Ministry for the Environment
Manatū Mō Te Taiao

OIAD-471

s 9(2)(a)

Tēnā koe s 9(2)(a)

Thank you for your email of 15 November 2022 to the Ministry for the Environment (the Ministry) requesting the following under the Official Information Act 1982 (the Act):

> *1. A table showing for each year, from 1990 out to the furthest year for which data or projected data is given in the ERP: (i) the net emissions figure derived using the target accounting basis (as presented in the ERP); and (ii) the standard net emissions figure for the same year (as determined in the internationally accepted manner). For years in which no emissions figure was derived based on the target accounting basis, this can be stated.*
>
> *2. Details of how the net emissions figures calculated on a target accounting basis were derived from the standard net and gross emissions figures.*

Part one of your request

The information outlined in the first part of your request is already publicly available, and I must therefore decline this part of your request under section 18(d) of the Act.

Information about Aotearoa New Zealand's projected greenhouse gas emissions to 2050 is available on the Ministry's website here: https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/emissions-reduction-targets/new-zealands-projected-greenhouse-gas-emissions-to-2050/. This page includes a link to an excel file containing the set of emissions projections that were used as the baseline for the supporting analysis for Aotearoa New Zealand's first emission reduction plan. This file includes historical and projected emissions on both a targeting accounting and net reporting basis, as per New Zealand's Greenhouse Gas Inventory Report submitted to the United Nations Framework Convention on Climate Change (UNFCCC).

Following the release of the emissions reduction plan, the Ministry published a technical information annex, which contains some further information on the baseline emissions projections used, including information on some key adjustments made to the emissions series. This document also contains a section on the accounting approach (target accounting) used in the emission reduction plan analysis. The technical information annex is available here: https://environment.govt.nz/publications/emissions-reduction-plan-technical-information-annex/.

Please note that the projections timeseries on the Ministry's website does not include the adjustments mentioned in the technical annex or the quantified impacts of emissions reduction plan policies. Further information on this can be found in the technical information annex itself. Emissions impacts of emissions reduction plan policies were only compiled over budget year periods (not on an annual basis).

The Ministry is in the process of publishing a spreadsheet to supplement the technical annex which contains more details on the quantified policy impacts and underlying emissions projections. Please note that, in addition, the Ministry will publish updated emissions projections on its website on 15 December 2022 to coincide with the publication of New Zealand's Eighth National Communication and Fifth Biennial Report under the United Nations Framework Convention on Climate Change.

Part two of your request

The Ministry has identified one document in scope of this part of your request, as listed in Table 1, which is being released to you in full.

You may also find the following information useful:

- A better ETS for forestry - proposed amendments to the Climate Change Response Act 2002: discussion paper (apo.org.au)
- https://environment.govt.nz/assets/publications/7-BRF-211-Supporting-paper-methodologies-for-defining-and-accounting-for-New-Zealands-NDC-v2.pdf
- https://environment.govt.nz/assets/publications/Files/Aotearoa-New-Zealands-first-emissions-reduction-plan-Technical-information-annex.pdf (page 32)

You have the right to seek an investigation and review by the Office of the Ombudsman of my decisions relating to this request, in accordance with section 28(3) of the Act. The relevant details can be found on their website at: www.ombudsman.parliament.nz.

Please note that due to the public interest in our work the Ministry publishes responses to requests for official information on our OIA responses page shortly after the response has been sent. If you have any queries about this, please feel free to contact our Ministerial Services team: ministerials@mfe.govt.nz.

Ngā mihi

Megan Hurnard
Director - Climate
Ministry for the Environment | Manatū Mō Te Taiao

Document schedule

Document no.	Document date	Content	Decisions	OIA sections applied
1	11 June 2021	Forestry's projected contribution towards New Zealand's net zero emission budgets and 2030 NDC target	Released in full	N/A

Ministry for Primary Industries
Manatū Ahu Matua

Forestry's projected contribution towards New Zealand's net zero emission budgets and 2030 NDC target

Technical background paper

Prepared by Craig Elvidge

Ministry for Primary Industries

11 June 2021

Internal Government circulation only

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Introduction

1. This paper presents the projected contribution that afforestation, reforestation, and deforestation could make towards New Zealand's First Nationally Determined Contribution (NDC1) over 2021–2030, and New Zealand's net zero 2050 target and emission budgets.

2. The Ministry for Primary Industries (MPI) is responsible for compiling the forestry projections for New Zealand's NDC1 target and emission budgets. The forestry projections are subject to regular internal and external peer review and quality control processes. The Ministry for the Environment (MfE) reviews the model, calculations, and assumptions upon each yearly update. MPI also completes regular reviews of the documentation, data, methods, model, calculations, and results. The NDC1 forestry projections are also subject to the United Nations Framework Convention on Climate Change (UNFCCC) review processes and guidelines to ensure the projections are complete, accurate, consistent, transparent, and comparable.

3. The forestry projections are under continuous improvement and subject to the best information available at the time. These forestry projections are based on land use statistics, scientific knowledge and policies that influence land use. Information was sourced from the latest Inventory report (MFE's 2019 Greenhouse Gas Inventory (GHGI) Report published in April 2021), which contains emissions estimates from 1990 to 2019. Projections are based on MPI commissioned research findings and analysis, surveys of forest owners and industry information.

4. These forestry projections are used to analyse New Zealand's potential international climate change commitments, emission budgets towards net zero in 2050, long-term mitigation planning and NZ ETS policy development. The forestry projections use the GHGI data from 1990–2019 and projections from 2020–2050. The projections include assumptions around land use change, forest management practices, forest owner intentions, and the impact of carbon prices and policy settings.

5. Scientific uncertainty, information gaps and the range of possible future outcomes are reflected in a scenario-based analysis representing circumstances expected to result in the maximum, most likely and minimum removals (termed 'Upper', 'Base-case' and 'Lower' removal scenarios). The scenarios include the likely ranges of the major contributing factors that influence removals and emissions from forestry activities.

6. Projections by their nature are highly uncertain. Although, the uncertainty in the projections is provided for in scenario modelling, these scenarios are based on our best estimates of landowners' behaviours and cannot consider future policy direction. Therefore, they should be considered as an estimate rather than a certainty.

Frequency of update

7. These projections are used to estimate the contribution of forests towards New Zealand's NDC1 target and emissions budgets are updated each year based on revised inventory data, changes in policy settings, or the completion of research and analysis into activity data, trends, drivers, and emissions factors.

File location

8. This document: Documentation

9. The model: Model

Changes since last update

10. The most significant changes since the projections completed in 2020 are listed below.

    a. This update includes the latest inventory emission factors and activity data used in the 2021 (1990-2019) GHGI report. Other general improvements to emissions factors and assumptions are included in the 2021 update. The 2021 projection update also applies a single area weighted species yield to calculate post-1989 forest removals up to the long-term average. Previous projections were based on individual species yields.

    b. The 2021 update includes afforestation and deforestation projections from 2019 – 2050 based on the 2021 Afforestation and Deforestation Intentions report.

11. Table 1 compares 2020 and 2021 forestry projections. The increase in projected removals is mainly due to higher levels of afforestation projected to be established over the 2020 – 2024 period than previously modelled.

Table 1: Comparing 2020 and 2021 projections towards New Zealand's NDC1 target by scenario (Million tonnes CO_2)

Scenario	2020 Projections	2021 Update
Lower	-62	-71
Base-case	-74	-81
Upper	-79	-90

Note 1: Applies NZ's Paris NDC1 target accounting rules (Post-1989 forest averaging and all forest deforestation)
Note 2: Negatives (-) represent CO_2 removals from the atmosphere, while positives (+) represent CO_2 emissions to the atmosphere.
Note3: Excludes any projected emissions / removals from pre-1990 forests.

12. Table 2 compares the forestry projection completed in 2020 to the 2021 update for emission budgets, 2050 net carbon zero, and NZ's NDC1. The increase in removals for the 2021 update is mainly due to higher forecast afforestation rates in the near term than previously forecast, and also improved mapping of afforestation over 1990 – 2019 in NZ's 2021 GHGI (see figure 1).

Table 2: Base-case 2020 and 2021 forestry projections (Million tonnes CO_2)

Target	2020 Projections	2021 Update
EB1	-24	-24
EB2	-43	-50
EB3	-59	-71
In the year 2050	-24	-25
NDC	-74	-81

Note 1: Applies NZ's Paris NDC 2030 target accounting rules (Post-1989 forest averaging and all forest deforestation)
Note 2: Negatives (-) represent CO_2 removals from the atmosphere, while positives (+) represent CO_2 emissions to the atmosphere.
Note3: Excludes any projected emissions / removals from pre-1990 forests.

13. The forest carbon model, long term averages, deforestation and afforestation data sources, assumptions and results are described in the following sections.

Carbon accounting methodology

14. The forest carbon model methodology used in these projections is based on a growth simulation method. Growth simulation for post-1989 forest starts at 1990 and uses a combination of national carbon yield tables that provide carbon stock and change estimates by age on a per-hectare basis.

15. The forestry projections model tracks the area planted and deforested through time and generates annual estimates of carbon stock and change by multiplying the area planted by the carbon yield per hectare. This method is used to estimate post-1989 forest removals from growth and emissions from all forest deforestation activities.

16. The growth simulation for post-1989 forest starts at 1990 which allows for legacy carbon emissions and removals from land use change between 1990 and 2019 to be included in the projections from 2020 - 2050, and for the forests average to be tracked for production forests. A weighted area species long term carbon average is applied to production post-1989 forests of 196.2 tC/ha, based on the Scion 2020[1] report.

17. Soil carbon and grassland emissions and removals from land use change into, and from forestry are included in the modelling consistent with New Zealand's GHGI methodology.

Long-term average carbon stock (LTA)

18. New Zealand submitted its intended 2030 Nationally Determined Contribution under the Paris Agreement to the UNFCCC in 2015, and the Addendum on LULUCF accounting in November 2015. This Addendum, confirmed in New Zealand's final NDC1 submitted to the UNFCCC in October 2016, sets out the basis for how New Zealand intends to account for forestry under its NDC1 commitment.

19. The principle behind the forestry rules contained in New Zealand's NDC1 is to retain the crediting of Afforestation/Reforestation (new forests), but only up until the long-term average carbon stock is reached. It does this by introducing an accounting distinction between 'new' and 'existing' activities. The averaging approach credits afforestation up until the long-term average carbon stock, and then transfers this land to the 'existing' forest category, where all subsequent removals from growth and harvest emissions are counted under a business-as-usual Reference Level. Currently, only pre-1990 forests are accounted for under this business-as-usual reference level (based on Kyoto Protocol CP2 accounting rules[2]).

20. The LTA has significant implications as to which production forests are accounted within NZ's NDC, emission budgets and net zero in 2050. For example, assuming harvesting occurs at 28, the LTA could be reached after 22 years. In this scenario only production forests established since 1999 would be included within NZ's NDC1 accounting, as forests planted between 1990 and 1998 will have already reached their LTA by 2021 and will have transitioned to Reference Level accounting.

21. Forests LTA carbon stocks and transition ages are based on research completed by Scion in 2020[3]. The long-term average within New Zealand's NDC1 and emission budgets is the average over the fifth rotation itself - i.e. after harvest residues and harvested wood products (HWPs) from previous rotations have stabilised. The projections assume harvesting occurs at age 28, with a resulting area weighted LTA of 196.2 tC/ha.

Carbon price assumptions

[1] Reporting New Zealand's Nationally Determined Contribution under the Paris Agreement using Averaging Accounting for Post-1989 forests S.J. Wakelin, T.S.H. Paul, T. West, L.J. Dowling

[2] Current International Panel on Climate Change (IPCC) Guidance allows countries to nationally define their appropriate roll over point in time. The IPCC default roll over is 20 years whereas New Zealand will use the long-term average carbon stock as the 'steady state' or transition point between categories.

[3] Reporting New Zealand's Nationally Determined Contribution under the Paris Agreement using Averaging Accounting for Post-1989 Forests, Scion, May 2020.

22. The ETR Bill was enacted into law by late June 2020[4]. This placed a cap on emissions in the New Zealand Emissions Trading Scheme (NZ ETS) and enables the Government to set emissions budgets that determine the amount of allowable emissions (the first period being 2022–2025). The March 2020 Treasury budget[5] also provided price options for surrender obligations[6] within the NZ ETS over the next few years.

23. The ETR Bill also introduces auctioning of New Zealand Units (NZUs) and accompanying price controls (set in regulations) to ensure the price of auctioned NZUs does not become unacceptably low or high. These price settings are the 'cost containment reserve' (set at $50 initially) and the 'price floor' ($20). An auction unit price in excess of $50 will trigger the cost containment reserve. Government could then release additional 'backed' units into the market to dampen prices. The price floor is the minimum price at auction. Cabinet has agreed to inflation-adjust these price controls annually.

Table 3: Carbon price scenarios used in the 2021 projections (nominal price)

Scenario	2021	2050*
Lower	$20	$36
Base	$35	$62
Upper	$50	$89

*NZU carbon price is inflation adjusted by 2 percent per year from 2021–2025 (Cab 2020-C-06573 ETS Settings Regulations). The same annual inflation rate is applied from 2026–2050.

Projection scenarios

24. Three scenarios are provided which address the uncertainty in the activity data and emissions factors, and assumptions used in the projections.

    a. **Upper removals:** This scenario assumes carbon prices around $50, average afforestation rates around 44,000 ha per year, and low deforestation rates.

    b. **Base-case**: This scenario attempts to capture the best estimate of current polices and measures on emissions and removals. This projection allows the Government (and Climate Change Commission) to estimate the mitigation impact if we continue with current settings and prices. This scenario assumes carbon prices around $35, average afforestation rates around 34,000 ha per year, and deforestation rates declining to around 750 ha per year by 2050.

    c. **Lower removals**: This scenario includes lower levels of afforestation and higher levels of deforestation compared to the base-case scenario. This scenario assumes carbon prices around $20, average afforestation rates around 24,000 ha per year, and higher deforestation rates.

25. The Lower, Base-case, and Upper scenarios also include forestry activities outside the NZ ETS that are not subject to carbon prices but have an impact on emission budgets and NZ's NDC1 accounting. Examples of these types of activities that are not subject to carbon prices include; emissions and removals from post-1989 forests not NZ ETS registered, emissions from pre-1990 natural forest deforestation and

[4] https://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/2020-C-06573%20NZ%20ETS%20settings%20regulations.pdf
[5] https://budget.govt.nz/budget/pdfs/estimates/v3/est20-v3-envir.pdf#page=13
[6] The carbon prices also include the impact of the changes to the fixed price surrender options6 (FPO). Participants have the option to use the $25 FPO for 2019 surrenders due by the end of May 2020 and will have the $35 FPO available for their 2020 emissions due by end of May 2021. Post-1989 forestry participants will have access to the $25 FPO for emissions from 2019 or earlier. For example, for an emissions return filed in 2021 covering 2018–2020: the $25 FPO could be used for 2018–2019 (or 2/3 of net emissions in that return), and the $35 FPO for 2020 (1/3 of net emissions).

emissions from pre-1990 planted forest deforestation which is exempt under the NZ ETS.

Permanent and uneconomic to harvest post-1989 forest

26. The forestry projections factor in a proportion of the smaller post-1989 forest planted between 1990 – 2018 that may not be harvested, but rather grows on beyond the optimal harvest age. This is based on MPI funded research completed by Scion in 2016[7] and by the University of Canterbury in 2018.[8] These research findings assume around 6.1 percent of post-1989 forest estate established between 1990 – 2018 is either unlikely to be harvested in the future, or that the forest is managed for other purposes. This permanent post-1989 forest is not treated under an averaging approach, rather under a stock change approach.

27. Estimates of permanent afforestation from 2019 are based on the 2021 Afforestation and Deforestation Intentions Report, where around 1/3 of total afforestation in the base case scenario is projected to be permanent.

Impact of NZ Government Policies and Measures

28. The methods in determining the carbon impact of each policy is briefly detailed. For the NZ ETS and government forestry initiatives only afforestation since the establishment[9] of the initiative is considered as being directly attributable. This then creates a distinction between forests that were established before and after the government initiative commenced, and ensures only forests established as a direct result of that initiative are included. The methods in determining the carbon impact of each policy is briefly described below.

29. The assessment of the historical and projected impact is primarily based on MPI data, annual evaluation surveys, research and modelling conducted by the University of Canterbury's School of Forestry. Annual deforestation intentions survey results from 2008 – 2021 are used to estimate the amount of deforestation that would occur 'with' and then 'without' the establishment of the NZ ETS. The deforestation estimates 'without the ETS' were then correlated with actual and projected deforestation rates to determine the impact of the NZ ETS at that time.

30. Historical afforestation that can be attributed to the NZ ETS from 2008 – 2019 is limited to only forests planted and registered since the establishment of the NZ ETS in 2008. This then creates a distinction between forests that were established before and after the government initiative commenced, and ensures only forests established as a direct result of the NZ ETS are included. NZ ETS afforestation projections from 2019 are based on the 2021 Afforestation and Deforestation Intentions Survey. The findings are used to estimate the 'additional' afforestation that can be attributed to the establishment of the NZ ETS.

31. The NZ ETS estimates are a combination of 'additional' afforestation and 'reduced' deforestation that could be attributed to the NZ ETS. The impact the NZ ETS has had on afforestation and deforestation varied between 2008 –2015 with the carbon price.

32. The impact of government programmes on removals also includes the Afforestation Grant Scheme, Permanent Forest Sink Initiative, Hill Country Erosion Programme, Erosion Control Funding Programme, and the One Billion Trees Programme.

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[7] Predicting harvesting and deforestation of radiata pine forest blocks using national spatial datasets (2016)
[8] https://www.mpi.govt.nz/dmsdocument/30687-intentions-of-forest-owners-following-harvest-of-post-1989-forests
[9] For example, the PFSI commenced in 2008 and enables landowners to receive carbon units through the creation of permanent forests since 1990. However only forests established and registered since 2008 are used to calculate the impact of 'additional' afforestation due to the PFSI.

Deforestation projections

33. Table 4 provides the projected area of forest deforestation from 2020–2050 used in the 2021 projections update.

34. Scenarios of future pre-1990 planted forest deforestation used in these projections are based on the 2021 Afforestation and Deforestation Intentions Report. This report estimated around 2,000 hectares of pre-1990 planted forest could be deforested between 2020–2030.

35. Natural forest deforestation estimates assume a continued small amount of regenerating land and tall forest clearance (around 630 hectares per year from 2020). Natural forest deforestation is projected to occur based on the average of the last six years reported in the 2021 GHGI. Lower and upper pre-1990 natural forest deforestation scenarios assume a 25% variation from the base-case scenario.

36. Post-1989 deforestation projections are based on small owner's intentions and the research completed by the University of Canterbury in 2018[10]. Post-1989 deforestation is assumed to be limited to production forest and forests planted between 1990–2007, as more recent plantings (from 2008) that include carbon revenue are assumed to have a more permanent management plan. No post-1989 deforestation is assumed to occur after 2036. The base scenario assumes 3.8% of post-1989 production forest planted between 1990–2007 could be deforested. Post-1989 forest deforestation is assumed to occur at the normal clear-fell optimal age of 28 years. All carbon in biomass is assumed to be an instantaneous emission at the time of deforestation.

37. Based on the 2021 Afforestation and Deforestation Intentions Report: 53% of all planted forest deforestation is assumed to be conversion infrastructure and mining, 31% to dairy (or dairy support), 10% to residential/lifestyle and 8% to sheep and beef.

38. Emissions resulting from post-1989 deforestation have a significant impact on the projected level of removals over the 2021–2030 period. The small owner deforestation estimate has a high level of uncertainty as owners' plans for the post-harvest use of their land is based on current opinions of future economic conditions, government policies, carbon prices, and land-use suitability. The amount of planned deforestation will change as unexpected events and trends occur.

Table 4: Projected deforestation scenarios from 2020 (hectares per year)

Forest type	Hectares / year	Deforestation scenarios		
		Lower	Base-case	Upper
Pre-1990 planted forest	2020	178	355	533
	2021-2050	0	118	533
Pre-1990 natural forest	2020 - 2050	472	630	787
Post-1989 forests	2020 - 2036	510	1,020	1,530
Post-1989 native	2020 - 2050	42	57	71

Afforestation projections

39. New Zealand has a history of changing land use in response to various drivers, predominantly economic. The trend for the past decade in New Zealand has been to convert more forestry into farmland (around 7,000 hectares per year) as this made the most financial sense given the high return on dairy farming. This trend is now starting to reverse, for reasons that include rising carbon and log prices, and growing awareness that trees can form an environmentally valuable and productive part of a

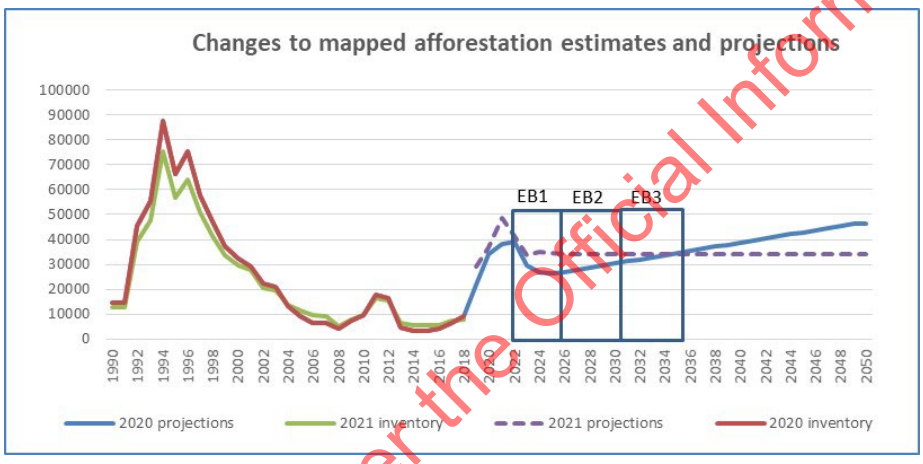
[10] https://www.mpi.govt.nz/dmsdocument/30687-intentions-of-forest-owners-following-harvest-of-post-1989-forests

wider farming operation. Between 1990 and 2017, afforestation was on average ~25,000 hectares per year. From 1992–1998, planting was particularly high (average of ~60,000ha per year). Planting then declined until 2008. From 2008–2012, afforestation increased, largely due to the incentives created by the ETS and Government planting schemes. Afforestation reached a low in 2014 due to the lower value of carbon units (~3000ha) and has remained relatively low up until 2018/19 due to the establishment of the One Billion Trees (1BT) programmes, increased log, and carbon prices.

40. Afforestation estimates are particularly challenging to forecast, and improvements to mapping changing historical estimates. Historical estimates from 1990 to 2019 are sourced from the 2021 GHGI report, while projections from 2020 to 2030 are based on the 2021 Afforestation and Deforestation Intentions Report and extrapolated to 2050 assuming similar incentives apply.

41. Figure 2 compares the 1990 – 2019 afforestation estimates contained in the 2020 and 2021 GHGI report, and the base-case afforestation projections used in the 2020 and 2021 projections.

Figure 2: 2020 and 2021 actual and projected afforestation rates



42. Over the longer-term, the ETS is projected to be a significant driver of afforestation, with rates projected to increase with the carbon price. Between 0.81 and 1.37 million hectares of new forest is projected to be established by 2050.

Table 5: Projected afforestation scenarios from 2020 – 2050 (Hectares)

Forest Type	Lower	Base-case	Upper
Natives	72,050	89,000	105,950
Permanent	171,400	219,700	268,000
Production	562,600	771,400	996,100
Total	806,050	1,080,100	1,370,050

43. Figure 3 shows the impacts that carbon price has had on levels of afforestation and deforestation since 2008. Land use in New Zealand[11] is very sensitive to current and future NZU carbon prices. Carbon price pathways can have a material impact on land-use decision making, and consequently, the level of mitigation required to meet emission reduction targets.

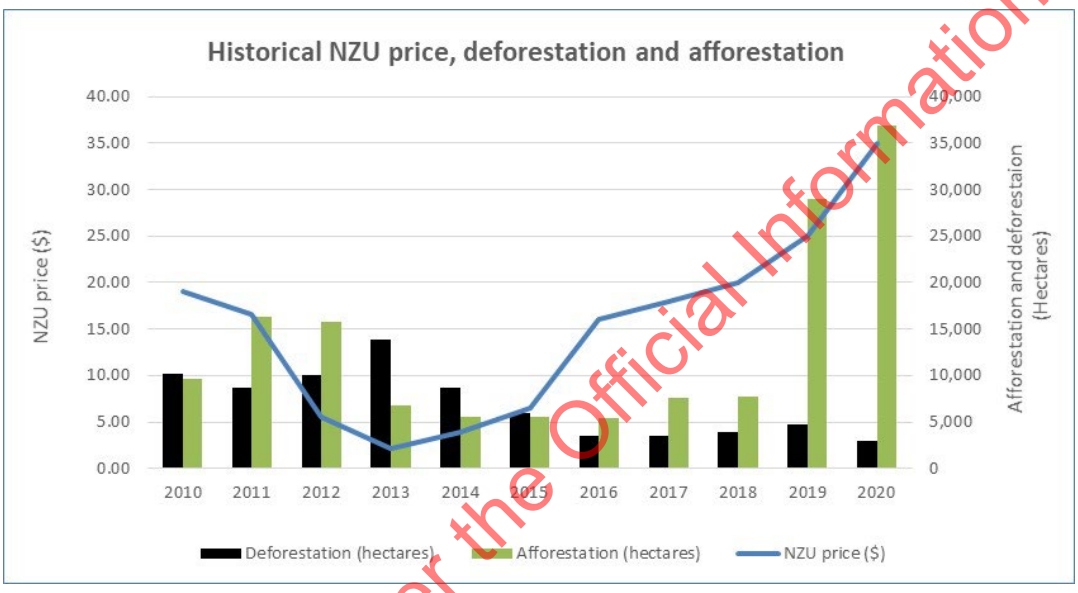
44. Historically, there has been a strong correlation between the rate of afforestation and Land Expectation Value (LEV). An increase in afforestation in 2011, and recent trends, signify the potential impact of carbon prices on increased forest value. Aside from log and carbon prices, additional factors which significantly incentivise afforestation include land availability, the different rates of return between forestry and

[11] Compared to many overseas countries, New Zealand has flex ble and dynamic land use. Our primary sector responds well to changes in markets and conditions, and landowners have considerable flexibility over changing land use.

other land uses, government planting schemes and future international and domestic emissions accounting rules.

45. Figure 3 shows that a higher NZ ETS deforestation liability (NZU carbon price) can significantly decrease rates of planted forest deforestation and increase afforestation rates. Until 16 May 2015, deforestation liabilities could be met with either domestic NZUs or international units, which were significant cheaper (ERU's were available at as low as 10 cents per unit). When this cheaper option was available, the NZ ETS had a limited impact on the level of deforestation. The value of NZUs has increased significantly since the restriction of access to international units. For example, the NZ ETS deforestation cost for one hectare has increased from approximately $250 in 2014 to $16,000 NZD in 2018.

Figure 3: Carbon price compared to historical and projected afforestation and deforestation rates



Note1: 2019 and 2020 afforestation rates based on the 2021 Afforestation and Deforestation Intentions Report
Note2: 2010 – 2019 deforestation rates based on the 2021 GHGI.
Note3: 2020 planted deforestation rates based on the 2021 Afforestation and Deforestation Intentions Report
Note4: 2020 pre-1990 native forest deforestation rates based on projections.
Note5: Afforestation includes both government programme funded and commercial.
Note 3: Carbon price is merely one of a multitude of reasons why a landowner may, or may not, choose to afforest. There are many limits to afforestation and future afforestation rates are subject to a range of factors such as: The landowner's interest in forestry (landowner preference), current and future wood product returns, differing rates of return between forestry and other land uses, nursery capacity and location, forest/landowners future intentions, capital to invest, future international and domestic carbon accounting rules, health and safety issues related to topography, government planting schemes, current private sector interest in participating in forestry schemes administered by the government, forest and landowner's carbon and wood price predictions, seed availability from suppliers and nurseries, labour (planting crews), and suitable land at the right price, government policy and regulations (National Environmental Standards for Plantation Forestry).

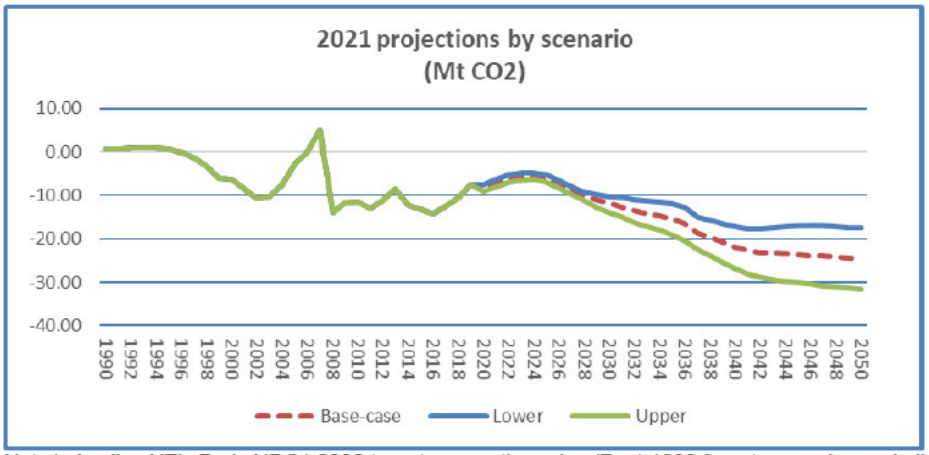
Results

46. This section provides a summary of the main 2021 projection results. Additional tables are provided in the appendix.

Post-1989 forest averaging and deforestation

47. Figure 4 shows net forestry carbon dioxide removals over 1990–2050. Estimates are provided either side of the actual NDC1 time period, and emission budgets. Carbon removals from initial planting are offset by the emissions from soil, and the removal of the previous land use biomass, therefore carbon sequestration is low for the first 6-7 years of exotic forest planting. The decline in removals over 2006 – 2008 is due to high deforestation rates over that period. The lower and upper projection scenarios reflect the uncertainty in projecting future rates of afforestation and deforestation.

Figure 4: Net removals based on NDC1 accounting (Millions of tonnes CO_2)



Note1: Applies NZ's Paris NDC1 2030 target accounting rules (Post-1989 forest averaging and all forest deforestation)
Note2: Negatives (-) represent CO_2 removals from the atmosphere, while positives (+) represent CO_2 emissions to the atmosphere.

48. Table 6 provides projected removals based on Lower, Base, and Upper scenarios. Forestry is estimated to contribute between 71 and 91 million tonnes of CO_2 removals towards our NDC1. This range mainly reflects uncertainty in the level of afforestation and deforestation over the NDC period.

Table 6: Contribution towards NZ's emissions budget, NDC1 and 2050 target

Target	EB1	EB2	EB3	NDC	Net Zero
Period	2022-2025	2026-2030	2031-2035	2021-2030	In 2050
Lower	-20.5	-43.9	-56.6	-70.8	-17.5
Base-case	-24.3	-49.6	-70.6	-81.3	-24.8
Upper	-26.8	-56.1	-85.7	-90.9	-31.7

Note1: Applies NZ's Paris NDC 2030 target accounting rules (Post-1989 forest averaging and all forest deforestation)
Note2: Negatives (-) represent CO_2 removals from the atmosphere, while positives (+) represent CO_2 emissions to the atmosphere.

49. Table 7 shows that forestry could remove around 25 million tonnes CO_2 in 2050, while gross emissions are projected to be around 63.3 million tonnes CO_2 in 2050. This is based on MfE December 2020 gross emissions projections out to 2050[12].

50. Table 7 and Figure 4 show the contribution from existing (1990 – 2019) and new forest (projected to be planted from 2020). Existing forests contribute significantly towards emission budgets 1, 2 and 3 (91%, 42% and 23% of total budgeted removals respectively). But this contribution diminishes over time as the exotic production forests planted over 1990 – 2019 reach their long-term average carbon stock and transition to forest management (counted under an international forest management carbon accounting approach)

51. Forests planted between 2020 – 2050 are projected to contribute the vast majority of removals in the year 2050. It is estimated that these new forests will contribute 24.1 Mt CO2 or 95.6 percent of total mitigation in the year 2050.

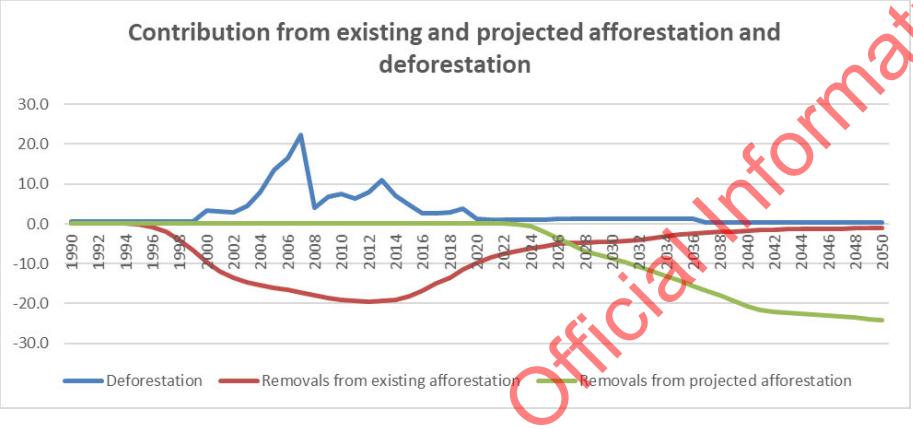
[12] https://www.mfe.govt.nz/climate-change/emissions-reduction-targets/projected-emissions

Table 7: Base-case contribution towards NZ's emissions budget, NDC1 and 2050 target

Existing or projected	EB1	EB2	EB3	NDC	Net Zero
	2022-2025	2026-2030	2031-2035	2021-2030	2050
Existing forest removals	-26.0	-23.6	-17.7	-58.0	-1.1
New forest removals	-2.6	-32.1	-59.4	-34.7	-24.1
Deforestation	4.3	6.1	6.5	11.4	0.4
% removals from existing forests	**90.8%**	**42.3%**	**23.0%**	**62.6%**	**4.4%**

Note1: Applies NZ's Paris NDC1 2030 target accounting rules (Post-1989 forest averaging and all forest deforestation)
Note2: Negatives (-) represent CO2 removals from the atmosphere, while positives (+) represent CO2 emissions to the atmosphere
Note3: Under all scenarios and species area weighted LTA carbon stock of 196.2 tC/ha (approx. 22 years) is assumed.
Note4: New Zealand's first NDC is over 2021 – 2030 so include 10 years of forestry emissions and removals. While 2050 is just a single years' worth of emissions and removals.

Figure 5: Base case projected contribution from existing and new forests



52. Table 8 shows the deforestation scenarios and emissions over budget periods and NDC1 by forest type. The level of deforestation and resulting emissions have a significant impact on the total contribution forestry could have on NZ's NDC1 and emissions budgets.

Table 8: Base-case deforestation over NDC1 (Million tonnes carbon dioxide)

Target	EB1	EB2	EB3	NDC	Net Zero
Period	2022-2025	2026-2030	2031-2035	2021-2030	2050
Post-1989 Forests	3.5	4.5	4.5	8.9	0.0
Pre-1990 Planted	-0.5	0.0	0.4	-0.6	0.1
Pre-1990 Natural	1.2	1.6	1.7	3.1	0.3
Total	4.3	6.1	6.5	11.4	0.4

Note1: Negatives (-) represent CO_2 removals from the atmosphere, while positives (+) represent CO_2 emissions to the atmosphere.
Note2: The scenarios refer to net emissions.
Note3: Numbers may not add due to rounding.

53. Table 9 shows forestry's contribution towards NZ's emissions budgets and NDC by forest type.

Table 9: Base-case contribution by forest type (Million tonnes carbon dioxide)

Target	EB1	EB2	EB3	NDC	Net Zero
Period	**2022-2025**	**2026-2030**	**2031-2035**	**2021-2030**	**2050**
Natives	-3.7	-5.1	-5.1	-9.6	-1.0
Exotic production	-17.8	-35.2	-50.9	-59.0	-15.6
Exotic Permanent	-7.1	-15.4	-21.1	-24.1	-8.6
Total removals	-28.6	-55.7	-77.1	-92.7	-25.2
Deforestation emissions	4.3	6.1	6.5	11.4	0.4
Total	-24.3	-49.6	-70.6	-81.3	-24.8
% Native Forests	15%	10%	7%	12%	4%
% Exotic Production	73%	71%	72%	73%	63%
% Exotic Permanent	29%	31%	30%	30%	35%

Note1: Numbers may not add due to rounding.
Note2: Negatives (-) represent CO_2 removals from the atmosphere, while positives (+) represent CO_2 emissions to the atmosphere.
Note3: Only funding for 2019–2023 is assumed for the Grants programme. Assumes 67% native and 33% exotic.
Note4: Joint Ventures assumes 100% exotic
Note5: Soils and biomass loss from the establishment of exotic permanent forest is included within exotic production forest

54. The projected impact of the various government forestry initiatives is provided in table 10. The combination of historical Government forestry initiatives and the NZ ETS is projected to have an important contribution to increasing net removals, and the contribution to emission budget and targets in the future. Without the inclusion of New Zealand Government forestry-related policies and measures, projected net removals would be significantly lower.

Table 10 provides the contribution from government forestry programmes towards emission budget and targets

Programme	EB1	EB2	EB3	NDC	Net Zero
	2022-2025	2026-2030	2031-2035	2021-2030	2050
Emission Trading Scheme	-8	-31	-51	-41	-20.1
Grants Programme	-1	-3	-3	-4	-0.1
Partnerships	-1	-3	-2	-3	0.0
Afforestation Grant Scheme	-2	-4	-3	-6	-0.3
Hill Country Erosion Programme	-1	-4	-4	-5	-0.2
Permanent Forestry Sink Initiative	-1	-1	-1	-2	-0.1
Erosion Control Funding Programme	-4	-5	-5	-10	-0.6
Total Government Programmes	**-19**	**-50**	**-68**	**-72**	**-21.4**
Avoided ETS Deforestation*	-5	-6	-6	-12	-1.2
Total All	-24	-50	-71	-81	-24.8

*Compares the levels of deforestation with and without an ETS, the removals represent avoided deforestation emissions
Note1: Removals are expressed as negatives (-) and represent net CO_2 removed from the atmosphere, while emissions are expressed as positives (+) and represent net CO_2 emissions to the atmosphere.
Note2: Removal estimates exclude the possibility of double counting. Afforestation and removals estimates are only assigned to the initiative or scheme that was attributed to the forest establishment.

Pre-1990 forest Reference Level

55. New Zealand will account for carbon stock changes in pre-1990 forests against a 'business-as-usual' (BAU) reference level. This is based on projected emissions during the compliance period (2021-2030) under the assumption that the forest management practices that applied during a baseline reference period will continue during the compliance period. If actual net removals of atmospheric CO_2 by pre-1990 forests are greater than the reference level net removals, an accounting credit will be generated. This creates an incentive for changes in management practices that increase net removals from these forests.

56. MPI have commissioned research and analysis to model, assess and project what the BAU level of carbon could be for pre-1990 forests over the NDC period. There are two phases under this research. The first phase is to compile the data and develop the model to be used to calculate the Forest Reference Level. The second phase is to examine the potential for increasing net removals by pre-1990 forests in terms of new practices, their impacts on net removals, their applicability to different forest types and the extent of those forests, and the opportunity to incentivise these management changes.

Limitations

57. These projections should only be used to determine the amount that forestry could contribute towards New Zealand's NDC1 target, emissions budgets and 2050 net carbon zero based on current policy settings. Only post-1989 forests up to their long-term average carbon stock and all forest deforestation is included. Other land use categories such as Grassland, Wetlands, Croplands, Other Land and Settlements are not included at this time.

Uncertainty

58. Uncertainty has been included in the projections using scenarios that incorporate variations in afforestation and deforestation. Even with completed external research and analysis the level of uncertainty in future harvest ages and rotation lengths remains high and is a significant area of uncertainty within the 2021 projections.

59. Afforestation and deforestation rates are challenging and difficult to predict. Afforestation rates have been surveyed out to 2030 but regular updates are needed

to ensure that the afforestation projections factor in the most current data, assumptions, and drivers.

60. Post-1989 deforestation are based on research and analysis completed by the University of Canterbury in 2018[13] and the 2021 Afforestation and Deforestation intentions Survey. However there still remain significant uncertainty in the amount, timing of post-1989 deforestation. Continued research in this area is needed to increase our understanding on the landowner's drivers, timing, and impacts.

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Appendix

Table 1: Upper removals scenario (Area)

Upper Scenario (Area)		2021-2030	2022-2025	2026-2030	2031-2035	2050
Afforestation (ha)	Native (ha)	36,850	13,400	15,750	15,625	3,125
	Exotic (ha)	413,500	167,775	205,125	205,125	41,025
	Total (ha)	450,350	181,175	220,875	220,750	44,150
Deforestation (ha)	Post-1989 Forests	5,524	2,210	2,762	2,762	0
	Pre-1990 Native	4,724	1,890	2,362	2,362	472
	Pre-1990 Planted	0	0	0	0	0
	Total (ha)	10,249	4,099	5,124	5,124	472

Table 2: Upper removals scenario (Mt CO2)

Upper scenario (Mt CO2)		2021-2030	2022-2025	2026-2030	2031-2035	2050
Total	Total	-90.9	-26.8	-56.1	-85.7	-31.7
Afforestation (Mt CO2)	Native	-9.7	-3.7	-5.2	-5.3	-1.1
	Exotic	-85.9	-24.8	-53.7	-83.6	-30.8
	Sub Total	-95.7	-28.5	-58.8	-88.9	-32.0
Deforestation (Mt CO2)	Post-1989 Forests	4.2	1.7	2.2	2.2	0.0
	Pre-1990 Native	2.3	0.9	1.2	1.2	0.3
	Pre-1990 Planted	-1.8	-0.9	-0.6	-0.2	0.0
	Sub Total	4.7	1.6	2.7	3.3	0.3

Table 3: Base-case removals scenario (Area)

Base-case (Area)		2021-2030	2022-2025	2026-2030	2031-2035	2050
Afforestation (ha)	Native (ha)	32,400	12,100	12,600	12,500	2,500
	Exotic (ha)	330,800	132,500	157,500	157,500	31,500
	Total (ha)	363,200	144,600	170,100	170,000	34,000
Deforestation (ha)	Post-1989 Forests	10,766	4,306	5,383	5,383	0
	Pre-1990 Native	6,299	2,520	3,150	3,150	630
	Pre-1990 Planted	1,183	473	592	592	118
	Total (ha)	18,248	7,299	9,124	9,124	748

Table 4: Base-case removals scenario (Mt CO2)

Base-case (Mt CO2)		2021-2030	2022-2025	2026-2030	2031-2035	2050
Total	Total	-81.3	-24.3	-49.6	-70.6	-24.8
Afforestation (Mt CO2)	Native	-9.6	-3.7	-5.1	-5.1	-1.0
	Exotic	-83.0	-24.9	-50.6	-72.0	-24.2
	Sub Total	-92.7	-28.6	-55.7	-77.1	-25.2
Deforestation (Mt CO2)	Post-1989 Forests	8.9	3.5	4.5	4.5	0.0
	Pre-1990 Native	3.1	1.2	1.6	1.7	0.3
	Pre-1990 Planted	-0.6	-0.5	0.0	0.4	0.1
	Sub Total	11.4	4.3	6.1	6.5	0.4

Table 5: Lower removal scenario (Area)

Lower Scenario (Area)		2021-2030	2022-2025	2026-2030	2031-2035	2050
Afforestation (ha)	Native (ha)	27,950	10,800	9,450	9,375	1,875
	Exotic (ha)	264,200	113,325	110,075	109,875	21,975
	Total (ha)	292,150	124,125	119,525	119,250	23,850
Deforestation (ha)	Post-1989 Forests	16,007	6,403	8,004	8,004	0
	Pre-1990 Native	7,874	3,150	3,937	3,937	787
	Pre-1990 Planted	5,325	2,130	2,663	2,663	533
	Total (ha)	29,206	11,682	14,603	14,603	1,320

Table 6: Lower removal scenario (Mt CO2)

Lower scenario (Mt CO2)		2021-2030	2022-2025	2026-2030	2031-2035	2050
Total	Total	-70.8	-20.5	-43.9	-56.6	-17.5
Afforestation (Mt CO2)	Native	-9.6	-3.7	-5.0	-4.9	-0.9
	Exotic	-82.2	-25.0	-49.7	-63.0	-17.6
	Sub Total	-91.8	-28.7	-54.8	-67.9	-18.5
Deforestation (Mt CO2)	Post-1989 Forests	13.5	5.4	6.8	6.8	0.0
	Pre-1990 Native	4.0	1.6	2.0	2.1	0.4
	Pre-1990 Planted	3.5	1.2	2.0	2.4	0.5
	Sub Total	21.0	8.2	10.9	11.3	0.9