Australian Greenhouse Policy and Australian Agriculture: A discussion paper

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Summary

While debate persists about both the science and the economics of global warming, there is growing concern within the broader community about the possible risks posed by increased greenhouse gas concentrations in the atmosphere. As a result, there seems little doubt that governments will implement further policy initiatives in an attempt to moderate greenhouse gas emissions and, hence, to slow the rate of growth of atmospheric concentrations of greenhouse gases.

Australian policy responses to global warming to date have been somewhat piecemeal, and driven more by state governments than the Australian government. Recent statements by Australian Government leaders, however, indicate an increasing interest in the implementation of more comprehensive national policy, an important element of which is likely to be a national scheme for greenhouse gas emissions trading.

The potential of a national greenhouse emissions trading scheme creates an imperative for Australian agriculture to be an active participant in the design of the scheme, to ensure that the sector is not unfairly disadvantaged. As the source of up to 26% of Australia's greenhouse emissions (agriculture and landuse change combined), farmers have a vital interest in ensuring that the sector receives equitable recognition for the contribution the sector has already made to moderating Australia's greenhouse gas emissions, and in ensuring that the sector maximises opportunities to take advantage of future policy developments.

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1. Introduction

Global efforts to limit the rate of increase of greenhouse gas concentration in the atmosphere, and as a consequence to reduce the risk of human-induced warming of the earth have gained considerable momentum over recent decades.

The initial focus during much of the 1990s was on the science of global warming. Significant international investment was directed at research agencies investigating the changing global atmosphere, the causes of those changes, and the likely climatic implications. Much of this science has been assimilated into publications produced by the Inter-governmental Panel on Climate Change (IPCC), first established by the United Nations in 1988.

Since that time, the IPCC has produced four major assessment reports (in 1990, 1995, 2001 and 2007). Broadly, these assessment reports have identified a growing scientific consensus that human activities are resulting in increased concentrations of greenhouse gases in the global atmosphere, which are increasing the risk that global temperatures will increase more than they would otherwise have during the next one hundred years.

These conclusions have been subject to criticism for a range of different reasons, most notably because future climatic and temperature projections are notoriously complex, and the results are subject to substantial variation depending upon the assumptions underlying the computer models used. Despite these criticisms, it is fair to say that scientific consensus in support of human-induced global warming has been growing, rather than diminishing over recent years.

More recently, the focus has shifted to the potential economic implications of projected climatic changes, and also the costs and benefits of taking action to moderate greenhouse gas emissions, and thereby reduce the risk of future warming. The most recent research into these questions, the Stern Report (Stern 2006) concluded that the potential future economic impact of global warming may be in the order of 5–20% of global Gross Domestic Product (GDP) annually by the latter half of the twenty-first century. The report also projected that early action to reduce greenhouse gas emissions, at a cost estimated at 1% of global GDP, could stabilise atmospheric greenhouse gas concentration levels by 2050, and greatly reduce the long-term economic impact of global warming. Stern recommended that the focus of global action should be on: emissions trading; technology cooperation; action to reduce deforestation; and adaptation.

The Stern Report has subsequently been criticised for relying on projections of global climate changes that are considered to be at the extreme end of the range of likely changes. Despite this, Stern's conclusion that early action is likely to be less costly in the long run has generally been accepted, although serious questions remain concerning the costs and benefits of different actions.

While substantial uncertainty still exists about both the science and the economics of global warming, scientists, policy-makers and the wider community are now sufficiently convinced of the potential risk of human-induced climate change that

they are prepared to take, or support, measures to reduce future greenhouse gas emissions.

While much controversy and uncertainty still exists, the political reality is that governments are being directed by their constituents to take action. As evidence, in late 2006 and early 2007, both the Australian Prime Minister and the Australian Treasurer have made comments supporting increased efforts to moderate greenhouse gas emissions, including an examination of a national greenhouse emissions trading scheme, something to which both have previously expressed opposition.

For Australian farmers, the reality that Australian governments will implement an increased range of policy initiatives to address global warming means that the sector urgently needs to become actively engaged in the policy debate, in order to minimise the chances that policy initiatives will have an adverse impact on the sector.

The aim of this paper is to provide a review of international and domestic policy developments in response to global warming, specifically from the perspective of the Australian farm sector. A particular focus will be on the potential development of emissions trading schemes, and the approach that the farm sector should adopt to the design and implementation of such policy developments.

This paper first provides some background information about international and Australian climate change policies. It then analyses the role that agriculture plays in Australia's national greenhouse emissions inventory. The paper then examines Australia's policy responses to date to climate change. Finally, the paper examines the opportunities and risks that may arise from further policy developments in response to global warming, in particular the likely development of a national greenhouse emissions trading scheme.

2. The International Climate Change Policy Framework

International awareness of the potential risk that human activities that generate increased concentrations of greenhouse gases in the atmosphere could have long-term impacts on global climatic conditions was formally recognised in the 1992 United Nations Framework Convention on Climate Change (UNFCCC). Subsequent international negotiations led to the development of the 1997 Kyoto Protocol to the UNFCCC, under which signatory countries agreed to estimate their annual national greenhouse gas emissions, and to implement measures to moderate or reduce those emissions in future years.

This protocol adopts, as a baseline, the 1990 greenhouse gas emission levels of 39 participating developed countries (referred to as Annexe 1 countries) [1]. By the first commitment period, which extends from 2008 to 2012, most of these 39 countries undertook to reduce their greenhouse gas emissions to an average of 95% of their 1990 emission levels. Developing countries that were participants in the negotiations and signatories to the agreements were not required to meet a greenhouse emissions target during this first commitment period. The adoption of the 1990 year as a baseline was considered advantageous for European nations, as the demise of industrial output in eastern Europe subsequent to that year (with an associated decline in greenhouse emissions), the closing down of coal mining in Europe and its greater reliance on nuclear power, and the implementation of a 'bubble' mechanism whereby European nations could combine their emissions meant the European emission reduction target appeared likely to be able to be achieved relatively easily.

While most Annexe 1 countries agreed to targets of between 92% and 95% of their 1990 emissions, for various reasons six countries were set targets of 100% or greater. Australia was one of these, and under the Kyoto Protocol was to be required to limit greenhouse emissions over the 2008–12 period to an average of 108% of 1990 national emission levels.

Negotiations subsequent to 1997 have resulted in some increased flexibility for countries attempting to achieve protocol emission targets. These include a limited ability to trade carbon 'credits' internationally, and recognition that activities such as reforestation can be regarded as carbon 'sinks' because they lock up or sequester carbon, which offsets greenhouse gas emissions.

Under Kyoto Protocol rules, the treaty entered into force if at least 55 parties to the convention ratified it, providing they accounted for at least 55% of the total 1990 emissions of the Annexe 1 countries. This milestone was achieved when the Russian Federation ratified the Protocol in November 2004, resulting in the Kyoto Protocol entering into force on February 16th, 2005. Of developed nations, only the United States (US) and Australia have not ratified the Kyoto Protocol.

[1] Annexe 1 countries are the 39 economically developed nations (Australia included) that were set specific emission targets under the Kyoto Protocol. Many developing countries (non-Annexe 1 countries) are also parties to the Protocol, but under its terms are not required to meet greenhouse gas emission targets.

While the Kyoto Protocol has been the main focus of international policy responses to climate change, there are many who have highlighted its significant shortcomings. These include:

- that many major global emitters of greenhouse gases are not bound by the Protocol
- that the targets set under the protocol take no account of potential costs
- that greenhouse-inefficient developing countries are or will quickly become major emitters and are unlikely to be participants within the foreseeable future
- that even if fully implemented, the net effect on the growth of global greenhouse emissions would be less than 1%.[2]

Supporters of the Kyoto Protocol argue that it was only ever intended to be a first step, and that developed nations need to demonstrate their willingness to take action before they ask developing nations to curb their emissions. It is also argued that the targets to be achieved by the initial commitment period were only ever intended to be modest, as alternative energy sources and technologies would take some time to develop, subsequent to which much more ambitious greenhouse gas abatement targets could be developed.

For Australian farmers, the major flaws in the Kyoto Protocol derive from the export-dependent nature of Australian agriculture. Trade statistics highlight that in each of Australia's major rural commodity export markets, there are at least two other countries that are major competitors and are not bound by the Protocol.

Any reduction in Australian agriculture's competitiveness (through regulations or taxes implemented as part of climate change policies) would see those countries secure market share at Australia's expense. Not only would this disadvantage Australian farmers, but there is the potential that global greenhouse emissions associated with those products would increase, as those competitor developing countries generally have less efficient technology and infrastructure, and would emit more greenhouse emissions in producing the same volume of output.

Despite the limitations of the Kyoto Protocol, nations that are signatories to it have implemented a broad range of policy measures which are consistent with the Protocol, and its framework seems likely to form the basis of future international policy developments in response to global warming.

It should be noted that the Kyoto Protocol emissions targets were set relative to a nation's emission performance averaged over the period from 2008–12. No agreement has been reached on what should happen post the 2008–12 period, either for Kyoto Protocol participants or for non-participants. One possibility assumed during the initial Kyoto Protocol negotiations was that a second commitment period would be defined with new emissions targets developed for participating countries. More recently, it has been suggested that the Kyoto Protocol 'architecture' might be abandoned in favour of a new international arrangement that incorporates both developed and developing nations.

[2] See for example: Fischer et. al. (2003), McKibbin and Wilcoxen (2002), Pew Center on Global Climate Change (2003), Kyoto Protocol Ratification Advisory Group (2003) and the Senate Environment, Communications, Information Technology and the Arts Legislation Committee (2004).

3. Australian Climate Change Policies

Australian governments have progressively implemented a range of measures aimed at moderating Australian greenhouse gas emissions. At the national level, the underlying philosophy of the approach has been that the Australian Government is not prepared to ratify the Kyoto Protocol until it is demonstrated that it is in the national interest to do so (Prime Minister Howard 2002). However, the Government '… *is committed to achieving its Kyoto target while maintaining the competitiveness of Australian industry and protecting Australian job.'* (Minister for Environment and Heritage 2003).

While the Australian Government has maintained a position of refusing to ratify the Kyoto Protocol, it has recently signaled a significant shift in policy by appearing to now be favourably disposed towards a national greenhouse gas emissions trading scheme – something which has been proposed by state governments for some time, but rejected by the Australian Government. A national emissions trading scheme is regarded by many as the most efficient way to reduce greenhouse emissions, as it puts a price on carbon, and enables those who can most efficiently reduce emissions to trade that benefit with others so that the net result is a reduction in national emissions at least economic cost.

3.1 Measures impacting on non-agricultural sectors

A range of measures have been implemented by both the Australian and state governments to achieve the broad objective of limiting national greenhouse gas emissions to 108% of 1990 emissions over the 2008–12 period. These are summarised in Table 1. For non-agricultural sectors, these measures include mandatory and incentive-based programs, plus other voluntary programs for various industries and incentives for research and development activities.

The Australian Government measures (as distinct from state government measures) listed in Table 1 are reported to have a combined total cost of $1 billion (Minister for the Environment and Heritage 2004), and are anticipated to generate a reduction in greenhouse gas emissions of around 60 Mt CO_2-e per annum (pa) by 2010, compared to emission levels under a 'business as usual' scenario (Commonwealth of Australia 2002). This equates to an average abatement cost of $16.70 per tonne CO_2-e. The costs and anticipated benefits of the state government initiatives are not as readily available.

Table 1: The main programs implemented by Australian governments to reduce greenhouse gas emissions from non-agricultural sectors of the economy.

Program	Government	Objective	Funding
Mandatory Renewable Energy Target (MRET)	Australian	Sets a requirement that electricity retailers and wholesalers source an additional 9,500 GWh of electricity from renewable sources by 2010. Estimate emission reductions of 7 Mt CO_2-e pa by 2010.	Costs borne by consumers, and a $40/MWh charge if suppliers fail to meet target. Government funding of $380 million over 10 years for research and development.
Greenhouse Gas Abatement Program (GGAP)	Australian	To reduce Australia's net greenhouse emissions by supporting activities likely to produce substantial net reductions in emissions. Estimated to save 11 Mt CO_2-e pa by 2010.	$400 million allocated to program.
National Greenhouse Challenge	Australian/ Industry	Voluntary program enables major companies to voluntarily undertake programs to reduce emissions, and report results. Estimated to save 16 Mt CO_2-e pa by 2010.	Voluntary program with initial funding of around $30 million, and subsequent internal Australian Greenhouse Office support.
National Green Power Accreditation Program	State	Encourage consumer demand for electricity generated from renewable sources.	Voluntary program, where the consumer pays additional cost of 'green' power.
NSW Greenhouse Gas Abatement Scheme (GGAS)	State	Regulation requires electricity suppliers to abate per capita intensity of emissions from electricity industry in NSW, while still allowing overall growth in total emissions.	Cost borne by consumers. Failure by suppliers to meet target incurs a penalty of $11.50 per Mt CO_2-e.
Queensland 13% Gas Scheme	State	Program to ensure 13% of electricity sold in Queensland is generated from new, gas-fired generators by 2019.	Program will be self-funding with any costs paid by consumers.
Victorian Greenhouse Gas Strategy	State	Program includes a range of voluntary measures and incentives. Estimated to save 5-8 Mt CO_2-e pa by 2008.	$100 million funding by the Victorian Government.

3.2 Measures impacting on agriculture

Australian governments have not implemented any greenhouse-specific policy measures targeted at reducing direct emissions from Australian agriculture. However, the regulatory controls that have been implemented to prevent farmers from clearing native scrub or trees on agricultural land have delivered very substantial national windfall gains in reduced greenhouse emissions. These regulatory measures have been progressively imposed by various state governments, in particular the New South Wales, Queensland and Western Australian governments, with active encouragement from the Australian Government.

While not explicitly included as part of the Australian Government's policy response to climate change, the Australian Government Minister for Environment and Heritage has claimed credit for these policies (Minister for Environment and Heritage 2004). In addition, numerous Australian Government publications have highlighted that in addition to achieving public-good environmental outcomes, such as biodiversity protection, these measures have delivered greenhouse gas emission reductions of approximately 60 Mt CO_2-e pa (Commonwealth of Australia 2002).

Recent research by Davidson et al. (2006) has identified that the cost impact of these measures on farmers in one region in Queensland alone is $520 million in net present value terms. Other researchers have examined the cost impacts of these measures in other regions, and reached similar conclusions.

4. Australia's Greenhouse Emissions Profile

Under the UNFCCC, countries are required to calculate and report on greenhouse gas emissions, based on internationally agreed methods of calculation. The Australian Greenhouse Office (2006) compiled Australia's most recent greenhouse gas inventory, providing estimates of national annual greenhouse emissions from 1990 to 2004 using Kyoto Protocol accounting methodology (Table 2).

Table 2: Australian greenhouse gas emissions by source: 1990 and 2004.

	Emissions Mt CO_2-e[(a)]		Per cent change in emissions
	1990	2004	1990 - 04
Energy	**287.5**	**387.2**	**34.7**
Stationary Energy	195.7	279.9	43.0
Transport	61.7	76.2	23.4
Fugitive Emissions	30.0	31.0	3.4
Industrial Processes	**25.3**	**29.8**	**18.0**
Agriculture	**91.1**	**93.1**	**2.2**
Land Use, Land Use Change and Forestry	**128.9**	**35.5[(b)]**	**-72.5**
Waste	**19.2**	**19.1**	**-0.7**
Australia's Net Emissions	**551.9**	**564.7**	**2.3**

(a) Carbon dioxide equivalent, CO_2-e, provides the basis for comparing the warming effect of different greenhouse gases.
(b) 2004 estimate is interim only and will be revised with the next update of the inventory. It includes approximately 53 Mt of emissions arising from land clearing, and approximately 18 Mt of carbon sequestration (absorption) arising from growing forests.

Source: Australian Greenhouse Office 2006

The energy sector is the largest contributor to Australian greenhouse gas emissions, and is the sector that has increased its emissions by the greatest amount over the past decade. By far the largest single source of greenhouse emissions within the energy sector is electricity generation; a consequence of Australia's strong reliance on coal-fired generators. In the states of New South Wales, Western Australia and Queensland, these electricity generators are predominantly owned by state governments.

The other strong growth in greenhouse emissions within the energy sector has been from passenger motor vehicles, which are calculated to have increased emissions by approximately 30% since 1990.

Agriculture was calculated to be Australia's second largest source of greenhouse gas emissions in 2004. Table 3 provides a breakdown of the sources of these emissions. Livestock emissions (*enteric fermentation*) are the biggest sub-sector of emissions within agriculture, although these have reduced since 1990 due to a decrease in sheep numbers. Since 1990, overall greenhouse gas emissions from the agricultural sector are estimated to have increased by around 2%, although emissions in most recent years are lower due to the effect of drought. Most of this increase is attributed to increased soil cultivation and savannah burning, although the Australian Greenhouse Office cautions that the savannah burning estimates are unreliable.

Table 3: Greenhouse gas emissions from Australian agriculture: 1990 and 2004.

Source of Agricultural Emissions	1990 Mt CO_2-e	2004 Mt CO_2-e	% Change
Enteric fermentation	67.50	61.74	-8.5%
Manure management	2.07	3.25	57.0%
Rice cultivation	0.49	0.24	-51.0%
Agricultural soils	14.12	16.58	17.4%
Savannah burning	6.61	11.03	66.9%
Agricultural residue burning	0.29	0.32	10.3%
Sub-total	**91.08**	**93.16**	**2.3%**
Landuse change[a]	128.80	53.28	-58.6%
Total	**219.88**	**146.44**	**-33.4%**

[a] Net of reforestation

Source: Australian Greenhouse Office 2006

Enteric fermentation refers to methane produced by the digestive processes of ruminant animals such as sheep and cattle. *Manure management* refers to emissions from livestock manure in intensive livestock industries such as piggeries (50%), beef feedlots (30%) and dairies (20%). *Agricultural soils* refers to emissions arising due to soil management, cultivation, and also through volatilisation of nitrogen fertiliser. *Savannah burning* refers to routine burning of savannahs in northern Australia.

It is noteworthy that total agricultural emissions are relatively stable, in contrast with emissions from other sectors of the economy. This highlights that in developing future national strategies to moderate or reduce national greenhouse emissions, the greatest challenge will arise in finding ways to slow or offset future emissions growth in the non-agricultural sectors of the economy.

Two further points are worthy of note in relation to agricultural emissions. The first is that, apart from the *manure management* category, agricultural emissions are very diffuse in their origins, and cannot be directly measured. These emissions are estimated using calculations based on 'average' results arising from limited experiments. For example, emissions from livestock are estimated using an average annual emission value for each type of animal, multiplied by the total numbers of those animals estimated to be on farms in Australia during the period in question.

The second is that reductions in emissions will be similarly difficult to measure directly, given the large number of farming businesses, the multiple enterprises on those farms, and the relatively small quantum of emission reductions possible on individual farms.

As noted earlier, emissions calculated for agriculture in Australia's official greenhouse inventory do not, however, provide the complete picture. A significant component of greenhouse gas emissions arising from Australian agriculture are the separately-calculated emissions from *landuse change* (ie. deforestation), more commonly referred to as land clearing. While reported as a separate category for accounting purposes, these emissions arise largely from management decisions made by farmers in areas where there is extensive tree cover on farmland, and as a

result, can predominantly be considered to be part of the emission inventory of agriculture.

Burning of cleared trees, decomposition of roots and subsequent soil cultivation related to land clearing activity was calculated to contribute 129 Mt CO_2-e of greenhouse emissions during the baseline 1990 year. Bans imposed on land clearing since 1990 are calculated to have reduced these emissions to approximately 53 Mt CO_2-e in 2004, a reduction of almost 70 Mt CO_2-e pa.

Combining these estimates with other agricultural emissions means that over the past decade, the agricultural sector has reduced annual greenhouse emissions by approximately 70 Mt CO_2-e pa, and is the only sector within the Australian economy to have reduced net emissions over that period.

This is emphasised in Figure 1, which shows Australia's progress in meeting its Kyoto Protocol target. It highlights that in the absence of reduced emissions from the combined agricultural sector, Australia's greenhouse emissions would already be 130% of 1990 levels.

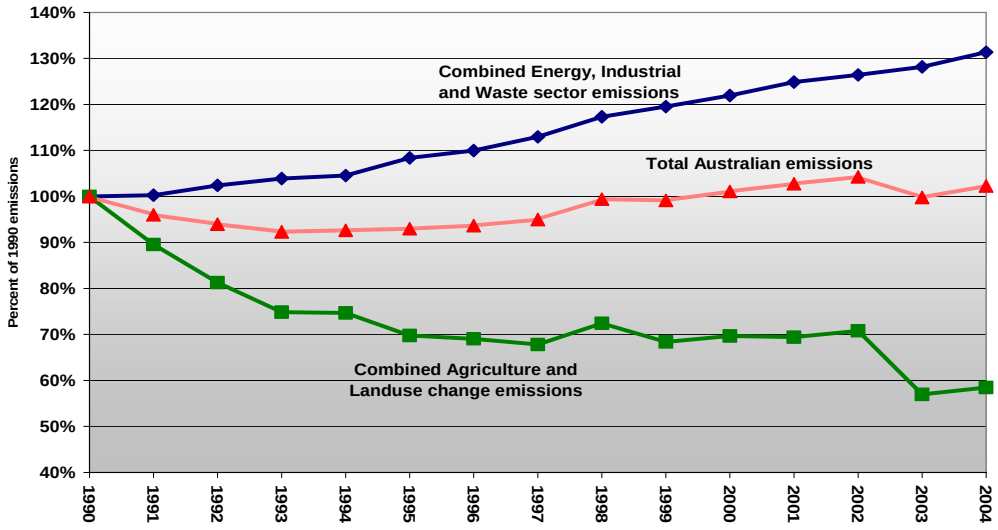

Figure 1: Trends in Australian greenhouse gas emissions, expressed as a percentage of 1990 emissions.

Source: Australian Greenhouse Office 2006

Largely as a consequence of combined agriculture emissions declining substantially from 1990 levels, Australia's aggregate greenhouse emissions were calculated to be 102% of 1990 emissions in 2004. This gives the impression that considerable progress has been made towards the goal of meeting Australia's Kyoto Protocol target of 108% of 1990 emissions by 2008–12.

The significance of reduced emissions from agriculture is reinforced by data provided as part of Australia's third national communication on climate change under the UNFCCC (Commonwealth Government 2002). It highlights that while

emissions from the energy, transport and industrial sectors are projected to continue increasing, and in some cases to equal almost 150% of their 1990 levels by 2010, agricultural emissions are projected to be 104% of 1990 levels, and emissions from landuse change are projected to be just 50% of 1990 levels.

It should be noted that, in relation to estimating the annual greenhouse emissions of Australian agriculture, a range of assumptions and estimations are used, as are a system of accounting rules that determine what can and cannot be counted. As a result, there is some considerable uncertainty surrounding the published data. As a simple example, the burning of savannahs in northern Australia is estimated using satellite image and included in agriculture's greenhouse emissions inventory.

However, based on emission accounting rules, areas of savannah burnt should only be counted in national emissions if the savannah was deliberately burnt by farmers, rather than started by lightning. Identifying which fires are deliberately lit, and which are natural wildfires is a considerable challenge, as can be imagined. In addition, even though the carbon released by a deliberate burn is counted in emissions, the carbon subsequently sequestered as plants quickly re-grow post the fire is not.

This is just one of many limitations about the way in which greenhouse emissions from agriculture are estimated, and unfortunately it is only possible to discuss these issues from the perspective of official or measured greenhouse emissions, even though the measured or estimated emissions may not be an accurate reflection of actual physical processes associated with carbon sequestration or emission.

5. Likely Future Policy Responses

In examining potential domestic policy responses by Australian governments to moderate greenhouse gas emissions, two main policy instruments loom as being most likely. The first is the development of a national emissions trading scheme, and the second is the implementation of some form of carbon tax.

It is unlikely any Australian farm businesses will become direct participants in an emission trading scheme in the near future. For a broad range of reasons, only large-scale emitters such as electricity generators and manufacturers are initially likely to be required to directly become active traders in emission markets. However, the potential for the farm sector to participate indirectly as active suppliers of sequestration credits to those organisations more actively involved in emissions trading is an opportunity that is already being realised, and one that creates considerable future potential to add an extra commodity enterprise – carbon – to the enterprise mix on many Australian farms. This opportunity also brings with it a number of risks, which need to be carefully considered in adopting a policy stance on the issue.

The second option – a carbon tax –does not bring opportunities for the farm sector, and in fact would bring significant disadvantages. A carbon tax could be implemented in the form of a tax on fuel or energy, or even extended beyond that to incorporate a tax on ruminant livestock or nitrogen fertilisers, some of which were proposed in New Zealand. However implemented, a carbon tax by itself would simply add an additional cost disadvantage on to Australian farm businesses. As Australian farmers are price takers in domestic and international markets, they would have little opportunity to pass the tax on to downstream processors or consumers. As such, a carbon tax would have most impact on export-dependent industries such as agriculture.

Aside from the adverse impact that a carbon tax would have on export-dependent sectors, it is also highly questionable how effective such a tax would be as a means of actually reducing greenhouse gas emissions. Research to date suggests that increases in the price of fuel or electricity have only limited impact on short or medium-term demand. Governments may argue that the proceeds from a tax would be directed towards carbon abatement projects and in that way reduce emissions in the longer term – however, this would almost certainly be a less efficient and less effective means of reducing emissions than a trading scheme would be.

6. Greenhouse Emissions Trading

Greenhouse emission trading is widely recognised as one of the more preferred mechanisms available to economically reduce greenhouse gas emissions. The underlying principal is that within an economy there are a range of different corporations in different industry sectors that are all contributing to total national greenhouse emissions. Some of these may have available relatively inexpensive ways in which to reduce greenhouse emissions, while others may not be able to reduce emissions without great expense.

From a national perspective, it is desirable that a required reduction in emissions is achieved at least economic cost. By implementing an emissions trading scheme, those organisations that can cheaply reduce emissions can sell their extra emission reductions to other organisations that cannot economically reduce their emissions.

The rationale for greenhouse emissions trading

Imagine that in a national economy, there are just two companies generating greenhouse gas emissions, and each of these produces 100 tonnes of carbon dioxide emissions pa. Firm A produces net annual output valued at $1million ($10,000 per tonne of carbon), while Firm B produces annual output of $500,000 ($5,000 per tonne of carbon).

Assume the government determines that national greenhouse gas emissions need to be reduced by 10% (20 tonnes), and passes a regulation requiring each firm to reduce their emissions by 10%. If neither firm A nor firm B has carbon efficiency options available, then the only option for each is to reduce annual output by 10%, resulting in aggregate national output decreasing by $150,000.

An alternative is for the government to require the same net emission reduction, but to do this within an emissions trading scheme under which firms can generate tradable emission credits for emission reductions in excess of 10%. The most economical outcome would be for Firm B to reduce output by 20% thereby achieving the 20 tonnes reduction in national carbon emissions. Firm B could then 'sell' its extra 10 tonnes of emission credits to Firm A at a price somewhere between the marginal cost of a tonne of carbon for Firm A and Firm B. If the firms agreed on a price of $7,500 per tonne of carbon credit (the midway price) then the aggregate output loss for the two firms combined is $100,000, in effect achieving the same national emissions reduction for only 67% of the loss of economic output.

While overly simplistic, the above example highlights the economic advantages available in utilising an emission trading scheme rather than regulations alone to achieve reductions in national greenhouse gas emissions.

A number of greenhouse emission trading schemes are already in operation globally. These include the European Emissions Trading Scheme, several schemes operating within and between states of the US through the Chicago Climate Exchange, and the Greenhouse Gas Abatement Scheme, operated by the NSW Government.

The most common form of emissions trading scheme is what is referred to as a 'cap and trade' scheme. The way in which a 'cap and trade' scheme operates is that organisations that are required to participate in the scheme initially measure their annual greenhouse gas emissions, with the common 'currency' used to create a combined measure composed of different gases being a tonne of carbon dioxide

equivalent emissions ($CO_{2\text{-}e}$). For the purposes of carbon sequestration, one tonne of elemental carbon, for example stored in timber, is equivalent to 3.67 tonnes $CO_{2\text{-}e}$ of greenhouse emissions.

Greenhouse gases

There are six different gases that are recognised as contributing to the greenhouse effect under the Kyoto Protocol. The thermal properties of each of these gases differ. To create a common unit of measure, the Global Warming Potential (GWP) of each gas has been estimated. This represents the warming potential of a tonne of the gas, relative to the warming potential of a tonne of carbon dioxide. The Global Warming potentials for the greenhouse gases regulated under the Kyoto Protocol under a 100-year timeframe are as follows

- carbon dioxide has a GWP of 1
- methane has a GWP of 23
- nitrous oxide has a GWP of 296
- halocarbons (HFC) has a GWP of 120 to 12,000
- sulphur hexafluoride has a GWP of 22,200

This means that in 100 years, one tonne of methane will have an effect on global warming that is 23 times greater than one tonne of carbon dioxide, and so forth.

Source: Houghton et al. 2001

Based on that information, the government sets a cap on the maximum level of emissions permissible for a certain period. For example, a government may decide to reduce emissions by 5%, in which case each participating organisation's 'cap' would be 95% of its previous year emissions.

The government issues and/or sells tradable greenhouse gas emission permits that allow organisations to emit the amount of emissions set under the cap, to those organisations required to participate in the scheme. Organisations are then required to limit their emissions to the level determined by the number of permits they hold.

If an organisation is able to reduce emissions to a greater degree than required by its cap, then it has excess permits which can be sold to other scheme participants. Conversely, if an organisation is unable to economically limit emissions, it is required to buy extra permits to match its total volume of emissions.

Governments typically make such schemes enforceable by imposing a penalty on those organisations which produce emissions in excess of the number of permits they hold. The price at which the government sets the penalty per unit of emissions effectively caps the price of emission permits.

One added element of a cap and trade emissions scheme is what are referred to as offset mechanisms. This refers to an arrangement whereby an organisation participating in the emissions trading scheme is able to contract a third party to engage in activities that sequester or store additional carbon. The most common example of this is where electricity generators pay landholders (who are not participants in the emissions trading scheme) to create forest plantations which lock up carbon.

The credits generated by the offsetting activity can be used to help a participating organisation meet its emission target, although it depends somewhat on the rules of the scheme as to how much participants are able to use offset credits to meet net emission targets.

The NSW Greenhouse Gas Abatement Scheme

The NSW Greenhouse Gas Abatement Scheme (GGAS) commenced in January 2003. It requires NSW and ACT electricity retailers and certain other organisations to reduce their average greenhouse gas emissions intensity (emissions per customer) through a range of mechanisms that involve creating and trading 'Abatement Certificates'. Abatement Certificates are issued for projects that are recognised as abating greenhouse gas emissions under the GGAS rules. These projects can be either:

- demand abatement activities
- reduced or low emission electricity generation
- carbon sequestration through activities such as forestry projects.

To obtain Abatement Certificates for carbon sequestration, the project must involve the planting of a forest on land that can be verified to have been a non-forest area on 31 December 1989. A forest is defined as an area more than 0.2 ha in size which has tree crown cover of 20%, and involves tree species that have the potential to reach a minimum height of 2 metres at maturity.

A requirement of the scheme is that estimates are made of the rate of accumulation of carbon and the eventual total carbon stock that will be created, but for risk management purposes, only 70% of the calculated carbon stock change is recognised. The project is required to pass a 'permanency test' – it needs to be demonstrated that carbon stocks will be maintained for 100 years. Part of this requirement is met by registering a caveat on the title to the land that restricts the use to which the land may be put. Projects are subject to an initial accreditation process, and to audit processes. In the event of a 'carbon depletion event' (such as a bushfire) the scheme requires that the area be replanted, or equivalent forestry Abatement Certificates are purchased to negate the loss of carbon stocks.

The scheme is given effect through legislation, and enforced via the imposition of a penalty of $11.50 per tonne of carbon on those participants who fail to meet their required abatement target by surrendering sufficient Abatement Certificates. Abatement Certificates currently trade for approximately $12.00.

Critical elements of an emissions trading scheme are:

- the sectors or organisations that are required to directly participate
- the level of the cap that is set, and projections of future cap levels
- the timeframes over which scheme rules are set
- scheme rules concerning the use of offsets
- the price of emissions penalties.

Australian state governments have established the National Emissions Trading Taskforce, which has the task of developing the possible design of a greenhouse emissions trading scheme for Australia. In August 2006, the Taskforce released a discussion paper on this issue (National Emissions Trading Taskforce 2006).

This work was carried out under the understanding that the Australian Government was opposed to a national greenhouse emissions trading scheme, however, recent developments suggest this position is changing. In any event, whether or not the Australian Government is involved makes little difference to the design principles of the scheme.

The Taskforce agreed on ten design principles that should form the basis for further investigation and analysis of a national greenhouse emissions trading scheme:

1. A cap and trade approach should be used as the basis of the scheme design.
2. The scheme should be national and sector based.
3. In setting the cap, consideration should be given to the overall national emissions abatement target, and how abatement responsibility is allocated between sectors covered by the scheme and those outside the scheme.
4. The scheme should initially cover the stationary energy sector (including electricity, gas and coal).
5. The scheme should cover all six greenhouse gases identified under the Kyoto Protocol.
6. Permit allocations should be made on the basis of a mix of administratively allocated and auctioned permits, with both long and short-term (annual) permits.
7. A penalty should be set to encourage compliance and to establish a price ceiling for the permit market.
8. Offsets should be allowed.
9. Mechanisms should be included to address any adverse effects and structural adjustments.
10. Mechanisms should be included to allow a transition for participants who have taken early abatement action and new entrants.

From the perspective of agriculture, a number of the emissions scheme design principles are of particular importance. The first point to note is that the scheme would initially be limited to the stationary energy sector. The rationale for this is that limiting the scheme to a small number of large point-source emitters would mean that measurement of emissions is simplified, while at the same time this sector is responsible for almost 50% of total Australian emissions, and also responsible for the greatest increase in emissions since 1990, making it critical to future emission reduction.

A second point to note is that under the proposed scheme, offsets would be allowed. The rationale for the inclusion of offsets in an emissions trading scheme is similar to the rationale underpinning the use of emissions trading schemes. It provides an opportunity for organisations inside the scheme to find lower-cost abatement options outside the scheme that provide the same net effect on greenhouse emissions, but at a lower economic cost. The inclusion of offsets potentially creates an opportunity for farmers to sell offset activities to scheme participants to assist them in meeting their emission targets.

A third point to note is that the scheme would be made enforceable via means of an emissions penalty, applied to those organisations whose annual emissions exceed their cap level. The maximum price of tradable emission permits and

offset credits will be determined by the level of the penalty. For example, if the penalty level was set at $15 per tonne of CO_{2}-e, then participants in the scheme will opt to incur a penalty, rather than purchase permits or offset credits, if the tax-adjusted price of permits or offsets exceeds $15.

While the above design principles are by no means confirmed in legislation, they do provide a strong indication of the likely design of a national emissions trading scheme, and provide an opportunity for agriculture to consider how the sector should respond to the proposals, and so develop a detailed policy response to emissions trading.

7. An Australian Emissions Trading Scheme

Based on existing greenhouse emissions trading schemes – the European Trading Scheme (ETS) and the NSW Greenhouse Gas Abatement Scheme (GGAS) – a national greenhouse emissions trading scheme is likely to incorporate the following features:

1. Direct participation in the scheme will initially be limited to major point-source emitters, such as electricity generators, refineries and major industrial enterprises whose emissions are relatively easily measured.
2. The scheme will likely be a 'cap and trade' scheme, whereby participating emitters initially establish their baseline level of emissions, and are then allocated a cap below that level, which is the annual emissions target they must reduce their emissions below by some future date.
3. Participants that are able to reduce their emissions by more than the required amount generate credits that may be carried over to future years, or sold to other scheme participants who have not been able to reduce their emissions by the required amount.
4. Scheme participants can reduce their annual greenhouse emissions below their cap level of emissions in three ways:
    - The first is to find ways to modify their operations to reduce greenhouse emissions.
    - The second is to buy credits from other scheme participants, who have found cost-effective ways to reduce their emissions by more than that required under their cap.
    - The third is to buy offsets from non-participants, who have undertaken actions that permanently sequester greenhouse gases from the atmosphere through actions such as planting trees.
5. Scheme participants that are unable to achieve their cap by any of these three means incur a penalty for each tonne CO_2-e of greenhouse emissions by which they exceed their cap. The penalty rate is set by government in legislation, and effectively becomes the maximum price of a tonne CO_2-e of greenhouse emissions. This is because scheme participants will not purchase emission credits that are higher in price than the penalty, but will instead opt to incur the penalty.
6. Over time, governments progressively reduce the cap, and may also expand participation in the scheme to other, smaller enterprises.

It is important to recognise that, internationally, governments have not relied solely on an emissions trading scheme to reduce emissions, because by its nature an emissions trading scheme cannot be efficiently expanded to incorporate all enterprises or households in an economy.

In addition to a trading scheme, governments have used a range of other measures that impact more broadly on the economy to bring about a reduction in emissions. These generally consist of incentives for particular forms of energy use, and broad taxes (such as taxes on fuel and energy) the revenue from which can be used either to create offsets such as tree plantations, or for research activities into alternative fuels or energy sources. For example, the New Zealand Government in

recent years proposed implementing a tax on livestock, the proceeds of which were to go towards research into ways to reduce emissions from livestock, and a tax on energy based on the greenhouse emission potential of that energy source.

These measures have the general impact of raising the cost of energy, fuel and manufactured inputs used in agriculture, especially when they are supplied by monopoly or near-monopoly organisations, such as electricity generators.

The potential implementation of a national greenhouse emissions trading scheme presents a number of potential risks and opportunities for Australian agriculture. The risks arise in two areas.

The first is that a national scheme will initially result in increased farm input costs, principally arising from the potential design of the scheme, which would in the first instance be limited to major emitters such as coal-fired electricity generators. It is likely, however, that an emissions trading scheme would expand to other carbon-based energy sources over time, resulting in additional energy costs being passed on both directly and indirectly to farmers, who are essentially price-takers and unable to offset higher input costs. If these additional costs were not also being faced by competitor agricultural exporters – especially those in developing nations – the result will be competitively disadvantageous for agriculture.

A second risk lies in the design of the rules associated with an emissions trading scheme, or a related carbon tax regime. The critical issue will be how such schemes treat emissions and carbon sequestration arising from the agricultural sector. As has already been experienced in New Zealand, a broad based carbon-tax and/or a national emissions trading regime that does not recognise agricultural offsets has the potential to have a significant negative impact on the agricultural sector.

Similarly, rules associated with an emissions trading scheme have the potential to disadvantage the agricultural sector due to the nature of its emissions, and the scale of its business enterprises. As an example, the following quote is from a report commissioned by the NSW Government in 1998 that detailed the design of an emissions trading scheme.

> 'A related issue, is the possibility of windfall gains associated with a reduction in emissions from non-traded sources like land-use change. Emissions from tree clearing, for example, could drop substantially in ways that cannot be credited to individual landholders. If this occurs, then these gains are available for distribution. Under one option, the benefits from this increase could flow to existing [trading scheme] shareholders. Alternatively, any windfall gains of this form could be treated as a new assignment and additional shares sold to the highest bidder or held by government as an investment. If retained as an investment, then the government would be able to periodically sell emission permits on the open market. It is recommended that the latter approach be taken. Legislation should define the government as the initial owner of any gains not generated by [trading scheme] shareholders' (New South Wales Department of Energy Emissions Trading Working Group 1998).

What this proposal would effectively mean if adopted nationally is that the credits arising from the reduction in carbon emissions from the 1990 baseline as a consequence of government bans on landclearing in Australia would be assumed

to be ‘owned’ by the government, and sold to carbon emitters who need to purchase offset credits to reduce their net greenhouse emissions. Given that many of the major coal-fired electricity generators which would potentially need to buy these credits are owned by state governments, the arrangement obviously has some attraction to those governments!

The potential opportunities arising from an emissions trading scheme are essentially those associated with the ability of farmers to generate offset credits through changes in land management or the planting of vegetation. This potentially provides an additional ‘commodity’ that farmers may be able to produce and market, and one that may be complimentary to other farm activities.

8. Some Key Issues for Agriculture

Based on the assumption that most agricultural businesses may not initially become direct participants in a national trading scheme, but that opportunities are likely to be available for farm businesses to market saleable offset credits into the national market, a number of key issues require careful consideration.

These issues arise from the rules associated with existing emissions trading schemes, and in particular the rules that have been developed for emissions trading under the Kyoto Protocol. These issues are discussed in more detail in reports by the Allen Consulting Group (2006), and the National Emissions Trading Taskforce (2006).

8.1 Offset principles

The broad principles underlying the development of a range of activities that could be considered acceptable for the generation of offset credits is that offsets meet additionality and permanency criteria, and that baseline and monitoring methodologies are robust.

Additionality is a key feature of eligible offsets, and involves a requirement that the activity to be recognised as an offset actually promotes additional reductions in emissions than would otherwise have occurred under a 'business as usual' scenario. The concept of additionality includes environmental additionality (a test whether the offset activity actually reduces net emissions), legal additionality (a test of whether the offset project is being undertaken simply to comply with existing legislation, or whether it is in excess of those requirements), and investment additionality (a test of whether the offset activity would have taken place if the revenue from the offset credit was not available)

A critical element in considering each of these aspects of additionality is the 'baseline scenario' against which subsequent or proposed actions are being measured. If, for example, the agreed baseline for agriculture is activities that were occurring in 1990, then the potential scope for farm offsets are much greater than would be the case if the baseline was considered to be a more recent or future date.

Permanency is a key requirement of any activity or project that is to be considered for inclusion as part of an offset credit. For inclusion as an offset that generates credits, the project or activity needs to result in the permanent sequestration or locking up of carbon. Under the NSW emissions trading scheme (GGAS), 'permanent' is defined as capable of being maintained for at least 100 years. This means that for forests, for example, offset credits can only be recognised for as long as the forest continues to exist, and the credits must be surrendered or replaced with other credits in the event the forest is harvested or removed. The GGAS also requires that carbon sequestration rights are registered on the title of the land, a further step in demonstrating and maintaining permanence.

8.2 Transaction costs

Transaction costs are a particular limitation on offset credit generation by the farm sector, given the relatively small-scale size of farm businesses. To put the issue in perspective, a tonne of carbon dioxide equivalent emissions is currently valued at approximately $12 under the NSW GGAS.

Under Australian conditions, growing pine and eucalypt forests accumulate between 7–9 tonnes of carbon per hectare pa, declining to about 6 tonnes per hectare pa at 10 years of age, with maximum carbon accumulation of between 100 and 250 tonnes per hectare (Grierson et al. 1992). Savannah woodlands in lower rainfall areas accumulate 0.5–2 tonnes of carbon per hectare pa, with a maximum carbon accumulation of 20–60 tonnes per hectare. To estimate CO_2-e tonnes of emissions, these figures need to be multiplied by 3.67. These figures highlight that, particularly in lower rainfall areas, administrative overheads are likely to make relatively small scale vegetation areas uneconomic for inclusion in an offsets scheme.

Carbon pooling arrangements, organised at a regional level and incorporating actions that generate multiple environmental benefits, may provide a potential mechanism to overcome the limitations that might arise as a consequence of transaction costs (Australian Greenhouse Office 2003) – especially if payment streams are developed for a range of environmental benefits, and not just carbon offsets.

8.3 Measurement baseline

An issue that is of particular importance to agriculture is the issue of the baseline point or measure, against which subsequent actions are measured in order to assess the extent to which additional carbon has been sequestered, or the extent to which previously 'normal' greenhouse emission levels have been reduced. A key aspect of understanding baselines is to understand the nature of the Kyoto Protocol. Rather than setting absolute limits on the volumes of emissions, the protocol sets national emission targets that are a proportion of the emissions that were occurring in 1990. As a result, the critical point in setting a baseline for a nation, sector or an organisation is the ability to estimate or measure the amount of emissions generated by that entity in 1990.

The NSW GGAS sets the baseline for abatement offsets such as forest areas as the condition of the project area on 31 December 1989. For an area to be considered eligible for abatement credits, it must be able to be demonstrated that the area in question was not under forest in December 1989, and has since been planted and maintained as an area of forest.

8.4 Legal liability

A clear understanding of trading scheme participants' potential legal liability is an issue that requires clarification in order for a soundly-based market for offset credits to develop.

A dilemma arises as to whether any potential liability for an offset credit should lie with the buyer or the seller. For offset credits such as those which might potentially be generated by farm businesses, it is likely that a 'seller' liability regime would be the most practical. That is, the 'seller' of the offset credit (the landholder) would incur a liability in the event that subsequent monitoring identified that the credit was no longer valid (eg, a forest plantation had been harvested). The alternative, being a buyer liability, would be very difficult to administer and would be likely to greatly limit both the value and the exchange of offset credits.

Partly to accommodate the reality of risk, the NSW GGAS only allows abatement credits to be recognised that amount to 70% of the estimated amount of carbon that will be stored or sequestered as a consequence of an abatement project.

8.5 International interaction

Either within a nation or on an international basis, a well-designed emissions trading scheme has the potential to achieve a reduction in greenhouse gas emissions for less economic cost than other policies do. Whether or not an Australian emission trading scheme should be bound by rules that might apply to an international scheme is a matter for discussion, especially as there is, as yet, no universally adopted and supported international emission trading scheme.

From an Australian perspective there are potential advantages in Australian companies being able to access international emission markets. There are also potential disadvantages, as the rules established in international emission markets may be inflexible, and may not be appropriate for Australian situations.

Irrespective of whether or not any Australian emissions trading scheme is compatible with the rules of international schemes, it is still likely to be the case that even a purely domestic emission trading scheme will be the most economical means of reducing Australian greenhouse emissions. This suggests that the focus needs to be on ensuring that the design of an Australian emissions trading scheme is compatible with the needs of Australian farmers, and that it is not necessarily bound by some preconceived notion of what design and rules an international emissions trading scheme might have.

8.6 Agriculture-specific technical issues

From the perspective of the farm sector, the extent of opportunities that a national emissions trading scheme might bring will be determined by the rules and definitions used within the scheme. Rules and definitions that maximise the opportunity for farmers to provide offset credits are obviously desirable.

8.6.1 Retained areas of native vegetation

An important issue for farmers, especially in the light of controversies over land clearing policies implemented by state governments since 1990, is the question of what is accepted as an action eligible to be recognised as creating a sequestration credit under any proposed national scheme.

As a consequence of the inclusion of Article 3.7 (the 'Australia clause') in the Kyoto Protocol, Australia was able to include emissions arising from land clearing in its 1990 baseline greenhouse emissions inventory and then subsequently claim a substantial reduction in emissions as a consequence of state governments banning land clearing. It therefore seems only logical and equitable that the retention of areas of native vegetation on farmland, that otherwise could have been subject to routine clearing but for legislation introduced since 1990, should be considered to be an action generating a sequestration credit, which can be sold to national emissions trading scheme participants.

The recognition of retained areas of native vegetation as eligible sequestration credits has a number of implications that require consideration. The first is the need to recognise that, even in the absence of landclearing legislation, landholders historically did not seek to clear 100% of the native vegetation present on a property, and it would therefore be difficult to sustain the argument that 100% of retained areas of native vegetation on farmland (which meets the definition of a forest) should be eligible for recognition as an action generating sequestration credits.

One way to separate out areas of native vegetation that could have been cleared may be to set an arbitrary threshold based on the proportion of the farm under native vegetation that meets the definition of a forest (more than 0.2 has in extent, with at least 20% crown cover of trees capable of exceeding 2 metres in height) . For example, a reasonable policy approach may be to require that landholders seeking to have retained native vegetation areas recognised as areas generating sequestration credits must have a minimum of 20% of the total area of their landholding covered by eligible native vegetation, and only areas of retained native vegetation above and beyond the 20% minimum threshold are eligible for inclusion. This would mean, for example, that a landholding with 30% of the total area covered by eligible native vegetation would be able to obtain sequestration credits for 10% of the landholding's retained native vegetation area.

Inclusion of areas of eligible retained native vegetation as sequestration credits would not mean that farmers retaining such areas would automatically receive payments for sequestration credits. All the other requirements that currently apply to the NSW GGAS, if adopted as part of a national emissions trading scheme, would also apply in relation to eligible areas of retained native vegetation. This would include a requirement to assess the amount of carbon sequestered, and to implement the permanence requirements by having ownership of the carbon rights recognised as part of the registered title to the land.

It would also mean that, having registered an area of retained native vegetation in order to gain recognition of sequestration credits, the landholder would effectively forego any potential future rights to clear the

native vegetation present on that land – at least unless the sequestration rights were subsequently purchased back by the landholder.

An important consideration in proposing this policy approach is the need to recognise that this could eventually add somewhere in the vicinity of 30–40 Mt CO_2-e to the available pool of sequestration credits (depending on how quickly landholders registered areas for inclusion), which could result in the supply of sequestration credits far in excess of likely short-term demand, and therefore result in very low prices being paid for sequestration credits.

This could be overcome in several ways. One would be for governments to set an ambitious initial cap on emission levels for trading scheme participants, forcing them to purchase relatively high volumes of sequestration credits in the initial stages of a national scheme. Another available mechanism could be that governments purchase and stockpile sequestration credits and only release a limited volume into the market over a specific timeframe. A third possibility may be that limits are set on the extent to which retained native vegetation sequestration credits can be utilised by emission trading scheme participants within a certain timeframe, but that participants be able to negotiate (and pay for) options to purchase sequestration credits from these sources at a future date.

While recognition of areas of retained native vegetation as sequestration credits under a national emissions trading scheme may require further refinement, it would help to redress a major inequity evident in current Australian policy settings dealing with greenhouse emissions, while at the same time providing major greenhouse emitters with a significant pool of sequestration credits that would enable them to more smoothly manage the transition to an era when carbon emissions are subject to price signals.

8.6.2 Areas of native vegetation regrowth

Under the NSW GGAS, areas of land generating sequestration credits must be deliberately planted to forest in order to be eligible. This is an understandable requirement in higher rainfall areas that have been cleared of trees for many decades, however, in much of the lower rainfall areas of Australia, and in particularly in NSW and Queensland, timber regrowth is a naturally occurring phenomena that landholders need to actively manage in order to continue to be able to crop or graze livestock on the land.

It would seem logical to recognise areas of land on which native timber regrowth has occurred since 1990 as being eligible to be used to generate sequestration credits, even though these areas have not been deliberately planted with trees. The logic for this proposal is that by allowing timber regrowth to occur, (and foregoing future rights to manage that regrowth) the landholder is creating an additional above-ground stock of carbon on that land and thereby sequestering carbon.

8.6.3 Soil carbon

Article 3.4 of the Kyoto Protocol provides the opportunity for changes in soil carbon under forest or agricultural areas to be recognised within national carbon accounting systems. Australia has not included soil carbon changes in the national greenhouse inventory, because it agreed to set a cap of zero on soil carbon sequestration for the purposes of calculating national greenhouse emissions, apparently based on the view that estimating soil carbon changes in areas of new forest may mean soil carbon changes would be a significant source of additional emissions. It is not clear whether the potential sequestration of additional carbon through changed management of agricultural soils was given any consideration in this decision-making.

In any event, there is no necessary requirement that the potential sequestration of carbon as a result of changed management of agricultural soils should be excluded from future greenhouse emission policy settings (noting also that the potential emission of carbon from agricultural soils as a consequence of certain carbon-emitting management changes would also need to be recognised).

There has been intermittent discussion in Australia about the potential for farm management practices – such as stubble retention and minimum tillage – to result in a build up of carbon stocks in agricultural soils. This, in turn, may create the potential for the resulting increase in soil carbon stocks to generate carbon sequestration credits. Voluntary greenhouse emission abatement schemes currently operating in the US recognise activities that bring about soil carbon increases as being eligible to generate sequestration credits, which can be sold by landholders.

Available research suggests that soil carbon interactions in Australian soils are quite different to that occurring in soils in the US. Australian soil carbon levels are relatively low, can be rapidly depleted, and take a considerable period of time to build up (Carter 2006). Soil carbon testing is also relatively expensive, and subject to considerable sampling error. As a result, it is difficult to foresee how activities that enhance soil carbon under normal Australian conditions could meet the probable requirements of a national emissions trading scheme, especially with respect to permanency. Improved management of soil carbon could, nonetheless, produce both greenhouse emission and farm productivity benefits.

There are, however, a number of emerging potential opportunities that may enable Australian agriculture to make a significant contribution to national greenhouse emission abatement in a cost-effective manner through changed management of soil carbon.

One of these is bio-char sequestration (Lehmann et al. 2006), a process whereby biomass is burnt at low temperatures as part of energy generation, and the resulting charcoal is incorporated into soil. The result is a relatively stable form of mineral carbon stored in the soil, and which also may generate some longer term soil fertility benefits. The amount of

carbon able to be sequestered in soil using this process is considerably greater than the amounts that are able to be sequestered through changed cropping and pasture management.

A second area of some interest for agriculture is phytolith occluded carbon or plantstone carbon. (Parr & Sullivan 2007). This refers to a process in grasses whereby plants form microscopic grains of silica which also incorporate organic carbon. Once formed, this plantstone carbon is highly resistant to decomposition in the soil or due to burning, and in effect becomes sequestered carbon. Some research has indicated that it is possible to select crop varieties with high plantstone carbon potential, which could be recognised as a sequestered form of carbon.

It seems critical that, given the likely low cost of some of these processes and the potentially significant greenhouse emission benefits, an appropriate policy approach would be to keep open the possibility that any agricultural activity that can currently, or may in the future demonstrate benefits for greenhouse emission abatement or sequestration should be able to be recognised and incorporated into future emissions trading or greenhouse abatement policies.

8.6.4 Methane from livestock

Methane from livestock (principally sheep and cattle) constitutes approximately two-thirds of agricultural sector emissions. Available research results indicate that, through a combination of different technologies and management strategies, a reduction of up to 30% of these emissions may be able to be achieved. A challenge arises, however, in that these changes will not result in a permanent abatement of livestock emissions – the abatement will only occur while the farmer involved continues to adopt those technologies and management practices.

This means that while a potentially significant quantum of greenhouse abatement is available from this source, considerable care will be needed in developing policies to ensure they provide appropriate incentives to encourage these changes to occur.

8.6.5 Vegetation thickening

An important issue identified through work carried out in Queensland (Burrows et al. 2002) over an extended period has been recognition of the propensity of mature woodland forests to undergo ‘thickening’ over an extended period. There is some conjecture that this may be a response to increased atmospheric carbon dioxide concentrations over recent decades.

Irrespective of the cause, the research has highlighted that mature woodland areas continue to accumulate additional stocks of carbon over an extended period. Vegetation thickening does not necessitate any special provisions within an emissions trading scheme, other than highlighting a requirement that the mathematical models used to estimate rates of carbon

accumulation in forest areas need to incorporate recognition of longer term vegetation thickening.

8.6.6 Verification of agricultural sequestration activities

One of the important challenges associated with recognition of activities resulting in carbon sequestration is the ability to verify the status of the area, in particular the status of the area at the time of the generally agreed baseline point, that being 1 January 1990. Fortunately, growing libraries of satellite photographs and associated digital spatial information have made it much easier to validate the state of a particular piece of land in 1990, and to record subsequent changes on that land since that time.

Disagreements still arise over definitions of areas of forest and how these should be measured, and little attention is paid to thickening within areas that are already classified as areas of forest. Some further work will be required to generate definitional agreements between various governments, and to ensure the required spatial information is readily available.

9. Implications for Agriculture

The potential implementation of a national greenhouse emission trading scheme and related greenhouse emission reduction policies has a number of implications for agriculture.

Firstly, the implementation of additional greenhouse policies are likely to indirectly increase the cost of a wide range of farm inputs including electricity, fuel, pesticides and fertilisers, and will also increase the cost of transport.

Secondly, any direct tax on livestock, fertilisers or pesticides would also increase farm costs, and disadvantage Australian agriculture relative to major developing country exporters such as Brazil or China, which are only likely to introduce greenhouse policies some time after Australia does.

Taken together, both the direct and indirect costs are likely to have a significant negative impact on an export-exposed and dependent sector such as agriculture, and on regional Australia. Australian agriculture accounted for $31 billion in exports in 2005–06, making up almost 20% of Australia's total exports, and 23% of Australia's merchandise exports. Agriculture's contribution to Australia's annual balance of trade is of great significance, although often overlooked.

In non-urban areas of Australia, agriculture and its related industries account for almost 20% of regional GDP and up to 35% of regional employment, reinforcing the need for caution in imposing costs that will reduce farm competitiveness.

Reinforcing this, analysis by the Australian Bureau of Agricultural and Resource Economics (ABARE) in 2006 (Ahammad et al. 2006) highlighted that under some greenhouse policy scenarios, agriculture would be the most disadvantaged sector of the national economy, losing up to a third of annual net value of output.

At the same time, however, Australian agriculture has the potential to make a significant and cost-effective contribution to reducing national annual greenhouse emissions. The sector is able to contribute in two ways, as illustrated in Figure 2.

The first of these is through actions that result in the **long-term sequestration of carbon** from the atmosphere, locking it up in permanent carbon sinks. The principal way in which agriculture is able to do this is via the establishment of areas of permanent forest vegetation, through tree planting or revegetation of areas of farm land.

For example, if an additional 1% of all Australian farm land was sown to trees, it could result in from 500–1,000 Mt of carbon being sequestered in total over a 100 year timeframe, which would be equal to 5–10 Mt of carbon[3], or from 18–36 Mt CO_2-e of greenhouse emissions pa. This is equal to between one fifth and one third of the entire sectors annual emissions of greenhouse gases.

[3] Note: to convert tonnes of elemental carbon to tonnes of CO_2-e, multiply by 3.67.

The ability of agriculture to continue expanding the amount of land dedicated to carbon sequestration via forestry plantations is, however, limited, as ultimately, diverting productive farmland to tree plantations will place a limit on agricultural output.

The second way that agriculture can contribute to lower net national greenhouse emissions is by actions that result in **short-term carbon sequestration or emission abatement** in the course of producing agricultural outputs.

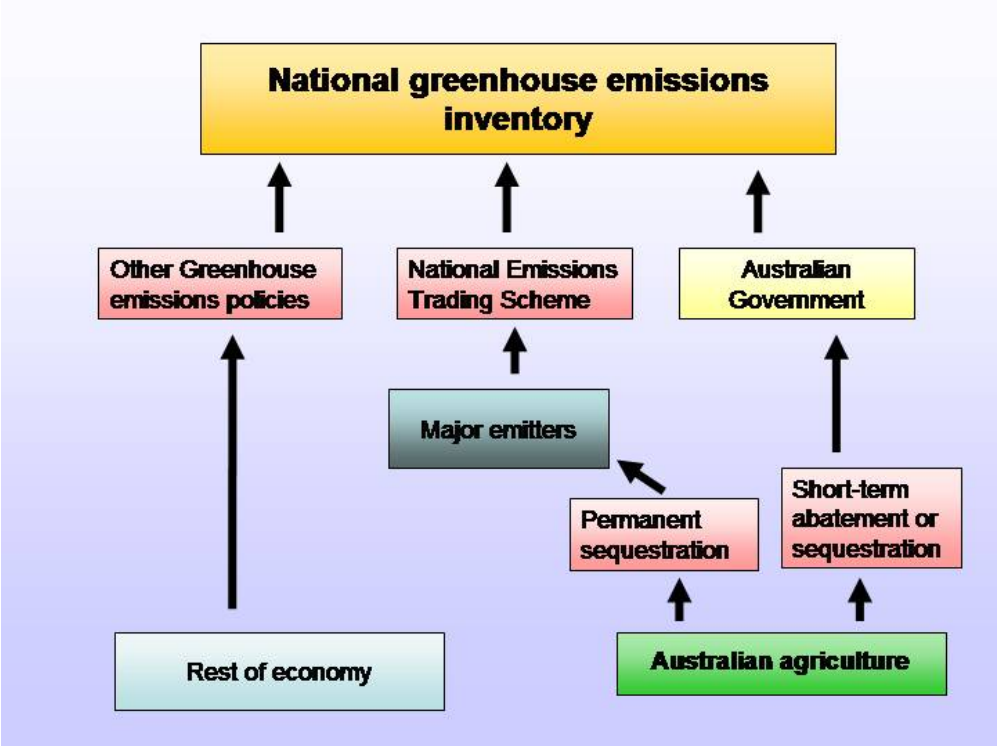

Figure 2: How agriculture can contribute to lower national greenhouse emissions

The potential to abate emissions arises because (as currently measured) the agricultural sector is a net emitter of greenhouse gases. Based on current greenhouse accounting rules, agricultural activities (not including landclearing) are estimated to produce approximately 90 Mt CO_2-e of greenhouse gas emissions pa. If individual Australian farmers adopted best management practices to minimise greenhouse emissions or to sequester additional carbon in soils, is appears likely from available research that a net change in emissions from the sector's current 'business as usual' level of up to 20% may be possible, with further reductions likely as research identifies ways for greater reductions to be made. This could result in the removal of up to 20 Mt CO_2-e of greenhouse emissions from Australia's annual inventory.

Future research is likely to increase the potential amount of short-term greenhouse emissions abatement or carbon sequestration that can be achieved through changes in on-farm activities, with the added benefit being that in some cases, the abatement of greenhouse emissions also generates positive farm productivity changes.

9.1 Long-term sequestration activities

In considering the two broad categories of actions which the agricultural sector can contribute to a net reduction in national greenhouse emissions, it is apparent that actions by farmers to create forest areas through the planting of trees or revegetation of farmland can result in a significant reduction in national greenhouse emissions over time, and would meet the requirements of a probable national emissions trading scheme to be recognised as an offset credit.

However, the amount of emission sequestration that many individual farm businesses are likely to be able to provide will be relatively small, and are also likely to involve multiple small areas of trees on the one farm.

As a consequence, it is important in designing a national emissions trading scheme that the relatively small 'parcels' of emission sequestration that can be created through farm-scale revegetation will be able to be efficiently amalgamated and marketed as offsets to participants in the national scheme. Remote sensing and the use of GPS technology could potentially provide a way in which this can be done in a cost-efficient manner, and land title systems will need to be able to provide information about the extent and ownership of stocks of carbon sequestered at a particular site.

Even with the use of such technology, the extent of sequestration by farmers will be limited (especially in higher rainfall areas) unless farmers are able to establish relatively small areas of timber, and have the emission sequestration arising from them sold as offsets into the market created by the national emissions scheme.

This suggests the need for emission pooling services at a regional or even local government level that incorporate all the accreditation and verification services required for the recognition of parcels of emission sequestration arising from farm tree planting and revegetation activities.

The rules of a national emission trading scheme, and the legislation that gives effect to any such scheme will need to be structured in a way that does not exclude farm-scale offsets, or creates significant cost burdens that make such offsets uneconomic.

9.2 Short-term greenhouse reduction activities

The range of activities that farmers can adopt at a farm level to reduce greenhouse emissions are quite extensive, and are evolving as research results progressively become available. For example, those activities include:

- adoption of minimum tillage technologies that reduce fuel use and soil carbon emissions
- adoption of livestock management and feeding practices that reduce livestock methane emissions
- changes to grazing and crop management systems that reduce soil carbon losses
- adoption of fertiliser management systems that reduce emissions

- adoption of manure management or effluent treatment systems that reduce emissions.

In addition, there are a range of farm management changes available that can result in the sequestration of additional carbon in farm soils. The amount of carbon sequestered as a result can be quite significant, although in general this form of sequestration is not likely to meet the permanency requirements noted earlier, which is likely to be a requirement for a tradable emission offset within a national emissions trading scheme.

The adoption of any or all of these or other greenhouse-friendly activities by a farmer has the potential to significantly reduce net annual greenhouse emissions from a farm, and collectively become a significant element in reducing Australia's annual greenhouse emissions.

However, because these farm management changes do not create a permanent, long lasting stock of stored carbon, the emission changes are unlikely to be able to be directly sold as credits or offsets to participants in any national emission trading scheme.

The net emission reduction achieved is dependent on the farmer having carried out the specific activity during the year in question, and would, if it could be counted in the national inventory, only result in a reduction in national greenhouse emission levels for that year. Whether or not a longer term impact on national greenhouse emission levels arises would depend on the farmers continuing to do that activity each year, and also on the farmer not doing any activities that reverse the effect, such as conventional cultivation of a paddock that had been subject to minimum tillage management over a number of years.

The dilemma for both farmers and government is that incorporating net short-term farm emission reductions arising from changed farm practices in a national emissions trading scheme would create enormous difficulties. On a single farm, there may be a dozen different practices that collectively reduce net greenhouse emissions from that farm, but the measurement and validation of those practices would be very expensive and impractical, as the practices would be carried out at many different times throughout the year

Despite this, achieving a significant reduction in net farm-generated greenhouse emissions is of considerable value for the Australian Government, in that being able to include this emission reduction in the national greenhouse inventory provides a more accurate reflection of national greenhouse performance, and for any given national greenhouse target, limits the extent to which emission reductions will need to be generated in other sectors of the economy, at potentially greater cost.

Recognising this, governments may be tempted to regulate farm activities, and/or to impose taxes or penalties to change behaviour and bring about net farm emission reductions.

Given the complexity of the management decisions required on an individual farm, to be effective a regulatory approach would have to be highly prescriptive. It might include, for example, the banning of uncoated nitrogen fertiliser, the need

for planning approval for conventional cultivation or changing pasture and cropping mixes, the need for approval to increase stock numbers above a certain level, taxes based on livestock numbers (as has been proposed in New Zealand), or mandatory requirements for anaerobic treatment systems for piggery or dairy effluent.

Taking a regulatory approach to achieve net farm emission reductions is likely to be administratively expensive, create numerous perverse outcomes, and create significant limitations for future farm productivity growth.

What is preferable for both governments and agriculture is that the full potential of farm emission reduction activities is able to be recognised and included in national emissions inventories, and that farmers have available flexible and evolving farm management strategies that provide strong incentives for activities that result in short-term greenhouse emission reductions to be carried out and recognised.

10. Agriculture's Response to Emission Trading

There is no doubt that, irrespective of whether Australia ratifies the Kyoto Protocol or not, the most economic way to reduce national greenhouse emissions will include the implementation of a national emissions trading scheme. The inevitable introduction of greenhouse emissions trading within the next half decade in Australia brings with it both risks and opportunities for Australian agriculture.

The behaviour of the Australian Government towards the agricultural sector during the 1997 negotiations over the Kyoto Protocol highlights the risks a relatively small sector of the economy, such as agriculture, faces. Without discussion with the sector, in 1997 the Australian Government negotiated a specific clause in the Kyoto Protocol to recognise emissions arising from agricultural land clearing, knowing that by banning land clearing Australia could achieve a very large reduction in emissions at little direct cost, other than for farmers.

Subsequent CoAG agreements with state governments required them to fully implement bans on land clearing in order to receive the promised Commonwealth funding. Based on current prices for a tonne of carbon emissions, the annual value loss arising from these measures for Australian agriculture is between $500 and $1,000 million pa.

Australian agriculture has sound reasons to support the introduction of a greenhouse emissions trading scheme that includes mechanisms that enable farm-scale emission sequestration actions, such as tree planting and revegetation, to be sold as offset credits to organisations that are required to participate in the emissions trading scheme. If farmers are able to provide and sell emission offsets, this will add an additional enterprise for many farm businesses, and generate steady revenues that could be very important in the future sustainability of farm businesses.

For farmers to gain recognition, and revenue, from short-term farm-level greenhouse emission reduction actions, a different approach is necessary.

One possibility is the development by agricultural commodity sectors of credible voluntary best management practice (BMP) farm management standards that reduce net greenhouse emissions while optimising farm production. These BMP standards would need to be industry-owned and developed, based on the best available science, and could evolve as research progressively develops ways to reduce the level of greenhouse emissions arising from farming activities. Some agricultural commodity groups have already commenced work on the development and implementation of these standards.

Farmers who voluntarily implement these agreed industry BMP standards – which could be subject to periodical audit to verify their continued implementation – could become eligible for an emissions abatement payment from the Australian Government. The payment should be based on the prevailing price of a tonne CO_2-e of greenhouse gas in the national emissions scheme (perhaps established

annually for administrative efficiency), and determined by the extent to which the BMP standard had been shown to reduce greenhouse emissions relative to a 'business as usual' farm management approach.

The existing methodology used by the Australian Greenhouse Office to calculate greenhouse emissions arising from agriculture provides a robust baseline, against which to measure the emission benefits able to be generated by a particular commodity BMP.

For example, a BMP standard for grass-fed beef cattle management might have been shown to reduce annual greenhouse emissions from cows by 1 tonne per head, compared with the current average level of greenhouse emissions per cow that forms the basis for calculating greenhouse emissions within the National Carbon Accounting System used by the Australian Greenhouse Office. A farmer running 500 head of cattle would, upon adoption of the BMP, be eligible for a payment of 500 x 1 x $15 (the current approximate price for a tonne of CO_2-e) or $7,500 annually. By adding additional elements to the BMP (such as practices that reduce fuel or energy use or minimise emissions from fertilisers) the farmer might be able to substantially increase the total emissions abatement achieved, and increase the potential payment accordingly. If the farmer subsequently decided to discontinue adoption of the BMP standard, the annual payment would cease.

The advantage for Government would be that, as the number of farmers who were accredited under the particular BMP and the total tonnes of net greenhouse emission reduction achieved by those farmers would be known, this amount of emission reduction could legitimately be deducted from Australia's calculated national greenhouse emissions inventory, enabling the achievement of a level of greenhouse emissions that could not be achieved as economically in other ways.

The national economy would benefit by not facing as large a cost for greenhouse emissions abatement as would otherwise be the case.

It might even be that the Australian Government could utilise the amount of net farm emission reduction in a pool of credits that could be available for sale to industry sectors involved in a domestic emissions trading scheme implemented to reduce net greenhouse emissions.

An advantage of linking the price of farm emission reductions to the prevailing price of carbon offsets in the national emissions trading scheme would be that the national economy would be achieving greenhouse emissions reductions at the most efficient price. If the price of carbon offsets in the national emissions trading scheme increased, more farmers would be encouraged to undertake BMP accreditation in order to access the payments. Alternatively, in the event that less expensive ways were found to generate a reduction in national emissions, there would be less incentive (and fewer payments) going to the farm sector and the extent of BMP adoption would slow.

A critical element for the success of the above proposal would be that the BMP standards remained owned by the industry, that participation in the BMP system remained entirely voluntary, and that participants adopting the BMP standard

would be subject to periodical audit in order to ensure the integrity of the system was maintained.

Some might argue that all sectors of the economy, including agriculture, will be required to reduce the amount of greenhouse emissions they produce, and on that basis there is no justification for the agricultural sector being paid to bring about a reduction in net sector emissions.

Such an argument ignores the reality that the agricultural sector is the only sector of the economy that has had a real cost imposed on it to achieve a reduction in greenhouse emissions, and this cost imposition is one that continues each year.

It also ignores the fact that, unless there are real incentives available for farmers to adopt greenhouse BMP standards, it will be almost impossible to achieve net agricultural emission reductions through regulation.

An additional benefit from this approach is that the Australian Government will legitimately be able to reduce calculated annual national greenhouse emissions by the amount of net emission reductions achieved by farmers, reducing the pressure on other sectors of the economy to achieve emission reductions – especially in the short term when the economic cost of greenhouse abatement in sectors such as electricity generation is likely to be high.

11. Some Key Questions

There are a number of key questions that the agricultural sector needs to consider in formulating a position on this issue. Some of these questions are also raised in the discussion paper that has been released by the Prime Minister's Task Group on emissions trading. These key questions, and some brief commentary on them follow.

1. Should Australian agriculture support a move to implement a national emissions trading scheme in advance of the development and implementation of a comprehensive international scheme?

A properly designed emissions trading scheme is generally recognised as being the most efficient, economical and equitable way to reduce national greenhouse emissions. If governments are committed to reducing emissions, then a trading scheme is probably preferable to the current mis-mash of policies that are applied at both state and Commonwealth government levels. Also evident in current policies is a government tendency to pick winners, with for example, large subsidies going to renewable energy and to existing major emitters in the energy sector, while large costs have been imposed on the agricultural sector.

A danger in implementing a national emissions trading scheme in advance of an international scheme is that the design of the Australian trading scheme may make it incompatible with a future international scheme, limiting the opportunity for Australian industry sectors to be involved in international emissions trading activities.

2. If Australia adopts a national emissions trading scheme, what position should agriculture take in response?
Alternatives include:

- **a. full participation, with farm businesses operating as participating businesses having emission caps and being able to trade emission debits, credits and offsets,**
- **b. conditional participation, with farm businesses being able to market sequestration offsets, and eligible to access payments for voluntarily reducing net emissions below industry benchmarks**
- **c. no participation, meaning that farm businesses would not have any emission targets set, and would not participate in the provision of offset credits or other emission trading instruments.**

These three options are perhaps somewhat simplistic, but provide a range of possible responses that may require refinement or supplementation.

Full participation by individual farm businesses in an emissions trading scheme would obviously entail significant administrative costs, although

current Rural Lands Board, fuel rebate and livestock and crop industry research levy arrangements could provide the basis of an annual farm greenhouse emissions statement (much like the current BAS statement), which could be used to calculate farm emission performance. This could then be used to assess whether the farm business had excess emission credits to sell, or would need to purchase credits or offsets to meet the farm emission cap. A further alternative for farmers would likely be to incur a financial penalty for excess emissions. Full participation by agriculture would also likely mean that the entire sector would have an emissions cap established on a routine basis, which would then become the target the sector needed to achieve in aggregate over a defined period.

A position of conditional support for a national emissions trading scheme by agriculture, whereby long-term farm sequestration activities would be recognised as offset credits eligible to be sold to trading scheme participants, and short-term sequestration and abatement activities that generated a net emission reduction would generate payments based on the market value of the emission reduction achieved, has been outlined in preceding sections of this paper. The risks with such a position are that the 'rules' for agriculture would be subject to government agreement and potential interference, whereas in a fully-functioning trading scheme the risk of governments suddenly changing the rules is somewhat less.

A position whereby agriculture opts not to participate in any way in a national trading scheme would (subject to government agreement) mean farmers would not be required to take any action in relation to greenhouse emissions, and would similarly not have any opportunity to benefit from greenhouse positive actions they may be able to take. In adopting this position, some judgment is required on the extent to which a national trading scheme may impose additional costs on farm businesses. Fuel and energy costs account for between 10 and 30% of the input costs of a farm business, and ABARE analysis suggests that these costs will rise under most greenhouse policy scenarios. Some judgment may also be required concerning the extent to which carbon status might in future become significant in international agricultural trade.

A decision by agriculture to not participate in any way as a broad sector in a trading scheme would raise questions about the potential for individual farm businesses to opt for voluntary participation. Unless the agricultural sector is a participant and, therefore, rules exist about agricultural sector emissions, it may be difficult for an individual farm business to voluntarily become a trading scheme participant.

3. If agriculture opts to be either a full or a conditional participant in an emissions trading scheme, how should agricultural sector emission rules be established or changed?

If agriculture opts for either full or partial scheme participation, a critical issue will be the 'rules' that will be established concerning different actions on a farm and how they will be recognised within a trading scheme framework. A relevant example is the issue of soil carbon, and how it

should be recognised as part of a farm emission inventory. Who or what determines whether certain actions that change soil carbon should be recognised as creating a permanent stock of carbon eligible for recognition as an offset credit? If new technologies become available, what is the process whereby that technology gains recognition and becomes part of either an emissions trading scheme or even a farm BMP standard?

Given the unique nature of farm sector emissions and the emission complications arising from various farm management decisions, it would seem essential that the farm sector develop some structure, and be strongly represented in a body that would set rules associated with agriculture emissions, and potentially also identify key issues in need of research and development.

4. Agriculture is recognised as a single economic sector, yet in reality consists of a range of different sub-sectors, each of which faces different challenges and opportunities arising from the potential implementation of a national emissions trading scheme. To what extent should different sub-sectors of agriculture adopt different rules or policy positions in response to a proposed scheme?

Sub-sectors of agriculture, such as dairy, pork, poultry, rice and horticulture face different challenges and opportunities arising from trading scheme policy developments. As a national trading scheme is likely to be sector-based (ie with targets and rules based on the sectors recognised in national and international emission inventories) some pragmatic decisions will be required from commodity sectors as to whether they should seek to be included within the agriculture 'tent' or should pursue their interests separately.

In the event that sub-sectors opt to be included with agriculture, a question will arise about how the specific rules for each of those sub-sectors should be determined.

5. What is the appropriate timing for agriculture's engagement with an emissions trading scheme?

Irrespective of agriculture's eventual position in relation to a national emissions trading scheme, a question arises concerning the timing of agricultures potential involvement. One option is that agriculture should be involved from day one. The advantages of such an approach may be that agriculture has a seat at the table in terms of decisions about rules and structures, and can therefore better guard against other sectors taking advantage of agriculture. The disadvantages may be that, as has been the case in the European Emissions Trading Scheme, there will be initial 'turbulence' as rules are modified and governments and industries respond to market signals and attempt to optimise market design.

The decision on the timing of agriculture's engagement may also need to reflect the fact that a trading scheme is unlikely to be the sole policy

mechanism adopted as a means of moderating or reducing Australia's national greenhouse emissions. A trading scheme is likely to be just one of a number of policy instruments implemented, each of which may have different impacts on the agricultural sector.

12. Conclusion

This discussion paper concerning the involvement of agriculture in a national emissions trading scheme aims to assist the development of policy responses by Australian agriculture.

The issue is obviously one which is surrounded by a large degree of uncertainty, making it difficult for agriculture to be definitive in what it is seeking. The paper identifies a range of risks associated with both action and inaction.

While some might be inclined to conclude that the extent of uncertainty and the risks involved mean that the best course for agriculture is to not have anything to do with an emissions trading scheme, this approach in itself also encompasses a large element of risk.

Past history has shown that a sector such as agriculture is vulnerable to unfavourable policy outcomes given political and economic realities. Unless the sector is actively engaged in issues such as greenhouse policy and emissions trading, it seems reasonable to assume that history will be repeated.

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