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## Climate change response strategy

Anne Bennett

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### Recommended Citation

Bennett, A. (2010), *Climate change response strategy*. Department of Primary Industries and Regional Development, Western Australia, Perth. Bulletin 4790.

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# Climate change response strategy



# Climate change response strategy

**Compiled by Anne Bennett**

**February 2010**



Department of  
**Agriculture and Food**



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## **Acknowledgments**

The climate of Western Australia is changing. This will affect all agricultural industries and therefore needs to be factored into planning and execution of all research and extension projects within the Department.

Development of a climate change response strategy for an organisation as large and diverse as the Department of Agriculture and Food has involved input from many individual staff members and teams over many months. The suggestions and comments received have been greatly appreciated.

We also thank the Office of Climate Change in the Department of Environment and Conservation, the Forest Products Commission, the Department of Premier and Cabinet, the Department of Treasury and Finance, the Department of Regional Development and Lands, and the Department of Water for their valuable feedback.

The resulting document will play a valuable role in guiding DAFWA climate change work over coming years.

## Foreword

The weight of scientific evidence indicates that:

- Human-induced global climate change is occurring and is having biophysical, social and economic impacts at local, regional and national scales that will likely become more severe over the coming decades.
- Discerning and measuring long term climate change, as distinct from climate variability, is complex, difficult and uncertain. Predicting future climate change is even more so. This new requirement is beyond individual farmers.
- Climate change presents both opportunities and threats for different agricultural products and for the communities that depend on them.
- Communities and their component sectors will vary in their vulnerability to the impacts of climate change, and some may reach critical thresholds sooner than others.

Climate change and policies introduced to reduce emissions will affect the agricultural sector and will lead to social and economic outcomes.

The cost of climate change will greatly depend on how well prepared communities are to respond. How risks are managed could mean the difference between costly remedial or crisis action, affecting the economic and social well being and stability of either Western Australia's rural and urban communities, or managed, integrated change enabling rural communities to continue to be sustainable in the long term.

In addressing the Government priority plan for the agriculture and food sector the Department of Agriculture and Food has identified five roles it can play to assist industry to adapt and respond to climate change:

1. Provide leadership in the context of Western Australia's Government policies and priorities
2. Raise awareness of climate change issues and provide information and training necessary for agribusiness to make informed decisions
3. Ensure climate change issues specific to Western Australia are addressed through innovative responses including research and development
4. Provide policy advice and strategic analysis of climate change issues to government
5. Facilitate linkages between government agencies, research institutions and industry to deliver successful outcomes in climate change research and development and land use planning.

This document consolidates information from across the Department to provide a balanced and coordinated strategic direction for climate change activities by identifying and prioritising key actions to be achieved over the next five years. All directorates have a responsibility to align their climate change activities with the identified actions.

The strategy is split into four chapters:

- emissions abatement
- carbon sinks
- adapting to climate change
- communication within the Department and with other governments.

Each chapter provides an overview, review of progress to date, key outcomes sought and a prioritised list of future works that will contribute to the achievement of the outcomes. High priority actions will be targeted initially. Although divided into chapters, none of the responses can be seen in isolation. Cognisance of future climate change needs to underpin all current and future research undertaken by the Department. Adaptation responses need to consider mitigation responses and vice versa while considering the greenhouse gas emissions that may be contributed.

Actions identified in each chapter are categorised according to the identified roles of the Department as providing information, innovative responses including research and development, policy and strategic analysis and facilitating linkages. Collectively, the actions ensure the Department is providing appropriate leadership in the context of the Government's policies and priorities. A table summarises outcomes and actions at the end of each chapter, providing a priority for each output and timeframe within which it needs to be completed.

The eight high priority short-term actions listed below have been identified in developing this strategy and will be the focus of the Department's climate change work.

- Continue to participate in and influence national research programs for the benefit of WA agriculture through improving emission estimates and identifying cost effective abatement technologies, focusing on enteric fermentation and savanna burning.
- Undertake economic analysis of costs, benefits and possible consequences to farming businesses of mitigation policies including the proposed Carbon Pollution Reduction Scheme using a range of farming systems models for industries/regions.
- Provide information products to producers on opportunities and risks arising from voluntary and mandatory carbon trading markets.
- Participate in Commonwealth Government policy processes investigating the best way to reduce greenhouse gas emissions from agriculture to ensure issues specific to WA agriculture are recognised.
- Undertake economic analysis of costs and benefits in the agricultural supply chain under emissions reduction policies such as the proposed Carbon Pollution Reduction Scheme.
- Assess how mitigation policies such as the Carbon Pollution Reduction Scheme and Renewable Energy Target will drive adoption of tree systems on rural land.
- Provide information on how trees can be integrated into conventional agricultural systems and the different types of trees available for sequestration.
- Participate in and influence State climate change policy and programs.

The actions listed in the strategy provide a framework for the Department on climate change, and our climate change initiatives will align with this strategy.



Rob Delane  
DIRECTOR GENERAL

February 2010

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# Chapter 1: Emissions abatement

## 1.1 Identified outcomes

The following outcomes in relation to emissions from agriculture are sought in the next five years:

- greenhouse gas emissions for agricultural systems and industries understood and quantified
- farmers have access to information on greenhouse gas emissions on-farm and options for management
- agriculture sector positioned to take advantage of the opportunities and respond effectively to the threats arising from the introduction of the proposed Carbon Pollution Reduction Scheme and/or alternative greenhouse mitigation policies
- food sector able to respond to the requirements of the proposed Carbon Pollution Reduction Scheme.

## 1.2 Overview of Australia's emissions

Australia reports its emissions against its commitments under both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, which has binding targets. The inventory is compiled in accordance with guidelines from the Intergovernmental Panel on Climate Change (IPCC)<sup>1</sup>, which has five main emission sectors: energy; industrial processes; agriculture; waste; and land use, land-use change and forestry (LULUCF).

There is a difference between the reporting for the Kyoto Protocol and the UNFCCC relating to the LULUCF sector which can be seen in the LULUCF figures in Table 1. Under the UNFCCC all carbon dioxide emissions from the LULUCF sector are included. However under the Kyoto Protocol LULUCF activities are more narrowly defined. Nations are required to report on afforestation, deforestation and reforestation, and can also opt to include other activities such as crop land management and revegetation. However, the Australian Government chose to exclude the optional activities from its Kyoto reporting (DCC 2009a). See Chapter 2 for further details on Articles 3.3 and 3.4 sinks.

A breakdown of emissions (megatonnes of carbon dioxide equivalents) from each of the sectors in 2007 according to both the UNFCCC and Kyoto accounting methodologies is provided in Table 1.

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IPCC 1996, Revised Guidelines for National Greenhouse Gas Inventories.

Table 1 **Estimates of greenhouse gas emissions based on 2007 from Australia's national accounts (DCC 2009a,b)**

Sector	Greenhouse gas emission estimates megatonnes of carbon dioxide equivalents		
	UNFCCC (Australia)	Kyoto (Australia)	Kyoto (WA)
<b>Stationary energy</b>	291.7	291.7	41.6
Transport	78.8	78.8	9.6
Fugitive emissions from fuel	37.7	37.7	4.3
Industrial processes	30.3	30.3	7.1
Agriculture	88.1	88.1	13.5
Waste	14.6	14.6	1.3
<i>Total net emissions (excl. LULUCF)</i>	<i>541.2</i>	<i>541.2</i>	<i>77.5</i>
Land use, land-use change and forestry (LULUCF)	284.7	56.0	-1.2
<b>Total net emissions (incl. LULUCF)</b>	<b>825.9</b>	<b>597.2</b>	<b>76.3</b>

### 1.3 Agricultural greenhouse gas emissions

Agricultural greenhouse gas emissions are methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). Methane and nitrous oxide are potent greenhouse gases with a global warming potential 21 and 310 times that of carbon dioxide, using a 100-year time horizon (DCC 2009a). Emissions from agriculture are estimated using the following categories as provided by the IPCC guidelines (DCC 2009b):

- Enteric fermentation (CH<sub>4</sub>)
- Manure management (CH<sub>4</sub> and N<sub>2</sub>O)
- Rice cultivation (CH<sub>4</sub>)
- Agricultural soils (N<sub>2</sub>O)
- Savanna burning (CH<sub>4</sub> and N<sub>2</sub>O)
- Field burning of agricultural residues (CH<sub>4</sub> and N<sub>2</sub>O).

Emissions from on-farm vehicle fuel use are accounted for in the transport sector; burning of fuel in plant, equipment and electricity use are reported under the energy sector; and emissions and sequestration from land clearing, forestry, management of biomass and soil carbon are reported in the LULUCF sector. However, it should be noted that Australia elected not to include activities associated with Article 3.4 of the Kyoto Protocol such as soil carbon, rangelands management, native forests and revegetation in its national accounts for the first Kyoto reporting period (DCC 2009c).

Agriculture sector emissions are a grouping of heterogeneous activities including intensive and broadscale cropping and livestock production.

Emissions from agriculture have unique characteristics. Unlike those from other sectors, those from agriculture are derived from biological reactions. In effect, this means that emissions are costly to assess, are subject to variations over time and across regions, interactions between climate, land type, management, and the genetic characteristics of crops and livestock (Garnaut 2008).

Agricultural emissions are also considered as generally diffuse, making them difficult to monitor and measure. They are generated on an irregular basis from multiple and variable points but can also be from single point-sources, for instance intensive animal industries such as feedlots (Garnaut 2008).

## 1.4 Estimating emissions and abatement options

Estimations of emissions from agriculture are generally inaccurate due to on-site differences as well as limited scientific research providing emission baselines. Emissions are calculated using emission factors which are an average from a particular activity, based on the best available research. An emission estimate is calculated by multiplying an activity by an emission factor. Default emission factors set by the Intergovernmental Panel on Climate Change are based on global averages. These are used where regional or country-specific data are not available (IPCC 2006).

Methods for estimating emissions and removals are divided into three tiers (IPCC 2006):

*A tier represents a level of methodological complexity. Usually three tiers are provided. Tier 1 is the basic method, Tier 2 intermediate and Tier 3 most demanding in terms of complexity and data requirements. Tiers 2 and 3 are sometimes referred to as higher tier methods and are generally considered to be more accurate.*

For example, in estimating methane emissions from livestock, Tier 1 methodologies consider only livestock type and numbers, whereas Tier 2 methodologies consider animal and feed characteristics.

In Australia reporting of emissions from agriculture is generally a mix of Tier 1 and Tier 2, and the estimates are made on a State or Territory basis. The only exception is for cattle in WA where estimates are made on a regional basis. Lack of scientific data prevents further regionalisation of emissions estimation (DCC 2009b).

The emission factor used could have financial consequences for producers if a price is placed on carbon. For example, research at Cunderdin investigating nitrous oxide emissions from cropping has demonstrated that emissions at this site are about 60 times less than the default value suggested by the IPCC.

This evidence, along with other research from eastern Australia, has led Australia to adopt a 'country-specific' nitrous oxide emission factor of 0.3 per cent of applied nitrogen for 'non-irrigated crops', instead of the IPCC default value of 1.25. An estimate of the benefits of this work can be derived by using an example of a farmer applying 70 kg N/ha to 1000 ha/yr.

Using the IPCC factor for nitrous oxide of 1.25 per cent, approximately 0.43 tonnes of carbon dioxide equivalents are produced per hectare from nitrogen fertiliser. If a farmer had to purchase carbon pollution permits at a price of \$20 per tonne this would have an estimated cost of \$8.60 per hectare or \$8600 for 1000 hectares.

When the new emission factor of 0.3 per cent is used the emissions per hectare from the fertiliser are reduced to 0.10 tonnes of carbon dioxide equivalents. If a farmer had to purchase carbon pollution permits at price of \$20 per tonne this would have an estimated cost of \$2.00 per hectare or \$2000 for the entire farm.

It is clear from this example that emissions research to increase the accuracy of emissions accounting for agriculture is critical to effectively manage possible associated costs. The example also suggests that improving certainty around emissions from the more significant contributing agricultural activities will likely provide better returns on investment than focusing on areas of lesser contribution.

Using estimates of greenhouse gas emissions from example livestock classes for the South West of the State, and assuming a carbon price of \$20/t CO<sub>2</sub>-e provides an indication of the potential cost of emissions per animal:

- Steer 1-2 years = \$32.20/yr
- Wether = \$3.40/yr
- Pig = \$21.60/yr.

Assuming a steer is equivalent to 8 DSE (dry sheep equivalents) and a wether is 1 DSE cost per hectare can be generated. Assuming a stocking rate of 4.5 DSE/ha for wethers the cost would be approximately \$15/ha and for steers about \$18/ha. Estimates do not include emissions from pastures. Values were obtained using the FarmGas calculator from the Australian Farm Institute ([www.farminstitute.org.au](http://www.farminstitute.org.au)).

To determine where to guide research in this area it is useful to determine what contribution each activity provides to agricultural emissions and to reflect on the estimated uncertainty of the emissions factor. Table 2 lists the seven categories in the agricultural sector that contribute 1 per cent or more of agricultural emissions (based on Australia's national accounts 2007), and lists the estimate of uncertainty for the emission factor calculated by the Department of Climate Change (DCC 2009b). The overall estimate of emissions uncertainty for the national inventory is  $\pm 3$  per cent. Table 2 shows there is significantly more uncertainty associated with a number of emissions from agriculture.

**Table 2 Western Australian agricultural activities contributing 1% or more to total agricultural emissions, based on national accounts (DCC 2009b,d)**

Activity	Contribution (%)	Emission uncertainty
Savanna burning (28% from grassland and 72% woodland)	33	-52 to +112 (CH <sub>4</sub> ) -55 to +115 (N <sub>2</sub> O)
Enteric fermentation from cattle (7% from dairy, 4% feedlot and 89% free range)	24	-5.1 to +5.9 (CH <sub>4</sub> )
Enteric fermentation from sheep	21	-5.1 to +5.9 (CH <sub>4</sub> )
Indirect emissions from soils (61% from atmospheric deposition, 39% leaching and run-off)	9	-61 to +107 (N <sub>2</sub> O)
Direct soil emissions (56% from synthetic fertilisers, 6% animal wastes applied to soils, 16% nitrogen-fixing crops and 22% crop residues)	7	-30 to +42 (N <sub>2</sub> O)
Emissions from soils from animal production	4	-49 to +120 (N <sub>2</sub> O)
Manure management of swine	1	-9.8 to +11.1 (CH <sub>4</sub> ) -10.1 to +10.6 (N <sub>2</sub> O)

Work undertaken by Kingwell (2009) identified the crucial need for research and development into emission reductions for farming businesses. In particular this work highlights the need for research into methane emissions from livestock due to the emissions intensity and the important role of livestock in the farming system. Therefore future work by the Department of Agriculture and Food should focus on enteric emissions from livestock (45 per cent) with the bulk of these emissions from free range cattle and sheep. It is unlikely that emissions from savanna will be allocated to agriculture under an emissions trading scheme or other policy mechanism, but there could be opportunities to benefit from reducing savanna burning emissions.

## 1.5 Proposed Carbon Pollution Reduction Scheme

The Australian Government has set a target to reduce greenhouse gas emissions to 60 per cent below 2000 levels by 2050. This target will be achieved via a range of policy mechanisms. The key mechanism the Government aims to use is an emissions trading scheme. The proposed scheme is called a *Carbon Pollution Reduction Scheme* (DCC 2008).

Under the proposed scheme agriculture will not be required to incur a liability for its direct emissions. However, producers will incur an indirect carbon price in many inputs such as energy and fertiliser. Some preliminary economic modelling on the financial implications of the introduction of the CPRS on Western Australian agriculture suggests farm profits will decrease by 4 per cent. This is based on a farm in WA's central wheatbelt, a carbon price of \$25 per tonne, and on the limited details available on the CPRS.

Agriculture will have the opportunity to generate offsets into the scheme from activities that count in Australia's greenhouse gas emissions reporting obligations.

To be able to provide offsets cost effectively, internationally recognised technologies and practices to reduce emissions will need to be identified. For example, at present there are no proven cost effective technologies available for reducing methane emissions from broadscale ruminant sources. Options recognised through Kyoto accounting are limited to reducing stock numbers or modest improvements in production efficiencies.

Offsets need to meet the principles of permanence, additionality, measurability, avoidance of leakage and be verifiable. Work will need to be undertaken by DAFWA to contribute to the development of national offset methodologies to ensure Western Australia's circumstances are recognised.

Savanna burning emissions are unlikely to be covered under an emissions trading scheme. Instead, the Commonwealth has stated interest in facilitating the participation of indigenous land managers in carbon markets with offsets for reducing emissions from savanna burning or through forestry (DCC 2008).

The burning of biomass will be considered as emissions neutral under the proposed CPRS. This provides an opportunity for agriculture in production of energy using biofuel and biomass discussed in Section 1.4 (DCC 2008).

## 1.6 Bio-energy

Using organic matter such as agricultural residues or forestry to create energy is referred to as biomass energy. Organic matter can also be used to create fuels such as biodiesel or ethanol, and this is commonly referred to as biofuel.

The proposed CPRS considers the burning of biomass and biofuels as emissions neutral and the Australian Government Renewable Energy Target (RET) could also have positive implications for the development of biomass energy industries. The RET requires that 20 per cent of Australia's electricity supply to come from renewable energy sources by 2020. The RET scheme provides a market incentive to accelerate the uptake of renewable energy sources including biomass, and is projected to increase demand for biomass energy production and biomass plantings in WA. Under the proposed CPRS energy from biomass will be treated as carbon neutral which may influence development beyond that required by the RET as the costs of traditional energy sources become more expensive and energy security concerns industry and governments.

Biofuels can provide alternative niche opportunities for fuel sources for farmers and the community, although are unlikely to be a major alternative source of transport energy. The State Government is developing a response to the Biofuels Taskforce Report which was completed in 2007.

There are a number of issues with intermittent generation from some renewable energy sources such as solar and wind which are not faced by biomass energy production. However, feedstock supply could be affected by factors such as fire or drought.

Biomass energy could have potential benefits to regional communities through the provision of more reliable energy supplies, and diversification of industries. However, an increase in biomass energy using trees as a feedstock could have long-term consequences such as the permanent conversion of productive agricultural land to trees and further depletion of ground and surface water supplies.

Crop residues in Western Australia could provide niche opportunities in feedstock for biomass energy. In 2004-05 agricultural waste biomass was estimated to be 26.4 million tonnes. The use of stubble for biomass production could have benefits such as additional income for growers and improved disease management through its removal from paddocks. But this must be weighed against the costs of removing stubble such as loss of organic carbon from the system, increased risk of wind erosion, and nutrient depletion. The Department has previously estimated the soil nutritional value of leaving stubble in the paddock to be approximately \$30 per hectare, although this figure does not account for any structural benefit and enhanced rainfall infiltration. The main challenge of using agricultural crop wastes for bio-energy is the cost and logistics of collection of the material and then transport to the biomass plant (Doug McGhie & Associates 2006).

Biogas generated from intensive animal industries and human waste is currently under-utilised and has potential to be more fully integrated into regional power supplies in a cogeneration capacity.

Biomass energy can also be produced through pyrolysis. This is a process where biomass is heated in a low-oxygen or no-oxygen environment to produce combustible synthetic gas, bio-oil and biochar. The gas and oil can be then be used to produce energy, and the biochar could potentially be used as a soil improver or long-term carbon store (Sohi et al. 2009).

However, the production benefits of biochar for agriculture are inconclusive. Further research is needed to assess optimal application rates, production benefits, long-term stability, toxicity potential and leaching, variability of feedstocks and logistical challenges.

Biochar is not recognised as a form of carbon sequestration under Kyoto accounting methodologies. However, it could be recognised under the National Carbon Offsets Standard. A biochar project would need to give consideration to the benefits from incorporating it into soils, the costs of transportation, allocation of the carbon right, risks of carbon loss through soil erosion, and alternative ways to store the carbon (for example burying the biochar).

## 1.7 Food industry emissions

A number of programs are available to help small businesses reduce their emissions. For example, a number of local governments provide programs through *Cities for Climate Protection*, and initiatives such as *Climate Wise* run through the South Metropolitan Regional Council. Various companies offer services to larger food companies seeking to develop strategies to manage emissions.

The food sector contributes to the production of greenhouse gas emissions through energy use, landfill and waste water emissions (DCC 2008). There is some difficulty in estimating total emissions from this sector using the national accounts.

To understand the consequences to the WA food industry of a price being placed on carbon, the Department will need to analyse if and how the industry will be covered under the scheme, and investigate the flow-through consequences such as increased food prices and higher input prices for manufacturers.

For instance, some food processors may have to surrender scheme permits because of their direct waste water and fuel combustion emissions. The threshold for coverage under the scheme is 25,000 tonnes of CO<sub>2</sub>-e annually from a facility. For most food processors, energy emissions will be covered upstream (the electricity generator will be liable) and the costs passed through. This will have implications for production costs and consequently food prices, and may affect demand for some products.

The proposed CPRS will provide assistance to food processors with obligations under the scheme through the provision of \$150 million over five years to install emission reduction measures. Larger food processors may also be eligible to access assistance for two years from the \$1.1 billion Transitional Electricity Cost Assistance Program.

Consumers are also becoming concerned with the greenhouse credentials of their food. Most recently this has been determined through the concept of 'food miles', the distance the food has travelled prior to consumption. However, greenhouse gas emissions embedded in food are more complex than just measuring distance travelled. For example, a recent study compared the total energy used in producing and transporting vegetables from New Zealand to the United Kingdom and the energy use for the same vegetables grown in the UK. The study found the total energy used for the New Zealand vegetables was lower than for those produced in the UK. That is because the energy used in transportation to deliver food products to consumers was only a small component of the total production process.

## 1.8 Work already underway

### ***Information and training***

The Department has:

- Developed a score card for farmers to determine environmental impact including greenhouse gas emissions.
- Developed a greenhouse emissions calculator and compiled an inventory of the challenges for reduction of greenhouse gas emissions.
- Undertaken work investigating on farm energy management resulting from practices such as precision agriculture and developing an on-farm energy use calculator.
- Published factsheets on the Carbon Pollution Reduction Scheme, emissions from agriculture, and the research investigating livestock emissions at Vasse.
- Developed best management practice guidelines for energy management in the form of a self-assessment tool and on-farm calculator to estimate fuel emissions from farming properties.
- Presented information on the proposed Carbon Pollution Reduction Scheme and agricultural emissions and mitigation at a number of workshops, seminars and conferences.

### ***Innovative responses including research and development***

The Department:

- Has contributed to national processes such as the Climate Change Research Strategy for Primary Industries (CCRSPI) that are run through ministerial committees to identify the key areas for research in climate change. The CCRSPI Strategy can be found at <http://lwa.gov.au/ccrspi/>
- Has received funding to investigate nitrous oxide emissions from cropping systems, emissions from cattle at Vasse Research Centre and the *Greener Pastures Project* which aims to increase the efficiency of nitrogen use in intensively grazed pasture systems to reduce nitrous oxide.
- Has reviewed a number of biofuel options such as biodiesel from canola and ethanol from crop residues, and continues to investigate species for their biofuel potential.
- Has undertaken research in controlled traffic farming (tramlining) to reduce greenhouse gas emissions from fuel use.
- Through its role with the Cooperative Research Centre for Sheep Industry Innovation (Sheep CRC) is involved in a number of projects related to methane mitigation and adaptation to climate change. The CRC program is led by the Department and includes:
  - Investigation of management and genetic options for reducing greenhouse gas emissions from sheep. This includes quantifying the heritability of methane emissions output and establishing the correlations between emissions output and production traits and feed conversion efficiency. Benefits arising from reducing greenhouse gas emissions with cost effective activities will have flow-through benefits to the production system by improving overall efficiency.
  - Matching genetics to production systems better able to cope under different climate change scenarios. The project will define how to select for sheep that are better able to cope with periods of poor nutrition (have 'doing ability') and value the impact of selecting for wool, meat, 'doing ability' and resistance to worms and flies on-farm profit, labour use, ease of management and sheep health.

- Development and delivery of *Lifetime Ewe Management* that aims to develop skills and confidence in pasture and sheep assessment and management to improve farmers' ability to cope with climate change.

### ***Policy and strategic analysis***

The Department has:

- Undertaken a number of economic studies investigating the implications of an emissions trading scheme on agricultural businesses (used as input in development of a response to the proposed CPRS).
- Investigated incentive programs to encourage the early adoption of greenhouse gas emission abatement practices.
- Commissioned life cycle assessment of biofuel production in Western Australia.
- Provided executive scientific support to the WA Biofuels Taskforce that provided its final report to Government in 2007.

## **1.9 Future work**

Future work will identify outputs to achieve the outcomes identified in Section 1.5. Table 3 assigns a priority and timeframe to each of the outputs identified below.

### ***Information and training***

- Develop and deliver extension materials encompassing research findings, information on emissions and emissions management and practical decision support tools to allow producers to assess on-farm emissions and emission reduction strategies for their businesses.
- Provide information products to producers on opportunities and risks arising from voluntary and mandatory carbon trading markets.
- Provide information to consumers on greenhouse gas emissions from WA food.

### ***Innovative responses including research and development***

- Continue to participate in and influence national research programs for the benefit of WA agriculture through improving emission estimates and identifying cost effective abatement technologies, focusing on enteric fermentation and savanna burning (also contributes to the DAFWA identified role of facilitating linkages).

### ***Policy and strategic analysis***

- Undertake economic analysis of costs, benefits and possible consequences to farming businesses of mitigation policies including the proposed Carbon Pollution Reduction Scheme using a range of farming systems models for industries/regions.
- Undertake economic analysis of costs and benefits to the agricultural supply chain under emissions reduction policies such as the proposed Carbon Pollution Reduction Scheme.
- Participate in Commonwealth Government policy processes investigating the best way to reduce greenhouse gas emissions from agriculture to ensure issues specific to WA agriculture are recognised (also contributes to the role of facilitating linkages).
- Analyse the implications of other international carbon pricing schemes and identify the likely implications for trade of Western Australian agricultural commodities.
- Investigate the opportunities for biomass energy in WA and the impacts on agricultural production resulting from the Renewable Energy Target and proposed Carbon Pollution Reduction Scheme.

- Implement the Government response to the Biofuels Taskforce report (also contributes to the role of facilitating linkages).

Table 3 Emissions abatement outcomes, actions, priority and timing

Outcome	Action	Priority*	Timing <sup>#</sup>
Greenhouse gas emissions for agricultural systems and industries understood and quantified	Continue to participate in and influence national research programs for the benefit of WA agriculture through improving emission estimates and identifying cost effective abatement technologies, focusing on enteric fermentation and savanna burning.	H	ST
Farmers have access to information on greenhouse gas emissions on-farm, and options for management	Develop and deliver extension materials encompassing research findings, information on emissions and emissions management and practical decision support tools to allow producers to assess on-farm emissions and emission reduction strategies for their businesses.	H	MT
Agriculture sector positioned to take advantage of the opportunities and respond effectively to the threats arising from the introduction of the proposed Carbon Pollution Reduction Scheme and/or alternative greenhouse mitigation policies	Undertake economic analysis of costs, benefits and possible consequences to farming businesses of mitigation policies including the proposed Carbon Pollution Reduction Scheme using a range of farming systems models for industries/regions.	H	ST
	Provide information products to producers on opportunities and risks arising from voluntary and mandatory carbon trading markets.	H	ST
	Participate in Commonwealth Government policy processes investigating the best way to reduce greenhouse gas emissions from agriculture to ensure issues specific to WA are recognised.	H	ST
	Analyse the implications of other international carbon pricing schemes and identify the likely implications for trade of WA agricultural commodities.	M	LT
	Investigate opportunities for biomass energy in WA and impacts on agricultural production resulting from the Renewable Energy Target and proposed CPRS.	M	MT
	Implement the government response to the WA Biofuels Taskforce report.	L	LT
Food sector able to respond to requirements of the CPRS	Undertake economic analysis of costs and benefits to the agricultural supply chain under emissions reduction policies such as the proposed Carbon Pollution Reduction Scheme.	H	ST
	Provide information to consumers on greenhouse gas emissions from WA food.	M	MT

\* H = High (agency must deliver output), M = Medium (preferable for agency to deliver output), L = Low (nice if this were to happen)

<sup>#</sup> ST = Short-Term (to be completed in the next year), MT = Medium-Term (to be completed within 1-3 years), LT = Long-Term (to be completed within 3-5 years)

## Chapter 2: Carbon sinks

### 2.1 Identified outcomes

The following outcomes in relation to carbon sinks are sought in the next five years:

- improved coordination and management of soil carbon research in WA
- industry and farmers informed of the opportunities and risks of trading carbon
- forestry and agriculture contribute to long-term opportunities in rural WA
- cost effective sequestration options identified, researched and proven.

### 2.2 Types of sinks

A carbon sink is something that absorbs (sequesters) carbon from the atmosphere through biological processes. The Kyoto Protocol allows for certain carbon sinks to be used to offset or compensate for emissions from other sectors.

Western Australia's rangelands and cleared agricultural lands have a large potential for carbon storage through the establishment of forests, trees and other perennial vegetation and through changes in land management practices. In the publication *Opportunities for the Western Australian land management sector arising from greenhouse gas abatement* (CRC for Greenhouse Accounting 2003) it was estimated that by reforesting all agricultural land a maximum of 2091 megatonnes of carbon dioxide equivalents (Mt CO<sub>2</sub>-e) could be sequestered, and by destocking the rangelands a maximum of 3072 Mt CO<sub>2</sub>-e could be sequestered.

Large scale and well targeted investment in revegetation of cleared farmland for carbon sink purposes could also have other benefits such as managing dryland salinity, land degradation and biodiversity loss.

There are considerable opportunities for the market associated with carbon sinks to support new rural industries and provide a more diversified base for rural economies and communities.

Carbon sinks fall into two categories under the Kyoto Protocol: Article 3.3 and Article 3.4. To qualify as an Article 3.3 forest a stand of trees will need to meet the following guidelines:

- a forest of trees with a potential height of at least 2 metres and crown cover of at least 20 per cent
- in patches 0.2 hectares or more in size
- established after 1 January 1990
- on land that was clear of forest at 31 December 1989 (not land cleared since 1990)
- established by direct human-induced methods, i.e. planting or direct seeding, or human-induced promotion of regeneration from natural seed sources (DCC 2009e).

Article 3.3 sinks are accounted in both Kyoto and UNFCCC reporting. The three subsets are afforestation, reforestation and deforestation. The Kyoto Protocol has specific definitions for each term, broadly that:

- Afforestation is the human-induced forestation of land that has not been forested for a period of at least 50 years.

- Reforestation refers to the human-induced forestation of land that was forested but has not been converted to non-forested land.
- Deforestation is the human-induced conversion of forested land to non-forested land (DEH 2006).

The proposed Carbon Pollution Reduction Scheme design allows afforestation and reforestation activities to voluntarily opt into and generate permits (DCC 2008). The Commonwealth indicated maps would also be developed to assist stakeholders to determine the eligibility of their forests.

There will be a number of legal requirements associated with trading carbon such as:

- who is legally entitled to the benefit of the sink
- how long the sink will need to be maintained after the first permit is issued. In the proposed CPRS the Commonwealth has indicated the sink will need to be maintained for 100 years.

A number of sequestration activities fall outside these specifications. The Kyoto Protocol makes allowance for some of these sinks through Article 3.4.

Article 3.4 activities as defined by the Kyoto Protocol relevant to agriculture are revegetation, forest management, cropland management and grazing land management (DEH 2006). Activities such as increasing soil carbon, the planting of saltland pastures or revegetation of degraded areas fall within the scope of Article 3.4 sinks.

Australia elected not to include Article 3.4 activities in the first Kyoto commitment period. The proposed Carbon Pollution Reduction Scheme (CPRS) is based on Australia's approach to Kyoto and consequently Article 3.4 sinks are not proposed to be included in the CPRS at first.

A number of these sinks could comply with the National Carbon Offset Standard (NCOS) and generate offsets for the voluntary market. Sinks can be used in the voluntary market that does not comply with the NCOS.

Article 3.4 activities have the potential over time to sequester significant amounts of carbon dioxide either as soil carbon or plant biomass. However, natural events such as drought and fire could result in this sequestered carbon dioxide being re-emitted to the atmosphere within a very short timeframe.

Under the CPRS (if these sinks were included later), this means that the carbon lost back into the atmosphere would need to be accounted for against any permits held by a person for carbon previously sequestered. Similar risks may also apply in the voluntary market, but it will be dependent on the legal contract generated. This may lead to a liability being imposed on the person to make good the lost carbon. For example under the proposed CPRS (if these sinks were included later), this means that the carbon lost back into the atmosphere would need to be accounted for against any permits held by a person for carbon previously sequestered. Similar risks may also apply in the voluntary market, but will be dependent on the legal contract generated. Currently there is not enough information in Australia on ways to measure and report on:

1. the amount of carbon that could be sequestered or stored in the soil or plant biomass – this requires complicated research given the wide range of vegetation types, soil types, and varying weather conditions that apply across agricultural lands
2. the amount of carbon that could be re-emitted into the atmosphere from the soil or the loss or destruction of vegetation due to various natural events such as drought and fire.

## 2.3 Possible sink options for Western Australia

Different sinks that could exist in Western Australia include:

- **Commercial Tree Farming** (Article 3.3). A number of commercial tree crops have been identified as potential sinks, mainly in the South West. These include maritime and radiata pines, oil mallees, blue gums and eucalypts for sawlogs. Indian sandalwood offers opportunities for the north. In the lower rainfall agricultural areas, crops under development include southern sandalwood, maritime pine (western margin), oil mallees, brushwood and some specialty timbers.
- **Agricultural Tree Crops** (Article 3.3). It is possible for tree crops such as olives and fruit trees to meet the requirements of Article 3.3 sinks.
- **Rangelands Management** (Article 3.4). Through revegetation, restoration, destocking, altered fire regimes and other forms of management, in some rangeland areas there is potential to increase stored carbon in both soils and vegetation.
- **Wheatbelt Revegetation** (Article 3.4). There is potential to increase carbon stored in native vegetation through revegetating areas of the wheatbelt. There are strong synergies between natural resource management and revegetation carbon sinks. However, transaction costs relating to small sink projects may restrict the market.
- **Saltland Pastures** (Article 3.4). Areas of saline land are steadily increasing. These areas traditionally go out of production, as the high levels of salt are prohibitive to traditional farming species. However, there are a number of saltland pasture species available to keep these areas productive as well as trying to reduce further salinity.
- **Cropland Management** (Article 3.4). Increasing the levels of carbon in the soil has been identified as a potential carbon sink. It is suggested that altering soil management towards conservation practices such as no-till will allow for an increase in soil carbon. However, such a store may disappear very quickly with small changes in management.
- **Perennial Pasture Phases** (Article 3.4). With encroaching salinity, deep-rooted perennial pasture species are being incorporated into farming systems. Being perennials these species are a possible carbon sink. These plants will have relatively high growth rates in comparison to saltland perennials.

## 2.4 Measuring carbon

Carbon sequestered in trees can be measured either through destructive sampling whereby actual on-site measurements are undertaken through digging up trees. The alternative is to use a computer model which uses growth data based on previous work. The Commonwealth is proposing to use a computer model, the National Carbon Accounting Toolbox (NCAT), to estimate carbon sequestered to allocate permits under the CPRS. Many of the species identified as Article 3.3 sinks in WA are not included in the NCAT and default values would be used. In many cases these values underestimate growth. There are no set standards for measuring carbon sold in the voluntary market, however the National Carbon Offsets Standard will detail requirements for those subscribing to its methodologies.

Work undertaken by Kingwell (2009) demonstrated that the use of actual growth rates is preferable to the NCAT default values as the lower sequestration rates can cause tree planting to become uneconomic. The same work identified the selection and development of trees as an important area for research and development to maximise the benefits received by farmers from sequestration activities.

With respect to State agencies, the responsibility for research into the role of investigating new species of trees and understanding growth rates (Article 3.3 sinks) rests predominantly with the Forest Products Commission. However, the identification and development of tree species specifically for carbon plantings integrated into farmland would in part be the responsibility of the Department of Agriculture and Food. Developing further understanding of possible Article 3.4 sinks also rests with the Department.

## **2.5 Work already underway**

### ***Information and training***

The Department has:

- Established the position of soil carbon spokesperson who is the media contact on soil carbon (this position also provides cross-industry research leadership on sequestration in agricultural soils).
- Published a discussion paper for local government, farmers, industry and the community on trees agriculture and carbon trading and provided a factsheet for farmers on some of the specifics of carbon trading and trees. Both are available on the Department website or in hard copy.
- Presented information on carbon sinks at a number of workshops, seminars and conferences.

### ***Innovative responses including research and development***

The Department:

- Has undertaken considerable work investigating the capacity of WA soils to build soil carbon. Examples of this include:
  - Involvement in a project developing national monitoring guidelines for soil carbon to ensure methodology used is consistent and to enable comparison of levels across space and time.
  - Detailed site study at nine locations in the drier parts of the South West comparing uncleared, short-term cleared and long-term cleared sites.
  - Involvement in work to calibrate the Rothamsted (UK) soil carbon turnover model (Roth-C) for Australian conditions and to 30 centimetres depth to conform to the Intergovernmental Panel on Climate Change (IPCC) guidelines.
  - Determining the pre-clearing levels of soil carbon in the top 30 centimetres of soil across Australia and producing a soil carbon map detailing the broad variability of soil carbon. The data will be used as an input into the 1990 baseline for the Land Use, Land-Use Change and Forestry components of the National Greenhouse Gas Inventory.
  - Establishment of benchmark sites for the long-term monitoring of soil organic carbon across the wheatbelt.
  - Evaluation of techniques for analysis of soil organic carbon and its fractions.
  - Involvement in cross-jurisdictional research to investigate the potential for WA soils to sequester carbon, and maintain that carbon over a long period.
- Is undertaking trials to investigate the implications and opportunities of biochar for the grains industry.

- Is undertaking work in the rangelands to determine the realistic potential for carbon sequestration of different land types under a suite of management options. These management options include different stocking rate levels, grazing management systems and fire regimes.
- Is modelling growth rates and collecting data on carbon stored in the roots of mallee trees. With widespread planting of mallees across the wheatbelt for carbon sequestration, improving estimates of sequestration could have significant financial benefit for landholders.

### ***Policy and strategic analysis***

The Department has:

- Prepared a discussion document outlining the possible roles for State and local government, communities and industry when new plantation developments are being considered.
- Undertaken preliminary analysis to identify the areas of Western Australia that will be targeted for carbon investment at different prices of carbon.

## **2.6 Future work**

Future work identifies outputs to achieve the outcomes identified in Section 2.3. Table 4 assigns a priority and timeframe to each of the outputs identified below.

### ***Information and training***

- Provide information on how trees can be integrated into conventional agricultural systems and the different types of trees available for sequestration.
- Continue and support the position of the Department soil carbon spokesperson to coordinate soil carbon research and respond to queries.
- Develop and deliver extension materials for the agricultural sector on carbon trading and sinks from land management such as trees (Article 3.3) and soil carbon (Article 3.4).

### ***Innovative responses including research and development***

- Bring soil carbon researchers together into one project.
- Continue to participate in and influence national research programs for the benefits of WA agriculture, including the rangelands, on Articles 3.3 and 3.4 sinks to better understand their roles in reducing emissions, identifying cost effective measurement and monitoring technologies, and the development of accurate accounting standards. (Also contributes to role of facilitating linkages.)

### ***Policy and strategic analysis***

- Assess how mitigation policies such as the Carbon Pollution Reduction Scheme and Renewable Energy Target drive adoption of tree systems on rural land.
- Work with the Commonwealth Government with the aim of ensuring that national and international agreements relating to carbon sinks recognise WA's circumstances. (Also contributes to role of facilitating linkages.)

Table 4 Carbon sink outcomes, action, priority and timing

Outcome	Action	Priority*	Timing <sup>#</sup>
Forestry and agriculture contribute to long-term opportunities in rural WA	Assess how mitigation policies such as the Carbon Pollution Reduction Scheme and Renewable Energy Target will drive adoption of tree systems on rural land.	H	ST
	Work with the Commonwealth Government to ensure national and international agreements relating to carbon sinks recognise WA's circumstances.	M	ST
Improved coordination and management of soil carbon research in WA, with work contributing to national knowledge on soil carbon	Bring soil carbon researchers together into one project.	M	MT
	Continue and support the position of the Department's soil carbon spokesperson to coordinate soil carbon research and respond to soil carbon queries.	M	MT
Cost-effective sequestration options identified, researched and proven	Continue to participate in and influence national research programs for the benefits of WA agriculture, including the rangelands, on Articles 3.3 and 3.4 sinks to better understand the role these sinks can play in reducing emissions, identifying cost effective measurement and monitoring technologies and the development of accurate accounting standards.	M	MT
Industry and farmers informed of the opportunities and risks of trading carbon	Develop and deliver extension materials for the agricultural sector on carbon trading and sinks from land management such as trees (Article 3.3) and soil carbon (Article 3.4).	H	MT
	Provide information on how trees can be integrated into conventional agricultural systems and the different types of trees available for sequestration.	H	ST

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## Chapter 3: Adapting to climate change

### 3.1 Identified outcomes

The following outcomes in relation to adapting agriculture to climate change are sought in the next five years:

- Informed decision-making leading to flexible robust agricultural and natural resource systems that are more resilient to climate change and climate variability (includes on-farm, pre-farm and post-farm industries).
- Agricultural industry and rural communities able to plan an orderly adjustment or transformation to the social, economic and environmental impacts of climate change.
- Farmers informed, flexible, supported and knowledgeable about risk management and best practice production processes.

### 3.2 Implications of climate change for agriculture

Climate change will have major implications for agriculture in Western Australia. The agricultural sector is vulnerable to climate change through increases in temperature and atmospheric carbon dioxide, decreases in rainfall over much of temperate Australia and increased frequency of extreme weather events such as drought, fire and flooding.

A number of implications for WA agriculture resulting from climate change are described below. Further information can be accessed from Farmnote 5/2002 *Climate change projections and impacts for WA* (Foster 2002).

#### ***Declining length of growing season***

Climate projections suggest a later start to the growing season, and reduced autumn, winter and spring rainfall. Therefore rainfall in the main growing season in the south is expected to reduce (Foster 2002).

#### ***Yields increase under high CO<sub>2</sub> concentrations***

An average warming of up to about 1 °C can increase yields under higher CO<sub>2</sub> concentrations, even under declining rainfall. However, this benefit declines as warming continues, especially if rainfall decreases (Foster 2002). Although increased levels of CO<sub>2</sub> may increase grain yield, the quality of grain may be reduced (Amthor 2001; Loladze 2002).

#### ***Changes to growth characteristics of longer lived agricultural crops***

Changes in rainfall and temperature may alter the suitability of some areas for particular crops such as fruit trees or grape vines. Given the long rotation times of some species, this will require consideration well in advance of actual significant rainfall decline or temperature increases (Foster 2002).

#### ***Large changes in heat or chill accumulation***

Rising temperatures have implications for agriculture through potential changes in heat or chill accumulation. Horticultural crops requiring vernalisation will likely face reduced cold accumulation, possibly affecting production. Adaptation will require a wider range of varieties to be available, or moving chill-dependent crops to new locations (Foster 2002).

### ***Water supplies affected***

On-farm water supplies will likely be affected by climate change due to a decrease in total rainfall, but also the frequency of rain events resulting in run-off. Combined with higher evaporation rates, it is likely that additional storage capacity or improved run-off generation systems will be needed (Foster 2002).

### ***Change in pest and weed risk***

Climate change will affect the competitiveness of weeds. There are projections suggesting that weeds will spread from their point of origin into other environments. There is also evidence that increased CO<sub>2</sub> levels will increase the herbicide tolerance of some weeds suggesting weed management could become more difficult under projected climate change (Fuhrer 2003).

Climate change will alter the competitiveness of insects through altered environmental conditions either directly or indirectly through changes such as reduced predators, increased competition, or changes in host physiology. Insects are able to move to new locations at a faster rate than plants and consequently can cause quite rapid destruction of their new environment. Increases in temperature will generally increase the rate of insect lifecycle causing an increase in population numbers. Droughts and floods are important triggers for outbreaks of insects, and shifts in these extreme events due to climate change may increase the incidence of insect outbreaks (Fuhrer 2003).

Changes in temperature, rainfall and humidity will affect plant diseases and animal diseases (Foster 2002).

### ***Climate change implications for the food industry***

The impacts on the supply chain remain unknown. Further research is required to identify the supply and cost implications, infrastructure requirements, climate change effects on overseas trading partners and competitors, employment issues, and import/export implications for the industry.

## **3.3 Adapting to climate change**

While the recent focus of public policy has been on climate change mitigation, the generally agreed viewpoint is that, even if national and international efforts to reach agreement on mitigation strategies are successful "Mitigation will come too late to avoid substantial damage from climate change" (Garnaut 2008).

Although not explicitly planned, the agricultural sector in the South West of the State has adapted to the impacts of significant long-term climate change since the mid-1970s through the adoption of new technologies and management practices developed to manage seasonal variability (DAFWA 2008).

The capacity of different primary industries sectors to successfully respond to climate change will vary based on the additional impact that climate change has on their comparative advantage and capacity to adapt. Assessing the vulnerability of agriculture to climate change, the capacity of the industry to adapt to climate change, and identifying critical threshold points that could challenge the capacity of industry to cope with climate change, will be important to ensure the long-term productive capacity of the industry (DAFWA 2008).

Risk management tools are often used to identify vulnerability to climate change by identifying critical thresholds, assessing impacts, identifying coping ranges, and developing responses. The ability to successfully manage and adjust to climate change is referred to as 'adaptive capacity' (DAFWA 2008).

Assessing the vulnerability and adaptive capacity of the agricultural industry can help to identify opportunities to increase the capacity of the industry to manage climate change. Identifying and developing options for managing climate change should form part of the Department's long-term planning for future sustainable agricultural industries.

To be able to respond to climate change agricultural industry will need to be able to:

- access improved climate science information as well as interpretation of the implications of climate change on their businesses
- identify their vulnerability to climate change and their capacity to adapt
- identify their informational needs to enhance their capacity to adapt
- access technology and management practices that reduce their exposure to climate change
- improve their capacity to adapt
- access information assessing the impacts of climate change on production and industry expansion into the future.

Given the prevailing uncertainty about climate change, Western Australia's adaptation response will require ongoing adjustment as new information and knowledge are uncovered.

## **3.2 Work already underway**

### ***Information and training***

The Department:

- Delivers the AcCLIMATise project that aims to build climate risk management capacity of the agricultural industry through the development and delivery of an integrated information package, tools and training.
- Held a series of three workshops in the South West in 2008 for the viticulture industry in preparing for a changing and variable climate. Producers identified areas that need on-going support including the need to identify impacts on grape and wine quality; the suitability of new and existing varieties; and new vineyard practices to moderate bunch zone temperatures and maximise grape and wine quality.
- Is preparing publications on possible adaptation responses for farmers in the different agricultural regions.

### ***Innovative responses including research and development***

The Department:

- Contributed to national processes such as the Climate Change Research Strategy for Primary Industries (CCRSPI) run through Ministerial committees to identify key areas for research. The CCRSPI Strategy can be found at <http://lwa.gov.au/ccrspi/>
- Is involved in the Climate Adaptation Program (CAP), a research partnership aimed at investigating climate change adaptation in the North East Agricultural Region.
- Investigated the impacts of climate change on agricultural land use sustainability and produced five reports on the vulnerability of wheat, barley, oats, canola and lupin yields to the impacts of climate change.
- Undertook research on the El Nino-Southern Oscillation (ENSO) and how it affects South West rainfall, climate risks and opportunities, and potential risks for farmers; and researched the effects of climate change on optimal farm plans in a low rainfall Mediterranean environment.

## ***Policy and strategic analysis***

The Department:

- Developed a strategic plan on drought preparedness based on a risk management approach, in response to the Productivity Commission’s inquiry on drought assistance.
- Developed and is implementing a strategic plan for the North Eastern Agricultural Region (NEAR) that provides a long-term management strategy for farmers during consecutive bad years. It aims “to achieve sustainable and profitable land management in an environment of increased climatic business uncertainty and changing.”
- Led the development of the cross-government publication *Climate change, vulnerability and adaptation for South West Western Australia from 1975 to the present* reviewing how the community adapted to change that has already occurred in the South West.

## **3.3 Future work**

Future work identifies outputs to achieve the outcomes identified in Section 3.1. Table 5 assigns a priority and timeframe to each of the identified outputs below.

### ***Information and training***

- Provide information to agribusiness on seasonal variability and climate change science.
- Develop and promote decision support tools that allow farm businesses to assess the risk of climate change and implement strategies to manage the transition to a new climate regime and monitor the resource condition.

### ***Innovative responses including research and development***

- Contribute to identifying global climate models best suited to WA and generating downscaled data where practical (also contributes to role of facilitating linkages).
- Interpret downscaled data to identify adaptation responses for agriculture.
- Improve seasonal forecasting methods and the information generated for farmers in their decision-making.
- Identify and understand critical thresholds that will cause farming systems to fail.
- Assess the impacts of climate change on future production and industry expansion.
- Develop an agricultural climate change adaptation framework for the State and in collaboration with regional communities develop regional agricultural adaptation responses based on the framework (also contributes to role of facilitating linkages).
- Continue to participate in and influence national research programs for the benefits of WA agriculture on adaptation to climate change (also contributes to role of facilitating linkages).
- Improve understanding and evaluation of biosecurity risks for WA agriculture resulting from climate change.
- Develop and promote new agricultural systems to suit the changing climate.

### ***Policy and strategic analysis***

- Evaluate the social, environmental and regional vulnerability of the agricultural industry to climate change (including the supply chain).

Table 5 **Adapting to climate change outcomes, action, priority and timing**

Outcome	Action	Priority*	Timing <sup>#</sup>
Informed decision-making leading to flexible robust agricultural and natural resource systems that are more resilient to climate change and variability (includes on-farm, pre-farm and post-farm industries)	Contribute to identifying global climate models best suited to WA and generating downscaled data where practical.	L	LT
	Interpret downscaled data to identify adaptation responses for agriculture.	H	MT
	Improve seasonal forecasting methods and the information generated used by farmers in their decision-making.	M	MT
	Provide information to agribusiness on seasonal variability and climate change science.	M	MT
Agricultural industry and rural communities able to plan an orderly adjustment or transformation to the social, economic and environmental impacts of climate change	Evaluate the social, environmental and regional vulnerability of the agricultural industry to climate change (including the supply chain).	H	MT
	Identify and understand critical thresholds that will cause current farming systems to fail.	H	MT
	Assess the impacts of climate change on production and industry expansion into the future.	H	MT
	Develop an agricultural climate change adaptation framework for the State, and in collaboration with regional communities develop regional agricultural adaptation responses based on the framework.	H	MT
	Continue to participate in and influence national research programs for the benefit of WA agriculture on adaptation to climate change.	M	MT
	Develop and promote new agricultural systems to suit the changing climate.	H	MT
	Improve understanding and evaluation of biosecurity risks for WA agriculture resulting from climate change.	H	MT
Farmers informed, flexible, supported and knowledgeable about risk management and best practice production processes	Develop and promote decision support tools that allow farm businesses to assess the risk of climate change and implement strategies to manage the transition to a new climate regime and monitor resource conditions.	H	MT

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## Chapter 4: Governance

### 4.1 Identified outcomes

The following outcomes in relation to governance are sought in the next five years:

- State Government making informed policy and investment decisions
- Commonwealth Government making decisions on agriculture and climate change that take into account issues specific to Western Australia
- the Department to have coordinated and consistent messages on climate change
- The Department to have input from industry on climate change policies and processes.

### 4.2 DAFWA governance roles and functions

The Department of Agriculture and Food contributes to local, state and national policy processes. Climate change is becoming both an issue for agricultural communities through policies being developed such as the Carbon Pollution Reduction Scheme, as well as long-term climate trends affecting agricultural production.

The Department contributes to national policy processes on climate change through working groups of the Natural Resource Management Ministerial Council (NRMMC) and Primary Industries Ministerial Council (PIMC). Issues such as coordinated national research for climate change, strategies for reducing emissions from agriculture, drought assistance and biosecurity receive attention through these ministerial councils and their associated working groups. It also contributed to the work of the Council of Australian Governments (COAG) subcommittee on adaptation and the National Climate Change Adaptation Research Facility (NCCARF).

At State level, the Office of Climate Change (OCC) based in the Department of Environment and Conservation is responsible for developing, coordinating and managing whole-of-government policy on climate change. This has a number of subcommittees including, but not restricted to adaptation, science and offsets, which report to the Climate Change Policy Interdepartmental Steering Group (CCPISG). The Department is represented on the CCPISG and most subcommittees. The CCPISG reports to the Directors General Group on Climate Change and Energy, of which the Department is also a member.

The Department has an External Reference Group on Climate Change made up of industry representatives to provide feedback on State policy and research directions. The group was established in April 2009 and its role will be reviewed by the Director General in May 2010.

Internally, the Department had a taskforce to steer the development of the climate change strategy, provide input into State and national policy processes, steer the development of communications and other work. These actions have been completed by the climate change policy team with oversight from the taskforce. With its main objectives met and the change in direction for the Department, the role and function of the taskforce have been reviewed, and it has been replaced with a formal network to coordinate policy responses.

The Executive Director of Natural Resource Management and Compliance is responsible for all climate change policy including mitigation, carbon sinks, carbon trading, biomass energy, biofuels and adaptation, and is supported by a small group of officers led by the Manager of Climate Change Policy, Anne Bennett.

The Executive Director for Research is responsible for climate change research and is supported by the Manager of Agricultural Systems Research, David Bowran.

## 4.3 Work already underway

### *Policy and strategic analysis*

The Department:

- Established an Internal Taskforce and an External Reference Group on climate change. The Internal Taskforce represented all divisions and has been used to coordinate input into the State policy process as well as a means to share information on activities being undertaken relating to climate change. The taskforce has completed the key tasks set out in its terms of reference and has been replaced with a formal network to coordinate climate change policy work.
- Established an External Reference Group consisting of industry representatives across all areas of agricultural production. The group provides industry with the opportunity to provide feedback on State Government processes and policies. Its terms of reference will be reviewed in May 2010.
- Is represented on several Office of Climate Change (OCC) working groups and the OCC Climate Change Policy Interdepartmental Steering Group. The Director General is a member of the Directors General Group on Climate Change and Energy.
- Provides input into national policy formation through the Primary Industries Ministerial Council (PIMC) and the Natural Resource Management Ministerial Council (NRMMC).

## 4.4 Future work

Future work identifies outputs to achieve the outcomes identified in Section 4.1. Table 6 assigns a priority and timeframe to each of the identified outputs below.

### *Policy and strategic analysis*

- Participate in and influence State climate change policy and programs (also contributes to the role of facilitating linkages).
- Participate in and influence national policy-making through the Primary Industry Standing Committee and the Natural Resource Planning and Policy Committee, and where appropriate COAG processes (also contributes to role of facilitating linkages).
- Coordinate climate change policy work through the climate change policy network.
- Support the External Reference Group in its role to provide feedback on State Government policy and processes (also contributes to role of facilitating linkages).

Table 6 **Governance outcomes, action, priority and timing**

<b>Outcome</b>	<b>Action</b>	<b>Priority*</b>	<b>Timing<sup>#</sup></b>
The Department to have coordinated and consistent messages on climate change	Coordinate climate change policy work through the climate change policy network.	M	ST
The Department to have input from industry on climate change policies and processes	Support the External Reference Group in its role to provide feedback on State Government policy and processes.	M	ST
State Government making informed policy and investment decisions	Participate in and influence State climate change policy and programs.	H	ST
The Commonwealth Government making decisions on agriculture and climate change that take into account issues specific to Western Australia	Participate in and influence national policy-making through the Primary Industry Standing Committee and the Natural Resource Planning and Policy Committee, and where appropriate COAG processes.	M	ST

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