such as Canada and Japan enter the market, it is very possible that prices of Kyoto-compliant emission instruments (AAUs, CERs, ERUs and RMUs) will increase, perhaps significantly. It is also possible that there will be significant volatility in prices for emission instruments in the future, given the unstable state of these markets (given these factors, hedging and forward-contracting may well be critical to New Zealand's success in the market).

In addition to New Zealand's objectives in the area, and supply and demand in the market, the other determinant of price relates to risk profiles. There are risks associated with projects, ranging from contract risks and project risks to country risks. Depending on whether the associated risks are borne by the buyer or the seller, different price premiums are to be expected.[138]

4.8.6 Conclusions

The variety of issues that surround the development of an appropriate and effective purchasing strategy highlight the need for the Government to immediately put in place a work programme, if the option of purchasing units to meet some of our CP1 obligation is to be kept. Early commencement of this work would allow the greatest scope to develop a strategy that met purchasing objectives while managing fiscal risk. Given the considerable uncertainty that surrounds the future price of emission units, it would be sensible to be in a position to purchase at least some units during 2006.

It is therefore recommended that work commence as soon as practicably possible on determining potential buying strategies for New Zealand that reflect New Zealand's objectives in this area and our risk profile, along with issues of management, timing and price. Especially if international carbon markets prove to be volatile in the future, early agreement of a buying strategy may prove to be extremely useful and valuable.

4.9 Alternative approaches to meeting New Zealand's commitments in CP1

Summary

This section discusses the results of economic modelling undertaken to help determine the economic effects of New Zealand using the Kyoto flexible mechanisms to meet its Kyoto shortfall, and of including or excluding agriculture in the coverage of a domestic price-based measure.

It concludes that:

- it is cheaper and more efficient to meet at least some of our target through

[138] In a recent survey of potential CDM market players, 82% of Japanese respondents believed that differences in the "quality" of CERs would result in price differences. The same work suggested that respondents are most concerned about the risk that the units would eventually not be acceptable under the CDM. Contract risks, such as the sellers' credibility, also command a high premium. Asuka and Okimura, 2005.

international emissions trading

- the more we seek to achieve emissions reductions via the imposition of a domestic carbon tax rather than international emissions trading, the more preferable it is to impose it on all sectors of the economy
- achieving domestic mitigation is likely to impact on some (more emissions-intensive) sectors more heavily than others.

4.9.1 Introduction

As part of the background work to the Review of Climate Change Policies, modelling on the economic impacts of different strategies for emission abatement in CP1 has been undertaken.

The modelling was undertaken by ABARE. ABARE is an Australian government economic research agency and has been involved in modelling climate change policy since 1993 (see the Annex for a description of the model). Previous ABARE analyses on the economic impacts of climate change policies are available on the Ministry for the Environment's website and ABARE (www.abareconomics.com).

The ABARE modelling is designed to help New Zealand answer the following questions:

- should New Zealand use flexibility mechanisms contained in the Kyoto Protocol, which include international emissions trading and the CDM, in meeting its CP1 commitment?
- from an economic viewpoint, should emissions from agricultural sources be subject to a carbon tax?

4.9.2 Modelled scenarios of New Zealand greenhouse emissions paths

To help answer the first of the questions posed above, three emissions paths for New Zealand were developed: low, medium and high. These are similar, but not identical, to the optimistic, most likely, and pessimistic scenarios that were developed when New Zealand's net emissions position was calculated in May 2005.[139] All of these scenarios model emission levels and prices in 2010, and draw results for CP1 from the 2010 year as representative of average conditions of the 2008 to 2012 period.

For each of the emissions path scenarios, effects on the New Zealand economy have been estimated assuming that New Zealand meets its CP1 commitment through a combination of domestic abatement and purchasing units using the Kyoto flexibility mechanisms. To contrast with these results, the effects on the New Zealand economy

[139] The low emissions path specified in the ABARE modelling has net emissions in 2010 slightly lower than our CP1 target would imply.

if New Zealand meets its CP1 commitments solely through domestic emissions reductions have also been estimated.

The estimated level of domestic abatement flows from the carbon price implicit in the model – where it is assessed to be cheaper to reduce emissions than pay the carbon price, then domestic emissions reductions occur. The scenarios outlined in Table 26 below assume that all sectors of the New Zealand economy are included, with no NGAs.

Where it is assumed that New Zealand meets all its required emissions reductions domestically, the carbon price in the economy rises until the required level of domestic abatement is attained. In cases where New Zealand meets its Kyoto obligations by a mix of purchasing international units and domestic abatement, in effect, the model estimates the international carbon price and imposes this international carbon price on the domestic economy.

4.9.3 Key results from the ABARE model runs

Key results from the ABARE modelling are shown below.[140]

Table 26 - Results as at 2010 – Effects on the New Zealand Economy

Emission Path	Low emissions path		Medium emissions path		High emissions path	
Internationally linked or domestic abatement only	Int. link	Dom. only	Int. link	Dom. only	Int. link	Dom. Only
Scenario	1	2	3	4	5	6
Abatement or purchase of units required to meet Kyoto commitment (Mt)	-1.1	-1.1	8.0	8.0	18.9	18.9
Abatement undertaken domestically (Mt)	4.8	0	5.1	8.0	5.5	18.9
Units purchased internationally (Mt)	-5.9	0	2.9	0	13.5	0
Effect on GDP of abatement	-0.02%	0.00%	-0.02%	-0.05%	-0.03%	-0.24%
Carbon price in 2010 ($/t CO_2e)	10	10	10	18	10	51

Source: ABARE

The interpretation of these results is not entirely obvious. To assist the reader, the figures from scenario 3 are explained below.

140 There are some rounding errors in the results presented.

Scenario 3 relates to a medium emissions path in which New Zealand meets its Kyoto commitments through a combination of international trading and domestic abatement measures. Under this scenario:

- the difference between our net emissions and our Kyoto target is 8.0Mt CO_2e in 2010. In order to meet our Kyoto commitment, New Zealand must either purchase units internationally or reduce its emissions domestically, or a combination of the two
- according to the model results, this amount would be met through domestic abatement, in response to a carbon price in the economy, to the tune of 5.1Mt CO_2e in 2010, and the Crown purchasing units internationally relating to 2.9Mt CO_2e in 2010
- the cost of meeting our Kyoto commitments (due to the combination of purchasing units internationally and abating domestic emissions) are estimated by the model to be 0.02% of GDP in 2010
- the international carbon price as predicted by the model, and assumed to be implemented in the New Zealand economy, is $10 per tonne of CO_2e in 2010.

Modelling results pertaining to agriculture

Separate modelling was undertaken to estimate the effects of including or excluding agriculture from New Zealand's domestic policies.[141] This involved running two different comparisons for the inclusion or otherwise of agriculture. All of the scenarios presented use the medium emissions path described above. The results presented also include modelled effects on output levels for some sectors of the economy.

[141] In the scenarios where agriculture was excluded from the carbon price, it was assumed that agriculture would continue to face the carbon price embedded in inputs such as fuel.

Table 27 - Results Pertaining to Agriculture

	Domestic abatement only		Internationally linked	
	Ag. included	Ag. excluded	Ag. included	Ag. excluded
Scenario presented	A	B	C	D
Required abatement	8.0	8.0	8.0	8.0
Abatement undertaken	8.0	8.0	6.4	2.6
Purchases internationally	0.0	0.0	1.6	5.4
GDP effect	-0.05%	-0.19%	-0.04%	-0.04%
Carbon price	18	67	13	13
Sectoral impacts – Change in outputs relative to 2010				
Dairy	-4.3%	-0.8%	-2.9%	0.0%
Meat	-2.4%	0.7%	-2.0%	0.2%
Electricity	-0.9%	-2.9%	-0.6%	-0.9%
Iron and steel	-4.5%	-18.4%	-2.9%	-4.4%
Primary aluminium	-6.2%	-21.9%	-4.3%	-4.3%
Services	0.2%	0.3%	0.2%	0.0%

Source: ABARE

Scenarios A and B compare the effects of including or excluding agriculture from domestic policy settings assuming that New Zealand meets its Kyoto commitments through domestic abatement measures only. In contrast, scenarios C and D compare the effect of including or excluding agriculture from domestic policy settings assuming that New Zealand meets its Kyoto commitments (at least partially) through purchasing Kyoto units internationally.[142]

The key result from this modelling is that the cost of New Zealand meeting its Kyoto commitment (in terms of effect on GDP) is likely to be less if agriculture is faced with a carbon price, as opposed to agriculture being excluded from a carbon price, in the case that New Zealand seeks to meet its Kyoto commitments through domestic abatement only. If New Zealand is linked to international carbon markets, the model suggests there is no difference (in terms of effects on GDP) whether it includes or excludes agriculture from its domestic policy settings.

Implications for other sectors of the economy

[142] Scenario A from Table 2 is the same as scenario 4 from Table 1. Scenario C from Table 2 is similar, but not identical, to scenario 3 from Table 1. The key point is that the comparisons between scenarios A and B, and between scenarios C and D, are both valid.

The model generally indicates that emissions-intensive sectors (such as iron, steel and aluminium production and, if included, agriculture) would be significantly more negatively affected than low-emissions sectors such as general services.

If agricultural non-CO_2 emissions are included in a carbon charge, the model estimates that the impact on agricultural production would be broadly comparable with the impacts of the same carbon charge on iron, steel and primary aluminium production.

If agricultural non-CO_2 emissions are excluded from a carbon charge, the impacts on agricultural outputs are reduced significantly. The effect on other sectors of excluding agriculture depends on whether New Zealand meets its obligations entirely by domestic actions or uses international emissions trading. With international emissions trading, the impact on other sectors is modelled to be relatively small. However, if New Zealand relies entirely on domestic abatement, excluding agriculture from a price measure would require a significantly higher domestic carbon charge for CO_2-emitting sectors. In this case, the model estimates significantly larger economic impacts on emission-intensive sectors such as iron, steel and aluminium production.

4.9.4 Discussion of the modelling results

The modelling results are broadly comparable with those from earlier model runs previously provided by ABARE (ABARE undertook a major tranche of work in 2001 on this topic), in that they anticipate a negative impact on economic growth from domestic emissions abatement, via the exposure to price on carbon (dollars per tonne of CO_2e).

There is a variety of limitations in any modelling exercise such as this. These limitations are described below:

- the model assumes that structural adjustment within the economy is costless. That is, it assumes that resources from one sector (eg, aluminium smelting) can be entirely (and without cost) deployed to others (eg, services)
- the model assumes that the implicit structural adjustment takes place in a steady manner. In reality, this is unlikely to be the case, and it is likely to take some years for the economy to fully adjust to the structural changes implied. It is not possible to estimate with any certainty the timing of such adjustment
- there is no account in the model for the costs of measuring emissions, or account taken of associated difficulties and inaccuracies in implementing the carbon price in the economy. In reality, there are costs of measuring emissions. Furthermore, and possibly more importantly, there are difficulties associated with measuring emissions accurately and at a point of obligation that enhances effective decision-making from a carbon-mitigation viewpoint (especially in agriculture)
- the model also assumes that decision-makers have access to, and will use, perfect information about costs and abatement opportunities, and will make decisions that will minimise their costs in the long term without constraints due to short-term transition costs

- offsetting these factors to some extent, the model excludes the effects of non-price and supporting policies designed to offset the costs to the economy of undertaking abatement. It also does not anticipate new patterns of industry behaviour or technological improvements beyond those currently available.[143] Furthermore, ABARE does not model the effects of new forestry plantings in generating new sink credits (any effect would, of course, be dependent on domestic policy settings vis-à-vis forestry).

The first two of these reasons are thought to be particularly significant. In reality, there is a cost to structural adjustment (at the minimum), and there are some resources that are unlikely to be able to be allocated elsewhere in the economy in an economic manner.

In terms of timing, a review of the ABARE model stated that a "new long-run equilibrium industry configuration could take 10 to 20 years to complete, with many downside adjustments occurring faster than many upside adjustments".[144] Effectively, this means that the costs in 2010 may be greater than those outlined in the results presented. Having said this, the reviewer was careful to point out that there is no clear direction of bias caused by the range of issues that he identified with the ABARE model – in his view, the ABARE model "is appropriate for a long-run analysis of the issues at hand".

4.9.5 Conclusions

Broad conclusions that follow from the model's results are:

- if we seek to meet our Kyoto obligations entirely through domestic abatement, the cost to the economy will be substantially higher than if we purchase units on the international market. That is, the domestic carbon price required to achieve sufficient mitigation is much higher than the prevailing international carbon price. This suggests that it is cheaper and more efficient to meet at least some of our target through international emissions trading
- if we seek to achieve emissions reductions by imposing a domestic carbon tax, it is preferable to have a broad-based tax that includes all sectors of the economy. The model's results suggest that excluding agriculture, for instance, increases the costs imposed on the remaining sectors of the economy (while agriculture is itself advantaged). The difference between including or excluding agriculture is significant if New Zealand wishes to meet all its obligations through domestic abatement, although the model does not suggest there is a difference if New Zealand uses international emissions trading
- achieving domestic mitigation (whether it be through trading or a domestic carbon tax) is likely to impact more heavily on some (more emissions-intensive) sectors

[143] Technological change is incorporated to the extent that existing technologies become cost-effective (and hence deployed) at particular carbon prices.

[144] In his 2002 review of ABARE and NZIER modelling to analyse the effects of the Kyoto Protocol on New Zealand, Grimes noted that although there is no clear direction of bias caused by this range of issues, these timing effects could mean that the present value of the costs of adjustment could well exceed those documented by ABARE.

than on others. The impact flows through into exports, hence affecting our terms of trade. However, excluding particular sectors has risks, as outlined above.

There are other relevant factors that a modelling exercise of this nature does not take into account. These relate to social and redistributive effects, and also to the extent that decisions implicitly influence New Zealand's emissions position post-2012.

The ABARE modelling does not attempt to model the transitional effects of any policy such as "temporary" unemployment. The model assumes that prices adjust to ensure full employment of resources; in practice, this is not often the case, particularly for the low-skilled elements of the workforce or where there is little regional mobility. As such, even if the economy did adjust in time to a new equilibrium, there is no measure of any social or redistributive effects implicit in this adjustment.

In terms of New Zealand's emission position post-2012, the decision on how much, if any, of its emissions deficit New Zealand chooses to abate domestically will influence its emissions position in 2012 and post-2012 and potentially, therefore, the ability and cost of meeting any future obligations that it may accept. Although this is self-explanatory, it is a relevant factor in determining the extent to which New Zealand should meet its Kyoto commitments by purchasing units internationally.