Parliamentary Commissioner for the Environment
Te Kaitiaki Taiao a Te Whare Pāremata

ENZ modelling: Projected price outcomes from the New Zealand Emissions Trading Scheme

Introduction

The Parliamentary Commissioner for the Environment has commissioned Concept Consulting to model price forecasts for the New Zealand Emissions Trading Scheme (ETS). This note provides preliminary results from a series of model runs. We expect to publish a full report on the results of this work later in the year.

The expected future ETS price trajectory is an important determinant of the levels of afforestation in New Zealand, and the harvesting regime this falls under. To a lesser extent the ETS price also affects gross emissions reductions. This relative scale of effect is due to forestry outcomes being more sensitive to the ETS price than gross emissions, and materially larger in scale.

The modelling presented here provides an in-depth exploration of the most likely price path of the ETS as it is currently configured. It also illustrates the anticipated balance between rotational and permanent forestry under different ETS prices. Finally, the impact of this price path on the ability of New Zealand to meet legislated climate targets is discussed.

Methodological challenges

It is challenging to model future ETS price paths for several reasons, mainly relating to the inclusion of forestry offsets in New Zealand's ETS. Firstly, afforestation levels in New Zealand have been uneven historically, with significant planting in the 1990s and early 2020s, but limited planting during the mid-2000s. This pattern is shown in Figure 1, split between the different ETS registration types. The large unregistered area in the last few years is due to a delay between planting and registration.

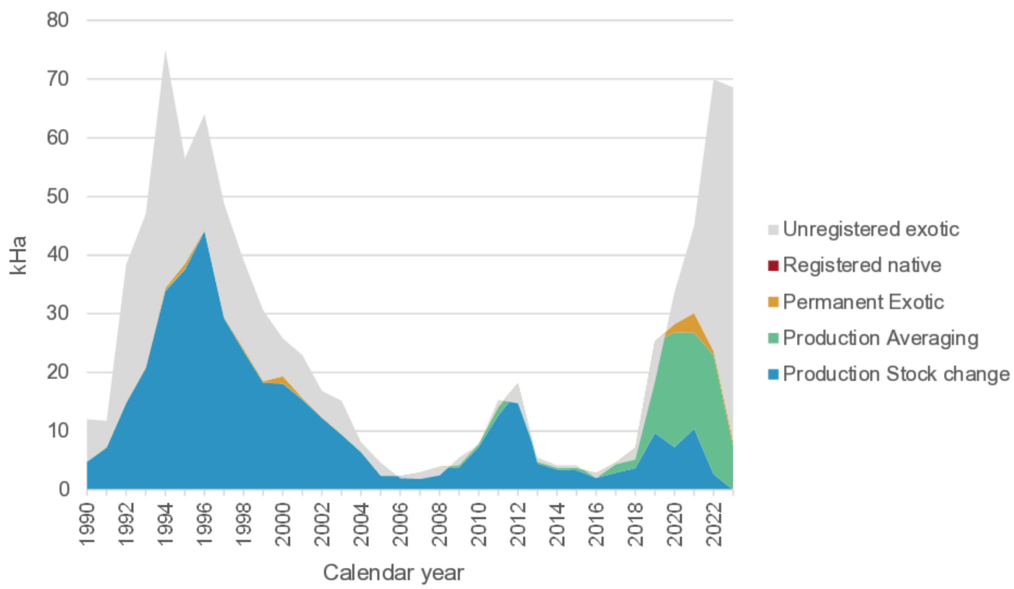

Figure 1. ETS-registered historical afforestation (1990–2023).

This uneven historical pattern of afforestation means that the future trajectory of New Zealand Units (NZUs) surrenders and removals will also not be even (Figure 2).

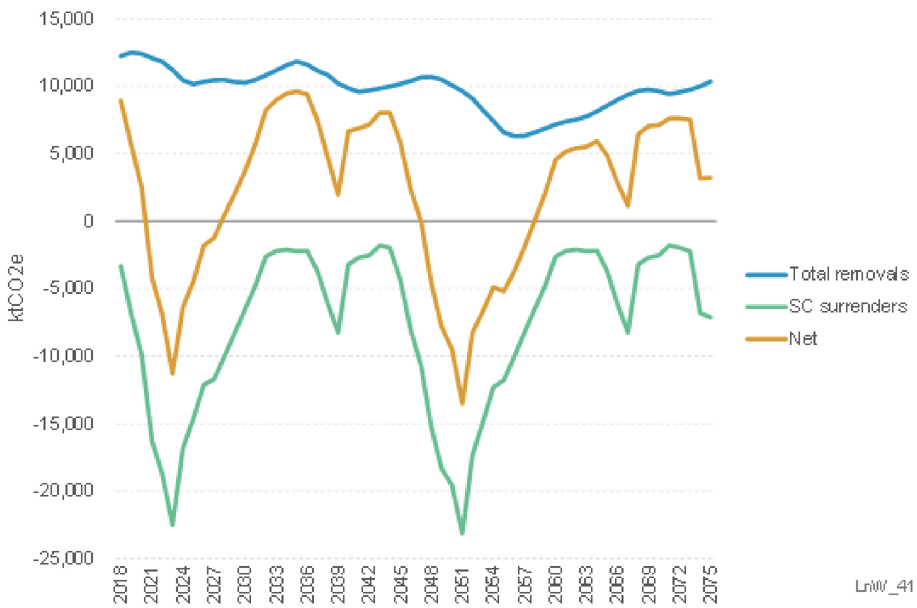

Figure 2. Future trajectory of removals and surrenders based on pre-2024 historical afforestation (2018-2075).

Adding to this complexity are the different forestry accounting regimes in play. The majority of forestry registered in the ETS prior to January 2023 was registered using so-called 'stock-change' accounting rules.[1] Under stock change accounting, forests owners are awarded units while the forests are growing, but they must surrender a significant proportion if the forest is then harvested. They can start to be awarded units again if the land is replanted.

Under stock-change accounting, a forest can effectively transition from being 'rotational' (i.e. harvested for wood on a cycle of rotations every 30 years or so) to 'permanent', based on the decisions of the owner. This adds a layer of uncertainty when estimating future NZU supply and demand in the ETS, as the status of forests currently considered rotational is uncertain. The use of averaging accounting after 2023 precludes a simple transition from rotational into permanent forestry. However, at a high enough carbon price this may also be possible.

The attractiveness of transitioning to permanent forestry is determined by the ETS price. The modelling undertaken by Concept Consulting illustrates that rotational forestry is economic over sheep and beef at relatively low ETS prices. At higher prices, permanent carbon forestry becomes more economic than either sheep and beef or rotational forestry.

Figure 3 illustrates this for a typical area of land currently being used for sheep and beef farming. Without a ETS price, sheep and beef is most profitable, but with a $40/t ETS price, forestry is the most profitable.

1 All forests registered prior to 2018 had to be registered using the stock-change methodology. Forests registered between 2018 and 2023 could choose between the stock-change and averaging methodology. From 2023, forests could also be registered in the 'permanent' category.

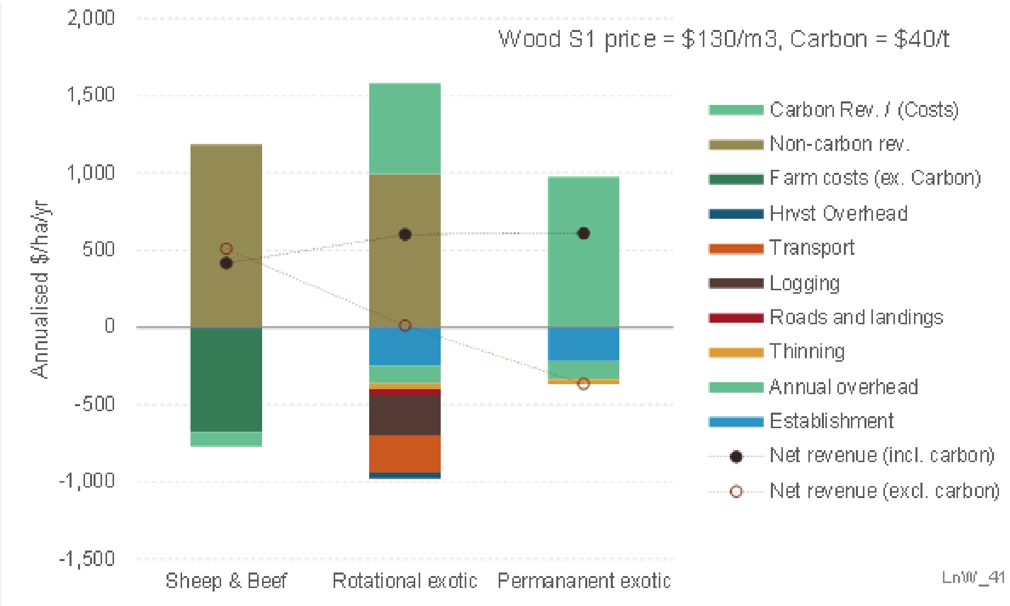

Figure 3. Relative economics of sheep and beef, rotational and permanent exotic forestry at a $40 ETS price

Figure 4 develops this further by showing how the relative economics changes with ETS price.

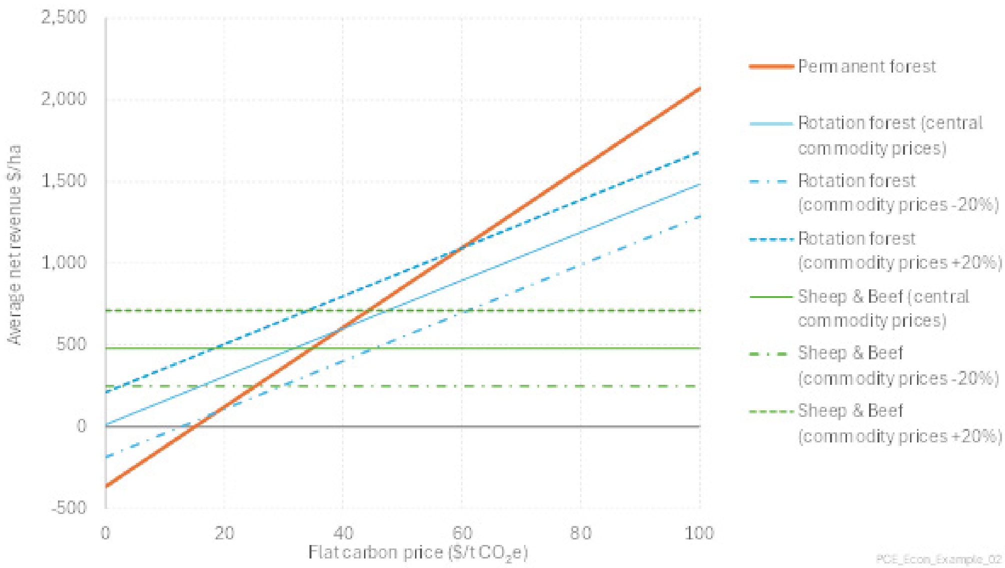

Figure 4. Economics of rotational and permanent forestry vs. sheep and beef farming (with a changing ETS price). On-farm emisisons are not priced.

At low ETS prices, sheep and beef farming is most profitable, but at higher ETS prices it starts to become economic to convert to rotational forestry, and at even higher prices, it is most economic to plant a permanent exotic forest. Figure 4 also shows the effect of sensitivity analyses for low vs. high commodity prices (i.e. the price of logs and the price of meat). Even at high commodity prices for sheep and beef, both rotational and permanent forestry are more lucrative when the ETS price surpasses $45. Similarly, permanent forestry is – on average – the optimal land use with ETS prices above ~$65 per tonne.

It should be noted that the above graphs are for a broadly typical sheep and beef farm. There is variation across farms that will alter the relative economics of pastoral farming vs. forestry. However, the general nature and scale of the effect of a carbon price on the economics of the two options can be clearly seen in the graphs. It is also important to note that Figure 4 assumes a continuation of the situation, whereby pastoral farming doesn't face an equivalent cost of carbon to forestry.

Figure 5 below shows the effect if this were to change and on-farm emissions faced the same price as forestry (and there was no free allocation of units). As can be seen, the economics of pastoral farming worsens as the carbon price rises. However, the gradient of the slope of pastoral farming's worsening position is not as steep as the gradient of the slope of forestry's improving position. This is because the average carbon emitted per hectare from pastoral farming is significantly less than the average carbon sequestered per hectare by forestry. In large part, therefore, carbon pricing doesn't price pastoral farming 'out' but prices forestry 'in'.

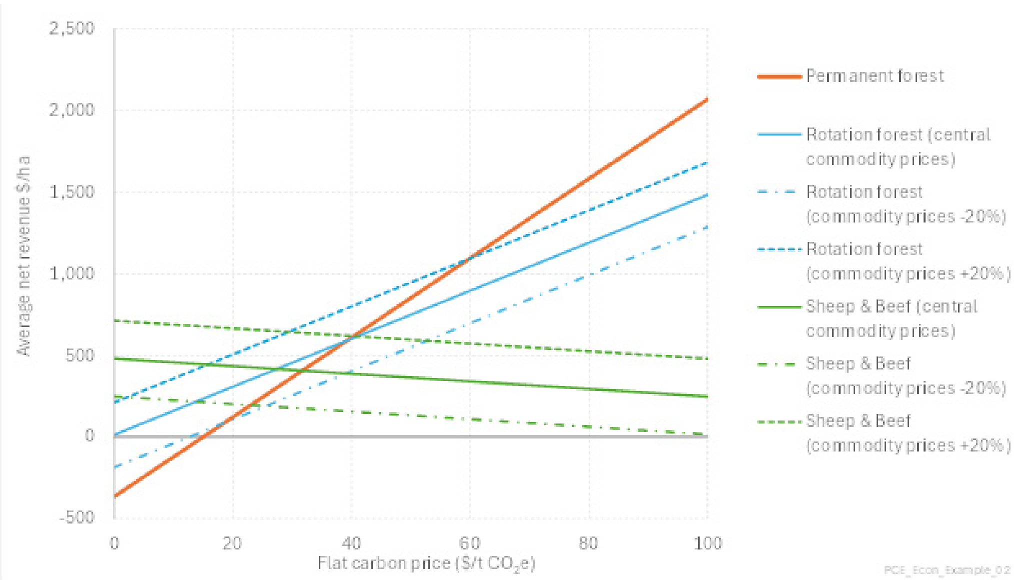

Figure 5. Economics of rotational and permanent forestry vs. sheep and beef farming (with a changing ETS price). On-farm emissions face the same price as forestry.

Key results

The results of the modelling revealed that forestry is considerably more responsive to ETS prices than gross emissions reductions (Figures 6 and 7).

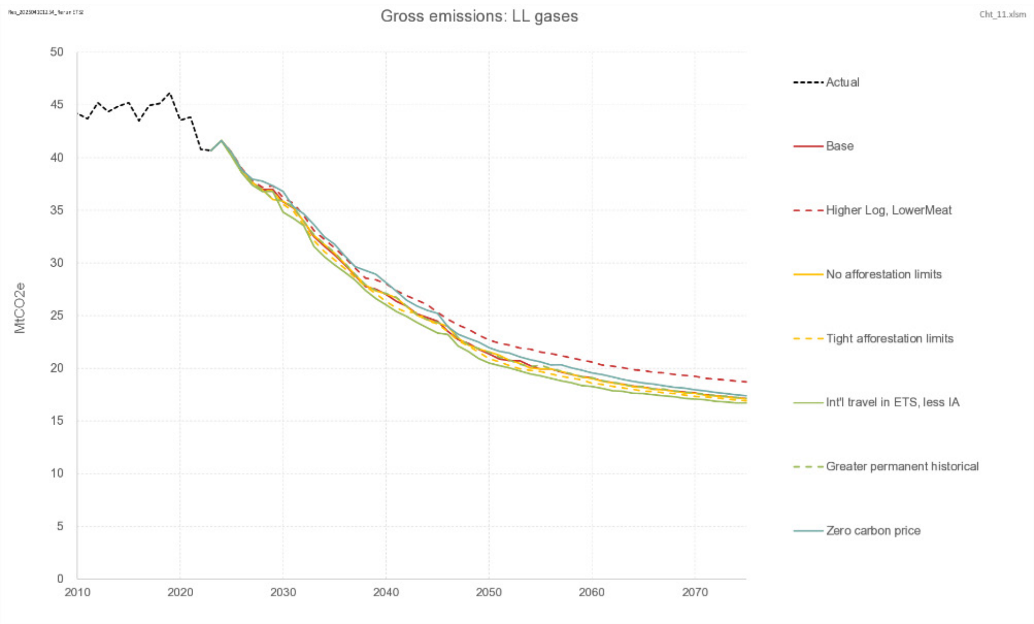

Figure 6. Sensitivity of long-lived gas gross emission to ETS pricing.

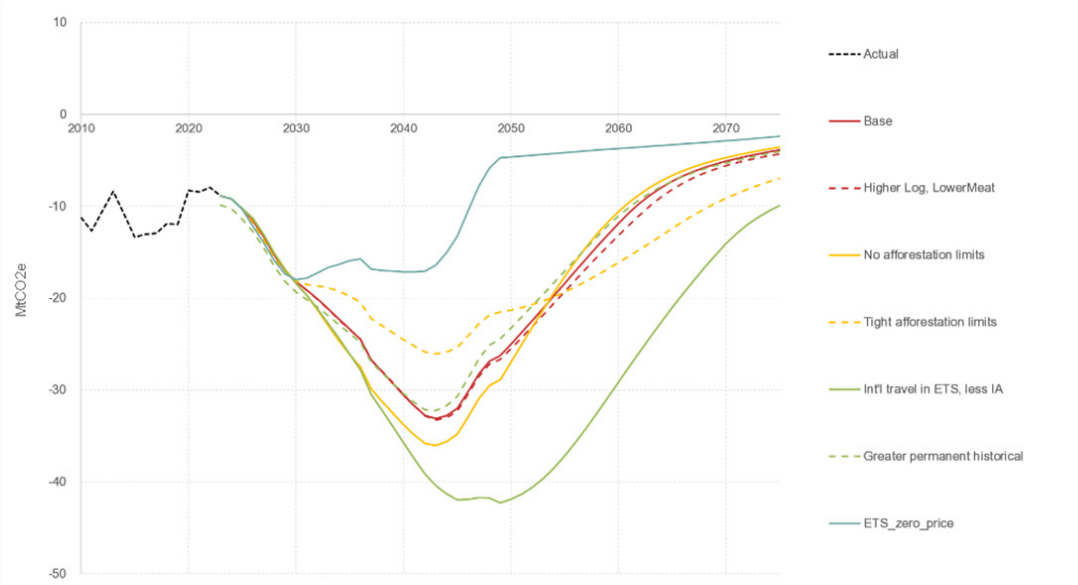

Figure 7. Sensitivity of forestry to ETS pricing.

The reason gross emissions reductions are less sensitive to ETS prices than forestry is because carbon is generally a much smaller component of the input costs for gross emission activities. For example, the carbon proportion of the relative economics of a petrol car versus an EV is much smaller than the carbon proportion of the relative economics of sheep and beef vs. forestry. For choosing a car or choosing a home heating appliance, other costs are more significant components, such as the capital cost or the non-carbon fuel costs. Accordingly, the point at which it becomes economic to transition from a fossil appliance to a low-emissions appliance generally coincides with the timing when the fossil appliance (petrol car or gas heater) is close to needing to be replaced anyway. This can be brought forward with a higher ETS price, but it requires a very high price to bring forward the timing significantly.[2] Accordingly, the movement in gross emissions is also heavily influenced by the cycle of capital replacement.

There are also significant gross emissions reductions that are likely to happen anyway, independent of ETS prices, resulting from:

- technological changes, including a transition to electric vehicles and renewable energy technologies
- policies outside the ETS, such as the phasing out of coal boilers by 2037
- other factors, such as New Zealand's domestic gas reserves declining significantly, causing markedly increased gas prices and driving a shift away from gas for non-carbon price reasons. (Key modelling assumptions are summarised at the end of this note.)

The gross emissions reductions anticipated to occur, even with a zero ETS price, are documented in Figure 8.

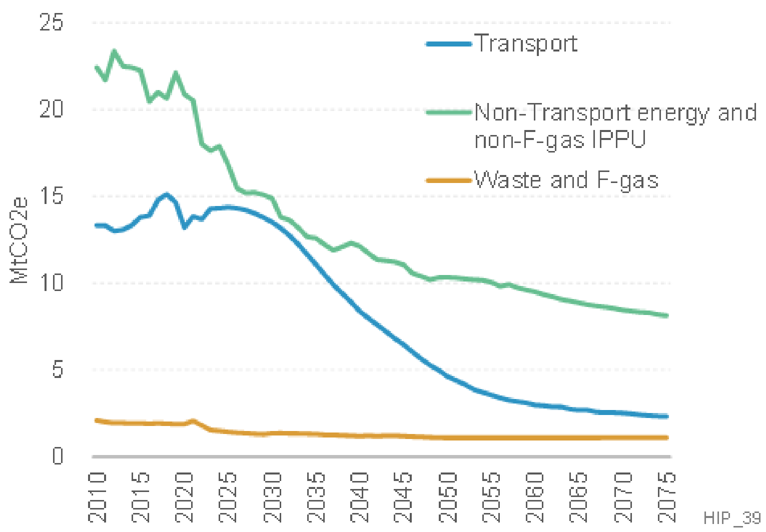

Figure 8. Gross emissions reductions across different sectors that are locked in regardless of ETS price (i.e. would still occur if the price was zero).

The gross emissions reductions that are responsive to price would only occur at prices significantly higher than are likely with current ETS forestry settings. The insensitivity of gross emissions reductions to ETS prices, and the capital-intensive nature of many of these decisions, underscores the importance of stable long-term price signals to encourage investment in low carbon assets and technologies. A fluctuating ETS price risks new investment going into polluting assets, which could lock in emissions for 20–30 years depending on their lifetime.

2 The necessary carbon price to materially bring forward capital replacement decisions varies by end-use. For industrial process heat (where fuel is the main cost of delivering the energy service) carbon prices of $100–300 can make a significant difference (depending on the specifics of the fossil fuel situation and the ability to transition to biomass or electricity). For household fossil applications, the necessary carbon price can be many hundreds of dollars a tonne to make it cost effective to scrap an existing fossil asset (e.g. petrol, car or water heater) many years earlier than would be needed because of the asset reaching the end of its life.

The modelling revealed that the price path for the ETS is likely to rise modestly in the 2020s to prevent the NZU stockpile falling below zero. This modestly rising price path will incentivise additional afforestation and release NZUs from government auctions, which are more likely to succeed when the price is high.[3]

During this time, gross emissions will fall for the reasons outlined above (technological change, fuel switching and a transition away from coal). In combination, from the mid-2030s onwards, the falling gross emissions, combined with the continued supply of units from forests that have already been planted and from industrial allocation, are anticipated to lead to a price collapse due to the oversupply of NZUs in the mid-2030s. At this time the incentive provided by the ETS for afforestation will be in decline (Figures 9 and 10).

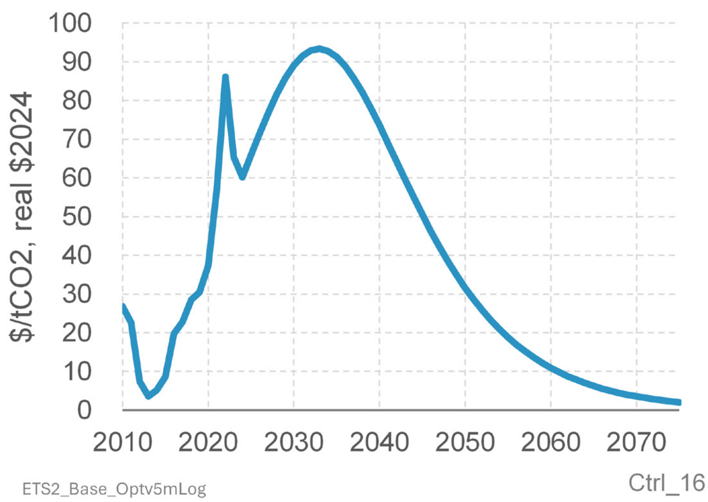

Figure 9. Base ETS price (2010–2075).

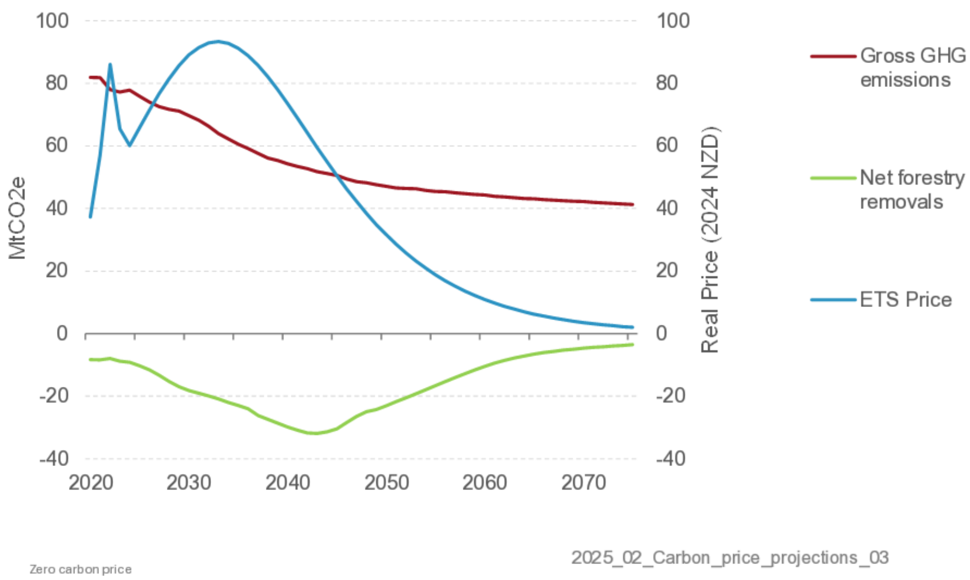

Figure 10. Base ETS price, gross GHG emissions and net removals from forestry (2020–2075).

3 The modelling shows NZUs are released from auctions, however the cost containment reserve is never triggered.

Importantly, the modelling showed that despite New Zealand achieving its net-zero target well before 2050 under most modelled scenarios, the ETS is unable to keep emissions below net-zero after 2050 (Figure 11). This is a requirement of our international commitments and Climate Change Response (Zero Carbon) Amendment Act. Consequently, significant changes to the ETS would have to occur for New Zealand to stay below net-zero past 2050. Some combination of the following ETS changes is likely to be required, absent significant 'complementary' (i.e. outside the ETS) policy measures: the inclusion of international transport, the inclusion of agriculture, some additional constraints on forestry registration, and possible linkage with international markets.

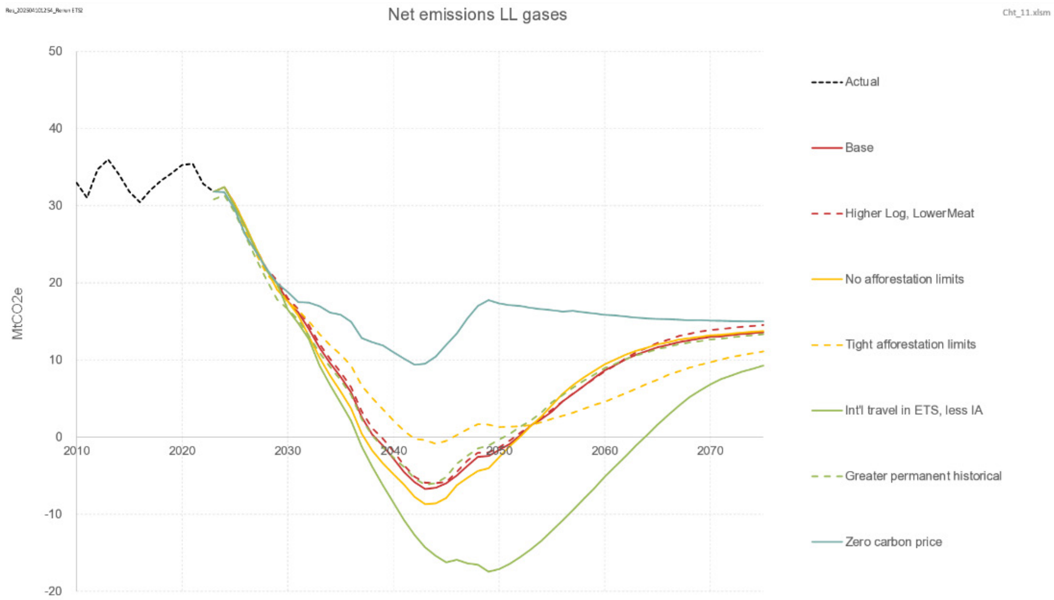

Figure 11. Long-lived net GHG emissions (excluding biogenic methane) under different ETS scenarios. None of the modelled scenarios keep emissions below net-zero after 2050.

Assumptions

- Actors in the model have perfect foresight of future prices.
- Commodity prices are assumed to remain stable over time (excluding specific model runs exploring varying commodity prices).
- There are no new significant gas discoveries – Methanex exits New Zealand completely at the end of 2031 (Mot1 is shut from 2024 and Mot 2 is shut from the end of 2031).
- The proportion of future forestry that registers in the ETS is 90%.
- It is assumed that all ERP2 policies will be implemented, with the exception of afforestation of crown land, as forestry is made endogenous within the model.