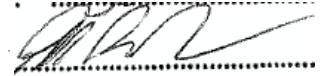


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**House of Representatives Primary Industries and Resources Committee's
Inquiry into the role of government in assisting Australian farmers to
adapt to the impacts of climate change**

September 2009

Key Messages

- Climate change is expected to engender biophysical, market and policy changes that are likely to have substantial implications for Australian farm businesses.
- In general, farm businesses are best placed to self-manage climate change risks, as by responding to their own needs and preferences, they will develop adaptation responses that are business specific, locally-appropriate and cost-effective.
- Many farm businesses are building risk management strategies and practices into their farm business plans in response to variable climatic conditions. There is an extensive range of prospective on farm adaptations to climate change which farm businesses may adopt depending on the relative costs and benefits for their business.
- Governments have an important role to play in enabling farm businesses to meet these challenges and make the most of any opportunities. In particular, governments have roles in addressing inefficiencies in markets, and regulatory and institutional arrangements, that are impeding farm businesses ability to adapt, and in ensuring the community's social equity and environmental objectives are achieved.
- Governments also have a critical role in efficiently managing assets which they own or control, such as schools, roads, railways and the natural environment. This is important in its own right, as climate change, and business and individual responses to it, can directly affect the efficient management of these assets, but can also be important because it can affect how well farm businesses can adapt.
- In all cases, the public benefits of government intervention must outweigh the anticipated costs to the community as a whole. This includes indirect costs or benefits which may occur as a result of such intervention (such as potential effects on biodiversity conservation).
- Rural R&D, and effective practice change to facilitate its adoption by farm businesses, will continue to play a critical role in assisting farm businesses to adapt to climate change.
- The Australian Government should continue to support the *Climate Change Research Strategy in Primary Industries*, and deliver its *Australia's Farming Future* program to coordinate future investments in rural R&D. In doing so, State and Territory Governments, and relevant research and industry bodies, should be consulted.
- Priorities for government consideration, in addition to research and development and practice change, include developing a national policy framework on the role of government in relation to climate change; reviewing existing policy, regulatory and institutional arrangements to identify and remove unnecessary impediments to business adaptation; reviewing public asset and infrastructure management and investment arrangements where the implications of climate change are substantial, and improving government's decision-making tools.

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Introduction to Victoria's Submission

The Victorian Government welcomes the opportunity to contribute to the House of Representatives Primary Industries and Resources Committee's Inquiry into the role of government in assisting Australian farmers to adapt to the impacts of climate change.

This submission has been prepared by the Victorian Department of Primary Industries, in consultation with the Department of Sustainability and Environment, the Department of Premier and Cabinet and other state agencies, on behalf of the Victorian Government. It aims to provide key principles that can help guide governments on their role in enabling farm businesses to adapt to climate change, as well as insights on Victoria's adaptation challenges, how the Victorian Government is responding to these, and the role rural research and development can play in building farm businesses' adaptive capacity. The Victorian Government recognises that its approach to assisting farm businesses to adapt needs to deliver on social and environmental, as well as economic goals.

The submission is divided into five parts, largely reflecting the terms of reference of the Inquiry:

- Part A provides a brief context to the discussion on climate change and trends in farming sectors, along with an outline of some of the Victorian Government's key policy programs in this area.
- Part B discusses current and prospective adaptations to the effects of climate change for farming sectors.
- Part C outlines the role of government in enabling farm businesses to adapt to the challenges and opportunities presented by climate change.
- Part D discusses the role of rural research and development in assisting farm businesses to adapt to climate change.
- Part E provides an overarching conclusion and highlights some of the high level priorities for action to best enable adaptation in farming sectors.

For the purposes of this submission, 'adaptation' refers to actions taken in anticipation of, or in response to, the impacts of climate change. The submission assumes that farm businesses will need to adapt to:

- *biophysical impacts* stemming from changes to climate averages, climate extremes and increases in climate variability;
- *market impacts* resulting from the effects of climate change on other farming producers and markets both in Australia and internationally; and
- *policy responses* globally and in Australia, which can impact on the farming sectors both favourably and adversely.

Part A: Background and context

Australia's farm businesses constantly face new challenges and opportunities. At present, these include challenges associated with the global financial crisis, increased global competition, demographic change, evolving consumer preferences and prolonged drought in the southern states.

Climate change provides another 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. Farm businesses will also be affected by changing global trade and consumer preferences, and government policies implemented in response to the impacts of climate change.

Victoria's farm businesses produce around 26% of Australia's food and fibre exports. Victoria's high production capabilities have been linked to a historically cooler climate with reliable rainfall and water resources, along with good infrastructure, short distances to markets and innovative and skilled farmers.

For the last decade, however, Victoria's climate trend has been considerably warmer and drier than the long term average (see Figures 1 & 2). Consequently, Victoria has already experienced the type of conditions predicted for 2050 under 'high emission projections' (CSIRO/BOM 2007). Climate change models show strong agreement that Victoria's climate will continue to become both warmer and drier over the coming decades based on both global and regional trends. A similar observation can be made regarding rainfall, which is estimated to decline in southern Australia (see Figures 3 and 4).

Figure 1

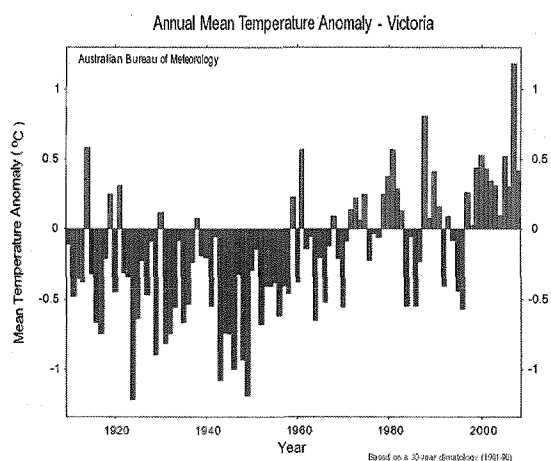
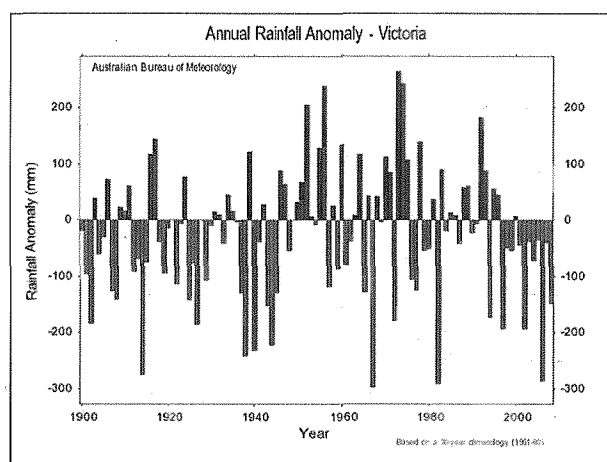


Figure 2



Source: Australian Bureau of Meteorology

Farm businesses need to perform at their best, managing an expanded set of challenges and risks with increasingly sophisticated management practices. Business flexibility, innovation, risk management and sustainable development will be central to many businesses' ongoing viability and profitability. The success of businesses will depend on their ability to adapt, mitigate adverse impacts and capture any benefits a changing climate might offer. Success will also be driven by the ability of businesses to respond to changes in the market in which they operate, or could operate. Current demographic changes in high amenity areas of regional Victoria are driving diversification of local economies and new sources of investment capital to facilitate on farm adaptation, by increasing farm equity and borrowing capacity (DPI 2008). Changes in government policies can also have substantial influences on the prices of farm inputs, and the set of opportunities and obligations businesses might experience.

Farm businesses in Australia have a long history of successful adaptation and innovation that will greatly assist in meeting these new challenges and opportunities associated with climate change. However, due to various market failures, and some government impediments, governments have an essential role in enabling farm businesses to adapt more efficiently and effectively.

Current and potential future impacts for Victorian farm businesses and downstream processors

Climate change is expected to engender biophysical, market and policy changes that are likely to have substantial implications for Victorian farm businesses.

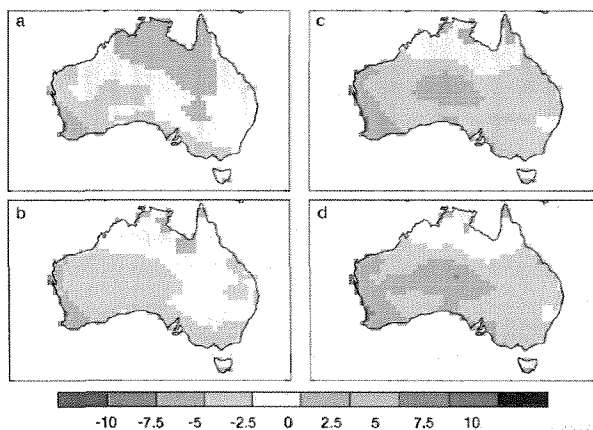
Biophysical effects

Australian farm businesses rely directly on natural systems - water, land and biodiversity – that will be fundamentally altered by climate change. Impacts such as reduced water availability; higher temperatures; damage from extreme weather events and changes in the nature and distribution of pests and parasites will have significant consequences for Australian farm businesses.

In Victoria, runoff and stream flow are both projected to decline significantly as a result of reduced precipitation and increasing evaporation. Current projections from CSIRO indicate a reduction of 10-25 percent in average flow in the Murray-Darling Basin by 2050. Recent modelling by the South East Australian Climate Initiative¹ suggests even greater streamflow reductions in the southern Basin – 10-40 per cent by around 2050 compared with the 1981-2000 average. Recent experience shows that reductions at the top end of this magnitude can have profound implications for the level of seasonal water allocations, and therefore for the viability of many irrigation enterprises in Victoria.

The Bureau of Meteorology (2007) has noted that ‘the combination of heat and drought during the past five to ten years over the Murray-Darling Basin and south eastern Australia is outside the typical range of variability experienced during the previous 100 years’. Rainfall trends have shown a noticeable decline across much of Australia’s farming regions (Figures 3 & 4).

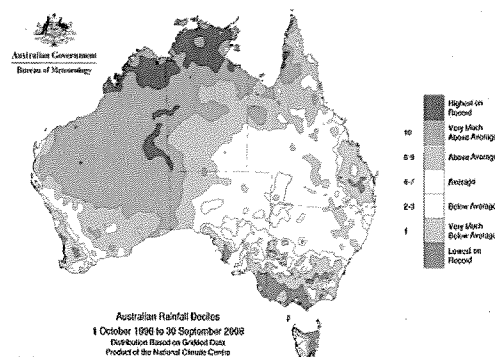
Figure 3: Rainfall models estimate more rain in the north and less in the south



Change in annual precipitation across Australia scaled by amount of global warming (unit % per °C) averaged over the CMIP3 models, using four different approaches: (a) means for 2070-2099 relative to 1990-2005; (b) the multi-model mean trend in precipitation in mm per day, as a percentage of the multi-model mean for the standard period 1961-1990; (c) the mean of trend as a percentage; (d) as (c) but using the model weights

Source: CSIRO/ Bureau of Meteorology 2007

Figure 4: Rainfall trends to date



Actual rainfall patterns from October 1996 to September 2008 closely matching the modelling trends.

Source: CSIRO/ Bureau of Meteorology 2009

¹ Launched in 2006, SEACI is a partnership involving government and industry, and is managed by the Murray-Darling Basin Authority. CSIRO and the Bureau of Meteorology are the initiative research partners.

The last decade provides examples of the impacts a warmer and drier climate has already had on Victorian farming sectors, and how Victorian farm businesses have responded. Most farm businesses have been able to modify their business structures, production systems and enterprise mixes in response to the last decade of exceptionally dry seasonal conditions.

Some recent climate related biophysical changes and implications for Victorian farm businesses are outlined in Box 1.

Box 1: Climate change related implications for farming sectors

The following changes that have been observed in Victoria are indicative of the types of changes that might be expected under climate change, but are not necessarily attributable to a long-term trend.

Reduced and more variable water availability

Some of the impacts on the farm sector include:

- falling cash reserves and equity, with some consultants advising clients to sell their liquid assets (water and stock) now while they still have value;
- water trade and carry-over being adopted in order to maintain production;
- increases in the exit rate from the irrigated farming sectors; and
- some food processors are looking elsewhere for reliable and affordable sources of quality plant products.

Pest pressures have changed

The frequency of some new and existing animal and plant diseases has increased over the last decade, and there are some indications that a changing climate may be playing a part. For example, the number of fruit fly detections, declared outbreaks (Kalang Consultancy, 2008) and costs associated with eradicating these outbreaks has increased markedly in the last five years. This is attributed at least in part to warmer winter conditions, with fruit fly detected in colder southern regions previously considered too cold, such as around Melbourne.

Regional climates have changed

Some implications of changing regional climates include:

- Warmer average night temperatures and reduced chilling of stone and pome fruit causing significant yield reductions. For example, a King Valley berry producer reported that his yield went from 'good' to 'only half a handful of berries per row', when one season was warmer than the chilling requirements for his crop.
- Incidences of drought induced mortality have risen in Shining gum plantations established as part of the Victorian Governments *Farm Forestry North East* program in 1996.
- Increase in summer rainfall (storms) and rainfall intensity, which increases some pest and disease pressure (brown rot in stone fruit) and has also increased soil erosion risk (Harcourt and Warburton Ranges).
- Some existing agricultural systems may reach their biophysical limits of adaptation sooner rather than later.
- Victorian grain production, while holding during the recent dry period, has varied according to area. For example:
 - Heavier soils types of northern Victoria have suffered consistently reduced yields in recent drier seasons, whilst the lighter, sandier soils have been more resilient.
 - Grain growers in the higher rainfall zones of southern Victoria have largely benefited from the drier than average conditions, which have reduced their risks of crop water logging. Along with higher crop prices, this has driven a significant expansion of cropping in southern Victoria.

More frequent and severe extreme events

Increasing climate variability and frequency, and intensity of extreme climatic events, is likely to pose a greater threat to many farm businesses than anticipated changes in average temperatures (ABARE 2009a). Examples of the implications of such extremes can be observed in:

- recent increased extreme high temperatures and increased heat damage to fruit, vegetables and summer plant crops,
- estimated production losses of around 20% from Victorian trout farming due to the 2009 bushfires, and
- extreme heat in late spring which has impacted table grape production negatively in some seasons over the last decade.

Impacts on downstream food and fibre processors and consumers

Implications of recent climatic changes for food processors include a:

- decline dairy industry output (milk supply from a peak of 7.4 billion litres in 2000-01 to 6.0 billion litres in 2007-08, mainly due to increasing scarcity of irrigation water in the Murray region (Dairy Australia 2009).
- shorter harvest window for citrus, which is impacting on the viability of large citrus packers and processors.
- rising number and severity of bushfires has affected Victorian crops, including 20,000 hectares of Victorian timber plantations and some high value harvestable ash species in public native forests in 2009.
- narrowing harvest window for wine grapes, which has also caused increasing pressure on the processing industry. For example, historically, a normal vintage occurs over 12 weeks, however, with warmer recent seasons, this has been reduced to only eight weeks.

Market effects

Australia's primary producers also face significant climate driven changes which are not directly related to its biophysical impacts in Australia. Climate change may affect the level and volatility of commodity prices internationally. For example, if Russian and Ukrainian wheat producers were able to benefit from the warmer conditions expected there, this could result in increased supply and lower global wheat prices. The magnitude and direction of climate change impacts on traded farm product volumes and commodity prices will vary across products and over regions. Consumer preferences may also change with demand increasing for low carbon footprint products.

Policy effects

Policy responses by Australian governments, and governments overseas, to climate change may also affect the farming sectors, directly or indirectly. Some policies may directly impact on the sector by mandating mitigation requirements, or supporting research and development.

The CPRS will impact on farming sectors from its commencement even though agriculture will not be included until 2015, if at all. Prior to 2015 farm producers will face increased costs of inputs that are emission intensive such as electricity, liquid fuels (offset for the first 3 years) and fertiliser. Recent analysis by the Australian Bureau of Agricultural and Resource Economics (ABARE) in a paper *Agriculture and the Carbon Pollution Reduction Scheme (CPRS): economic issues and insights*, released at its March 2009 Outlook Conference, provides estimates of the impacts of these costs, along with estimates of the cost impacts of agriculture's direct emissions (namely methane and nitrous oxide) covered by the scheme (see Box 2). The study estimates that electricity costs may increase by 17% and 28% at carbon prices of \$20 and \$28/tonne CO₂e respectively (ABARE 2009). These changes in energy input prices post inception of the CPRS in 2011 may lead to farmers adapting or changing their business operations or just reducing returns.

Work by the Centre for International Economics (CIE) for the Rural Industries Research and Development Corporation (RIRDC) also analysed the impacts of the CPRS on agricultural businesses, using slightly different, but plausible, assumptions. In their scenario where farmers received 90% free permits due to the trade exposed nature of these commodities, cattle production costs are estimated to increase by 4% with net farm income reducing by 14.1% at a permit price of \$25/tonne CO₂e. Other livestock industries also face significant impacts but to a lesser degree than cattle. The key differences in the assumptions between CIE and ABARE are that CIE does not incorporate the liquid fuel credits or any adaptation by farm businesses, and ABARE assumes that agriculture is covered in the emissions trading schemes of developed countries whereas CIE only assumes New Zealand includes agriculture.

Other policies may affect Victorian farming businesses through impacts on market prices and market access. For example, the decision of the US Government to promote biofuels (albeit for the purpose of energy security rather than reduction of greenhouse gas emissions) is an example of a policy risk for Australian farm businesses originating in another country. The policy diverted grain production away from food to fuel leading to upward pressure on grain prices. This benefited Australian wheat growers, but adversely affected dairy farm businesses, feed lotters and piggeries that purchase grains to finish cattle for market.

Box 2: Estimated effects of the CPRS for agriculture**Implications for Australian agriculture (with agriculture not included in the CPRS)**

	<i>Change in Production Costs Relative to the Reference</i>	<i>Change in Production Costs Relative to the Reference</i>
	<i>Case</i>	<i>Case</i>
Sector	2010	2015
Beef and Sheep Meat	0.2%	0.9%
Dairy Cattle	0.5%	1.1%
Wool	0.2%	1.1%
Other Animals	0.1%	0.9%
Grains	0.1%	1.3%
Other Crops	0.2%	1.1%

Implications for Australian agriculture (with agriculture included in the CPRS by 2015)

	<i>Change in Production Costs Relative to the Reference</i>	<i>Change in Production Costs Relative to the Reference</i>
	<i>Case</i>	<i>Case</i>
Sector	2020	2030
Beef and Sheep Meat	-0.1%	19.9%
Dairy Cattle	-1.2%	6.7%
Wool	2.4%	15.8%
Other Animals	1.5%	4.0%
Grains	1.7%	1.0
Other Crops	1.1%	0.2%

Note: Agriculture included in the CPRS in 2015 and Emissions Intensive Trade Exposed (EITE) assistance ends in 2026.

Key assumptions include unlimited international trade in permits and EITE assistance is assumed as per the CPRS White Paper. Abatement activities are accounted for, however, these activities are uncosted and as such the results underestimate the costs of the CPRS.

Source: ABARE (2009).

Victorian Government programs to enable farm adaptation

The Victorian Government has made substantial investments to enable the State's farming industries to adapt to the diverse impacts of climate change and become more innovative and sustainable. For example, in April 2008, the Victorian Government released its *Future Farming* strategy. The strategy boosts services to farm businesses and provides support for additional research and other initiatives to encourage productive, innovative and competitive farm businesses. The strategy provides a sound framework to guide future government investments and actions.

The *Future Farming* strategy includes four major initiatives directly relevant to climate change:

- The \$5.2 million *Planning for Climate Change* program to give farm businesses access to relevant information, techniques and research about climate change, and expand their understanding about carbon and bioenergy markets and mitigating GHG emissions.
- The \$6.22 million *New Technologies and Strategies* program which involves DPI working closely with industry groups to provide lamb, grains and horticulture farm businesses with new technologies and strategies to adapt their farming systems and practices in the context of a changing climate.
- The \$8.57 million *High Productivity in the Dairy Industry* program over four years to ensure that Victoria's dairy farm businesses have the information, new knowledge and technologies for making rational decisions about their future, and to return industry productivity gains to around 3 percent per annum in order to maintain international competitiveness.
- The \$2.4 million '*Adaptation of fisheries, aquaculture and fisheries management to climate change initiative*' to determine the vulnerability of the sectors to climate change and to facilitate their adaptation to these

changes. This initiative will deliver on the *Victorian Climate Change Strategy for Fisheries and Aquaculture 2008-2018* which will assist these sectors to develop their adaptive capacity and better position themselves to capture opportunities.

As part of the *Future Farming* strategy, the Victorian Government also released its new approach to government services to farm businesses through its *Better Services to Farmers* on 20 April 2009. This will change how the Victorian Government designs and delivers services, so farm businesses receive better targeted, more accessible and relevant services that help them make better decisions about their businesses and strengthen the farm sector. To improve services, the Victorian Government will collaborate with services providers, industry and community groups who are well placed to meet the changing needs of farm businesses.

The Victorian Government released the *Timber Industry Strategy* public consultation draft on 8 April 2009. The aim of this strategy is to maximise the economic value to Victoria from production and processing of timber (plantations and native forests, on public and private land) in a socially and environmentally sustainable manner, and assist the timber industry to adapt to environmental, social and economic change, including climate change. The strategy includes a Victorian Government commitment to develop a Farm Forestry Plan. This plan will, among other things, set out the role of government in assisting landholders who wish to manage native forests on their land for sustainable timber production.

The *Future Farming* strategy and *Timber Industry Strategy* public consultation draft will build on many other policies and programs aimed at enabling competitive, innovative and sustainable farming businesses in Victoria. A key example is the *Victorian Climate Change Adaptation Program (VCCAP, 2008)*. VCCAP is an inter-departmental program under the Victorian Government's Environmental Sustainability Action Statement, which commenced in 2006-07.

VCCAP contributes to the ability of farm businesses, and governments, to adapt to climate change by:

- contributing to the identification of likely impacts of climate change for rural and regional Victoria;
- assessing the implications for some of the most vulnerable industries and regions in Victoria;
- helping to communicate the potential impacts and risks to regional communities;
- building the capacity of government, industry and farm businesses to adapt; and
- developing decision-making tools, resources and risk management strategies to deal with climate change.

As part of this program, the Victorian Government has commissioned a three-year study on the resilience of farming businesses in the South-West of Victoria to various climatic change scenarios.

The Victorian Government has also commissioned CSIRO to downscale future climate scenarios for the ten Victorian Catchment regions to better inform policy makers, communities and industries on the potential biophysical impacts of climate change.

In addition, the Victorian Government is currently preparing a Climate Change White Paper for Victoria which will provide a comprehensive framework for the Government's action on climate change. It will outline key government priorities and actions across emissions reduction, adjustment to carbon prices, adaptation to changed climatic conditions, as well as a clear articulation of the roles of respective parties (including different levels of government). In developing this paper, a Victorian Climate Change Green Paper was released for public comment on 3 June 2009. This paper will provide a foundation for extensive consultation with the community before the release of the White Paper at the end of 2009.

The Victorian Government will also release in late 2009, a White Paper on 'Land and biodiversity at a time of climate change'. This follows release of a Green Paper in April 2008 and extensive public consultation. The White Paper will set out the Victoria Government's position on managing land use and land use change in the context of climate change, and recognises that Victoria's primary producers will need to work smarter and harder to remain competitive, whilst not eroding the natural capital of their land.

The development of integrated regional blueprints, via the Victorian Government's Regional Strategic Planning Initiative, will set a new strategic direction for provincial Victoria, focused on delivering productive, sustainable and innovative regional communities.

These initiatives support past Victorian Government commitments, such as *Our Water Our Future: Securing our Water Future Together* (Department of Sustainability Environment, 2007). The Water White Paper and four regional Sustainable Water Strategies set the policy framework for the long-term sustainable management of Victoria's water reserves which aim to secure Victoria's water future for the next 50 years. The White Paper includes more than 100 initiatives for preserving water access including:

- allocating \$4.9 billion for the Victorian Water Plan, which includes modernising irrigation infrastructure in northern Victoria and expanding Victoria's water grid;
- developing regional sustainable water strategies to plan for long term water security across Victoria; and
- requiring businesses that use large amounts of water to develop Water Management Action Plans.

The future health of Victoria's regional economies will depend on a diverse and competitive primary industries sector with production activities undertaken within the sustainable limits of natural resources. Together, the three White Papers will provide a foundation for better managing our natural environment during times of considerable change.

Part B: Current and prospective adaptations to climate change

Key messages

- Australian farm businesses have an enviable record of adaptation in the face of multiple pressures including climate variability, industry and trade deregulation, and changing terms of trade. However, without substantial change the impacts of climate change may overwhelm some farming businesses as they get closer to the adaptive limits of their existing production systems and business plans.
- Many farm businesses are changing the way they operate and building risk management strategies and practices into their farm business plans in response to variable climatic conditions. Different farming sectors have adopted a diverse range of risk management strategies, including increased use of recycled water in horticulture, drought-tolerant wheat varieties in cropping, purchased feed in irrigated dairying, and mixed farm businesses adjusting their existing enterprise mixes.
- There is an extensive range of prospective on farm adaptations to climate change. By developing these, farm businesses will have a range of options available to adopt depending on the relative costs and benefits for their business. Examples include new foraging systems for the dairy sector, managing the impacts of smoke taint on viticulture and low input grazing systems based on native grasses.
- The Victorian Government is working with industry and other partners on a range of adaptation research and development initiatives, focused on building the adaptive capacity of the dairy, grains, horticulture and extensive livestock sectors. The Victorian Government is also responding to climate change risks at the landscape scale, by investing in rural R&D in areas such as carbon fertilisation, pests and disease threats, and extreme climatic events, as well as asset management upgrades such as improving irrigation infrastructure.
- Food processors and manufacturers are responding to climate change by seeking to reduce the carbon footprint of their own internal operations and the goods and services that they provide.

The purpose of this section is to outline current and prospective adaptations to the impacts of climate change for farming sectors.

The section is divided into three sub-sections:

- Existing on-farm adaptation options being deployed by Victorian farm businesses;
- Prospective on-farm adaptations to climate change; and
- Response from downstream processors.

Existing on-farm adaptation options being deployed by Victorian farm businesses

Victoria's farm businesses have learnt to adapt and prosper in a highly variable physical environment. This experience has provided farm businesses with useful lessons which will help them prepare for climatic changes. Practices which have assisted many Victorian farm businesses in recent times to adapt to natural variability include:

- diversification (mixed farming);
- extensive use of agribusiness advisers;
- opportunities to generate additional income by trading irrigation water;
- increasing farm size; and
- in the grains sector, selecting 'non-traditional' crops as opposed to staples like wheat or barley.

In some farming industries, and for some farm businesses, maintaining current productivity growth may enable them to adapt to the impacts of incremental climate change. For these farming industries, many adaptation options will be an extension or enhancement of existing activities to improve farm productivity and manage the risks of increasing climate variability. As farm businesses develop their capability to adapt to change, they may also need to develop more sophisticated environmental management systems to reflect the multiple production and environmental values of their land.

However, where traditional farming systems are at their limits of adaptation (threshold) and viability, new farming systems and/or alternative land uses may need to be adopted. Farm managers may also need to re-evaluate and re-shape their preferences for maximising income versus minimising losses, by applying new risk management strategies. Risk management strategies for farm businesses can include:

- on-farm strategies reflected in their farm management practices, technology adoption and daily business; and
- off-farm risk-sharing strategies including forward contracts, hedging, insurance and vertical integration.

Farm businesses may also make use of the Australian Government's Farm Management Deposit scheme, which allows farm businesses to save pre-tax dollars rather than post-tax dollars and, as such, provides a tax effective income smoothing device.

The rest of this section discusses examples of adaptive responses in some of Victoria's key farming activities.

Irrigated farming

Many irrigation farm businesses are coping with water scarcity (price rises) by treating irrigation water as a tradeable commodity that can be used in several ways as:

- a temporary income source (temporary trade);
- an opportunistic input to farming systems that is able to respond at short notice; and
- a bankable input carried forward to the following year.

Temporary and permanent water trade, and carryover of allocation, provide irrigation farm businesses with greater capacity to manage their risks associated with seasonal variation.

In response to water scarcity and higher input prices, many irrigation farm businesses are adjusting to higher value perennial crops, abandoning less profitable areas ('new dryland') and abandoning unproductive horticultural crops, blocks and varieties. These risk management practices may be further accelerated by the:

- implications of increased irrigation infrastructure charges per farm user, as 'new dryland' areas now means water is delivered to fewer farms per channel; and
- increased use of water budgeting tools and other decision support software for the economic analysis of individual areas of land that are proposed to be irrigated with purchased water.

Horticulture

Many horticultural producers are building risk management strategies and practices into their farm business plans in response to variable growing conditions. There are a range of strategies that the horticulture industry has put in place which are market and water/climate related. Examples include:

- use of cultivars that are more tolerant to a wider spectrum of growing conditions;
- protection of plants and fruit from changed weather conditions, such as use of shade and hail cloth covers, clay based sunscreen products on fruit trees (citrus, pome), frost fans and other frost negating devices;
- more efficient and strategic irrigation systems and use of recycled water. For example, the adoption of contingency plans for reduced water supply and use of winter fill storage dams as an insurance for summer production;
- adjusting farm size and structure to achieve more efficient and effective water use; and
- use of organic/alternative nutrient sources to reduce the use of chemical fertilizers and potentially lower their carbon footprints.

Dairy

Dairy farm businesses have adapted to changing climate conditions in recent years, including higher temperatures (which have caused heat stress for cows), and varying pasture growth patterns. They have responded to drier, more variable seasonal conditions and lower water allocations for irrigated farms by:

- embracing risk management strategies. Examples include forward-contracting grain, and the carrying over, buying and selling of irrigation allocations from one season to the next.
- using more purchased feed and undertaking more fodder conservation. Examples include increased use of annual pastures and lucerne, and increasing use of water in spring and autumn.
- 'cow parking' whereby farm businesses relocate their cattle temporarily. Many farm businesses in northern Victoria, for example, have consigned some of their herd to Gippsland to protect the ongoing productive capability of their dairy businesses.

Beef and sheep

Victorian livestock businesses have improved their business management over the last decade by:

- adjusting enterprise mix in response to both seasonal variability and relative profitability (e.g. more crop and less livestock in Southwest Victoria);
- adjusting feeding according to shorter and more variable seasons by implementing short-term feed budgets and making greater use of intensive systems to finish both cattle and sheep;
- improving their grazing management to make better use of fodder grown on farm including using results of research and development, such as *Evergraze*. This program is an example of collaborative R&D between the Victorian Government, Meat and Livestock Australia, Australian Wool Innovation and the Future Farm Industries Cooperative Research Centre. *Evergraze* seeks to plant and specifically graze pasture species best adapted to specific areas of individual farms (e.g. hill tops, slopes, flats) instead of trying to manage a uniform pasture mix over the entire farm; and
- developing their management skills via State Government programs like BeefCheque and LambCheque, which have helped them to survive the prolonged drought.

Cropping

Recent dry years have had a substantial affect on Victoria's grain growing industry. Cropping farm businesses appear to be making more use of risk planning and risk management techniques, including better understanding of meteorological modelling and seasonal predictions.

In the northern cropping regions there has been a large swing away from legume and canola cropping options towards repeated cereal rotations. For example, following two years of low yields, the area planted to canola in Victoria fell by 31 per cent in 2008-09 (ABARE, 2009c).

In southwest Victoria there has been a very large and steady upward trend in area planted to crops, and an increasing yield trend (reduced in 2008), and an increase in varieties. The drier decade in southern Victoria has contributed to an increase in production of barley, especially high quality malting barley, milling wheat, canola and to a lesser extent pulse crops. Prior to the last decade, the southwest was considered more suitable for lower quality (feed) wheat varieties, but drier seasons have enabled increasing production of milling wheats.

Aquaculture

Aquaculture farm businesses are responding largely to changes to water quality driven by reduced flows, increasing evaporation and water temperatures. While these businesses do not consume water, they have had to respond to water scarcity.

Many aquaculture producers are building risk management strategies and practices into their farm business plans such as:

- collaborating with water owners to establish multi-use farms;
- selecting species to suit the changing conditions;
- enhancing survival of vulnerable life stages through hatchery facilities; and
- increasing resilience of production facilities to extreme events (such as increasing depth of ponds).

Plantations

Victorian plantation managers are adopting silvicultural techniques to better match appropriate tree species to a wide variety of potential sites. As with other agricultural crops, this has included:

- research into matching tree (crop) species, and in some cases provenances, best adapted to differing biophysical conditions;
- using chemical, mechanical or natural means to reduce the abundance of competitive species, coupled with thinning to increase the soil moisture for the remaining trees and reduce canopy interception of rainfall;
- utilising water-holding gels and protective tree covers during establishment to retain moisture;
- manipulating seed bed characteristics to reduce frost damage and, where frost risk is reduced, replacing less productive frost tolerant species such as *E.nitens* with frost sensitive and more productive species such as *E.globulus*;
- incorporating integrated tree plantings into whole farm management plans (farm forestry); and
- undertaking thinning in areas exposed to risk from high wind damage, to promote increased diameter growth relative to height.

Prospective on-farm adaptations to climate change

The spectrum of possible on-farm adaptations to climate change is enormous as each business makes decisions based on its own production system, business plan, environmental conditions and other external drivers of change.

Rather than speculate on the wide range of prospective on-farm adaptations, this section focuses on possible adaptation responses of strategic importance for Victoria where the State Government has focused its research, development and extension effort. Investment in these areas has been made after a thorough review of key climate change challenges for the sector and an assessment of the role of the Victorian Government. A comprehensive investment and evaluation process underpin these programs. Many of these activities are undertaken in collaboration with industry, *Rural Industry Research Corporations (RIRCs)* and the Commonwealth Government.

A number of these activities focus on particular industries, while others cover a broader spectrum of issues and sectors. Although these activities are focused on farm level production, it is noted that the downstream processing sector will benefit from an improved ability of farm businesses to competitively and sustainably provide farm produce. By developing new on-farm adaptations, farm businesses will have a wider range of options available to adopt depending on the relative benefits and costs to their business. In addition, governments can direct their R&D investments in new on-farm adaptations that will promote multiple environmental, economic and social benefits.

Enabling industry-specific adaptation

DPI, in conjunction with industry and other partners, is:

- developing new foraging systems for the dairy sector that increase productivity and flexibility under climate change by:

- modelling Victorian dairy farming systems to inform industry about the drivers of profit and the associated risk factors for different dairy farm types through robust analyses of the impact of potential changes in climate policy and technology on the profitability of dairy farm systems; and
- supporting the development of forage systems for dryland dairying with increased adaptability and resilience to climate change.
- enabling grain growers to be equipped with tools and techniques to adapt to a changed Victorian environment and increased variability by:
 - supporting the development of agronomic management practices for new pulse varieties that are adapted to a changed climate; and
 - researching options to decrease nitrous oxide emissions from cropping systems, and thereby reduce the exposure of grain growers to potential future requirements to reduce emissions.
- enabling horticulture producers to improve productivity with uncertain water supply, fewer cold days, increased CO₂ levels, and other changes expected due to climate change, by:
 - modelling the potential effects of climate change relevant to horticulture;
 - assisting the development of strategies to manage the impact of smoke taint in vineyards, due to the expected increased incidence of bushfires; and
 - developing strategies to maintain grape and wine production and quality in a changing climatic environment.
- improving the capacity of extensive livestock producers to improve productivity and agilely adapt to variable seasons by:
 - developing new grazing systems, which incorporate summer active pastures that increase productivity and profitability, and are more resilient under climate change;
 - developing low input grazing systems based on the native grasses that are potentially more resilient under climate change; and
 - modelling farm based scenarios for the lamb industry to better understand the potential impact of climate change.

Enabling adaptation across industries and regions

DPI is also enabling adaptation responses that are relevant across industries. This includes:

- analysing the impacts of elevated CO₂ on crop and vegetable growth and their interaction with changed moisture and fertility. This is being undertaken by DPI in collaboration with the University of Melbourne, with support from Department of Climate Change and the Grains Research and Development Corporation.
- tackling pests and weeds by improving DPI's early response capability for new and emerging pests in a changing climate.
- undertaking research to assess the significance of recent extreme weather events on crops and animals, and guide potential collaborative research to help enable farm businesses to prepare for forecast extremes in the future.
- building the adaptive capacity of farming industries in southwest Victoria at a regional and landscape level through the Victorian Climate Change Adaptation program (VCCAP) by providing:
 - a better understanding of plausible alternative futures for Victorian primary industries under climate change using scenario analysis;
 - a broader understanding of the impacts of climate change on current and potential future farming production systems, and possible responses, from the use of tools such as land suitability analysis;
 - an improved understanding of climate change impacts on the socio-cultural, economic and governance aspects of regional communities;
 - a framework to assist policy makers to choose a package of policy instruments for promoting adaptation; and

- a central virtual resource centre that allows users and key stakeholders to share data and information related to climate change.
- facilitating access to risk management tools that will enable farm businesses' to develop tailored adaptation strategies for climate change at the farm level. In doing so, this will enhance their risk management in response to the cumulative implications of increasing climate risk, commodity volatility, water resource limitations, global financial crisis and implications of a carbon price on the economy over the coming decade.

Responses from downstream processors and retailers

Food processors and manufacturers along the agriculture value chain have also responded to a changing climate. Key responses to date have related to emissions and a desire to appeal to consumers with low-carbon or carbon neutral products. Examples include:

- Sapporo, a Japanese brewer, and Tasmania's Cascade Brewery have both developed low carbon beers. Victorian barley suppliers to Sapporo will be expected to measure the carbon footprint of their barley production processes.
- Tesco (UK's largest food retailer) have introduced carbon labelling on some of their products.
- In October 2008, Japan released a proposal for voluntary carbon footprint (CF) labelling and will begin a pilot project in 2009. The proposal calls for a label that bears a numerical rating based on an estimate of CO₂ emissions over the product's lifecycle. The Japanese Department of Trade (METI) have introduced the scheme which includes the food industry.
- Life cycle analysis has been conducted on the Australian Dairy Industry by Dairy Australia to measure the environmental impact of milk production on the environment. The study identified that about 80% of dairy emissions are on farm, which implies that dairy farm businesses will need to adapt (change) to play a significant abatement role in the future.
- Concerns around market access for Australian food exports are apparent as overseas Governments (such as Japan), and retail chains (such as UK food retailers) move to reduce the carbon footprint of food production in the value chain.

'Food miles', which relate to the distance travelled by food products from 'plough to plate', is a topical issue for retail chains in the United Kingdom (UK). The argument is that the further food products travel, the more damaging they are to the global environment. However, a UK study noted that the 'Food Miles' concept was misleading, and it would be better to think about food-tonne miles, and develop a more sophisticated understanding of how the food is being transported (DEFRA, 2005). The food miles argument is also based on the flawed assumption that greenhouse gas emissions associated with on-farm production remain constant, irrespective of the country of origin.

A Lincoln University study by Saunders et al (2006) compared total energy consumption and associated CO₂ emissions on-farm in New Zealand and the UK for identical produce. It found that New Zealand producers were more energy efficient, even after allowing for transportation of their dairy and sheep meat products to the United Kingdom. New Zealand's lower energy intensity for sheep meat, lamb and dairy reflected its reliance on extensive pastures, organic fertilisers and hydro-electricity. While some of the assumptions of this study have been drawn into question, it is widely accepted that full lifecycle or carbon footprint assessments will be more useful indicators of the greenhouse emissions in food than 'food miles'

Part C: Role of government in enabling farm businesses to adapt to climate change

Key messages

- In general, farm businesses are best placed to self-manage climate change risks. By responding to their own needs and preferences, farm businesses can best develop optimal adaptation responses that are business specific, locally-appropriate and cost-effective.
- Government's role in adapting to climate change is different to its role in mitigating greenhouse gas emissions where, without government intervention to reduce anthropogenic greenhouse gas emissions, Australian farm businesses are likely to face relatively weak incentives to reduce their emissions. In contrast, there are strong financial incentives for farm businesses to take action to adapt farm practices to the effects of climate change.
- The role for government in facilitating farm businesses to adapt to climate change largely relates to addressing inefficiencies in markets and regulatory and institutional arrangements that are impeding businesses ability to adapt and improve productivity, along with ensuring the community's social equity and environmental objectives are achieved. In particular, there may be a role for government where:
 - there is compelling evidence of market failure, including 'information failures', 'public goods', 'externalities', and 'market power';
 - existing government policies, regulations or investments (inadvertently) pose unnecessary impediments to efficient and effective farm business adaptation;
 - substantial social equity concerns arise that cannot be adequately managed by existing private and government arrangements.
- Where a number of businesses or individuals undertake substantial change this can give rise to structural change in the economy, and therefore to industry and/or regional adjustment. This is generally desirable because by having resources move to where they are most valued greater economic wealth can be generated. The role of government in these circumstances is similar to its role in enabling individual businesses to change (adapt), although there may be some additional characteristics of such 'aggregated' or larger scale change that can affect government decisions, especially regarding infrastructure or education and skill needs.
- Governments also have a direct role in efficiently managing the assets they own or control (eg schools, roads, railways, native forests) which can be affected by climate change. This function is important in its own right, but may also be critical to enable effective adaptation by farm businesses and individuals.
- In all cases the public benefits of government intervention must outweigh the anticipated costs to the community as a whole. This assessment needs to account for any beneficial or adverse externalities that might occur in response to such action (such as affects on biodiversity), and appropriate responses to these.
- The level of government responsible for an action should be at that level that can deliver the greatest net community benefits, in terms of outcomes, cost and desirable process. Factors to consider in this context include aligning accountabilities with responsibilities; matching skills and resources; economies or diseconomies of scale; balancing innovation and diversity with consistency and standardisation; and existing activities and relationships.
 - In the event that government intervention is deemed beneficial, adaptation and adjustment policies should, among other things, satisfy good policy development criteria such as the development of clear objectives, an assessment of alternatives, and a transparent evaluation framework before implementation.
 - Given the importance of efficient and equitable adjustment to climate change in agriculture and other sectors, the potential increase in requests for adjustment assistance that may be forthcoming, and the benefits of similar principles being applied across jurisdictions, an agreed national framework for adjustment assistance could offer enormous benefit.

Introduction

This section outlines the potential roles of government in enabling farm businesses to efficiently and effectively adapt to climate change. It also considers the potential role of government in enabling broader industry and community adjustment to climate change. It considers equity as well as efficiency rationales for possible intervention. The respective roles of various levels of government are also considered as part of this discussion.

This section is divided into four subsections:

- Role of governments to facilitate effective farm business adaptation
- Role of governments to facilitate farming industries' and regional adjustment
- Respective roles of the Commonwealth and state and local governments
- Principles to guide government action.

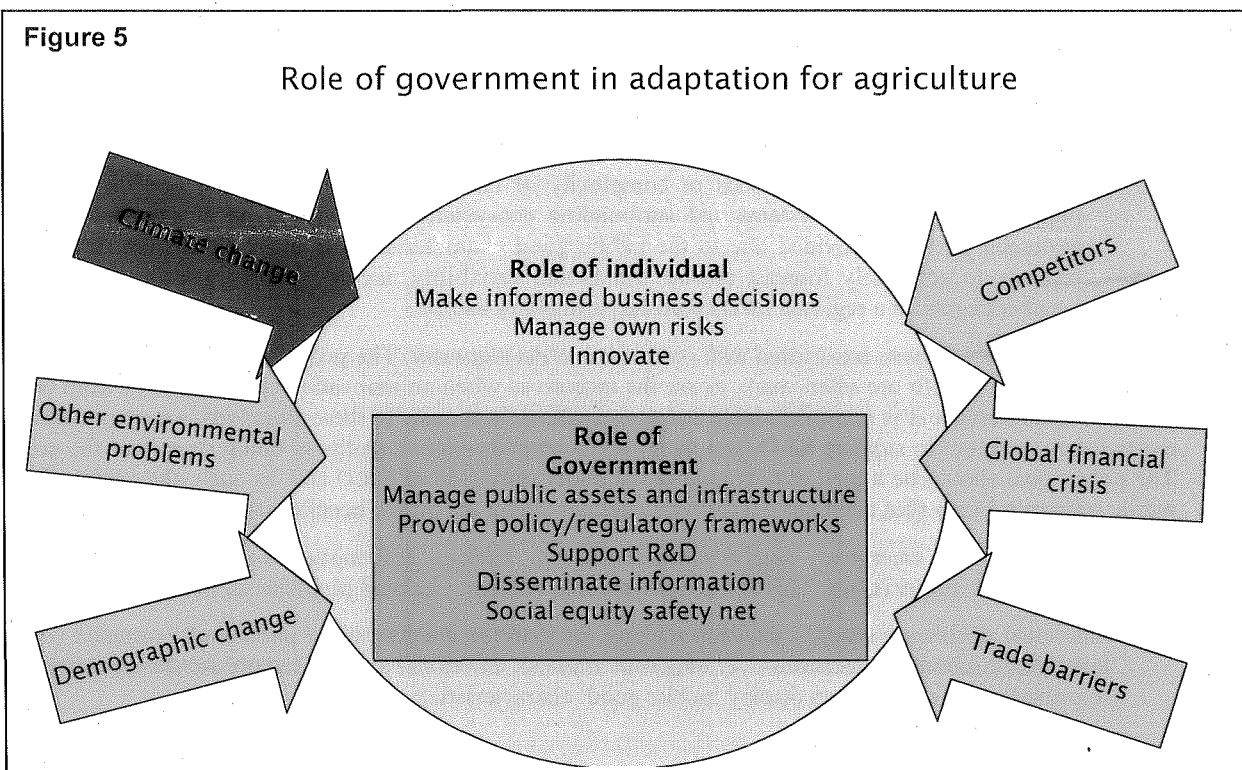
The principles raised in these sections are not only critical to guide good government decision making and public investment, but to provide a clear framework for businesses and individuals to understand their roles and responsibilities in adapting to climate change. This in itself is an important role of government.

Role of governments to facilitate effective farm business adaptation

Government's role in adapting to climate change is very different to its role in mitigating greenhouse gas emissions. Without government intervention to reduce anthropogenic greenhouse gas emissions globally, Australian farm businesses are likely to face relatively weak incentives to change their behaviour in response to this global externality. In contrast, there are strong financial incentives for farm businesses to take action to adapt farm practices to the impacts of climate change, where it is in their own private interests to do so, i.e. they bear the financial consequences for their actions or lack of them.

In general, farm businesses will be best placed to self-manage climate change risks. By farm businesses responding to their own needs and preferences, they can best reflect the most business specific, locally appropriate and cost effective adaptation responses. This is especially important because the most effective and efficient farm business adaptation strategies will vary by region, farming business model and over time. Hence, a one-size-fits-all adaptation strategy is unlikely to deliver consistently beneficial results at the farm level.

Moreover, climate change risks and opportunities are only one of many changes facing farm businesses. Indeed, climate change risks and opportunities will generally be considered by businesses in light of these other change factors, many of which will be unique to their business (see Figure 5).



However, private markets can 'fail' to function in an efficient way or can result in socially undesirable outcomes, including negative environmental externalities, eg water, biodiversity and greenhouse gas emissions. Governments may then have an important role to address market failures and/or social equity issues, although their mere existence does not constitute a *prima facie* case for intervention (see Box 3). Government should only intervene when the public benefits of doing so outweigh the costs to taxpayers. This could include the provision of ecosystem services through public land management.

In addition to facilitating efficient and equitable outcomes, government also have a direct role in managing the assets they own or control, and the policy frameworks and regulatory arrangements they have established. Effective management of these items is important in its own right, but can also make a substantial difference to the ability of farm businesses to change and adapt to new environments.

Box 3: Explanation of terms associated with market failure and policy impediments

The key characteristics of market failure are explained below.

- 'Externalities' arise when a firm undertakes activities that impose costs (a negative externality) or confer benefits (a positive externality) on others and no compensation is paid or received. For example, a negative externality is generated if pollution is discharged into a river and this affects downstream users. An example of a positive externality is weed control – weed control on one farm provides benefits to neighbours. Externalities are often called spillover benefits and costs, and often persist because there is no efficient market to account for them.
- 'Information asymmetry' can occur when one party to a transaction has information which is not available to the other party (hidden information) or one party can influence the outcome of a transaction by behaving in a certain way that is unobservable to the other party (hidden action). The seller of a used car, for example, has more knowledge about the quality of the car than potential buyers and can use this superior information to obtain an advantage. This type of asymmetry can distort behaviour and causes inefficiencies in the economy if low cost market responses (such as third party vehicle inspections) are not available.
- 'Market power' occurs when a firm can influence the price / quantity of goods in a market for increased profits, such that the allocation of resources in that market is inefficient.
- 'Public goods' are non-excludable (suppliers cannot exclude anyone from obtaining the good or service) and non-rivalrous (one person's consumption is not limited by others) in their consumption. Examples include national defence and basic research.
- Policy impediments refer to government policies, including regulations, institutional arrangements and investment decisions that are unnecessarily restricting the efficient decisions of businesses or individuals. This might occur because the business or physical environment has changed such that a policy is no longer optimal or would benefit from a change in design or implementation.

Prospective areas where government action to facilitate farm business adaptation could be desirable can include:

- *Addressing information deficiencies, inaccuracies or asymmetries regarding climate change and potential adaptation strategies.* This may enable farm businesses to make better informed, more timely decisions and investments. These 'market failures' in information availability and use can arise due to the:
 - The 'public good' characteristics or complexity of climate change information and its potential impacts on agronomic systems and surrounding ecosystems. Information on ecosystems may in particular be underprovided due to the public good characteristics of such information. Improved capacity to accurately forecast climate trends and variability, including early warning of extreme weather events, at a regional level could be particularly useful.
- *Overcoming market failures associated with research and development.* The private incentives for R&D with substantial public benefit are often weak, as are the incentives when an innovation cannot be kept from other potential users because it is non-excludable and non-rivalrous in its use. In these situations, a case potentially exists for government to support R&D, assuming the community-wide benefits of doing so exceed the costs. The policy goal should be aimed at overcoming the under provision of R&D and, as such, the extent of the public support is likely (but need not be) relatively greater where the public benefits are greater.
- *Developing enhanced emergency response capabilities to address information and public good market failures, along with equity issues.* This can be to overcome efficiency related problems associated with:
 - individual decision making – decision making for extreme events can be particularly complex (often involving discounting decisions over long time frames), emotional and can require substantial scientific information which itself can display 'public good' characteristics;

- insurance markets and risk sharing – individuals may underprovide for emergencies if (i) they believe others (eg governments) will bail them out or (ii) insurance markets fail to perform efficiently from a community wide perspective given potential information asymmetries and uncertainties.
 - the ‘public good’ nature of many emergency response activities – where action to mitigate an extreme event by one person also assists others without easy (low cost) mechanisms to seek compensation or to agree co-payments for actions. This can be made easier or harder by the involvement of public agencies (and often multiple agencies) which may have their own risk management and community safety objectives to achieve.
 - social equity concerns whereby regardless of ‘efficient decision making’ the community considers the impacts of extreme events and emergency situations unacceptable such that they would jeopardise the achievement of the social justice and equity objectives sought by the community.
- *Addressing potential policy impediments.* These can occur when existing government regulations, policies or investments have become suboptimal in the context of emerging climate change impacts. For example, biosecurity regulations will need to remain relevant and least cost, as will rural land use planning policies and water management rules (including those related to water trading).
 - *Ensuring that government’s service delivery and funding remains at best practice and continues to address relevant government objectives.* This can include services to farm businesses through practice change information and advice, co-investment in research and development, training and skills development, and existing adjustment or assistance measures such as drought assistance.
 - *Implementing adaptation actions for public assets and investments, where government has primary responsibility.* These include the management of biodiversity conservation, public assets such as schools, hospitals, native forestry and defence facilities, as well as public infrastructure such as roads, railways, ports and dams. For example, the Victorian Government is piloting market-based initiatives, such as BushTender and EcoTender, to develop markets for ecosystem services on private land. Such actions can be important in their own right but can also be important to enable farm businesses to more efficiently adapt to climate change.

The policy tools available for government to correct for market failures, unnecessary institutional and regulatory impediments, and potentially inefficient public investment and management, is wide and varied. Often a mix of instruments will engender the best results with flexibility often important given the uncertainties of climate change.

In all cases, preferred options and alternatives should be evaluated to determine (or at least gauge) the options that will offer a greater net community benefit. This assessment should consider a full range of costs and benefits, including transaction costs and potential perverse incentives for risk management or the achievement of other government goals, such as social equity and biodiversity conservation goals. In doing so, however, opportunities to directly respond to these potential externalities should be explored before modifying actions to facilitate adaptation.

To support such assessments, government decision making tools and processes need to be effective. In particular, risk assessment tools which can account for long time horizons and considerable uncertainty, and effective valuation approaches for traditionally ‘hard to measure’ affects, need to be adopted. With changes in economic, environmental and social environments happening rapidly (in part due to climate change), there is a need to re-invigorate good decision making processes, including greater transparency and accountability for government decisions. Businesses and communities are more likely to embrace change and new government policies if the benefits of doing so are clearly and transparently articulated.

In relation to equity related concerns, these are normally managed through private means (such as family or civic groups) or through the general safety net provisions and health and support arrangements that are available regardless of the drivers of disadvantage or misfortune. A strong case would need to be made for ‘special’ assistance, especially given the potential incentive and equity implications of such a decision.

That said, governments may wish to accept greater responsibilities in enabling adaptation to a policy driven change than a market or environmental driven change given they are deliberate decisions made by governments on behalf of the community. In particular, because reforms often involve winners and losers, governments may choose to assist the ‘losers’ in some way as part of a social agreement for reform. This is, however, more likely to be the case when the changes will result in substantial adverse effects which could not reasonably have been predicted and mitigation responses by affected parties are limited. Responses can involve staggered implementation, re-training or cash payments. In general, the tier of government responsible for the reform should

ideally be the tier that takes responsibility for providing the resources necessary to deliver that assistance (although other tiers of government may be more appropriately placed to deliver programs).

Unfortunately, clear and consistent guidelines for the circumstances under which this may occur are often lacking. Given the importance of efficient and equitable adjustment to climate change in agriculture and other sectors, the potential increase in requests for adjustment assistance that may be forthcoming due to climate change and the benefits of similar principles being applied across jurisdictions, an agreed national framework for adjustment assistance could offer enormous benefit. Moreover, given broader questions over the role of government related to climate change, there would be benefits in developing a national policy framework on the role of government in relation to climate change. This could include transparent guidelines for research and development funding as well as transitional adjustment assistance applicable to all industries and regions.

Role of governments to facilitate farming industries' and regional adjustment

If many individual businesses face adaptation and change this may mean that the nature and structure of whole industries or regions can substantially change (structural change). This is often driven by a number of factors, of which climate change may be one.

This of itself is not necessarily a problem, as resources frequently move to where they are most valued across industries and regions, such that the size and make-up of the economy in terms of the distribution of activity and resources among firms, industries and regions changes. Moreover, structural change and industry and regional adjustment to it can build profitable, efficient and sustainable businesses that are responsive to markets, embrace change, deal self-reliantly with risk and are innovative. Indeed, in many cases change will be driven by opportunities for farm businesses due to climate change. These include potential spikes in rural commodity prices on global markets, new crop varieties for Australian conditions emerging out of research and development, shorter time to market due to changed growing conditions, improved crop yields due to the CO₂ fertilisation effect (assuming adequate soil moisture and nutrients), and entering new markets based on demand for lower carbon products.

As stated above, businesses and individuals (families) are generally best placed to manage the changes they experience or expect. Therefore, the changes a business or individual may experience as a result of generic changes across an industry or changes in the economic and social make up of a region, is generally best managed by them. This would include changes to the demand for their products or the asset value of their land or house (or shares in a particular industry undergoing rapid change). This would apply to the emotional and social challenges that may be associated with a substantial change as well as the economic challenges.

As noted above there may be market failures and government impediments that prevent the efficient adaptation by farm businesses or individuals to these structural changes. These may need addressing to achieve appropriate economic, social and environmental objectives, as per the previous sections.

Large scale industry or regional change may bring about new challenges that might not have emerged if only a small number of businesses or individuals were adjusting. The loss of businesses in an area may, for example, result in some services to the area being reduced or withdrawn. This might apply to a trucking network or bus services, or water infrastructure. These responses are not in themselves inefficient (indeed, they are largely the result of the efficient decision of suppliers of these services), but they can add to the other challenges a business or individual may face.

Sometimes, however, the nature or size of the change may be most efficiently dealt with by a coordinated response across businesses in an industry or across supply chains. Coordination across businesses (sometimes with assistance of industry associations) is common, and can often find optimal solutions. Similarly, neighbourhood and community responses can help assist individuals in adjusting to regional shifts.

Governments may consider involvement in this response, however, if such 'coordinated' market and community responses are likely to result in inefficient or inequitable outcomes from the community's viewpoint. For example, if a response deemed advantageous for a number of businesses within an industry generated new and unaccounted adverse consequences for the environment, government may wish to intervene to address this negative externality. An information failure may also lead to an inefficient 'coordinated' response which may again benefit from government action.

Government may also have a role to play in addressing especially inequitable outcomes associated with industry and regional change. This may occur if farm businesses or individuals are extraordinarily adversely impacted such that the nature or scale of impact is more severe than society is prepared to accept to achieve an equitable and just society. This is more likely to be the case the more dramatic, unexpected and devastating the impact (particularly if the affected group is already relatively 'disadvantaged'). An individual business going insolvent because it failed to change its production practices would not meet these criteria.

As noted above, where climate change results in 'unacceptable' adjustment and hardship on particular individuals the first response by government should be to consider its existing adjustment and re-training policies and welfare safety net. In many cases, these will deal with society's concerns over equity and justice. However, where existing responses are inadequate to respond to the nature or magnitude of the problem then additional measures may be considered (assuming the best solution is not to revise existing arrangements due to a systemic or more generic weakness in arrangements).

Unfortunately, clear and consistent guidelines for the circumstances under which adjustment assistance may be warranted are lacking. An agreed national framework for adjustment assistance in response to a policy change could offer enormous benefit.

Furthermore, governments have a clear and direct role in managing the assets they own or control, and the policy framework and regulatory arrangements they have established. How government manage these issues can have substantial implications for businesses adapting and therefore the consequences for industries and regions. For example, ensuring road networks are extended to facilitate growth in new areas may be critical for businesses to move to a more suitable location or expand to further diversify income.

On this point, there would most likely be substantial advantages in whole-of-government reviews of priority areas where asset management may need to change, and where new public funding of infrastructure is required, due to climate change. This would contribute to governments' adaptive response to climate change which would in turn benefit businesses and communities.

The tools available to governments in relation to industry and regional adjustment are diverse. Targeting responses to the underlying problem rather than symptoms or providing blanket responses can be particularly beneficial (acknowledging the transactions costs of increasingly tailored responses). Clearly defining objectives is particularly important in this regard. Mistakes can be made by targeting a pre-determined approach, such as aiming for a pre-determined skill set or output mix rather than more open goals such as 'an outstandingly productive, sustainable and liveable region' (regardless of what it produces). Such an approach opens up the possibilities for action. This is especially important in the context of modern communities and climate change where flexibility, on-going innovation and creativity are so beneficial.

Options to assist regional and industry adjustment include: removing policy impediments to efficient resource movements and resource deployment; reviewing service deliveries such as education and training funding; ensuring investment in major infrastructure is efficient; and reducing unnecessary regulatory costs. In the case of policy driven adjustments, providing a staggered introduction or time for businesses or individuals to prepare can help, as can the pursuit of 'offsetting' policy burdens. Again, a comparison of alternatives and assessment of the net benefits (often over time) is essential.

In this context, revisiting and expanding current thinking on options for governments in enabling regional and industry adjustment to climate change can be useful. Given the inter-linkages across jurisdictions and the potential need for changes in Commonwealth-state arrangements, a national exploration of these issues would be desirable. The development of an enhanced national climate change policy framework to articulate the role of governments (at all levels) in assisting individuals, businesses and communities to adapt to the impacts of climate change could be an appropriate task for COAG.

Respective roles of the Commonwealth and state and local governments

The respective roles of state, local and Commonwealth governments are complex and affected by many factors. If insufficient attention is given to the selection of an appropriate level of government there can be risks of duplication (costly overlap) or gaps in governments' collective response.

In broad terms, the level of government responsible for an action should be that level that can deliver the greatest net community benefits, in terms of outcomes, cost and desirable process. Factors to consider in this context include aligning accountabilities with responsibilities; matching skills and resources; economies or diseconomies of scale; balancing innovation and diversity with consistency and standardisation; and existing activities and relationships (see Box 4). Gains from policy contestability, economies of scale and national markets should be actively sought.

Box 4: Factors to consider in determining an appropriate tier of government:

- Aligning 'accountabilities with responsibilities' – in other words, assign the delivery to the respective tier of government that has the most appropriate electoral accountability for the desired outcome. Matters of international or national significance, for example, which affect all Australians, are best managed by the Australian government, whereas matters of state or local concern are often better dealt with at a state or local level. State and local governments, as the levels of government closest to the community, are often best placed to deliver policies and programs that affect communities directly.
- Matching existing skills sets, experience and resource availability to the activity requirements – if a tier of government lacks the critical expertise or ease of access to capital that is required for effective delivery then this may suggest joint implementation or an alternative tier. If a strong knowledge of local conditions is important, this may suggest delivery is undertaken by a lower tier of government (such as a state or local government).
- Economies or diseconomies of scale – economics of scale in the design, development and delivery of 'lumpy' public services and key infrastructure assets which require significant capital and high-level coordination may be better done centrally, whereas other functions may suffer from diseconomies such that lower tiers of government may be more appropriate.

- Balancing the benefits of innovation (competition) versus the benefits of consistency (standardisation) of delivery. In certain circumstances policy contestability between jurisdictions can generate more innovative delivery solutions than a standardised (one-size-fits-all) national approach. However, for other activities, a consistent national approach is more likely to offer greater benefits. Transaction costs should be considered.
- Existing activities and relationships –government agencies which have already developed good working relationships with key farm-based stakeholders, based on mutual respect and trust, may be better placed to influence their beliefs and attitudes and ultimately facilitate the desired behaviour change.

There are also substantial constitutional factors which shape the roles of the Commonwealth and States, and these also need to be acknowledged.

In addition to considering respective roles for different governments, it is essential to highlight the importance of coordination and cooperation across Commonwealth, state and local governments.

Principles to guide government action

In addition to considering ‘what’ the potential roles of governments might be, and the potential requirements to ensure net community benefits, there are important design and process factors that are relevant to ‘how’ governments may best fulfil their prospective roles.

Useful principles to guide government policies aimed at enabling adaptation and adjustment in farming sectors include:

- not unnecessarily crowding out private sector responses or create perverse outcomes or incentives for farm businesses, i.e. government services should not be provided in competition with private providers;
- being technology neutral to ensure the market determines the least-cost path to efficient adaptation, and being equitable in their treatment of farm businesses and individuals in similar circumstances regardless of their industry or region, unless there is evidence of clear market failures or other unintended consequences;
- being based on the use of the most efficient, effective and equitable instrument or mix of instruments available;
- government’s contribution reflecting the anticipated share of public benefits when both public and private benefits are likely to result;
- integrating with policy responses for non-climate challenges facing farm businesses and governments, recognising that climate change is just one of the many drivers of adjustment;
- avoiding interventions that promote dependence on government assistance and reduce incentives for self-reliance;
- align with government’s long-term social, economic and environmental objectives in the context of intergenerational equity and where there is a risk of irreversible losses to natural capital;
- being flexible to maintain efficient and equitable outcomes given uncertainties and the prospect of change;
- avoiding shifts in risks from businesses to governments, unless doing so addresses a specific market or government failure, and facilitating change rather than preventing or impeding long term adjustment;
- targeting the problem being addressed – in particular, policies should aim to address an inefficiency or inequity in an adjustment process, not a particular outcome (such as achieving a particular output target). Governments should also avoid addressing welfare issues through policies to assist businesses because doing so often confuses the objectives of the intervention, rarely targets the welfare problem and can distort market incentives; and
- be transparent with clear lines of accountability.

In addition, policies should be reviewed and revised every few years to reflect latest projections and observed trends in climate change, and to ensure consistency with broader policy objectives. Time periods for review should be nominated in advance, along with clear evaluation frameworks.

The points on integration and flexibility in the list above are worth exploring further. First, that government’s policy responses to climate change should involve careful consideration of critical inter-relationships between the achievement of adaptive and profitable farm businesses and other policy goals, such as natural resource management goals (including water management and biodiversity objectives). In particular, there is a need to take into account the risk of perverse outcomes, where one goal (eg on-farm productivity) is improved only at the cost

of another (eg biodiversity conservation). Where trade-offs are needed, these should be transparent. Where synergies can offer greater net benefits, these should be captured.

In terms of seeking flexibility in policy levers designed to deal with a significant degree of ongoing uncertainty and change, it is worth recognising the diversity of biophysical and policy changes that may need to be taken into account in ensuring policies remain efficient and effective over time.

Part D: The role of rural research and development in assisting farm businesses to adapt to the impacts of climate change

Key messages

- There is a continuing need for the farming sectors to maintain strong productivity growth in order to cope with the potential pressures emerging from climate change.
- Rural R&D can play a critical role in assisting farm businesses to adapt to climate change, as improved farming technologies and systems will be important in reducing its potential impacts and taking advantage of opportunities.
- The Australian Government should continue to support and recognise the role that the *Climate Change Research Strategy in Primary Industries* can play in helping to facilitate the delivery of rural research and development to adapt to the impacts of climate change.
- Australian Government should continue its *Australia's Farming Future* program, with a view to expansion, to allow for further co-investment between the Australian and State Governments and industries, through the Rural R&D corporations.
- Good climate change science is a critical foundation for effective business adaptation and rural R&D. The development of a Climate Change Science Framework should therefore be supported. In doing so, State and Territory Governments, along with relevant research and industry bodies, should be effectively consulted.
- Rural R&D should adopt a systemic approach to tackling climate change impacts on the landscape that recognises the importance of natural assets and ecosystem services, and seek to deliver net environmental benefits.

The purpose of this section is to outline the role of rural research and development in assisting farm businesses to adapt to the impacts of climate change.

In an earlier section of this submission, reference was made to the role of governments in addressing market failures, including in relation to public good characteristics associated with research and development (R&D). This may occur where private enterprises may be unable to capture the benefits from an R&D investment, because the results cannot be restricted from competitor access. As a result, farm businesses and farming industries may tend to under-invest in R&D.

Implicit in this statement is the assumption that rural R&D has a role in assisting farm businesses to adapt to the impacts of climate change (this was discussed in the previous section). The Australian Bureau of Agricultural and Resource Economics (ABARE) also provides support for this assumption in a recent report on the impacts of climate change on farming sectors. In their report, ABARE (2007) concluded that:

'There is a continuing need for the agriculture sector to maintain strong productivity growth in order to cope with the potential pressures emerging from climate change. In this context, adaptation measures, including improved agricultural technologies, will be particularly important in reducing the potential impact.'

ABARE went on to make the linkage between productivity growth and R&D as follows:

'In order to respond to climate change in an efficient manner and maintain and enhance the productivity and international competitiveness of Australian industries, further research and development is required in both climate change adaptation and mitigation technologies and measures.'

This thinking has been reflected in a number of reports by government and non-government organisations in the period since the ABARE report. Most recently the Productivity Commission's (2009) Inquiry Report on *Government Drought Support* recommended that:

'Significant public funding should be directed to research, development and extension to assist farmers prepare for, manage, and recover from the impacts of climate variability and change.'

This logic is also reflected in the Victorian Government's *Future Farming Strategy*, released in 2008, and supported by initiative funding. Amongst other things, the *Future Farming Strategy* commits the Victorian Government to facilitate the farming sector's access to the information and tools it needs to anticipate and manage the impacts of climate change. It has committed \$6.22 million over four years to undertake R&D, in most cases with co-funding from industry, to provide lamb, grains and horticulture farm businesses with new technologies and strategies to enable them to adapt their specific farming systems and practices to future climate change conditions. These new technologies and strategies will be derived from the latest research and will integrate with existing and planned government and industry practice change programs to ensure that farm businesses have access to the best and most appropriate management practices.

This specific program is complemented by a major initiative to drive innovation in the dairy industry (\$8.57 million over four years) to enable dairy farm businesses to access the information and technology they need to boost annual industry productivity in the context of climate change and other pressures.

Both of these actions are in addition to the ongoing funding that the Victorian Department of Primary Industries invests in rural R&D, which is increasingly taking into account the predicted impacts of climate change in its design and implementation.

In turn, the Government of Victoria recognises the support that the Australian Government is making to climate change R&D through the Climate Change Research Program component of *Australia's Farming Future* initiative. As such, we urge the Australian Government to continue this program, with a view to expansion, to allow for further co-investment between the Australian and State Governments and industries, through the Rural R&D corporations.

It is important that these emerging innovative R&D technologies and practices are adopted on farm, if they are to contribute to increasing the adaptive capacity and competitiveness of the Australian farming sector. For a number of farm businesses there can be a substantial gap between actual productivity and potential good practice due to a lack of information on innovation possibilities. The Victorian Government will help facilitate the flow of this information through a collaborative service delivery model that wholesales the outputs of R&D to partners in service delivery to provide efficient and effective practice change services to all farm business sectors.

In undertaking R&D to assist farm businesses to adapt to the impacts of climate change, the value and benefit of collaborative R&D efforts are recognised and supported. To that end, the Government of Victoria, as represented by the Department of Primary Industries, has made a clear commitment to support and participate in the Climate Change Research Strategy for Primary Industries (CCRSPI). CCRSPI has been established under the auspices of the Primary Industries Ministerial Council (PIMC) and its National Framework for Research Development and Extension. It is the only body involving all major rural R&D and extension providers and funding bodies including all rural R&D corporations, State Government primary industries departments, CSIRO, and the Australian Government, through the Department of Agriculture, Forestry and Fisheries.

From Victoria's perspective, CCRSPI has already demonstrated its potential worth in a coordinating, facilitating and brokering role for rural R&D investment in the recent call for project proposals by DAFF for its Climate Change Research Program, funded under the Commonwealth's *Farming Future* initiative. CCRSPI has also provided a comprehensive summary of existing climate change research and development, and identified many gaps and major opportunities for new collaboration. The scale and nature of the climate change challenges for farming sectors means resources can ill afford to be wasted on duplication or for key projects to fail due to a lack of critical funding or coordination.

As such, the Victorian Government would urge that the Federal Government continues to support and recognise the role that CCRSPI can play in helping to facilitate the investment in, and delivery of rural research and development to adapt to the impacts of climate change.

Victoria is also supportive of the Commonwealth Government's decision to develop a national framework for climate change science. Good climate change science is critical to inform business and individual adaptation, along with R&D and extension activity. The development of such a framework provides the opportunity for Australia to more efficiently and transparently prioritise information needs, target capability requirements, gain synergies from domestic and overseas climate science efforts and, in doing so, guide investment in climate science and applied research. In doing so, however, it is critical that the framework has clear objectives and accountabilities, articulates clear roles for Commonwealth, State and Territory governments and the private sector, establishes criteria for developing priorities, and links climate science research with policy and decision making processes.

Part E: Concluding comments

The potential challenges and opportunities for farm businesses resulting from the many and varied implications of climate change are enormous. Businesses that can adapt to these changes and make the most of them and integrate them with the other changes occurring in the markets and environment they operate in, are likely to prosper.

Farm businesses in Victoria as well as other parts of Australia have an outstanding ability to adapt to change. The wide range of adaptations already occurring in Victoria provides an indication of choice of options that are currently available and which could be more widely adopted moving forward. However, the climate related challenge facing farm businesses is growing, adding to an array of other factors affecting business performance. Productivity growth, innovation and flexibility are key to ongoing profitability in the sector.

Most of this response will be business driven. By responding to their own needs and preferences, farm businesses can best develop optimal adaptation responses that are business specific, locally-appropriate and cost-effective.

However, governments have important roles in enabling farm businesses adapt by addressing market failures and unnecessary policy impediments. Governments also have important roles in responding to other market failures, such as managing 'public goods' (eg 'biodiversity') and social equity objectives. This submission has outlined a number of circumstances when this occurs and provided guidance of how governments may achieve their goals most efficiently and equitably.

Critically, however, to respond to the challenges and opportunities of climate change as a community the roles of respective parties – government, business, individuals and community groups – must be clear. As much as possible they should be agreed and owned by these parties, at least the high level principles and frameworks. An important role of government is to show leadership on outlining its role and engaging with businesses and communities on this. The Victorian Government's forthcoming Climate Change White Paper will contribute to this. This inquiry is also pertinent in this regard.

Businesses, research organisations and government agencies, including DPI Victoria, are investing strategically in many areas to develop new technologies, practices and systems to build the adaptive capacity of farming sectors to meet the challenges and make the most of the opportunities that arise. The Victorian Government clearly sees the role of rural research as central to the farm sectors overall ability to lift productivity, meet the expectations and possibilities it can offer, and to prosper into the future. It also recognises that to capture the full value of R&D new practices and technologies need to be transferred to farm businesses so they can integrate innovations into their primary production systems. The Victorian Government's *Future Farming* strategy and related *Better Services to Farmers* initiative are examples of the Government's commitment in these areas. Collaboration and cooperation across relevant parties will be important in delivering these opportunities.

A number of important policy issues have been articulated throughout this submission. In this respect, it is useful to conclude by highlighting some of the key issues for government's attention moving forward:

- Developing an agreed national policy framework to articulate the role of governments (at all levels) in relation to climate change in enabling individuals, businesses and communities to adapt to the diverse implications of climate change, which includes transitional and adjustment assistance.
- Undertaking whole-of-government reviews of priority areas where asset management may need to change, and where new public funding of infrastructure is required, due to climate change, would contribute to governments' adaptive response, which in turn would benefit businesses and communities.
- Pushing ahead with strategic investments in rural research and development taking into account the *Climate Change Research Strategy for Primary Industries* and other national processes.
- Reviewing existing policy, regulatory and investment arrangements that may be impinging on the ability of farm businesses to efficiently and effectively adapt to the impacts of climate change.
- Developing and maintaining adaptive and flexible policy options in the face of considerable uncertainty in regard to future climate changes, emerging technologies and evolving markets and policies.

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