Report on revised projections for the Kyoto Protocol first commitment period 30 April 2004

1. Executive summary

1. New Zealand is projected to have a net surplus of emissions of 33 Mt CO_2-equivalent over the first commitment period 2008-2012 (Table 1).
2. High and low emissions growth projections have been derived under a plausible range of assumptions for key drivers in most sectors. Under the optimistic scenario New Zealand's net position is estimated to be 50 Mt CO_2-equivalent during CP1 and under a pessimistic emissions scenario New Zealand's net position is projected to be 17 Mt CO_2-equivalent.
3. Projected business as usual greenhouse gas emissions are projected to be 399 Mt CO_2-equivalent over the first commitment period. Business as usual projections are projections of emissions, excluding abatement attributable to policies that reduce greenhouse gas emissions.
4. A range of policies have been initiated that will reduce greenhouse gas emissions relative to business as usual emissions growth and set New Zealand towards a downward path in greenhouse gas emissions. These policies include:
    - National Energy Efficiency and Conservation Strategy;
    - The New Zealand Waste Strategy;
    - Price Based Measures (including emissions charges and Negotiated Greenhouse Agreements);
    - Projects to Reduce Emissions;
    - Local government initiatives;
    - Small Medium Enterprises and Business Opportunities; and
    - Research.
5. Overall these polices (including Projects to Reduce Emissions) are expected to deliver 39.0 Mt CO_2-equivalent over the first commitment period.

Table 1: Estimated Kyoto Balance Sheet over the First Commitment Period (2008-2012)

	M tonnes CO_2 equivalent
Projected emissions 2008 – 2012 agriculture sector only	201
NZ total projected emissions 2008 - 2012	399
NZ assigned amount	308
Emissions units allocated to Projects	10
Net NZ assigned amount balance	298
Assigned amount balance less projection	-101
Impact of policies (excluding Projects)	26
Projects to reduce emissions	13
Total Impact of Policies	39
Excess emissions over assigned amount	-62
Total sink credits 2008 to 2012	95
Excess sink credits	**33**

2. Introduction

6. The projection of New Zealand's net position is developed from projected emissions from the energy, industrial processes, agriculture and waste sectors, and projected removals and emissions from land use change and forestry. The basis for the projections is discussed in the following sections.

7. Greenhouse gas emissions projections have been updated since last reported in New Zealand's Third National Communication (3NC) reported to the United Nations Framework Convention on Climate Change (UNFCCC) in 2001 to incorporate realised outcomes and changes in expectations for key drivers (such as GDP and population). This update also includes improved certainty with respect to outcomes for major projects such as the shelving of project Aqua.

8. This update is based on the latest Greenhouse Gas Inventory Report NZCCO (2004) (submitted to UNFCCC 15 April 2004), and includes revisions to the implied emissions factors. The base year emissions (1990) on which New Zealand's assigned amount of emissions for CP1 is based have also been revised and incorporated in this calculation of New Zealand's net position in CP1.

3. Projected emissions (business as usual)

9. Business as usual (BAU) projections report emissions that would have occurred in the absence of any government policy initiatives such as the National Energy Efficiency and Conservation Strategy (NEECS).

10. BAU projections have been updated for each source of emissions and removals, including energy (including transport), agriculture, waste, industrial processes, and land use change and forestry.

11. Total BAU projections of greenhouse gas emissions for the first commitment period are 399 Mt CO_2-equivalent. BAU projections are summarised by sector.

3.1. Energy

12. Emissions from the energy sector are the second largest single source of greenhouse gas emissions. In 2002 greenhouse gas emissions from this sector were 32 Mt CO_2-equivalent or 43 per cent of New Zealand's total emissions.

13. Greenhouse gas emissions from the energy sector include carbon dioxide, methane and nitrous oxide from the combustion of fossil fuels in electricity generation, transport, industrial energy needs (eg producing iron and steel), residential and on farm energy combustion, fugitive emissions from mining oil and gas, and geothermal electricity generation.

14. Greenhouse gas emissions projections for energy are sourced from the Ministry of Economic Development (MED) Supply and Demand Energy Model (SADEM). SADEM is a dynamic model of energy supply and demand. Prices of fuel commodities (such as coal and oil), which are determined on international markets are based on external projections. Demand and some energy prices (where the price determined within New Zealand) are solved for within the model.

15. MED have updated their energy projections since October 2003 when Outlook projections to 2025 were published (MED 2003) incorporating updated GDP projections to 2008, and the announcement by Meridian to shelve 'Project Aqua'.

16. The best estimate projection for BAU emissions during CP1 is 170 Mt CO_2-equivalent, or 43 per cent above 1990 levels.

17. High and low emissions projections from the energy sector have been developed, predicated on plausible high and low growth rates for GDP.

3.2. Industrial Processes

18. Emissions (mainly carbon dioxide) from the industrial processes sector are a minor source of greenhouse gas emissions in New Zealand. In 2002 greenhouse gas emissions from this sector were 4 Mt CO_2-equivalent or 5 per cent of New Zealand's total emissions.

19. Greenhouse gas emissions from the industrial processes sector also include sulphur hexafluoride (SF_6), hydrofluorocarbons (HFC's) and perfluorocarbons (PFC's). The Global Warming Potentials (GWPs) of these gases are large. However, emissions of these gases are small and in carbon dioxide equivalents contribute less than one per cent of New Zealand's total emissions. Primary sources of emissions include, electricity transmission switchgear, metals and chemical manufacturing.

20. Greenhouse gas emission projections for industrial processes were calibrated to the inventory estimate, submitted in 2004, of industrial process emissions for 2002. Growth projections of carbon dioxide emissions from MED energy sector industrial processes were then used to project emissions of industrial processes gases for CP1.

21. The best estimate projection for BAU emissions during CP1 is 19 Mt CO_2-equivalent, or 29 per cent above 1990 levels.

22. The projection for industrial processes was based on projections of carbon dioxide emissions from industrial processes from the energy sector. The industrial processes sector was not sensitive to the high and low GDP assumptions applied to the energy modelling.

3.3. Agriculture

23. The agriculture sector is New Zealand's largest source of greenhouse gas emissions, in 2002 emissions from this sector were 37 Mt CO_2-equivalent, 49 per cent of total greenhouse gas emissions.

24. Agricultural greenhouse gas emissions include methane and nitrous oxide, sourced from animal digestion, animal waste, and agricultural soils (including nitrogen fertiliser use).

25. Projections of agricultural sector emissions are based upon modelling work by the Ministry of Agriculture and Forestry (MAF) and are influenced by changing total animal numbers, and species balance changes (eg grazing sheep vs dairy) and increasing animal performance. The model for projecting animal numbers has recently been updated to factor in the affect of longer term relative prices between agriculture commodities. The basis for calculating emissions from grazing livestock has also changed based on the latest empirical research. No allowance has been made for the introduction of any methane reduction technologies prior to 2010.

26. The drivers for shifts in species balance and intensification of production are largely economic. Total animal numbers are affected by changing land use patterns. For example, planted forest has been occupying previously farmed land at an average rate of 40,000 ha per year over the last 10 years. This rate of planting has declined to an estimated 15,000 ha per annum in 2003. The high country tenure review will also result in a decline in animal numbers. Land is being taken out of livestock production and is being converted into lifestyle blocks as well as intensive horticulture, mainly wine growing.

27. A counter to these potential impacts on declining animal numbers through changing land use is increasing land use intensification. This is increasing average animal performance.

28. Under business as usual agricultural emissions are projected to be 201 Mt CO_2-equivalent during CP1. The current projection is that these emissions will be 26 per cent above 1990 levels during the first commitment period.

29. MAF used Monte Carlo numerical simulation to determine the high and low emissions growth scenarios. Under the high emissions growth scenario agricultural emissions are projected to be 211 Mt CO_2-equivalent during CP1 (33 per cent above 1990 levels) and under the low emissions growth scenario agricultural emissions are projected to be 191 Mt CO_2-equivalent (20 per cent above 1990 levels).

3.4. Waste

30. Emissions from the waste sector are a significant source of greenhouse gas emissions in New Zealand. In 2002 greenhouse gas emissions from the waste sector were 2 Mt CO_2-equivalent or 3 per cent of New Zealand's total emissions.

31. Greenhouse gas emissions from waste include methane and nitrous oxide. Primary sources of emissions from the waste sector include emissions from:

    - disposal of organic waste materials to landfill; and
    - domestic, commercial and industrial waste water.

32. Business as usual projections of emissions from waste are based largely on population projections and assume existing waste management practices and

waste disposal rates are continued. Business as usual projections also incorporate some increased landfill gas capture for electricity generation, as the technology is becoming economic under business as usual.

33. High and low business as usual projections are not available for waste. Uncertainty around the outcome for waste emissions projections is captured in a moderately large uncertainty range around the impact of abatement from the waste strategy as discussed in section 5.

4. Assigned amount from 1990 emission levels

34. The latest National Inventory Report (NZCCO 2004) submitted in April 2004 reports base year (1990) total emissions as 61.64 Mt CO_2-equivalent. Based on this estimate New Zealand's assigned amount over CP1 is 308 Mt CO_2-equivalent, or 5 times New Zealand's base year emissions.

5. Effect of existing policies

5.1 National Energy Efficiency and Conservation Strategy

35. The National Energy Efficiency and Conservation Strategy (NEECS) is a package of policy measures that aims to improve energy efficiency by 20 per cent and increase renewable energy sources by 30 PJ by 2012.

36. The government has introduced a range of initiatives to achieve the NEECS targets including:

- improvements in energy efficiency across central and local government;
- increased renewable energy supply, and development of an industrial base to develop increased capacity to produce renewable energy;
- improvements in industrial energy use;
- improvements in building and appliance energy efficiency; and
- improvements in transport, including actions to improve transport mode choice, energy efficiency of the vehicle fleet and reducing need for transport.

37. The Energy Efficiency and Conservation Authority (EECA) have derived an estimate of the impact of NEECS during CP1 based on bottom up assessment of what are reasonable outcomes that could be achieved under each individual programme.

38. A best estimate of the impact of NEECS is 5 Mt CO_2-equivalent during CP1. If all individual programmes are successfully and fully implemented up to 13 Mt CO_2-equivalent of abatement could be achieved during CP1. For the purpose of developing a confidence range for the overall net position in CP1 a worse case scenario of 1 Mt CO_2-equivalent abatement is assumed.

5.2 The New Zealand Waste Strategy

39. The New Zealand Waste Strategy was launched in March 2002 with the objective of moving towards zero waste by 2010. The strategy extends to all waste streams including landfill waste, mine and quarrying waste, and sewage. The objective will be met through measures to:

- ensure a sound legal framework for waste management with clear roles for central, regional and local government;

- reduce waste and maximise re-use, recycling and recovery, and provide economic incentives to reduce wasteful behaviour;
- improve information and communication to increase community and individual understanding of waste issues; and
- establish standards and guidelines for waste management.

40. A national environmental standard (NES) for landfill gas collection and destruction is to be introduced under Section 43 of the RMA to be applied to landfills that will accept over one million tonnes of refuse throughout their design life.

41. In terms of the quantification of reductions in greenhouse gas emissions from landfills, a methodology recommended by the International Panel on Climate Change (IPCC) is used in order to determine emissions under both the 'status quo' and 'national environmental standard' options.

42. The IPCC methodology uses data specific to New Zealand on waste generation rates (based on population), waste composition, the percentage of waste disposed to landfills and landfill gas extraction and combustion. Under business-as-usual conditions (i.e. current practice without the NES) the waste sector delivers an estimated reduction of 5 Mt CO_2-equivalent in CP1.

43. To estimate the potential benefit of the NES, waste data from The 2002 Landfill Review and Audit (Ministry for the Environment, 2003) has been used to generate emissions estimates, applying an annual increase of 1.5 per cent of waste to landfill to extrapolate the waste contained in landfills to 2016 (the end of the analysis period – 10 years after the transition period). The estimated reduction of emissions from the waste sector with the NES in place is 6.5 Mt CO_2-equivalent in CP1.

44. The best estimate of abatement from the New Zealand Waste Strategy during CP1 is 6 Mt CO_2-equivalent, with a range of 6.5 Mt CO_2-equivalent and 5.5 Mt CO_2-equivalent.

5.3 Price based measures

45. The Government will introduce an emissions charge (on fossil fuels and industrial process emissions, ie. carbon dioxide and fossil methane) by 2008 to create an incentive to reduce emissions. The charge will approximate the international emissions price, but be capped at NZ$25 a tonne of carbon dioxide equivalent.

46. ABARE (2003) estimate 11 Mt CO_2-equivalent of additional abatement will be achieved over CP1 if a $NZ15/tonne emissions charge is implemented on all modelled greenhouse gas emissions. Emissions of methane and nitrous oxide from agriculture were excluded from the charge in the modelling, as agriculture is not subject to the emissions charge.

47. The analysis assumes industries considered 'competitiveness at risk' will have some firms that are eligible for NGAs. [sentence withheld under the OIA s.(9)(2)(j)] NGA firms will be required to undertake significant improvements in emissions intensity before the end of CP1 in return for temporary relief from the emissions charge.

48. The ABARE analysis assumed NGA firms would not receive relief for any impacts passed on through increased electricity charges. This is expected to occur, and its consequences for emissions will depend on whether electricity

use efficiency is improved by more or less under NGAs than by the notional price impact.

5.4 Projects to Reduce Emissions

49. The Projects to Reduce Emissions programme is a key part of the Government's climate change policy package to contribute to achieving New Zealand's Kyoto Protocol emission obligations. The programme is a climate change policy initiative and contributes to achieving the outcomes of NEECS including capacity building in renewable energy, and improving energy efficiency, and aims to do this by providing an incentive for projects that reduce emissions below business as usual during CP1.

50. The first Projects tender round and the two early projects have resulted in 4.8 million emission units being allocated for projects that are expected to achieve 5.0 Mt CO_2-equivalent of abatement. If two more rounds are carried out, with 6 million units each, before the timing starts to encroach on proponents' ability to start by 2008, then 16.8 million units will have been allocated. Assuming conservatively that 60 per cent of the resulting projects are fully implemented, the result would be 10 ± 2 Mt CO_2-equivalent of abatement.

51. [withheld under the OIA s.(9) (2) (i) and (9) (2) (j)]

52. [withheld under the OIA s.(9) (2) (i) and (9) (2) (j)]

5.5 Local Government Initiatives

53. A three year programme, the "Communities for Climate Protection" (CCP-NZ) programme will be rolled out in New Zealand from May 2004. It is modelled closely on the "Cities for Climate Protection" programme, which has proven successful internationally in reducing greenhouse gas emissions from both councils themselves and their communities by:

    - improving energy efficiency;
    - reducing waste;
    - encouraging sustainable transportation;
    - enhancing urban design; and
    - promoting sustainable farming practices.

54. The success of CCP Australia in galvanising local action and achieving significant GHG reductions is world class. In 2002-2003 year, the programme saved 766,716 tonnes of CO_2-equivalent emissions. In the most recent 3-year period, the programme reduced over 1.23 million tonnes of CO_2-equivalent emissions.

55. CCP-NZ will overlap with some existing polices such as efficiency improvements under NEECS and the New Zealand Waste Strategy. To be conservative it is assumed half of the outcome may be attributable to NEECS and Waste Strategy. The best estimate of abatement from local Government initiatives is 0.6 Mt CO_2-equivalent.

5.6 Small to Medium Enterprises and Business Opportunities

56. [sentence withheld under the OIA s.(9) (2) (f) (iv)] The policy aims are to encourage SMEs to reduce emissions and to mitigate possible effects on them

of an emissions charge. It is estimated that SMEs contribute emissions (mainly energy related) of around 5 Mt CO_2-equivalent per annum.

57. [sentence withheld under the OIA s.(9) (2) (f) (iv)]. Potential exists for a climate change industry to deliver substantial greenhouse gas reductions. One estimate puts potential savings at 9 Mt per annum.

58. The best estimate of abatement from these policies is 3 Mt CO_2-equivalent. A range of 2 Mt CO_2-equivalent to 4 Mt CO_2-equivalent has been assessed as the uncertainty range for this estimate. This is a preliminary estimate and is predicated on a conservative judgement of achieving a 10 per cent energy efficiency improvement over business as usual improvements.

5.7 Research

59. The potential of technologies to reduce emissions, particularly in the agriculture sector, has not been estimated. For example, there are new products currently entering the market aimed at reducing nitrous oxide emissions, but for this report the impacts have not been able to be quantified. There are also some prospective technologies that are currently being researched through the Pastoral Greenhouse Research Consortium, a partnership between industry and Government but much of this research is still at the discovery and proof of concept stage.

5.8 Total Impact of Policies

60. The best estimate of the impact of current policies that reduce greenhouse gas emissions is 38 Mt CO_2-equivalent. Table 2, summarises the current estimates of the impact of policies. Future updates of the net position will incorporate improved treatment of uncertainty for these estimates as more information is obtained to quantify these policy impacts.

61. A plausible high and low estimate of abatement from existing measures was developed to approximate a 95 per cent confidence interval, using Monte Carlo simulations by fitting triangular distributions to policy estimates where a high and low estimate was available. The best estimate was the mode of the distribution, and the high and low estimates formed the range at the base of the distribution.

62. The implied range of abatement from existing measures is 33Mt CO_2-equivalent to 45 Mt CO_2-equivalent.

Table 2: Summary of emissions abatement by policy (2008-2012)

Policy	**Low estimate** Mt CO_2-e equivalent	**Best estimate** Mt CO_2-e equivalent	**High estimate** Mt CO_2-e equivalent
National Energy Efficiency and Conservation Strategy	1	5	13
The New Zealand Waste Strategy	6	6	7
Price based measures	11	11	11
Projects to Reduce Emissions	10	13	17
Local Government Initiatives	0.6	0.6	0.6
Small to Medium Enterprises and Business Opportunities	2	3	4
Total	**33**	**39**	**45**

Note: Totals in high and low columns may not sum to totals because they have been determined using Monte Carlo simulation.

6. Removal (sink) credits generated

6.1. Landuse Change and Forestry

63. The current best estimate of sequestration from land use change and forestry has been updated on the basis of consultation between the New Zealand Climate Change Office and MAF. The revised estimate updates the previous estimate of 105 Mt CO_2-equivalent on the basis of expert judgement and presents a high low range around the best estimate.

64. Deriving data for the land use, land use change and forest sector is difficult. Uncertainties will continue to be refined and improved over time as science methodologies and research improve. Science improvements will have ramifications for our current understanding of biological systems and for future emission and sequestration projections. An explanation of the assumptions used to revise the previous estimate are provided in Annex 1.

65. The best estimate of sequestration from sinks during CP1 is 95 Mt CO_2-equivalent with a low estimate of 69 Mt CO_2-equivalent and a high estimate of 107 Mt CO_2-equivalent.

66. There are a number of key drivers in determining a net sinks position for CP1. Significant factors include new planting rates, deforestation and soil carbon. These factors present downside risk to the base case of 103.06 Mt CO_2-equivalent over CP1.

67. Planting rates have declined in recent times to 15,000 ha for 2003. A planting scenario less than the base case represents less carbon accumulated over CP1. Three scenarios have been used – the base case of 30,000 ha, one of 20,000ha and one of 10,000ha. The latter scenarios represent a downside risk

of -5.3 Mt CO_2-equivalent and -10.3 Mt CO_2-equivalent over CP1 to the base case of 103.06 Mt CO_2-equivalent.

68. The base case scenario did not take account of deforestation. This is because deforestation policy was still in development. Historical levels of deforestation have been 2-4 per cent per annum of forest area harvested. The Government's deforestation cap is set at 10 per cent per annum of forest area harvested or 21 Mt CO_2-equivalent. A deforestation range of 3-10 per cent of forest area harvested represents downside risk of -6.3 Mt CO_2-equivalent to -21 Mt CO_2-equivalent to the base case of 103.06 Mt CO_2-equivalent.

69. The quantum for future harvesting and deforestation liabilities will depend on new planting rates over the next 15 to 20 years and what, if any, accounting rules are agreed for forests in future commitment periods. It is likely, at some future point - probably around the early to mid 2020s when the large areas of forests planted in the mid-1990s come up for harvest – that a future Government will face net liabilities from Kyoto forests for perhaps 2 to 5 years.

70. Soil carbon is also likely to present some downside risk. The Government's net emissions forecast assumed that soil carbon under forest would be neutral. Advice from soil scientists estimates that soil carbon reduces when land use change from agriculture to forestry. While more research is needed, this downside risk is assumed to be in the order of -3.1 Mt CO_2-equivalent to 0 over CP1.

7. Estimate of Net Position

7.1 Kyoto Accounting for Net Position

71. The current best estimate of New Zealand's net position is 33 Mt CO_2-equivalent, with a range 17 Mt CO_2-equivalent to 50 Mt CO_2-equivalent.

72. New Zealand assigned amount during CP1 is equal to five times the 1990 base year emissions (61.64 Mt CO_2-equivalent) or 308 Mt CO_2-equivalent. Up to 10 million emissions units from New Zealand's assigned amount will be allocated to project tenders under Projects to Reduce Emissions. This leaves a balance of emissions units of 298 million.

73. Best estimate business as usual projection of emissions for CP1 is 399 Mt CO_2-equivalent. Accounting for the impact of existing policies the best estimate of total emissions with current polcies in CP1 is 360 Mt CO_2-equivalent, a net excess of emissions of 62 Mt CO_2-equivalent.

74. The best estimate of sequestration from sinks is 95 Mt CO_2-equivalent. Subtracting the best estimate for sinks leaves a balance of 33 Mt CO_2-equivalent over CP1.

75. Confidence intervals were developed for New Zealand's net position for CP1 using the Monte Carlo simulation approach described in section 5. A plausible confidence interval for New Zealand's net position over CP1 approximating a 95 per cent confidence interval is 17 Mt CO_2-equivalent to 50 Mt CO_2-equivalent.

Table 3: Estimated impact of existing policy on greenhouse gas emissions in the first commitment period (Mt CO_2-equivalent)

Projected emissions (business as usual)	**Low**	**Best**	**High**
Energy	169	170	171
Industrial processes	19	19	19
Agriculture	191	201	211
Waste		9	
TOTAL		399	
Assigned amount for 1990			
2002 inventory data		308	
Emission units allocated under Projects to Reduce Emissions		10	
Net amount of excess emissions to be covered		-101	
Existing policies			
National Energy Efficiency and Conservation Strategy	1	5	13
The New Zealand Waste Strategy	6	6	7
Price Based Measures		11	
Projects to Reduce Emissions	10	13	17
Local government		0.6	
Small-Medium Enterprises and Business Opportunities	2	3	3
Research		Not estimated	
Estimated amount to be covered		-62	
Sink credits generated	69	95	107
Estimated net position	17	33	50

Note: Totals in high and low columns may not sum to totals because they have been determined using Monte Carlo simulation.

8. Reconciling with 2003 Estimate

76. A comparison of New Zealand's net position estimates for 2003 and 2004 is provided in table 4.

Table 4: Reconciliation with 2003 Net Position Estimate

	2003 data Mt CO_2 equivalent	**2004 data Mt CO_2 equivalent**
Projected emissions 2008 – 2012 agriculture sector only	185	201
NZ total projected emissions 2008 - 2012	383	399
NZ assigned amount	309	298[1]
Assigned amount balance less projection	-74	-101
Impact of Policies (Including projects)	25	39
Excess emissions over assigned amount	-49	-62
Total sink credits 2008 to 2012	105	95
Excess sink credits	**56**	**33**

[1] NZ assigned amount balance is 308 less an estimate of 10 million units to be allocated to projects.

77. The most significant sources of change in the projections are due to an increase in projections of business as usual growth in agricultural emission of 16 Mt CO_2-equivalent, and a reduction in the estimate of sinks credits of 10 Mt CO_2-equivalent since the 2003 projection.

78. The revised estimate incorporates an estimate of the Projects to Reduce Emissions programme. [withheld under the OIA s.(9) (2) (i) and (9) (2) (j)]

9 Conclusions

79. The best estimate of New Zealand's net position over CP1 is 33 Mt CO_2-equivalent, with a pessimistic outcome of 17 Mt CO_2-equivalent and optimistic outcome of 50 Mt CO_2-equivalent. This range approximates a 95 per cent confidence interval.

80. The best estimate and confidence range estimated provide improved certainty that New Zealand's net position will be in surplus over CP1. Lack of current information on some areas affecting the projections have been addressed within this paper by using conservative assumptions.

81. Projections are inherently uncertain, however, officials will continue to monitor how New Zealand's greenhouse gas emissions are tracking towards CP1.

82. Future revisions to New Zealand's net position will be better informed by further information, and as projections will become more robust and transparent. Improved assessment of the impact of policies such as research which is currently not estimated (currently zero abatement assumed) will be estimated as further information is obtained.

83. At present the greatest source of uncertainty is attributable to uncertainty around the best estimate projection for sinks.

84. Multiple assumptions have been made in calculating New Zealand's total sink credits balance. In making the major assumptions explicit, it is evident that there is some downside risk and upside benefits to the assumptions that have been made previously. Deriving data for the Land use, land use change and forest sector is difficult. Uncertainties will continue to be refined and improved over time as science methodologies and research improve. Science improvements will have ramifications for our current understanding of biological systems and for future emission and sequestration projections.

8 References

ABARE (Australian Bureau of Agricultural and Resource Economics) 2003, Economic Implications of the Kyoto Protocol for New Zealand, Sensitivity Analysis, ABARE *e*Report 03:11, CANBERRA.

MED (Ministry of Economic Development) 2003, New Zealand Energy Outlook to 2025, WELLINGTON.

NZCCO (New Zealand Climate Change Office) 2004 National Inventory Report, April 2004, WELLINGTON.

Annex 1: Assumptions for revised estimate of sinks

Forest Sinks

1. Multiple assumptions have been made in calculating New Zealand's total sink credits balance. In making the major assumptions explicit, it is evident that there is some downside risk and upside benefits to the assumptions that have been made previously. Deriving data for the land use, land use change and forest sector is difficult. Uncertainties will continue to be refined and improved over time as science methodologies and research improve. Science improvements will have ramifications for our current understanding of biological systems and for future emission and sequestration projections.
2. Field work will also inform future sink credit balance estimates e.g. through the carbon monitoring system. Forest Research is now building a new model to allow Kyoto sink credit balances to be estimated under a wide range of planting and accounting rules scenarios. This model will test the robustness of previous modelling work and enable multiple parameters (assumptions) to be manipulated. This model will be ready for testing by the end of May 2004.
3. We note that the quantum for future harvesting and deforestation liabilities will depend on new planting rates over the next 15 to 20 years and what, if any, accounting rules are agreed for forests in future commitment periods. It is likely, at some future point - probably around the early to mid 2020s when the large areas of forests planted in the mid-1990s come up for harvest – that a future Government will face net liabilities from Kyoto forests for perhaps 2 to 5 years.

Assumption 1 - Deforestation

4. The Government's net emissions forecast used in the 2001 for the preferred policy package assumed zero deforestation for non-Kyoto forests.1 Deforestation was not included in the net emissions balance because the policy for the treatment of deforestation was still in development.
5. The minimum deforestation rate that should be provided for is the historical average (though we note that this is based on very limited data). We estimate that this presents a downside risk of somewhere between 6.3 Mt CO_2-equivalent and 21 Mt CO_2-equivalent over CP1 i.e. 6.3 to 21 Mt CO_2-equivalent less sink credits than the estimated 103.06 Mt CO_2-equivalent sink credits accumulating over CP1. The lower limit is the mid-point of best guess estimates of historic rates of deforestation (3 per cent). The upper limit is the allowance under the deforestation cap. [sentence withheld under the OIA s.(9)(2)(ba)(i)]

Assumption 2 – Planting Rates

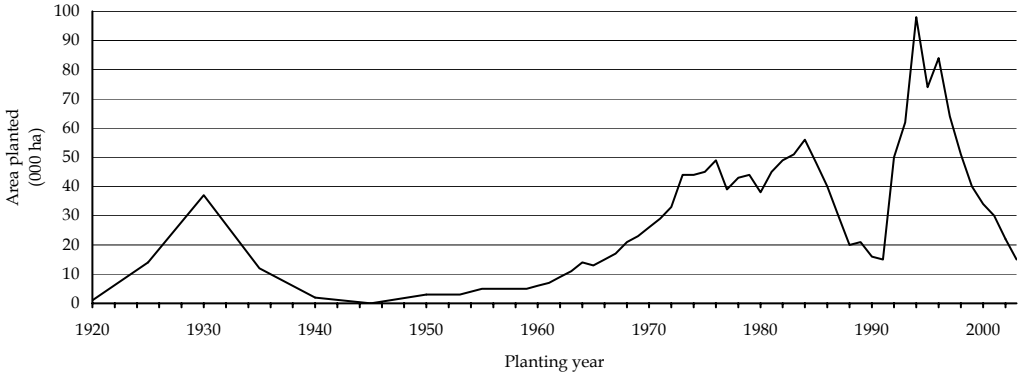
6. The Government's net emissions forecast assumed 30,000ha of planting per annum (103.06 Mt CO_2-equivalent over CP1). The cyclical nature of forestry, agriculture, exchange rates and bulk shipping costs has seen a downturn in forestry plantings. If the planting rate assumption was revised from 30,000 hectares per annum to 20,000 hectares the impact would be less carbon accumulated over CP1 (approximately -5.3 Mt CO_2-equivalent less over CP1).

[1] Deforestation of non-Kyoto forests is the conversion of forest land to other land uses on harvest of forests that were in existence prior to 1990.

Similarly, if the planting rate assumption was revised from 30,000 hectares per annum to 10,000 hectares there would be -10.34 Mt CO_2-equivalent less carbon accumulated over CP1. An average of 10,000 hectares of new planting annually to 2010 is pessimistic, but not implausible. In the 2003 calendar year the planting rate is estimated to be 15,000 ha.

7. The average new planting rate over the last 30 years has been 44,900 hectares per year. In the period 1992 to 1998 new planting rates were high; during this period new planting averaged 69,000 hectares per year. Since 1998 the rates of new planting have declined. At 14,900 hectares in 2003, new planting is now well below the average afforestation rate of the last 30 years.

New Land Planted in Production Forest in New Zealand



Assumption 3 – Yield tables (forest growth rate)

8. The Government's net emissions forecast uses a national area-weighted yield table based on NEFD yield tables and CNI radiata pine medium carbon relationships. The same yields are assumed for first and subsequent rotations. Some experts consider that current carbon sink estimates may be underestimated because forests planted on more fertile soils would suggest higher growth rates, though there is no consensus on this point. There is also downside risk because of growth selection. In particular, this is a risk where radiata pine growth and carbon models have been applied to slower growing alternative species for which no suitable models currently exist. The Carbon Monitoring System plots and revision of yield tables will help clarify this situation.

Assumption 4 – Kyoto Scrub

9. 'Kyoto scrub' was not included in the Government's net emissions forecast. Identifying such land is dependent on the 1990 baseline map (in 2005), completion of the Land Cover Database 2 (June 2004) and interpretation of the international rules governing what qualifies as Kyoto Forest. Landcare Research believes the quantum of Kyoto scrub to be small. While New Zealand has 1-2 million ha of scrub, much of this is considered to have been established prior to 1990 and therefore not eligible to generate sink credits. Identifying the proportion of scrub that is Kyoto forest scrub will present some up-side benefits. This is estimated to be in the order of +3.75 Mt CO_2-equivalent over CP1.

10. Conversely, there would be an over-estimate of sink credits if some scrub land cleared for forest planting since 1990 was considered to have already been forest as at 1990 i.e. the new planting would then not qualify as Kyoto Forest. This presents some down-side risk. Landcare Research is undertaking work to test, through historical land use practice, a hypothesis that in New Zealand, scrubland suitable for forest planting generally does not return to forest without direct human intervention.

Land Cover Prior to New Planting (Calendar Years) – Scrub (000) hectares

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Scrubland Area	9.92	15.68	8.14	11.76	7.04	4.59	5.6	5.78	6.9	4.4
Total New Planting Area	62	98	74	84	64	51	40	34	30	22

Assumption 5 – Soil Carbon

11. The Government's net emissions forecast assumed that soil carbon under forest would be neutral. There is some suggestion that average soil organic carbon for pasture is around 60t CO_2 per ha higher than for forest. Therefore, afforestation could be assumed to emit soil carbon and conversion of forest to agriculture could sequester carbon. By comparison, a hectare of mature radiata pine contains around 700 - 800 tonnes CO_2 at maturity. However, the difference between soil carbon on pasture and forest sites may reflect the underlying site quality rather than the result from land use change. The Carbon Monitoring System plots and further scientific investigation will continue to address these uncertainties.

12. A best guess figure for soil carbon would suggest that the range is in the order of -3.1 Mt CO_2-equivalent to 0 Mt CO_2-equivalent.

Assumption 6 – Kyoto Accounting Rules

13. This issue is most relevant post CP1. The Government's net emissions forecast assumed Kyoto accounting rules established for CP1 would continue for future commitment periods, for example the "fast growing forest fix" which limits liabilities to previous credits claimed. Because New Zealand would be one of a few countries to harvest Kyoto forests in CP1 it argued that being debited more carbon (i.e. carbon accumulated since 1990) than that able to be claimed (2008-2012) was unfair. Therefore, those countries that will harvest Kyoto forests in CP1 need only "pay back" the equivalent carbon units earned in CP1.

Assumption 7 - Rotation Age

14. This issue is most relevant post CP1. The Government's net emissions forecast assumed a rotation age of 28 years. An earlier cut will result in higher carbon emissions during the first commitment period and a later cut would defer carbon emissions. Decisions on the treatment of deforestation liabilities will also impact firms' behaviour. [sentence withheld under the OIA s.(9) (2) (f) (iv)]

Assumption 8 – Accounting for Article 3.4 Forest Management not included

15. Under Article 3.4 of the Kyoto Protocol, New Zealand has until 2007 to elect which additional Article 3.4 land use, land use change and forestry (LULUCF)

activities, if any it wishes to account for in the first commitment period (2008–2012). Forest management is one such activity and would include accounting for non-Kyoto forests over CP1. The government has agreed in principle not to account for these activities in the first commitment period. However, a final decision will not be made until closer to 2007, when further information is available.

16. At present, there is considerable uncertainty in the data on carbon stocks and carbon stock changes for forest land. The available data suggest that carbon stocks are likely to be in a steady state or a slight decline. An assessment[2] of the significance to New Zealand of Article 3.4 forest management activities concluded that the net position lay somewhere between -92 Mt CO_2-equivalent to 11 Mt CO_2-equivalent over CP1.

17. Whether New Zealand will be obliged to account for such activities in subsequent commitment periods is a matter for future international negotiations. If New Zealand is obliged to account for pre-1990 forests and these forests are in fact losing carbon, then this would add to New Zealand's emissions liabilities.

Probable Adjustments to Sink Credit Balance over CP1

Assumptions	**Potential Downside Risk**	**Potential Upside benefit**
Planting rates	0 for 30k ha new planting per annum -5.3Mt CO_2 for 20k ha new planting per annum -10.3Mt CO_2 for 10k new planting per annum.	No upside benefit unless new plantings are greater then 30k.
Forest Growth Rate	Further work is required to yield tables.	Further work is required to yield tables.
Kyoto scrub	Not applicable	+3.75Mt CO_2
Post 1990 planting on Kyoto scrub	Further work is required	Not applicable
Soil carbon	-3.1Mt CO_2 to 0	Not applicable

[2] An Assessment of the Significance to New Zealand of Article 3.4 Activities under the Kyoto Protocol, a report prepared for the Ministry of Agriculture and Forestry, 8 June 2001.

Other Items

Assumptions	**Potential Downside Risk**	**Potential Upside benefit**
Deforestation	-21Mt CO_2 to -6.3Mt CO_2	No upside benefit unless no land use change over CP1.
Article 3.4 Accounting (Government agreed in principle not to account for Art 3.4 in CP1)	-92Mt CO_2	+11Mt CO_2
Rotation age (post CP2 issue)	If rotation age brought forward.	If rotation age extended to future CP.
Kyoto Accounting Rules (post CP1 issue)	To be negotiated	To be negotiated