



New Zealand's Net International Position during the First Commitment Period

Review of projections of greenhouse gas emissions and sinks

1 Executive Summary

The Government is expecting absorption of CO₂ by Kyoto forests during the first Commitment Period (2008 – 2012) to more than adequately cover New Zealand's increase in emission above 1990 levels, which is New Zealand's target level. With its policies, the Government expects emissions to have grown to 359 million tonnes CO₂equivalent (MT CO₂) during the First Commitment Period, compared to a target of 309 mt CO₂. The Government expects forest sinks to provide credits of 105 mt CO₂ to cover this growth.

The Government's expectations are based on four key assumptions:

- That agricultural emissions will grow in the next ten years at a fraction of the rate at which they have been growing since 1990
- That total energy emissions will actually decline from their current levels during the next ten years
- That new plantings of Kyoto forests (plantings on land that was not used for forestry before 1990) will continue at 30,000 ha per annum
- That non-Kyoto forests (planted prior to 1990) will be replanted in their entirety as they are harvested.

Our analysis concludes that these assumptions are unlikely to hold. We believe:

- Agricultural emissions are likely to continue growing in line with agricultural output, particularly since these emissions are exempt from carbon tax
- Energy emissions growth may slow down in response to Government's policies, but there is no basis for believing that the overall level will fall
- New plantings of Kyoto forests have already fallen sharply, and are likely to remain at a level well below the assumed 30,000 ha per annum. Developments in the international lumber markets are likely to make the presumed expansion rates unviable
- A significant and growing proportion of non-Kyoto forests is not likely to be replanted once harvested. Deforestation will be driven by the economics of the forestry sector and alternative land uses.

We used the NZIER model as well as the Government's own model of the forestry sector to estimate the effects of more probable assumptions on New Zealand's net international position during the First Commitment Period. We note that while we were not able to use the Government's own ABARE model, the structure of the model suggests that it would produce very similar results to the NZIER model.

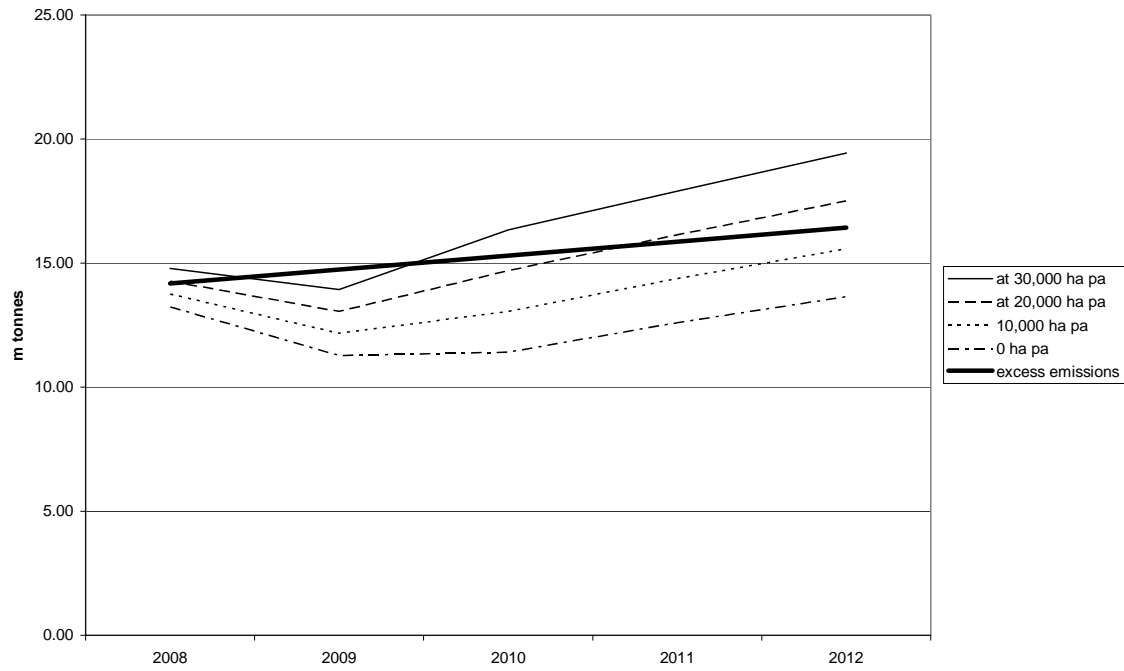
The table below summarizes the difference between the Government's current official position and our analysis.

	Million tonnes CO2 over 5 year commitment period	
	Government	Castalia
Assigned Amount	309	309
Emissions with announced policies	359	385
Gross Excess	50	76
Sinks	105	91
Deforestation	0	22
Net Position	55	(7)

The key result is that the Government's planned for surplus of 55 mt CO2 is likely to be turned into a deficit of 7 mt CO2 for the first commitment period. There is obviously significant uncertainty in both our and the Government's forecasts, so that both should be interpreted as central scenarios around a range of possible outcomes.

That deficit represents a fiscal liability. The deficit in the Second Commitment Periods will be even greater if, as expected, the emission reduction targets are strengthened by more than the expected increase in net sequestration. The following graph summarizes the net position. It draws net sinks – sequestration from Kyoto forests minus deforestation of all forests – against the forecast annual excess of gross emissions over the assigned amount. Net sinks are drawn for different new planting assumptions.

New Zealand's Net International Position: Excess Emissions and Net Sinks



2 Introduction

The Government's attitude to the economic effects of the Kyoto Protocol is strongly influenced by the belief that during the first commitment period New Zealand is in a comfortable position. The Government has repeatedly emphasized its belief that New Zealand has carbon sinks well in excess of its emission reduction obligations. Our research indicates that, even in the short term, this sense of abundance may be misplaced. It appears that New Zealand would be lucky to have sufficient credits to cover the growth in emissions, and that some level of deficit is more likely.

Domestic policies announced by the Government so far are likely to result in only a minimal slow down in carbon emissions growth. Energy and agricultural emissions growth is likely to be higher than the Government figures. The forest industries are not in good financial health and new plantings are likely to be substantially below the Government's expectations. The credits from CO₂ sequestration in growing Kyoto forests are therefore likely to be lower than the Government's projection. In addition, the Government has not allowed for deforestation. When forests, Kyoto and non-Kyoto, are harvested, if they are not replanted and are instead converted to another land use, there is a debit for deforestation. That debit from non-Kyoto forests could be substantial during the First Commitment Period.

This paper examines these projections in greater depth.

3 The Government's numbers

The numbers underlying the official Government position have not been published officially. The current official forecast of expected emissions during the first commitment period by the Climate Change Office is 383 mt CO₂ over five years under the business as usual scenario, and 359 mt CO₂ with announced policies. This forecast applies a new methodology to the calculation of agricultural methane emissions, which has resulted in a substantially lower level of such emissions in each year. Correspondingly, New Zealand's assigned amount (based on 1990 emissions) has also been reduced to 309 mt CO₂.

While the Government does not provide an official breakdown of its projection, we believe that the following breakdown reflects the official view. The table below presents this breakdown on an annual basis, with the 2001 annual emissions for comparison (2001 is the latest year for which actual emissions are available):

(million tonnes CO₂)	2010 with policies	2001 Actual
Agriculture	37.9	35.8
Energy and Industrial Processes	32.3	34.1
Waste	1.5	2.3
Total Gross Emissions	71.7	72.2

The Government still assumes that the accumulated sinks for the first commitment period will amount to 105 mt CO₂. This figure represents sequestration of CO₂ by Kyoto forests during the First Commitment Period, assuming new plantings at 30,000 ha per annum through to 2012. Surprisingly, it does not have any deduction for deforestation, which is the conversion of forest land to other land uses on harvest. Deforestation has been low in New Zealand in recent years (between 2 to 4 percent of harvested areas), but is expected to rise over the next decade because of high timber supply from around the world, and hence poor returns, especially on marginal forest land.

We summarize the official numbers for the first commitment period below:

(million tonnes CO₂)	Business as Usual	With Policies
Forecast emissions	383	359
Target – Assigned Amount	309	309
Difference to be covered by sinks	74	50
Sinks	105	105
Surplus	31	55

4 Our projections of Emissions

Our business as usual projections and projections with different levels of carbon tax for 2010 using the NZIER model are presented below. We think that the most appropriate comparator to the Government’s official “with policies” forecast is the scenario with \$15 carbon tax – this is consistent with the MED’s reference scenario for energy use and emissions.

2010 CO2 Emissions in million tonnes

Tax level	Agricultural emissions	Other sector emissions (including industrial processes and waste)	Total emissions
No tax (business as usual)	39.7	39.5	79.2
\$5 per tonne	39.5	38.9	78.4
\$10 per tonne	39.3	38.3	77.7
<i>\$15 per tonne</i>	<i>39.2</i>	<i>37.9</i>	<i>77.1</i>
\$20 per tonne	39.0	37.5	76.5
\$25 per tonne	38.8	37.2	76.0

Our projections indicate 79.2 mt for 2010 on a business as usual basis and 77.1 mt for 2010 with announced policies, which represents 396 mt CO₂ and 385 mt CO₂ respectively for the First Commitment Period. The application of the \$15 carbon tax would contract output and induce re-allocation of resources to reduce emissions by about 2.5 percent over the First Commitment Period. The model predicts that, with a \$15 tax, GDP would decline by 0.1 percent – or about \$100 million per annum if excess sinks are available. If there are no excess sinks, output falls by about \$300 million per annum.

We discuss the forecasts for the main sectors below.

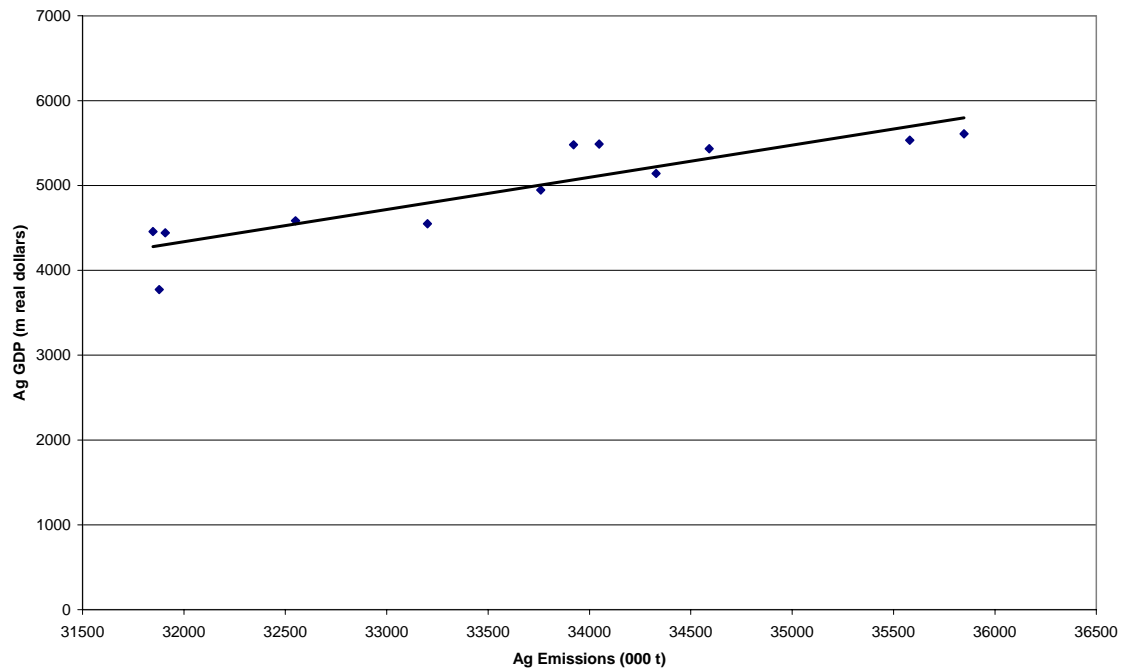
4.1 Agriculture Emissions

The Government's projection for agricultural emissions appears to be 37.9 mt CO₂ for 2010, compared with actual emissions of 35.6 mt CO₂ in 2000. We believe the Government's projection to be too low. It appears to assume either a significant break in the relationship between agricultural output and emissions, or an unrealistically slow pace of expansion in agricultural GDP.

There are two ways to project agricultural emissions. The first is to look at the relationship between agricultural output and agricultural emissions, and to project emissions forward on that basis. The other method is to examine the relationship between the numbers of agricultural animals, the trend in emissions per animal, and the total level of agricultural emissions. MAF publishes long range livestock forecasts, and these can be used for forecasting.

We begin by looking at the relationship between the agricultural GDP and emissions. The graph below plots the actual relationship from 1990 to 2000. The relationship appears to be quite stable.

Plot of Agricultural GDP Against Agricultural Emissions



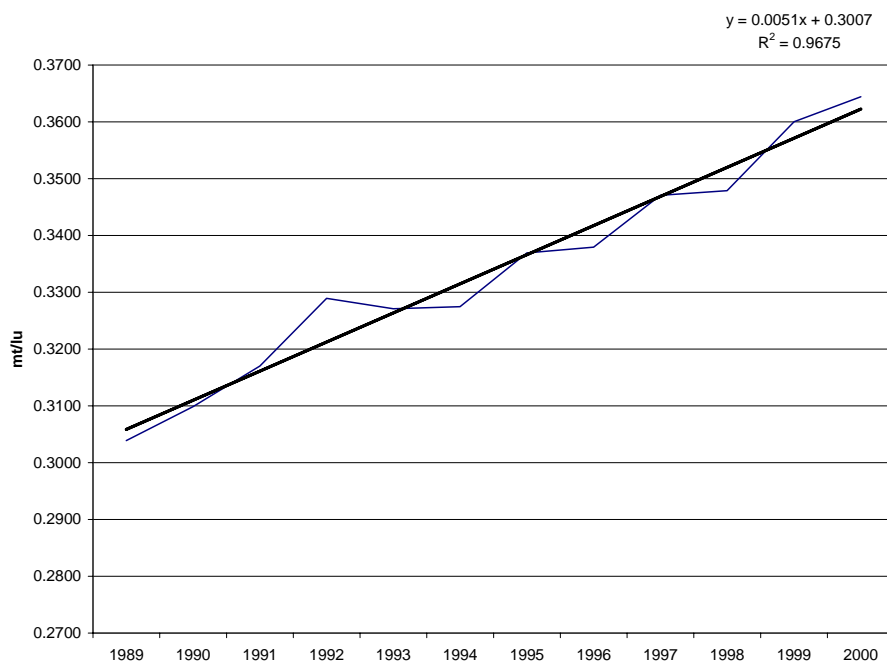
Agricultural GDP increased by 25 percent between 1990 and 2000. Over this 10 year period, agricultural emissions grew by 11.6 percent. On current forecasts, agricultural GDP is again expected to grow by about 25 percent in the ten years from 2000 to 2010. We would expect at least similar growth in emissions to the previous decade, but the MfE projection would imply that emissions over the same period would increase by only about 6.5 percent. This is half the historic relationship between the rate of growth of agricultural

output and the rate of growth of agricultural emissions. We are not aware of any biological or economic reasons for the change in the relationship.

The alternative way to look at these numbers is to consider how emissions are likely to evolve given the forecast changes in livestock numbers, and the increase in the level of emissions per animal. Emissions per animal have been growing due to more intensive farming practices and breeding improvements, allowing each animal to process more grass. The chart below shows the actual levels of emissions per livestock unit from 1990 to 2001, and the trend rate of increase.

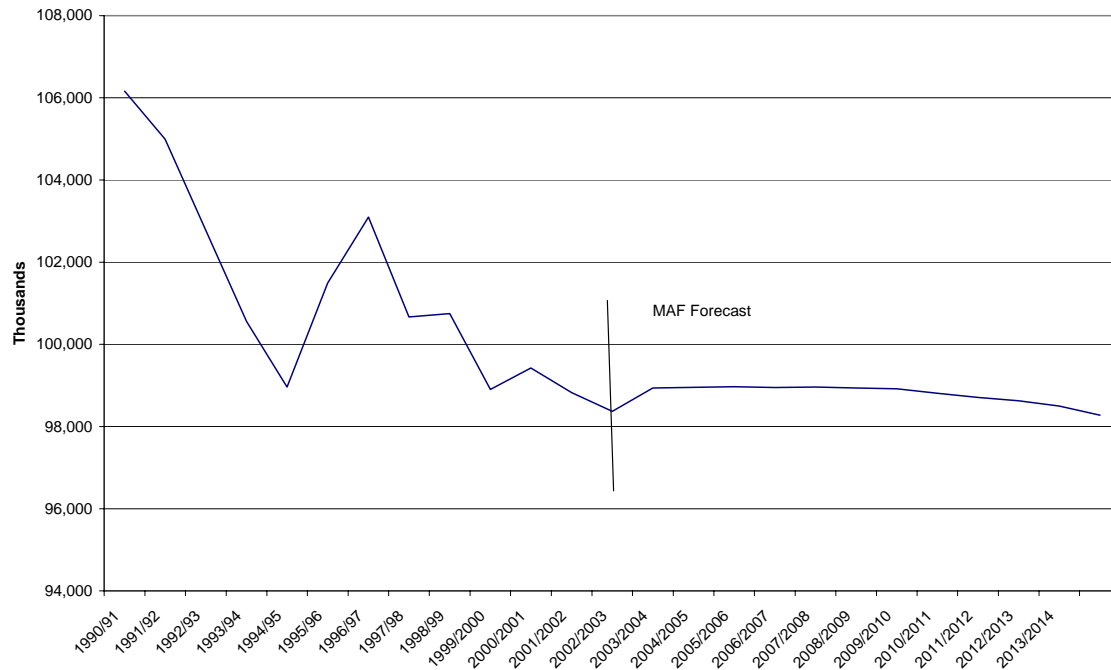
The average livestock unit is calculated using MAF conversion factors, which express dairy animals, beef animals, deer and goats as sheep equivalents in terms of feed use. A dairy cow is 7 sheep, a beef unit is 4.5 sheep, a deer is 1.8 sheep and a goat is 0.5 sheep.

Agricultural emissions per livestock unit



The following graph sets out official MAF livestock forecasts, converted to standard livestock units. We note that total livestock units declined by 6% from 1990 to 2001. The increase in agricultural emissions is entirely explained by the growth in emissions per animal, which offset the reduction in the number of animals.

Livestock Units



If we apply the trend increase in emissions per livestock unit to the forecast number of livestock units, total emissions can be expected to rise to 40.3 mt CO₂ by 2010. In other words, on this basis, the same level of agricultural GDP growth during 2000 – 2010 would lead to faster emissions growth than in 1990 – 2000. This is because the expected GDP growth is associated with almost flat livestock numbers, rather than the declining number of livestock during 1990 – 2000.

The agricultural emission forecast derived from extrapolating the existing relationship between sector output growth and emissions growth gives a slightly lower number of 39.7 mt CO₂ of agricultural emissions in 2010. The NZIER model then tracks the decline in these emissions when carbon tax is applied to inputs into agriculture. In essence, the model picks the decline in agricultural output compared to business as usual as the costs of production increase as a result of the carbon tax. Hence, our “with policies” forecast of agricultural emissions using the GDP approach is 39.2 mt CO₂ in 2010.

For the purposes of this report, we prefer to adopt the more conservative GDP-based approach than the livestock-based approach. We note, however, that this conservatism leaves a further upside for our projections of agricultural emissions. As it stands, our forecast of agricultural emissions is 2.4 mt CO₂ per annum greater than the Government’s forecast, a difference of 12 mt CO₂ over the first commitment period.

4.2 Energy and Other Emissions

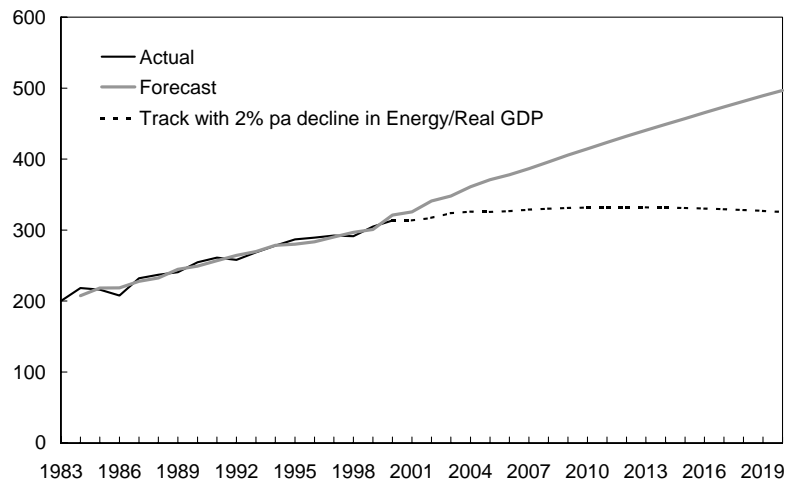
The Climate Change Office projections for energy and industrial process carbon dioxide emissions of 32.3 mt CO₂ per annum appear to be at odds with the MED energy carbon dioxide emissions projections. The MED reference scenario projects energy and industrial process carbon dioxide emissions for 2010 at 31.1 mt CO₂. This scenario is based on a carbon tax of \$15 per tonne and on a partial achievement of NEECS energy efficiency objectives. Thus, the MED reference scenario is 1.1 mt CO₂ per annum lower than the official projection.

We consider that the MED projection of 31.1 mt CO₂ in 2010, compared to the Climate Change Office's actual of 34.1 mt CO₂ in 2001, is itself off the mark. The energy efficiency assumptions underlying the projections are too optimistic. There appears to be a stable long term relationship between energy use and GDP in New Zealand. Short term variations, such as the apparent decline in the energy to GDP ratio in 1990, tend to be corrected in the medium term. In any case, reductions in energy use per unit of GDP in 2003 were the result of extraordinary conservation measures in a dry year, rather than indications of any new trend.

The graph below shows the difference between a forecast based on the currently well established trend relationship between energy and real GDP, and the track set out in the MED reference scenario. While the proposed policies may alter the relationship somewhat, the extent of change suggested in the MED track does not appear to be plausible.

Projected energy use

PJ



Source: NZIER and MED

Our projections for non-agricultural emissions are based on the following assumptions:

- Further NGAs for cement, steel, aluminium, wood processing and dairy processing in addition to the existing NZ Refining Company NGA
- Methanex is assumed to close down its New Zealand operations before 2008
- Carbon tax is applied to all non-agricultural emissions not covered by NGAs. The tax base in the model is approximately 20 mt CO₂ per annum. This does include possible further exemptions granted to “Projects”
- Business as usual case is generated by the model to be consistent with NZIER’s macroeconomic forecasts to 2010. NZIER is currently among the most pessimistic forecasters. More optimistic GDP forecasts would be consistent with greater emissions growth
- The model assumes that energy efficiency improvements continue at their current trend rate, which does not significantly affect energy intensity (i.e. energy to GDP ratio) in each sector.

The key issue addressed in the model is the need to pick the relative growth rates of different sectors, given that some sectors emit more than others. Clearly, if the more emitting sectors grow faster, the average emissions to GDP will increase.

The model is based on the 1996 inter-industry data (the latest available). The latest official data breaking down GDP by sector is for 2001. At our request, NZIER developed a growth algorithm which allows us to apply actual GDP growth from 1996 to 2001 to the 1996 industry data and replicate the 2001 industry structure. This algorithm is essentially a set of relative prices, which send signals for the reallocation of resources from sector to sector. We then apply this algorithm to the overall macroeconomic forecast to 2010 to project the industry structure in that year.

Our projections for non-agricultural emissions, including industrial processes and waste, are 39.5 mt CO₂ on a business as usual basis, and 37.9 mt CO₂ with policies. They are significantly above MED’s reference scenario, which would imply emissions of 35.8 mt CO₂ (when waste is added to the figure for energy and industrial processes), and above the CCO projections of 33.8 mt CO₂ with policies.

5 Sinks and deforestation

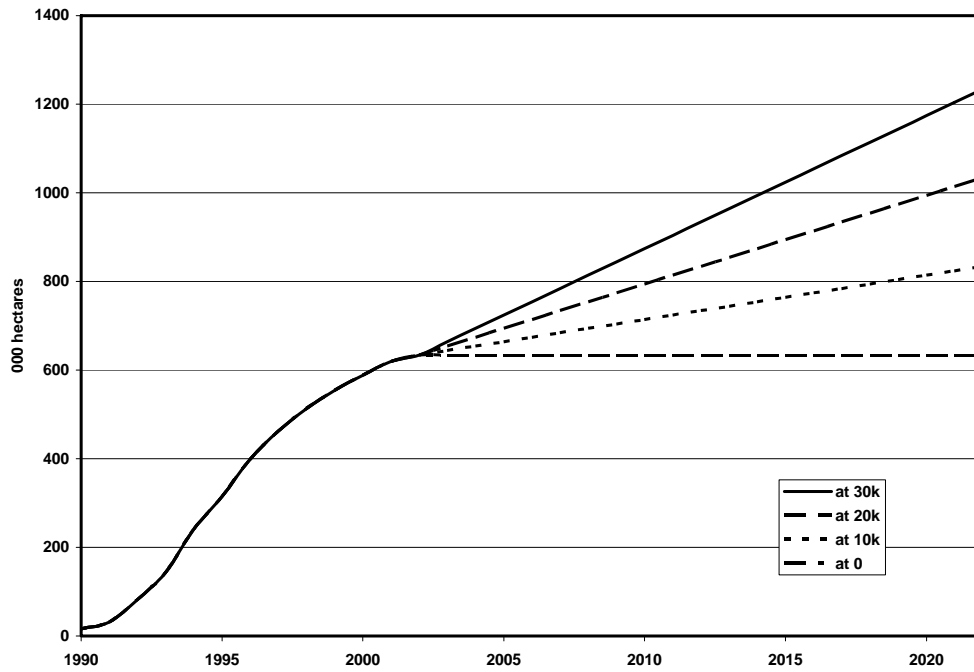
5.1 Sinks

Sinks are the carbon sequestered during each commitment period by Kyoto forests (new forests planted after 1990) as they grow. In this report we focus on the First Commitment Period (2008 – 2012). The official figure for sinks in this period is 105 mt CO₂ (an approximation of the 104.2 mt CO₂ generated by the computational model), which is based on new plantings of 30,000 ha per annum from 2003. The following table shows the relationship between average new plantings and the availability of sinks during the first commitment period.

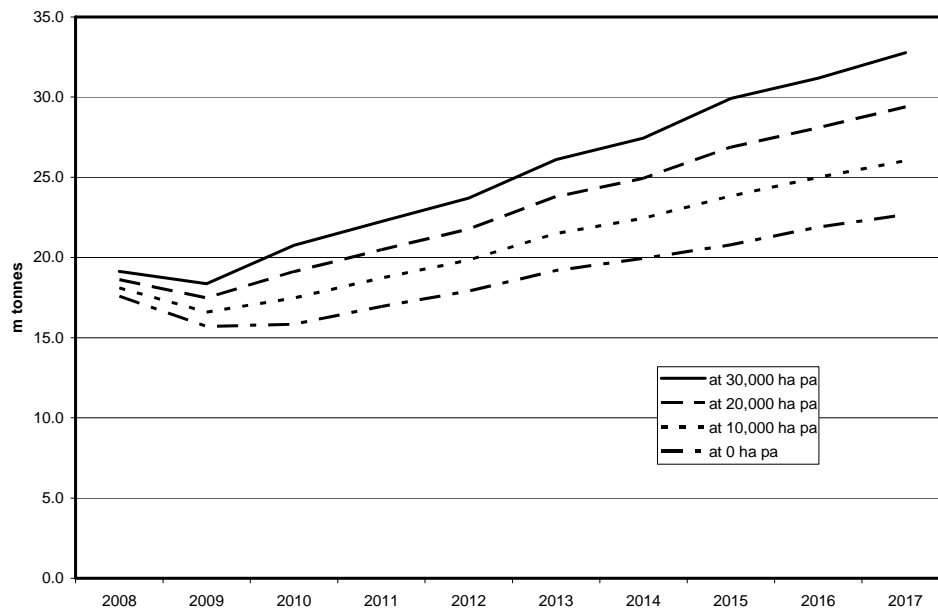
2003 onwards hectares per annum	Million tonnes of CO₂ absorption during the First Commitment Period
0	84.0
10,000	90.8
20,000	97.6
30,000	104.2

The following graphs demonstrate the impact of new planting assumption on the total area of Kyoto forests, and the consequent effects on carbon absorption. The graphs are based on the same computational model as used by the Government.

Kyoto Forests from 1990 to 2003 and Scenarios for Different Planting Assumptions



Kyoto Forest Forecast Absorption during First and Subsequent Commitment Periods for Different Planting Assumptions



For reference, new plantings from 1988 to 2003 were as follows (the numbers with asterisks have not been officially released yet, and represent MAF estimates):

Year	New forest (000ha)	Year	New forest (000ha)
1988	20	1996	84
1989	21	1997	64
1990	16	1998	51
1991	15	1999	40
1992	50	2000	34
1993	62	2001	29
1994	98	2002	23 *
1995	74	2003	15 *

MAF's latest view is that new plantings to 2010 are more likely to average 20,000 ha per annum. This view has not been incorporated into the Climate Change Office forecast. In any case, the current financial position of the forest industry suggests that planned new plantings could be much lower than that. The most recent numbers are looking catastrophically low, and there is no obvious reason to expect a recovery.

We believe that annual plantings of 10,000 ha represent the most realistic, if still somewhat conservative, scenario. There are a number of reasons why it would not be reasonable to expect growth in new plantation forests:

- International lumber prices are expected to remain low, as supply from around the world expands (including New Zealand's own "wall of wood"). The value of forestry land tends to be determined by current prices for harvested timber (even though new plantings will not be harvested for more than 25 years). Hence, forestry is going to find it hard to compete with other land uses
- Marginal lands with easy road access have already been planted. Assumed new plantings would need to take place in areas where harvesting is likely to be uneconomic
- The nationalization of sinks by the Government removes the incentive to plant for carbon absorption
- Increased harvesting of pre-1990 forests will put pressure on nursery and other resources if they are to be replanted. Hence, costs of new planting are likely to rise.

5.2 Deforestation

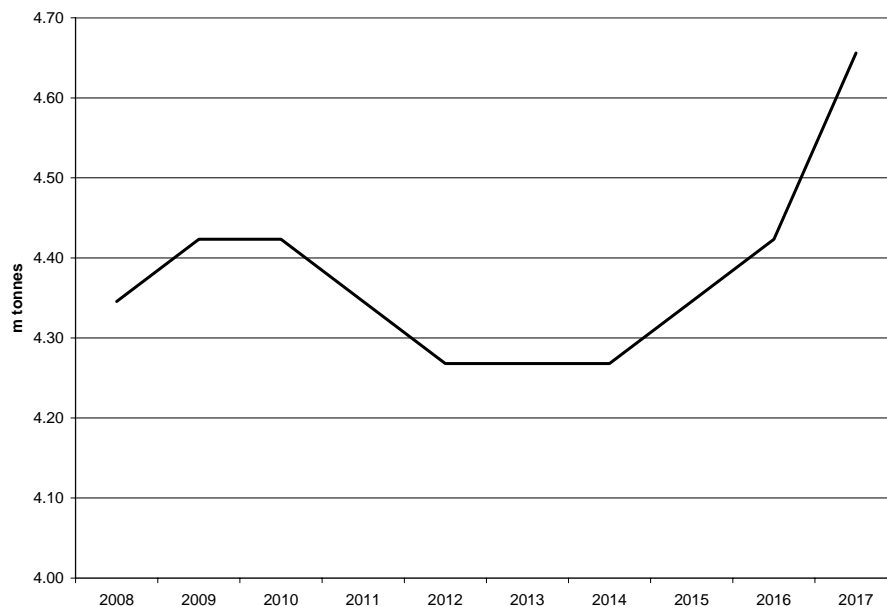
In addition, the calculation of New Zealand's performance during the first Commitment Period requires a deduction to be made for deforestation of both Kyoto and non-Kyoto forests. Deforestation is the conversion of forest land to other land uses following harvest.

Deforestation has traditionally been 2-4% of the total forests. The Government figure does not include anything for deforestation. However, the forestry industry itself anticipates significant deforestation, and there are some signs that deforestation is currently increasing, as very poor economics of the forestry sector are prompting more land conversions away from forestry. Moreover, the expected significant increase in timber harvesting during the first commitment period (the “wall of wood”) would of itself tend to generate at least a temporary increase in deforestation.

The projected emissions from deforestation are based on the official MAF estimates of harvest volumes over the next 20 years. For simplicity, we apply a constant deforestation rate to these volumes. In fact, the proportion that is deforested is likely to rise more than in line with the growth in harvest areas. There are a number of reasons for this:

- Areas that were planted with the benefit of the advantageous tax treatment available in the past are less likely to be viable for another rotation without the same tax benefit
- Economics of forestry are making conversion to other land uses more attractive
- There are limits on the availability of planting stock, as harvested areas increase.

Projected Emissions from Deforestation

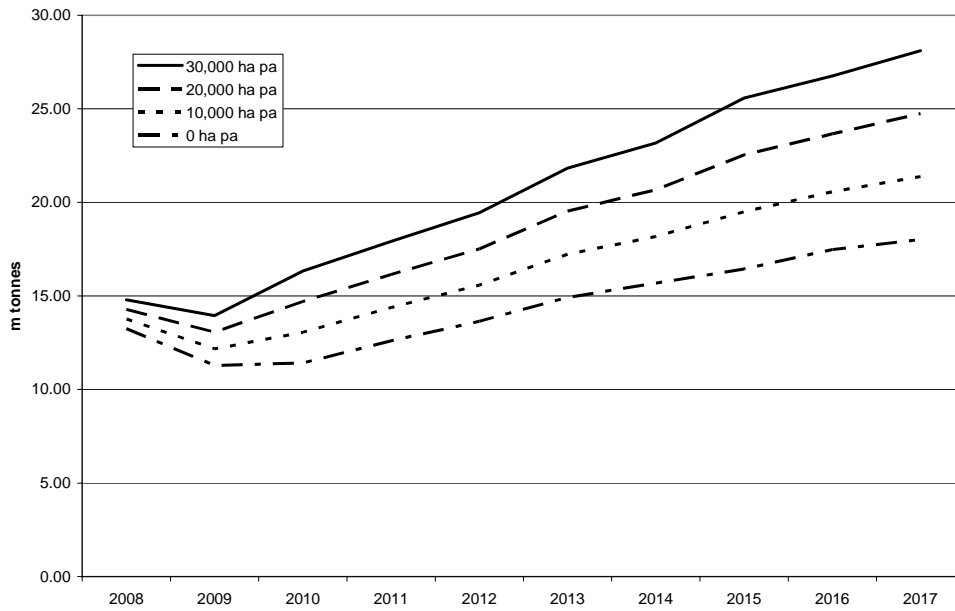


We have estimated the deduction that would be due for deforestation at 10% of harvested areas, which is in line with the forest industry’s expectation and coincides with the cap being placed by the Government on its share of the liability for this deduction. Deductions, or

debits, would be about 4.4 mt CO₂ per annum, or 22 mt CO₂ over the first Commitment Period.

These results result in a revision of the annual net absorption numbers during the first commitment period as shown below.

Net Absorption: Sinks minus Deforestation



6 Conclusion

The following table summarizes the overall picture:

Summary Table (million tonnes of CO₂)

	Business As Usual		With announced policies	
	Government	Castalia	Government	Castalia
Assigned Amount	309	309	309	309
Emissions	383	396	359	385
Difference	74	87	50	76
Sinks	105	91	105	91
Deforestation	0	22	0	22
Net Position	31	(12)	55	(7)

With the announced policies in place, we believe emissions will be 76 mt CO₂ over the assigned amount, whereas the Government expects them to be only 50 mt over. We believe sinks from sequestration by Kyoto forests would be 91 mt CO₂ or less, whereas the Government expects higher new plantings and sinks of 105 mt CO₂. There will need to be a debit for deforestation, which we estimate at 22 mt CO₂, whereas the Government has not allowed for this debit. There is obviously considerable uncertainty, and all forecasts should be considered as likely scenarios within a range of possible outcomes. In this report, we have deliberately adopted a conservative approach wherever possible.

It therefore appears to us that the Government's comfort over the First Commitment Period is misplaced. The situation is more serious for subsequent Commitment Periods.

The deficit in the Second Commitment Period will be even greater if, as expected, the emission reduction targets are increased by more than the expected increase in net sequestration. The following graph summarizes the net position. It draws net sinks – sequestration from Kyoto forests minus deforestation of non-Kyoto forests – against the forecast annual excess of gross emissions over the assigned amount. Net sinks are drawn for different new planting assumptions.

New Zealand's Net International Position: Excess Emissions and Net Sinks

