Cover note to the release of briefing 09-B-0897
Mitigation and mitigation costs estimates for the period 2013-2020: Background and intended approach to engaging with stakeholders.

In considering the mitigation cost estimates appended to this briefing, it is important to remember that they were prepared before December 2008 and drew on the best information available at that time. Since then both the data that these estimates were drawn from and understanding of mitigation options has progressed. Specific issues are discussed below.

Energy

Assumptions used in energy modelling are continuously being updated. The latest results of modelling by the Ministry of Economic Development (MED) can be found in the updated New Zealand Energy Outlook, due to be released in September 2009, available on MED's website.

Land-Use, Land-Use-Change and Forestry

It is widely acknowledged that projecting land use changes in New Zealand has been very difficult in the past, and is dependent on the long term certainty of revenue streams from different land uses. Two reports commissioned by the Ministry of Agriculture and Forestry both note that uncertainty is compounded by including carbon price effects into traditional forest management decisions.

The forestry mitigation estimates appended to this briefing were developed by the Ministry for the Environment from publicly available information and consideration of their expert opinion of the likely responses to different emissions prices. Since these estimates were developed the initial LUCAS results have become available. These include new sequestration tables and land areas under pre-1990 and post-1989 forest.

Agriculture

When the marginal abatement estimates were made the methodology for including different technologies in projections of future agriculture productivity were still being developed. Since then the Ministry of Agriculture and Forestry (MAF) has incorporated as part of business as usual (BAU) behaviour several technologies and practices previously classified as mitigation options. This was done to better reflect a continuation of historical trends, the need for continual productivity improvement to maintain the sectors growth, and a greater movement towards best practice across the sector.

In addition to incorporating some options as business as usual, MAF has continued to assess whether the evidence of all options' effectiveness is suitable for assessment by the United Nations Framework Convention on Climate Change and reflection in New Zealand's inventory. This is done to better reflect the credit that using these different mitigation technologies would receive under the Kyoto Protocol, rather than their theoretical or potential performance. Several options included in mitigation estimates showed promise in initial trials, but there is not yet have sufficient evidence for them to be reflected in the inventory. In addition to this there have been continual updates in the science concerning the effectiveness of the options and uptake rates.

Ministry for the Environment
Manatū Mō Te Taiao

Mitigation and mitigation costs estimates for the period 2013-2020: Background and intended approach to engaging with stakeholders

Date:	16 April 2009	**MfE Priority:**	Urgent
Security Level:		**Number of Attachments:**	One
		MfE Ref No:	09-B-0897

Action Sought

	Action Sought	**Deadline**
Minister for Climate Change Issues Hon Dr Nick Smith	**Note** that we have developed estimates of the amount of emissions mitigation expected over the period 2013-2020 as a result of planned policy settings, including for different emissions price signals **Note** the attached material that summarises results to date, which we intend to release in response to an Official Information Act request and publish on the MfE website with appropriate caveats	16 April

Ministry for the Environment Contacts [if required]

Name	**Position**	**Telephone (cell)**	**Telephone (work)**	**1st Contact**
Principal author	Daniel Twaddle		439 5507	
Responsible Manager	Matthew Everett	**[Withheld]**	439 7415	✓
Responsible General Manager	Prue Densem		439 7667	

Executive Summary

We briefed you in March on work that has been undertaken to estimate the amount of greenhouse gas emissions mitigation expected to occur over the period 2013-2020 as a result of planned policy settings, including for different emissions price signals. These sector based estimates will help to inform New Zealand's position with respect to post-Kyoto emissions target setting.

There is considerable ongoing stakeholder interest in this work and we have received a number of inquiries about its status. To engage with stakeholders, we prepared draft material for the MfE website that summarises expected mitigation, but we decided not to publish this on the website until it could be updated for results of other work, including the 2009 Net Position Report's baseline emission projections and new model runs estimating energy sector mitigation.

However MfE has recently received an OIA request from **[Withheld]**, in which he asks for the latest results of this work. In our view there are no grounds to withhold this information and we plan to release the draft material prepared for the MfE website to satisfy his request. Given that he is likely to refer to this work publicly, and in light of the considerable stakeholder interest in this work, we propose to publish it on the MfE website with appropriate caveats to cover off the work that remains to be done to update our estimates.

Recommended Action

We recommend that you:

(a) **Note** that with MED, MAF and EECA we have developed estimates of the amount of greenhouse gas emissions mitigation expected to occur over the period 2013-2020 as a result of planned policy settings, including for different emissions price signals

(b) **Note** the attached material that summarises results to date, which we intend to release in response to an Official Information Act request and publish on the MfE website with appropriate caveats.

Matthew Everett **Date**
Acting Central Government Policy Group Manager

Referred to Ministry Communications Staff: No

Hon Dr Nick Smith **Date**
Minister for Climate Change Issues

Purpose of Report

1. To brief you further on work that estimates the amount and cost of greenhouse gas emissions mitigation expected to occur in New Zealand during 2013-2020 under current policy settings, and under a range of possible emissions price signals.

2. We are drawing this to your attention because of increasing stakeholder interest and an Official Information Act Request which is leading us to engage with the public on this work and share our findings to date.

Background

3. Last year we developed sector based estimates of emissions mitigation from government policies and programmes, including for different emissions prices, in collaboration with MED, MAF, and EECA. These estimates show how much we expect projected baseline emissions to fall as a result of these initiatives.

4. A first estimate of mitigation for the energy sector was provided to the Climate Change Leadership Forum in February last year and then publicly released on the Ministry for the Environment website. This estimate has since been refined, and estimates of mitigation in the agriculture and forestry sectors have been added.

5. In March we briefed you on the headline results of this work to date (09-B-00576) which outlined that, with no new mitigation policies in place, emissions are expected to be about 40% above 1990 levels by 2020, but that with current planned non-price measures and a $25 per tonne economy wide emissions price this reduces to about 25% above 1990 levels. At a price of $50 per tonne emissions only increase by about 15%.

6. These estimates are of course subject to a degree of uncertainty and will be refined on an ongoing basis. In the near term we plan to update our estimates for recently completed new baseline projections from the 2009 Net Position Report and latest estimates of mitigation in the energy sector. Further work is also required on estimates of afforestation and farmer uptake of mitigation technologies in response to a price signal. Completed estimates will be useful in informing New Zealand's position with respect to a post-Kyoto emissions target.

Engaging with stakeholders and release of information

7. Stakeholder groups have expressed considerable ongoing interest in this work. In order to inform stakeholders of our results so far, and to get feedback to inform further work in this area, we had planned to place details of our latest estimates on the Ministry for the Environment website. Draft material has been developed for this purpose but we decided to delay publishing it until the latest updates could be added.

8. We have now received an Official Information Act Request for the results of this work from **[Withheld]** of **[Withheld]**. We believe that there are no grounds to withhold this information and due to the wider interest in this work we consider that publishing the draft material on the MfE website is the best way to satisfy this request.

9. In addition to the Official Information Act request from **[Withheld]**, interest from a number of other stakeholders has also increased recently. The **[Withheld]** has asked officials to present the results of work completed to date at their

next meeting in late April, and some of these results have been requested by the Board of Inquiry investigating a national policy statement on renewable electricity generation.

10. In light of this level of interest and the recent OIA request we consider that it would be appropriate to publish the draft material that we have prepared on the MfE website (attached) with appropriate caveats to cover off the work that remains to be done to update the estimates.

11. Officials believe that while interest is high there is little risk in publishing this information given that much of it is in the public domain already and is likely to be disseminated further by **[Withheld]**, following its release to him. Feedback on published material from interested stakeholders will help to inform further development of these estimates, which will assist in identifying where improvements can be made and where further work is required.

12. We have attached the draft material that we intend to release to **[Withheld]**, and following appropriate editing will publish on the MfE website.

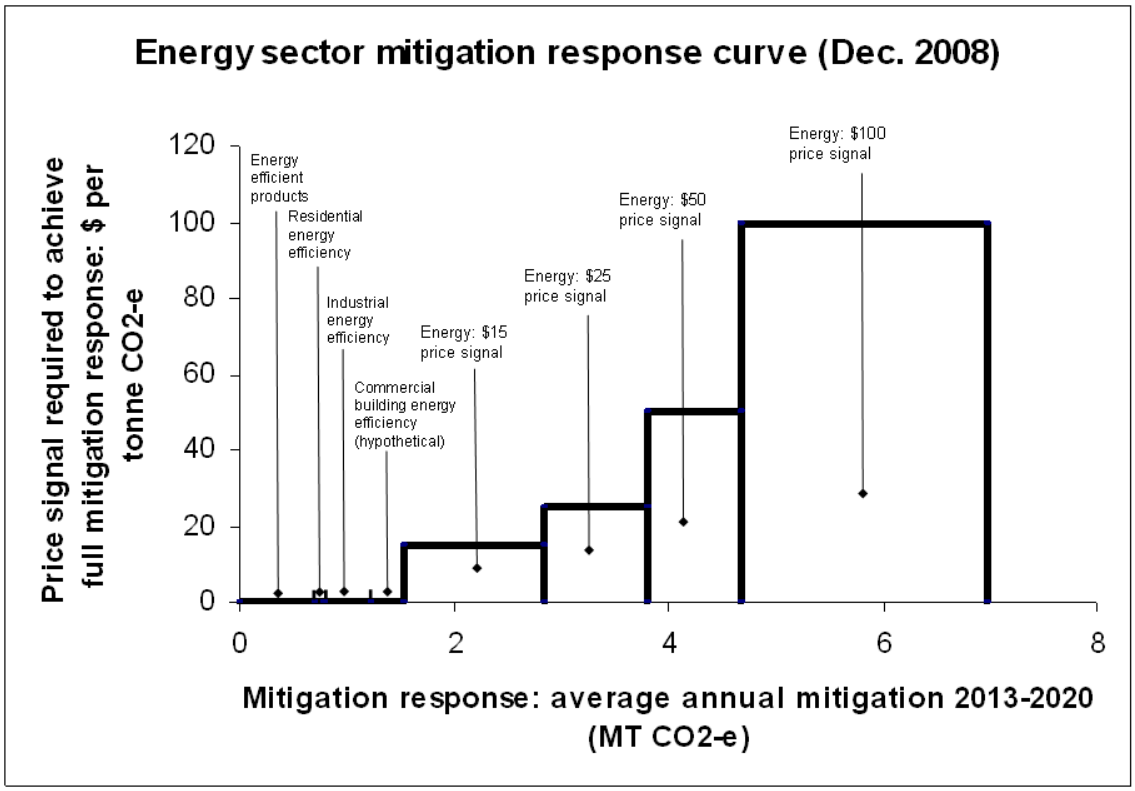
Appendix 1

Greenhouse Gas Mitigation Response and Cost Curves for Energy

(December 2008)

The following mitigation response and cost curves for energy have been developed as part of the work to estimate sectoral greenhouse gas (GHG) mitigation response and cost curves for the period 2013 - 20.

Figure 1 Energy sector mitigation response curve



The greenhouse gas mitigation response curve shows estimated average annual mitigation in the energy sector for the period 2013 – 20, at different emissions price levels. Each bar on the curve represents the expected reduction in CO_2 emissions either from a particular emissions price or government programme. The estimated annual mitigation for each emissions price or policy is represented by the width of the bar on the horizontal axis, with the mitigation for each emissions price bar being additional to mitigation at lower prices. The vertical axis shows the emissions price associated with the mitigation response for each bar.

All emissions reductions are estimated relative to a hypothetical "business as usual" scenario in which policy settings as at 31 December 2006 are assumed to continue and none of the policies/programmes shown on the response curve are implemented.

Because the funding and extent of existing government energy efficiency programmes are largely independent of the emissions price, mitigation from these measures is shown as occurring at a price signal of zero.

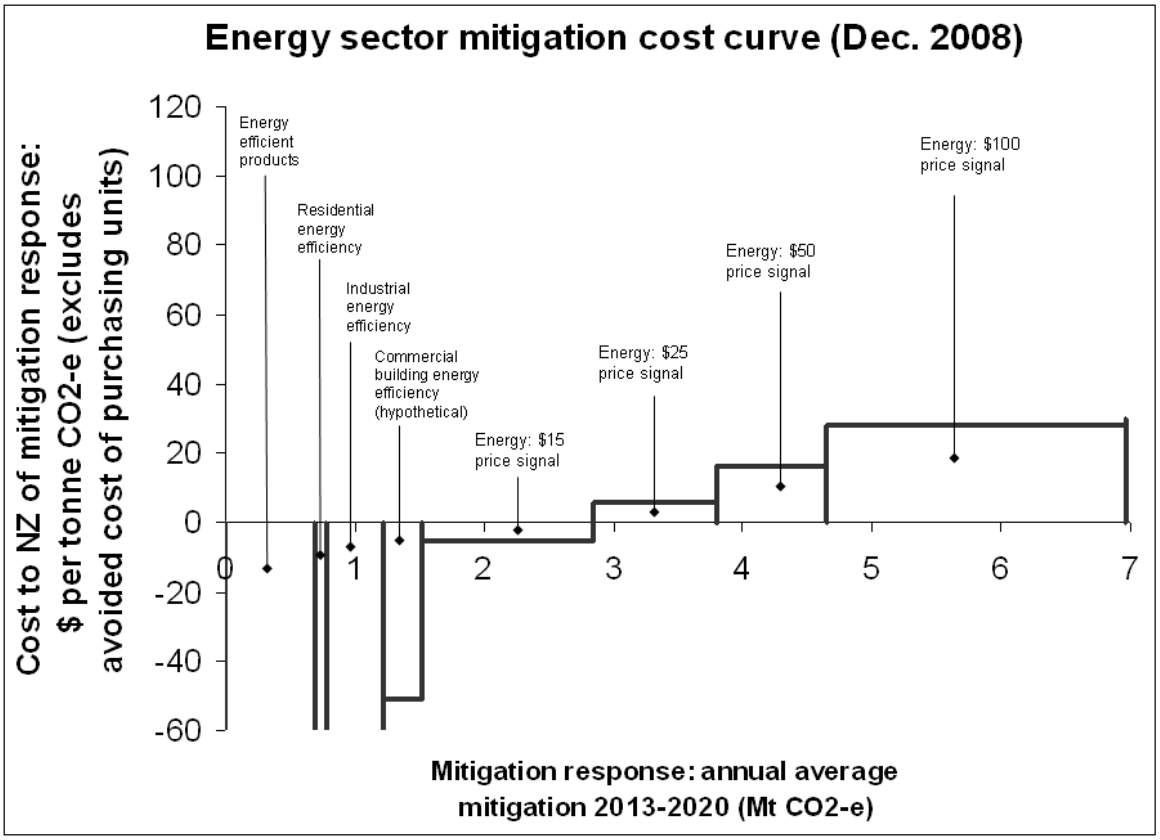
Mitigation for three current energy efficiency programmes (energy efficient products, residential energy efficiency and industrial energy efficiency), one hypothetical energy efficiency programme

(energy efficiency in commercial buildings), and four emission price signals ($15/tonne, $25/tonne, $50/tonne and $100/tonne) is shown.

The majority of the emissions reduction attributable to emissions pricing relates to stationary energy use – primarily avoided fossil fuel generation of electricity. Demand for transport, particularly commercial transport, is relatively inelastic to price which limits the impact of emissions pricing on reducing emissions from the transport sector.

Following an initial screening of policies for the size of emission mitigation expected, only policies that were estimated to result in mitigation approaching about 0.8 million tonnes for the full 8 year period have been included. No new major technologies or behaviour shifts were included in this analysis on the basis that they would be unlikely to result in significant emission reductions prior to 2020.

Figure 2 Energy sector mitigation cost curve



The greenhouse gas mitigation cost curve (above) shows the estimated mitigation, and the cost to the New Zealand economy of that mitigation, resulting from each of the emission price levels and each of the particular policy measures. It is similar to the mitigation response curve except that the vertical axis shows the net cost to New Zealand of the mitigation for each emissions price or programme, rather than the level of the price signal. Mitigation policies that have a cost per tonne less than the cost of purchasing emission units are of net benefit to the New Zealand economy.

Estimates for energy efficiency programmes

The estimates on the curve for energy efficiency represent mitigation through energy demand reductions below baseline levels caused by energy efficiency programmes run by the Energy Efficiency and Conservation Authority (EECA). Mitigation and cost per tonne estimates for each programme are derived from analysis in EECA project evaluation templates.

Cost per tonne estimates include EECA administration costs, programme costs (such as energy efficiency grants) and private sector costs (such as private sector programme contributions). The benefits of these programmes are also included, such as energy cost savings from lower energy demand and health benefits (for instance as a result of insulation retrofits or improved air quality). Cost per tonne estimates for each of the energy efficiency programmes are negative, which means that overall the economic benefits from these programmes are greater than the costs.

It should be noted that the estimates for commercial building energy efficiency are only hypothetical. A commercial building energy efficiency programme has not yet been developed, although options for one are being investigated. The hypothetical estimate included is based on previous EECA project evaluation estimates, and should be read as *indicative* of what may be achieved *if a commercial building programme of this type is implemented*.

Estimates for energy emissions pricing

The emissions price bars for energy represent the impact that placing a price on emissions from stationary energy and transport would have if that price was $15, $25, $50, or $100 per tonne of CO_2 equivalent respectively. Each price bar is additional to the previous one: ie the price bar for a $25 price on emissions estimates the mitigation that would be achieved at a price of $25 *in addition* to the mitigation that would have occurred under the lower $15 price.

For each of the emission price bars the cost per tonne of emissions reduced is less than the emission price. This is because the most that any electricity generator or fuel purchaser would be willing to spend to reduce emissions would be equal to the level of the emissions price, and with opportunities to reduce emissions existing below this price the average cost will be less than the level of the price.

These mitigation and cost per tonne estimates are largely based on the approach used by the Ministry of Economic Development in chapters 4-6 of its “Benefit Cost Analysis of the New Zealand Energy Strategy”.

Greenhouse Gas Mitigation Response and Cost Curves for Forestry 2013 – 20

(December 2008)

Introduction

The purpose of these curves and those prepared for other sectors is to estimate:

- How much mitigation will occur in New Zealand over the period 2013 – 20, relative to baseline projections, in response to policies adopted since 1 January 2007;
- What additional mitigation 2013 – 20 would result from additional policy measures; and
- The cost to the economy of the mitigation associated with the above, i.e. recently adopted and potential policy measures, and a range of possible emission price signals under the New Zealand emissions trading scheme (NZ ETS).

These estimates, when added to the 'business as usual' (ie. baseline) projections of sectoral emissions and removals give sectoral estimates of emissions and removals under current policy settings. In this work 'business as usual' projections are defined as the projection of emissions and removals that would have occurred under policy settings there were in place at 31 December 2006.

Mitigation in the forestry sector comprises—

- removal of carbon dioxide from the atmosphere from forest planting
- reduced agriculture emissions from livestock displaced from the afforested land
- avoided emissions from avoided deforestation
- avoided agriculture emissions associated with avoided deforestation.

All estimates are for the effect of activities from 2008 onwards. No emissions from harvest of land that is planted as a result of government policies are included because forests planted in 2008 are only 12 years old by 2020. While some owners of "Kyoto forests" planted 1990-2007 might respond to emission pricing by delaying harvest, we do not estimate for this in our forecasts.

This work is intended as an input to the negotiations for the post-2012 climate change agreement(s). It is a work-in-progress. We have necessarily made broad assumptions. Our results should be regarded as illustrative and subject to considerable uncertainty.

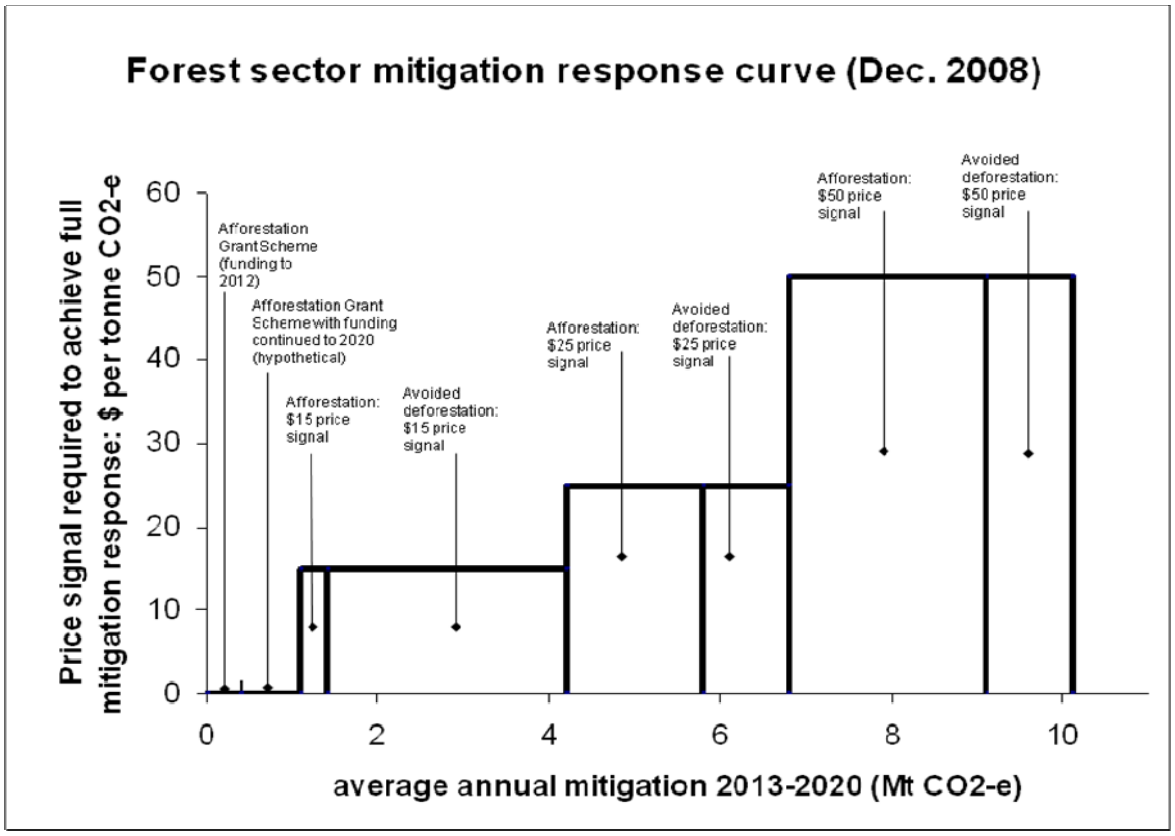
For general information concerning the NZ ETS and other government policy to address climate change, please visit www.climatechange.govt.nz/. For information on the specifics of policy for the land use, land use change and forestry sector (LULUCF), please visit www.maf.govt.nz/climatechange/

Mitigation response and cost curves

We forecast separately for: the Afforestation Grant Scheme (AGS); a hypothetical situation whereby the AGS is extended (funding continues beyond 2012 when it is currently scheduled to finish); and for both afforestation and avoided deforestation under an emissions trading scheme and emission price signals of $15, $25 and $50 per tonne CO_2-e.

Figure 2 shows the emission reductions estimated in response to different level of an emissions price and in response to particular policy measures (the 'emission price' bars have been positioned on the response curve to reflect the fact that the full mitigation associated with them is not available until the emissions price reaches the relevant level: $15, $25, $50. In practice some of the mitigation associated with these 'emission price' bars will be stimulated by emissions prices below those price levels).

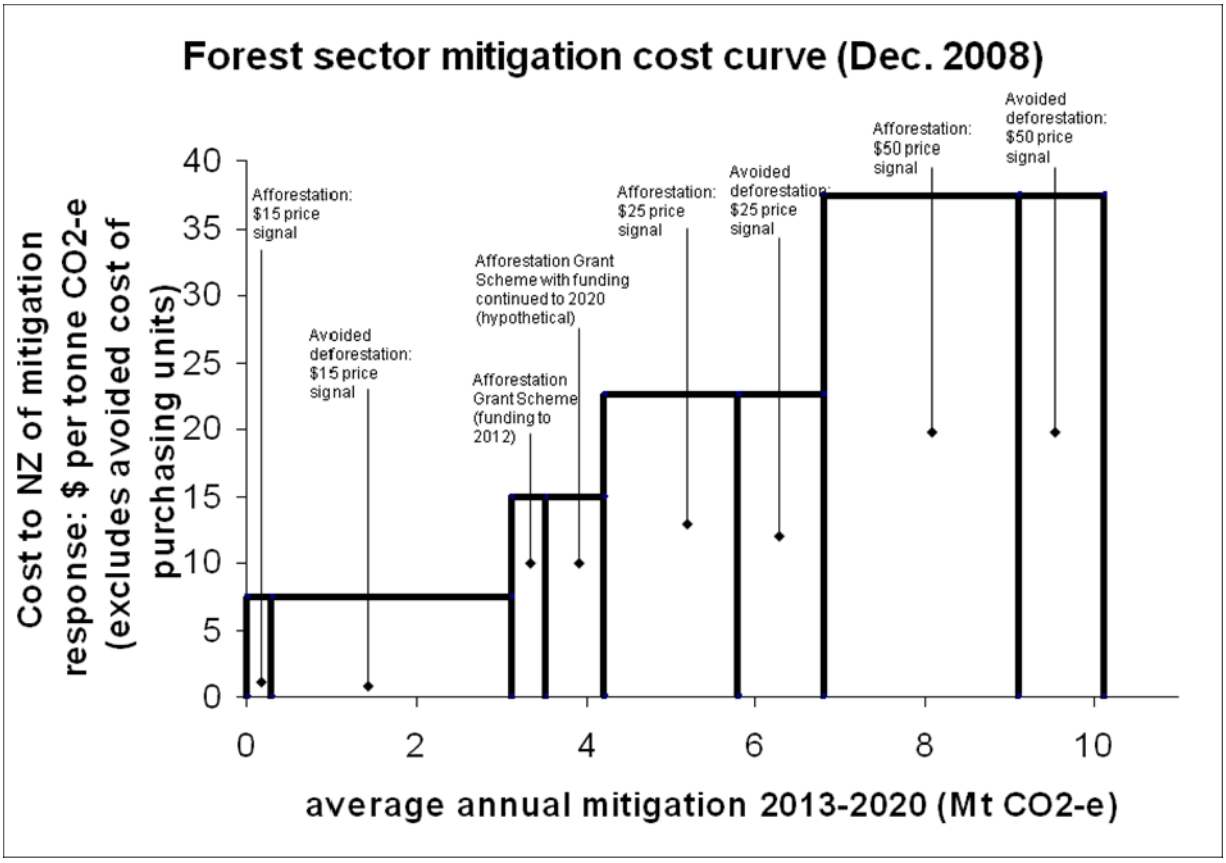
Figure 3 Forest sector mitigation response curve



Text description
A price signal of $15/t CO_2e is estimated to give average annual mitigation for the period 2013-20 of about 3 Mt CO_2e (most of which is from avoided deforestation); a price signal of $25/t CO_2-e is estimated to give additional average annual mitigation of about 2.5 Mt CO_2e (about 2/3 of which is from afforestation); a price signal of $50/t CO_2e is estimated to give average annual mitigation of about 3 Mt CO_2e (about 3/4 of which is from afforestation). The current Afforestation Grant Scheme (AGS) is estimated to give average annual mitigation of about 0.3 Mt CO2-e; and if the AGS was to be extended from 2012 to 2020 it is estimated to give additional annual average mitigation of about 0.5 Mt CO_2e.

The mitigation cost curve (Figure 2) shows the estimated cost to the New Zealand economy of the mitigation resulting from each of the emission price levels and each of the particular policy measures. The average cost per tonne is less than the relevant emission price ($15, $25, $50) because in each tranche of mitigation some will occur at prices lower than the emission prices indicated on the graph.

Figure 4 Forest sector mitigation cost curve



LULUCF Activity descriptors

The model is based on 3 forestry activities:

- *"ETS AFF"* is the type of forestry we expect the private sector to deliver in response to the New Zealand Emissions Trading Scheme (ETS). We expect predominantly *Pinus radiata* production forests.
- "*ETS Avoided DF*" relates to exotic forest established before 1990 on land now known to be suitable for dairying. These lands are mainly in the Central North Island. When carbon is priced, less deforestation will occur. We forecast land use change (hence emissions) at the carbon price in question
- *"Grant Afforestation"* is the type of forestry we expect farmer-land owners to establish in response to the incentive of the Afforestation Grant Scheme (AGS). We assume a grant payment of $1600 per hectare regardless of the ETS carbon price and forest composition of 100 percent planted Pinus radiata. The AGS programme is funded only until 2012 and we assume it will terminate at that point. We have included separate analysis of a hypothetical Extended AGS under which the AGS continues for the period 2013 – 20.[1]

Preliminary analysis indicated that indigenous forestry is likely to be a relatively minor contributor over the forecast period (less than 0.5MT/annum). Compared to exotic, indigenous afforestation has high per hectare establishment costs (in excess of $5000 per hectare) and low sequestration rates (3 tonnes/ha/yr).

[1] The current estimates for the Afforestation grant scheme do not reflect recent funding changes, which are expected to result in a small reduction in mitigation from the scheme. This will be adjusted for in the final web content.

Area forecasts

At emissions prices of $20 and above, *"ETS AFF"* is the largest of the three forestry activities. Pricing carbon through the ETS increases the profitability of the forestry investment by providing a new revenue stream. We assume the forestry investors will respond to revenue from carbon in the same way as they do to log price changes. A study has been done that establishes a correlation between planting rates and the forecast internal rate of return (IRR) at the time the investment decision was made[2]. We forecast business-as-usual planting at 1500 hectares per annum and deduct this from the afforestation forecast derived from the IRR model. We ramp-up planting over the period 2012-2015, taking 2012 as the date when the policy setting are accepted by forestry investors and sufficient tree stocks are available.

At the $50 emissions price, the estimated internal rate of return is of the order of 15%, a figure well above historic profitability norms. We think investor response will be constrained by short-run industry capacity, and estimate this to be at 90,000 hectares of afforestation per annum.

Our estimate of *"ETS Avoided DF"* derives from a 2007 Deforestation Survey, by Bruce Manley of the University of Canterbury[3]. The Survey contained questions aimed at gauging the effect of the Government's proposed Emissions Trading Scheme (ETS) on deforestation intentions. Survey participants were aware that the liability for deforesting mature plantation forest would be in the region of 800 tonnes CO_2-e per hectare. At that time it was thought likely the carbon price via the ETS would be in the range $15 to $30.

The Survey indicated 45,000 hectares of deforestation over the forecast period if there was no policy intervention and 12,000 hectares if the ETS, as introduced to Parliament, became law. We have assumed that 'no policy intervention' is equivalent to an expectation of a zero emissions price in the short term but a charge on deforestation emissions in the longer term, and 'ETS as introduced to Parliament' is equivalent to a $20 emissions price in place from early 2008. We have inferred deforestation at other prices by assuming a concave relationship between the emissions price and deforestation and fitting a curve to the two data points. The total area of deforestation over the forecast period is assumed to be spread in equal annual amounts.

To forecast *Grant AFF,* we linearly increase planting during 2008 - 12 (CP1) to the point where 100% of the AGS budget ($10mill/yr) is utilised by the end of the commitment period (6250 hectares per annum). We deduct 500 hectares business-as-usual planting as the estimate of what would have occurred without the AGS, for example, under regional council soil conservation grant programmes.

To forecast *Extended Grant Aff* we assume continued funding of $10 million/yr for the period 2013 – 20 achieving additional planting of 5750 ha/yr.

Afforestation during CP1 is relevant because this forest removes carbon during the period 2013 - 20. On the other hand, deforestation during CP1 is irrelevant. As a consequence of the assumption of instantaneous oxidisation, the associated emissions are deemed to have occurred outside of the forecast period.

Per hectare sequestration rates

For all afforestation, we estimate sequestration by using a carbon calculator provided to MfE by Dr Steve Wakelin of Scion. The calculator is for radiate pine. For *ETS Avoided DF* we use an emissions factor of 800t/ha in the year the avoided deforestation occurs.

[2] Horgan (2007), *Financial Returns and Forestry Planting Rates*, http://www.maf.govt.nz/climatechange/forestry/ets/returns/returns-and-new-planting-rates.pdf

[3] http://www.maf.govt.nz/climatechange/forestry/ets/deforestation/2007/2007-Deforestation-Intentions-Survey.pdf

Treatment of agricultural emissions

In the National Inventory, agricultural emissions are reported and accounted within the agriculture sector. Within our LULUCF forecasting model, however, we have included avoided agricultural emissions. Afforestation is assumed to occur in the hill country and will reduce sheep and beef cattle numbers by 6 stock units per hectare afforested (0.35 tCO_2e/su/annum). In the case of avoided deforestation, we assume the new land use will be dairying. We assume a stocking rate of 2 cows per ha and an emission factor of 2.7 tCO_2e/cow/annum, lagged 1-year to allow for pasture establishment.

Further work

Our analysis suggests that within the range of emissions prices considered, the mitigation opportunity offered by the LULUCF sector is large compared to other sectors. In conjunction with other departments, we need to improve our understanding of the sector response, and the barriers that might stand in the way. Further work could include:

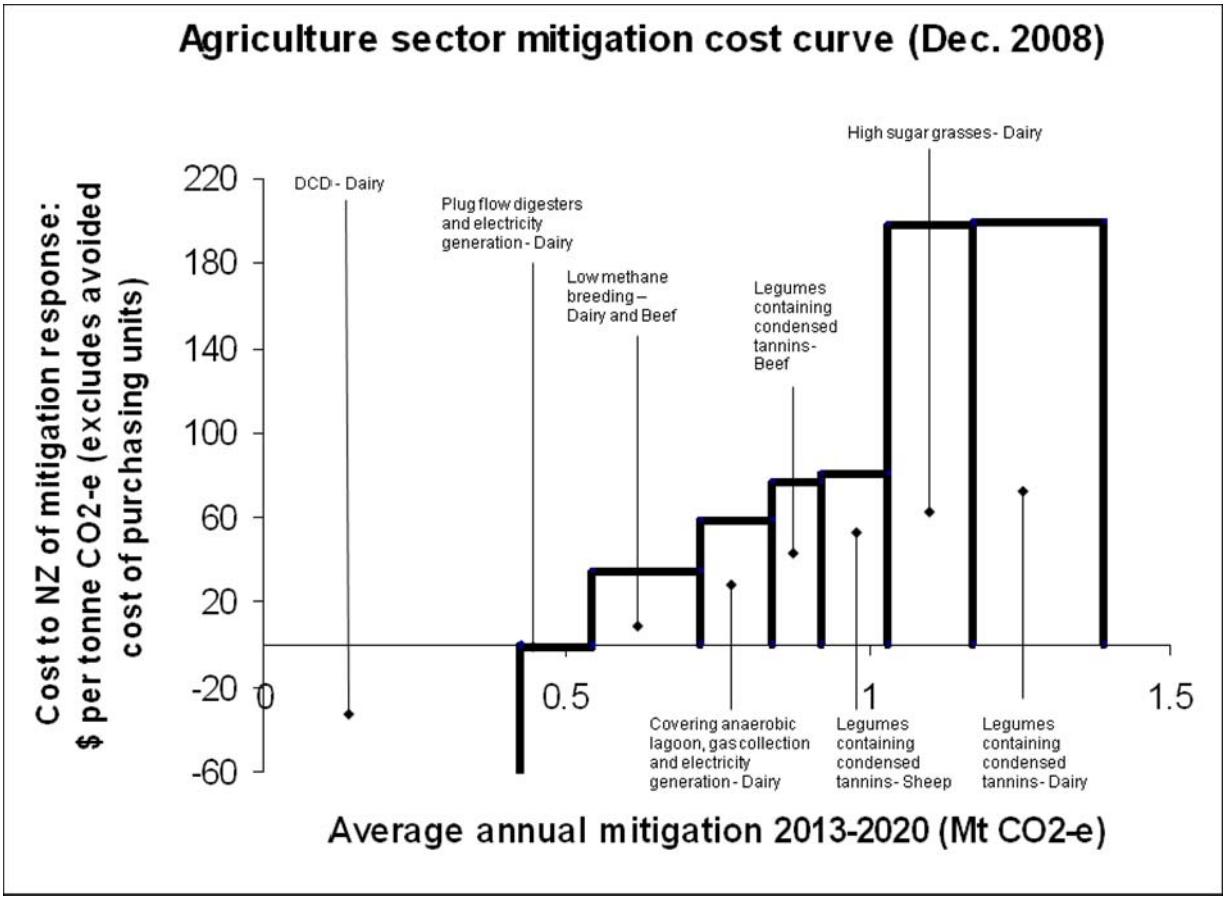
- Improving our understanding of the extent to which the owners of Kyoto (post-1990) forests might elect to join the ETS and manage their forests differently as a consequence.
- Improving our understanding of how best to tap the Afforestation opportunity on public conservation land.
- Compliance cost considerations. Particularly at the lower carbon prices, the costs associated with the inventory systems the forest owner must have in order to claim ETS units could be prohibitive. We may need to refine the forest budget model that sits behind the internal rate of return relationship in this regard.
- Carbon price volatility. We assume carbon prices over the forecast period will be steady. Prices may well be volatile and this creates an investment risk. Our analysis does not consider ways in which price risk could be mitigated, or the possible costs involved in doing so.
- Changes to silvicultural practice. The forest budget model assumes *Pinus radiata* managed for production over a 28 year rotation in line with current industry practice. At carbon prices of $25 and above, it becomes profitable to extend rotation lengths or perhaps establish forests purely for carbon. Such a change in practice impacts on both wood supply forecasts and GHG mitigation forecasts.
- Land prices. The forest budget model is based on a land price of $5000/hectare. Log haul distance and terrain considerations tend to dictate the location of production forests. At the higher carbon prices, forests could be grown purely for carbon and location is no longer important. Afforestation projects could utilise cheaper land, say $2000/hectare. The pool of such land is large, but foresters' demand could eventually drive land prices up, reducing the profitability of the investment, and dampening the afforestation response.

A Greenhouse Gas Mitigation Cost Curve for Agriculture

(December 2008)

The following mitigation cost curve for agriculture has been developed as part of the work to estimate sectoral greenhouse gas (GHG) mitigation response and cost curves for the period 2013 - 20.

Figure 5 Agriculture sector mitigation cost curve



Text description: The greenhouse gas mitigation cost curve for agriculture shows estimates of the average annual quantity of greenhouse gas reductions. It covers the period 2013 – 20 and identifies the cost of those reductions ($ per tonne CO_2e) for eight technologies. The largest reduction, about 0.4 million tonnes a year, comes from applying a nitrification inhibitor, Dicyandiamide (DCD), to dairy farms. In total the eight technologies give a reduction of about 1.4 million tonnes a year. Applying DCD to dairy farms is estimated to have negative costs, while the other technologies have costs ranging from $0 to $200 per tonne.

There is a high level of uncertainty about both the quantities and the costs on this mitigation cost curve. The curve and its components should be treated as indicative only. The curve will be updated as new information comes to hand.

The curve is based on the report *Analysis of the Potential and Costs for Greenhouse Gas Emission Reductions within the New Zealand Agricultural Sector (25 August 2008)* prepared by ICF International for the Ministry of Agriculture and Forestry (MAF) and on subsequent analysis by MAF.

Emissions reduction estimates

The emission reduction estimates are based on judgements by industry experts and MAF on two factors:

- applicability and uptake rate, and
- technical effectiveness.

'Applicability' and 'uptake rate' determine the proportion of total emissions from a particular emission source (e.g. methane from enteric fermentation in dairy cattle) to which the particular technology option is expected to apply at a given date. For example, by 2020 it is expected that 50 percent of the national dairy herd is being fed legumes containing condensed tannins.

'Technical effectiveness' is the proportion by which emissions to which the particular technology option can be applied, are expected to be reduced by that technology option. For example, feeding a dairy cow legumes containing condensed tannins is expected to reduce methane emissions from that cow by 9 percent.

Cost per tonne estimates

The initial framework for calculating cost per tonne of emissions mitigation has been derived from a model based on the on-farm costs of implementing each mitigation measure from the perspective of the farm owner/operator. Typically this involves taking into account upfront capital/establishment costs, recurring expenses, and the financial effects of production changes. A few mitigation measures can lead to increased production, with the financial effects of this resulting in 'negative' cost per tonne estimates – i.e. the farmer profits from implementing the mitigation measure.

No government costs for promoting uptake have been included in the ICF analysis or the subsequent MAF analysis. Business tax is included in the ICF analysis but because it is a transfer payment from one sector of the economy to another it has been excluded from the subsequent MAF analysis to better estimate the cost to the economy as a whole.

The estimated cost does not incorporate any benefit for avoiding having to buy emissions units for the greenhouse gas emissions that are reduced. The estimated mitigation cost of a particular technology indicates the minimum value that would have to be placed on reducing a tonne of greenhouse gas emissions if the implementation of that technology is to have a net benefit for the economy.

Further information

The ICF report, under a covering explanatory note, is available from MAF. Information on the susbsequent analysis by MAF and on how the mitigation cost cuve has been derived from the ICF report and MAF's subsequent analysis is set out in *GHG Mitigation Cost Curve for Agriculture (December 2008) – Analysts' version.* This paper can be obtained from the Ministry for the Environment.