Projected Impacts of the New Zealand Emissions Trading Scheme at the Farm Level

Executive Summary

This paper summarises the results of a range of analyses carried out by the Ministry of Agriculture and Forestry (MAF) on the potential impacts of the New Zealand Emissions Trading Scheme (NZETS) at the individual farm level. The purpose of these analyses is to inform the policy process and indicate how typical farms of varying types could be financially affected by the NZETS.

The report shows the results of an illustrative "static" analysis of the potential impacts of the NZETS on farms using MAF's 2006/07 model farm budgets. In effect, the analyses reveal how some typical farm types might be affected if the NZETS, including agricultural gases, were implemented without warning on 1 July 2006.

At a high level, the results show that if the NZETS were applied to a typical farm business in the 2006/07 year, there would be significant impacts on overall farm level profitability for some farms and farm types. The relative impacts would be greater for sheep and beef and deer farms than for dairy farms, and as expected, the potential impacts increase along with the price of carbon and as the quantity of free allocations are reduced.

The results should, however, be considered within the context of a range of important assumptions used in the analyses, and with reference to some important observations about the 2006/07 production year for New Zealand farmers. These include:

- The flow-on impact on farm output prices from increased costs at the processor level were not taken into account;
- The 2006/07 production year was one of particularly low farm output prices and overall farm profitability, therefore the relative impacts shown here are higher than might be the case in other years;
- The base case results assume that farmers do nothing to adapt to the new cost structure over time; no allowance was given to the ability for farmers to adjust to the new structure over the period in which free allocations are phased-out;
- There is no allowance made for potential for advances in abatement technology over the phase-out period;
- There is no allowance made for possible macro-economic changes or effects which may influence the impact on farms (eg. exchange rate).

Beyond the static analysis described above, the report provides some perspective on the importance of base-year farm profitability and the importance of mitigation technology and options such as forestry offsets.

An analysis of farm output prices for dairy, sheep and beef and venison over the past ten years indicates that variation in farm output prices tend to have a higher relative impact on farm profitability than do the carbon costs.

An analysis of the potential impacts of nitrification inhibitors on dairy farms shows that use of the inhibitor can potentially ameliorate the impacts of the carbon cost to a large degree. This rests on an important assumption that farmers will be able to receive credit for inhibitors under the NZETS however.

Also, an analysis of the potential use of forestry as an offset on sheep and beef farms indicates that some conversion of land away from sheep and beef towards forestry would positively impact on farm profits - particularly as the price of carbon increases.

In general, the report shows that the potential impacts of the NZETS at the farm level should not be understated. However, it also indicates that we should not underestimate farmers' capacity to innovate, adapt their businesses to manage new cost structures, and adopt new technology where it exists. This analysis also speaks nothing of the potential costs to New Zealand agriculture of doing nothing to address greenhouse gas emissions in the sector.

Context and Methodology

In September 2007, Government published a range of potential input and output price impacts from the NZETS in *The Framework for a New Zealand Emissions Trading Scheme*. These included impacts on petrol, diesel, coal, gas and electricity inputs; and agriculture outputs including milksolids, and meat. MAF also estimated the price impacts on nitrogen fertiliser.

MAF translated these potential input and output price impacts to potential farm-level impacts using the 2006/07 model farm budgets from MAF's Farm Monitoring Programme. MAF's model farms are analytical tools developed to allow a better understanding of on-farm trends, including profitability and land use. Although all New Zealand farms are unique, the model farms represent, as far as possible, a typical New Zealand farm for the purposes of monitoring.

In practice, economic impacts on the agriculture sector from the NZETS will come in tranches. Stationary energy and industrial processes enter the NZETS in 2010, followed by liquid fossil fuels in 2011, and finally methane and nitrous oxide from livestock and nitrous oxide from nitrogen fertiliser enter the scheme in 2013.

For the purposes of this exercise, staggered implementation of the NZETS was not taken into account. Instead, these impacts were applied simultaneously to 2006/07 model farm budgets. Also, only the direct on-farm impacts of energy and fossil fuels were taken into account. The potential flow-on impacts on farm output prices from increased energy and fuel costs at the processor level were not modelled.

The following 2006/07 models were considered:

- National Dairy
- National Sheep and Beef;
- North Island and South Island deer;
- Canterbury Arable;
- Bay of Plenty Kiwifruit;

- Hawkes Bay Pipfruit;
- Marlborough Viticulture; and
- Greenhouse Tomato operations.

The analyses illustrate, in effect, how the 2006/07 model farms might be impacted if the NZETS had been implemented, without warning, on 1 July 2006. To provide greater perspective, MAF also analysed a range of output prices and possible emissions mitigation and offset scenarios for selected models.

As noted above, every farm is unique and in reality there will be significant variation away from the results that the model farms provide. Some farms will be impacted to a lesser degree and others to a greater degree than shown. The best way for individual farmers to estimate the financial impact on their own operation is to apply estimated input and output price impacts to their own farm budgets and forecasts.

Base Case Assumptions

- Expenditure and output are based on 2006/07 data. Results should be interpreted as shocks to the 2006/07 farm monitoring model.
- Assume that the input price changes caused by the NZETS have no impact on:
    - Farm-level output or output mix.
    - Consumption of inputs of electricity, fuel, fertiliser and other non-carbon inputs. (In reality, some input reductions are expected, but the effect of these on net profit will be partly offset by a resulting reduction in output. These have not been modelled.)
    - Stock value. (In the long run this is an adjustment that will reduce costs, but this is difficult to model. The impact on stock value is assumed to be a once-off.)

The following table summarises some key parameters of the farm models.

Model	Area (ha)	Affected inputs[1]	Output		
National Dairy (360 milking cows)	126	Fuel: $13,528 Power: $17,799 N Fert: $47,813	*Output type*	*Sales*	*Carcass weight (kg)*
			Calves	243	16
			Cows	66	190
			Bulls	4	340
			Milk solids	127,176kg	

[1] Fuel costs include assumed 50% of contractors' fees for arable and horticultural models, and 10% of freight costs. Power costs include power component of irrigation and frost protection costs for horticultural costs.

Model	**Area (ha)**	**Affected inputs**[1]	**Output**
National Sheep and Beef (4,528 stock units)	708	Fuel: $9,283 Power: $3,355 N Fert: $22,575	*Output type* — *Sales* — *Carcass weight (kg)* Lambs/hoggets — 1960 — 17 MA ewes — 511 — 24 Heifers/steers — 97 — 300 CFA cows — 14 — 200 Bulls — 62 — 300 Wool — 18,800kg — A mix of types[2]
North Island Deer[3]	140	Fuel: $8,172 Power: $2,800 N Fert : $22,747	*Output Type* — *Sales* — *Carcass weight (kg)* Hinds — 211 — 35 Stags — 223 — 58
South Island Deer[4]	180	Fuel : $8,327 Power : $3,266 N Fert: $ 1,737	*Output type* — *Sales* — *Carcass weight (kg)* Hinds — 265 — 31 Stags — 252 — 60
Canterbury Arable	285	Fuel: $34,200 Power: $23,100 N Fert: $54,038	*Output type* — *Sales* — *Carcass weight (kg)* Ewe lambs — 366 — 17 MA ewes — 250 — 24 Wether lambs — 920 — 17 Wether hoggets — 575 — 17 Ram lambs — 366 — 17 Wool — 2060 kg Wheat — 405.9 t
Bay of Plenty Kiwifruit (2006-07)	5	Fuel: $3,113 Power: $1,950 N Fert: $5,800	37,455 trays

[2] The mix of wool types is broadly nationally representative, mainly crossbred with the exception of merino, some Marlborough Hill (Half-bred) and possibly Otago dry hill. The assumed mix reflects a trend towards favouring fecundity over wool quality.
[3] The North Island deer model represents a stand alone deer farm located in the Rotorua/Waikato area with 2,197 stock units.
[4] The South Island deer model represents a stand alone deer farm located in the Southland/Otago area with 2,752 stock units.

Model	Area (ha)	Affected inputs[1]	Output
Hawkes Bay Pipfruit (2006 calendar year)	28	Fuel: $13,571 Power: $4,000 N Fert: $2,123	Apples: 57,401 tray carton equivalents
Marlborough Viticulture	25	Fuel: $18,280 Power: $4,950 N Fert: $4,223	248 tonnes
Greenhouse Tomatoes, North Island	1	Fuel: $8,616 Gas: $139,728 Power: $14,364 N Fert: $36,500	420 tonnes
Greenhouse Tomatoes, South Island	1	Fuel: $8,616 Coal: $150,237 Power: $14,364 N Fert: $36,500	420 tonnes

Base case net profits

The following table summarises beginning net profits for each farm type.

Model (Dollars)	Revenue (net of stock purchase)	Working expenses	Interest	Rent and lease costs	Depreciation	Net profit before tax
National Dairy	566,816[5]	370,538	104,814	0	25,315	71,690
North Island Deer	148,688	99,817	19,688	0	6,953	22,230
South Island Deer	183,216	93,857	27,112	0	16,947	45,299
National Sheep and Beef	291,114	176,109	40,610	4,614	21,439	48,342
Canterbury Arable	692,757	425,497	109,770	7,500	64,575	85,415

[5] Milk solids income component equals $526,481 based on average price of $4.14 per kg of milk solids

Model (Dollars)	Revenue (net of stock purchase)	Working expenses	Interest	Rent and lease costs	Depreciation	Net profit before tax
Bay of Plenty Kiwifruit	158,721	123,739	18,270	0	11,490	5,222
Hawkes Bay Pipfruit	849,910	690,447	44,132	18,876	21,054	75,401
Marlborough Viticulture	587,261	207,925	61,475	18,900	31,150	267,811
Greenhouse Tomatoes, North Island	840,000	676,271	40,671	0	70,232	52,826
Greenhouse Tomatoes, South Island	840,000	686,780	40,671	0	70,232	42,317

Assumed price impacts

- MAF estimates of absolute change in output price (based on national aggregate model);

- Livestock purchase expenditure adjusted down because all livestock (including stock purchased for finishing) should drop in value due to the NZETS;

- Change in electricity, fuel expenditure based on percentage change in "current prices"[6] applied (as near as possible) to current expenditure;

- Change in fertiliser price, based on a recent MAF estimate, applied to fertiliser consumption (if able to be estimated);

- Estimate of impact of fuel price change on contractors' costs, assuming full pass-through to farm;

- Estimate of impact of fuel price change on freight costs, where these are specified in our models;
- Allocation scenarios (effected as a "progressive obligation" approach) assumes:
  - 90% of non-CO_2, non-fertiliser pastoral emissions from each pastoral sector apportioned equally across all emissions expected from that sector in 2013.
  - 90% of N_2O emissions from N fertilisers in 1990 and 2005 equally apportioned across all emissions expected from N fertiliser in 2013.

Note the assumed approach means that sectors that reduce in size between 2005 and 2013 will receive a greater allocation per expected tonne of emissions. All emissions from dairy cows are treated as being linked to the production of milk solids.

[6] Estimated changes provided by the Emissions Trading Group

Output price impacts

		Allocation of 90% of 2005 emissions from each species[7]			Full Liability		
Carbon Price>		$15	$25	$50	$15	$25	$50
Milk Solids	c/kg	-5.1	-8.5	-17.1	-16.1	-26.7	-53.4
Non-dairy Beef	c/kg,cwe	-0.7	-1.1	-2.3	-16.6	-27.6	-55.2
Sheepmeat	c/kg,cwe	-3.0	-5.0	-10.1	-38.8	-64.6	-129.2
Venison	c/kg,cwe	-0.8	-1.4	-2.8	-59.7	-99.5	-199.1

Input price impacts

Energy:

Carbon Price>		$15		$25		$50	
Petrol	c/litre (% if 1.48/l)	3.7	(2.50%)	6.1	(4.00%)	12.2	(8.00%)
Diesel	c/litre (% if 1.00/l)	4	(4.00%)	6.7	(7.00%)	13.3	(14.00%)
Electricity	c/kwh (% if 20c/kwh)	1	(5.00%)	2	(10.00%)	4	(20.00%)

Nitrogenous fertiliser:

			Allocation of 90% of 2005 emissions across all N_2O emissions from fertiliser[7]			Full liability		
Carbon price>			$15	$25	$50	$15	$25	$50
Fertiliser (N %)	Price/t	tCO_2e/t						
Urea (46%)	$579	2.63	$590.80	$598.66	$618.32	$618.45	$644.75	$710.50
DAP (18%)	$670	1.03	$674.62	$677.70	$685.40	$685.45	$695.75	$721.50
Ammonium Sulphate(22%)	$388	1.17	$393.25	$396.75	$405.49	$405.55	$417.25	$446.50

Initial results

The following table shows preliminary results for the impact of the NZETS on 2006/07 net profits before tax for a range of farm models and carbon prices. In practice, methane and nitrous oxide emissions will enter the NZETS in 2013 with a free allocation of 90% of 2005 emissions. This allocation may occur in such a way that there is effectively a lower liability per unit of emissions[8]. The current policy is for the allocation to reduce to zero in a linear fashion over the following 12 years, although longer phase-out options are being considered.

[7] Assumes that 90% of 2005 pastoral emissions of N_2O and CH_4 related to each species are freely allocated (e.g. through processors) in a way that benefits each pastoral species in direct proportion to its emissions of these gases. Other allocations are possible; e.g. lump sum allocations to farmers to ensure that incentives to reduce actual emissions are retained

[8] For example, a progressive obligation approach to assistance would see farms face a reduced marginal price for emissions. An allocation to processors under a processor level point of obligation may also, in effect, reduce the marginal price that farms face for emissions.

Percentage change in profit before tax

	Allocation of 90% of 2005 emissions			Full Price of Emissions		
Carbon Price>	**$15**	**$25**	**$50**	**$15**	**$25**	**$50**
Model						
National Dairy (assumes base year payout of $ 4.14 per kg ms)	-12.0	-20.4	-40.7	-36.8	-61.6	-123.1
National Sheep and Beef	-4.6	-7.9	-15.9	-48.1	-80.3	-160.5
North Island Deer	-3.8	-6.6	-13.2	-59.8	-99.9	-199.8
South Island Deer	-1.5	-2.6	-5.2	-31.8	-53.1	-107.7
Canterbury Arable	-4.9	-8.8	-17.6	-17.2	-29.3	-58.6
Bay of Plenty Kiwifruit	-4.3	-7.9	-15.8	-5.5	-9.8	-19.7
Hawkes Bay Pipfruit	-0.9	-1.6	-3.1	-1.0	-1.7	-3.4
North Island Greenhouse Tomatoes	-21.3	-36.0	-72.1	-21.7	-36.7	-73.3
South Island Greenhouse Tomatoes	-60.7	-98.5	-192.2	-61.1	-99.2	-193.7
Marlborough Viticulture	-0.55	-0.84	-1.48	-0.56	-0.86	-1.53

As expected, all farm types will suffer adverse profit effects, but the size of the impact varies widely. Among our models, greenhouse tomato growers face the largest impacts and most of this is due to the entry of coal and gas into the NZETS. MAF anticipates that other greenhouse growers with large energy inputs will face similar impacts.

Kiwifruit and pipfruit face relatively small to moderate impacts depending on the carbon price, but the largest impacts on these operations have not been captured in the models. Most of the impacts on these operations will occur as a result of flow-on impacts on packing, coolstorage, and shipping costs from the entry of fossil fuels in 2009 and stationary energy in 2010. These flow-on effects are more difficult to quantify. Viticulture shows the least exposure to greenhouse gas charges with minimal reductions in profitability, even at a comparatively high carbon price.

The size of the negative impacts on dairy, sheep and beef and deer farms varies from small to large depending on the quantity of free permits allocated, the price of carbon, and the amount of profit recorded in the base year 2006/07. The latter factor has particular relevance to dairying where, if recent increases in the dairy payout were sustained, the estimated relative impact of the NZETS on dairying profitability would be substantially reduced. For example, given an average payout price of $6.40 kg milk solids, the base year profit before tax would increase from about $72,000 to $359,518. In that case, even under a full carbon price scenario of $50, the relative decline in profits would be only 24.5% compared with 123% if the base year average payout is $4.14, as it was in 2006/07.

The full price scenarios represent the longer-run worst-case situations assuming no breakthrough in emission reduction technologies or changes in farming practices in response to the emission charges.

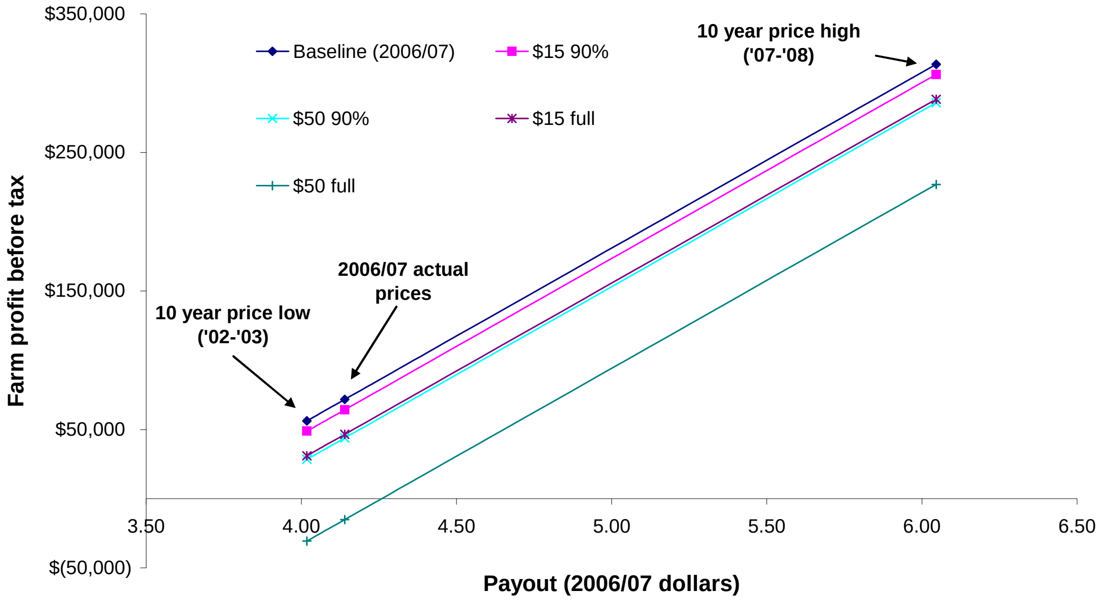
The pre-tax impacts are larger than the after-tax impacts would be

Farms use a range of business structures and earn different levels of off-farm income, so the figures in this paper ignore the effects of tax. Tax effects also vary in terms of farmers' access to tax losses, and their potential to utilise current-year losses in a future year. In general, the absolute dollar impacts of the NZETS on after-tax profit would be between 19.5% and 39% less than the pre-tax profit effects indicated below. The percentage impacts would tend to be somewhat less than shown because of the progressive structure of personal tax rates.

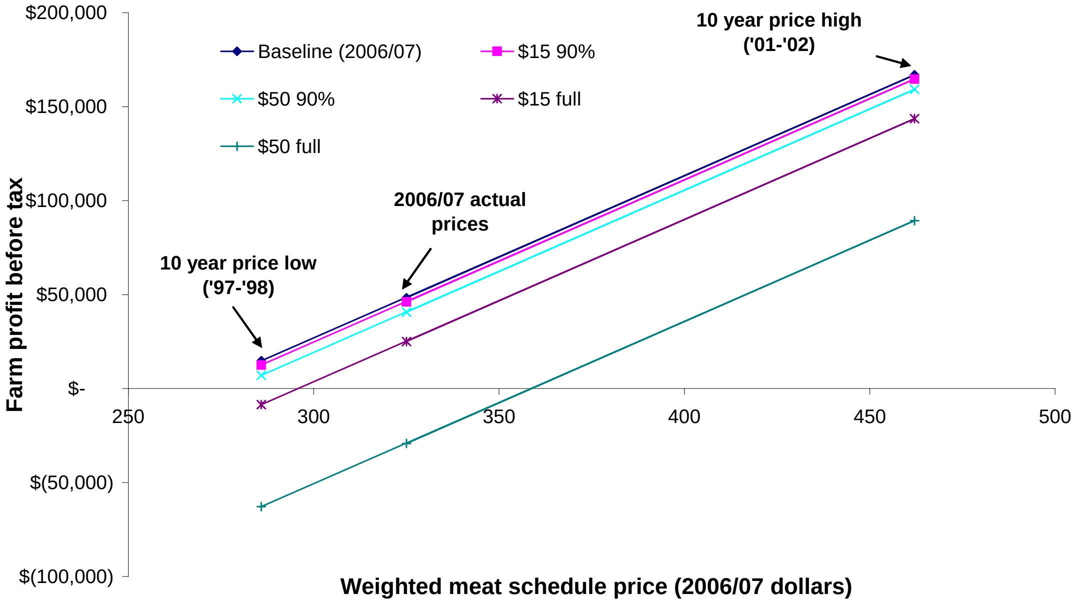
Output Price Sensitivities

As discussed above, the relative impact of carbon charges may vary widely as farm output prices change. The following charts illustrate how changes in output prices would affect the model farms' profit before tax. High and low price scenarios were developed based on the highest and lowest output prices received (or expected) over the decade of 1997/98 through to 2007/08. In the case of the sheep and beef model, highs and lows in the lamb and beef schedule price occurred during the same years. No change to expenses has been assumed across the different output price scenarios.

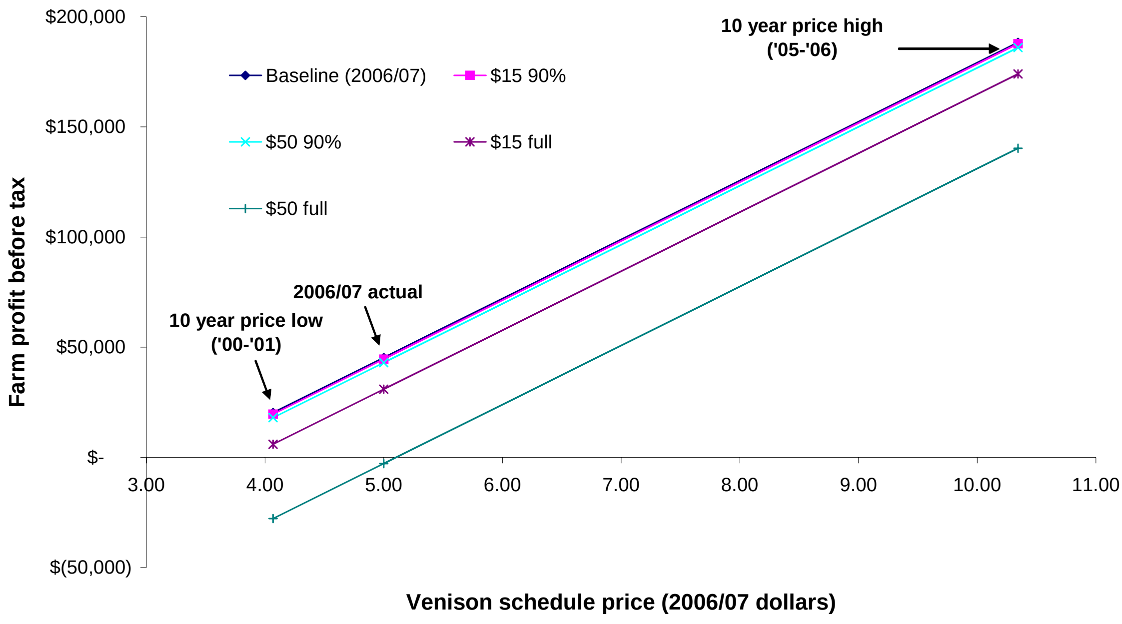
Dairy payout sensitivity



Sheep and Beef schedule price sensitivity



South Island Deer – venison schedule sensitivity



Farmer responses

The potential impacts of the NZETS (particularly the full liability scenarios) need to be considered within the context of likely farm changes leading up to 2030 when allocation is completely phased-out. The above analysis illustrates potential impacts of the NZETS on a static farm business, whereas farms are dynamic systems that adapt to new operating environments.

Some possible farmer responses to the NZETS (and related policies such as the Afforestation Grant Scheme) can be anticipated, but the best response on a particular farm is a decision only the individual farmer can determine. A key advantage of a market-based instrument is that it leaves participants to make their own decisions on how to manage emissions.

Broadly-speaking, farmers have three levers through which to influence the impact of the NZETS on their incomes:

- The level of production of outputs that involve high emissions;
- The emissions intensity of output (emissions per unit of production);
- In some cases, taking opportunities created by the NZETS, such as deriving emission units through afforestation[9] or leasing land to the renewable energy industry (whose profitability will increase with liabilities falling on thermal electricity generation).

Examples of possible actions include:

- Changes in land-use toward activities that are less-heavily impacted, or are positively impacted, by the NZETS. This could include a shift toward, for example, more viticulture or forestry depending on the circumstances of each farm;
- Reduced rate of conversions to land-uses that are more heavily impacted (eg. reliant on pumped irrigation);
- To the extent that the NZETS takes account of livestock age at slaughter, farmers may dispose of non-breeding stock at a younger age when there is a lower ratio of lifetime emissions to weight;
- Reduced use of emissions-intensive inputs such as nitrogen fertiliser and fossil fuels (for example, more-efficient nutrient management, irrigation or greenhouse heating; greater use of renewable energy, such as windmills and solar water heating, to meet on-farm energy needs)[10];
- Hedging against adverse changes in carbon prices through off-farm investment in post-1989 forest by participating in the NZETS or the Permanent Forest Sinks Initiative;
- Leasing of land for wind farms.

A shift towards beef and away from sheep on sheep and beef farms would reduce adverse revenue impacts, but the cost of this would also need to be considered.

Some technological responses are also being developed and tested. If proven, and if ways are found to recognise them through the NZETS, they could offer further opportunities to reduce net farm emissions. They could include:

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[9] Schemes available include the Permanent Forest Sinks Initiative (www.maf.govt.nz/forestry/pfsi/) and, under development, the forestry element of the broader emissions trading scheme. There are also opportunities in "grey market" afforestation schemes such as Landcare's "Ebex21" (www.ebex21.co.nz/).

[10] One possible starting-point for farmers investigating this option is the website of the Energy Efficiency and Conservation Authority (EECA), particularly the guidelines for dairy farmers and for vegetable and greenhouse growers at http://www.eecabusiness.govt.nz/eib/industry-guidelines/index.htm. The website also has details of assistance available for energy audits and for projects to improve the efficiency of energy intensive businesses.

- Nitrification inhibitors;
- High-sugar grasses.

Effects of Potential Mitigation and Offset Options on Farmers Liability

Nitrification Inhibitor

Field trials show that the use of nitrification inhibitors can lead to significant reductions in nitrous oxide emissions in the dairy sector, providing soil temperatures are not too high nor the soil too wet. Reductions are conservatively estimated to amount to at least a 20% reduction across the sector. Furthermore, as the inhibitor acts to increase the amount of nitrogen retained in the soil, the farmer can use the extra nitrogen to either increase dry matter production or as a substitute for the use of nitrogenous fertilisers and any feed supplements containing nitrogen.

Farmers should able to achieve significant gains from the use of inhibitors, but in practice it will depend on local conditions. It will also require international recognition of nitrification inhibitors as a mitigation tool on New Zealand pasture based systems. Assuming the latter is achieved, and that farmers use inhibitors to the maximum extent possible, the question then arises as to how that might change the estimated impacts of the NZETS for the national dairy model.

To answer this, MAF reworked earlier analysis, which used the 2006/07 dairy payout price of $4.14/kgMS. This used the following assumptions[11]:

- 100% uptake of inhibitors outside Northland and the West Coast;
- No use of inhibitors in Northland or the West Coast;
- 50% reduction in direct nitrous oxide emissions per kilogram of milksolids for excreta and nitrogen fertiliser; for five months of the year;
- 35% reduction in nitrous oxide emissions through leaching per kilogram of milk solids; for five months of the year.

MAF developed two scenarios: one where farmers use the inhibitor to increase milk production; and another where farms use the inhibitor to eliminate use of nitrogenous fertilisers and nitrogen-based supplements holding production constant. The results are shown below for varying carbon prices:

[11] The assumptions related to farmer uptake were designed to reflect that the efficacy of the nitrification inhibitor will vary depending on local conditions. Estimates for per-unit emission reductions are conservative compared with results from field trials and are derived from the paper "*Accounting for the Utilisation of a Nitrous Oxide Mitigation Tool in the IPCC Inventory Methodology for Agricultural Soils*" by T.J. Clough et al 2006.

National Dairy Farm - Change in profit before tax with nitrification inhibitors

		Baseline (06/07)	Free allocation 90% of 2005 emissions			Full price of emissions		
Carbon price $/t			**$15**	**$25**	**$50**	**$15**	**$25**	**$50**
1. No inhibitors	**Farm profit before tax**	71690	63095	57060	42482	45282	27550	-16550
	Percentage change		-12.0%	-20.4%	-40.7%	-36.8%	-61.6%	-123.1%
2. Inhibitor + no increase in output	**Farm profit before tax**		89792	84530	71895	73532	57446	17728
	Percentage change		25.3%	17.9%	0.3%	2.6%	-19.9%	-75.3%
3. Inhibitor + 10% output increase	**Farm profit before tax**		93245	87408	73341	75071	57135	12796
	Percentage change		30.1%	21.9%	2.3%	4.7%	-20.3%	-82.2%

These results suggest that inhibitors would allow most dairy farmers to improve or maintain their profitability during the period of maximum free allocations. Once free allocations are phased out, the outlook for dairy farmers' profits varies depending on the price of carbon. Any increase in the milk payout would accentuate the benefits of any inhibitor-linked output increases, allowing dairy farmers more room to withstand higher carbon charges before any adverse impacts on profitability became significant. Dairy farmers may still face difficulties at high carbon prices.

Forestry Offsets

Nitrification inhibitors are expected to be of limited effectiveness on much of the hill country occupied by sheep and beef farmers. The more obvious option for sheep and beef farmers to reduce the impact of the cost of carbon involves conversion of part of the farm to forestry. A large number of scenarios are possible. For example, farmers could move enough land into forestry to simply offset livestock emissions over say a 29 year period. Alternatively, the conversions could be part of a larger move to diversify the farm into farm forestry activities as a separate profit-making activity. In this case farmers would be taking advantage of the carbon credits earned under the NZETS through the creation of forest sinks.

MAF restricted analyses to two possible scenarios for illustration purposes:

Scenario 1: The national sheep and beef farmer converts sufficient land to radiata pine forest to offset animal emissions over a 29 year period given 2006/07 stock numbers;

Scenario 2: The national sheep and beef farmer converts 20% of the farm to radiate pine forest with harvesting taking place in year 30.

The modelling assumes that any land converted to forestry requires some reduction in sheep and beef stocking rates, but at a rate which is less than the average stocking rate per hectare. This is because the less productive farmland is used for forestry. Forestry returns, which in reality would be spread over a 29-year period or longer, are converted to an annuity at a discount rate of 8% to allow comparison with annual income flows from the rest of the sheep and beef sector. In the case of scenario 1, there are no returns from forest as the credits are simply used to offset animal emissions. Planting and carbon monitoring costs must, however, still be allowed for.

The table below shows revised impacts on net farm profit for the two forestry scenarios, under varying allocation and carbon prices.

National Sheep and Beef Farm - Change in profit before tax with forest sinks

		Baseline (06/07)	Free allocation 90% of 2005 emissions			Full price of emissions		
Carbon price $/t			**$15**	**$25**	**$50**	**$15**	**$25**	**$50**
Base case - no forestry	**Farm profit before tax**	48342	46081	44512	40675	25072	9544	-29255
	Percentage change		-4.7%	-7.9%	-15.9%	-48.1%	-80.3%	-160.5%
Scenario 1: Forestry sufficient to offset animal emissions (carbon neutral on animal emissions for 29 yr)	**Farm profit before tax**		45954	45366	43993	28510	27434	24841
	Percentage change		-4.9%	-6.2%	-9.0%	-41.0%	-43.3%	-48.6%
	Percentage of land in forestry		0.9%	0.9%	0.9%	8.7%	8.7%	8.7%
Scenario 2: Forestry on 20% of land with 29 yr harvest cycle	**Farm profit before tax**		47004	67786	119826	26126	35190	57884
	Percentage change		-2.8%	40.2%	147.9%	-46.0%	-27.2%	19.7%

Scenario 1, where forestry plantings are used only to offset animal emissions liabilities, is still likely to result in a significant decline in profit under full pricing of emissions. This is because some output from sheep and beef will be forgone in order to accommodate the trees and charges on energy, fuel and nitrogenous fertilisers still have to be paid for.

Under Scenario 2, at a low carbon price there is little to be gained from converting to forestry. However, as the carbon price increases, higher profits from forestry more than offset the reduction in stocking rates. This leads to an improvement in overall profitability. At high carbon prices there will be strong incentives for sheep and beef farmers to convert a substantial portion of their land to forestry.

These results should be treated as indicative only. It is expected that production responses to use of nitrification inhibitors will vary widely across regions as will the best forestry option in the case of sheep and beef. The analysis needs to be extended further to analyse impacts at the regional level.

Energy Efficiency/ Energy Audit

As discussed earlier, greenhouse tomato growers, and particularly those in the South Island, face the largest impacts of the sectors modelled. The main driver of these impacts is the entry of coal and gas into the NZETS, rather than agricultural emissions, therefore the opportunities to reduce or mitigate emissions in this sector lie around energy.

The table below illustrates how performing an energy audit and optimising greenhouse climate control can reduce emission costs and thus mitigate the impact on profits. This option assumes that the greenhouse system is generally well set up, but requires the computer settings to be adjusted and minor changes made to optimise energy use.

North Island and South Island Greenhouse Tomato Model - Change in profit before tax with energy efficiency

		Baseline (06/07)	Free allocation 90% of 2005 emissions			Full price of emissions		
Carbon price $/t			**$15**	**$25**	**$50**	**$15**	**$25**	**$50**
North Island base case - no mitigation/reductions	**Farm profit before tax**	**56 508**	44 450	36 149	15 789	44 239	35 798	15 087
	Percentage change		-21.3%	-36.0%	-72.1%	-21.7%	-36.7%	-73.3%
+ Energy Audit and Improved Climate Control	**Farm profit before tax**		50,346	42,409	22,959	50,135	42,058	22,257
	Percentage change		-10.9%	-25.0%	-59.4%	-11.3%	-25.6%	-60.6%
South Island base case – no mitigation/reductions	**Farm profit before tax**	**46 601**	18 332	711	- 42 949	18 122	360	- 43 650
	Percentage change		-60.7%	-98.5%	-192.2%	-61.1%	-99.2%	-193.7%
+ Energy Audit and Improved Climate Control	**Farm profit before tax**		25,189	8,398	-33,187	24,979	8,047	-33,888
	Percentage change		-45.9%	-82.0%	-171.2%	-46.4%	-82.7%	-172.7%

While the results indicate that gains can be made by improving energy efficiency, the applicability of this option will be variable, and may apply only to mid-sized growers. The largest growers already employ consultants for this purpose, so their savings would be minimal. Further, many smaller growers have less sophisticated computers and may not be able to fine tune their systems to the same extent.

The cost of this option would also be highly variable depending on time taken and the nature of the changes required. It is also assumed that growers are trained during the process so that ongoing adjustments are made to optimise computer settings with changing external weather conditions and other factors.

ENDS