New Zealand Agricultural and Resource Economics Society (Inc.)

Friend or Foe? The Kyoto Protocol and the NZ Greenhouse Industry

Andrew Barber
AgriLINK NZ, Pukekohe. New Zealand

Irene Parminter
MAF Policy, Hamilton. New Zealand

Paper presented at the 2004 NZARES Conference
Blenheim Country Hotel, Blenheim, New Zealand. June 25-26, 2004.

Friend or Foe? The Kyoto Protocol and the NZ Greenhouse Industry.

Andrew Barber[1] and Irene Parminter[2]

Note: this paper reflects the views of the authors and does not necessarily represent the views of MAF Policy or the NZ Government

Abstract

The greenhouse sector has reinvented itself as a technologically advanced and relatively environmentally friendly industry over the past 15 years. However it remains a high energy user. Two recent surveys have highlighted the potential impact on greenhouse grower costs of the proposed emissions charge on fossil fuels. Growers may be unable to pass on the extra costs due to competition on domestic and export markets from non-Kyoto countries. It is likely that the emissions charge would accelerate the rationalisation of the industry that has already been occurring, and in addition may lead to more profound changes such as the relocation overseas of larger growers. This paper draws out the likely implications of the proposed charge for the greenhouse sector in the light of the policies which are available to mitigate its impacts, and highlights the policy lessons that can be learned.

Introduction

The Kyoto Protocol to the UN International Convention on Climate Change sets binding targets for the emission of greenhouse gases, and allows for emissions trading between countries and the ability to offset emissions against the development of carbon sinks.

The NZ Government has made an internationally binding commitment through ratifying the Kyoto Protocol. New Zealand's commitment is not to exceed 1990 emissions on average in the period 2008-2012, or to otherwise take responsibility through emissions trading or carbon sinks.

The Government's policy package to achieve the emissions target includes an emissions charge for fossil fuels and industrial process emissions (except for firms with a Negotiated Greenhouse Agreement). The charge will approximate the international emissions price, but be capped at $NZ25 a tonne of carbon dioxide equivalent. It will apply in the Kyoto Protocol's first commitment period 2008-2012 and not before 2007. At $NZ25/tonne, at 2002 prices, the charge would increase the price of petrol by 6%, diesel by 12%, electricity by 16%, gas by 24% and coal by 44%. The revenue generated will be "recycled" (rather than being used to improve the Government's fiscal position), for example through the tax system and into funding climate change Projects and programmes (Climate Change Office, 2004a).

The primary sector most affected by the emissions charge is the greenhouse sector.

[1] AgriLINK NZ, Pukekohe.
[2] MAF Policy, Hamilton

The Greenhouse Sector

The greenhouse sector encompasses vegetable, flower, bulb and nursery crops. The official statistics indicate that there were 688 ha of indoor crops (excluding mushrooms) harvested during the year ending March 2002. Of the harvested area, 38% was used for the three main vegetable crops (tomatoes, cucumber and capsicum), 34% for flower and flower bulb production, and 17% for nursery crops. The official statistics indicate that the greenhouse industry is concentrated in the Auckland region (44% of the total area), and 81% of the greenhouse area is in the North Island. Between 2000 and 2002 the official statistics recorded a slight (1%) decline in greenhouse area harvested. However this obscures an ongoing trend towards the replacement of small scale businesses operating older greenhouses with large scale modern greenhouse complexes. The official statistics do not differentiate between heated and unheated greenhouses.

However, to understand the impact of the proposed emissions charge, it is necessary to determine the size and nature of the *heated* greenhouse sector. Nearly all commercial greenhouse tomato, capsicum and cucumber houses are heated. A small proportion of the total greenhouse flower area is routinely heated. A recent survey[3] (Barber, 2004) of greenhouse vegetable and flower producers analysed heated growing operations[4] as distinct from the total greenhouse industry. The survey confirmed the dominance the Auckland region. Of the total usable responses, 60% of the heated area of both vegetable and flower growing is located in the Auckland region. In the South Island, Canterbury is the main growing region accounting for 10% of New Zealand's heated vegetable and flower growing area. Areas and fuel types by region are detailed in Tables 1 and 2.

The survey indicated that natural gas is the main fuel source for greenhouse vegetable growing in Auckland (92%) and consequently is the fuel used by just under half of the total NZ heated area (49%). Coal is the next most popular fuel source at 32% (though 94% of the fuel used in the South Island greenhouse vegetable sector is coal). Responses from flower growers indicate that coal is the main fuel source at 35% followed by natural gas at 26%, waste oil at 20% and diesel at 15%. On the basis of this survey, energy use was estimated at 2.2 – 2.8 PJ for the greenhouse vegetable sector, and 0.4 – 0.7 PJ for the greenhouse flower industry (Barber, 2004). Total consumer energy for the agriculture sector was 20.9 PJ in 2002 calendar year (MED, 2004).

[3] A questionnaire was sent to all known greenhouse vegetable and flower growers. However, surveys of the greenhouse sector are challenging due to the lack of a complete frame especially for flowers other than orchids. The response rate was 67% for vegetable growers, 100% for orchid growers, and 76% for other flower growers. The "other flowers" responses are considered by the industry to be a reasonable representation of growers whose main income is derived from flowers.

[4] A heated greenhouse is defined as one in which heating is used for environmental control, but excludes those in which heating is used only for frost protection.

Table 1: Heated Greenhouse Vegetable Growing Area by Fuel Type (ha)

Government Region	Natural Gas	Propane	Coal	Oil	Diesel	Electricity	Total
Northland	0.3	0.1	0.9	0.4	2.8	0.2	4.8
Auckland	53.3	1.9	5.3	2.5	6.1	1.9	71.1
Waikato	0.6	3.2	2.7	0.1	0.2	0.1	6.9
Bay of Plenty	0.2		2.3		0.1	0.1	2.9
Gisborne	0.4				0.7	0.0	1.1
Hawke's Bay	0.7			0.2	0.4	0.1	1.3
Taranaki	2.0	0.2				0.2	2.3
Manawatu-Wanganui	0.3		0.4		0.2		0.8
Wellington	0.3						0.3
North Island	58.1	0.2	0.4	0.2	0.2	2.6	91.5
Tasman / Nelson			8.9		0.4		9.4
Marlborough			3.8				3.8
West Coast			0.9				0.9
Canterbury			11.6	0.1	0.3	0.4	12.4
Otago	0.1		0.8	0.1		0.2	1.1
Southland			0.3				0.3
South Island	0.1	0.2	26.7	0.2	0.3	0.6	210.9
New Zealand	58.2	5.4	37.9	3.4	11.2	3.2	119.4

Table 2: Heated Flower Growing Area by Fuel Type (ha)

Government Region	Natural Gas	Propane	Coal	Oil	Diesel	Electricity	Total
Northland			0.3	0.5	0.1		0.9
Auckland	9.0		5.1	4.4	3.0	0.3	21.9
Waikato			4.2	2.2			6.3
Bay of Plenty		0.1	0.1		0.9	0.2	1.2
Gisborne							
Hawke's Bay	0.7			0.4		0.2	1.3
Taranaki							
Manawatu-Wanganui							
Wellington							
North Island	9.7	.1	9.7	7.5	4.0	0.7	31.5
Tasman / Nelson			1.0				1.0
Marlborough							
West Coast							
Canterbury			1.8		1.6	0.7	4.0
Otago						0.2	0.3
Southland							
South Island	0.0	0.0	2.8	0.0	1.6	0.9	5.2
New Zealand	9.7	0.1	12.4	7.5	5.5	1.5	36.7

An Industry in Transition

The greenhouse sector has transformed itself over the past 10 years, especially the greenhouse vegetable sector. For example, tomato yields have increased from 28 kg/m^2/year in 1993/4, to 45 kg/m^2/year in 2003 (Barber, 2004). This 61% increase in production is the result of major technical advances, including soil-less growing media, the replacement of older style houses with modern designs, carbon dioxide enrichment of the atmosphere and full environmental control. Over the same period, biological control of greenhouse pests has dramatically reduced the use of chemical sprays in the sector.

Exports from the sector have also dramatically increased over the period (Table 3). The value of capsicum exports in 2004 are 26 times larger than they were a decade earlier and the volume has increased 45 times.

Table 3: Exports from Heated Greenhouses

Year ending March	1994		2004 (provisional)	
	Volume (kg)	FOB Value ($)	Volume (kg)	FOB Value ($)
Capsicum	91,590	934,734	4,168,456	24,192,986
Tomatoes	593,843	1,591,677	1,599,334	6,050,364

Source: Statistics NZ

The greenhouse industry has engaged in considerable capital investment. Over three quarters (78%) of the protected vegetable greenhouse industry is less than 10 years old, enabling the installation of more energy efficient systems. In the greenhouse flower industry, there is an even mix of new (less than 10 years old) and old greenhouses.

As a result of significant recent investments the greenhouse vegetable industry is now dominated by a few large operations. The survey by Barber (2004) indicates that four operations control 42% of the area. Large scale operations, of which 17 are now a hectare or more, lifted the average heated area per operation to 6,150 m^2 in the survey. However the median size of just 2,400 m^2 is a better representation of most in the industry, meaning half of the operations are 2,400 m^2 or less.

The average heated area of the surveyed flower growers was 6,020 m^2 with a median area of 4,000 m^2. The larger average and median size of flower holdings surveyed compared with vegetable holdings is likely to be due in part to the targeting of the flower survey at larger commercial operations, whereas the vegetable survey was sent to all of VegFed's registered members.

The farm-gate value of the heated greenhouse sector in 2002 was estimated at $150 million (Parminter, 2002)

Counting the Cost

The cost of the proposed emissions charge depends on the energy use of the sector, the types of fuel burned, and the level of the charge. Current price expectations are in the range of three to fifteen euros, with a median of seven euros, i.e., NZ$15.

Assuming the charge is $15/tonne of CO_2, it is estimated that the average annual emissions charge for a vegetable growing operations would be $10,000 in the North Island, and $12,000 in the South Island. For flower growing operations the average annual charge is estimated at $6500 (Barber 2004). The charges for median sized operations are somewhat lower (Table 4). An earlier pilot survey found that for the largest vegetable growing operations, the annual charge would be of the order of $500,000 at $25/tonne (Barber, 2003), or $300,000 at $15/tonne.

Table 4: Estimate of the average and median annual cost of a $10 ($25) per tonne emissions charge

	Average Annual Charge ($)	Median Annual Charge ($)
North Island Greenhouse Vegetable Operation	10,050 (16,750)	2,010 (3,350)
South Island Greenhouse Vegetable Operation	12,000 (20,000)	4,470 (7,450)
Greenhouse Flower Operation	6,540 (10,900)	3,180 (5,300)

Source: Barber, 2004.

The greenhouse sector is an industry that has narrow profit margins and a large fixed capital investment. Most greenhouse crops are focused on the domestic market, and are subject to strong competition from overseas suppliers, particularly Australia. This limits their ability to pass on emissions charges to consumers. The greenhouse crops grown predominantly for export (capsicum and orchids) face fierce competition and have limited ability to pass on increased costs to their customers.

As a result, the industry considers that many firms would be non-viable with emissions charges of $25/tonne, and would go out of business. This assertion has not been independently verified. The charges described in Table 4 need to be set in the context of total business costs and returns to evaluate their impact. Currently this data is not available.

In summary, reducing emissions presents a particular challenge in the greenhouse industry due to a combination of factors:

- Large and inflexible capital investment, resulting in high fixed costs – this dilutes the impact of the charge on overall costs
- Yield is very responsive to changes in heat and carbon dioxide enrichment
- Reducing energy loss (e.g. through the use of double skin plastic or thermal screens) often also reduces light and therefore yield.

These factors suggest that the industry's demand for fossil fuels is relatively inelastic, and the charge would not have a large effect on emissions. The final complicating factor – the inelastic relationship between prices received and quantity produced in New Zealand – suggests that rather than reducing emissions per holding, the charge is likely to reduce the size of the New Zealand industry as a whole.

Potential Avenues for Reducing the Impact of the Emissions Charge

1. Negotiated Greenhouse Agreements

Negotiated Greenhouse Agreements **(**NGAs) are a key component of the Government's climate change policy package. The NGA policy is designed to partially address the issue that an emissions charge may reduce the competitiveness of firms or industries on domestic or export markets, resulting in industry output (and emissions) shifting to other countries which do not have equivalent climate change policies (this shift in emissions is termed "leakage"). Firms or industries that face significant risk to their competitiveness as a result of an emissions charge are able to apply for an NGA. Under an NGA, firms receive a full or partial exemption from the emissions charge in exchange for moving towards the world's best practice in emissions management. The Government has completed an NGA with the NZ Refining Company and is negotiating with a number of others.

Provision is made for whole sectors to apply for a collective NGA. The greenhouse sector could then, in principle, apply for an NGA since it considers itself to be "competitiveness-at-risk", and because of the potential for "leakage"[5]. For example, the New Zealand Vegetable and Potato Growers Federation (VegFed) could apply on behalf of the greenhouse vegetable sector. However, the NGA policy is best suited to individual large scale companies, or when applied to whole sectors, to cohesive industries with a small number of large scale players. It would be exceptionally difficult for VegFed to ensure that all greenhouse vegetable growers are moving towards the agreed set of "world's best practices" for the sector. Since the NGA is a legally binding agreement, it would seem unwise for VegFed to commit to it without the ability to enforce the required changes on its grower members.

2. Projects to Reduce Emissions

A second component of the Government's climate change policy package is the "projects to reduce emissions" programme. In this programme, companies tender for emission units (often referred to as carbon credits), which are expected to be internationally tradable when the Kyoto Protocol comes into force. The programme is designed to reduce New Zealand's greenhouse gas emissions by supporting projects that provide emission reductions in the Kyoto Protocol's first commitment period

[5] If the New Zealand greenhouse industry down-sized as a result of the emissions charge, production would increase in countries outside the Kyoto regime, and global emissions would not necessarily fall. For example, Korean capsicum growers would increase heated glasshouse production to take New Zealand's place in the Japanese market. However, the New Zealand tomato market would have increased supplies of Australian product, most of which is grown outdoors, so the leakage argument would not apply in this case.

(2008-2012) beyond the reductions that would have occurred without the project, and are not viable without the tendered emission units. There must be a measurable reduction in greenhouse gases and go beyond business as usual (Climate Change Office, 2004b).

Two greenhouse companies were successful tenderers in the first tender round. One of these is a capsicum producer called Southern Paprika. This Warkworth based greenhouse complex won emission units to build a bio-energy plant, a combustion and boiler system using woody biomass (sawdust shavings, waste wood and bark) to generate heat that will be stored in large water tanks until required in the glasshouses. It will replace a gas-fired boiler.

The Projects mechanism provides a potential avenue for the larger greenhouse producers to reduce the impact of the emissions charge, but is unlikely to be taken up by smaller family-owned and operated businesses.

3. Policies for Small to Medium Size Enterprises.

Policy development is continuing for small to medium enterprises (SMEs) that are likely to be competitiveness-at-risk. The broad policy direction is for a package that encourages SMEs to reduce emissions and mitigates any potential adverse effects on them of emissions charges. These policies are the ones most likely to be applicable to individual greenhouse operations.

4. Energy Use Reduction

Greenhouse growers could reduce the impact of an emissions charge by reducing energy use. Technologies and management tools already exist which would achieve this, and have been publicised over the past year in the Grower, an industry magazine. Those that are currently cost-effective have already been adopted, but the emissions charge would shift the incentives for adoption. VegFed and MAF's Sustainable Farming Fund have funded a project to investigate ways to improve greenhouse energy use and efficiency by improving boiler efficiency, repairing leaks, and fine tuning computer-based heat controls. Other potential savings could be made by relocating greenhouses to sites where non-fossil based fuels are available. For example, a greenhouse complex has recently been established at Mokai using geothermal heat. Location decisions are currently influenced most strongly by access to good quality water (critical that sodium levels are low), labour, energy, and markets (whether domestic or export departure points – for export by air, Auckland airport is the critical departure point, with exports from Christchurch being considerably more expensive (MAF, 2004)). The ultimate relocation decision is to move overseas. Large players in the greenhouse tomato and capsicum sectors have already threatened to move to Australia. Modern Venlo style greenhouses are reasonably easy to dismantle and reassemble elsewhere.

Policy Reflections

Climate change is a controversial issue, and climate change policies are often unpopular. However, given that New Zealand is committed to the Kyoto Protocol, methods must be found to achieve the emissions target set. The concept of an emissions charge for achieving the target has been well accepted by the economics

profession (for example, Scrimgeour and Piddington, 2002). The policy problem is therefore to introduce the charge in a way that achieves the emissions target, is equitable, politically acceptable, and mitigates the adverse effects on competition, investment, prices and economic efficiency (ibid). While the energy intensive sectors could not be expected to be wildly enthusiastic about the charge, policy developers also need to work to minimise the adverse reaction of the affected sectors.

The effectiveness of policies aimed at reducing carbon dioxide emissions from the greenhouse sector in the Netherlands may also provide some indication of the effect of an emissions charge. Grants and tax incentives have been available to install energy saving technologies, and a programme of education, information, research and demonstration projects has been in place for some years. A review (Netherlands Court of Audit, 2002) found that of the technologies covered[6] only the use of residual heat had a demonstrable effect in reducing the amount of energy used, reducing consumption per unit output by around 4%. A survey of growers found that over 70% of the enterprises had received information on energy-saving technologies. Of those enterprises, 33% said it had prompted them to invest in the technologies. Over half the enterprises had also invested in one or more of the five specified technologies between 1997 and 2000, with 72% using a government scheme, particularly accelerated depreciation of environmental investments (available since 1991) and the energy investment allowance (available since 1997). Use of these incentives had led to a clear drop in energy consumption per unit product in only one case - the use of accelerated depreciation for purchasing facade insulation. Companies that had received information about energy conservation were not found to have demonstrably lower consumption per unit product than those that had not received information. The Court of Audit report (2002) concludes:

Other factors not directly linked to energy conservation policy were found to have an important effect on energy consumption in the glasshouse horticulture industry. For instance, reglazing under the restructuring policy for the industry lowers energy consumption, while the use of technologies designed to raise production and the growing of certain crops lead to higher energy consumption.

Possible explanations for the energy-saving alternatives' lack of effect include:

- *the enterprises are not using them to their full potential once installed;*
- *the impact of energy conservation measures is fairly marginal compared with a number of other factors that determine energy consumption.*

It appears that even where a range of incentives are available, significant long term energy savings are extremely difficult to deliver.

In the New Zealand greenhouse sector, vigorous opposition and anger has been expressed against the emissions charges, though with less media impact than the dairy farmer protests against the agricultural emissions levy in 2003. The delay and necessary secrecy in developing the SME policy has further increased the concerns of the industry, and lack of certainty is likely to be curtailing investment by the sector.

[6] Climate computers, condensers, heat buffers, combined heat and power, use of residual heat (a byproduct of electricity production and industrial processes), movable screens and facade insulation

To reduce the "aggravation" levels of affected industries, the following may be helpful:

- Long lead in times: the early announcement of the emissions charge has been helpful (it was announced in October 2002). Early announcement of the policy for SMEs would have reduced the uncertainty facing the sector. Gradual introduction of the charge may also be useful (EEA, 1996).
- An understanding of the competitive position of energy-intensive industries, and the cost of reducing energy use is an important factor in the design of "mitigating policies" and should be sought early in the policy development process. For example, it may be that the cost of reducing energy use is very high, and the emissions levy would have little effect on energy use by a sector. In this case competitiveness would be reduced for little benefit is terms of emissions reduction.
- An understanding of the way industry players "think" is critical. For example, some growers say that they would respond to tax write-offs more enthusiastically than to subsidies for more energy efficient technologies. While this may not be in accord with general thrust of public policy, it illustrates the need to research the motivations of target audiences thoroughly, rather than assuming that all sectors think the same way as policy analysts.

Future Scenarios

Whether the Kyoto protocol turns out to be "friend or foe" depends on the transition paths open to growers and the responses they make. It seems likely that the SME policies developed will be of assistance to the greenhouse sector, and will assist with adjustment towards more energy efficient systems. Some smaller growers may well leave the industry – especially those with older or less energy-efficient houses and heating systems. Adjustment of this type is an acceleration of an existing trend towards larger, more modern greenhouse complexes. Some growers may become larger to take advantage of economies of scale, which appear to be significant in this industry

It remains to be seen whether the viability of the industry is seriously affected, and this depends to a large extent on the impact on medium and large scale enterprises, which itself is dependent on the size of the emissions charge, the nature of the SME package, and a range of business and personal considerations. One larger grower cites the emissions charge as an addition to the already high compliance costs facing him in New Zealand, and causing him to seriously consider relocation. Relocation of the large growers overseas would have considerable regional economic and employment effects. One large grower in the Franklin District claims to be the second largest single employer in the district, with 150 full-time staff.

However the historical performance of the industry in terms of innovation and ability to withstand competition in this sector provides cause for cautious optimism.

References

Barber, A., 2003. *Greenhouse energy use and carbon dioxide emissions.* MAF Technical Paper No 2003/03, MAF, Wellington.

Barber, A., 2004. *A national survey of the New Zealand vegetable and greenhouse industry 2004: Energy use and carbon dioxide emissions.* VegFed, Northern Flower Growers Association, Sustainable Farming Fund (unpublished).

Climate Change Office, 2004a. *New Zealand Climate Change Policy*. http://www.climatechange.govt.nz/policy-initiatives/index.html

Climate Change Office, 2004b. *Projects to reduce emissions.* http://www.climatechange.govt.nz/policy-initiatives/projects/index.html

EEA, 1996. *Environmental taxes: implementation and environmental effectiveness.* Environmental Issues Series No 1. European Environmental Agency, Luxembourg.

MAF, 2004. *Horticulture monitoring report July 2004.* MAF, Wellington.

MED, 2004. *Energy Data File, January 2004*. http://www.med.govt.nz/ers/en_stats/edfonlin/edfjan2004/overview/index.html#P497_8205

Netherlands Court of Audit, 2002. *Effectiveness of energy saving policy in greenhouse horticulture,* http://www.rekenkamer.nl/9282200/v/

Parminter, I., 2002. *Value of the heated greenhouse sector*. MAF Policy unpublished internal document.

Scrimgeour, F. and K. Piddington, 2002. *Environmental taxation in New Zealand: what place does it have?* IPS Policy Paper No 12. Institute of Policy Studies, Victoria University of Wellington.