Submission by the Victorian Department of Primary Industries to the Garnaut Climate Change Review

Issues Paper 1:

Climate Change: Land use - Agriculture and Forestry

January 2008

Key Points

- Climate change will affect agriculture and forestry businesses though biophysical, global trade and policy impacts. In some cases, trade and policy affects may occur sooner, and possibly be more significant, for these businesses than many longer-term biophysical impacts.
- Climate change is one of many factors that will drive changes in the agriculture and forestry sectors, and these need to be considered holistically in developing policy responses.
- Climate change brings with it business risks, challenges and opportunities. It highlights the importance of flexibility, innovation and sustainable development.
- Adaptation and mitigation will be critical for agriculture and forestry businesses. Farm and business level strategies in both these areas, including financial strategies and new approaches to business structures, will be important.
- Governments need to address market failures arising from the global externality associated with greenhouse gas emissions, and the public good characteristics of some information and research and development activities. Governments also need to reform existing policies, programs and institutional arrangements that are no longer optimal and ensure welfare safety net arrangements are adequate.
- Development of climate change policies must be undertaken within a strategic framework that is comprehensive, consistent, integrated, has a long-term focus and includes the consultation of affected stakeholders. Coordination and cooperation across governments in Australia is required if mitigation costs are to be minimised and opportunities maximised.
- Agriculture and forestry can make an important contribution to Australia reducing its net emissions by sequestering carbon. However, producers need to be aware of the costs as well as the benefits of offering sequestration products.
- Mitigation must be achieved at least cost, not only for economic efficiency and community welfare, but for sustaining community support for reducing net emissions.
- Agriculture and forestry's inclusion in a domestic emissions trading scheme offers advantages through increased efficiency from expanded sectoral coverage. In the case of agriculture, however, transaction costs related primarily with measurement and verification need to be reduced before its inclusion. No single policy instrument can fully address the mitigation challenges for these sectors and a package of measures is needed.

Submission by the Department of Primary Industries

The Victorian Department of Primary Industries welcomes this opportunity to contribute to the Garnaut Climate Change Review. The Review's Issues Paper 1 raises a number of important issues for the agriculture and forestry sectors in Victoria.

This submission aims to provide some Victorian perspectives on the climate change challenges and opportunities facing agriculture and forestry sectors, and offers the Review some comments on policy issues. It also provides some information on the work the Victorian Government is already undertaking in this area. Given the timeframes, this submission does not attempt to cover all the issues involved. However, DPI would welcome the opportunity to continue to provide input into the Review over 2008.

The Victorian Government will release a *Future Farms Statement* around the time of the 2008 May Budget which will outline many of the challenges and opportunities facing agriculture now and in the future, and will provide a framework for policy to build the profitability, resilience and sustainability of farming businesses in Victoria. Many of the issues covered in this statement will be relevant to the Review.

This submission is divided into three parts:

- Part A: Background and context;
- Part B: Key messages relevant to policy considerations; and
- Part C: Further information on Victorian Government policies and programs.

Part A: Background and context

The Victorian agriculture and forestry sectors in brief

Victoria's agribusiness and forestry sectors contribute significantly to Victoria's wealth and wellbeing by producing food and fibre essential for life. In 2005-06, these sectors contributed approximately $6.0 billion to Victoria's Gross State Product (DPI 2007b). Together, the production and processing of agriculture and forestry products employs over 130,000 Victorians and is responsible for more than 36% of all Victorian exports. Victoria is Australia's largest food and fibre exporting state, accounting for 26 per cent of the national total (DPI 2007b). Victoria's largest export earner, the dairy industry, provides no less than 13% of dairy products traded globally. In regional economies, these sectors are even more important (DPI 2007b). Exports of agriculture and forestry products accounted for almost 8% of Victoria's merchandise exports in 2005-06 (DPI 2007b).

The Climate Change Challenge for Agriculture and Forestry

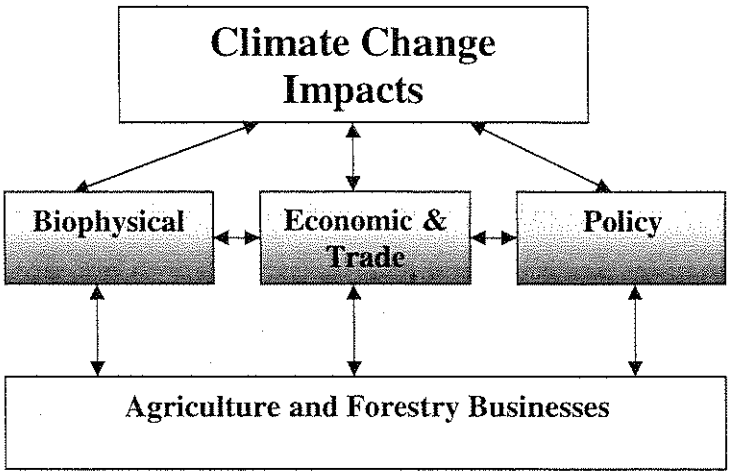
Victoria's agrifood and forestry businesses constantly face new challenges and opportunities. At present these include challenges associated with full employment, a strong Australian dollar, increasing global competition, demographic change, and prolonged drought and reduced water availability. Opportunities include those arising from increasing prices for many agricultural commodities, expanding markets in Asia and access to cheaper credit relative to recent decades.

Climate change adds a new dimension to these challenges, contributing to and compounding some existing pressures, such as reduced water availability, as well as presenting new ones, such as changing climatic zones. It also adds new dynamics to global trading markets and is stimulating policy responses in Australia and globally with varied, but potentially significant, implications for business.

In particular, climate change for agriculture and forestry businesses will bring:

- biophysical impacts stemming from changes to climate averages, climate extremes and increases in climate variability;
- economic impacts resulting from the effects of climate change on other agricultural and forestry producers and markets both in Australia and internationally; and
- policy responses globally and in Australia, which can impact on the agricultural and forestry sector both favourably and adversely (Figure 1).

Figure 1: Climate Change Impacts for Agriculture and Forestry Businesses



As part of Australia's policy response to climate change, agriculture and forestry businesses will need to consider their role in mitigating emissions. The Victorian Greenhouse Gas Inventory (2005) notes that Victoria's agriculture sector contributed 12.9% of the state's total emissions in 2005, the third largest sector behind transport (16.9%) and stationary energy (54.8%). Methane from livestock contributed 76% of agriculture's total emissions, and nitrous oxide from agricultural soils and livestock manure contributed most of the remainder. These figures, however, do not include the sinks offered by agriculture which are much harder to measure. Victoria's forests act as a net carbon sink, and removed 3.49 Mt CO2 equivalents (CO2e) from the atmosphere in 2005.

More than ever, agriculture and forestry businesses need to be performing at their best, managing an expanded set of challenges and risks with increasingly sophisticated management practices. Business flexibility, innovation and sustainable development will be central to many business's ongoing viability and profitability. In particular, the success of businesses will depend on their ability to adapt, mitigate adverse impacts and capture the benefits a changing climate might offer. But success will also be driven by the ability of businesses to respond to changes in the market in which they operate, or could operate. Changes in government policies can also have substantial influences on the prices of farm and forestry inputs, and the set of opportunities and obligations businesses might face.

Key biophysical impacts

The productivity of most agricultural and forestry industries is heavily influenced by weather and climate, particularly temperature, evapotranspiration, rainfall and seasonal variability.

Table 1 **Summary of potential biophysical impacts for Victorian Agriculture and Forestry**

Sub-sector	
Cropping	• Increased crop water-use efficiency due to higher carbon dioxide concentrations but potentially reduced grain quality. • Reduced water availability due to reduced rainfall and increased evaporation rates coupled with reduced catchment water yield. • High probability of reduced crop yield for existing crop varieties, based on reduced annual precipitation. • Increased risk of pests, parasites and pathogens.
Horticulture	• Changes to frost frequency and severity may lower yields and reduce fruit quality. • Damage from more extreme storm events such as hail, wind and heavy rain. • Increased risk of pests and disease. • Warmer conditions may impact chilling requirements for stone fruit and apple trees. • Reduced catchment water yield.
Viticulture	• Higher ripening temperatures may reduce optimum harvesting times. • Potential changes to time of first flowering and consequent wine quality. • Warmer conditions may allow new varieties to be grown in some areas. • Reduced catchment water yield.
Dairy	• Possible decline in availability and consistent supply of potable water due to reduced catchment water yield. • Elevated CO_2 could result in lower protein content per weight of purchased feed. • Increased risks of heat stress and susceptibility to pests and diseases with rising frequency of very hot and humid days reducing milk yields.
Grazing	• Increased growth from elevated carbon dioxide may be offset by reduced rainfall and higher evaporation. • Decreases in forage quality. • Increased rainfall variability reducing livestock carrying capacity of pastures. • Increased incidence of heat stress impacting livestock productivity and welfare. • Increased risk of pests, parasites and pathogens.
Forestry	• Increased short term growth from higher carbon dioxide levels, but potentially offset by increased pest, fire and frost damage. • Reduction in average run-off may reduce forest productivity and water yield. Reduction in average run-off may reduce forest productivity and water yield from forested catchments. • Increased temperatures will promote plantation productivity for fertile sites with access to sufficient water. • Increased forest fire danger and increased likelihood of estate damage by large fires.

Sources: DSE 2004 and Allen Consulting 2005.

Climate change is expected to affect current agricultural and forestry production systems through increased average temperatures, altered rainfall patterns, increased levels of atmospheric carbon dioxide and increasing climate variability. 'Best estimates' of rainfall indicate a trend of decreasing average annual rainfall for most parts of Victoria, particularly western Victoria (CSIRO 2007). This decline in rainfall is likely to have a profound impact on surface water run-off, with commensurate affects on water captured in farm dams and larger dams used to support irrigation systems. Increasing surface temperatures will amplify the effect of reductions in rainfall and reduce soil moisture content.

Changes in temperature and water availability can also alter the rate of photosynthesis and translocation of nutrients in vegetation, including pastures, crops, trees and competing weed species (Table 1). This in turn affects the growth of crops for humans and livestock, and growth of native forests and plantations. Climate change is also likely to increase heat stress and climatic exposure for livestock, affecting weight gain and milk production. There may also be indirect effects through changes in the incidence of diseases and pests, and increased rates of soil erosion and degradation (IPCC 4AR 2007, Salinger MJ 2005). Climate change can, therefore, have major implications for the viability of different agricultural or forestry systems in different regions and, in some cases, may make land unviable for agricultural or forestry production.

The overall biophysical impact of long term changes to Victoria's climate will depend on the magnitude of change, the pace of change and the interaction between particular changes. Moderate average temperature rises are expected to increase aridity and decrease productivity in northern Victoria, but could lead to increased agricultural productivity in temperate regions, given adequate rainfall. For instance, the Western District, which is traditionally too wet and cool for profitable wheat growing, could become viable for growing wheat. At the upper range of projected temperature increases (those above 3°C), however, production from agriculture and forestry is projected to decline over much of southern and eastern Australia (IPCC 4AR 2007).

The biophysical impacts of climate change on forests will depend on the particular tolerance range or 'climate envelope' of the forest species. Most native forest species have a relatively narrow climatic envelope and therefore are predicted to have a poor adaptive capacity to climate change (Allen Consulting 2005).

Economic and trade impacts

Climate change will affect the level and volatility of agricultural product prices, both locally and internationally. The magnitude and direction of climate change on production levels and prices will vary from region to region and between crop types and enterprise types. Box 1 summarises multiple factors potentially affecting crop yields across the globe and, thereby, potentially prices.

In addition to effects on crop yields, climate change is also expected to increase sea levels and the acidification of surface layers of the ocean with potentially significant adverse effects on food production over the coming 100 years. Climate projections also indicate an increased frequency and intensity of extreme weather events, which can have significant economic and trade implications. Areas that could be especially affected include:

- the Mekong Delta foodbowl which is important to Asian communities, and
- the Bangladesh foodbowl which is important to the Indian Subcontinent.

Working Group III of the IPCC's Fourth Assessment Report (AR4) has undertaken a major review of the potential impacts of climate on global agricultural output. The review confirms that the picture is a complex one, with output varying significantly from system to system, region to region and temporally (Easterling et al 1996). Nevertheless, a general view of the impacts of climate change on crop and livestock yields and forestry production emerged from its analysis. In particular, livestock and crop productivity was expected to increase in the high latitude areas of the Northern Hemisphere and decrease in tropical and mid latitude areas. This conclusion is based on projected changes to 2050 and

draws on wide range of literature and expert judgement. However, it assumes that no adaptation takes place.

Box 1: Climate change factors affecting crop yields across the globe

Depending on present conditions, global warming and CO_2 enrichment can have positive or negative impacts on agricultural production and hence world prices. Simulated yield increases in the mid and high latitudes are caused primarily by:

- Positive physiological effects of CO_2. At sites with cooler initial temperature regimes, increased photosynthesis more than compensates for the shorter growing period caused by warming, as long as other factors such as water availability do not limit growth.
- Lengthened growing season and amelioration of cold temperature effects on current growth. At some sites near the high-latitude boundaries of current agricultural production, increased temperatures can extend the frost-free growing season and provide regimes more conducive to greater crop productivity.

The primary causes of decreases in simulated yields are:

- Shortening of the growing period. Higher temperatures during the growing season speed annual crops through their development (especially the grain-filling stage), potentially causing less grain to be produced.
- Decrease in water availability. This is due to a combination of increases in evapotranspiration rates in the warmer climate, enhanced losses of soil moisture and, in some cases, a projected decrease in precipitation in the climate change scenarios.
- Poor vernalization. Vernalization is the requirement of some temperate cereal crops, e.g., winter wheat, for a period of low winter temperatures to initiate or accelerate the flowering process. Low vernalization results in low flower bud initiation and ultimately reduced yields.

Source: Marsden Jacob Associates 2007 (unpublished).

Economic modelling of the impacts of climate change on agricultural crop yields suggests that world prices overall will increase, with a decline in welfare in all regions – with gains in producer surplus being more than offset by losses in consumer surplus (Tsigas et al 1999). Unfortunately, it too did not take account of adaptation.

As Stern (2006) notes, how climate change ultimately affects production and world agricultural trade and prices will depend critically on the degree of adaptation, which itself will be influenced by income levels, market structure and farming types.

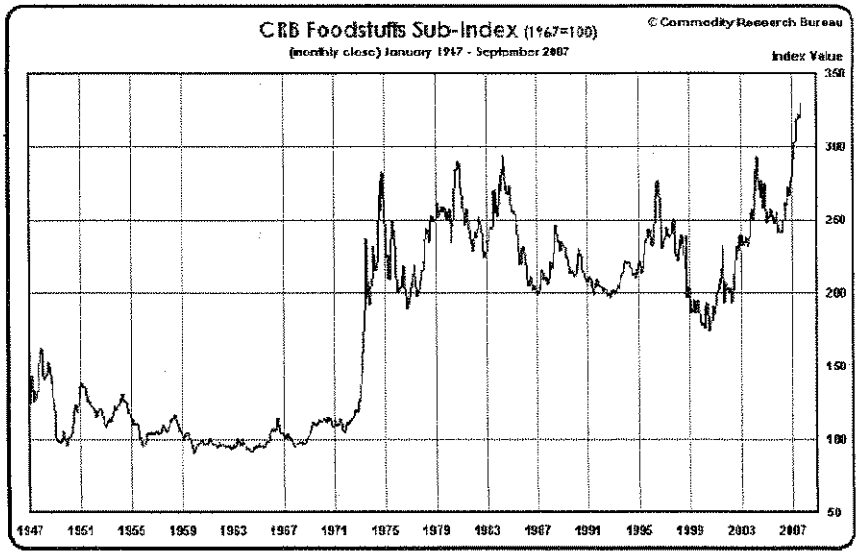
Further, other forces will have substantial impacts on the global demand for and prices of agricultural and forestry products. In the last year or so, there has been an underlying trend of higher world agricultural commodity prices. Prices are now at an all time high (Figure 2), particularly influenced by the demand for agricultural goods from China.

Whether Victorian agricultural businesses can benefit from a continuation of this trend, quite possibly accentuated by the global impacts of climate change, will be determined by the impacts of climate change on systems here, policy responses here and overseas, and the degree of adaptation. It is worth noting that the recent drought in Australia has restricted many Australian farmers from fully realising the opportunities from the recent boom in world commodity prices, especially in grains and dairy.

There has been little research conducted on the economic impact of climate change on the forest industry. Policies to mitigate climate change overseas, however, could restrict the supply of timber from some of Australia's competitors. For example, the recent 'Bali Action Plan' agreed at the thirteenth UN Conferences of the Parties, included a commitment to 'reduce emissions from

deforestation in developing countries' (UNFCCC 2007). This could present an opportunity for the forestry sector by reducing the global supply of timber and placing upward pressure on timber prices.

Figure 2: Global Trend in Food Commodity Prices



Source: Marsden Jacob Associates 2007.

It is also likely that the competitiveness of timber products will increase relative to its substitutes in a carbon-constrained environment given many substitutes are far more greenhouse intensive to produce. For example, the manufacture of aluminium, steel and concrete releases 270, 23 and 1.3 times more carbon per tonne respectively than timber (FWPRDC 2004).

An ability to supplement traditional revenues from wood products with revenue from carbon sequestration could increase the profitability of forestry businesses. However, if the Australian forestry industry is not subject to rules compatible with international protocols, then opportunities may be more limited. The competitiveness of Australian forestry may also be adversely affected to the extent other countries implement emissions trading schemes (ETS) including forestry and Australia does not. For example, as of 1 January 2008, the NZ ETS will commence, and the NZ forest industry will be able to generate additional income from Kyoto-compatible carbon offsets. As a result, NZ softwoods could potentially gain a competitive edge while Australian forestry remains outside a domestic ETS.

Policy impacts

Both the Australian and Victorian Governments have a number of policy commitments to tackle the challenges of climate change. The Victorian Government's 2006 election statement, for example, '*Tackling climate change – Helping Victoria play its part*', included a commitment to a target of reducing Victoria's greenhouse gas emissions by 60 per cent by 2050, based on emission levels in 2000. A similar target has been adopted by NSW and South Australia and was reflected in the new Australian Government's 2007 election commitments. Governments in other countries also have a range of policy commitments. These commitments and associated policies can have substantial impacts on agriculture and forestry businesses, directly and/or indirectly.

Some domestic policies, for example, may directly impact on the agriculture and forestry sectors by mandating mitigation targets, including the sectors in emission trading schemes (as a source and/or a sink), or supporting research and development activities. Other domestic or overseas policies may affect Victorian farming businesses indirectly through impacts on market prices. For example, the decision of the US Government to promote biofuels (albeit for the purpose of energy security rather than emissions reduction) is a policy risk for Australian farmers originating in another country. This policy diverted grain production away from food to fuel leading to substantial upward pressure on

grain prices. This benefited Australian wheat growers but adversely affected dairy farmers and feed lotters who purchase grains to finish cattle for market.

High level domestic policies with potentially substantial impacts on agriculture and forestry businesses include the Australian Government's and State and Territory Government commitments to introduce a national ETS by 2010; and Australia's formal ratification of the Kyoto Protocol.

The commitment of the Australian Government and State and Territory Governments to an emissions trading regime is likely to:

- indirectly impact on agriculture and forestry businesses through affects on energy prices and transport costs, and the cost of inputs which require considerable energy for their production such as fertiliser; and
- directly impact on agriculture and forestry businesses if they are included in the scheme.

Australia's ratification of the Kyoto Protocol adds another dimension to Australia's policy response. In particular, it provides opportunities for abatement technologies and practices developed for primary industries to be exported to other developed countries (*Kyoto's Joint Implementation Mechanism*) and/or developing countries (*Kyoto's Clean Development Mechanism*) to generate national carbon credits.

Significant Kyoto Articles for the agriculture and forestry sector include:

- **Kyoto Article 3.7**: recognises carbon sequestered by growing forests. This article includes emissions arising from the clearing of native forests.
- **Kyoto Article 3.4:** recognises carbon stock changes due to additional human-induced activities in agricultural soils and the land-use change and forestry categories, to be used to meet emission reduction targets. Eligible activities include 'forest management', 'revegetation', cropland management and grazing land management. There are significant technical and logistical barriers, however, to accurately account for soil carbon stocks and flows across diverse agricultural landscapes. Australia rejected adoption of this Article in 2001 for calculation of its national inventory, due to a concern that it would incur a net liability (Keogh et al 2007).
- **Kyoto Article 3.3:** outlines the rules for afforestation and/or reforestation of pre-1990 cleared agricultural land. The Commonwealth Government has focused on forest sink activities, as covered in this article, to define eligible offsets for its proposed national ETS. A number of forestry companies have already registered and sold forest carbon offsets through the NSW Greenhouse Gas Reduction Scheme (GGAS) and the Australian Greenhouse Office (AGO) Greenhouse Friendly scheme.

DPI is undertaking research into the economic, environmental and social impacts of different government policies related to adaptation and mitigation by agriculture and forestry businesses. As part of this, DPI is committed to undertake a review of how agriculture and forestry could be included in a domestic ETS.

Some analysis has already been undertaken, including a study by Hatfield-Dodds et al (2007), which modelled the impacts of an ETS on agriculture, when only the stationary energy sector is included. It estimated that the ETS impacts on farm input costs would be relatively modest in the short term with:

- real increases above inflation of 5% for petrol and 10% to 15% for diesel over 20 years, based on a carbon price range of $40 to $50 per tonne; and
- a similar increase in fertiliser costs pushing up farm input costs by less than 3% above inflation by 2025, ignoring improved farm practices or changes in farm input mix used as relative prices change.

However, much more analysis is required. The more energy intensive sectors of broad cropping and dairy, whose net energy consumption accounts for over 40% of their input costs, will be more exposed

to the imposition of a carbon price than others. These increased input costs for the dairy and broad acre cropping could reduce their export competitiveness, unless their major international competitors face similar policy settings or increased input costs (Hatfield-Dodds et al 2007).

The Victorian Office of Climate Change (OCC) and DPI are currently making headway on these and other related climate change issues. For example, the OCC has commissioned research work into the possible impacts of domestic climate change policies on Victorian regions and key sectors. This information should help expand the knowledge available on the nature and scale of such impacts for agriculture and forestry businesses.

The OCC and the Department of Industry, Innovation and Regional Development (DIIRD) have also undertaken a preliminary analysis of the potential impacts of the policies of governments from other countries on Victoria's key export sectors. They concluded that there were unlikely to be substantial impacts in the short term, but that this would change if global agreements or unilateral actions were to step up. DPI has a range of work underway, including research into the resilience of agricultural businesses in selected industries under various carbon price scenarios. DPI is also leading six key projects under the Victorian Climate Change Adaptation Program (VCCAP), including the development of a number of future farming systems scenarios and modelling the impacts of climate change on land suitability for various agricultural production systems (see Part C).

Part B: Key messages

This part outlines a number of key messages DPI would like to make to assist the Garnaut Review. These messages relate to:

- impacts and opportunities climate change presents for agriculture and forestry in Victoria;
- appropriate roles for government in responding to climate change;
- adaptation issues and policies; and
- mitigation issues and policies.

One overarching message is that it is critical that the development of climate change policies is undertaken within a strategic framework that is comprehensive, consistent, integrated, has a long-term focus and includes the consultation of stakeholders that may be affected. Such a framework needs to consider the nature and extent of the challenges facing business, governments and individuals, the appropriate roles of government and the private sector, alternative policy instruments and mixes of instruments, the costs and benefits of action/inaction, and the need for consultation, evaluation and review.

Agriculture and Forestry Sector Impacts

From a policy perspective, some of the key points to note in terms of impacts are that:

- Climate change is but one of several factors that will drive changes in the agriculture and forestry sectors over the next decade and beyond. These need to be considered holistically along with climate change in developing appropriate policies. Others factors include:
  - growing competition in product markets;
  - growing competition for resources, including water and labour;
  - demographic changes and in particular the ageing profile of farmers in Victoria (over 56 years on average);
  - the changing demand and supply of capital resources, including expanding demand for capital to achieve economies of scale, and new sources of capital such as superannuation funds and international investors;
  - new technologies and practices; and
  - expanding consumer and community demands and expectations (including new product demands, and improved animal welfare and environmental performance).
- Extensive agriculture and forestry enterprises are heavily climate dependent and have been identified as the second most at risk sector in Australia, after biodiversity (Allen Consulting Report 2005).
  - Even intensive agricultural producers, which are shielded from most direct impacts of climate change on their production systems, rely on purchased fodder crops and young animals sourced from pasture-based extensive farm systems and are, therefore, at risk from the wider impacts of climate change.
  - ABARE (2007b), for example, projected that Victoria's dairy farm sector output could decline by around 4-5 percent by 2030 and by 10 percent by 2050 compared to the reference case, in the absence of any adaptation. (These projected falls in production were due to the direct impacts of climate change on Victorian dairy farm productivity, as well as indirect impacts of climate change on reduced global economic activity. This analysis did not discuss impacts on prices or profitability.)

- Increased climate variability, which implies an increased frequency and intensity of extreme climatic events, is likely to pose a greater threat to many agriculture and forestry businesses than anticipated changes in average temperatures (ABARE 2007a). This is due to its combination of greater unpredictability coupled with increased intensity of natural disasters e.g. fire, flood, drought and disease. An important issue for farmers is their capacity to recover from extreme climate-related events such as droughts, floods and fires.
- These sectors may be substantially affected by climate change policies introduced in Australia and overseas, and changing global commodity prices, which can have more immediate, and possibly more significant, impacts for agricultural businesses than many long-term biophysical changes. These impacts can be favourable as well as adverse.

Role of Governments

In many cases, markets will operate efficiently and private agents in the agriculture and forestry sectors will be best placed to handle decisions about investment, production, distribution, risk management and many other actions. However, in some cases markets can 'fail' to function in an efficient way or can result in socially undesirable outcomes. In these cases, there may be a role for government intervention, provided that the benefits of such intervention exceed the costs.

Key points to emphasise include:

- Governments have important roles to play in responding to the mitigation and adaptation challenges of climate change due to:
  - Market failures arising from:
    - the global externality associated with greenhouse gas emissions where private sector activities cause problems for the wider community that individual enterprises do not take into account, so that their level of production is excessive from a social viewpoint. This externality includes an inter-generational externality as the actions of current generations will affect those of future generations;
    - public good characteristics or the complexity of some information which can inhibit a proper functioning market. This can result in (i) consumers making suboptimal choices or responding inefficiently to price signals and (ii) producers making suboptimal choices given their preferences to voluntarily mitigate, adapt efficiently, and participate in carbon markets or other opportunities. Of critical importance is the provision of information on the impacts of climate change which displays public good characteristics.
    - public good characteristics associated with research and development (R&D) where private enterprises may be unable to capture the benefits from an R&D investment because the results cannot be restricted from competitor access such that private agents and businesses tend to under-invest in R&D.
  - Policy impediments where existing government policies no longer enhance community welfare or impose unnecessary costs:
    - Of particular relevance are impediments to economic and social adaptation and adjustment. Governments need to ensure policies and institutional arrangements for water management and drought assistance, for example, achieve government goals in these areas while encouraging efficient resource use and adjustment. Ensuring water markets are efficient is pertinent in this regard.
    - Other policies and programs aimed at addressing market failures may need to be re-evaluated, such as research and development policies and programs

(which might need to be recast in terms of focus and scale), regulatory arrangements which will need to remain relevant and least cost, capital investments which need to include greenhouse (GHG) considerations and service delivery which needs to remain at best practice.

- Government's ownership or control of numerous public infrastructure assets, such as roads, railways, ports and other assets such as school and university buildings.
- Equity objectives where the community seeks to protect those that may suffer unacceptable harm and where existing safety net arrangements are inadequate.

- Governments do not have responsibility for businesses adjusting to climate change impacts outside the above mentioned areas. Climate change involves a business risk and, as such, businesses are best placed to manage these risks as they relate to their own individual operations. This can include the risk of asset appreciation or depreciation as well as changes to annual revenues.
- Government's responses to climate change should be:
  - predicated on evidence of market failure or other circumstances noted above;
  - designed so as not to unnecessarily crowd out private sector responses or create perverse outcomes or incentives;
  - technology neutral to ensure the market determines the best and least cost path;
  - equitable in their treatment of businesses in different industry sectors, regions and communities;
  - based on the use of the most efficient, effective and equitable instrument or mix of instruments available which will often involve flexible market based instruments (eg a national emissions trading scheme) and complementary measures such as information programs;
  - cognisant of the share of private and public benefits from an action, and involve cost sharing arrangements so that the contribution by different parties align with the benefits that flow to them; and
  - introduced after careful assessment of the costs and benefits where social, environmental and economic affects are considered, including associated transaction costs. Assessing the broad costs and benefits of possible actions may require the use of several evaluation techniques, such as cost-effectiveness analysis, formal Cost Benefit Analysis, risk assessments and multi-criteria analysis. When required, selecting an appropriate discount rate should be done carefully, and its use and reason for selection made transparent (see, for example, a report released by the Productivity Commission (Baker et al 2008)).
- Policy levers designed to deal with climate change and greenhouse gas emissions will need to deal with a significant degree of ongoing uncertainty regarding the future operating environment for Australia, including uncertainty over:
  - economic, social and environmental impacts from the projected increase in frequency and intensity of extreme climatic events eg fire, flood, storm and drought;
  - the pace and extent of changes in average temperature, rainfall, water availability and sea level rise;
  - technologies available for mitigation and adaptation;
  - the nature and extent of the response to climate change and greenhouse by industry and the wider community;
  - international climate change policy; and

- changes in global trade flows arising from the impacts of climate change policies and biophysical changes in Australia and overseas.

- Government actions will be especially important in developing improved diagnostic capabilities around predicting extreme climatic events, as well as working with industries and communities to assess possible impacts (eg drought for Mallee-Wimmera and flooding in the Thomson Catchment, East Gippsland).
    - The Victorian Government's Water Plan, for example, aims to enhance the resilience of Victorian agricultural and rural communities by (among other things) helping to identify threats to water supplies.
    - It will be important for governments to effectively communicate climate change information to relevant parties. To assist in achieving this goal, DPI is investigating the use of 'visualisation technology' to bring together information on the biophysical, social and economic aspects of climate change. The Victorian Government's Water Plan also involves the communication of the long-term water situation to local communities.
- Climate change policies for the agriculture and forestry sectors should be integrated and coordinated with other Government initiatives on issues such as water use, ecosystem services, environmental management systems and land use planning.
    - This includes taking into account environmental impacts of increased land use change and multi-benefit considerations, as new markets develop for carbon and other ecosystem services.
    - A systematic approach to abatement will reduce the risk of pollution swapping where one environmental issue (eg improved irrigation water use efficiency via pressurised water distribution systems on farms) is improved only at the cost of increasing another (eg increased CO2 emissions from the energy used to pressurise water).
- Transitional approaches can be useful, and the approach proposed in Issues Paper 1 is worthy of further consideration.

Adaptation considerations

Adaptation by agriculture and forestry businesses will be critical. Several broad observations can be made including that:

- A risk-management approach will be central to adaptation responses. Adaptation responses to climate change largely involve Government responding to public and community risks, and primary producers responding to their identified private risks.
- Adaptation in agriculture and forestry needs to be business driven reflecting the full set of variables impacting an enterprise's profitability. Key observations are that:
    - Farm level strategies for adapting to climate change will be important and could include:
        - *Cropping sub-sector*: diversification of crop varieties; species change; shifting planting seasons; changing crop management practices such as spacing, tillage and rotation; nutrient, erosion and salinity management; moisture conservation; pest management; and taking advantage of seasonal forecasting (Howden et al. 2006). Crop varieties and regimes with low water use intensity, such as hydroponic vegetables and native grasses, may become increasingly viable, particularly in the marginal areas.
        - *Livestock sub-sector*: changing livestock breeds; managing heat stress in animals by increasing shade and water provision; responding to increasing

costs of inputs (eg purchased water and fodder) by improving the irrigation systems and feeding efficiencies; managing pasture productivity, pests and disease. Another risk management strategy is to operate farm enterprises across a range of climate zones (eg cropping north and south of the divide).

- *Irrigated sub-sector*: improving water use efficiency and water trading (Beare and Heaney 2002).
- *Forestry*: Changes in rotation periods, hardwood/softwood species mix, salvaging residual wood and landscape planning to minimise fire and insect damage (Howden et al 2007). Other approaches include thinning and fertilisation regimes to minimise drought losses, control burning and debris management.

- Productivity gains and efficiencies across whole-of-supply chains can help keep businesses profitable under circumstances of rapidly changing global trade, policies and climate.
- Adaptive capacity can be enhanced through synergies between forestry and agricultural land uses. For example, shelterbelt tree planting can reduce heat stress for livestock and climatic exposure for pastures and crops, and tree canopies can provide a feed source for livestock during the summer months and drought conditions, usually as a last resort.
- Financial strategies can play a critical role and can include purchasing from a diverse range of available income protection products (eg storm damage, crop failure, currency hedging etc), entering long term supply contracts (for inputs or final outputs), buying or selling options or futures contracts (where such markets exist), using lease arrangements or the more strategic use of Farm Management Deposits.
- Resource management will be critical, especially efficient water management. Water trade strategies, and efficient water use technologies and practices, can make a contribution in this regard. Integrating these strategies with whole-of-farm management, including the management of other resources such as labour and fertilisers, and the value of outputs, will be important. Appropriate approaches will vary across businesses.
- Other responses can include retiring land from active production, switching to alternative farm production systems (eg broad acre cropping to range land grazing), diversifying or specialising farm production, diversifying into off-farm employment, investing in non-farm assets or exiting the agricultural sector.
- Adaptation should include developing enhanced emergency response capabilities where relevant to manage the increasing frequency of extreme climatic events.

- The effectiveness and efficiency of adaptation strategies by businesses will vary across regions, agricultural activities, as well as over time. A key aspect of adaptation is that it has to be applied at a local level or scale.
- Although Victoria's agricultural businesses have shown considerable capacity to adapt to climate variability, adjustment capacity and the resilience of businesses, and thereby industries and regions, varies.
  - DPI has recently commissioned a study on the resilience of agricultural businesses to various climatic change scenarios as part of the Victorian Climate Change Adaptation Program (VCCAP). The results of this study should be available around March 2008.
- Adaptation options will increase over time as innovation and new management practices and technologies emerge.
- Some adaptation activities might increase emissions while others reduce them.

- Shifting to no or low till agriculture, for example, may increase reliance on agricultural chemicals which might be emissions intensive to produce.
- Adaptation could include cultivating and selling carbon sequestering products. This could be used to offset an agricultural business's existing emissions (if included in the covered ETS sector), or to diversify its income stream.

- Forestry businesses face distinct adaptation challenges. In particular, forestry plantation management has long-term planning horizons and early attention to the impact of climate change impacts is needed to maintain the viability and profitability of forestry businesses.
  - Native forest may have more limited adaptive capacity than exotic species although planning and human intervention may help ensure native species survival. Some native Eucalypt species have a very narrow climate range and are considered highly vulnerable to climate changes (Allen Consulting 2005).
- Governments can play a role in reducing impediments to business-driven adaptation (as discussed on pp. 12-15).

Adaptation (and mitigation) is likely to involve structural adjustment

- Structural adjustment is a normal economic process. Structural adjustment can build profitable, efficient and sustainable businesses that are responsive to markets, embrace change, deal self-reliantly with risk and are innovative.
- Climate change will accelerate the rate of rural adjustment, especially for those businesses and regions which are more exposed to its impacts.
  - The impacts of increasing climate variability, including greater frequency and duration of extreme climatic events, may be hard for primary producers to adequately prepare for and recover from.
  - While rapid and unanticipated structural adjustment may be difficult for individual farmers and regional communities to manage, the long term effect of such adjustments can still be beneficial for individuals and communities.
- There are also opportunities for agriculture and forestry businesses due to climate change and making the most of these can help businesses adjust. These include spikes in rural commodity prices on global markets, new varieties for Australia, shorter time to market due to changed growing conditions, improved crop yields due to the CO_2 fertilisation effect (assuming adequate soil moisture and nutrients), and entering new markets that can provide carbon mitigating products such as some biofuels and sequestration.

In general, businesses adaptation to climate change would benefit from:

- Further research on the possible impacts of climate change, including biophysical impacts, economic and trade impacts, and the impacts of domestic and overseas policies.
- Drawing on existing best management practices being deployed in agricultural and forestry production systems to cope with climate variability and extremes across Australia:
  - Government along with the private sector can play a role in disseminating both new R&D and existing best practice knowledge.
- Collaboration across agricultural industries involving an integrated and systematic approach to climate change (ie livestock/cropping/dairy/horticulture):
  - Industry groups and governments could play a useful role in facilitating such collaboration, as previously demonstrated in responding to salinity issues in Victoria.

- Consideration of the conversion of biomass from agricultural enterprises into a variety of alternative energy sources such as biofuels or bioenergy (both thermal and electrical).
- Growth in their skills and knowledge of climate change and its potential impacts.
- Using risk management approaches to better explore, understand and manage enterprise risks (including biophysical, market and policy risks):
  - Greater use of existing and emerging software that forecasts climatic conditions, optimises sowing times, and assesses risk in relation to various climatic scenarios.
- Diversification of on-farm/forest income sources.

Mitigation considerations

Victorian agriculture is a significant emitter of greenhouse gases and needs to play its part in reducing emissions

- Enteric methane emissions from ruminants, which accounts for around 76% of Victorian agriculture's total greenhouse gas emissions, is clearly an abatement priority for the sector.
- Nitrous oxide emissions from soils, animal dung and urine, nitrogen fertiliser and manure management account for about 20% of Victorian agriculture's total emissions, and could materially contribute to mitigation for the sector.
- The potential for agriculture in Victoria to mitigate biological emissions associated with livestock and soils varies across businesses, and will require a change in practices or technology which in most cases will involve extra costs. In terms of technical opportunities:
  - Eckard (2007) considers that the Victorian dairy farm sub-sector could reduce its emissions intensity by up to 20% for both methane and nitrous oxide by 2020, if all available mitigation technologies were widely adopted on-farm.
  - In the cropping and horticulture sub-sectors the adoption of best management practices for fertiliser application coupled with minimum till, stubble retention and precision agricultural practices, could reduce their emissions of nitrous oxide by about 10% over the next decade.
  - Fertiliser best management practices targeting nitrous oxide emissions and nitrate leaching have been developed in Victoria and adopted by Fertcare, the national industry body in Australia.
  - Abatement technologies for nitrous oxide from grazed pastures have been developed and commercialised in New Zealand.
  - There are numerous opportunities available to the forestry sector to reduce emissions from its harvest operations. Activities to reduce soil disturbance such as the use of 'chording and matting' to protect soil during harvest, optimisation of transport routes, increased fire protection activities, and in-coupe residue management can all help reduce emission from forest operations.
  - Increasing the levels of carbon-rich organic matter in agricultural soils, via diverse farm management practices, including stubble retention, manure spreading and the application of agri-char (activated charcoal), can contribute to enhanced soil moisture retention and cropping productivity, as well as elevated levels of soil carbon sequestration (DPI 2006). However, accurately assessing soil carbon sequestration levels across broad acre landscapes remains a technically challenging and costly exercise.

- As noted above, the adoption of technologies or practices to reduce emissions will often involve additional costs. Therefore, while technically feasible, it may not be financially sensible for a business to adopt them. Introducing a carbon price (including all GHGs) would increase the incentives for a business to adopt such technologies and practices. However, some may remain uneconomic with on-farm offset activities (such as planting trees for sequestration), or the purchasing of offsets from other providers, potentially a more efficient response.
- Even after all existing and planned methane mitigation technologies have been implemented there are still likely to be substantial emissions attached to the livestock industry's outputs of dairy, wool, and meat production.
- Governments can play a role in promoting mitigation practices via information provision, support for R&D and incentives such as carbon pricing (see pp. 12-15).

Agriculture can also play a role by sequesting carbon, particularly in plants and soils, but farmers need to be aware of the costs as well as the benefits of offering sequestration products

- Plant-based sequestration can involve growing plantations, crops and/or native vegetation. This can give rise to the creation of offsets for the purposes of carbon trading as part of a future ETS or for voluntary offset schemes. This could include earning credits from 'permanent' vegetation sinks, or the conversion of biomass into biofuels for transport or bioenergy for the stationary energy sector. In the latter case, while credits may not directly accrue to farmers they may benefit from increased demand for their products, if transport and energy businesses earn ETS credits for any net sequestration achieved (acknowledging this may sometimes be modest given fertiliser and transport inputs).
  - There are some limitations, however, on agriculture's ability to earn plant sequestration offsets in an ETS based around Kyoto due to the verifiability and permanence of the offset. Such obligations and transaction costs may reduce many producers' willingness to participate, although there are methods of aggregating offset activities across farms which could make participation more cost effective.
- Soil sequestration presents potentially substantial opportunities by increasing the annual rate of carbon uptake in soil structure per hectare. However, it is more difficult to monitor and quantify than plant-based sequestration and has not been included in Australia's national greenhouse inventory for Kyoto accounting purposes. It should also be noted that:
  - The potential of some soils to sequester carbon is limited, and is influenced by factors beyond the control of the land manager such as clay content (Skjemstad 2006).
  - Soil carbon can take a long time to sequester, and is also easily reversed if soil conservation activities are discontinued.
  - Despite the above, the Chicago Climate Exchange has developed protocols and provides offset credits for farmers who implement soil best management practices, such as minimum till.

Opportunities for private forestry businesses to sequester carbon are more established

- The private forestry sector can play a significant abatement role as a permanent carbon sink. Net afforestation of previously cleared agricultural land (pre-1990) in Victoria makes a significant contribution to reducing the State's net annual greenhouse gas emissions. However, under the Kyoto Protocol, carbon storage in wood products is not recognised, and offsets can only be generated by a net increase in the area of permanent forest estate:

- If carbon storage in wood products were to be recognised as a legitimate reservoir of carbon, commercial forest owners could potentially claim offsets for each successive harvest cycle and substantially increase the defined carbon pool being offset.

- The ability to trade forestry offsets in an ETS is constrained by a number of factors, in addition to the non-inclusion of carbon storage in wood products. These include:
  - the long term maintenance and monitoring requirements (currently around 70 – 100+ years under the AGO Greenhouse Friendly scheme and NSW Greenhouse Gas Abatement Scheme);
  - the relatively high cost of monitoring, verification and legal requirements;
  - liabilities associated with a loss of forest carbon due to fire or other disturbance and the complexity of forest carbon accounting methodologies;
  - transaction costs which may be prohibitive for farm foresters and other landholders with relatively small amounts of carbon to sell. Methods to aggregate or 'pool' carbon offset activities across farms, however, can make participation more cost effective;
  - the need to comply with Kyoto's 'additionality' criteria (as is required under the AGO's *Greenhouse Friendly Scheme*), which may be a potential barrier for some private plantation companies; and
  - a shortage of suitable land in Victoria for commercial carbon sinks. Victoria's prime areas for plantation forestry are those with a higher than average rainfall (over 600mm) and fertile, well drained soils, which are also prime agricultural landscapes.

- Some Victorian forestry growers are already playing a role in curbing climate change through voluntary carbon trading and are gaining the financial benefits of trading carbon generated from their forests. This is occurring through a voluntary market which has emerged to connect carbon-conscious growers with businesses and rural landholders to offset carbon. However, there are some consumer concerns over the credibility of sequestration products in the voluntary market given the absence of a clear governance regime (Campbell 2007).

- Supplementary revenue from selling carbon offsets might allow commercial plantations to be established in areas previous considered marginal or unviable. Otherwise, permanent carbon sinks, using native vegetation and forestry, may be more attractive in these marginal agricultural landscapes.

Policies to facilitate mitigation in the agriculture and forestry sectors need to be carefully assessed, designed and implemented

- Governments need to develop a package of policy measures for the agriculture and forestry sector to respond to its greenhouse externalities (both positive and negative) in the most efficient, effective and equitable manner. Given the diversity of agricultural and forestry systems, their diffuse emissions sources and potential sequestration sinks, no single policy instrument could fully address the mitigation challenges for these sectors.

- The optimal set of policy instruments in response to the mitigation challenge for agriculture and forestry will be those that best meet the key criteria of efficiency, effectiveness and equity. Policies more likely to fulfil these criteria are those that are:
  - linked to a clear and accepted purpose, eg reduce national emissions by 60% by 2050;
  - flexible and adaptive to changing circumstances, eg abatement technologies, market conditions;
  - measurable and enforceable against defined performance standards;
  - designed to be least cost to the economy;

- transparent and understandable to all relevant stakeholders;
- a good fit with existing management approaches or can be adopted without excessively expensive changes;
- non-distortionary in resource allocation between businesses in agriculture and forestry or between sectors in the economy. Cross-sectoral efficiency would be maximised if all sectors faced the same marginal cost of abatement; and
- well targeted - if they offer welfare assistance in regard to mitigation they should (i) target individuals not businesses or industries and (ii) not reduce incentives for abatement.

- The principle that abatement must be achieved via least-cost means is of critical importance not only for economic efficiency, but also for sustaining industry and community support for abatement efforts in the long term.
- There is a need to account for early action and to avoid perverse incentives to increase emissions prior to inclusion in an ETS or other scheme. This can be assisted by using recent, but prior baselines preferably on a multi-year average to avoid yearly distortions due to climatic extremes.
- Carbon markets may need to be complemented by creating markets for other ecosystem services, or use of alternative policy tools (such as regulations, taxes or subsidies), to avoid potentially perverse outcomes where efforts to reduce emissions have adverse affects on other environmental services. An example could be the encouragement of forest plantations via a carbon price which may then substantially reduce water availability in streams.
    - The Victorian Government's *EcoTender Project* is an example of the creation of an ecosystem market which aims to delivers multiple environmental benefits at the local and landscape level, including improvements in salinity, biodiversity, carbon and water quality.

Including forestry in an ETS can have major benefits

- Including forestry in an ETS can reduce the overall abatement costs of meeting emission reduction targets, improve the products tradable in an ETS and, at least in some cases, achieve other environmentally beneficial outcomes.
- Including forestry offsets within an ETS could bring significant benefits for Victoria's forest sector, which has the largest area of plantations (over 395,000 ha) of any Australian State or Territory; a significant proportion of which are 'Kyoto-eligible' (ie planted post 1 January 1990). As other countries begin to include forests within their domestic ETS (eg: New Zealand), the competitiveness of Australia's forestry sector may decline if it remains unable to realise its potential carbon sink revenues.
- Recognition of wood products as a carbon sink in a domestic ETS would benefit Australia's forestry and forest products sector by allowing carbon offsets to be generated with each successive harvest cycle and providing incentives to substitute timber for more emissions intensive alternatives in residential buildings, furniture and construction.
    - This would, however, require an understanding of the full life cycle analysis of the timber production supply chain.
- The Australian Greenhouse Office has developed the FullCAM model to assist forest managers in accounting for carbon stock changes in their forests. This software, together with routine forest inventories, may provide sufficient metrics to underpin the forestry sectors participation in an ETS.

- DPI (2007a) has prepared a fact sheet to inform tree growers of some of the basic opportunities and obligations regarding the selling of carbon offsets, and provide links to other information sources.

Including agriculture in an ETS has its benefits but there are several practical impediments

- The dairy, beef, wool and sheep meat sub-sectors have greater potential for ETS inclusion than other sub-sectors, because they account for over 80% of total agricultural emissions. In stark contrast, the GHG emissions from Victoria's grains and horticulture sub-sectors accounted for just 5% of agriculture's total annual emissions.
- In principle, the inclusion of agriculture's major livestock emitters in an ETS is advantageous as it expands the sectoral coverage of any scheme with resource allocation benefits across the economy. In particular, its inclusion would:
  - increase farmers' incentives to invest in on-farm emissions abatement;
  - provide farmers' with the potential ability to sell offsets; and
  - reduce the abatement burden carried by those remaining industries which are included in an ETS, including expanding the opportunities for mutually beneficial trading of permits and offsets.
- However, agriculture's inclusion in a domestic ETS could generate substantial transaction costs, if not designed and implemented well, due to the diverse and dispersed nature of its biological emissions The main difficulties arise because:
  - there are over 130,000 (>30,000) farms in Australia (Victoria), each with their own unique production systems and emission profiles;
  - reliability of standard emissions estimation at the enterprise level is generally low for agriculture;
  - there are long time frames associated with changes in soil carbon stocks; and
  - information on current on-farm emissions is limited making it difficult to determine an accurate baseline and assess their notional carbon liability.
- The *National Emissions Trading Taskforce* and the *Prime Ministers Task Group* both omitted agriculture from their initial domestic ETS designs, but recommended its future inclusion once the technical issues of monitoring on-farm emissions are resolved.
- More research is needed to help overcome the barriers and uncertainties relating to agriculture's inclusion in a domestic ETS. This could include research to better understand the:
  - reasons for variation in the emission profiles of biologically-based farming systems;
  - carbon assets and liabilities across agricultural industries, regions and farms which could be associated with their inclusion in an ETS;
  - impact on the overall efficiency of an ETS of adding several thousand farm participants;
  - current level of on-farm emissions, and the costs and benefits of available abatement technologies, including trade-offs and leakage to other industries (eg farm chemical suppliers); and
  - marginal costs of abatement across agricultural production systems by region.

Further work will be required before agriculture can be incorporated in an ETS

- Resolving emissions measurement and compliance issues on-farm will be a priority to facilitate the implementation of appropriate policy instruments for mitigation. However, there are tradeoffs between the benefits of enhanced accuracy and associated costs – emissions measurement need not be 100% accurate for agriculture's participation in an ETS, and some uncertainty will inevitably remain.
- An on-farm emissions measurement and compliance system will be required to:
  - generate reliable on-farm emissions monitoring and reporting to comply with international standards;
  - provide agricultural emitters with adequate abatement incentives; and
  - underpin the integrity of agriculture's participation in an ETS.
- Farm-level implementation of an emissions measurement system, a pre-requisite for inclusion in any ETS, will be a trade-off between accuracy and cost:
  - A modelling tool, such as New Zealand's Overseer, can be easy to apply on-farm, but may blur distinctions between best practice and average mitigation performers, thus reducing incentives for operators at the upper margin.
  - A more complicated measurement tool may accurately capture differences in emissions mitigation between high and average performers, but may be both more costly and complex to apply at the farm-level.
  - The optimal measurement solution will ensure the benefits outweigh the costs.
- DPI is undertaking research, in collaboration with other public and private entities, on how to measure on-farm emissions from ruminants and agricultural businesses more generally, based on the use of:
  - calorimeters to accurately benchmark individual breeds under laboratory conditions;
  - laser measurement technologies to calculate the herd's emissions in the paddock;
  - life cycle analysis to better understand the carbon footprint of all on-farm production activities; and
  - a National Carbon Accounting System to accurately calculate all agricultural emissions at the landscape level across regions, states and the nation.

Agriculture is also trade exposed so a well designed policy package will be important

- Agriculture businesses could lose international competitiveness if included in an ETS. Much of the agricultural sector is trade exposed, with over 70 per cent of Australian agricultural output exported and input competition present for many manufactured food products (DAFF 2005).
- There are, however, a number of points that need considering when assessing the issues of trade exposure and implications for policy:
  - Not all agriculture businesses are likely to be included in a future ETS. Indeed, it may only target larger agricultural emitters, which exceed specified minimum thresholds for parameters such as business size, annual emissions or energy consumption totals.
  - Some of Australia's competitors are also imposing emission constraints on their businesses and, to the extent they do, impacts on competitiveness would be reduced.
    - This is particularly the case for the dairy industry where New Zealand is including agriculture in its ETS in 2013. Its dairy industry currently provides

over 40% of the world's traded milk products. Other large dairy producing nations include several EU member states, where emissions mitigation policies can have direct and/or indirect impacts on their costs of dairy production.

  - This is less likely, however, for the beef industry where Australia's major competitors are the United States, Brazil, India, Uruguay and Argentina.

- The impact on business competitiveness may not be as significant as it might appear because:
  - some Australian businesses would be able to benefit from selling offsets if included in an ETS;
  - many factors influence the competitiveness of Australian businesses, such as exchange rates, labour costs and skills, taxes and infrastructure costs, and these factors may be more important in determining competitiveness; and
  - businesses will be able to adjust and innovate, especially if adequate lead times are given.
  - consumers may express a preference for products from countries or companies with a lower carbon footprint and this could provide new opportunities for low emitting Victorian businesses. It will be important, however, that consumers are adequately informed given the complexity of measuring and reporting carbon footprints.
- The broader the coverage of an ETS and the more effective are complementary policies, the lower a carbon price will need to be to achieve Australia's emissions targets. This will reduce any effects on competitiveness in the agriculture sector.
- The risk that businesses overseas might gain a net competitive advantage is not of itself a reason to exclude agriculture from an ETS. Two important issues arise in relation to this: trade competitiveness impacts on Victorian businesses; and the potential for carbon leakage and increased global emissions (due to any offshore migration of production in response to the introduction of a domestic ETS).
  - In relation to possible trade competitiveness impacts on Victorian businesses, it is noted that Australia has committed to reducing its GHG emissions and it should do so at least cost to the community. Whether these costs are borne by businesses exporting or selling domestically is not important in its own right. It would only be a policy concern if there were greater efficiency losses to the economy or unacceptable social costs from adjusting export oriented businesses compared to domestic oriented businesses. As with general trade policy, Australian businesses must compete accepting world prices even though biophysical and policy differences exist (with the exception of anti-competitive conduct). That said, governments may have a role in providing some *temporary* assistance to emissions intensive, trade exposed businesses to help them adjust to a new policy environment where major competitors are not emissions constrained.
  - The potential for carbon leakage requires consideration of the need for and form of any domestic policy response. The potential level of carbon leakage from Australian agriculture needs to be assessed in the light of expected investment trends and policy settings which will impact on emission intensities of production in competitor countries, and which may mitigate or exacerbate the extent of carbon leakage over time. If a unilateral Australian ETS is expected to result in a material and inefficient agricultural relocation

of production from Australia and a net increase in global emissions, this may further justify interim protection.

- The inclusion of some agricultural businesses in an ETS would, however, add to the adjustment pressures such businesses face, and may lead to reductions in output and profitability if adaptation and ETS related opportunities are insufficient to offset additional costs. This of itself is not necessarily a problem as resources frequently move to where they are most valued.
    - However, business and community adjustment may be considered excessive in some circumstances (especially for smaller communities heavily reliant on the adjusting sector). This may occur as input prices and resources move in response to carbon prices or due to a substantial change in international competitiveness (as noted above). Measures to deal with these problems need to be carefully designed. Policies should be targeted at the specific problem identified, avoid breaches with international agreements, not compensate firms that are operating at below best practice levels of emission intensity for their industry more than others, allow market prices to direct adjustment and offer clear net benefits to the community. Financial assistance is generally best target at the effected individuals and their families, not the adjusting business entities.
    - Regional adjustment mechanisms should concentrate on general 'good governance' measures such as minimising barriers to new investment, employment or relocation, ensuring that public infrastructure (including transport networks) is appropriate and that markets are working efficiently, including input markets (such as for labour and water).
    - Setting appropriate lead times could assist businesses to prepare for inclusion in any ETS. As noted above, practical constraints related to measurement and verification would need to be resolved before agricultural businesses could be included.

- Given the trade exposure of many agricultural businesses, it is particularly important that mitigation policies are well designed, and that market failures and government impediments to adjustment are dealt with promptly and properly.

Policies other than an ETS need to be used to achieve mitigation

- If the inclusion of an agricultural sub-sector, or business within a covered sector that falls below a given threshold, remains too difficult or is assessed to be sub-optimal in terms of policy choices, alternative policies should be considered. Ideally, the overall affect on resource allocation of these alternative policies would be similar to that which would occur under an all inclusive ETS which treats sectors equally. Alternative policies could include:
    - minimum emission standards (eg nitrification inhibitors for cattle urine);
    - subsidies or tax rebates to facilitate the adoption of best practice abatement on-farm;
    - flat rate or differential carbon taxes, which reflect:
        - average emissions per unit of output, eg milk, beef or sheep meat;
        - per head of livestock by breed within species;
        - different classes of land use, eg broad acre, pasture-based or intensive;
    - mandatory farm level mitigation plans; and
    - industry codes of practice.

- Complementary policies will be needed, regardless of whether agriculture is included in an ETS or not, to respond to other market failures and satisfy other roles for government. Examples include:
  - information dissemination to enable primary producers to make informed choices regarding abatement technology; and
  - government co-investment with industry into R&D and extension to identify and commercialise cost-effective agricultural abatement technologies.

Part C: Victorian Government's Policies and Programs

The Victorian Government has a number of policies and programs to respond to the challenges and opportunities of climate change, and support agriculture and forestry businesses in their mitigation and adaptation efforts. Examples of these include:

- The **Victorian Governments Sustainability Framework** '*Our Environment Our Future*' (2005) which identified a changing climate as one of the six major environmental challenges for Victoria's future. It provided circa $15 million in funding for the *Victorian Climate Change Adaptation Program* (VCCAP) over four years, which included $3.2 million for policy research on adaptation in the agriculture, forestry and fisheries industries. DPI modules to address on-farm adaptation to climate change under VCCAP include:
  - Farming Systems Scenario Development;
  - Impacts Modelling and Land Suitability Analysis;
  - Institutional Adaptation; and
  - Virtual Resource Centre (VRC) and Visualisation.
- The Victorian **Office of Climate Change** was established within the Department of Premier and Cabinet in early 2007. The office will be responsible for whole of government policy and strategy, focussing on longer term issues and the economic, environmental and social impacts of climate change. The Office will also lead inter-jurisdictional policy development.
- **Our Rural Landscape Extension** (ORLE) provided $13 million in 2007-08 to develop a new Government Strategy to help position agricultural industries and communities to more effectively respond to climate change challenges. This involves undertaking a number of targeted research projects including *Future Farming Systems to Meet the Challenge of Greenhouse Emissions and Climate Change*, and *Our Landscapes in a Changing Climate*.
- DPI has also developed a series of policy frameworks and strategies in response to climate change and greenhouse issues for agriculture and forestry, including:
  - Priorities for Action: Greenhouse and Agriculture (2005) which outlined a policy framework for future Government investment.
  - Priorities for Action: Water for Victoria's Agriculture 2005-2008 (2005) to guide future investments in water efficiency projects in agriculture.
  - Action Agenda on Greenhouse and Climate Change (2006) for primary industries, which outlined DPI's key strategies.

In addition, DPI has been reviewing the climate change challenges and opportunities for agriculture and forestry, and will continue with research in these areas over 2008. The Department is also undertaking a number of collaborative research projects including the Greenhouse in Agriculture (GIA) program in collaboration with the University of Melbourne, Department of Sustainability and Environment and a range of peak agricultural industry bodies (Box 2).

Box 2: Mitigation of Biological Emissions – A DPI/ University of Melbourne Case Study

The GIA program is an ongoing program of research, development and extension aimed at delivering measurable abatement of methane and nitrous oxide from farming systems in Victoria, whilst maintaining profitable and viable production systems (ie 'no regrets' options). This program has already made significant breakthroughs in developing more accurate benchmarks for agricultural emissions of methane and nitrous oxide. Mitigation opportunities for the dairy farm sector now being verified include selective cattle breeding, use of dietary supplements and extended lactation management. A comprehensive list of these best management practices is available on the GIA project web site at www.greenhouse.unimelb.edu.au.

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