calculated 'surplus'. For P89 units held for harvest liability, weighting the average harvest age based on historic data, as well as accounting for varying levels of 'safe carbon' within small and large estimates results in a decrease in the surplus stockpile volume. Additionally, adjustments to the LFF hedging assumption to lessen the volume of annual compliance demand and account for minimum intra-year holding volume has a similar effect on the 'surplus' stockpile volume, further increasing the variance calculated.

As a result of the annual adaptive management framework in the NZ ETS, there is an opportunity to adjust auction volumes every year and correct for an overestimation of 'surplus' units in prior years. Additionally, P89 and P90 unit holders have the ability to respond to changes in the supply of auction units and price of NZUs through decisions about whether to buy, sell and for P89 holders, harvest. Hedging unit holders do not have the ability to respond as quickly to any changes in supply and/or price but as stated, the adaptive management framework provides a mechanism to enable volumes to be adjusted before any significant issues with availability of hedging units arises. As/if the surplus is drawn down over the coming years, the importance of getting an accurate surplus calculation will increase because the hedging/holding volumes will become a much more material component of the overall stockpile volume. However, as/if the stockpile were to reduce over the coming years, the volume uncertainties presented by the P90 and P89 components are likely to diminish as more data about these components becomes available.

2. P90 Analysis and findings

2.1 Analysis performed

Outlined below is the process that the EY New Zealand team applied to analyse and assess the methodology for estimation, assumptions and appropriateness of the central case estimate and range for P90 units:

- Assessed the CCC's Technical Annex 1[6] to understand assumptions and methods applied.
- Assessed MfE's ETS setting workbook and calculations to understand in practice how historic data has been used to inform estimates.

2.2 Findings

2.2.1 Methodology for estimation

The initial estimates (as at 20/06/2024) assessed by the EY New Zealand team were calculated by MfE as follows:

- Large: Used the trend line for P90 Unit holdings from Q4 2022 to Q2 2024 to estimate transfer rate.
- Central: Used the trend line for P90 Unit holdings from Q1 2021 to Q2 2024 to estimate transfer rate.
- Small: Used the trend line for P90 Unit holdings from Q1 2020 to Q2 2024 to estimate transfer rate.

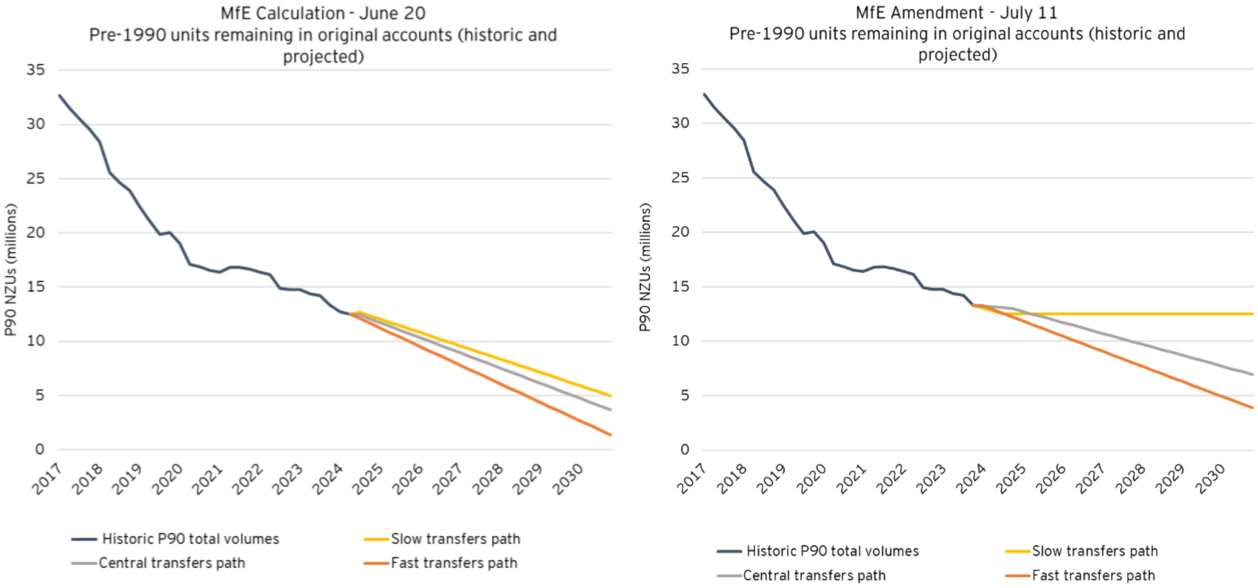
The differences between the small, central and large P90 unit estimates that this methodology delivered were small. The EY New Zealand team raised the question with MfE that the range considered could be too narrow given the uncertainty inherent in the estimate and suggested widening the range.

MfE amended these methodologies per below and in doing so widened the range of estimates. Transfer rates in 2024 were assumed to be anomalous (faster than the trend would otherwise suggest) and ignored in estimating the central and small cases:

- Large: Assumes no transfers since prior period e.g., P90 Units held long term remains constant at 2024 Q2 number.
- Central: Used the trend line for P90 Unit holdings from Q2 2020 to Q4 2023 to estimate transfer rate.
- Small: Used the trend line for P90 Unit holdings from Q4 2022 to Q4 2023 to estimate transfer rate.

[6] *Advice on NZ ETS unit limits and price control settings for 2025-2029, Technical Annex 1: Unit Limit Settings*, He Pou a Rangi (Climate Change Commission), February 2024.

Figure 1 MfE P90 unit transfer path calculations[7]



Source: Reproduced by EY from MfE analysis

2.2.2 Assumptions

MfE initially assumed in its central estimate that the transfer of P90 Units in the future would follow the rate over the period Q1 2021 to Q2 2024. This was updated to take the rate over the period Q2 2020 to Q4 2023. This reflects MfE's view that the faster transfer rate observed over the last three and a half years is a better predicter of future transfer rates than the slower transfer rate observed longer-term. It also reflects MfE's view that the rate observed in 2024 was anomalous and that it should not be considered in determining the small and central cases.

2.2.3 The EY New Zealand team's view on central case and range

The EY New Zealand team considered the initial range too narrow for the breadth of uncertainties that this estimate is exposed to. The initial central case estimated a faster transfer based on a short recent transfer trend. The update to consider a slower earlier trend period for the central case and a wider range of outcomes is considered appropriate by the EY New Zealand team. Equally, ignoring the rate in 2024 to determine the central case is deemed appropriate by the EY New Zealand team given the uncertainty experienced by the market because of policy uncertainty driving unusually large transfers in the first two quarters.[8]

[7] Slow transfer path in the graphs is equivalent to "Large" estimate and fast transfer path equivalent to the "Small" estimate.
[8] "New Zealand needs a strong and stable ETS", The Beehive, 6 December 2023.

3. P89 Analysis and findings

3.1 Analysis performed

Outlined below is the process that we have applied to analyse and assess the methodology for estimation, assumptions and appropriateness of ranges applied in determining units of P89 forest harvest liability:

- Gained understanding of the NZ ETS Forestry Model[9] methodology and assumptions.
- Assessed reasonableness of methodology and tested that model calculations are accurate.
- Assessed reasonableness of central case assumptions and tested that the model calculations aligned with these assumptions.
- Identified inputs into the model and determined whether the resulting variables are measured or estimated.
- Performed sensitivity analysis over the estimated variables.
- Developed 'extreme scenarios' to further test the appropriateness of ranges applied.

3.2 Findings

3.2.1 Methodology for estimation

MfE has used a Forestry Model developed by the Ministry for Primary Industries (MPI) with an overlay developed by the CCC to estimate the number of P89 Units held for harvest liabilities by foresters. This model is publicly available through the CCC's website. The overlay developed by the CCC has been used by MfE to vary inputs and develop a range of outputs that have then been used to develop the central, small and large cases.

The EY New Zealand team sense checked the model methodology and calculations and tested whether calculations were working as intended. Where raw data fed the model, the EY New Zealand team traced back the data to source. The EY New Zealand team did not identify any methodological issues, model inaccuracies or model misalignments with methods.

The EY New Zealand team did identify a potential improvement to considering a range of harvest ages in these estimations. MfE currently applies an average across the identified harvest ages instead of weighting the outcomes for different age assumptions based on the distribution of historic average harvest ages.

3.2.2 Assumptions

The key assumptions in estimating the number of P89 Units held for harvest liabilities by foresters are outlined below. The EY New Zealand team assessed the reasonableness of the central case assumptions and that the model calculations aligned with these assumptions.

Table 3 Forestry Model assumptions and reasonableness

Assumption	Description	Value in central case	Reasonableness assessment
Harvest percentage	Percentage of P89 hectares registered that will not be harvested. The more forest area that is harvested, the higher the volume of units within the P89 harvest liability.	80%	A University of Canterbury study carried out for the Ministry of Primary Industries in 2019 found 86% of P89 forests were harvested.[10] Recent trends and engagement with foresters undertaken by MPI indicate increasing intentions to not harvest due to increasing NZU prices.[11] 80% is assessed as reasonable given the above.

[9] "NZ ETS Forestry Model: Workbook", *NZ ETS unit limits and price control settings for 2025–2029,* He Pou a Rangi (Climate Change Commission), May 2024.
[10] *Intentions of forest owners following harvest of post-1989 forests*, University of Canterbury, 2018.
[11] "Technical Annex 1: Unit Limit Settings", *Advice on NZ ETS unit limits and price control settings for 2025-2029*, He Pou a Rangi (Climate Change Commission), February 2024.

Assumption	Description	Value in central case	Reasonableness assessment
Harvest age	The age at which a forest is harvested or the length of a forest rotation. The older the forest at harvest, the higher the volume of units within the P89 harvest liability.	N/A – an average is applied using these ages: 28, 29, 30, 31.	12% of annual average harvest ages since 1990 and until 2022 have been less than 28 and only 6% of annual average harvest ages since 1990 and until 2022 have been greater than 31, supporting the ages used by MfE in determining the central case[12].
'Safe' carbon amount	The amount of carbon sequestered by a forest that is considered 'safe' - i.e., the units that will not need to be surrendered due to residual carbon stored in roots underground. The more carbon assumed 'safe,' the lower the volume of units within the P89 harvest liability.	392tCO2/ha	MfE takes 85% of the theoretical maximum 'safe' carbon as the 'safe' carbon amount in their estimates. 'Safe' carbon levels increase for foresters with portfolios of forests of different age. 85% reflects that the majority of total hectares of forests registered in the NZ ETS are managed by large commercial forestry operators who have diverse forestry portfolios.[13] The 'safe' carbon amount is therefore assessed as reasonable.
Registrations in process that will be registered	Percentage of in process registrations under MERP 3 that are assumed to be successful. The higher the percentage of registrations assumed to be successful, the higher the volume of units within the P89 harvest liability.	87%	MPI expectations in December 2022 were that 80% of registrations would be approved. Data from 2023 showed that approvals had been higher than this original estimate.[14] Given the above the 87% assumption is assessed as reasonable.
Replant lag after harvest	Number of years between harvesting and replanting. The greater the harvest lag, the lower the volume of units within the P89 harvest liability.	1 year	One year planting lag is based on the ideal but could vary between one and two years.[15] One year is assessed as reasonable, especially given sensitivity analysis showed no material change if two years was assumed.

3.2.3 Sensitivity ranges

In order to undertake sensitivity analysis, inputs into the model were identified and assessed as either measured i.e., based on measurable data points, for example proportion of biomass removed at harvest, or estimated i.e., things that will happen in the future, for example harvest percentage. Plausible upper and lower bounds for estimated variables were determined to identify the range of reasonable outcomes possible and the materiality of estimated variables. Measured variables were considered fixed and therefore were not subjected to this sensitivity analysis.

Table 4 Measured vs estimated variables and testing range.

Input/variable	Measured or estimated	Setting in central case	MfE range considered	Testing range	Comments on testing approach
Harvest percentage	Estimated	80%	70-90%	60-95%	The EY New Zealand team's range is wider than MfE range
Harvest age	Estimated	29 years[16]	28-31 years	25-32 years	The EY New Zealand team's range is wider than MfE range
'Safe' carbon amount	Estimated	391.9tCO2/ha	N/A	230-461tCO2/ha	Input not varied by MfE

[12] Based on harvest data for pre-1990 forests.
[13] "Technical Annex 1: Unit Limit Settings", *Advice on NZ ETS unit limits and price control settings for 2025-2029*, He Pou a Rangi (Climate Change Commission), February 2024.
[14] Based on discussions with MPI, the CCC and MfE.
[15] Based on discussions with MPI, the CCC and MfE.
[16] The forestry model has been varied by MfE/CCC to consider all harvest ages within the range 28-31 years for three harvest percentages – 70%, 80% and 90% in determining the range of outcomes. The average of the model runs over these ages for each harvest percentage has been used as the high (90%), central (80%) and low (70%) estimates.

Input/variable	Measured or estimated	Setting in central case	MfE range considered	Testing range	Comments on testing approach
Registrations in process that will be registered	Estimated	87%	N/A	0-100%	Variable not varied by MfE
Replant lag after harvest	Estimated	1 year	N/A	1-2 years	Variable not varied by MfE
Forest rotations	Estimated	Maximum of 3	N/A	N/A	Given this is immaterial to short term estimates no analysis completed by the EY New Zealand team.
Proportion of biomass removed at harvest	Measured	[redacted]	[redacted]	[redacted]	[redacted]
Carbon residue reduction rate	Measured	[redacted]	[redacted]	[redacted]	[redacted]
Yield table	Measured	[redacted]	[redacted]	[redacted]	[redacted]

The outcomes of our sensitivity analysis are displayed in the tornado chart and table below. Three variables have been identified as material to the estimation of the liability. The range of outcomes identified by the EY New Zealand team is 15 million NZUs to 76.58 million NZUs.

Figure 2 P89 sensitivity analysis outcomes

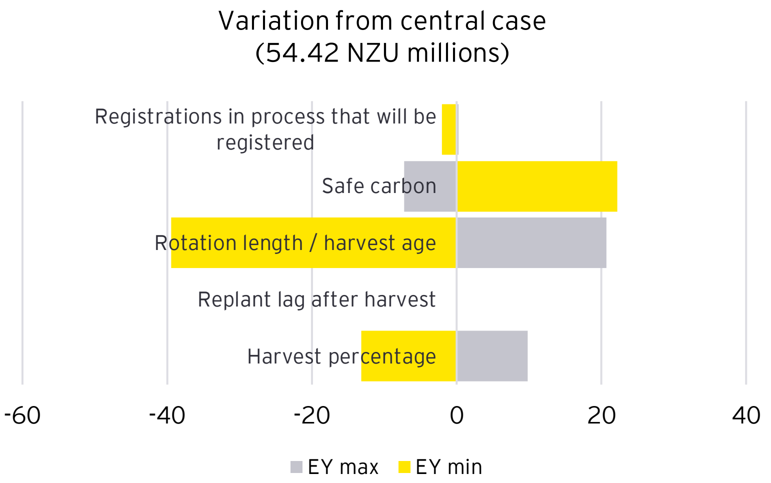


Table 5 P89 sensitivity analysis outcomes and implications

Input/variable	Varied by MfE	Material	Implications
Registrations in process that will be registered	No	No	N/A
'Safe' carbon	No	Yes	Given the materiality and uncertainty of this variable it would be sensible to apply a range of safe carbon assumptions which would increase the estimation range
Harvest age	Yes	Yes	N/A
Replant lag after harvest	No	No	N/A
Harvest percentage	Yes	Yes	N/A

3.2.4 Impact on overall surplus number and range

MfE's estimates have been calculated as outlined below:

- Large: Harvest percentage has been assumed to be 90%, safe-carbon levels 85% of the theoretical maximum and an average of the units held for harvest for the following average pinus radiata harvest ages: 28, 29, 30 and 31, used.
- Central: Harvest percentage has been assumed to be 80%, safe-carbon levels 85% of the theoretical maximum and an average of the units held for harvest for the following average pinus radiata harvest ages: 28, 29, 30 and 31, used.
- Small: Harvest percentage has been assumed to be 70%, safe-carbon levels 85% of the theoretical maximum and an average of the units held for harvest for the following average pinus radiata harvest ages: 28, 29, 30 and 31, used.

The EY New Zealand team recalculated a small, central and large case using the MPI forestry model with the CCC overlay but with the following amendments from the approach taken by MfE:

- ‘Safe’ carbon level varied: Units held for harvest have been calculated using three ‘safe’ carbon levels rather than one:
  - Large: 75% of theoretical maximum ‘safe’ carbon levels applied.
  - Central: 85% of theoretical maximum ‘safe’ carbon levels applied (MfE's assumption).
  - Small: 90% of theoretical maximum ‘safe’ carbon levels applied.
- Harvest age proportions: In calculating the small, central and large estimates the area weighted average harvest age distribution from 2013 to 2022 (most recent 10 years of data) was used to weight outcomes.

The EY New Zealand team's recalculations of the small, central and large cases are outlined below with variances[17] to MfE's values shown in brackets:

- Large: 72.0 million NZU (+6.51)
- Central: 66.8 million NZU (+8.64)
- Small: 64.2 million NZU (+13.27)

The EY New Zealand team's estimates of P89 units held for harvest liabilities are higher than MfE's estimates, the EY New Zealand team's estimation range is narrower than MfE's estimation range and the EY New Zealand team's estimation range is right skewed (whereas MfE's range is more normally distributed).

Figure 3 MfE approach vs the EY New Zealand team's approach

MfE approach

Pinus radiata harvest age range

Harvest percentages	28	29	30	31	Average	
90%	48.0	61.2	73.1	79.6	65.5	Large
80%	42.6	54.4	65.0	70.8	58.2	Central
70%	37.3	47.6	56.9	61.9	50.9	Small

Range: 14.55
Skew: 0.00 Normally distributed

Source: Reproduced by EY from MfE analysis

MfE's approach fixes the ‘safe’ carbon level at 85% of the theoretical max, varies non-harvest percentages and pinus radiata harvest age and applies an average across the age outcomes for each non-harvest percentage.

[17] A positive variance represents that EY's estimation is larger than MfE's.

EY approach

Safe carbon % of theoretical max	Harvest percentages	Pinus radiata harvest age range							
		29	30	31	32	33			
	Average age % distribution	20%	30%	30%	10%	10%			
75%	90%	66.6	78.5	85.0	89.9	92.3			
	80%	59.6	70.1	75.9	80.3	82.4			
	70%	52.5	61.7	66.8	70.6	72.5			
Average x proportion of harvest age range:		11.91	21.03	22.77	8.03	8.24	Sum:	72.0	Large
85%	90%	61.2	73.1	79.6	84.3	86.6			
	80%	54.4	65.0	70.8	75.1	77.2			
	70%	47.6	56.9	61.9	66.0	67.8			
Average x proportion of harvest age range:		10.88	19.50	21.23	7.51	7.72	Sum:	66.8	Central
90%	90%	58.1	70.0	76.4	81.4	83.7			
	80%	51.8	62.3	68.1	72.5	74.6			
	70%	45.5	54.7	59.8	63.6	65.4			
Average x proportion of harvest age range:		10.36	18.70	20.43	7.25	7.46	Sum:	64.2	Small
							Range:	7.78	
							Skew:	0.90	Right skew

Source: Produced by EY from MfE and MPI data and analysis

The EY New Zealand team's approach varies the 'safe' carbon level, non-harvest percentages and pinus radiata harvest age and applies a weighted average to the outcomes based on the distribution of average harvest age over the 10 most recent years for which there was harvest data available.

4. Hedging analysis and findings

4.1 Analysis performed

4.1.1 Analysis of sectoral hedging assumptions

In estimating the hedging volume of each ETS emitting sector, it is important to note that neither the EY New Zealand team nor MfE have access to sufficient data, across all the impacted sectors, to calculate the total volume each sector holds for hedging purposes. Instead, both the EY New Zealand team and MfE must infer these volumes based on an understanding of each sector's approach to NZU price risk management, including forward-pricing contracts and the ability of different sectors to pass NZU price movements through to their customers.

In the EY New Zealand team's calculations, we have broken down each sector's emissions exposed to the ETS by fuel-use/sub-emitter category, before making assumptions for each sub-emitter as to how far in advance they might purchase units and begin to hedge their emissions. Again, while the EY New Zealand team does not have substantive data to justify these assumptions, we were able to sense-check MfE's assumptions for each emitting sector by consulting with subject matter specialists. As the largest emitting sector with the best available data, we performed a more in-depth estimation in regard to the Liquid Fossil Fuels sector as the most material sector within MfE's surplus estimate calculations.

Our methodology in calculating the emissions hedging profile of the fossil fuel sector involved building up a potential hedge profile for the sector based on assumptions made for each fuel use (sub-sector) with Liquid Fossil Fuels. These assumptions were made based on our own understanding of the sector, and from discussions with EY New Zealand subject matter specialists who provided us insight into forwards price flexibility of various transport providers.

For LFF, we then plotted these forward hedging assumptions in alongside the proportion of emissions from each LFF user type (i.e., Industry, domestic aviation, land transport, residential) to graph the emitting sector's hedging requirements across time. This data was taken from MBIE's quarterly 'Data tables for oil' publicly available on their website.[18]

By summing the area graphed, and annualising the figure, our sectoral hedging assumption (%) could then be used to determine steady-state hedging volume for the sector when multiplied by the emissions exposed.

Note: we could only perform this analysis for the LFF sector as it had the data available to do so. It is also the most material emitting sector in terms of emissions exposed to surrender under the ETS.

4.1.2 Analysis of estimation methodology

As a core part of our analysis, we assessed the intra-year hedging and holding patterns of emitters within the ETS. We analysed the behaviour of emitters within the scheme, who begin purchasing compliance units at the start of each calendar year and surrender these the following May. Whilst not colloquial terms within the ETS, we distinguish between 'hedging' and 'holding' units using the following definitions:

Holding units:
Holding units are units that are bought by an emitter and held only for the period of purchase throughout each calendar (i.e., compliance) year. These units are bought throughout the 12 months of the calendar year for emitters' annual compliance. These units are held for an additional 5 months until May the following year for surrender. These holding volumes help protect emitters from exposure to NZU price movements occurring between the point of time where their products were sold (at fixed prices) and the point of surrender. Emitter's inventory of these units therefore fluctuates over an overlapping 18-month cycle.

[18] "Data tables for oil", *Oil statistics"*, Ministry of Business, Innovation & Employment, March 2024.

Hedging Units:
Hedging units are units that are held by an emitter in order to reduce and mitigate the NZU price risk for product sales that are yet to physically occur, but which have been committed to at fixed prices with their customers. As emitters must purchase compliance/holding units each year, purchasing carbon via spot units or futures contracts for hedging purposes allows participants to lock in prices for carbon credits in advance, thereby providing increased certainty about future costs and managing the financial risk associated with fluctuating carbon prices.[19] Generally, the volume of hedging units an emitter needs will depend on a number of factors, such as: annual actual/forecasted emissions, the volume of industrial allocation available, risk tolerance, regulatory exposure, decarbonisation strategy, as well as the ability for emitters to pass on increased carbon costs to customers.

For the avoidance of doubt, we assume that holding and hedging demands do not overlap and are separate volume requirements for participants within the NZ ETS. Hedging units are purchased in order to manage future NZU price risk uncertainty when NZ ETS participants are signing fixed price forward sale agreements, where the physical transaction of products is yet to occur. Holding units are used to manage the NZU price risk for sales where the physical transaction of products has occurred in the past.

As part of this analysis of intra-year hedging and holding patterns, we created intra-year compliance graphs for each of the four emitting sectors who surrender units within the ETS. For three sectors (Stationary Fuel, Industrial Processes and Waste) we used MfE's emissions data and assumptions as we agreed with the assumptions used. For the LFF sector, we used our updated sectoral hedging assumption (%) in calculating the steady-state hedging volume of this sector, with MfE's annual compliance demand data used to model intra-year volume.

We then produced a graph where all four sectors' intra-year holding volumes were aggregated to assess the overall market's hedging/holding volume. From this aggregation, we calculated the minimum intra-year holding volume (volume that is not sold down due to overlapping unit purchasing periods) and could sum the market steady-state hedging volume (that differed from MfE's calculation per 4.1.1).

4.1.3 Analysis of December calculation date

Finally, we assessed the end-year December assessment date that MfE has proposed for the calculation of the surplus estimate going forward. The choice of assessment date is important because of the significant intra-year variation in holding volumes amounting to 100% of the annual compliance demand which is needed in excess of the industrial allocation available.

19 Syriopoulos T, Roumpis E, Tsatsaronis M. "Hedging Strategies in Carbon Emission Price Dynamics: Implications for Shipping Markets". *Energies*. 2023, https://doi.org/10.3390/en16176396

4.2 Findings

4.2.1 Findings on sectoral hedging assumptions

The following table summarises our analysis of the assumptions and ranges MfE has produced in calculating hedging volumes:

Table 6 Summary findings of MfE's hedging assumptions per ETS emitting sector

Industry	MfE range	EY New Zealand team commentary
Liquid fossil fuels	50% annualised (range 25%-75%) The central case was derived from setting the hedge volume at 50% of compliance volume in year 1 and leaving all future year's blank	These numbers appear higher than what we might expect based on our understanding of the hedging behaviour of this sector. While the industrial and domestic aviation sectors probably have some longer-term fuel hedges, the purchasing in the LFF sector is dominated by personal car use and commercial transportation. Many major freight companies in New Zealand operate on an owner-operator basis which makes centralised fuel hedging impractical. Table 7 and Figure 4 for further breakdown of our LFF hedging analysis.
Stationary energy	200% annualised (range 150%-250%) The central case was derived from setting the hedge volume at 100% of compliance volume in year 1, 66% in year 2 and 33% in year 3	These hedge volumes are consistent with our understanding of the sector's approach to NZ ETS price risk management. Forward contracts for energy supply often extend two to three years into the future and NZ ETS volumes are procured to manage their price risk. This volume can be purchased as either spot volume which is held until delivery, or in forward/future markets where it is delivered at a specific future date.
Industry	175% annualised (range 150%-200%) The central case was derived from setting the hedge volume at 100% of compliance volume in year 1, 50% in year 2 and 25% in year 3	These hedge volumes are consistent with our understanding of the sector's approach to NZ ETS price risk management. Industrial customers can have multi-year fixed price contracts for energy supply and/or product delivery which require them to build, and hold, substantial NZU price hedges. Many of the largest industrial companies in NZ get industrial allocation and this substantially reduces the exposed volume of NZ ETS demand that they need to cover.
Waste	100% annualised (range 100%-100%) The central case was derived from setting the hedge volume at 100% of compliance volume in year 1 and leaving all future year's blank	These hedge volumes are consistent with our understanding of the sector's approach to NZ ETS price risk management. Many of the buyers in this sector are councils, or companies contracted to councils. As councils need to announce and fix their rates at least a year in advance, they typically need to have at least a year of their NZ ETS costs are covered by a fixed price hedge.

As stated in Table 4 above, MfE's assumptions in regard to the Stationary Energy, Industry and Waste sectors are consistent with the EY New Zealand team's understanding of the sector's hedging behaviour. The EY New Zealand team's estimates for the behaviour of the Liquid Fossil Fuel sector, however, differs slightly from MfE's estimations.

Whilst the EY New Zealand team does not have access to the primary market data or research which would allow these numbers to be calculated, our estimations of the Liquid Fossil Fuel sector's hedging assumptions were based our prior understanding of the sector, as well as discussions with the EY New Zealand team's subject matter specialists. For each fuel use within the sector, our assumptions can be viewed in Table 5 below:

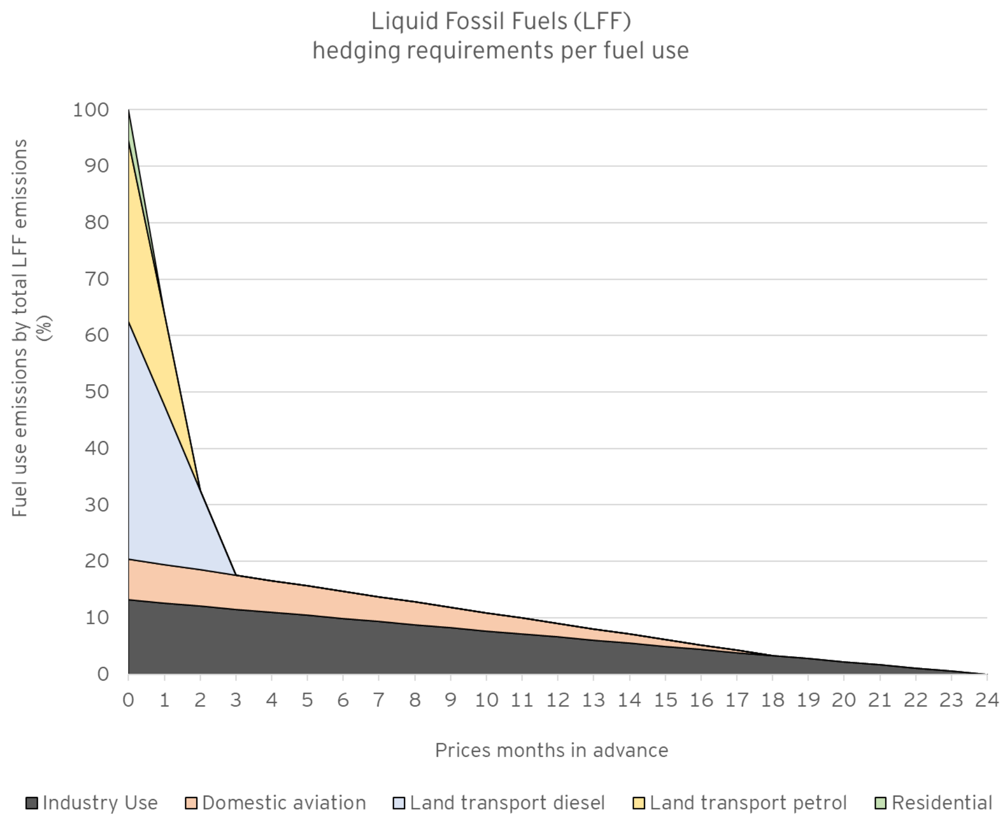
Table 7 EY New Zealand team's hedging assumptions per fuel LFF fuel use

LFF user	Hedge duration	Rationale
Industrial Use	24 months	Matches hedge duration for industrial sector
Domestic Aviation	18 months	Airlines sell seats up to 18 months in advance at fixed prices
Land Transport (Petrol)	2 months	Most consumption is at the pump for private vehicle consumption, requiring very little forward hedging
Land Transport (Diesel)	3 months	Potential for some of this volume to be sold forward under hedges for commercial (transport) operations
Residential	1 month	Most consumption is at the pump for private vehicle consumption, requiring very little forward hedging

By using these assumptions for each fuel user alongside MBIE's quarterly 'Data tables for oil'[20]dataset, we can produce the following graph showing the LFF sector's hedging requirements:

[20] "Data tables for oil", *Oil statistics",* Ministry of Business, Innovation & Employment, March 2024.

Figure 4 LFF sector hedging requirement



Source: EY New Zealand generated figure using data from MBIE's "Data tables for oil"

By annualising the sum of the area of the graph, we have estimated the volume of hedging units (as a percentage of annual compliance demand) to be 31%. This is lower than MfE's central estimated figure of 50%. Of this 31%, 4% of annual compliance demand is bought/hedged more than 12 months in advance, whilst 27% is bought within the front year.

4.2.2 Findings on estimation methodology

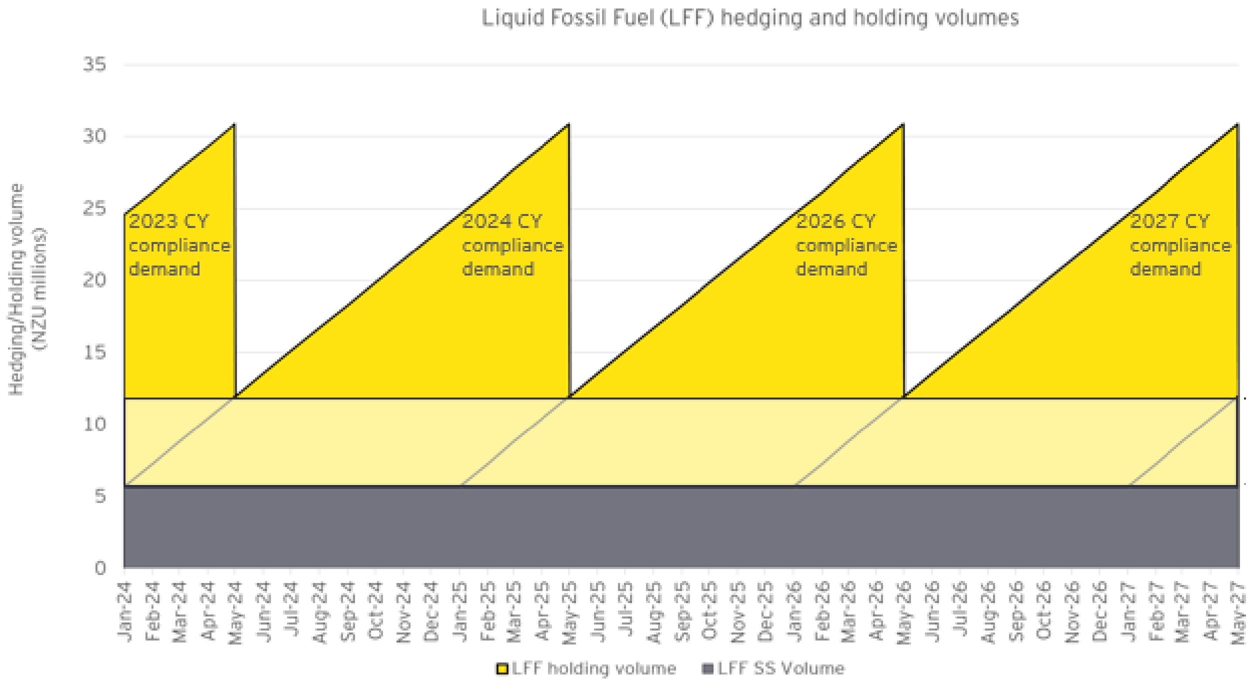
Our assessment is that units are held by participants in the NZ ETS to manage two different types of NZ ETS price risk:

1. Units are held to manage forward price risk. We refer to this as 'hedging volume' (refer to 4.1.2) with its rationale for not being included within the unit surplus being comprehensively described by MfE and the CCC in their NZ ETS advice. The EY New Zealand team's estimation of hedging volume is not substantially different than MfE's estimation, however differs due to the EY New Zealand team's analysis of LFF hedging assumptions in 4.1.2.

2. Units held within each year to manage the price risk of emissions that have already occurred. We refer to this as 'holding volume' (refer to 4.1.2 above). While the EY New Zealand team agrees with MfE's approach of including this holding volume generally within the ETS unit surplus, the EY New Zealand team's view is that the minimum holding volume (as shown in light yellow in Figure 5 below) should not be included within the unit surplus, as this volume is held constant across compliance periods due to the overlap of annual compliance periods (as holding volumes are built up across a 18-month period before surrender in May).

In Figure 5 below, ‘holding volume’ is shown in yellow, whilst ‘hedging volume’ is shown in grey.

Figure 5 LFF intra-year hedging and holding demand.



Source: EY New Zealand generated figure using data from MBIE’s “Data tables for oil”[21]

Additionally, in this graph, the overlapping saw-tooth ‘holding volume’ pattern creates a steady-state minimum volume. This volume can be considered as an addition to the steady-state hedging demand as a minimum volume of units which need to be continuously available within the NZ ETS.

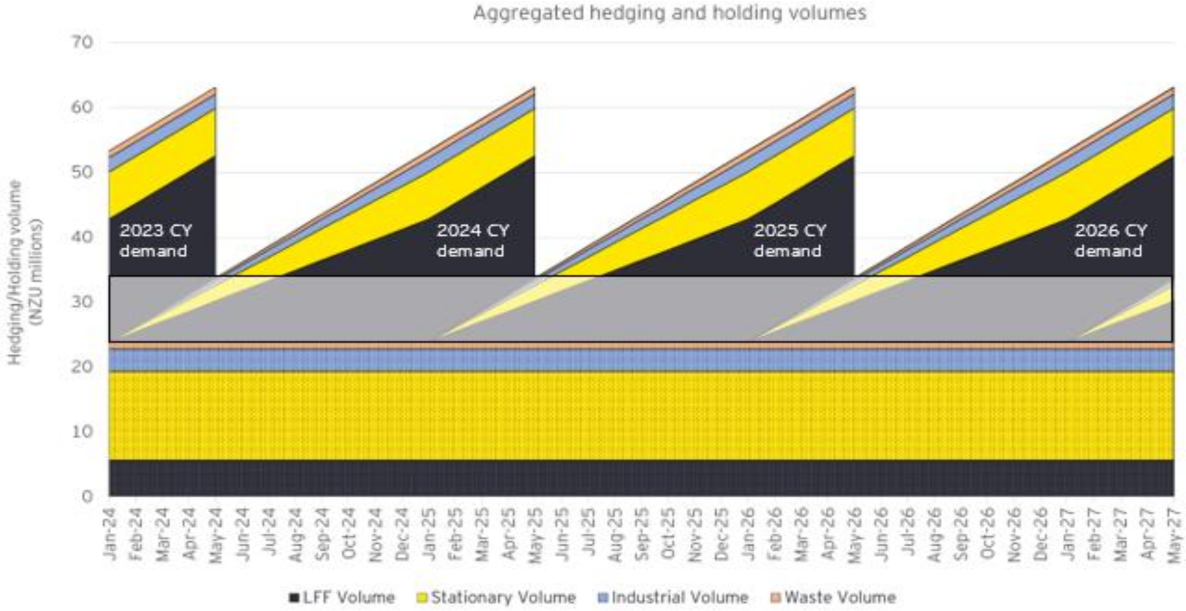
Shown as the light yellow band, this minimum inta-year holding volume is analogous to the ‘safe carbon’ volume seen within stock-change accounting in the NZ ETS forestry sector, except that instead of being volume that can be sold, this is volume that needs to be continuously held by participants.

Following the production of each sectors graph, we then aggregated these volumes into a market-wide graph showing total hedging/holding volumes (Figure 6 below). From this graph, we calculated:

- The total ‘steady state hedging volume’ as 23.9 million units (slightly smaller than MfE’s estimate of 27.7 million units).
- The minimum intra-year holding volume as 9.8 million units.

[21] “Data tables for oil”, *Oil statistics”*, Ministry of Business, Innovation & Employment, March 2024.

Figure 6 Aggregated market intra-year hedging and holding volumes

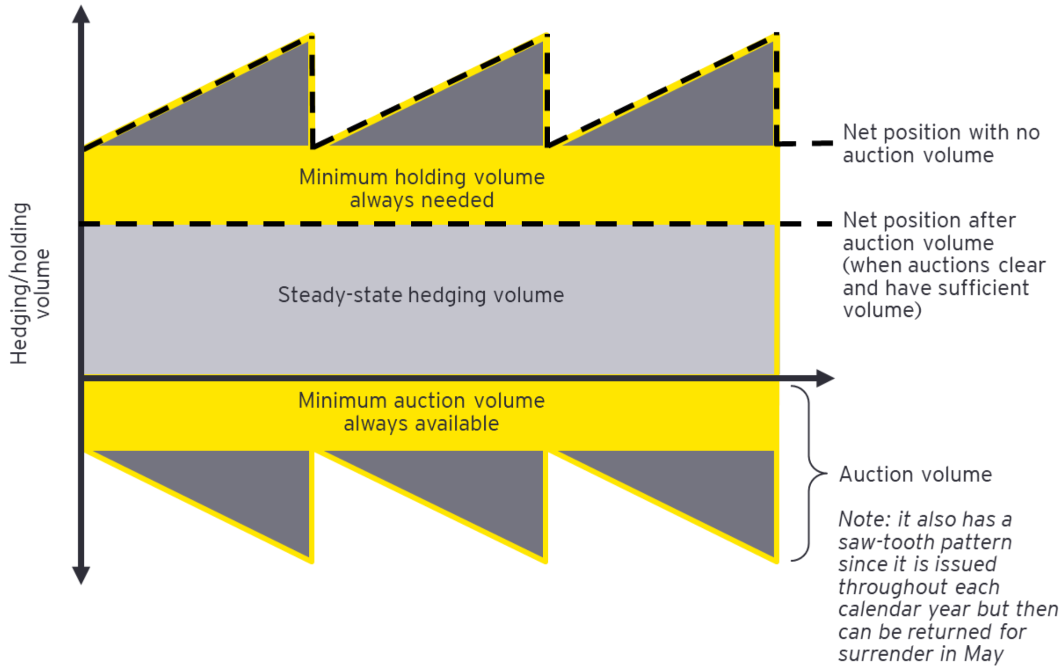


Source: EY New Zealand generated figure using emissions data from MfE's analysis.

An additional consideration arising from our assessment of MfE's methodology is the challenge of balancing auction supply and compliance demand for hedging/holding volumes. As shown by Figure 7 below, where there is auction volume available to the market (which in our illustrative example clears and is exactly equivalent to the compliance buying demand) the saw-tooth profile of intra-year holding volumes would be exactly offset by the saw-tooth supply from auction volumes. This means that the only volume not accounted for is the steady-state hedging demands from compliance buyers. If auction/supply volume is less than compliance buying demand (or even 0 as auctions don't always clear) then the demand for compliance buyers will increase above the 'normal' saw-tooth holding volume and the volume of 'surplus' units in the market will decrease.

A similar role to auction supply could be played by forestry supply (from averaging forests) in the future. If sufficient forestry supply was available, unencumbered by harvest liabilities, then it could also help to smooth out the saw-tooth holding profile.

Figure 7 Market supply considerations to meet aggregated market demand.



Source: EY New Zealand generated figure.

The EY New Zealand team does not have access to hedging data or reports from NZ ETS participants and so our assessment can only be based on our understanding of the approaches that these different sectors may choose to use for hedging their exposure. In summary, the result of the decrease in steady-state hedging volume in the LFF sector alongside accounting for minimum holding volume, results in a net surplus decrease of 6.0 million units.

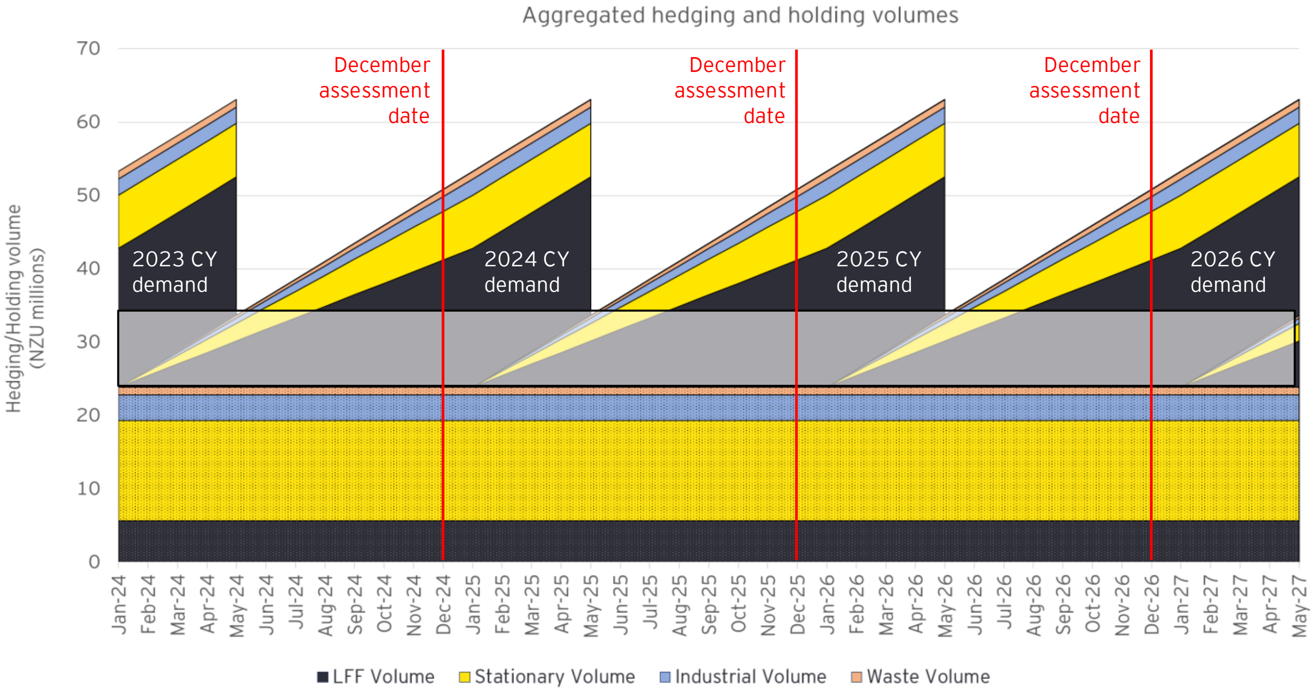
Whilst this result is based on estimations of hedging behaviours in FY24, this surplus calculation is subject to change with emitter behaviour as emissions decrease within each sector going forwards, resulting in a reduction of hedging volumes as we look ahead to future years. Hedging behaviour may also change as a result of increased market price stability in the ETS.

4.2.3 Findings on December calculation date

As shown in Figure 8 below, we believe the December date of assessment MfE has proposed is an appropriate time to make these calculations as it represents and approximate mid-point within the saw-tooth pattern created from intra-year holding volumes.

This date will also give a good indication of the impact of any auctions which didn't clear throughout the year and thus, whether any available units will be removed from supply at the end of calendar year.

Figure 8 Aggregated market hedging and holding volumes overlayed with December assessment dates



Source: EY New Zealand generated figure using data from MfE's analysis.

Appendix A The Market Stability Reserve (MSR) of the EU ETS

Given the similarity of the challenges presented by managing surplus volumes within the NZ ETS and the EU ETS (historically) this Appendix has been included as an illustration of the approach taken to addressing surplus volume in another market.

The Market Stability Reserve is a key component of the European Union Emissions Trading System (EU ETS). The EU ETS operates on a "cap-and-trade" principle, where a cap is set on the total amount of certain greenhouse gases that can be emitted by installations covered by the system. Companies receive or buy emission allowances, which they can trade with one another as needed.

The MSR was introduced in January 2019 to address the surplus of emission allowances that had accumulated in the EU ETS, which was putting downward pressure on the price of allowances and thus reducing the incentive for companies to invest in low-carbon technologies. It was designed to improve the resilience of the EU ETS to economic shocks by adjusting the supply of units to be auctioned.

The MSR works by automatically removing a percentage of the total number of auctioned units when the surplus exceeds a threshold. Conversely, if the number of units in circulation falls below another threshold, the MSR releases additional units onto the market through the auction platforms. This mechanism helps to maintain scarcity in the carbon market, supporting a more stable and robust carbon price.

The thresholds for the MSR are predefined: if the total number of units in circulation is greater than 833 million, units are placed into the reserve. If the number falls below 400 million, they are released from the reserve. The decision-making process for the MSR is therefore transparent and predictable, as the European Commission annually publishes the total number of units in circulation to inform market participants about the potential adjustments to the supply.

The MSR is intended to strike a balance between ensuring the stability and predictability of the carbon market while allowing for flexibility to respond to market dynamics.

However, criticism has been levelled at the MSR for making changes to auction volume which are too abrupt, and modifications have been proposed to it by a range of stakeholders which seek to make its response more graduated.

The development of the MSR within the EU ETS offers an alternative approach to dealing with the challenges of managing surplus units with key differences to the more flexible process that exists within the NZ ETS. These differences include:

1. Automatic Adjustments: The MSR operates with predefined thresholds that trigger the absorption or release of units. This automatically enables the system to respond to market conditions without the need for constant manual intervention, which can be politically challenging.

2. Transparency and Predictability: The EU's approach to publishing the total number of units in circulation annually provides market participants with clear signals about potential adjustments.

3. Supports a Robust Price Signal: By adjusting the supply of units to maintain scarcity, the MSR supports a more stable and robust carbon price, which incentivises low-carbon investments.

4. Market Sensitivity: The MSR is designed to be sensitive to economic fluctuations, which helps mitigate the risk of a surplus during economic downturns or a shortage during economic expansions

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