

September 2004

Prepared by the Western Australian Greenhouse Task Force

GREENHOUSE STRATEGY



Climate change is one of the greatest threats to Western Australia's natural environment.

ISBN: 0730755517

Acknowledgment:

Some of the material in this publication has been drawn from:

- "The Greenhouse Effect and Climate Change", Commonwealth Bureau of Meteorology, Commonwealth of Australia, 2003. Copyright Commonwealth of Australia reproduced by permission.
- CSIRO Atmospheric Research reproduced by permission.
- Reports of the Intergovernmental Panel on Climate Change.

MINISTER'S FOREWORD

Climate change presents major challenges and opportunities for Western Australia.

Climate dependent industries and resources – such as tourism, agriculture, forestry and water resources – will need to cope with warmer temperatures and changed rainfall patterns. Emerging climate conditions will further endanger natural environments. Human health may be affected by increased disease risk from factors such as increased mosquito numbers, and by higher temperatures.

International agreements on global climate change in time will require nations and their industries to limit greenhouse gas emissions. This is a particular challenge for Western Australia because our society and industries are so energy intensive.

An effective response to climate change is essential for Western Australia to continue prospering economically, to protect our biodiversity and to maintain our social wellbeing. With careful planning we may also gain a variety of other benefits ranging from competitive energy security to revegetation.

The Gallop Labor Government committed itself in 2001 to develop a comprehensive Greenhouse Strategy for Western Australia.

Developing a comprehensive strategy for such a complex issue is complicated by uncertainties about the implications of climate change for regional climate and weather conditions and uncertainties about future national and international policies and business arrangements.

The Western Australian Greenhouse Strategy, which has been endorsed by the Western Australian Government following extensive public input, is based on introducing those initiatives which can already be supported and on investigating further initiatives for possible future introduction. It also sets out research actions to ensure future decision-makers have the information they require.

It is not possible at this time to foresee all that effective responses to climate change might require of us as individuals and as a community. It might require fundamental reconsideration about the way we plan and live in our cities, plan our economic development, and manage our farms and forests. It might require increased investment in biodiversity protection and greenhouse gas sequestration.

What is clear, however, is that all sectors of the community must be involved in forming the responses that we will take in coming years.

To sharply focus our efforts, the Government has established a new Greenhouse Unit in the Department of the Premier and Cabinet. This new Unit will coordinate and direct all activities concerned with climate change and oversee the implementation of the Strategy.

We commend the Western Australian Greenhouse Strategy to you as a catalyst towards an ongoing series of actions to deal with global climate change in Western Australia. We look forward to your ongoing involvement and contribution to this vital issue.



Judy Edwards

Dr Judy Edwards, MLA Minister for the Environment



Francis Logan, MLA Chair, Greenhouse Task Force

EXECUTIVE SUMMARY

What is the greenhouse effect?

The 'enhanced greenhouse effect' is an alteration of the world's climate system caused by increasing levels of certain gases in the Earth's atmosphere. Scientists believe the enhanced greenhouse effect is already causing higher average air temperatures in the lower atmosphere, changed rainfall patterns and rising sea levels resulting from warmer oceans and ice melting from glaciers and Arctic and Antarctic ice sheets. Climate changes due to the enhanced greenhouse effect are often referred to as 'global climate change' or 'global warming'.

- Aller

Atmospheric concentrations of greenhouse gases have increased significantly since the Industrial Revolution about 250 years ago. Australia emits about one per cent of global emissions, a small proportion of the total, but one of the highest on a per capita basis. Western Australia emits about 12 per cent of Australia's emissions with emissions increasing at about 2.8 per cent per year since 1990. Most of Western Australia's greenhouse gas emissions result from fossil fuel use and livestock production.

Over the last decade the Western Australian Government, industry and community have worked together to significantly reduce land clearing, conserve remnant vegetation and undertake revegetation works. As a result the land use change and forestry sector in Western Australia changed from being a net emitter of greenhouse gases into a net sink between 1990 and 2002. The contribution of this sector in offsetting a portion of the State's emissions as organic carbon sinks will continue to be important for some decades.

What impact will the greenhouse effect have on Western Australia?

Impacts of global climate change are difficult to predict at a sub-continental or regional level or for particular time scales. However, international global climate models suggest that as atmospheric greenhouse gas concentrations continue to rise, Western Australia will become warmer and rainfall patterns will change. The South West is likely to receive less rainfall.

These changes to the State's climate could directly affect agriculture, forestry, health, biodiversity, water resources, energy demand and tourism. There could be indirect but significant impacts on fisheries and industrial development.

What is being done about the greenhouse effect?

International agreements aim to limit atmospheric greenhouse gas concentrations to levels below those at which unacceptable impacts would occur. The Kyoto Protocol assigns emission targets to developed nations, including Australia. Australia's Kyoto emission target is not greater than 108 per cent of the nation's 1990 emissions on average between 2008 and 2012. Although the Federal Government has stated it will not ratify the Kyoto Protocol, it has indicated the 108 per cent target will be achieved.

What is Western Australia's position on Kyoto Protocol ratification?

The Western Australian Government recognises the significant weaknesses and limitations of the Kyoto Protocol, yet believes the Protocol represents an essential step towards the global approach necessary to prevent dangerous climate change.

The Western Australian Government calls upon the Federal Government to ratify the Kyoto Protocol and will support national measures to meet the Kyoto Protocol target that recognise Western Australia's circumstances and interests.



What does the Western Australian Greenhouse Strategy outline?

In 2002, Western Australia established a Greenhouse Task Force to prepare a Western Australian Greenhouse Strategy to ensure the State's industry and community could contribute to reducing global greenhouse emissions and effectively respond to any opportunities and challenges generated by climate change.

The Task Force consulted with industry, the community and Western Australian Government agencies in preparing the Strategy.

The final Western Australian Greenhouse Strategy provides a comprehensive response to the greenhouse issue.

The Strategy is based on leadership, research, and public and industry engagement. It establishes research programs to enable the State to better adapt to the changing climate, delivers the Western Australian Government's greenhouse-related policy commitments and establishes a Greenhouse Unit in the Department of the Premier and Cabinet to enable Western Australian interests to be represented nationally and internationally. The Greenhouse Unit will coordinate implementation of the Strategy and enable the State to more effectively develop and advocate State greenhouse and climate change policy initiatives.

Western Australia's Greenhouse Strategy defines several objectives for its strategic response to global climate change. The objectives of the Strategy are to:

- maximise opportunities for a sustainable future for Western Australians;
- create voluntary market-based measures to enable all emitters to access least-cost greenhouse emissions abatement initiatives;
- establish a realistic and effective long term commitment to addressing climate change;
- · ensure all sectors contribute to solutions; and
- enable Western Australia to contribute to national and international solutions on a cost-effective and equitable basis.

The Strategy will be reviewed in 2008. The eight main elements of the Strategy follow.

1. Government leadership

The Western Australian Government will work to minimise its own contribution to climate change by demonstrating emission reductions, thereby helping industry and the community to determine and implement effective responses.

Targeted purchasing by the Western Australian Government will help generate desired market opportunities.

The existing *Energy Smart Government* program aims to achieve a 12 per cent reduction in stationary energy (or non-transport energy) use in Government agencies by 2006-07, using 2001-02 as the base year.

The Strategy commits the Western Australian Government to purchasing the equivalent of five per cent of its electricity from cost effective renewable sources by 2006-07.

Government agencies and trading enterprises will annually report greenhouse gas emissions to the Western Australian Greenhouse Gas Inventory from 2005-06 and from 2006-07 lodge greenhouse gas estimates for the coming year and develop strategies to minimise anticipated emissions.

New Western Australian Government housing will aim to exceed minimum energy efficiency requirements.

EXECUTIVE SUMMARY cont'd

2. Reducing greenhouse emissions

It is important that greenhouse gas emission reductions are achieved across all sectors. Action is needed to increase awareness and engagement, and establish programs that will yield short, medium and long-term emission reduction benefits.

The industry and electricity sectors together are responsible for producing about 57 per cent of the State's greenhouse gas emissions. The Strategy aims to encourage the development of market-based mechanisms in these sectors to achieve lowest cost emission reductions and protect Western Australia's economic and environmental interests. As larger markets offer greater opportunities for more cost effective options to be realised, the Strategy strongly emphasises the value of a national approach to addressing greenhouse gas emissions and the importance of access to international market opportunities. There are several actions to enable major Western Australian greenhouse gas emitters to prepare for such market-based mechanisms:

- The Strategy will require major industrial emitters to report greenhouse gas emissions annually to a Western Australian Greenhouse Gas Inventory, lodge greenhouse gas emission estimates for the coming year, and develop strategies to minimise anticipated emissions. This will involve public reports every three years and triennial audits.
- A Greenhouse Abatement Fund to hold and deal with organic sequestration rights and credits generated by Government institutions will be created.
- A Greenhouse Registry with the ability to certify and document organic sequestration claims and emission reductions by industry and Western Australian Government institutions will be established.
- The Western Australian Government will support the development of confident and viable national and international trading markets. Western Australia will determine its own preferred emission abatement framework that best suits the State's circumstances and promote this in any national negotiations.

The Strategy promotes the expansion of the sustainable energy sector and industries based on renewable energy sources in Western Australia. It includes a range of mechanisms aimed at developing a competitive renewable energy sector that capitalises on the opportunities and resources in Western Australia, while working within the framework created by the Commonwealth Government Mandatory Renewable Energy Target (MRET) scheme. An increase in the MRET is supported.

Waste management produces about 2.5 per cent of the State's emissions. Enhanced implementation of the *Strategic Direction for Waste management in Western Australia* and targeted research on waste separation options are supported.

Energy use in households and commercial operations is responsible for generating about 16 per cent of Western Australia's greenhouse gas emissions. The Strategy outlines a series of actions and proposals to reduce energy demand and greenhouse gas emissions from these activities by increasing energy efficiency of buildings and appliances.

Transport generates about 16 per cent of Western Australia's greenhouse gas emissions. The Strategy aims to reduce transport emissions through travel demand management programs such as the *TravelSmart* initiative, traffic management strategies, investment in infrastructure that will promote energy efficient transport options such as the new MetroRail Project in Perth's southern suburbs, fuel efficiency and low greenhouse gas emission fuels. The Strategy also includes actions for further integration of land use and transport planning.

Agriculture produces about 28 per cent of Western Australia's greenhouse gas emissions. The Strategy outlines actions to investigate emissions from agriculture to enable producers and land managers to develop and implement focused and efficient actions to reduce the emissions associated with their business practices. Many agricultural practices that reduce greenhouse gas emissions also promote increased productivity and sustainability. The Strategy supports development and promotion of low emission agricultural practices.

The new MetroRail Project will ensure there is a fast, comfortable and affordable alternative to car travel for Perth's southern suburbs. The greenhouse gas saving is estimated at more than 67,000 t CO2-e in its first year of full operation.

> Photo courtesy of Department for Planning and Infrastructure



3. Carbon sequestration

Carbon sequestration resulting from plantation establishment, revegetation or increased soil carbon can offset greenhouse gas emissions from fossil fuel use or other sources. These activities can also generate other benefits, including salinity and erosion control and biodiversity protection. The value of rights arising from organic carbon sequestration could promote revegetation.

The Strategy contains a series of actions aimed at promoting nationally consistent carbon rights legislation, more accurate and efficient carbon accounting for plantations and revegetation, and revegetation which delivers a range of natural resource management benefits beyond carbon sequestration.

Geological sequestration of carbon

dioxide is an emerging option for storing carbon dioxide removed from a natural gas stream or an industrial waste stream. It offers significant promise for reducing the net greenhouse gas emissions from an operation. The Strategy includes actions to investigate several technical, regulatory and risk-management issues associated with geological sequestration and promote community and stakeholder knowledge about it.

4. New opportunities

Global climate change will generate new opportunities for Western Australia's businesses and residents. Some of these opportunities are being pursued, such as revegetation for organic carbon sequestration, while others will only become evident as climate conditions evolve. The Strategy includes actions to help enable Western Australia to take advantage of new opportunities.

5. Adaptation

Global climate change is already occurring and is projected to continue for many years, even if greenhouse gas emissions were immediately and significantly reduced. A vast range of impacts are likely, affecting community health, regional water resources, biodiversity and climate dependent industries such as agriculture, forestry and fisheries.

The Strategy contains a set of projects to generate and communicate information to enable Western Australia to prepare for unavoidable changes to the State's climate conditions. Projects include continuation of the Indian Ocean Climate Initiative and investigating biodiversity impacts and farming and forestry system requirements of future climate scenarios.

6. Local government and community involvement

Local governments and community groups can make significant contributions to address the greenhouse effect. The effectiveness of such groups arises from their capacity to make decisions and to take direct action on matters affecting their own responsibilities. Many local governments are involved in Local Agenda 21 programs or are members of the Cities for Climate Protection (CCPTM) campaign.

The Strategy contains actions to encourage local governments to participate in greenhouse initiatives.

7. Research

The Strategy is based on a philosophy of informed action. Research forms a major part of every element of the Strategy. The Strategy gives responsibility for monitoring international, national and Western Australian climate change research activities and findings and recommending further research to the Greenhouse Unit.

8. National and international representation

Global climate change is already being addressed by international agreements to which nations, including Australia, are parties. These agreements can affect Western Australia in many ways, including our industrial development opportunities and the value of our carbon sequestration initiatives. The Strategy includes actions to ensure the State's circumstances are recognised when Australia negotiates international agreements or develops national greenhouse policies, and when international rules are formed for matters associated with global climate change.

CONTENTS

CONTENTS

Foreword	1
Executive summary	3
PART A - SCIENCE AND POLICY	
INTRODUCTION	9
THE SCIENTIFIC FINDINGS AND POLICY CONTEXT	10
Introduction	10
Future climate projections	14
Greenhouse climate projections for Western Australia	15
OUR CONTRIBUTION TO GLOBAL CLIMATE CHANGE	18
Australia's greenhouse gas emissions	18
Western Australia's greenhouse gas emissions	20
POLICY RESPONSES TO GLOBAL CLIMATE CHANGE	24
International agreements	24
Australian national responses to climate change	25
Western Australia's response to climate change	27
Western Australia's Greenhouse Strategy	29
PART B - STRATEGY AND ACTIONS	
INTRODUCTION	33
1 GOVERNMENT LEADERSHIP	34
Greenhouse response actions	37
2 REDUCING GREENHOUSE EMISSIONS	38
Introduction	38

	2.1 Industry and electricity generation emissions			
		Greenhouse response actions	49	
	2.2	Waste management	50	
		Greenhouse response actions	53	
	2.3	Energy use in households and commercial operations	54	
		Greenhouse response actions	61	
	2.4	Land use planning and transport	62	
		Greenhouse response actions	67	
	2.5	Reducing agricultural emissions using good agricultural practice	68	
		Greenhouse response actions	72	
3	CAR	BON SEQUESTRATION	74	
	Intr	oduction	74	
	3.1	Organic carbon sequestration	75	
		Greenhouse response actions	80	
	3.2	Geological sequestration of carbon dioxide	82	
		Greenhouse response actions	87	
4	NEV EME	N INDUSTRY OPPORTUNITIES ERGING FROM GREENHOUSE ISSUES	88	
	Gre	enhouse response actions	91	
5	RES	PONDING TO A CHANGING CLIMATE	92	
	Gre	enhouse response actions	99	
6	WO ANI	RKING WITH LOCAL GOVERNMENT D THE COMMUNITY	100	
	Gre	enhouse response actions	105	
7	RES	EARCH	106	
	Gre	enhouse response actions	109	

8 REPI	RESENTING WESTERN AUSTRLIA'S ERESTS NATIONALLY AND	110
Cro	-Kivanolivalli	110
Gree	ennouse response actions	113
Referenc	es and further reading	114
Acronym	is and abbreviations	115
LISTOF	IGURES	
PART A		
Figure 1	How does the greenhouse effect work?	10
Figure 2	Increases in major greenhouse gas concentrations	11
Figure 3	Global temperature change (°C)	11
Figure 4	Observed trends in mean surface temperatures for Australia	12
Figure 5	Western Australian maximum temperature trend 1910-2003 (°C/10yrs)	12
Figure 6	Western Australian temperature annual maximum T anomaly	12
Figure 7	Western Australian trend in annual total rainfall 1900-2003 (mm/10yrs)	12
Figure 8	Western Australian annual rainfall	12
Figure 9	Winter rainfall in Manjimup	13
Figure 10	Annual rainfall Rottnest Island	13
Figure 11	Inflows into Perth reservoirs	13
Figure 12	Climate equilibrium requires many years	14
Figure 13	Annual warming ranges (°C) (relative to 1990)	15

Figure 14 Annual rainfall change (%) (relative to 1990)

PART B

Greenhouse gas emissions for stationary energy in Australia 2002	38
Energy use in a typical Western Australian home	55
Western Australian agriculture sources of greenhouse gas emissions 2002	69
Emission free vision	83
Sleipner CO₂ storage project, North Sea	84
	Greenhouse gas emissions for stationary energy in Australia 2002 Energy use in a typical Western Australian home Western Australian agriculture sources of greenhouse gas emissions 2002 Emission free vision Sleipner CO ₂ storage project, North Sea

LIST OF TABLES

15

16

Table 1	Major anthropogenic greenhouse gases and their contribution to global warming	11
Table 2	Net sector greenhouse gas emissions – Australia – 1990 and 2002	19
Table 3	Western Australia's greenhouse gas emissions by sector – 1990 to 2002	21
Table 4	Energy intensive project planned or under construction	40
Table 5	Organic carbon sink potential: Kyoto Article 3.3	75



Part A - Science and Policy

Introduction

Global climate change generates a complex set of major challenges to which Western Australia must respond.

Our response must be based on the best knowledge available and take account of international agreements, commitments and requirements and national policies and programs. The response must be based in sustainability concepts, and address community and global concern about climate trends, possible human influences on these trends and the impacts climate changes might have on Western Australia, other parts of Australia and the world.

Western Australia's Greenhouse Strategy establishes short term actions and sets the basis for ongoing effective long term programs and engagement by all sectors of the community.

In forming this Strategy, it has become clear that even the best knowledge available internationally, nationally or within the State remains partial and uncertain. Similarly, international agreements remain unratified and so have not yet come into effect, and the national policy context is still evolving.

The Strategy therefore must embrace uncertainty and the evolution of policies as part of its strategic environment to ensure the Western Australian Government, residents and businesses are able to make decisions that are informed by likely future outcomes and requirements.

Section A of the Strategy outlines the scientific and policy background on which the Strategy is based. It also describes the process by which the Strategy was produced and arrangements for its implementation and review.

Development of the Greenhouse Strategy

The Strategy builds on work undertaken by individuals and groups since the early 1980s. It was developed through extensive consultation activities and reflects the many comments received. The State Greenhouse Task Force was formed in March 2002, with a mandate to develop a greenhouse strategy through engagement with the community. Headed by Mr Francis Logan, MLA, Member for Cockburn and Parliamentary Secretary to the Minister for the Environment and the Minister for Agriculture, Forestry and Fisheries, the Task Force held a series of meetings with industry, conservation, commercial and rural stakeholders and Government agencies.

In December 2002 a discussion paper was released about the full range of issues associated with global climate change to generate comment. In the same month a greenhouse web site was established to enable Western Australians to inform themselves about global climate change and to submit comments on the discussion paper. These activities generated 72 formal written submissions. Visit www.greenhouse.wa.gov.au for a summary of these submissions.

In December 2003 a Draft Western Australian Greenhouse Strategy was released for public comment. It addressed issues raised by the earlier released greenhouse discussion paper. It sought to establish a balanced strategic framework to position Western Australia to promote its quality of life and economic development while limiting its own greenhouse emissions as a responsible member of the global community. Community consultation forums were arranged throughout Western Australia to generate comment and debate on the content and direction of the Draft Strategy. Approximately 400 people attended these sessions. These activities generated 85 formal written submissions. Visit www.greenhouse.wa.gov.au for a summary of these submissions.

THE SCIENTIFIC FINDINGS AND POLICY CONTEXT

10

¹ Albedo is the fraction of light that is reflected by a body or surface. It is commonly used in astronomy to describe the reflective properties of planets, satellites, and asteroids.

Figure 1 How does the greenhouse effect work?

THE SCIENTIFIC FINDINGS AND POLICY CONTEXT

Introduction

For millions of years, life on Earth has evolved in an environment made possible by a natural 'greenhouse effect' (Figure 1). A warmer and more seasonally moderated world has resulted from carbon dioxide (CO_2), water vapour and other gases released into the atmosphere by natural processes.

The chemical composition of the atmosphere and global climate conditions have varied for millions of years. But during the past 250 years, human activities have increased the atmospheric concentrations of several greenhouse gases. These relatively recent changes to the atmosphere are now understood to be affecting the climate in virtually all parts of the world. These changes are happening at a much faster rate than previously experienced.



The gases which have the most significant impact on climate change are CO₂, methane, nitrous oxide, and 65 related gases termed 'halocarbons'. The relative contributions of these gases to global climate change are indicated in Table 1.

Many other factors also affect atmospheric and global warming, these include ozone concentrations in the stratosphere and troposphere, aerosols of sulphur and other materials, the albedo¹ of the earth's surface and variations in solar radiation.

Scientists agree climate change resulting from human actions is already occurring. Because greenhouse gases can remain active for a century or more we can expect climate change to continue for many years even if greenhouse gas emissions are reduced immediately. Research has indicated a range of climate change impacts are likely. However, there is little knowledge about the severity and cost the changes will have on Western Australia's regional climate conditions, our environment, our industries and our lifestyles.

CONTEXT	
POLICY (
AND	
INDINGS	
TIFIC F	
SCIEN.	
THE	

11

Gas	Formula	Atmospheric lifetime	Relative cotribution to global warming	Relative GWP ² over 50 year	Relative GWP ³ over 100 year	
Carbon dioxide	CO_2	50 – 200 years	60%	1	1	
Methane	CH4	12 years	20%	62	23	
Nitrous oxide	N2O	114 years	6%	275	296	
Halocarbons		Various	14%			

Table 1 Major anthropogenic gases and their contributions to global warming

² GWP = Global Warming Potential. GWP is a measure of how much a given mass of greenhouse gas is estimated to contribute to global warming. It is a relative scale which compares the gas in question to that of the same mass of carbon dioxide whose GWP is one.

- ³ The IPCC identifies 65 distinct chemicals as halocarbons that contribute to atmospheric warming and global climate change. These chemicals generally have
- very high GWP. See Table 6.7 at
 - http://www.grida.no/climate/ipcc_tar/wg1/ 248.htm for further information.

What is global climate change?

Global climate change and the greenhouse effect are terms used to describe climate changes resulting from human induced alterations to the chemical composition of the earth's atmosphere. These chemical changes have been caused primarily by the use of fossil fuels (coal, petroleum, natural gas), land clearing, agriculture and the massive expansion of industrial processes during the past 250 years.

Since the beginning of the industrial revolution, CO_2 levels in the atmosphere have increased by one third, methane levels have doubled and nitrous oxide concentrations have increased by 15 per cent (Figure 2). Changes at this rate are not known to have happened in the past. They have created an enhanced greenhouse effect and have contributed to rising global temperatures that have been particularly noticed in the past 20 years (Figure 3).

Figure 2 Increases in major greenhouse gas concentrations



Figure 3 Global temperature change (°C) 1861 – 2000





Figure 4 Observed trends in mean surface temperatures for Australia

This rising temperature trend has become evident over most of Australia during the twentieth century (Figure 4). The warming is evident during both summers and winters, with night time minima rising faster than daily maxima. Daily average temperatures have also increased throughout Western Australia during the past ninety years (Figures 5 and 6). Consistent regional trends in rainfall changes are also evident during this period. During the last 50 years drying has been evident along Australia's east coast and in Western Australia's South-West. By contrast northern regions of Western Australia have shown wetter conditions.





maximum T anomally (base 1961-90)

Figure 6 Western Australia annual



Source: Commonwealth Bureau of Meteorology

Figure 7 Trend in annual total rainfall Figure 8 1900-2003 (mm/10yrs) annual



Figure 8 Western Australia annual rainfall



Source: Commonwealth Bureau of Meteorology

Figure 9 Winter rainfall in Manjimup



Figure 10 Annual rainfall at Rottnest Island



Figure 11 Inflows to Perth reservoirs



As shown on Figure 7 the South-West experienced a decline in rainfall during the twentieth century. Research undertaken under the Indian Ocean Climate Initiative (IOCI) has revealed that this occurred as an abrupt decline in annual rainfall of 15-20 per cent in the mid 1970s (Figures 9 and 10). This resulted in about a 40 per cent reduction in stream flow and a probable decline in groundwater recharge. Inflows to Perth reservoirs fell significantly in response to rainfall reductions (Figure 11).

The Intergovernmental Panel on Climate Change (IPCC)



Albany, Photo courtesy of Western Power

Formed in 1988 by two United Nations bodies, the IPCC involves a wide range of scientists from many countries, including the world's top climate experts.

> The IPCC prepares globally accepted summaries of current scientific research into humaninduced climate change, covering climate science, the impacts on human communities and ecosystems and policy options to reduce emissions and effectively mitigate impacts. IPCC assessments were prepared in

1990, 1995 and 2001. They have been used as the basis for agreement by governments to the United Nations' Framework Convention on Climate Change (UNFCCC) at Rio de Janeiro in 1992 and the ongoing climate change policy process.

Future global climate projections

Research into global climate change is regularly summarised by the Intergovernmental Panel on Climate Change (IPCC). In its *Third Assessment Report*, released in 2001, the IPCC declared climate change was already evident and measurable. The IPCC also stated climate change will have adverse impacts on water resources, agriculture, human health, forests, coastal zones and biodiversity. Some of these effects will continue for decades or centuries even if greenhouse gas concentrations are stabilised soon (Figure 12).

Time taken to reach equilibrium

Sea-level rise due to ice melting: **several millenia**

Sea-level rise due to

thermal expansion: centuries to millenia

CO2 stabilization: 100 to 300 years

CO₂ emissions

1000 years

Temperature stabilization: a few centuries Under IPCC emission scenarios, CO_2 concentrations are projected to increase from the current level of 379 parts per million (ppm) to between 540 and 1000 ppm during this century, generating a 1.4-5.8°C rise in average global temperatures.

This rate of temperature change has not occurred in the last 10,000 years and is likely to produce worldwide impacts on weather and ocean energy⁴ levels.

Model projections show high latitudes (polar regions) are expected to warm more than low latitudes (tropics). Precipitation may increase in the tropics and high latitudes and decrease in Mediterranean climate areas.

Indications are that weather events may generally be more extreme, with increases in floods and droughts. Tropical cyclones may have greater peak wind intensity and more intense rainfall.

Sea levels are forecast to rise as oceans warm and expand, possibly boosted by the loss of major ice sheets in Antarctica and Greenland. Increased glacier melt might, however, be matched by increased snowfall in polar areas.

PART A - BACKGROUND AND CONTEXT TO THE STRATEGY

14

Figure 12 Cimate equilibrium requires many years

Today 100 years Source: IPCC

CO2 emissions peak o to 100 years

Magnitude of response

Ocean energy – oceans generate thermal energy from the sun, they also produce mechanical energy from the tides and waves while the sun affects all ocean activity, the gravitational pull of the moon primarily drives the tides and wind powers the ocean waves (US Department of Energy website: http://www.eere.energy.gov/ consumerinfo/refbriefs/nb1.html).

15

Greenhouse climate projections for Western Australia

Western Australia's climates range from our tropical north through arid zones to the Mediterranean climate of our South-West. All of these climate types are likely to be affected by global climate change.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) analysis of global climate model projections of Western Australia's climate under greenhouse conditions suggests that the drying trend experienced in the State's South-West since 1975 broadly reflects the changes in rainfall anticipated from global climate change. The CSIRO analysis also suggests that average temperatures could increase significantly during the coming 70 years, if atmospheric greenhouse gas concentrations continue to rise.

The CSIRO has reported that on a continental basis, temperatures increased by about 0.7°C in Australia between 1910 and 1999, with the majority of that increase occurring after 1950. The CSIRO was not able to determine any changes to the continental average rainfall during the twentieth century.

Figure 13 Annual warming ranges (°C) (relative to 1990)





Source: CSIRO Atmospheric Research

16

The CSIRO has also used its global climate models to project future climate conditions for Australia's regions under differing greenhouse gas emission scenarios for 2030 and 2070. Figure 13 suggests that over this period, temperatures will progressively increase, particularly in the Pilbara. Figure 14 indicates that there is a likelihood that rainfall will decrease in the State's South-West with less certain projections for other parts of the State.

The climate changes projected, such as those suggested by the CSIRO, could have significant impacts on the State's water resources, climate dependent industries and natural environments. For instance, biophysical modeling suggests that a temperature rise of only 0.5°C, coupled with a five per cent rainfall decrease, would result in the local extinction of half of the species of vascular plants found in one location south of Carnarvon. Similar impacts are likely to affect some agricultural crops, water supplies and disease conditions.

Figure 14 Annual rainfall change (%) (relative to 1990)







Source: CSIRO Atmospheric Research



Similar impacts are likely to affect some agricultural crops, water supplies and disease conditions. Other impacts expected to occur as a result of climate change include more frequent and prolonged droughts, more frequent bushfires, increased susceptibility to pestilence, increased spread of vectorborne diseases such as Ross River Virus, more frequent heat waves, and increased potential for storm surge along coastal developments.

See http://www.dar.csiro.au/impacts/ future.html for further information about future regional climate projections and impacts.

Indian Ocean Climate Initiative

To enable Western Australians to understand their climate and the forces that drive its variability and change, the Western Australian Government has developed the Indian Ocean Climate Initiative (IOCI). IOCI brings together research scientists at the CSIRO and the Bureau of Meteorology in partnership with Western Australian Government agencies to define critical climate research questions and undertake research to investigate them. In its first five year stage, IOCI has concentrated on investigating apparent changes in rainfall and runoff patterns in Western Australia's South-West since 1975. In its second five year stage, IOCI will focus on generating a better understanding of climate variability and change, and on improving predictive tools and information, such as improved rainfall forecasting and adaptation strategies. It also aims to expand its focus beyond Western Australia's South-West.

See www.ioci.org.au/ for further information on climate variability and change in South-West Western Australia. OUR CONTRIBUTION TO GLOBALCLIMATE CHANGE

OUR CONTRIBUTION TO GLOBAL CLIMATE CHANGE

Australia's greenhouse gas emissions

Australia's overall greenhouse gas emissions are relatively small - about one per cent of global emissions. However, because our national economy is based on low cost fossil fuel and an energy intense society, we have one of the highest per capita greenhouse gas emissions in the world.

Using the United Nations Framework Convention on Climate Change (UNFCCC) greenhouse gas emission accounting rules, Australia has reported its 1990 greenhouse emissions as 515.9 MtCO₂-e¹ and its 2002 emissions as 539.2 Mt CO₂-e. This comprised an increase of 4.5 per cent². Australia's emissions by sector can be seen in Table 2. Australia's accounting under the Kyoto Protocol is different primarily in land use, land use change and forestry sector emissions. Emissions estimates under Kyoto accounting rules are 543.1 Mt CO₂-e for 1990, and 550.1 Mt CO₂-e for 2002, an increase of 1.3 per cent in this period.

In 2000, the energy sector as a whole, comprising stationary energy, transport and fugitive emissions³, generated 67.5 per cent of Australia's (Kyoto accounted) emissions. Agriculture produced about 19.2 per cent, land use change and forestry about 5.3 per cent and industrial processes and waste produced the remainder.

¹ Mt CO₂ mega or million tonnes of carbon dioxide equivalents in total emissions of all gases.

- ² Australia's Third National Communication on Climate Change; 2002.
- ³ Fugitive emissions are not fully controlled, but in most cases are not accidental. Examples include leaks from gas pipelines and valves, venting and flaring of gases, methane emissions from coal seams and vapour given off by petroleum stores.

Greenhouse gas emission inventory accounting systems, UNFCCC and Kyoto Protocol

As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), Australia annually reports its total net greenhouse gas emissions according to internationally set inventory accounting rules. These require reporting all human induced greenhouse gas emissions and removals. They specify methods for estimation of direct emissions from special groupings of emission-generating activities.

Under the Kyoto Protocol, the inventory accounting rules have a more limited scope. They specify only six greenhouse gases, allow choice of base year for the synthetic gases (1990 or 1995) and according to *Article 3.3* of the Protocol, provide for a limited set of forestry activities, namely afforestation (plantations established after 1990), reforestation and deforestation. Countries may elect to apply any or all defined additional sinks such as revegetation, forest management, cropland management and grazing land management.

Kyoto accounting applies to emissions in the first reporting period 2008-12. However the Australian National Greenhouse Gas Inventory includes annual emission figures based on Kyoto accounting rules to estimate progress against Australia's Kyoto target.

Between 1990 and 2000, emissions from the land use change and forestry sector have decreased by between about 76 and 81 per cent (depending on the accounting system). The emissions from all other sectors increased during this period.

Projections of future greenhouse gas emissions, including current abatement measures, suggest the nation will emit an average of 11 per cent more greenhouse gases during the first accounting period for the Kyoto Protocol (2008-12) than it did during 1990. This suggests that meeting Australia's Kyoto target (108 per cent of 1990 emissions) is possible, but challenging. Moreover, success would result primarily from reducing land clearing and revegetation options which are available only once. Further emission reductions will require new technologies, such as renewable energy options, lower energy consumption or other actions.

See www.greenhouse.wa.gov.au for further information about Australia's greenhouse gas emissions.

did during 1990. This suggests that gas emissions. Table 2 Net sector greenhouse gas emissions - Australia - 1990 and 2002

Sector	1990	2002 Mt CO ₂ -e	Change Mt CO ₂ -e	Change %
Energy	286.2	371.4	85.2	29.8
Stationary energy	195.5	261.9	66.4	34.0
Transport	62.0	79.2	17.2	27.8
Fugitive	28.8	30.2		5.0
Industrial processes	26.1	26.4	0.3	1.0
Agriculture	95.1	105.6	10.5	11.0
Waste	15.3	17.6	2.3	15.1
LUC&F ⁴ (UNFCCC)	93.1	18.2	-74.9	-80.4
LULUC&F ⁵ (Kyoto)	120.4	29.2	-91.2	-75.7
Total net national emissions (UNFCCO	C) 515.9	539.2	23.3	4.5
Total net national emissions (Kyoto)	543.1	550.1	7.0	1.3

(Mt CO₂-e)

⁴ LUC&F = Land use change and forestry

⁵ LULUC&F = Land use and land use change and forestry



Western Australia's greenhouse gas emissions

Western Australia's latest formal inventory compiled by the Australian Greenhouse Office (AGO) was for 1995. In 2004 the AGO intends to establish a web-based National Greenhouse Gas Inventory from which State and Territory emission estimates can be prepared on a regular basis.

As an interim measure, a State emissions estimate was calculated for 2002 using information from Australia's National Greenhouse Gas Inventory (NGGI) and State data relating to fuel use, land management, and industrial production. This best available emissions estimate of Western Australia's net greenhouse gas emissions shows the State emitted 65.9 Mt CO₂-e in 2002; 55.4 Mt CO₂-e in 1995 and 57.2 Mt CO₂-e in 1990 including the land management sector activities of land clearing and revegetation (Table 3). On this basis, the net increase in the State's emissions between 1990 and 2002 was about 15 per cent. The land management sector changed between 1990 and 2002 from being a net emitter of greenhouse gases, mainly because of land clearing for agriculture, to a net sink of greenhouse gas emissions, due to carbon sequestration by tree plantations. However, all other sectors increased by between 15 per cent and 43 per cent during the same period.

If land management emissions and sequestration are omitted from the State's by about 34 per cent between 1990 and 2002. This is an increase in emissions of about 2.8 per cent per year. The contribution from land management practices to lower Western Australia's total greenhouse emissions will continue to be important for some decades, especially through the establishment of tree plantings through programs such as *Infinitree*[™]. However, once Western Australia's net organic sequestration has become saturated, this option will no longer be available as an offset for emissions from other sectors of the economy and direct emission reductions will be required.



Table 3 Western Australia's greenhouse gas emissions by sector - 1990-2002 (Mt CO₂-e) (UNFCC accounting)

Sector	1990	1995	2002	% increase over 1990
Energy	33.7	39.9	48.1	42.5%
Industrial processes	0.7	0.9	1.0	38.4%
Agriculture	16.0	16.0	18.7	16.5%
LUC&F	5.2	-2.9	-3.6	-167.9%
Waste	1.4	1.5	1.7	15.0%
TOTAL Net	57.2	55.3	65.9	15.2%
% increase over 1990	0	-3.4	15.2	
TOTAL (excluding LUC&F)	52.0	58.2	69.5	33.9%
% increase over 1990	0	12.0	33.7	

Greenhouse gas emission projections

Projecting the underlying emission increase of 2.8 per cent per year from 2002 estimates, and excluding the land management sector, indicates that Western Australia's gross greenhouse gas emissions will be about 82 Mt CO₂-e in 2008 and 92 Mt CO₂-e in 2012. Projected emission levels correspond broadly with estimates generated independently on the basis of approved or proposed major industrial developments. Organic sequestration during the period from 2008 to 2012 that complies with *Article 3.3* of the Kyoto Protocol has been estimated at six Mt CO₂-e per year, not including the potential contribution of the InfinitreeTM program.

On this basis, the increase in Western Australia's greenhouse gas emissions during the first Kyoto Protocol accounting period is projected to be about 39 per cent above the 1990 baseline year figure. While the InfinitreeTM program is likely to increase carbon sequestration in Western Australia, the net increase will be much higher than the national target of 108 per cent.



A new national approach on greenhouse

Western Australia has had, and will continue to have, higher rates of growth in greenhouse gas emissions than the rest of Australia because of the economic drivers for the State, notwithstanding the higher rate of use of natural gas. Nevertheless, emission intensity of the Western Australian economy has fallen by 28 per cent since 1990 as measured by tonnes of CO_2 -e/\$GSP.

'Greenhouse Gas Abatement', ACIL Tasman – March 2004.

Several factors affect Western Australia's existing and projected emission profiles:

- Western Australia has already implemented a substantial shift to natural gas from coal and oil for stationary energy. While 85 per cent of Australian electricity is produced from coal, the proportion in this State is only 40 per cent. This shift in fuel use, which occurred in the mid 1980s, has reduced the State's annual greenhouse gas emissions.
- Land clearing and resultant emissions were significantly reduced between 1990 and 1995. This one-off reduction delivered a greenhouse gas emission reduction of about 7.2 Mt of CO₂ per year. In July 2004 the *Environmental Protection Act 1986* was amended to introduce a more comprehensive system to regulate clearing of native vegetation from land and substantially increase penalties for unauthorised removal.
- A large number of energy intensive industries have been developed during the past decade, and many more are proposed. Approved and proposed industries could generate up to 17 Mt CO₂ more emissions than are currently emitted. Most of the products of these industries would be exported.
- Energy exports are projected to expand significantly.
- Substantial areas of tree plantations have been established, which have already sequestered substantial amounts of carbon. The InfinitreeTM program aims to establish considerably more plantations on cleared agricultural lands.

Western Australia needs to develop its emissions management program in light of these factors, national policies and international agreements.



Renewable energy in Western Australia

Western Australia's energy use is dominated by fossil fuels used for electricity generation, heat and transport. Nevertheless, about 1.7 million tonnes of CO_2 -e a year, or about 2.6 per cent of the State's net 2002 CO_2 -e emissions are avoided by the current use of renewable energy sources.

Of these current avoided emissions, small scale photovoltaic, wind and bioenergy facilities avoid about 20,000 tonnes of CO₂-e per year, wind power installations about 81,000 tonnes of CO₂-e a year and solar water heaters approximately 170,000 tonnes of CO₂-e a year. The Ord River hydro plant avoids about 161,000 tonnes of CO₂-e per year whilst landfill gas used for electricity generation avoids about 570,000 tonnes of CO₂-e a year. About 40 per cent, or 660,000 tonnes of CO₂-e is avoided by burning of wood for heat. Over their remaining lifetimes, these existing renewable energy applications will save about 29 million tonnes of greenhouse gas emissions.

Several projects, likely to be implemented by December 2006, may reduce Western Australia's emissions by about a further 500,000 tonnes per year. A number of other new projects are also expected to commence operations by December 2006 but are still being developed. If all these proposed projects are implemented, Western Australia's emissions could be reduced by a further 1.9 million tonnes of CO_2 -e per year.

If these proposed projects were added to existing renewable energy facilities, Western Australia could avoid greenhouse gas emissions by about 3.6 million tonnes of CO_2 -e a year, or five per cent of the State's total net greenhouse gas emissions in 2002, and about 7.5 per cent of energy sector emissions in that year. See http://www.greenhouse.wa.gov.au/ for further information.

Source: Western Australian Renewable Energy Projects, Estimates of Greenhouse Benefits, May 2004. 24

POLICY RESPONSES TO GLOBAL CLIMATE CHANGE

POLICY RESPONSES TO GLOBAL CLIMATE CHANGE

Australia's target is to emit not more than 108 per cent of its 1990 levels

International agreements

The 1990 Inter-Government Panel on Climate Change (IPCC) scientific report led to 186 countries endorsing the United Nations Framework Convention on Climate Change (UNFCCC) at the Earth Summit in Rio de Janeiro in 1992. This Convention, a legally binding instrument, came into effect in 1994 and aims to stabilise atmospheric greenhouse gas concentrations at levels below which unacceptable impacts would occur. It states: 'Developed country Parties should take the lead in combating climate change and the adverse effects thereof'.

The 1997 Kyoto Protocol established a greenhouse gas accounting framework and defined targets for greenhouse gas emissions for developed countries for the period between 2008 and 2012, as a proportion of their 1990 emissions. Australia's target is to emit not more than 108 per cent of its 1990 levels. Most other developed countries have targets to reduce their emissions during this period to below their 1990 levels.

International business approaches to greenhouse

A survey of the FT500 Global Index companies reveals that 35 per cent are taking action to address the anticipated risks and opportunities of climate change. Among European electric utilities, the costs of achieving emission reductions range from 20 per cent of net income to three per cent where nuclear and hydro are the major sources. Early movers include Merril Lynch, Hypovereinsbank, Allianz, Daimler-Chrysler, GM, Dupoint, Agilent, ST Microelectronics, RWE, Iberdola, Mitsubishi, Intel, Anglo American. A report on this survey can be viewed at www.cdproject.net/.

(Carbon Disclosure Project October 2003)

The Kyoto Protocol provides that a nation's greenhouse gas emissions are the net total of all emissions from that nation during a specified time, less any emission credits gained from another nation, and less any sequestration that occurs within its boundaries. A number of flexible emissions reduction mechanisms are proposed to enable trading emissions reduction credits or offsets cost effective emission reduction. It is anticipated that when markets in greenhouse emissions credits and offsets develop, they will likely help emitters determine how they can most cost effectively achieve any emissions reduction targets they face.

The Kyoto Protocol will take effect when signed by at least 55 nations producing at least 55 per cent of greenhouse gas emissions from developed nations.

In July 2003 the European Union agreed to establish a greenhouse emissions trading market that would facilitate least cost emissions target achievement by its members and industries operating within its boundaries.

Australian business approaches to greenhouse

Australian business was initially opposed to ratifying Kyoto as it was considered likely to impose costs that would not be imposed on business in less developed countries – making Australian business uncompetitive. The Business Council of Australia reported in February 2003 that it was not in a position to either support or reject ratification of the Protocol. However members would continue to actively support and work towards achieving the limitation of Australia's greenhouse gas emissions in 2012 to 108 per cent of 1990 emissions as stipulated in the Protocol.

(Business Council of Australia News Release 28 February 2003)

Photo courtesy of Department of Environme



Australian national responses to climate change

International agreements

Australia is a signatory to the UNFCCC and the Kyoto Protocol.

So far the Commonwealth Government has declined to ratify the Kyoto Protocol because it is concerned that doing so would damage Australia's international competitive trading position and economic growth. A concern raised by the Commonwealth is possible leakage of investment and industry from Australia to developing countries that do not have emissions reduction targets. Australia's refusal to ratify the Kyoto Protocol has also been made on the basis that developing country parties to the UNFCCC are not bound by it.

Nevertheless, the Commonwealth Government has committed Australia to meeting its Kyoto Protocol target. For as long as Australia does not ratify the Protocol, Australian companies cannot gain access to international emissions trading flexibility mechanisms that have been developed to minimise the cost of reducing emissions levels globally. This means Australian companies must achieve all required emissions abatement domestically. A study commissioned by New South Wales, Victoria and South Australia reported there would be a significantly lower cost for Australia to meet its Kyoto target if our nation was able to access international emissions trading opportunities. The study suggested achieving our Kyoto target through a combination of actions including international trading would result in Australia's GDP being 0.11 per cent lower in 2012. This compares with a 0.26 per cent reduction if Australia were to achieve its target without access to international emissions trading options available to nations that have ratified the Kyoto Protocol¹. For this reason, New South Wales and Victoria have urged the Commonwealth to ratify the Protocol.

The financial impact of the Commonwealth Government's intention to comply with Australia's emissions target under the Kyoto Protocol in the first commitment period to Western Australia's economy has been estimated at less than one per cent of Gross State Product². Such estimates are dependent on various assumptions, including the price of emissions credits, and transaction costs. Nevertheless, whatever assumptions might be used, Australia needs to have an effective long-term strategy to reduce emissions for the period to 2050 and beyond. Western Australia will continue to advocate for the Commonwealth, through consultation with the States and Territories, to develop a national strategy that recognises jurisdictional issues and effectively positions the nation's long term response to greenhouse.

Council of Australian Governments

The Council of Australian Governments (COAG) is the peak intergovernmental forum in Australia. COAG comprises the Prime Minister, State Premiers, Territory Chief Ministers and the President of the Australian Local Government Association. Established in 1992, the role of COAG is to initiate, develop and monitor the implementation of policy reforms that are of national significance and which require cooperative action by Australian Governments.

Over 40 Commonwealth-State Ministerial Councils and forums currently facilitate consultation and cooperation between governments in specific policy areas. They also initiate, develop and monitor policy reform jointly in these areas, and take

¹ Report of the Kyoto Protocol Ratification

Advisory Group (2003)

² The Allen Consulting Group study



A new national approach on greenhouse

State and Territory leaders agreed that a new national approach on greenhouse will assist Australia meeting its Kyoto Protocol target and ensure Australia is well placed to contribute to future international efforts to reduce greenhouse gas emissions. There is also a need to position Australia for the transition to a carbon constrained global economy over the medium to longer term by building on its existing competitive strengths and facilitating the adoption of new and emerging technologies and practices. Premiers and Chief Ministers agreed that COAG should consider at its first meeting in 2004, a detailed assessment of issues (including impacts) and options with a view to agreeing a new national approach to greenhouse.

Communiqué - Joint Statement - Leaders Forum August 29, 2003.

joint action in the resolution of issues that arise between governments. Outcomes from many of these processes and other forums will, directly or otherwise, address greenhouse emissions. These are actions that are best delivered through national frameworks and will complement the initiatives outlined in this Strategy.

National Greenhouse Strategy

In 1998 the Commonwealth, State and Territory Governments agreed on an Australian national greenhouse strategy which extended a program of action launched by all governments through the 1992 *National Greenhouse Response Strategy* (NGS). The NGS took account of factors that had emerged and evolved since 1992, particularly the improved information base on emissions and the Kyoto Protocol. The goals of the NGS are to:

- limit net greenhouse gas emissions;
- foster knowledge and understanding of greenhouse issues; and
- lay the foundations for adaptation to climate change.

The NGS defines eight modules relating to distinct areas of interest and concern, and within each module a set of measures is defined for implementation by all governments or by various combinations of the Commonwealth and one or more State and Territory Governments as appropriate. In 2000 a progress report summarised achievements, including the preparation of implementation plans by all governments and considerable progress in implementing the majority of measures.

See http://ngs.greenhouse.gov.au/action_ plans/index.html for a summary of State responses to the NGS modules.

Australian Greenhouse Office

In 1998 the Commonwealth Government established a central greenhouse agency, the Australian Greenhouse Office (AGO), to coordinate Commonwealth action on climate change matters. This Agency has developed several innovative programs and products to reduce emissions, which frequently involve partnerships between the Commonwealth Government, local government, industry and the community. The existence of a national greenhouse agency has enabled Australia to focus its climate change effort in a way few other nations have been able to.

The way ahead for Australia

The Commonwealth Government is seeking to develop a new strategic approach to climate change. The four main elements of the program are:

striving for a comprehensive global response;

- reducing the greenhouse intensity of Australia's energy intensive and trade exposed industries through the development of technologies;
- reducing the greenhouse intensity of Australia's economy through other least cost means; and
- preparing for unavoidable climate changes through adaptation plans.

See www.environment.gov.au for more information on these and other national responses to climate change.

Renewable energy initiatives

The Commonwealth Government has sought to promote renewable energy through a number of initiatives. The most significant is the Mandatory Renewable Energy Target (MRET) that requires electricity wholesalers and large users to purchase renewable energy, with a 2010 target of 9500 gigawatt hours. Other programs have included the Renewable Energy Action Agenda, the Renewable Energy Showcase Program, the Photovoltaic Rebate Program and the Renewable Remote Power Generation Program.

Western Australia's response to climate change

The Western Australian Government recognises the significant weaknesses and limitations of the Kyoto Protocol, yet believes the Protocol represents an essential step towards the global approach necessary to prevent dangerous climate change.

The Western Australian Government calls upon the Federal Government to ratify the Kyoto Protocol and will support national measures to meet the Kyoto Protocol target that recognise Western Australia's circumstances and interests.

The Protocol coming into force, and Annex One countries including Australia meeting their commitments for 2008-12, would help set a direction conducive to negotiating and achieving better long term international outcomes.

Meeting the Kyoto Protocol targets, and negotiating and meeting the more challenging targets that appear likely in the future will be a national task. Western Australia will play its part in meeting any targets and will expect to participate fully in the development and adoption of national measures. By participating, the Western Australian Government will work to ensure that no inequitable burden falls on any sector or region of Western Australia. Western Australia has already taken action to address the challenges and opportunities arising from climate change.

In June 2002, the Government introduced legislation to Parliament to reduce the commercial and legal risks associated with the ownership of carbon and forest tree plantation rights by providing a simple and secure system for registering these rights against the title of the relevant land. This will encourage sequestration investments and deliver significant economic and environmental benefits. These plantings will generate organic material such as timber, wood chips, natural products and bio-fuels. They will also generate regional employment and diversification, carbon rights and credits, and environmental improvements to counter salinity and biodiversity loss.

The Environmental Protection Authority's *Guidance Statement for Minimising Greenhouse Gas Emissions No 12* (October 2002) encourages new projects to be at world best practice greenhouse emission standard and to report annual and total emissions of more than 500,000 tonnes of CO₂-e.

The new Sustainable Energy Development Office (SEDO) is developing and implementing policies and programs aimed at stimulating growth in the sustainable energy industry. It promotes awareness and provides tools for households, government and businesses to better manage energy in ways that make a tangible difference to the environment. It also provides a number of grants, rebates and incentives for homes and businesses to adopt renewable energy and works with other government agencies, industry and the community to develop and implement policies that increase the sustainability of energy supply and use.

See http://www1.sedo.energy.wa.gov.au for further information about SEDO and its associated activities.

Focusing on Western Australian industrial greenhouse gas emissions

The environmental impact assessment process currently requires proponents with projects emitting more than 500,000 tonnes per annum of carbon dioxide equivalent greenhouse gas emissions to submit a greenhouse emissions management plan. Large industrial projects recently approved by the Minister for the Environment have contained such a condition. Examples include HiSmelt at Kwinana, Austeel at Cape Preston, and the suite of projects recently approved on the Burrup Peninsula. The Greenhouse Gas Emissions Management Plan ensures that the best available technologies are used to minimise total net greenhouse gas emissions and/or greenhouse gas emissions per unit of product, and that emissions are mitigated in accordance with the UNFCCC. These requirements are detailed in the Environmental Protection Authority's *Guidance Statement Number 12*.

The Plan must include:

- the proposal's projected greenhouse gas emissions;
 - specific measures to minimise emissions;
- · emission monitoring;
- greenhouse emission efficiency estimates and comparisons with similar projects;
- an analysis of the extent to which the proposal meets the requirements of the National Greenhouse Strategy using a combination of emission reduction measures, organic carbon sequestration and international emission offset mechanisms; and
- a target set by the proponent for reducing total net greenhouse gas emissions and / or greenhouse gas emission per unit of product over time and annual reporting of progress made in achieving this target.

Western Australia's Greenhouse Strategy

The Western Australian Government developed the Western Australian Greenhouse Strategy to build on current and former initiatives. In doing so, it has defined several objectives for its strategic response to global climate change. The Strategy will:

- maximise opportunities for a sustainable future for Western Australians;
- create voluntary market-based abatement measures to enable all emitters to access least cost greenhouse emissions initiatives;
- establish a realistic and effective long term commitment to addressing climate change;
- ensure all sectors contribute to solutions; and
- enable Western Australia to contribute to national and international solutions on a cost-effective basis.

This Strategy provides a framework for actions from 2004. Because the external environment remains undefined, due to uncertainty about whether the Kyoto Protocol will come into force and whether Australia will ratify it, regular revisions of the Strategy will be necessary to ensure it remains properly directed and focused. The Western Australian Government decided that for this Strategy to be comprehensive and balanced, it required four substantive elements:

- reducing emissions of all greenhouse gases;
- sequestering carbon;
- adaptation; and
- creating and promoting new commercial opportunities from climate change initiatives.

To support these elements, the Western Australian Government agreed the Strategy include actions to:

- establish and demonstrate Government leadership;
- raise community awareness and involvement;
- continue developing and implementing research; and
- engage with national and international processes.

The Strategy creates opportunities for a sustainable future for Western Australians

Strategy time frames

The Strategy is broadly based on three time-frames:

- 1. A short term time-frame (2004 to 2008) covers the period from the release of the Strategy to the commencement of the first Kyoto Protocol reporting period (2008-12). All proposed actions within this timeframe are defined in sufficient detail to be included in agency work programs. During this time-frame a Greenhouse Unit will be established which will help seek to ensure that Government agencies, local government, industry and the community include climate change considerations (ie emission reductions and climate adaptations) in their planning processes. Towards the end of this period, the Strategy will be reviewed and international negotiations relating to the period after 2012 will commence.
- 2. A medium term time-frame corresponds to the First Kyoto Protocol reporting period (2008 to 2012). The Strategy does not propose detailed initiatives for this period because (a) it is as yet uncertain how Kyoto commitments might affect Australia's emission management arrangements and (b) the impacts of climate change are likely to be much better understood by 2008 than they are now. Detailed actions for this period would be developed in the review of the Strategy to be undertaken in the period leading to 2008.
- 3. A long term time-frame relates to the period beyond 2012. Our current consideration of this time frame is set within the policy uncertainty affecting international and national arrangements and the increasing scientific certainty that global climate change is already affecting our regional climate conditions.

The Western Australian State Sustainability Strategy

Western Australia's Premier, Dr Geoff Gallop, released the *State Sustainability Strategy* in September 2003. This Strategy addresses the broad range of issues that the Western Australian community will need to consider during the next decade, including climate change.

The *State Sustainability Strategy* has a number of initiatives which aim to reduce our contribution to climate change and lessen the impact on communities, industries and natural values. This Strategy builds on the *State Sustainability Strategy*, the community's response to it and previous greenhouse issues papers.

Visit www.sustainability.dpc.wa.gov.au for more details.



Implementing the Strategy

The Greenhouse Unit, located within the Department of the Premier and Cabinet (see Action 1.1), will coordinate the implementation of the Strategy and will report annually to Parliament and the community. All new actions are identified with an asterisk. Some of these actions will be implemented using existing resources. Other actions will be implemented using new resources specifically provided. Further resources for several new actions will be sought by responsible agencies. The Strategy is to be reviewed and updated before 2008 to ensure it effectively reflects national and international circumstances leading into the first Kyoto Protocol reporting period. As new policy issues or scientific knowledge arises, this Strategy will be further developed and extended.

Further long-term strategies will be required for overcoming the climate-generated challenges and for taking advantage of the opportunities climate change will deliver to Western Australia as further information becomes available and international and national arrangements evolve.

This Strategy sets out a framework for exploring these issues and provides directions for resolving them.

Action on ozone

Ozone depleting gases, particularly chlorofluorocarbons (CFCs), can trap heat energy in the lower atmosphere, thereby contributing to the greenhouse effect. Gases used by industry to replace CFCs, such as hydroflourocarbons, can be several hundred times more potent than carbon dioxide (CO₂) in trapping this heat energy. For example, the hydrofluorocarbon 134a, used in most car air conditioners, is 1300 times more potent than CO_2 on a tonne-for-tonne basis. Western Australia was the first State in Australia to introduce ozone protection legislation which banned the use of CFCs in certain aerosols (pressure packs) in 1988. Current legislation such as Western Australia's Environmental Protection (Ozone Protection) Policy 2000, (subsidiary legislation under the Environmental Protection Act 1986) and the Commonwealth's Ozone Protection and Synthetic Greenhouse Gas Management Act 2003 aims to minimise the release of CFCs and other such potentially harmful greenhouse gases. Western Australia also cooperates with the Commonwealth and other State and Territory Governments in the National Ozone Protection Program to minimise greenhouse emissions. A recent National Report Card noted that phase out targets for ozone-depleting gases in Australia are being achieved or exceeded. This includes methyl bromide, which is due to be phased out by 2005.



Part B - Strategy and Actions

Introduction

B

This Strategy provides a framework for reducing Western Australia's greenhouse gas emissions and for ensuring the State can effectively address the unavoidable impacts of global climate change.

The framework takes account of the State's historical economic dependence on energy intensive industry and the potential future development prospects associated with the enormous natural resources of the North-West Shelf. In response to this situation the Strategy introduces short-term actions which will increase our capacity to contribute to national and international emission reduction goals and programs as these become clarified through policy decisions and commitments. It also sets the basis for effective medium and longer term actions. Similarly, the framework is built on an emerging perception that Western Australia could be vulnerable to early impacts of global climate change. The Strategy promotes and focuses research into these potential impacts and will ensure all sectors of the community can inform themselves about these impacts.

The framework also highlights opportunities, such as new industries or plantation establishment, that might develop as a result of climate change.

Some of the actions in the Strategy have been in development for some period or are already being implemented, such as energy conservation or efficiency initiatives. Some actions are new initiatives that will extend the boundaries of existing actions or extend Western Australian Government policy.

GOVERNMENT LEADERSHIP

CONTEXT

Successfully addressing the greenhouse effect requires everyone – individuals and organisations – to make significant changes to how decisions are made and resources are used.

The Western Australian Government can demonstrate in practical ways how the causes and impacts of climate change can be overcome. Its purchasing power can also help drive the social and technological transformations needed to reduce greenhouse gas emissions.

OBJECTIVE

To define and demonstrate the diverse initiatives necessary to reduce Western Australia's contribution to climate change and to ensure the State is prepared for unavoidable climate shifts.

BACKGROUND

Climate change affects everyone. The Western Australian Government is demonstrating its leadership by:

- developing and implementing this Strategy to address climate change and its impacts; and
- working to minimise its own contribution to climate change.

The Western Australian Government leases and operates about 8300 vehicles, purchasing about 3200 new vehicles each year. Government agencies are estimated to consume about 419 GWh of electricity annually, which was approximately two per cent of electricity generated in the State in 2000-01. These agencies also use about 196 GWh of natural gas. This figure does not include energy consumption by trading entities such as Western Power or the Water Corporation.

STRATEGIC DIRECTIONS Developing and implementing a comprehensive Greenhouse Strategy

This Strategy was developed through extensive interaction with Western Australia's community and business sectors. It has involved an extensive program of scientific review and issue analysis, relating to the complexity of global climate change.

Actions

- 1.1 A Western Australian Greenhouse Unit will be established in the Department of the Premier and Cabinet to coordinate and report on the implementation of the Western Australian Greenhouse Strategy. The Unit will also ensure Western Australia's interests and opportunities are properly represented nationally and internationally.
- 1.2 Progress on implementing the Strategy will be reported annually, with the report being available from the Greenhouse Unit and on the Western Australian Greenhouse website.
- 1.3 The Strategy will be reviewed and updated before 2008.

34

CHAPTER 1 - GOVERNMENT LEADERSHIP
The STEP Program

Transport is a major Government cost and a significant source of Government greenhouse gas emissions. The Department for Planning and Infrastructure (DPI) is implementing a Sustainable Transport Energy Program (STEP) that involves:

- a '6 to 4' program, to give preference to purchasing four cylinder vehicles (rather than six cylinder) for Departmental use;
- acquiring and undertaking a trial of 20 Toyota Prius 'hybrid cars'; and
- considering the feasibility of greenhouse gas emission offsets.



Photo courtesy of Department for Planning and Infrastructure

Reducing greenhouse gas emissions from Government operations

Western Australia's Government operations produce greenhouse gas emissions directly through the use of transport, materials, fuels and gas, and indirectly by using electricity and resources.

Embedded energy in materials used by Government

Western Australian Government departments are already working to reduce their use of materials through extensive recycling programs for paper, plastic, glass and metal. Policies are being developed to favour purchasing goods and services that meet certain minimum sustainability requirements. Many departments have signed Cleaner Production Agreements committing to better resource use, recycling and energy efficiency. The State Supply Commission has introduced a greenhouse gas reduction policy requiring public authorities to take account of the energy efficiency of goods or services, when making purchases.

Action

1.4 Western Australian Government purchasing policies will encourage minimisation of the environmental impact of procurement and promote selection criteria that provide positive advantage to goods, services and/or processes that promote sustainability, including energy efficiency. 1.5 A Sustainability Procurement Statement, including greenhouse requirements, will be developed to encourage more sustainable procurement by Government.

Energy efficiency in Government offices and facilities

In 2002 the Minister for Energy announced the *Energy Smart Government* initiative. This requires all Western Australian Government departments with 25 or more full-time employees to reduce their electricity and gas use by specified percentages. Other agencies and Western Australian Government trading enterprises are encouraged to adopt the principles of the policy as an integral part of their business.

Individual agency Chief Executive Officers are responsible for achieving these energy conservation targets and must report their progress in annual reports from 2002-03. Funding programs for identifying energy saving opportunities and undertaking energy saving capital projects are available to help agencies meet their goals.

Action

1.6 The Energy Smart Government initiative aims to reduce Western Australian Government stationary energy (or non transport energy) use by 12 per cent below the 2001-02 baseline levels by 2006-07.

Renewable energy

The purchase of renewable energy supplies (such as electricity from wind power, photo-voltaic or biomass sources) or the utilisation of renewable sources (such as solar or geothermal) where they displace conventional technologies can reduce energy-related greenhouse gas emissions. Some agencies already purchase some renewable energy as part of their grid electricity supplies and give priority to installing renewable energy technology in remote locations. Other Western Australian Government agencies are using funds available through the *Energy Smart* Government initiative to develop innovative renewable solutions to meet their energy requirements. Western Australian Government purchases can help support the expansion of the State's renewable power industry.

Action

1.7 The Western Australian Government will purchase the equivalent of five per cent of its electricity from costeffective renewable sources by 2006-07.

Energy efficient Government housing

The Western Australian Government is a major purchaser and manager of housing, with its housing design specifications, construction contracts and tenders now incorporating energy efficiency measures to ensure architects address energy efficiency issues. Since 2001-02, solar hot water systems have been supplied to public housing in the Kimberley, Pilbara,

TravelSmart Workplace Program

The Department of Environment (DoE) and Department for Planning and Infrastructure (DPI) TravelSmart Workplace program has facilitated the introduction of green transport plans in 21 Perth workplaces to date. At one of the 21 workplaces, the Water Corporation's Leederville office, the plan seeks to decrease the number of vehicle trips generated by encouraging staff to carpool, use public transport, cycle or

walk where they can. Through its Green Transport Plan, the Corporation has provided travel information and incentives, improved management of car parking and the vehicle fleet and upgraded bicycle facilities. This resulted in a 23 per cent reduction in car commuting between 1998 and 2001.

At another workplace, Department of Environment staff working at the Hyatt Centre in Perth reduced their driver-only trips to work by five per cent between December 2002 and December 2003 and increased the use of green transport modes by six per cent. DoE employee car commuting is estimated to have been reduced from 6,208 km a week in 2002 to 4,577 km a week in 2003. The DoE reduced its overall kilometres travelled and emissions by 18,795 kg of carbon dioxide and 179 kg of nitrogen oxides.



and Murchison. New briefs will reflect the recent changes to the Building Code of Australia (BCA) that promote energy efficiency. All building plans will be energy rated to ensure design consultants comply with BCA requirements.

Actions

- 1.8 New Western Australian Government housing will aim to exceed the minimum energy efficiency requirements under the Building Code of Australia for all dwellings where an industry recognised rating tool exists.
- 1.9 The Western Australian Government will examine options to install solar water heaters and other energy efficient measures on all new Government houses and buildings from 1 July 2004.

Greenhouse gas emission accounting and reporting

The Western Australian Government releases greenhouse gases or is responsible for some greenhouse gas emissions as a part of its operations. There are strong similarities between greenhouse gas emission reduction actions available to Western Australian Government, business and the community including increased energy efficiency, changes to existing practices and carbon sequestration offsets.

The Western Australian Government will reduce emissions from its operations in a cost effective manner.

Actions

- 1.10 Western Australian Government agencies and trading enterprises will determine the sources and amounts of significant emissions arising from their operations and report annually to the Greenhouse Gas Inventory established through Action 2.1.1 from 2005-06.
- 1.11 Western Australian Government agencies and trading enterprises reporting their greenhouse gas emissions to the Inventory will also (a) annually prepare and lodge greenhouse gas emission estimates for the coming year by total and by intensity; and (b) develop strategies to minimise anticipated emissions. Strategies and estimates for the coming year will be required to be lodged from 2006-7.

Reducing transport emissions

Greenhouse gas emissions from the Government vehicle fleet can be reduced through measures such as rationalising vehicle usage, choosing more efficient vehicles and using gaseous fuels where appropriate.

Actions

1.12 Require agencies to take actions to reduce greenhouse emissions from their vehicle fleets.

Purchasing emission offsets generated through the Western Australian Greenhouse Abatement Fund (Action 2.1.7), carbon sequestration in plantations or through renewable energy projects can also reduce the net effect of Western Australian Government transport emissions.

1.13 Implement an emissions offset scheme for vehicle emissions in 2005-06, with costs to be borne by agencies in proportion to their emissions.

Investigating Western Australia's preferred emission reduction models

The Western Australian Government can learn about emission reduction models, and how they can be implemented effectively across the complexities of society, by applying them to its own operations.

The Western Australian Government will initiate a process aimed at exploring the relative effectiveness of alternative greenhouse emissions reduction frameworks through applying these frameworks, on a nominal basis, to selected Western Australian Government entities. This activity will contribute to the development of a preferred Western Australian emission reduction framework (Action 2.1.6) and will help avoid exposing industry to a new and different set of requirements and processes that have not been tested and refined through application and review.

Action

1.14 The Western Australian Government will explore possible emissions trading models by reviewing and assessing trading structures through voluntary trial application within Government operations.

Greenhouse response actions

No.	Action	Responsible Department or Agency	Action timetable		
1.1*	A Western Australian Greenhouse Unit will be established.	DPC	Ongoing		
1.2*	Progress on implementing the Strategy will be reported annually.	Greenhouse Unit	Ongoing from 2005		
1.3	The Strategy will be reviewed and updated before 2008.	Greenhouse Unit	Annual, ongoing		
1.4*	Western Australian Government purchasing policies will encourage minimisation of the environmental impact of procurement and promote selection criteria that provide positive advantage to goods, services and/or processes that promote sustainability, including energy efficiency.	State Supply Commission (goods & services), DHW (works), Sustainability Policy Unit	Ongoing		
1.5*	A Sustainability Procurement Statement, including greenhouse requirements, will be developed to encourage more sustainable procurement by Government.	DTF, Sustainability Policy Unit, State Supply Commission	Ongoing		
1.6	The <i>Energy Smart Government</i> initiative aims to reduce Western Australian Government stationary energy (or non transport energy) use by 12 per cent below 2001-02 levels by 2006-07.	SEDO	2002-07		
1.7*	The Western Ausralian Government will purchase the equivalent of five per cent of its electricity from cost-effective renewable sources by 2006-07.	SEDO, DTF	Ongoing from 2004-05		
1.8*	New Western Australian Government housing will aim to exceed the minimum energy efficiency requirements under the BCA for all dwellings where an industry recognised rating tool exists.	DHW	Ongoing		
1.9	The Western Australian Government will examine options to install solar water heaters and other energy efficient measures on all new Government houses and buildings.	DHW, agencies delivering Government buildings	2004		
1.10*	Western Australian Government agencies and trading enterprises will determine the sources and amounts of significant emissions arising from their operations and report annually to the Greenhouse Gas Inventory established through Action 2.1.1 from 2005-06.	All Government agencies and trading enterprises, DOE	From 2005-06		
1.11*	Western Australian Government agencies and trading enterprises reporting their greenhouse gas emissions to the Inventory will also (a) annually prepare and lodge greenhouse gas emission estimates for the coming year by total and by intensity; and (b) develop strategies to minimise anticipated emissions. Strategies and estimates for the coming year will be required to be lodged from 2006-07.	All Government agencies and trading enterprises, DOE	From 2006-07		
1.12*	Require agencies to take actions to reduce greenhouse emissions from their vehicle fleets.	All Government agencies	Ongoing		
1.13*	Implement an emissions offset scheme for vehicle emissions in 2005-06, with costs to be borne by agencies in proportion to their emissions.	DoE, DTF	2005-06		
1.14*	The Western Australian Government will explore possible emissions trading models by reviewing and assessing trading structures through voluntary trial application within Government operations.	Greenhouse Unit, DoE	From 2004-05		
New programs are indicated with an asterix *					

REDUCING GREENHOUSE EMISSIONS

Western Australia's net greenhouse gas emissions increased by about five per cent between 1990 and 1999. However, if land use change and forestry emissions and sequestration are excluded, greenhouse gas emission increased by approximately 27 per cent during that period. Projections of the State's emissions suggest that this rate of increase is likely to continue unless effective action is taken to reduce the existing trend.

The State's greenhouse gas emissions are dominated by its energy-related emissions. These emissions comprised about 73 per cent of the State's emissions in 2002 and increased by about 43 per cent between 1990 and 2002¹. This sector includes stationary energy use, electricity generation and transport. Some energy-related emissions are generated by activities that will result in lower emissions in other places, such as where natural gas is liquefied and exported to replace coal for electricity production. However, a significant amount of energy-related emissions are associated with transport and commercial and domestic activities within Western Australia.

The other major greenhouse emitting sector is agriculture. This sector emitted about 28 per cent of Western Australia's emissions in 2002. Emissions from the sector increased by about 17 per cent between 1990 and 2002².

Emissions from other sectors, industrial processes and waste, are relatively low by comparison, but are still significant.

This section addresses these sectors separately. It sets out actions to increase awareness and engagement and to establish programs that will yield short, medium and long term emission reduction benefits.



Figure 15 Greenhouse gas emissions from stationary energy in Australia 2002

¹ NGGI 2002 emissions data

² NGGI 2002 emissions data.

Narrogin bioenergy plant – demonstration of integrated wood processing

Western Power is building a 1 MW demonstration plant that will generate 7.5 GWh per year of renewable electricity – enough to power 1000 homes - and produce activated carbon and eucalyptus oil from locally planted mallees.

The plant uses fluidised bed technology developed by the CSIRO to turn wood into charcoal which is then converted to 'activated' carbon. Oil will be distilled from the mallee leaves and the residue gasified to fire a boiler. Heat from both processes will generate electricity.

The electricity produced is considered to be carbon dioxide neutral and will displace fossil-fuelled electricity generation. Some of the activated carbon will remain as carbon, becoming a greenhouse sink. An additional carbon store is created when the land use is changed from agriculture to agroforestry and carbon is stored in the continuing growth of roots. This characteristic of the mallee, and its rapid regrowth after harvesting, make it an ideal species for this application. Revegetation can also contribute to natural resource values such as salinity control, biodiversity and erosion control.

The Narrogin plant will take the technology from theoretical prototype to proof of concept. Full scale, fully economic operations would be five times the size of this plant, with each operation requiring the planting of 20 million trees. There is potential for at least ten such Integrated wood processing plants throughout the State's wheatbelt resulting in diversified farming options and regional development. Many more are possible in other states and overseas.'

2.1 Industry and electricity generation emissions

CONTEXT

OBJECTIVES

Western Australia produces approximately 12 per cent of the nation's greenhouse gases and, unlike the eastern states, the dominant sources are not coal-fired power stations generating electricity.

The fastest growing section of the Western Australian economy is energyintensive or energy producing industries. The Western Australian energy and resource industry is heavily dependant on gas.

Most industries are aware of the global climate change imperative and the need to address greenhouse gas emissions.

All stakeholders agree that action to reduce emissions is inevitable. The aim is to find the least cost option.

It is widely accepted that a national approach to emission abatement will be the most effective in meeting Australia's commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and our Kyoto target. However, Western Australia must protect its economic and environmental interests through developing a preferred approach and framework for reducing emissions, reflecting our unique situation.

- To create institutions and encourage the development of market-based mechanisms that will deliver least cost greenhouse gas abatement and protect Western Australia's economic and environmental interests in any nationally developed emission framework.
- To encourage the use and development of energy saving and sustainable energy technologies.

BACKGROUND

Reducing greenhouse gas emissions from industry is a difficult issue facing all developed nations but it is a particular challenge for Western Australia because of our vast energy supplies and the growing number of energy-based industries.

Some companies are concerned that emission reduction programs could increase their costs and reduce their ability to compete, particularly against those competitors located in countries not bound to cut greenhouse gases under the Kyoto Protocol.

Other industry operators accept that a carbon constrained future is inevitable and are already taking practical steps to reduce their emissions. These companies

<u>Cockburn 1 – A new best practice combined cycle gas turbine</u>

Gas turbines operated in the combined cycle mode (CCGT) are the most greenhouse efficient technology for power generation using natural gas, and are coming into use throughout the world.

Western Australia's first power station to use this generation technology is the 240 MW Cockburn 1 plant at Kwinana, commissioned by Western Power in October 2003. The plant uses natural gas to drive a gas turbine generator which produces 160 MW of electricity. Waste heat in the turbine exhaust is captured in a Heat Recovery Steam Generator to produce a further 80 MW from a steam turbogenerator.

From an energy and greenhouse perspective, CCGT technologies are more efficient than other conventional fossil fuel electricity generation technologies. The two-stage process achieves a generation efficiency close to 50 per cent, compared with around 40 per cent attainable from super critical coal technology. From a greenhouse perspective the benefits of CCGT's are significant, with a greenhouse intensity 49 per cent that of a coal fired plant.

> are building into their internal accounting Ta procedures the future price of carbon as a way of reducing the future effects of emission abatement on their cost structures.

Western Australia has already converted a significant proportion of electricity generation activities from coal to natural gas, a transition New South Wales, Victoria and Queensland have yet to make. Whilst there is room for further fuel switching in Western Australia, future reductions of emissions on a significant basis will be limited.

A major point source of greenhouse gas in Western Australia is on the North-West Shelf and the Burrup Peninsula. This is the result of the production of domestic gas and LNG for export, the use of gas as an energy input in the powering of the industrial plant, and the venting and flaring processes used to dispose of the by-products.

Up to seven other industries using massive quantities of natural gas have indicated a desire to establish operations in the North-West over the next 10 years. These operations would significantly increase Western Australia's level of greenhouse gas emissions, yet their export product will contribute to reductions globally.

Table 4Energy intensive projectsplanned or under construction

Photo courtesy of Department of Industry and Resources

Project	Annual CO ₂ Emissions (Million Tonnes)	
Woodside 4* & 5:	2.9 Mt/a	
Burrup Fertilisers*	1.4 Mt/a	
Dampier Nitrogen	0.8 Mt/a	
Liquigas	0.5 Mt/a	
Japan DME	1.0 Mt/a	
DME International	Not as yet determined	
Hi Smelt* (1.5 Mt/a each stage)	3.0 Mt/a	
Gorgon (3.2 Mt/a with geo sequestration)	7.4 Mt/a	
TOTAL:	17 Mt/a	-

Western Australia is extremely fortunate to have some of the world's largest gas reserves. Natural gas is becoming an increasingly important energy commodity, bridging the gap between the existing oil and future hydrogen-based economies. Natural gas is also a relatively greenhouse friendly replacement source for generating electricity compared to traditional coal fired stations.

How then does Western Australia further exploit its natural resources while abating greenhouse gases?

After extensive community and stakeholder consultation, research and debate, the following strategic directions to manage and reduce greenhouse gas emissions have been endorsed by the Western Australian Government.



STRATEGIC DIRECTIONS

1. Establish a Western Australian Greenhouse Gas Inventory

Western Australia will identify and record the level of individual greenhouse gas emissions from industry by establishing a Greenhouse Gas Inventory. The Inventory will also need to allow for emissions from other sectors to be reported. The starting point will be to identify and record individual greenhouse gas emissions from industry and the future levels of intensity from committed and proposed developments. The National Greenhouse Gas Inventory (NGGI) collates and models emission information for the purpose of international reporting and negotiations.

Identification of emissions from an individual company, or even a specific industry, is not currently possible using NGGI figures as published by the Australian Greenhouse Office (AGO).

At present Western Australia does not have a systematic approach that requires companies to provide statistical evidence on their greenhouse gas emissions. To determine a baseline, encourage abatement of greenhouse gases and establish appropriate market mechanisms for potential future trading and offsets, we need to know the exact levels of emissions. This requires an inventory system with a greenhouse gas emission trigger point where reporting becomes mandatory. Emitters should not have to duplicate resources for the purpose of meeting their mandatory reporting obligations. It is envisaged the Inventory will require the same type of information that is currently provided to the AGO voluntarily, to be submitted annually. For emitters below 500,000 tonnes per annum who currently are not part of the Australian *Greenhouse Challenge* program, reporting will be phased in over a two year period.

Actions

- 2.1.1 A Western Australian Greenhouse Gas Inventory will be established, based on mandatory annual reporting of all of the six greenhouse gases by significant emitters at decreasing trigger points introduced on the following timetable:
 - 2004-05 more than 500,000 tonnes CO₂-e year
 - 2005-06 more than 250,000 tonnes CO₂-e year
 - 2006-07 more than 100,000 tonnes CO₂-e year
- 2.1.2 Western Australian emitters of greenhouse gases who are not required to report to the Inventory will be able to voluntarily join the mandatory scheme from 2007-08.
- 2.1.3 A summary of the Western Australian Greenhouse Gas Inventory will be released for public information every three years and that information, gathered annually, will be provided to the NGGI.

The Environment Protection and Heritage Council is investigating a proposal to include greenhouse gas emissions in the National Pollutant Inventory (NPI) program. Western Australia will progress with the establishment of the Western Australian Greenhouse Gas Inventory and support the inclusion of greenhouse gas emissions in the NPI should it proceed. 2.1.4 Annually provided data will be audited against the operation of the company and its plants for the purpose of verification. Audits will be conducted on a three-year cycle. Information provided for the purpose of the audit will be treated as commercial-in-confidence.

2. Industry emission reduction strategies

Many industries are already committed to reducing their greenhouse gas emissions through company policies, such as BP, or through membership of the Australian *Greenhouse Challenge* program, such as Western Power, ALCOA, Woodside and Wesfarmers. Industry organizations such as the Chamber of Commerce and Industry and APPEA support the *Greenhouse Challenge* program.

Developing greenhouse gas reduction strategies for anticipated emissions through increased energy efficiency, fuel substitution, improved processes and other means, is an effective first step in determining cost effective options to reduce greenhouse gas emissions. The level of potential emission reductions will vary across sectors and emitters, but opportunities for reductions will exist in most if not all operations.

Action

2.1.5 All emitters required to report their greenhouse gas emissions to the Inventory will also be required to (a) annually prepare and lodge greenhouse gas emission estimates for the coming year by total and by intensity; and (b) develop strategies to minimise anticipated emissions. Strategies will be required to be lodged from the year after emissions are first reported.

3. Defining an emissions abatement framework

An emissions abatement framework would be most efficient and effective if implemented on a national basis. This is because climate change is an international issue, addressed by international agreements to which nations negotiate commitments and also because a least cost outcome will result from the broadest possible pool of abatement options.

At present there is no clear proposal for a national abatement framework and a national emissions trading market has been rejected by the Commonwealth Government. This failure to act led New South Wales to establish its own structure through the *Electricity Supply Amendment (Greenhouse Gas Emission Reduction) Act 2002*, which came into force on 1 January 2003. Victoria and South Australia are exploring the possibility of joining the New South Wales emissions trading market.

Inter-jurisdictional Working Group on Emissions Trading

State and Territory Governments have established a working group to develop a multi-jurisdictional emissions trading scheme. The Commonwealth Government has been invited to join the group, but at this time has declined. The initial focus of the working group will be the development of an acceptable model, most likely targeting the stationary energy sector, but with scope to allow for expansion to other sectors or an economy-wide scheme. The model will also take into account international developments and the need for reasonable sharing of any economic burden between jurisdictions.

In considering the key preferred option, the working group will assess the economic, social and environmental impacts within each jurisdiction. The impact on trade exposed industries will be part of the assessment, along with the issue of how pre-existing programs such as the Mandatory Renewable Energy Target can be harmonised with the agreed scheme.

State and Territory Governments are also exploring the different emissions trading approaches through the Inter-jurisdictional Working Group on Emissions Trading to determine the best possible model for all States if a national emissions trading market were to be considered.

Western Australia must determine, define and promote its own preferred models of emissions abatement frameworks that could apply either to the State as a whole or to industry sectors, in order to protect our unique economic and environmental interests in any national negotiations over the introduction of national emission targets. If there is inadequate or unsuitable action prior to the first abatement period under the Kyoto Protocol at a national level to establish a framework to achieve lowest cost emissions abatement through market mechanisms, the Western Australian Government will consider implementing a State framework or joining with other states in a multi-state scheme.

Action

2.1.6 Western Australia will determine its own preferred models for greenhouse emission abatement and promote these in any national negotiations over the introduction of national greenhouse targets or programs that are likely to impact on this State's economic or environmental interests. The models will be developed as a matter of urgency and be undertaken and co-ordinated by the Greenhouse Unit.

If there is no action at a national level to establish a framework to achieve lowest cost emissions abatement through market mechanisms prior to the first abatement period of the Kyoto Protocol, the Western Australian Government will consider implementing a State framework or consider joining with other states in a multi-state abatement scheme.

4. Establish a Western Australian Greenhouse Abatement Fund

The Western Australian Government has a direct interest in market-based greenhouse abatement solutions to minimise industry costs in meeting its climate change responsibilities. It also has a direct interest in promoting revegetation and reforestation to improve environmental quality and regional economic development. Both interests can be supported through the establishment of a repository for organic sequestration and emission credits that have been generated by Western Australian Government institutions or initiatives.

A Western Australian Greenhouse Abatement Fund will initially hold carbon credits belonging to the Crown (State Government), registered under the *Carbon Rights Act 2003*.



The need for leadership

In the absence of Commonwealth action sufficient to reverse the continued upward trend in industry emissions, the States must independently address this issue. Early action by Governments, like early action by industries, is a key factor leading to success and cost saving. The longer investments continue to be made using emission intensive technologies, the more difficult and expensive it will be to make the necessary changes.

Adoption of this Strategy for cost effective abatement of greenhouse gases will:

- establish institutions capable of encouraging reductions in emission intensity;
- protect Western Australia's economic interests; and
- provide a base from which Western Australia can negotiate in any future national framework proposed by the Commonwealth.

4 CHAPTER 2 - REDUCING GREENHOUSE EMISSIONS

Compulsory reporting of greenhouse gas emissions is not a new concept. The State of Wisconsin established a greenhouse gas emissions inventory and mandatory annual reporting of levels of CO₂-e above 100,000 tonnes in May 1993. It also established a registry of greenhouse gas emissions in early 2003. Other states such as California and New Hampshire have also been developing their own registries. Canada too has implemented mandatory reporting for large emitters with the first reports required by June 2005.

(Source: Pew Centre on Global Climate Change) The Western Australian Greenhouse Abatement Fund may also be the repository for any credits that have been generated from emission abatement actions or energy reduction programs undertaken by Western Australian Government entities. These credits may be traded within Western Australia, or with other State markets, such as that established under the New South Wales *Electricity Supply Amendment (Greenhouse Gas Emissions Reduction) Act 2002*, or even internationally, if Australia ratifies the Kyoto Protocol.

A Greenhouse Abatement Fund for Western Australian Government owned greenhouse emission credits would provide a mechanism for the orderly marketing of a publicly owned property right and would create a pool of organic sequestration and emission credits backed by Government ownership and recognition.

Income generated from the sale of publicly owned emission credits could be re-invested in sequestration and emission abatement projects to reduce the State's net greenhouse gas emissions and produce further credits. Such projects can provide multiplier benefits for the community and environment if aimed at tackling issues such as salinity and providing alternative sources of energy to regional towns and centres.

Action

2.1.7 A Western Australian Greenhouse Abatement Fund will be established as a repository initially for organic sequestration rights and credits generated by Western Australian Government institutions.

If an emission abatement rights and credits structure is created at a later date, then those generated by Government entities may also be deposited in the Fund. The objective of the Fund will be to:

- encourage the development of a stable and confident emissions trading marketplace;
- provide for the orderly marketing of Western Australian Government-owned carbon based rights and credits; and
- invest funds generated from sales into abatement projects that may have multiplier benefits for the community and environment.

5 Establish a Western Australian Greenhouse Registry

Certification of sequestration or emission rights and credits through a greenhouse registration body provides a quality assurance process to any trading market and a process for documenting early abatement actions where a market has yet to emerge. Sellers can provide documented proof of the rights they are offering and buyers can authenticate or validate the rights and credits that will be generated, by reference back to an approved registry.

The Western Australian Government has an interest in promoting market-based greenhouse abatement solutions to minimise industry costs in meeting its climate change responsibilities.



A registry can be established even before an emissions abatement framework is created, in order to recognise and certificate early abatement actions undertaken by emitting companies and institutions.

New South Wales operates a Greenhouse Gas Abatement Scheme under the New South Wales Electricity Supply Amendment (Greenhouse Gas Emissions) Act 2002 which allows parties to certify emission abatement and sequestration credits.

The New South Wales Scheme uses a set of methodologies developed by the New South Wales Department of Energy, Utilities and Sustainability for measuring emission reductions and uses the interim Australian Standard for measuring sequestration claims in carbon rights.

A compatible approach to accounting and verification tools by both States and the Commonwealth is needed to provide certainty to both buyers and sellers and a high level of quality assurance. This is critical for the development of any national carbon trading market. The needs of international trading, whether or not under the Kyoto Protocol, will also need to be considered.

Action

2.1.8 A Western Australian Greenhouse Registry will be established for the purpose of certifying and documenting carbon credit sequestration claims and providing proof of emission

reductions. The Registry will ensure carbon credit standards are consistent with those adopted by other States and work closely with the AGO in the issuing of certificates.

6. Establish a trading market

To maximise the value of emission and carbon rights and thereby achieve the least cost abatement outcomes for those seeking offset programs, it is necessary to create a trading market that is stable and deep enough to meet demand and provide confidence to buyers. A number of voluntary ad-hoc trades have already taken place in Western Australia, primarily in organic sequestration and significant interest is being shown in the plantation and carbon credit company InfinitreeTM, a subsidiary of the Forest Products Commission (FPC).

A greenhouse emission trading market can help achieve least cost abatement options for affected industries and provide confidence to sellers and buyers. To achieve a level of confidence in the value of carbon sales and ultimately, national and international recognition, such an emissions trading market will need to have carbon rights and credits measured and traded in common terms of dollars per tonne of CO₂-e.

If Australia does not ratify the Kyoto Protocol, international trading may be initially limited. A national or multi-state market will be both important for local purposes and a springboard into an

Electricity reform agenda

The Western Australian Government has embarked on an extensive reform of the State's electricity sector. The main objective of the reform process is to establish a more competitive framework for the industry as a means of facilitating investment in electricity infrastructure, ensuring adequate reliability and security of supply and delivering downward pressure on prices for all customers. The lack of competitive pressure, manifested through the current monopolistic, vertically integrated industry structure has impeded the uptake of renewable energy and demand management and inhibited innovation.

The reform process will facilitate sustainable energy outcomes, through the introduction of market-based mechanisms to encourage investment in these technologies. Already, the announcement of the reform process has stimulated the development of large scale renewable and cogeneration projects that are unlikely to have eventuated under the previous industry structure. Distributed generation (including renewable) and demand management, which increase the efficiency of electricity supply and use, reducing the need for system expansion and often utilising less greenhouse intensive fuel sources, will also be encompassed. The restructured market will encourage sustainable outcomes in the electricity sector by:

- establishing a market structure that does not impose barriers to renewable energy generators;
- encouraging demand management participation in the electricity market as an alternative to generation;
- establishing an independent Access Code to ensure all new entrants can access the electricity network through a transparent independently regulated process;
- developing requirements to ensure that demand management and embedded generation are considered as alternatives when significant network expansion or augmentation is being considered; and
- mandating reporting on efficiency and greenhouse emissions in the licensing regime for electricity market participants.

almost certain future of significant international trading. In the continuing absence of a national emissions trading market, recognition of Western Australian generated carbon rights by other States will be an important step forward.

This could be initiated through bilateral or multilateral agreements between Western Australia and other State Governments to allow interstate exchange of emission and carbon rights, with a parallel recognition of the credits realised in each other's States.

Given the importance that trading plays in achieving least-cost abatement of greenhouse gases, it is appropriate that the Western Australian Government supports the investigation of national abatement and emissions trading models with other States.

Actions

- 2.1.9 The development of a confident and viable carbon trading market, preferably on a national and international basis will be supported by the Western Australian Government. In particular, the multiplier benefits of organic sequestration to the environment as a whole is recognised and the Government will encourage the creation and sales of carbon rights from Western Australia.
- 2.1.10 The Western Australian Government will investigate with other jurisdictions the viability of possible

national emissions trading and abatement models.

2.1.11 To ensure a commonality of systems for both interstate and international trading purposes, the unit of exchange in the purchase and sale of rights or certificates will be based on the \$ per tonne of CO₂-e. This form of valuing a unit of exchange must apply to tonnes of CO₂-e that have been measured or quantified in any of organic sequestration, emission abatement or energy reduction methods.

7. Energy market reform

Efficient and effective energy markets are critical to the successful integration of greenhouse management with the provision of reliable low-cost energy. A poorly designed energy market can introduce barriers to actions that decrease the greenhouse intensity of energy supply or act as a disincentive to lowering consumption. The Western Australian Government has embarked on an extensive strategy to restructure the gas and electricity markets to introduce competition between suppliers of fuels and providing greater choice for consumers. Efficient markets remove unnecessary impediments to fuel switching, distributed generation and demand side management options, facilitating participation of renewable energy generators and energy efficiency in system planning and design.

Electricity reform and sustainable energy

The Western Australian Government will also implement a package of measures to further facilitate sustainable energy through the electricity reform agenda. These include:

- establishment of an improved balancing and trading arrangement for all generators that will operate in the transition period until the
 new market is established. This Top Up and Spill (TUAS) market has special significance for renewable generators and, in particular,
 intermittent technologies such as wind. Under the new market rules, independent power producers who participate will be able to
 purchase balancing energy to meet variations between their generator output and their customer demand under much improved
 arrangements. They will be able to purchase 'top-up' electricity from Western Power whenever their own output is less than its
 customer load. When their output exceeds customer demand, they will be able to sell their excess to Western Power. Western Power is
 required to provide published balancing prices based on 'cost neutral' principles;
- a \$6 million renewable energy production subsidy that will provide a subsidy of 1 cent/kWh in the transition period to provide support for new renewable energy generators;
- a metering subsidy that will reduce the cost of metering for smaller contestable customers wishing to purchase renewable energy;
- a licence condition that will require electricity retailers to ensure they test the local market when meeting their requirements under the Mandatory Renewable Energy Target (MRET);
- exploring the potential for demand management and energy efficiency to participate in the electricity market; and
- examining ways to maximise the renewable energy potential of the South-West Interconnected System, particularly in regard to wind power.

Further information is available in the publication *Electricity Reform: a New Deal for Sustainable Energy*, which is available from the Electricity Reform Implementation Unit or can be downloaded from the website at www.eriu.energy.wa.gov.au.

Creating a market structure that facilitates renewable energy, embedded generation and demand management will provide enhanced opportunities to reduce and manage greenhouse gas emissions in the electricity sector.

The gas and electricity markets are being carefully designed to cater for local circumstances and to deal with dominant market players. In particular, the new electricity market will implement a framework that accounts for a vertically integrated Western Power and delivers sustainable energy benefits.

The effective operation of emissions abatement frameworks are predicated by the establishment of efficient markets. Restructuring energy markets will ensure that market mechanisms for managing greenhouse gas emissions result in least cost abatement outcomes.

Further details on the electricity reform agenda can be found on page 46.

Actions

- 2.1.12 The Western Australian Government will establish efficient energy markets facilitating greater investment in renewable energy and demand side management initiatives that enhance the efficiency of energy supply and use.
- 2.1.13 The Western Australian Government will undertake an independent study to examine ways to maximise the renewable energy potential of the South West Interconnected System.
- 2.1.14 The Western Australian Government will commission a study that will explore the potential for demand management and energy efficiency to participate in the electricity market.

8. Renewable energy

Increasing the use of renewable energy reduces greenhouse gas emissions from energy sources and can bring considerable economic benefit to the local community. Western Australia has excellent renewable energy resources and has led the country in the development of many technologies. An example of this is the wind diesel hybrid control technology developed by Western Power. This technology allows the contribution of wind energy to be maximised while providing a high quality electricity supply to regional towns. As well as reducing the environmental impact of energy use, renewable energy technologies can increase the viability of remote communities through lower energy costs and can increase the efficiency of electricity networks by reducing line losses.

The Commonwealth Government's Mandatory Renewable Energy Target (MRET) has created a significant driver for renewable energy in Western Australia. Demand side responses will ensure the potential of the State's significant renewable resources are realised and will accelerate the penetration of renewable energy in the State. Western Power has already established competitive procurement processes to meet its MRET requirements from Western Australian renewable energy projects.

In his 1997 statement, *Safeguarding the future: Australia's response to climate change*, the Prime Minister announced the measure would increase the amount of electricity supplied from renewable sources by two per cent. Following industry lobbying the target was changed to annual targets steadily increasing to 9500 GWh by 2010. Unprecedented growth in electricity demand will see the targets set by the Commonwealth fall well short of two per cent. Compounding this, a significant portion of the target has been supplied from existing generators.

Despite a Commonwealth Government rejection of both ratification of the Kyoto Protocol and a national emissions trading market, the Government of New South Wales has recently signed an agreement worth \$172 million for the planting, on the mid-north coast of NSW, of a 12,000 hectare carbon sink with a French-Italian electronic semiconducter manufacturer.

Links to other initiatives

Western Australia State Sustainability Strategy Infinitree[™] Carbon Rights Act 2003 Energy Smart National National Greenhouse Strategy National Greenhouse Gas Inventory Generator Efficiency standards Greenhouse Challenge Mandatory Renewable Energy Target

Other sections of this Strategy Government leadership New industry opportunities Carbon sequestration Research

PART B - GREENHOUSE RESPONSE ACTION

CHAPTER 2 - REDUCING GREENHOUSE EMISSIONS

The Western Australian Government believes the MRET scheme is an effective market approach to providing cost efficient renewable energy as well as reducing greenhouse gas emissions and has consistently called upon the Commonwealth to restore the MRET targets to a full two per cent to enable it to achieve the goals for which it was intended and meet the expectations of the wider Australian community.

Further details on electricity reform and sustainable energy can be found on page 47.

Actions

- 2.1.15 The Western Australian Government will continue to support the use of renewable energy and the development of renewable energy technologies throughout the State. This support will address a range of issues facing small and large scale renewable energy projects. Measures will include:
 - encouraging local authorities to utilise planning guidelines when assessing proposals for the development of wind farms in Western Australia. The Planning Bulletin provides local government, other relevant approval authorities and wind farm developers with a framework for the balanced assessment of land-based wind farm developments in Western Australia;

- finalising negotiations with the Commonwealth Government to expand the Renewable Remote Power Generation Program (RRPGP), to replace the use of diesel for electricity generation in off-grid regional areas. This would be achieved by:
- extending funding for the program up to 2012;
- ensuring renewables replace fossil fuels;
- using renewable energy on the fringe of grid; and
- encouraging energy efficiency off-grid;
- fostering innovation in renewable energy research and development through the continued support of the Sustainable Energy Development Office Grants Program;
- cooperating with the Commonwealth Government on the establishment, funding and focus of the Research Institute for Sustainable Energy at Murdoch University;
- increasing the use of solar energy in residential applications through incentive programs for solar water heaters; and

- continuing to support the MRET and to advocate for an increase in the target to the original two per cent announced by the Prime Minister.
- 2.1.16 Electricity retailers will be required to test the local market in sourcing Renewable Energy Certificates (RECs) to meet their MRET requirement.
- 2.1.17 In procuring RECs, Western Power will continue to give priority to certificates created by projects located in the State.
- 2.1.18 The Western Australian Government will provide a fixed term subsidy of 1c/kWh for new renewable electricity generation projects not selected under Western Power's first RECs Procurement process and not eligible for RRPGP funding.

Greenhouse response actions

No.	Action	Responsible Department or Agency	Action timetable
2.1.1*	A Western Australian Greenhouse Inventory will be established, based on mandatory annual reporting by significant emitters at decreasing trigger points.	DoE	2004 & Ongoing
2.1.2*	Western Australian emitters of greenhouse gases who are not required to report to the Inventory will be able to voluntarily join the mandatory scheme from 2007-08.	DoE	2007 & Ongoing
2.1.3*	A summary of the Western Australian Industrial Greenhouse Inventory will be released for public information every three years and provided to the NGGI.	DoE	Annual & Ongoing
2.1.4*	Annually provided data will be audited against the operation of the company and its plants for the purposes of verification. Audits will be conducted on a three year cycle. Such information provided for the purpose of the audit will be treated as commercial-in-confidence.	DoE	Ongoing
2.1.5*	All emitters required to report their greenhouse gas emissions to the Inventory will also be required to (a) annually prepare and lodge greenhouse gas emission estimates for the coming year by total and by intensity; and (b) develop strategies to minimise anticipated emissions. Strategies will be required to be lodged from the year after emissions are first reported.	DoE	Annual & Ongoing
2.1.6*	Western Australia will determine its preferred models for greenhouse emissions abatement and promote these nationally.	Greenhouse Unit	2004 & Ongoing
2.1.7*	A Western Australian Greenhouse Abatement Fund will be established to encourage the development of a stable and confident emissions trading marketplace and to manage Government-owned carbon rights and emission credits.	Greenhouse Unit	Ongoing
2.1.8*	A Western Australian Greenhouse Registry will be established to document and certify carbon credit sequestration and emission reductions achievements.	Greenhouse Unit	Ongoing
2.1.9*	Promote the involvement of Western Australia in a confident and viable carbon trading market, preferably on a national and international basis.	Greenhouse Unit	From 2005
2.1.10*	The Western Australian Government will investigate with other jurisdictions the viability of possible national emissions trading and abatement models.	Greenhouse Unit	From 2004
2.1.11*	Ensure that for trading purposes the unit of exchange in the purchase and sale of certificates be based on the \$ per tonne of C02-e.	Greenhouse Unit	From 2005
2.1.12	The Western Australian Government will establish efficient energy markets facilitating greater investment in renewable energy and demar side management initiatives that enhance the efficiency of energy	nd	<u> </u>
2.1.13	supply and use. The Western Australian Government will undertake an independent study to examine ways to maximise the renewable	OoF	Ongoing
2.1.14	The Western Australian Government will commission a study that will explore the potential for demand management and energy	OoF	2005
2.1.15	The Western Australian Government will continue to support the use of renewable energy and the development of renewable energy technologies throughout the State.	SEDO, DPI	Ongoing
2.1.16	Electricity retailers will be required to test the local market in sourcing RECs to meet their MRET requirement.	; OoE	Ongoing
2.1.17	In procuring RECs, Western Power will continue to give priority to certificates created by projects located in the State.	OoE	Ongoing
2.1.18	The Western Australian Government will provide a fixed term subsidy of 1c/kWh for new renewable electricity generation projects not select Western Power's first RECs Procurement process and not eligible for RPRCP funding	ed under	Onesine
New pr	rograms are indicated with an asterix *		



The major source of greenhouse gas in the waste sector is the disposal and decomposition of organic material in landfills

2.2 Waste management

CONTEXT

Waste is a relatively minor source of greenhouse gases - about three per cent of Western Australia's total emissions. Most waste generation represents a loss or misuse of resources. Reducing it is a significant sustainability objective in itself.

Photo courtesy of Department of Environment

OBJECTIVE

To reduce greenhouse gas emissions resulting from waste management practices in Western Australia.

BACKGROUND

The major source of greenhouse gas in the waste sector is the disposal and decomposition of organic material (for example food and garden material) in landfills. When this material decomposes in the absence of oxygen, it produces a mixture of methane and carbon dioxide that filters through the landfill and eventually emerges into the atmosphere. The mixture can have a global warming potential eight to 20 times that of carbon dioxide alone.

Waste disposal in the Perth Metropolitan Region ranges between 1.7 and 2.1 tonnes per person annually. Outside the metropolitan area, the quantities of waste per head of population are about two thirds that of Perth. In 2002 the overall quantities of waste in Western Australia were estimated to be about 2,541,165¹ tonnes of material, of which less than half is organic or household waste with the potential to decay and emit greenhouse gases. About half is from the construction and demolition industry, most of which is organically inert material.

WESTERN AUSTRALIAN WASTE MANAGEMENT FRAMEWORK

The Waste Management Board was established in 2002 to develop a State framework for waste management. The *Strategic Direction for Waste Management in Western Australia* was released in August 2003 to enable the community to play a role in contributing to the framework to reduce waste in Western Australia. Waste management strategies are developed in consultation with industry working groups, other State and local government representatives and organisations, and the Western Australian Local Government Association, plus the broader community.

Since July 1998, a levy of \$3 per tonne of putrescible matter, and \$1 per tonne of inert material has been charged. The intention of the levy is to fund programs that manage, reduce, reuse, recycle, monitor or measure waste.

Waste Management Board hierarchy

The Waste Management Board is promoting a strategic direction for waste management in Western Australia with the following priorities:

1. Avoid

2.

- waste minimisation - conserve resources
- Minimise Recycle 3. 4. Treat
- less energy and resources used than first-use materials
- reduce environmental impact of waste disposal
- in an environmentally responsible manner 5. Dispose

ourtesy of Department of Environi

Funds raised during the operation of the levy have been used to promote cleaner production, provide a rebate for local government kerbside recycling, provide grants for research, the development of new technologies and recycling programs, plus the collection of data on waste management.

Periodic reviews of the landfill levy and the use of the Waste Management and Recycling Fund are conducted to ensure the effectiveness of the levy and grant scheme.

RECYCLING AND TREATING

Half the Waste Management and Recycling Fund is used to promote local government recycling of household waste through the Resource Recovery Rebate Schemes. A payment is made for each tonne diverted from landfill. As construction and demolition waste is such a major part of the waste stream, levy payment levels have been inadequate to divert much from landfill. However, market forces have promoted a thriving salvage industry based on demolishing structures and recycling materials which removes considerable quantities of higher value building materials from the waste stream.

Western Australian Government offices have mandated paper recycling schemes that collect more than 30 tonnes of paper each month from central business district offices.

ENERGY FROM WASTE

Four Perth metropolitan energy recovery facilities currently extract gas at landfill sites for energy production. Expansion of existing sites is planned and development of another site is currently under consideration. The current constructed capacity for energy production is 14 megawatts (MW). Current production levels are about 93,000 MW hours per annum. The plant expansion is predicted to increase capacity by 24 per cent to over 17 MW.

The Western Australia waste management direction document currently focuses on generating compost from organic waste rather than using this material for energy production, which is seen as destroying the resource. There is a concern about the possible creation of dioxin gases during burning and potential health impacts. It is also thought, at current prices, composting may maximise economic benefits from the resource. The demand for the product and its role in water conservation requires market analysis.

Future increases in the value of energy from renewable sources may make production from sources such as animal litter more valuable and shift the preferred use.

Recycling waste

In 2000, about 140,000 tonnes (or 16 per cent of materials collected by local governments) was diverted from landfill for recycling. Most of this (45 per cent) was green waste which was usually shredded and used as mulch or compost. The decomposition of this produces CO₂ that has a lower greenhouse impact than methane. The target for recycling is 50 per cent. In 2000, industry recycled about 180,000 tonnes of solid organic waste, converting it to saleable product.





STRATEGIC DIRECTIONS

The following actions are intended to identify programs that use a range of mechanisms to meet greenhouse performance and sustainability standards.

Voluntary waste management plans

Voluntary waste management plans will be encouraged to include greenhouse concerns as a key parameter in all waste management decisions.

Action

2.2.1 Voluntary waste management plans will be encouraged to include greenhouse considerations, based on world best practice and continuous improvement principles.

Compost and secondary use organics

Waste recycling programs need to be aligned with other relevant programs, such as water conservation. Specific standards (preferably Australia-wide) should be encouraged and developed for recycled products such as mulch, compost, soil conditioner and similar secondary use organic products from the green and organic sector.

Action

2.2.2 The Western Australian Government will encourage the increased use of compost and secondary-use organics to restore degraded land and facilitate water conservation, through research and development and programs on standards, performance and pricing.

More needs to be known about how market forces can be used to encourage the separation of various food waste streams and how appropriate food waste can potentially be used as animal food. Alternative options need to be examined for funding waste management and market participation, including ensuring appropriate pricing signals go to purchasers of products.

Action

2.2.3 Research the range of mechanisms available to encourage organic waste separation.

No.	Action	Responsible Department or Agency	Action timetable
2.2.1	Encourage voluntary waste management plans to include greenhouse considerations, based on world best practice and continuous improvement principles	DoE	Ongoing
2.2.2	Increase the use of compost and secondary use organics through research and development and programs on standards, performance and pricing.	DoE	Ongoing
2.2.3	Research the range of mechanisms available to encourage organic waste separation.	DoE	Ongoing

Greenhouse response actions

minimisation strategies

Curtin Centre of Excellence in Cleaner Production

Western Australian Sustainable Industry

Group Action Plans

Local Government Association waste

minimisation programs Motor Trades Association green stamp programs Local government waste minimisation & recycling programs Community sustainability projects Regional Councils' sustainability programs Department of Environment Waste Management Section Department of Health, Environmental Health Section

Western Australia	National
State Sustainability Strategy	Waste minimisation and recycling
Waste Management Board waste	promotion strategies of:

Links to other initiatives

- Environment Protection and Heritage Council
 - Environment Australia
 - National Packaging Council
- Waste Management Association of Australia

Other sections of this Strategy Government leadership Working with community and local government New industry opportunities

2.3 Energy use in households and commercial operations

CONTEXT

Each Australian household produces in excess of an estimated 15 tonnes of greenhouse gas emissions per year¹. The main emission sources for households in Western Australia are transport (47 per cent), domestic energy use (45 per cent) and waste (eight per cent)².

In 1999-2000, residential energy use contributed about 10 per cent of the State's greenhouse gas³. Most domestic energy consumption results from heating water (31 per cent), home heating and cooling (26 per cent), and refrigeration (16 per cent). Improving the energy efficiency of homes and appliances is therefore an effective way of reducing greenhouse gas emissions, while also saving on household energy bills.

Australia's commercial sector generates about 35 million tonnes of carbon dioxide⁴ each year and this is expected to double by 2010⁵. This sector was responsible for about six per cent of Western Australia's greenhouse gas emissions resulting from energy use in 1999-2000³. Generally, the energy consumption of commercial buildings is influenced by the building fabric (25 per cent), building services (25 per cent) and building occupiers (50 per cent)⁶. To effectively reduce this sector's greenhouse gas emissions, each of these areas needs attention, particularly building use by occupants.

OBJECTIVE

To reduce greenhouse gas emissions arising from energy use in households and commercial operations.

STRATEGIC DIRECTIONS

Greenhouse emissions from household and commercial energy use can be reduced by examining the settings (homes and commercial buildings) in which we use energy, the tools (appliances and equipment) that we use, and our behaviour in operating the tools and buildings.

Improving the energy efficiency of buildings

Improving the efficiency of new and existing homes and buildings lowers greenhouse gas emissions by reducing the energy used to provide heating and cooling. House and building design can

- ¹ Australian Greenhouse Office website. Accessed March 2003: www.greenhouse.gov.au/community household.html.
- ² EPA Victoria, Australian Greenhouse Calculator web site. Accessed March 2003: http://www.epa.vic.gov.au/Greenho useCalcultor/calculator/default.asp.
- ³ Office of Energy estimates.
 ⁴ Alan Pears, Sustainable Solutions,
- 1998, 'Rating Energy Efficiency of Non Residential Buildings: A path forward for New South Wales'.
- ⁵ Sustainable Energy Authority Victoria and Sustainable Energy Development Authority NSW web site. Accessed April 2003: www.greenhousegases.gov.au/how_ to_help/commercial_building_tips. html
- ⁶ Energy Efficiency Victoria, 2000, 'Building Energy Brief for Commercial and Public Buildings'.



be made more energy efficient by incorporating improved solar access, insulation, and clever use of shade. Other benefits include lower energy costs, improved indoor air quality and increased levels of comfort.

Improving the energy efficiency of appliances and equipment

Energy used by appliances and equipment generates significant emissions. Increasing their efficiency and improving their use by householders and businesses can mean significantly less greenhouse gas emissions, lower energy costs and less use of fossil fuels.

Raise awareness and facilitate behaviour change by providing information on energy efficiency and the use of renewable energy

For improvement to occur, consumers must become aware of opportunities and ways to adopt energy efficient practices or renewable energy. Businesses and the community need to be empowered to make better choices to help achieve reductions in greenhouse emissions.

CURRENT INITIATIVES

Many actions to reduce emissions from households and the commercial sector are initiated nationally because our behaviour and energy needs are similar across Australia. These actions are managed at State level by various agencies but require grass roots implementation or business sector involvement to be effective.

Energy efficient buildings

Building Code of Australia - energy efficiency standards for residential and commercial buildings

The Building Code of Australia (BCA) provides a framework for nationally consistent, efficient and cost-effective building regulatory systems. The BCA has recently been amended (with involvement from the Western Australian Government) to incorporate mandatory minimum energy efficiency standards for new residential homes. An amendment to introduce energy efficiency provisions for commercial buildings is currently under development, with the first stage proposed for release in May 2005.

Energy efficiency standards for new homes became effective on 1 July 2003 in Western Australia.

The standards can be met either by:

- satisfying the 'deemed to comply' requirements (eg for insulation, window covering, window-wall ratios etc); or
- designing houses to achieve a minimum four-star rating through a house rating scheme (eg. *FirstRate*).

House energy rating software and training

There are two house energy rating systems available for use in Western Australia - the Nationwide House Energy Rating Scheme (NatHERS) and FirstRate. These tools enable the assessment of the energy efficiency of house designs and completed homes. They provide a zero to five star rating and options for improving the energy efficiency of the assessed building. The Sustainable Energy Development Office (SEDO) promotes the use of FirstRate and accredits Western Australian assessors. Training is available through Central TAFE, the Housing Industry Association (HIA) and the Master Builders Association (MBA).

Energy efficient Government housing

The Department of Housing and Works (DHW) includes energy efficiency measures in new public housing. Architectural briefs include issues such as correct building orientation, insulation, building materials and window placement. All new buildings will be energy rated to ensure they comply with the BCA energy efficiency amendment.



Photo courtesy of Sustainable Energy Development Office

Year of the Built Environment 2004

2004 has been proclaimed the Year of the Built Environment. The aim is to help Western Australians understand the contribution infrastructure makes to their lifestyle and well-being. This is an opportunity to explore how our

built environment can be made more sustainable and less greenhouse gas intensive. Some of the proposed activities include:

- conference and seminars;
- · design competitions and community design workshops;
- local government initiatives to improve planning and streetscape designs; and heritage tours and study trips.

Sustainable housing design - Broome Sustainable Housing Design competition

DHW conducted the Broome Sustainable Housing Design competition in late 2002. This was aimed at demonstrating that sustainable design provides comfortable living at an affordable price, reduces energy and water consumption and reduces waste generation. The competition invited practical design submissions from architects, designers, builders and architecture students that could be developed and incorporated into a display home, using sustainability principles.

Housing Industry Association GreenSmart program

The BCA energy efficiency standards for residential buildings are complimented by a voluntary, industry-driven program managed by the HIA. The HIA GreenSmart program works in partnership with industry and State and local governments to instil sustainability principles into housing industry culture. Features of the program include environmental training and accreditation for building and construction industry professionals plus demonstrations of sustainable building principles and practices. The HIA GreenSmart program is part of the Partnership Advancing the Housing Sector, a partnership between HIA, Environment Australia and the Australian Greenhouse Office (AGO).

Australian Building Greenhouse Rating scheme for commercial buildings

The Australian Building Greenhouse Rating (ABGR) is a world first initiative for rating the greenhouse performance of commercial office buildings. It provides accredited assessments by awarding a star rating on a scale of one to five. A high star rating generally means an office is more energy efficient, is cheaper to run, and has lower greenhouse gas emissions. ABGR does not rate the building design, only the operation of the building. This is a national program administered by SEDO in Western Australia.

Energy efficiency design in community infrastructure projects

The DHW requires that attention be paid to the passive solar design of public buildings. The Department has produced a series of guidelines about public building design requirements relating to solar orientation. It also helps develop specific project briefs.

The ABGR is a world first initiative for rating the greenhouse performance of commercial office buildings.



Energy efficient appliances and equipment

National Appliance and Equipment Energy Efficiency Committee

The National Appliance and Equipment Energy Efficiency Committee (NAEEEC), including Western Australian Government representatives, coordinates a national program to improve the energy efficiency of appliances and equipment used in homes and businesses. NAEEEC initiatives include mandatory energy efficiency labelling for electrical appliances (refrigerators, washing machines, dishwashers), plus regulated Minimum Energy Performance Standards for various appliances and equipment. Further projects include the reduction of standby energy requirements of appliances and equipment and the Energy Star program for office equipment and household appliances (TVs, VCRs, DVD players etc).

Reach for the Stars – energy efficient appliances

Reach for the Stars is an awareness program promoting the sale, manufacture and use of energy efficient domestic appliances. It works to raise the profile of the energy rating label on domestic appliances such as air conditioners, washing machines, refrigerators and gas hot water systems. The program consists of a consumer awareness campaign and the training of sales staff of major retail appliance stores. SEDO is working with various retail partners to encourage further promotional activities.

Incentives for renewable energy equipment

Greenhouse gas emissions can be reduced by using renewable energy (wind, solar, biomass and mini-hydro). These currently account for only a small percentage of Australia's total energy consumption. To encourage the uptake of renewable energy, grants are provided for some specific technologies and projects.

Incentive programs currently administered by SEDO include:

- the Solar Water Heater Subsidy;
- the Sustainable Energy Development Office Grants Committee;
- the Renewable Remote Power Generation Program; and
- the Photovoltaic Rebate Program.

Energy and greenhouse rating the built environment

The energy consumption of a building is determined by the building design and the use of appliances and equipment. Energy efficient buildings need minimal energy for heating and cooling. Overall energy consumption also depends on the type of appliances and equipment and the way they are used. Systems have been developed for rating different aspects of building energy use on a zero to five basis.

Energy and greenhouse rating systems for residential and commercial buildings in Australia

	Design	Performance
Residential	FirstRate; NatHERS (soon to be upgraded to AccuRate)	Currently addressed through information programs and promoting the availability and use of more efficient appliances
Commercial	The BCA is considering requirements for commercial buildings	Australian Building Greenhouse Rating (ABGR)

Awareness of energy efficiency and renewable energy

Sustainable Energy Information

SEDO provides a range of resources, including web-based material, aimed at assisting the Western Australian community, Government agencies and business to understand and manage their energy consumption as well as save the environment through reduced greenhouse gas emissions. There are over 30 publications available covering energy usage at home and at work. Topics include designing an efficient house, purchasing energy efficient household appliances, and how to select appropriate equipment for commercial and industrial applications. Case studies on renewable energy and how to reduce energy consumption are also available.

SEDO also runs a range of seminars for the community and business sectors to provide practical advice on reducing energy consumption and, as a consequence, greenhouse emissions.

Energy Smart Line

The SEDO *Energy Smart Line* is an independent telephone advice service offering information on energy efficiency and the use of renewable energy, for the cost of a local call. Advisors provide unbiased expert advice on topics like house design, water heating, cooling and heating, whitegoods, commercial refrigeration, motors and variable speed drives, plus renewable energy. The service offers a variety of printed information developed by SEDO.

Energy Smart Directory

SEDO has established the *Energy Smart Directory* for Western Australia. The directory is an on-line database of sustainable energy product and service providers, ranging from lighting to renewable energy specialists, from insulation and window glazing suppliers, to engineering consultants and building designers. Companies can register on the web-site at no cost.

Green energy

Green Power is a national accreditation program for renewable energy products offered by electricity retailers throughout Australia. Products offered under the *Green Power* scheme are audited annually. This ensures that electricity retailers have purchased equivalent energy to that supplied to *Green Power* customers from accredited renewable energy sources.



SEDO represents Western Australia on the National Green Power Accreditation Steering Group that oversees the program.

Western Power is the only organisation in Western Australia able, under current arrangements, to offer a *Green Power* product. 'NaturalPower' customers select the percentage of their electricity they wish to purchase as renewable, and pay a premium for this component of their bill.

Western Power also offers an 'Earth Friendly' product. The greenhouse gas emissions created in generating the power are offset or abated by certified abatement projects. 'Earth Friendly' is certified under the AGO *Greenhouse Friendly*™ program.

Actions

A variety of national initiatives are currently taking place, or are being developed, to improve households' and commercial operations' energy efficiency and to reduce their greenhouse gas emissions. Western Australia must have strong representation in national processes so these programs are driving maximum greenhouse abatement and meet State needs. Initiatives proposed by Western Australia need to be compatible with agreed national directions.

The following actions are recommended for the short to medium term:

Energy efficient building

- 2.3.1 The Western Australian Government will continue to support and encourage actions to reduce energy use in the building sector. The program will provide a range of measures to address both residential and commercial buildings, ensuring consistency with national programs. Measures will include:
 - development of strategies to increase the use of the ABGR in the commercial building sector to encourage best practice energy management. This could include disclosure of the greenhouse performance of State Government office buildings and tenancies using the ABGR;
 - contribution to national initiatives to increase the building types covered by the ABGR methodology;
 - promotion of innovative mechanisms for funding sustainable energy initiatives by business; and
 - support for energy rating software tools and encouragement of their use for residential and commercial buildings.

- 2.3.2 When negotiating new office leases for all Western Australian Government departments, the DHW will initially require potential lessors to disclose their ABGR. This information will be taken into account when determining which potential tenancies best meet the Governments' functionality, financial and environmental requirements. The Government will eventually require lessors to meet the prescribed ABGR standard if they are to be considered for a Government tenancy.
- 2.3.3 Designs for new public buildings, including office buildings, will be required to meet minimum energy performance standards before design approval.
- 2.3.4 A display home based on the winning entry of the Sustainable Housing Design competition held in 2002 - will be built in Broome and its performance monitored.

Links to other initiatives

State Sustainability Strategy Air Quality Management Plan Energy Smart Line Energy Smart Directory

Western Australia

National Appliance and Equipment Energy Efficiency Committee's programs Building Code of Australia Australian Building Greenhouse Rating Reach for the Stars Green Power Cities for Climate Protection campaign

National

Other sections of this Strategy Government leadership Working with local government and the community

Energy efficient appliances and equipment

2.3.5 Western Australia will contribute to the National Appliance and Equipment Energy Efficiency Program to ensure the State maximises its share of the expected financial and greenhouse savings. Improving the energy efficiency of appliances and equipment is best addressed nationally. Cumulative savings of \$372 million and 10.3 million tonnes of greenhouse gas emissions for 2003-18, are targeted for Western Australia through this program.

Awareness of energy efficiency and renewable energy

- 2.3.6 Identify, develop and promote best practice sustainability standards and incorporate these standards into all Western Australian Government housing and buildings through sustainability benchmarks as they relate to sustainable buildings.
- 2.3.7 Support best practice standards through Western Australian Government procurement policies.
- 2.3.8 Provide consumer education programs to raise the awareness of energy-related greenhouse emissions and actions everyone can take to reduce them.

- 2.3.9 Revise the marketing strategy to raise the profile and use of the SEDO Energy Smart Line and other information resources. This may include:
 - targeted advertising of available services;
 - public seminars; and
 - special events and promotions.
- 2.3.10 Develop a mechanism for mandatory greenhouse gas labelling of residential and commercial energy bills.

Actions requiring further investigation

A number of potentially valuable initiatives require further investigation with regards to their viability, costs and potential impacts. Such initiatives include:

- the disclosure of the energy efficiency rating for houses at their point of sale;
- a best practice technology program for the commercial sector;
- incentives for adopting energy efficient or renewable energy technologies;
- analysis of the emissions generated, and the potential for emission reductions, in the commercial building sector; and
- determining a detailed breakdown of energy-consumption within the residential and commercial building sectors.
- 2.3.11 Further initiatives will be investigated for inclusion in a revised Greenhouse Strategy or interim implementation as appropriate.

60

No.	Action	Responsible Department or Agency	Action timetable	
2.3.1*	Support and encourage measures to improve energy efficiency in the residential and commercial building sectors.	SEDO	2004-08	
2.3.2*	Require energy efficiency information about office space when acquiring or renewing Western Australian Government office leases.	DHW	2004	
2.3.3*	Require designs for new public buildings to meet minimum energy performance standards.	DHW	2004	
2.3.4*	Develop and monitor a display home in Broome.	DHW	2004	
2.3.5*	Contribute to the <i>National Appliance and Equipment</i> <i>Energy Efficiency Program</i> to ensure Western Australia maximises its share of the expected financial and greenhouse savings.	SEDO, DoCEP	Ongoing	
2.3.6	Identify, develop and promote best practice sustainability standards and incorporate these standards into all Western Australian Government housing and buildings through sustainability benchmarks as they relate to sustainable buildings.	DHW	Ongoing	
2.3.7	Support best practice standards through Western Australian Government procurement policies.	State Supply Commission (goods & services), DHW (works)	Ongoing	
2.3.8*	Provide consumer education programs to raise the awareness of energy-related greenhouse emissions and actions.	SEDO	Annually	
2.3.9*	Revise the marketing strategy to raise the profile and use of the SEDO <i>Energy Smart Line</i> and other information resources.	SEDO	Ongoing	
2.3.10*	Introduce greenhouse gas labelling on residential and commercial energy bills.	Western Power	To be advised	
2.3.11*	Investigate further initiatives for inclusion in a revised Greenhouse Strategy or interim implementation, as appropriate.	SEDO, Western Power	Ongoing	
New programs are indicated with an asterix *				

Greenhouse response actions

62

2.4 Land use planning and transport

CONTEXT

Greenhouse gases from transport are a significant component of total Western Australian emissions and are growing rapidly. Emissions from car travel contribute more than half of all transport emissions, while emissions from urban freight are increasing. Reducing the demand for car travel and increasing the use of non-car modes and alternative fuels are key elements in limiting greenhouse gas emissions from transport sources.

Transport emissions can be significantly influenced by the urban form of settlements. Distances travelled, and the mode of travel, are influenced by the closeness of residential areas to activity centres and community infrastructure. Transport patterns are also influenced by subdivision design, the accessibility and appeal of different travel options and transport infrastructure.

OBJECTIVES

- To reduce greenhouse gas emissions from transport.
- To reduce greenhouse gas emissions from urban forms through the integration of car and urban freight transport systems and land use.

BACKGROUND

Car travel is the predominant method of travel in most of metropolitan Perth and throughout Western Australia. While travel distances can be long and public transport may not be available, generally cars are used because of a lack of awareness, or acceptance, of alternative transport options. For example, safety concerns prevent greater use of cycling and walking.

To encourage popular use, other methods of travel need to be able to compete with the convenience of cars. Public transport should be networked across the city and compete with cars in speed, comfort and cost. Walking and cycling can be promoted where distances travelled are relatively short and adequate infrastructure is provided.

Car dependence

Car dependence is one of the clearest indicators of urban transport greenhouse emission levels.

The use of the motor car is influenced by a city's shape and infrastructure and whether acceptable public transport options are available. A city's history and culture – including the awareness and acceptance of travel options – also contribute. Data on the suburbs of Perth, Sydney and Melbourne show that the sprawl of a city is the major factor in determining transport greenhouse emissions. Average levels of these emissions can be predicted with 80 per cent certainty, just by knowing how far people live from the city centre or a good sub-centre.

Perth is highly car dependant – 58 per cent of all trips were made by drivers in cars in 2000. As part of the Dialogue with the City process, four concepts were devised to investigate this problem:

- Dispersed City the status quo with sprawl continuing north and south.
- Central City redevelopment focusing on the centre of Perth at high density.
- Polycentric City redevelopment focusing on centres throughout the city, especially train stations.
- Integrated Activity City redevelopment focusing on centres, areas and corridors of activity.

Reducing the sprawl of Perth will also deliver other benefits, including better regional air quality and generally lower transport costs.

On completion of the new Metro Rail Project in Perth's southern suburbs, the city's three main corridors will have a fast, comfortable and affordable alternative to car travel. After completion of rail electrification and the northern suburbs line, total train boardings in the metropolitan area increased from 14.2 million passengers in 1992-93 to 31.1 million in 2002-03¹. Rail patronage is expected to double to 60 million per annum after the southern suburbs line is completed, complemented with a reduction in greenhouse gas emissions.

The benefits of integrated urban development

Investment in high quality public transport, like urban rail systems or frequent bus services, benefits the suburbs along the routes they serve. New houses, commerce, services and recreational activity are attracted to such areas. Concentrated development in nodes can generate options for residents and visitors to leave their cars and dramatically increase public transport use. For instance, train use at Subiaco station increased by about 100 per cent between 1998 and 2002, as the Subi-Centro development neared completion.

Electric suburban rail services save more greenhouse gas emissions than replacing one car journey with one train journey. There is thought to be a reduction of between five and seven kilometres of car travel for every one kilometre of efficient public transport used. This is because trains travel more directly, and people often combine several trips and tasks (for example, shopping on the way to the train or using child care next to the rail station).

Freight transport efficiency

Emissions from freight transport can be reduced by better operational planning. The *Freight Network Review* has suggested that appropriately promoting rail freight and increasing the efficiency of freight movements, can reduce costs and environmental impacts, including greenhouse gas emissions. Better planning can also reduce the demand for further urban road construction.

Dialogue with the City

Dialogue with the City is part of a process to develop a new planning strategy for Perth and Peel. A number of the *Dialogue*'s objectives will lead to better greenhouse outcomes. These include aligning transport systems and land use to optimise accessibility, delivering an energy efficient transport system that provides travel choice and delivering urban growth management.

STRATEGIC DIRECTIONS Travel demand programs

Travel demand management (TDM) strategies can reduce the demand for cars by promoting more sustainable modes of travel including public transport, walking and cycling. TDM initiatives in urban areas also help to improve local air quality and traffic congestion, and provide health benefits to participants.

Actions

- 2.4.1 Undertake TravelSmart initiatives throughout the Perth Metropolitan Region.
- 2.4.2 Promote focused programs for cycling and walking and link these to the Premier's Physical Task Force.
- 2.4.3 Identify opportunities to influence travel behaviour and reduce car based trips, through analysis of travel surveys.

¹ PTA – May 2004

Every day Perth drivers travel the equivalent distance of 500 times around the world (more than 20 million km) in their car.

Nearly 250,000 of daily car trips are less than one km - the equivalent of a 10 to 15-minute walk or a five minute bike ride. Programs such as the *TravelSmart, Walk There Today* and *CycleInstead* are designed to encourage a shift away from short car transport trips in favour of other modes.





Rail versus road

The Perth Urban Rail Development Office has compared greenhouse gas emissions from travel by electric passenger railway to those from passenger vehicles. Transporting an equivalent number of passengers by car is estimated to contribute 68 per cent more greenhouse emissions than travel by electric rail. For the Perth to Mandurah railway's first year full operation, the greenhouse gas saving is estimated at more than 67,000 tCO₂-e.

Traffic management strategies

Traffic management strategies, including parking management schemes, intelligent transport systems and promoting ride sharing, can limit fuel use and greenhouse gas emissions by reducing congestion and travel times, especially in peak travel periods.

Actions

- 2.4.4 Support more car pooling programs such as those implemented at Curtin University of Technology, the University of Western Australia, Murdoch University, and in selected workplaces.
- 2.4.5 Review all aspects (public parking, tenant parking, urban form and amenity) of the Perth Parking Policy that helps to manage parking in the central city. The parking licensing fee supports the free central area and CAT bus services.

2.4.6 Investigate ways to reduce traffic congestion and therefore emissions.

Photo courtesy Department of Industry and Resources

2.4.7 Review the structure of public transport fares to encourage long distance travellers to use public transport.

Transport infrastructure investment

Public transport, cycling and walking require specialised infrastructure to properly compete with cars. Bus priority and interchange facilities, cycle routes and pedestrian friendly road and intersection planning can significantly improve the use of these travel options.

Actions

2.4.8 Extend and improve the suburban rail system (such as the Perth to Mandurah Railway and the Northern Suburbs Railway). A spur line off the Armadale line to a new station at Thornlie, and rail services in the Victoria Park area will be upgraded.

- 2.4.9 Review and upgrade the Bike Ahead Strategy and Perth Bicycle Network Plan that aims to improve services and infrastructure for cycling and cyclists.
- 2.4.10 Support local governments to prepare local integrated transport plans that prioritise improvements to public transport, cycling and walking facilities.
- 2.4.11 Construct principal shared paths, particularly along new rail lines and freeways, along with other road routes and paths for cyclists that enable access to stations and accessibility and connectivity to local communities.
- 2.4.12 Develop a strategic plan for bus priority improvements.

The importance of urban form and design

Urban form significantly influences greenhouse gas emissions from transport sources (NTILUTP, 2001). Conventional metropolitan and regional urban growth, focusing on developments at the edge of existing cities, leads to segregated land uses and car dependence. People then rely heavily on their vehicles to reach services, jobs, schools and shops (Western Australian Planning Commission (June 1999).

TravelSmart household

This is an 'individualised marketing' campaign to promote the use of public transport, cycling and walking. Western Australia's *TravelSmart* approach has been widely recognised as an effective solution and is being copied in South Australia, Victoria, Queensland, the United Kingdom, USA, Sweden, France, and Germany.

Existing *TravelSmart* programs have reduced the kilometres travelled by motor cars and have transferred many trips to walking, cycling and public transport. There have been demonstrated changes for trial programs in Western Australia, including seven to 14 per cent reductions in car trips, 10 to 20 per cent increases in public transport, 60 to 70 per cent increases in cycling and 10 to 30 per cent increases in walking. Although these increases come from a low base, the *TravelSmart* program provides leadership for greater gains along with other health and lifestyle benefits. Between 2000 and 2004, the program achieved annual greenhouse gas reductions of more than 30,000 tCO₂-e from an investment of \$5 million. *TravelSmart* household program is supported by specialised programs for schools, workplaces and local governments.

Fuel efficiency and alternative fuels

Emissions from transport can also be reduced by using low emission fuels and fuel-efficient vehicles. Alternative fuels such as hydrogen fuel cells that are being developed and trialled may provide avenues for reductions in greenhouse gas emissions.

Actions

- 2.4.13 Continue the regular replacement program of diesel buses with compressed natural gas (CNG) buses.
- 2.4.14 Trial three hydrogen fuel cell buses in Perth during 2004-06.
- 2.4.15 Assess opportunities for the sale of excess energy created by the use of regenerative power technology (the capture of energy produced while braking) on new trains back into the grid.
- 2.4.16 Support the strengthening of national vehicle energy efficiency standards.
- 2.5.17 Reconsider the introduction of periodic vehicle licensing and emission testing to assess equity issues and economic, social and environmental benefits and costs.
- 2.4.18 Consider opportunities where car owners could voluntarily purchase a 'green licence' at an additional cost to normal licence fees, with the extra revenue being used for sequestration activities to offset the car's greenhouse emissions.

Integrated urban development

Recent trends in land use planning are towards avoiding urban sprawl and the segregation of land uses, to limit distances travelled and reduce greenhouse gas emissions. The need for vehicle travel can be reduced by transit-oriented, mixed use, medium to high density development. Urban areas are being built and rebuilt so greater integration of land uses can be achieved. This supports the greater use of public transport, walking and cycling.

The *Liveable Neighbourhood Code* is a voluntary planning design code that promotes the development of sustainable communities with mixed land use and a balanced transport system. It encourages reduced car usage, better use of public transport, more walking and cycling, improved access to services and more efficient land use.

Actions

- 2.4.19Investigate making the Liveable Neighbourhood Code mandatory, as well as the option to:
 - fast-track' Liveable Neighbourhoods development applications through the planning approvals system;
 - apply the Code to revitalisation projects; and
 - combine the Code with the Residential Design Code.
- 2.4.20 Address greenhouse gas emissions during the Dialogue with the City process through further development of the 'Network City' concept that is

based on a series of activity corridors supporting more intensive commercial, recreational and residential activity and urban growth management tools.

- 2.4.21 Adopt and strengthen the Western Australian Planning Commission (WAPC) Residential Design Code Policy to encourage environmentally sensitive urban design, including climate sensitive design of dwellings to reduce energy consumption, optimise on-site solar access, protect solar access from neighbouring properties, conserve water and limit waste.
- 2.4.22 Prepare a new Statement of Planning Policy for Integrated Land Use and Transport Planning to provide guidance on the integration of transport and land use planning in Western Australia. This will consider, for example, how the transport system can increase accessibility, allow for greater modal choice and promote efficient freight movement systems. The Policy will be implemented through a requirement for Transport Impact Assessments.
- 2.4.23 Review the Perth Metropolitan Transport Strategy and associated strategies to reflect current sustainability and greenhouse objectives.
- 2.4.24 Assess options for managing urban growth for the Perth Metropolitan Region and indicating an advantage to developers for sequential development.



Links to other initiatives

Western Australia

State Sustainability Strategy State Planning Strategy Dialogue with the City Metropolitan Transport Strategy Transport Energy Strategy Perth Air Quality Management Plan Liveable Neighbourhoods Policy TravelSmart Program Freight Network Review Perth Bicycle Network Plan Building Better Stations Program Perth Parking Strategy 10 Year plan for Transperth, 1998-2007 Capital City Perth 2012 Fuelwatch - http://fuelwatch.wa.gov.au/ Premier's Physical Activity TaskForce http://www.patf.dpc.wa.gov.au/

National National Greenhouse Strategy Emissions Abatement Package for Urban Transport (Australian Transport Council) Prime Minister's Energy Taskforce National Hydrogen Study National Framework for Energy Efficiency

Other sections of this Strategy Government leadership Energy use in households and commercial premises Working with local government and the community

Urban transport efficiency

Cities vary considerably in their generation of transport related greenhouse gases. Many USA cities emit around five tonnes per person per year. Cities such as Singapore and Amsterdam produce around one tonne per person per year, to provide similar levels of urban amenity and well-being. In global terms, Perth's urban transport emissions are relatively high, even for developed nations. Perth's are the highest in Australia in per capita terms at slightly less than three tonnes – about 30 per cent higher than Sydney's.

Sustainability scorecard

The sustainability scorecard approach provides a transparent and manageable tool to implement sustainability issues within government decision-making processes.

Action

2.4.25 A sustainability scorecard that includes greenhouse criteria will be developed by the Western Australian Planning Commission Sustainability Committee's and the Sustainability Roundtable's Sustainable Building and Land Development Partnership Group

Freight transport efficiency

Freight journeys contribute considerably to the generation of greenhouse gases in Western Australia. Most freight is moved by road in the metropolitan area. The Western Australian *Freight Network Review* has developed strategies to increase the amount of freight transported by rail, improve inter-modal transfers, consolidate freight transport and to limit the growth of road freight to the Fremantle Port.

Actions

- 2.4.26 Prepare a strategic and detailed plan for a container terminal in the Fremantle Port's outer harbour.
- 2.4.27 Develop a policy to specifically focus on the efficient and effective management of freight routes.
- 2.4.28 Identify opportunities to retain the benefits of just-in-time deliveries and to limit greenhouse gas emissions from this source.
- 2.4.29 Develop a State Rail Freight Strategy to guide Government rail initiatives.

The Transport Energy Strategy (TES) notes that although gas is a cheaper fuel than petrol or diesel, the vehicles are more expensive to purchase. The Strategy suggests that an incentive to encourage natural gas use for transport could increase its use to a significant proportion and thus appreciably diversify Western Australian transport fuels. In order to show leadership and encourage uptake, the TES Committee has recommended a greater financial initiative be provided for the purchase of new private passenger vehicles powered by LPG, that the current LPG retrofit subsidy be extended, and that consideration be given to State Government vehicles switching to gaseous fuels wherever possible.

Greenhouse response actions

No.	Action	Responsible Department or Agency	Action timetable
2.4.1	Undertake <i>TravelSmart</i> initiatives throughout the Perth Metropolitan Region.	DPI	2000 – 2010
2.4.2	Promote focused programs for cycling and walking.	DPI	Ongoing
2.4.3	Identify opportunities to influence travel behaviour.	DPI	Ongoing
2.4.4	Support more car pooling programs.	DPI	Ongoing
2.4.5	Review the Perth Parking Policy.	DPI	2003-04
2.4.6*	Investigate ways to reduce traffic congestion and therefore emissions.	DPI	2004-06
2.4.7	Review public transport fare structures.	DPI	2004
2.4.8	Extend and improve the suburban rail system.	РТА	Ongoing
2.4.9*	Review and upgrade the <i>Bike Ahead Strategy</i> and <i>Perth Bicycle Network Plan</i> .	DPI	2004-05
2.4.10	Support preparation of local integrated transport plans by local governments.	DPI	2004-05
2.4.11	Construct principal shared paths and other Perth Bicycle Network routes.	DPI	2001-07
2.4.12	Develop a strategic plan for bus priority improvements.	DPI	2005
2.4.13	Continue the diesel to CNG bus replacement program.	DPI	Ongoing
2.4.14	Trial three hydrogen fuel cell buses.	DPI	2002-06
2.4.15	Assess opportunities to sell energy regenerated from braking systems back into the grid.	DPI	2003-05
2.4.16	Support the strengthening of national vehicle energy efficiency standards.	DPI	Ongoing
2.4.17	Consider introduction of a periodic vehicle licencing emission testing trial.	DPI	2004-05
2.4.18*	Consider opportunities for a voluntary green vehicle license fee.	DPI	2005
2.4.19	Investigate enforcement and expansion of the <i>Liveable Neighbourhoods Design Code</i> .	DPI	Ongoing
2.4.20	Address greenhouse gas emissions through the <i>Dialogue</i> with the City process.	DPI, WAPC	Ongoing
2.4.21	Adopt and strengthen greenhouse related actions in the <i>Residential Design Code</i> .	DPI, WAPC	Ongoing
2.4.22	Prepare an Integrated Land Use and Transport Planning Policy.	DPI, Wapc	Ongoing
2.4.23*	Review the Perth Metropolitan Transport Strategy.	DPI	2004-05
2.4.24	Assess options to manage urban growth.	DPI	Ongoing
2.4.25	Develop a sustainability scorecard that includes greenhouse criteria.	DPI, WAPC	Ongoing
2.4.26	Plan for a container terminal in the Fremantle outer harbour.	DPI, Fremantle Ports	Ongoing
2.4.27	Prepare a policy on freight routes.	DPI	Ongoing
2.4.28	Identify opportunities to retain the benefits of just-in-time deliveries and to limit greenhouse gas emissions from this source.	DPI	To be determined
2.4.29	Develop a State Rail Freight Strategy.	DPI	2004
New pr	ograms are indicated with an asterix *		

68

CHAPTER 2 - REDUCING GREENHOUSE EMISSIONS

2.5 Reducing agricultural emissions using good agricultural practice

CONTEXT

Agriculture produces approximately 28 per cent of Western Australia's greenhouse gas emissions, mainly from methane production by livestock, nitrous oxide derived from nitrogenous fertilisers and savanna burning.

There is limited ability to reduce emissions from agriculture in the short term.

Measures to reduce emissions are consistent with good agricultural practice.

OBJECTIVE

To move towards greenhouse neutral agriculture.

BACKGROUND

In 2002, greenhouse gas emissions from the State's agriculture production were about 19 million tonnes of carbon dioxide (CO_2) equivalents. This is about 28 per cent of the State's net emissions, and about 117 per cent of 1990 levels¹. As agricultural production in 2002 was about 165 per cent of 1990 production, the greenhouse efficiency of agricultural production, (that is the output per tonne of greenhouse emissions), has increased by about 42 per cent. This trend is likely to continue as farming practices improve. For Australia, total agriculture emissions in 2002 were 111 per cent of 1990 levels. Emissions are projected to be 104 per cent of 1990 levels by 2012.

About 75 per cent of Western Australia's agricultural produce is exported, with the emissions accounted in the Australian inventory, rather than to the country receiving the goods. Given the State's comparatively low emissions per unit of product of agricultural production, it makes global sense that Western Australia remains a prominent producer of agricultural products.

The main greenhouse emissions from agriculture are methane and nitrous oxide, but further research is required for a better understanding of this sector's emission's profile.

Figure 17 demonstrates that nearly 77 per cent of Western Australia's agricultural greenhouse gas emissions are from enteric fermentation (animal digestive processes) and the burning of savanna.

What about methane from livestock digestion?

Methane produced by stock contributes 33 per cent of Western Australia's agricultural emissions. Pasture manipulation and animal breeding and vaccination can help reduce these emissions, but further research and development are required to prove these options.

Savanna burning

Savanna burning is estimated to contribute about 45 per cent to the State's agricultural greenhouse emissions and 14 per cent of Australia's emissions. This level of emissions demands further research to ensure our accounting is accurate. In particular, we need to be able to distinguish between fire associated with human activities such as agriculture and fires resulting from lightning strikes, accidents and arson. Such research will also guide the development of practices that can help reduce savanna fire emissions.



Photo courtesy of Department of Agriculture

Figure 17 Western Australian agriculture sources of greenhouse gas emissions 2002



Managing greenhouse gas emissions from agriculture

For many agricultural crops and pastures, there is likely to be a balance between CO_2 uptake and emissions. Although there are some CO_2 emissions from agricultural practices the low global warming potential of CO_2 means it is only a small part of agriculture's emission profile. Methane from livestock is estimated to generate about 9.3 per cent of Western Australia's net greenhouse gas emissions. Methane is also produced from fuel use, land clearing and the burning of agricultural wastes and savannas.

Nitrous oxide is thought to account for about 27 per cent² of Australian agriculture's total greenhouse gas emissions. These emissions arise from fertiliser, soils, fuel use, animal excrement and burning of savannas and agricultural residues. However, better ways to measure nitrous oxide emissions are required to enable effective abatement strategies to be developed.

Land clearing was formerly a major source of CO_2 emissions, but this has been significantly reduced in Western Australia. It needs to be noted that changes to land clearing are accounted for under the land use change and forestry sectors and are not a component of the agriculture sector emissions.

The trend for lower emissions per unit of production is expected to continue as producers continue to use more sustainable practices. In the long term, research efforts and innovation will develop new practices of emissions abatement. 69

Sustainable agricultural practices also reduce greenhouse emissions



• Shorten stock finishing time.

- Use minimum tillage practices.
- Improve the digestibility of pastures.
- Use nitrogen fertiliser more efficiently.
- Improve drainage in water logged soils.
- Minimise and reduce soil sodicity and compaction.
- Reduce fuel use.

Photo courtesy of Department of Agriculture

STRATEGIC DIRECTIONS

Reducing emissions from agriculture to move towards a greenhouse neutral agricultural industry will require a combination of emission reduction strategies and carbon sequestration. Because methane and nitrous oxide have much higher global warming potentials than CO₂, actions to reduce emissions of these gases need to be closely investigated. There is very little quantitative information either about nitrous oxide emissions from agriculture or the reductions that can be achieved through changed management. Obtaining this information is basic for management purposes and the subject of considerable national and international research. The Department of Agriculture (DAWA) is an active participant in this work. Once we have better information and knowledge about agricultural emissions the focus will shift to promoting effective practices.

Short term actions - clarifying baseline emissions from agriculture.

We need better information about sources of agricultural emissions. Baseline information is required to assess which management practices achieve the best combined outcome in emissions reduction and whether emissions have decreased at all.

Western Australia is already contributing to research being undertaken by organisations such as the CRC for Greenhouse Gas Accounting, the Grains Research and Development Corporation and the Australian Greenhouse Office. Further work would help focus and extend this research and make it more directly relevant to Western Australian circumstances.

Actions

Modeling

- 2.5.1 Accounting methods for savanna burning emissions from Western Australia will be reviewed.
- 2.5.2 National agricultural emission estimate methodologies for estimating agricultural emissions will be reviewed to ensure they correctly represent State conditions.

Research

- 2.5.3 Nitrous oxide emissions research will be undertaken in collaboration with national partners to quantify baseline emission information for cropping farming systems and the effectiveness of changing management.
- 2.5.4 Western Australia will investigate options to contribute to national projects examining base line emissions of methane from agriculture.
- 2.5.5 Western Australia will contribute to national research into the effect of feed quality, feed additives and chemical inhibitors on methane emissions.

70

CHAPTER 2 - REDUCING GREENHOUSE EMISSIONS


Extension

- 2.5.6 Research findings on emission risks and reduction measures will be disseminated to producers and industry through papers and seminars and integrated with extension and training activities.
- 2.5.7 Producers and industry will be encouraged to participate in research and to adopt findings leading to reduced emissions.

Long term actions - developing and promoting good agricultural practice guidelines

Good agricultural practices lead to lower greenhouse emissions.

Actions

Developing good agricultural practice guidelines

2.5.8 A set of good agricultural practice guidelines and management advice will be developed to help farmers minimise greenhouse gas emissions and to encourage implementation of guidelines.

Promoting good agricultural practice

2.5.9 Practical decision support tools allowing producers to assess emission risks and reduction strategies for their property will be developed and promoted.

- 2.5.10 Opportunities to export latest sustainability and greenhouseeffective agricultural technology and knowledge to other countries will be pursued.
- 2.5.11 Incentive schemes to encourage the adoption of abatement measures for minimising greenhouse gas emissions will be investigated.

CRC for Tropical Savannas -Northern Australian Fire Abatement (NAFA) project proposal

The NAFA Project proposal, if successful, will aim to develop and apply community-based fire management strategies to reduce savanna burning in northern Australia. More than 350 000 km² of northern Australian savannas are burnt on average every year representing about 21 per cent of the 1.9 M km² tropical savannas region. This represents over 70 per cent of Australia's fires between 1997-2002. Such burning is also estimated to result in 2.9 per cent of Australia's accountable greenhouse gas emissions. If successful, the NAFA project will coordinate and facilitate strategic fire management by land managers in fireprone regions. In Arnhem Land, Aboriginal owners will re-establish effective fire management of their lands reducing greenhouse gas produced under the current regime of widespread and frequent uncontrolled fires. By using strategic and controlled burning early in the fire season to make fire breaks, the spread of larger and more intense fires that typically come at the peak of the fire (dry) season will be prevented. The proposed management strategy will produce smaller, patchier fires that cover less area and consume less fuel than under the current regime. Thus accountable emissions of nitrous oxide and methane due to savanna burning will be reduced. Total abatement of 2.07 Mt CO2-e over the period 2008-2012 in the Arnhem Land project area, and realistically additional abatement of 0.59 Mt CO₂-e in supplementary Kimberley and north Queensland project areas over this same period is expected. Because the severity of the fire regime will be reduced by the project (ie. less dry season fires), plant growth will recover and soil organic matter and litter pools will increase leading to carbon being sequested.

In the Kimberley, agencies are currently working with all land managers (indigenous and non-indigenous) to encourage strategic, early dry season burning of firebreaks. This is aimed at producing a mosaic pattern, so reducing the extent of subsequent later dry season fires.

Green	house res	ponse act	ions

No.	Action	Responsible Department or Agency	Action timetable
2.5.1	Review current savanna fire accounting methods.	DAWA, FESA	2004
2.5.2	Review national agriculture emission accounting methods for estimating agricultural emissions to ensure they correctly represent Western Australian circumstances.	DAWA	Ongoing
2.5.3	Improve nitrous oxide emission baseline information and knowledge.	DAWA	2004-06
2.5.4	Investigate options to contribute to national projects using modeling techniques to determine baseline emissions.	DAWA	Ongoing
2.5.5	Contribute to national research into the effect of feed quality, feed additives and chemical inhibitors on methane emissions.	DAWA	Ongoing
2.5.6	Promote research findings to producers and industry and integrate with extension and training activities.	DAWA	Ongoing
2.5.7	Encourage producers and industry to participate in research and adopt findings leading to reduced emissions.	DAWA, funding bodies	Ongoing
2.5.8	Develop a set of good agricultural practice guidelines for minimising greenhouse gas emissions and to encourage implementation of guidelines.	DAWA, Ago	2007 onwards
2.5.9	Develop and promote practical decision support tools that allow producers to assess emission risk and reduction strategies for their property.	DAWA, Ago, Crcga	2005 onwards
2.5.10	Pursue options to export greenhouse and sustainability technology and knowledge.	DAWA, DPC	2004 onwards
2.5.11	Investigate incentive programs to encourage the early adoption of greenhouse emission abatement practices.	DAWA	2008 onwards



Links to other initiatives

Western Australia

State Sustainability Strategy Tree Plantation Agreements Act 2003 Regional NRM Strategies Regional Development Statement

National Greenhouse Strategy National Action Plan for Salinity and Water Quality Natural Heritage Trust extension CRC for Greenhouse Accounting

Other sections of this Strategy

Industry and electricity generation emissions Carbon sequestration New industry opportunities 74 CHAPTER 3 - CARBON SEQUESTRATION

CARBON SEQUESTRATION

Sequestering (or storing) carbon or other greenhouse gases in sustainable organic growth or geological formations are options for reducing a nation's net greenhouse gas emissions.

Organic sequestration of carbon dioxide occurs when plants create carbohydrates from carbon dioxide, water and minerals in the presence of sunlight, a process termed *photosynthesis*. Photosynthesis is currently the only realistic option for reducing atmospheric concentrations of carbon dioxide, a greenhouse gas, from the atmosphere. All other options for limiting greenhouse gases are concerned with reducing emissions at source. Organic sequestration of carbon dioxide is specifically addressed in the Kyoto Protocol, and certain types of organic sequestration may be accounted and, in some circumstances, used to offset greenhouse gas emissions.

Geological sequestration of carbon dioxide occurs where the gas is taken from a waste stream (such as from processes in an electricity generating station or oil industry facility) and is compressed and injected into a stable, competent geological formation. The geological structure must also have the integrity to hold the gas in place until it goes into solution, or reacts with the bedrock to precipitate as a solid or otherwise ceases to have significance as a greenhouse gas.



Table 5 Organic Carbon Sink potential: Kyoto Article 3.3

Carbon sink	Projected area of planting (1000 ha)	Average CO ₂ sequestered	Estimated sequestered CO ₂ CO ₂ 2008 – 2012 (1000 tonnes)
Hardwood/bluegums	266	103	19,990
Hardwood/eucalyptus sawlogs	34	100	1,234
Softwood/pinaster and radiata	158		7,631
Oil mallees	Uncertain	At least 15	Uncertain
TOTAL			28,855

Source: Department of Agriculture, WA Photo courtesy of Department of Industry and Resources

3.1 Organic carbon sequestration

CONTEXT

- Removing carbon dioxide (CO₂) from the atmosphere through plant-based carbon sinks reduces net emissions and lowers atmospheric concentrations of this greenhouse gas.
- Carbon sinks may be valuable if an emissions-trading market is established.
- Planting vegetation to create plantbased carbon sinks can also have natural resource management benefits.

OBJECTIVE

To encourage plant-based carbon sinks, especially where the environment or other values will benefit.

BACKGROUND

Plant-based carbon sequestration occurs when CO₂ is removed from the atmosphere by photosynthesis and is stored in plants or soils.

Organic carbon sequestration can offer a relatively low-cost, short to medium term option to reduce atmospheric CO_2 concentrations. It is, therefore, a key part of any integrated greenhouse response program. It is also recognised as a legitimate emission reduction option under international agreements, including the Kyoto Protocol.

Where there is a national greenhouse gas emission market, such as in the United Kingdom, or an international trading market, such as between nations that have ratified the Kyoto Protocol, carbon sequestration rights may have an economic value. New South Wales has established a state-level market for carbon sequestration credits as part of its emission reduction program for the electricity supply sector.

Western Australia's cleared agricultural lands and rangelands have significant potential for plant-based carbon sequestration through the establishment of plantations or other perennial vegetation or changes in land management practices. Large scale revegetation can also help counter dryland salinity, land degradation and biodiversity loss as well as support new rural industries and employment.

A strong synergy exists between establishing carbon sinks and the Western Australian Salinity Strategy. Planting trees and native vegetation is a management option for salinity as well as providing a carbon sink. If commercial tree farming under the National Action Plan for Salinity and Water Quality (NAP) were guided by regional natural resource management (NRM) strategies they would more effectively contribute to regional, State and national NRM targets.



Planned large scale Government investment is expected to catalyse action by investors seeking returns from carbon sequestration and wood products. This overall investment will significantly increase the State's plantation estate. If commercial tree farming under NAP were guided by regional natural resource strategies they would more effectively contribute to regional, state and national NRM targets.

Estimates suggest carbon sequestration from commercial and community tree planting could potentially amount to over 28 million tonnes of CO₂ in the first Kyoto Commitment Period (2008-12).

Plant-based carbon sinks and the Kyoto Protocol

The Kyoto Protocol allows changes in CO_2 emissions arising from changes to land management practices to be included in national greenhouse accounts. Land management contributes emissions where land is cleared and reduces net emissions where CO_2 is sequestered in plants and soils (Table 5).

Two types of carbon sequestration activities are included under the Protocol. These are:

- afforestation and reforestation on cleared land with trees meeting specified criteria (*Article 3.3*), such as blue gums, maritime pine, oil mallees and Australian sandalwood; and
- revegetation, land management and soil management (*Article 3.4*) such as altering soil management in croplands or perennial pastures or revegetating, restoring or de-stocking wheatbelt lands, saltland pasture or rangelands.

Article 3.3 activities, both clearing and replanting, must be included in the 2008-12 Kyoto Protocol accounting period. Nations can choose to include Article 3.4 options in that accounting period, but are required to include them in following periods.

Accounting for plant-based carbon sinks

International carbon accounting requirements are being developed for organic sequestration to ensure this option can be assessed transparently when national greenhouse accounts are reported to the UNFCCC.

Removals of greenhouse gases by eligible sink activities generate so-called 'removal units', which must be verified by expert review teams under the Kyoto Protocol's reporting and review procedures.

Challenges for carbon offset markets

Establishing markets for carbon removal units generated through plant-based carbon sequestration faces a number of unique challenges.

Recognition in international and

national accounting: Australia's participation in formal international emissions trading flexible mechanisms will only be possible if this nation ratifies the Kyoto Protocol. Even with ratification, *Article 3.4* sinks will only have value if the Commonwealth decides to include them in the national accounts for the first Kyoto Commitment Period. Accounting: Accurate, cheap and easy accounting and projection methods for plant-based carbon sequestration are available to support trading in carbon sequestration offsets. The Western Australian Government has undertaken extensive research into carbon sequestration rates for tree plantations, but accounting for other revegetation remains under trial and costly.

Permanence: Sequestered carbon could be lost through natural hazards such as fire, flood or storm, or through changed land management practices. Markets will require sophisticated risk management strategies.

Carbon Rights Act 2002

Landholders, or those who have an interest in the land, can register proprietary ownership to carbon sequestration rights with the Department of Land Administration. These rights might then be sold to buyers who seek to reduce their greenhouse gas emissions and who wish to do so through organic carbon sequestration offsets. Since 1990, the Crown (State Government) has planted significant forestry and vegetation through its agencies and authorities. These may be registered as carbon rights and made available for sale through a central body, owned and operated by the Western Australian Government, in order to maximise their full value and potential in encouraging greenhouse gas abatement.



Government action to create plant-based carbon sinks

The Western Australian Government is identifying and establishing plantations in areas close to regional centres in the South West. Several eucalypt and pine species and sandalwood are being planted to reflect the diverse conditions found in this region. The trees can help control groundwater levels with associated effects on salinity, biodiversity and land degradation. They can also provide broader land management benefits such as countering wind erosion, providing shelter for livestock and adding to the landscape's visual diversity. The development of new regional industries based on the supply of timber and other forest products is another potential benefit. Through the Forest Products Commission (FPC) the Government is seeking private sector investment for carbon sequestration projects from Australian and overseas interests.

The Western Australian Government is identifying and establishing plantations in areas close to regional centres in the South West.

STRATEGIC DIRECTIONS

The key strategic directions for plant-based carbon sinks are to:

 create an environment which will promote the development of a market for carbon sinks; and

rtesy of Department of Agriculture

 encourage investment in sinks that will also deliver natural resource and regional benefits.

Promoting markets for plant-based carbon sinks

Markets require clear property rights and assets identification. The Western Australian Government can help markets develop by ensuring rights to vegetation and sequestered carbon needs are clarified and carbon accounting and verification costs are minimised.

Under the Kyoto Protocol, the certainty of international recognition for *Article 3.3* carbon sinks is higher than for *Article 3.4* sinks. It will therefore be to Western Australia's advantage to include as many plant-based carbon sinks as possible under the *Article 3.3* classification.

Actions

- 3.1.1 Western Australia will promote a common national scheme of statutory carbon sequestration rights, based on our system.
- 3.1.2 Further research will be undertaken to develop cost-effective and accurate carbon sequestration and accounting standards for Western Australian circumstances.
- 3.1.3 The Western Australian Government will work through the Commonwealth Government aiming to ensure national and international agreements relating to organic carbon sequestration that recognise Western Australia's circumstances.

Potential sellers and investors need to know about opportunities and risks arising from carbon sequestration rights and values.

Action

3.1.4 The Western Australian Government will develop and implement an information and awareness program relating to plant-based carbon sequestration rights.

<u>Inifinitree™</u>

Launched in June 2003, *Inifinitree™* is a collaborative tree farming program, partnering the Forest Products Commission with private investors and farmers, to grow commercial tree crops on Western Australian farms. The Government will spend \$21 million over the next four years to implement the program – providing the direction and investment that is required to rebuild sustainable land use in the cleared agricultural regions of the State.

It's a pioneering approach to tree farming, with the capacity to deliver multiple economic, social and environmental benefits to mitigate serious land degradation problems such as soil salinity, erosion and water logging.

The program will provide a renewable timber resource and help revitalize rural economies with new industries and job opportunities. The right trees, grown in the right place, and working with the right industries, provide a commercial contribution to the battle against salinity and water logging.

An area the size of the Western Australian agricultural zone can provide a very significant 'greenhouse sink' that may help to reduce atmospheric CO_2 levels more quickly than other measures.

It's very probable that tree farming could provide time for technology and economic adjustment to deliver the anticipated long-term 'low-carbon' economy of the future. Infinitree™ is the start of an exciting new era in tree farming in Western Australia.

Promote plant-based carbon sinks which deliver natural resource management benefits

Expand existing plant-based carbon sink activities

Western Australia has a significant plantation program focused on the sustainable supply of plantation timber to the wood market. A carbon market could help expand the plantation timber industry and thereby help reduce salinity, improve water quality and farm profitability and expand the industry base of many regional communities.

Actions

- 3.1.5 Planning for plant-based carbon sinks will be integrated with planning for other natural resource management initiatives.
- 3.1.6 Western Australian Government investment in plant-based carbon sinks will be linked to Government policies and strategies such as the Action Plan for Tree Farming and the Western Australian State Sustainability Strategy.
- 3.1.7 Opportunities for investments in Western Australia in carbon sequestration projects and their broader resource management benefits will be promoted nationally and internationally.

Develop investment opportunities in new plant-based carbon sinks

Western Australia is well placed to attract carbon-related investment in blue gum and pine plantations as these are well understood here. However, for the State to attract other carbon sequestration investments, such as through other tree species or Kyoto Protocol *Article 3.4* initiatives, investors will need to be confident about the sequestration benefits that are projected to result. Developing the information to support such confidence will require further targeted research.

Actions

- 3.1.8 Western Australia will contribute to national and international forums determining the status, eligibility and measurement requirements of Article 3.4 sinks.
- 3.1.9 Opportunities to actively participate in national programs to determine the duration and certainty of Article 3.4 sequestration and to further define measurement techniques will be explored.
- 3.1.10 Research will be conducted into the potential for plant species disseminated to produce cost-effective carbon removal credits and natural resource benefits.

- 3.1.11 A comprehensive cost benefit analysis will be conducted into the value of revegetation and tree plantation establishment, including natural resource system benefits.
- 3.1.12 The adoption and use of plantation timber grown in agricultural environments as a renewable resource will be encouraged.
- 3.1.13 Local governments will be encouraged to plan for and support carbon sequestration and bio-energy generation.

<u>Green</u>	<u>house response actions</u>

No.	Action	Responsible Department or Agency	Action timetable
3.1.1	Western Australia will promote a common national scheme of statutory carbon sequestration rights, based on our system.	Greenhouse Unit	Ongoing
3.1.2	Further research will be undertaken to develop cost-effective and accurate carbon sequestration and accounting standards for Western Australian circumstances.	CALM, FPC, DAWA	2004-06
3.1.3	The Western Australian Government will work through the Commonwealth Government aiming to ensure national and international agreements relating to organic carbon sequestration that recognise Western Australia's circumstances.	CALM, DAWA, FPC, Greenhouse Unit	Ongoing
3.1.4*	The Western Australian Government will develop and implement an information and awareness program relating to plant-based carbon sequestration rights.	FPC, DAWA	2004-05
3.1.5	Planning for plant-based carbon sinks will be integrated with planning for other natural resource management initiatives.	FPC, DAWA, CALM	Ongoing
3.1.6*	Western Australian Government investment in plant-based carbon sinks will be linked to Government policies and strategies such as the <i>Action Plan for Tree Farming</i> and the <i>State Sustainability Strategy</i> .	FPC, Dawa, Calm	Ongoing
3.1.7*	Opportunities for investments in Western Australia in carbon sequestration projects and their broader resource management benefits will be promoted nationally and internationally.	FPC	Ongoing
3.1.8	Western Australia will contribute to national and international forums determining the status, eligibility and measurement requirements of <i>Article 3.4</i> sinks.	FPC, DAWA, CALM,	Ongoing
3.1.9*	Opportunities to actively participate in national programs to determine the duration and certainty of <i>Article 3.4</i> sequestration and to further define measurement techniques will be explored.	DAWA, Calm	2005-07
3.1.10	Research will be conducted into the potential for plant species disseminated to produce cost-effective carbon removal credits and natural resource benefits.	FPC, DAWA, CALM	Ongoing
3.1.11*	A comprehensive cost benefit analysis will be conducted into the value of revegetation and tree plantation establishment, including natural resource system benefits.	FPC, DAWA, CALM	2005
3.1.12	Encourage adoption and use of plantation timber grown in agricultural environments as a renewable resource.	FPC	Ongoing
3.1.13	Encourage local governments to plan for and support carbon sequestration and bio-energy generation.	FPC	Ongoing
New pr	ograms are indicated with an asterisk *		



Links to other initiatives

Western Australia State Sustainability Strategy Salinity Strategy Action Plan for Tree Farming Carbon Rights Act 2003 Tree Plantation Agreements Act 2003 Regional NRM Strategies Local government NRM strategies Regional Plantation committees **National** National Greenhouse Strategy National Action Plan for Salinity and Water Quality Natural Heritage Trust extension CRC for Greenhouse Accounting

Other sections of this Strategy Government leadership Industry and electricity generation emissions Reducing agricultural emissions

3.2 Geological sequestration of carbon dioxide

CONTEXT

Western Australia's stationary energy and industry sector emissions of carbon dioxide (CO_2) are increasing rapidly. CO_2 already can be captured from emission streams of some of these activities, such as natural gas extraction. Research is developing mechanisms to capture CO_2 from flue gases associated with electricity generation.

Geological sequestration is proposed as a mechanism to store CO₂ for very long periods of time.

OBJECTIVE

To ensure Western Australia has the required knowledge, the appropriate policy settings and effective regulatory frameworks to enable informed decisions about geological sequestration proposals.

BACKGROUND

Geological sequestration involves storing gases such as CO₂ underground in integral and competent geological structures, such as saline formations and depleted oil and gas reservoirs. CO2 sequestered in this way would first be captured from, for example, an industrial or energy generation waste stream or from an oil or natural gas resource stream, then it would normally be compressed so it becomes like a liquid, and finally it would be pressure injected into a geological formation. In some instances it might be injected in a highly compressed gaseous form. Once in the geological formation, the pressure in the formation or aquifer would keep the CO₂ compressed and the integrity of the formation would keep it in place. The situation would be monitored and action taken in case of leakage.

Proponents of geological sequestration suggest the sequestered CO_2 would remain in or near the formation into which it had been injected for long periods of time, perhaps thousands of years. This would immediately reduce the amount of CO_2 being released into the atmosphere.

Figure 18 An emission free vision for the future



Image courtesy of CO2CRC, 2003

Geological sequestration of CO_2 to address emissions is largely experimental, with only one pilot operating project in the North Sea off Norway. Experimental projects are being progressed in the North Sea off Holland and on land in Germany, Canada and the USA. Further operational projects are being proposed in Norway and Algeria.

Substantial research is being undertaken on geological sequestration in Europe, North America and Australia, both by oil and gas companies and by government and independent scientists. Much of this research is based on information and knowledge gained from more than 30 years of compressing and injecting CO_2 to enhance the recovery of oil and gas from partially depleted oil and gas fields.

In Western Australia, geological sequestration has been proposed as a means of reducing CO_2 emissions from a proposed natural gas development at Barrow Island off the State's North-West coast. If approved, this would be the largest geological sequestration project in the world, sequestering about four million tonnes of CO_2 annually. However, a number of legal and technical issues remain to be resolved.

There are many potential sites for injection off the coast of Western Australia. If geological sequestration became a proven and acceptable means of reducing CO_2 emissions, it could significantly reduce total global greenhouse gas emissions.

STRATEGIC DIRECTIONS

In October 2003, a report, Geosequestration of Carbon Dioxide – Key Technical, Legislative and Policy Issues, summarised the key issues associated with geosequestration. This report identified several important matters that require further investigation and consideration by government, industry and the community.

- What technical issues associated with geological sequestration still need to be addressed to satisfy the needs of approval and regulatory authorities and the public?
- What regulatory framework would best ensure that environmental values and the public interest are protected now and in the longer term?
- How can CO₂ liability and ownership issues be managed for the medium to long term?
- How can the public become well informed about the opportunities and issues associated with geosequestration?

Figure 19 Sleipner: example of a major CO₂ storage project in the Norwegian sector of the North Sea



Technical issues

The main technical question is 'Will the CO_2 remain in the geological formation into which it has been injected?' The formation must have an impermeable geological cap, and sufficient volume and pore space so that the CO_2 doesn't leak. The injection wells must be properly sealed and maintained to ensure integrity for the very long term and exploratory or other boreholes into the formation must similarly be properly plugged and maintained. Effective management of the surface compression and injection facilities is also important.

The October 2003 geosequestration report also identified four main technical issues, which are:

- characteristics of effective long term storage sites;
- the value of combining geosequestration with enhanced oil and gas recovery wherever possible;
- the need for adequate health and safety procedures; and
- long term monitoring and remediation of leaks.

Actions

3.2.1 The Western Australian Government should develop and communicate clear policies relating to key technical issues associated with geosequestration prior to approving specific proposals.

Regulating geosequestration

The injection of CO₂ into deep geological formations can be classified as storage of waste, as an action to enhance oil or gas production or as storage of a resource to be accessed in the future to extract CO2, such as for industrial purposes. However it is classified, it must be managed under appropriate legislation to ensure ongoing security of the storage. Current arrangements worldwide to manage the storage of CO2 use regulations that cover such topics as pollution control, enhanced oil or gas recovery, and hazardous waste disposal. However these regulatory arrangements may not be appropriate to manage CO₂ storage over the longer term, especially out to hundreds or thousands of years.

In Western Australia, petroleum activities including injecting water produced with oil and gas production, rehabilitation and shutting down operations are normally regulated under the Petroleum Act. While carbon storage and consequent geosequestration share some features of these activities, it is principally a longterm storage activity, which may not be adequately addressed by these existing petroleum regulations. Similarly, the Commonwealth mining and petroleum legislation and regulations, the Environmental Protection Act, Contaminated Sites Bill and the Waste Management Act do not appear to

effectively address the storage of CO₂ and possibly other greenhouse gases in the longer term. An effective regulatory scheme will be required, probably relying on current legislation combined with new legislation specifically tailored to address geosequestration.

Actions

3.2.2 The Western Australian Government will establish an effective regulatory regime for geosequestration, including new specific legislation and regulations if necessary, to manage CO₂ handling, injection and storage prior to approving specific proposals.

Liability

Liability issues for CO2 storage and eventual sequestration can arise from transport by pipeline, rail, road or ship to the injection site, compression and injection at the well site or from the CO₂ stripping process or collection site. Finally, effective geosequestration must aim at storing CO2 for hundreds of years or longer and there is the potential for some leakage from the formation to occur during this period. This is far longer than the normal period of mine and petroleum closure responsibility faced by resources development companies, and is longer than most private sector enterprises have existed.

Industry representatives have suggested that liability for injection operations should rest with industry for the life of the project or until government and industry are satisfied with a high degree of certainty that the potential liabilities are minimal. History suggests the long term industrial and mining legacies eventually fall to government to manage.

The community needs to be in a position to form a judgement regarding an acceptable balance between the benefits it gains from particular industrial developments versus the scale of potential liabilities the developments may generate now and in the future. For geological sequestration, such potential liabilities would be associated with the leakage rate from the geological formation storing the CO₂.

Actions

3.2.3 The Western Australian Government will develop its view as to how liability for carbon sequestration operations should be addressed in consultation with industry, the public, and other Governments. 86

Public awareness and acceptance

Geosequestration offers a potentially effective means of sequestering large quantities of CO_2 for extremely long periods of time. This option will need to be well understood and supported by the community if it is to be implemented, even if technical, regulatory and liability issues are resolved.

The community will need to be assured the technical aspects of geosequestration will be effectively managed and governments will need to demonstrate how the regulatory and policy issues are to be resolved in ways that are equitable across generations and jurisdictions. Community awareness has already been raised through the release of the report *Geosequestration of Carbon Dioxide – Key Technical, Legislative and Policy Issues* and public seminars, national conferences and discussions between Government agencies and public stakeholder groups. These activities will continue as the option becomes more fully explored and understood.

Actions

3.2.4 The Western Australian Government will develop and implement a public information program about geosequestration.

Carbon Geosequestration Regulatory Reference Group

The Carbon Dioxide Geosequestration Regulatory Reference Group (RRG), comprising industry representatives, research organisations and government officials is in the process of drafting regulatory guiding principles with the aim of producing a framework of nationally agreed standards for regulating carbon dioxide geosequestraition. This national group, chaired by Western Australia, acknowledges both technical and administrative issues in the development of regulatory principles.

At the international level, Australia is a member of the Carbon Sequestration Leadership Forum (CSLF). The CSLF is an international climate change initiative, focused on the development of improved cost-effective technologies for the separation, capture and storage of carbon dioxide. Technical, political, and regulatory environments for the development and implementation of geosequestration are explored within the group. Within the CSLF, Australia is leading the legal, regulatory and financial issues task force. Outcomes from the National RRG will form Australia's input into the CSLF.

The Australian delegation to the CSLF comprises government officials, industry and the research body, the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC). The CO2CRC is a contributor at the national and international level, and researches the logistic, technical, financial and environmental issues of geosequestration.

Greenhouse response actions

No.	Action	Responsible Department or Agency	Action timetable	
3.2.1*	The Western Australian Government should develop and communicate clear policies relating to key technical issues associated with geosequestration prior to approving specific proposals.	DOIR	Ongoing	
3.2.2*	The Western Australian Government will establish an effective regulatory regime for geosequestration, including new suitable specific legislation and regulations if necessary, to manage CO ₂ handling, injection and storage prior to approving specific proposals.	DOIR	Ongoing	
3.2.3*	The Western AustralianGovernment will develop its view as to how liability for carbon sequestration operations should be addressed and communicate this view to industry, the public, and to other governments.	DOIR	Ongoing	
3.2.4*	The Western Australian Government will develop and implement a public information program about geosequestration.	DOIR	Ongoing	
New programs are indicated with an asterisk *				

NEW INDUSTRY Opportunities emerging From greenhouse issues

CONTEXT

Western Australia has substantial knowledge and extensive experience in managing change. Tapping into our social, technical and economic resilience will be vital if we are to capitalise on the opportunities that could emerge from climate change impacts and agreements.

OBJECTIVE

To encourage Western Australia's managers and technology developers to embrace the opportunities offered by climate change.

BACKGROUND

The greenhouse debate often focuses on the potential risks and costs of climate change for Western Australia. However, global changes arising from a carbon constrained economy and from changes to weather conditions may also present 'early mover' opportunities to develop new industries here. Efforts to reduce greenhouse gases could be a catalyst for innovation and economic growth. Such opportunities could be a strong force supporting the State's longer-term economic health.

Because it is difficult to define which new industries and opportunities may emerge as a result of climate change, ongoing research will help ensure the State is in a position to capitalise on opportunities as they arise. Expected new developments and business opportunities include:

- new production processes or technologies that reduce the net greenhouse impact of existing industries or existing products;
- new and replacement products made in greenhouse-friendly ways; and
- new business models encouraging service industries in greenhouse areas.

These opportunities will be particularly important for our large-scale export-based industries in the mineral, energy and materials processing sectors. These industries can also be models for other sectors of the economy in a drive to reduce their greenhouse emission intensity. A specific challenge for Western Australia will be to ensure that technology used in power generation and resource processing is world's best practice.

The Western Australian Government's role is not to identify specific new technologies but to establish the fundamental framework for costeffectively reducing greenhouse gas emissions, consistent with other environmental, economic and social policy objectives. The Western Australian Government can work over a range of timelines to enhance the response by business and industry to climate change.

- In the short-term, immediate gains can be made. These include community and industry education programs that encourage incremental improvements in the production of goods and services, or where fuel substitution can be achieved.
- In the medium term, industries can develop new technologies that achieve similar production outcomes with lower greenhouse effects, thereby generating export opportunities for the State's existing and emerging products or services.
- In the long term, new industries can implement greenhouse-friendly strategies to ensure sustained high economic growth for Western Australia, as part of a global community committed to a greenhouse-friendly future.

New greenhouse-driven business opportunities seem set to emerge from three key areas.

Photo courtesy of Department of Environment PART B - GREENHOUSE RESPONSE ACTION

89

Innovation through applied research and development: This could see the emergence of diverse new goods and services across all industries to meet greenhouse challenges.
 Greenhouse management: Auditing and managing greenhouse emissions and carbon sequestration could generate new cost effective goods, services and technologies likely to meet growing global demand.
 Regional industries: Sectors such as agriculture and forestry can generate greenhouse emissions credits, which may have significant value. They may develop new fuels, or even new regional industries, while contributing to the fight against salinity.

STRATEGIC DIRECTIONS

Promoting greenhouse innovation

The Western Australian Government can help businesses capitalise on opportunities to develop innovative greenhouse friendly technologies and business models, particularly in industry sectors where the State has major activities.

Actions

- 4.1 A Greenhouse Foresight Study will be carried out to investigate opportunities for Western Australia in greenhouse technologies and services. This should:
 - examine global trends and developments in the demand for greenhouse-related goods, services and technologies;
 - analyse and assess Western Australia's capacity to supply greenhouse goods, services and technologies; and
 - evaluate overseas export opportunities in greenhouse-related goods and services, and developments in new environmental laws, standards, policies and technologies.

4.2 The Western Australian Government will encourage greenhouse-focused institutions so they can develop into world-class centres of expertise in greenhouse research, innovation and technology development.

Such centres could include:

- (a) A global centre for sustainability in Perth which would link significant areas of sustainability research being done in Western Australian universities, the CSIRO, Government and industry. The centre would:
 - promote the development of greenhouse partnerships;
 - help participants gain overseas greenhouse projects;
 - stimulate debate on the public policy implications of combating greenhouse; and
 - provide information about the State's greenhouse-related projects, capabilities and developments;

- (b) the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) focusing on geological carbon sequestration and related innovations;
- (c) the new CRC in Sustainable Resource Processing, based at Curtin University of Technology, opening new opportunities in resource management with significant greenhouse gains; and
- (d) The Murdoch University Environmental Technology Centre, a United Nations regional partner, promoting Western Australia's export of environmentally sound technologies.
- 4.3 The Department of Industry and Resources will aid State enterprises that request assistance to gain Commonwealth greenhouse innovation funds.

CHAPTER 4 - NEW INDUSTRY OPPORTUNITIES EMERGING FROM GREENHOUSE GAS ISSUES



Managing greenhouse gas emissions

TheWestern Australian Government will encourage the development of new technologies, professions, and goods and services offering solutions to greenhouse challenges and reducing greenhouse gas emissions.

Actions

4.4 The Western Australian Government will develop a Strategic Energy Resources Policy.

This policy should seek to:

- optimise the production and consumption of reserves of fossil fuels;
- encourage the long term export of relatively cleaner fossil fuels such as LNG; and
- promote the longer term development of alternative sources of energy, particularly related to the hydrogen economy.
- 4.5 A comprehensive Renewable Energy Strategy will be developed to support the needs of evolving greenhousefriendly innovative technologies.
- 4.6 The Western Australian Government will advocate the development of national standards for collecting and analysing greenhouse gas performance indicators for industrial and commercial processes and products.

- 4.7 The identification of new business opportunities emerging from emissions trading, joint implementation, and clean development mechanism projects will be facilitated. These opportunities include carbon accounting, energy efficient technologies, carbon sink establishment and measurement, adaptation planning and implementation, and emergency services planning and provisions.
- 4.8 The development of investment attraction strategies to entice new greenhouse management companies to Western Australia will be facilitated.
- 4.9 A greenhouse requirement in the sustainability scorecard for urban development will create opportunities for new planning and building skills, and for urban innovation to be developed.
- 4.10 Development and delivery of courses in greenhouse auditing and accounting professional skills by tertiary institutions and other appropriate providers will be encouraged to ensure the State enjoys the world's best practice

Developing regional greenhouse industries

The Western Australian Government will work to ensure greenhouse emissions from agriculture and forestry are reduced in ways that encourage the development of new industries in country areas.

Actions

- 4.11 A comprehensive Bio-energy Industry Development Strategy covering biomass, biodiesel, carbon credits and by-products such as activated carbon will be developed.
- 4.12 The plantation timber industry and other revegetation initiatives will be supported to expand rural economic opportunities, associated environmental benefits and emissions trading opportunities.
- 4.13 The Sustainability Policy Unit will continue to investigate the feasibility of regional sustainability strategies as a mechanism to create opportunities in regional areas for new industries.

CHAPTER 4 - NEW INDUSTRY OPPORTUNITIES EMERGING FROM GREENHOUSE GAS ISSUES

No.	Action	Responsible Department or Agency	Action timetable
4.1*	A Greenhouse Foresight Study will be undertaken to investigate Western Australian investment opportunities in greenhouse technologies and services.	TIAC, DOIR, DoE	2004-05
4.2*	The Western Australian Government will encourage greenhouse-focused institutions so they can develop into world-class centres of expertise in greenhouse research, innovation and technology development.	Office of Science and Innovation, DPC	Ongoing
4.3*	The Department of Industry and Resources will aid State enterprises that request assistance to gain Commonwealth greenhouse innovation funds.	DOIR	Ongoing
4.4*	A Strategic Energy Resources Policy will be developed.	DOIR	2004-05
4.5	A comprehensive Renewable Energy Strategy will be developed.	SEDO	Ongoing
4.6*	The Western Australian Government will advocate the development of national standards for collecting and analysing greenhouse gas performance indicators for industrial and commercial processes and products.	DoE, OoE	2005 onward
4.7*	The identification of new business opportunities emerging from emissions trading, joint implementation, and clean development mechanism projects will be facilitated.	DOIR	2004-05
4.8*	The development of investment attraction strategies to entice new greenhouse management companies to Western Australia will be facilitated.	DOIR	2004-05
4.9*	A greenhouse requirement in the sustainability scorecard for urban development will create opportunities for new planning and building skills, and for urban innovation to be developed.	DPI	2004-05
4.10*	Development and delivery of courses in greenhouse auditing and accounting professional skills will be encouraged.	Greenhouse Unit	From 2004-(
4.11*	A comprehensive Western Australian Bio-energy Industry Development Strategy will be developed.	DOIR, DoE, Sedo	2005-06
4.12*	The plantation timber industry and other revegetation options will be supported.	DAWA, FPC	Ongoing
4.13*	The feasibility of regional sustainability strategies as a mechanism to create opportunities in regional areas for new industries will continue to be investigated.	Sustainability Policy Unit	2003-06
New pr	ograms are indicated with an asterix *		

Greenhouse response actions

34

RESPONDING TO A CHANGING CLIMATE

CONTEXT

Scientists now agree regional climates have already changed and will continue to do so even if there is concerted global action to reduce greenhouse gas emissions.

OBJECTIVES

- To prepare the Western Australian community for unavoidable climate changes.
- To generate the information needed to form realistic and useful projections of future climate conditions and impacts and to make the information available to all community sectors.
- To integrate strategies to mitigate unavoidable adverse impacts of climate change into strategic planning and decision-making.

BACKGROUND

Climate change is likely to fundamentally impact on our natural environment, community and industries.

While the general nature of climate change impacts are reasonably well understood, less is known about the impact on regions. Such local knowledge is needed to support effective responses to specific impacts.

Preparing and implementing climate change response strategies needs to involve all sectors of government, business and the community. Climate change response strategies need to take account of the complexity of global atmospheric circulation, climate variability and other factors such as salinity.

Western Australia's philosophy of 'informed adaptation' allows initiatives to be taken even where there is considerable uncertainty. This approach does not recognise uncertainty as an excuse for inaction. Adapting to climate change will involve sharing the best available information with potentially affected groups who will be encouraged to take personal or corporate responsibility. Legislation, regulations, planning overlays, codes, standards and incentives will, however, be considered where necessary. Government can lead by example through ensuring its own services and responsibilities are prepared for climate change impacts.

STRATEGIC DIRECTIONS

Improve knowledge and awareness of climate change projections

In 2001, the Intergovernmental Panel on Climate Change (IPCC) reported that human activities were already interfering with the Earth's climate, human-induced climate change would continue for many centuries and regional climate changes were affecting many physical, biological and human systems.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has developed projections of future climate conditions that suggest Western Australia's South-West is likely to



Photo courtesy of Department of Health

A changing

climate could harm human health through supporting an increase in numbers of disease carrying insects such as mosquitoes

have higher temperatures and reduced autumn and winter rainfall. Other parts of the State will also experience increased temperatures and changes to rainfall and storm patterns.

The South-West has already had reduced rain during the past 25 years. Significant changes to its rainfall patterns have affected water resources and agriculture during this time.

Since 1998, the Western Australian Government has supported the Indian Ocean Climate Initiative (IOCI), a long term climate research program studying South-West climate variability. IOCI has recently suggested global climate change was at least a partial cause of the demonstrated rainfall decrease since 1975¹.

Climate research and modeling is not able to predict future weather patterns in detail or with certainty. However, scientists are able to prepare and provide increasingly useful climate scenarios based on atmospheric modeling and analysis of climate and weather records. Downscaling global climate models will improve our capacity to project likely future climate patterns under greenhouse conditions. Understanding the forces behind our current climate and scenarios of likely future weather conditions can also generate an understanding of potential future risks and opportunities to guide appropriate support plans.

Better understanding enables researchers to identify likely effects on transpiration, vegetation cover, water retention, pest and disease occurrence, flooding and erosion. The resultant impacts on human health, agriculture, forestry, biodiversity, water resources, infrastructure, industry and tourism can also be better understood.

Stage Two of the IOCI program will help define the forces underlying Western Australia's climate conditions, variability and change. More emphasis will be placed on climate change, the geographic scope will be extended to include the Mid-West and Pilbara regions and community information and extension will be increased.

See http://www.ioci.org.au/ for further information on the IOCI program.

Actions

- 5.1 The Western Australian Government will support Stage Two of the IOCI program - a five year research partnership with the CSIRO and the Bureau of Meteorology.
- 5.2 Stage Two of the IOCI program will extend climate research communication to all affected sectors of the Western Australian community via more frequent publications and regular website updates.

In 2001, the IPCC reported human activities were already interfering with the Earth's climate

HEALTH

More people will be exposed to vector-borne and water-borne diseases and there will be more heat stress mortality. Secondary impacts are likely to occur where water resources or water quality are reduced or there is flooding. Climate change might, however generate some health benefits, such as

AGRICULTURE AND FORESTRY

Agriculture and forestry production will be affected by changing soil moisture due to altered rainfall, higher temperatures and changing territories of insects and other pests. The likely higher incidence of fires could harm crops that take longer to grow. Agricultural practices and rangelands countries could generate new competitors or open new markets for Western Australian produce. Climate changes within the State are also likely to mean new production options.

WATER RESOURCES

The vulnerability of surface water resources to changes in rainfall is already well recognised in Western Australia. Even the continuation of existing rainfall patterns (since 1975) will create water resource management challenges for the South-West's main population centres and irrigation areas. Higher temperatures are likely to increase transpiration and evaporation. There will be reduced certainty for both water resource

FISHERIES

The IPCC has suggested that if climate change causes the *El Nino* to become more common, the Indonesian through-flow and the Leeuwin current could weaken³ and that if winds were favourable for up-welling, Western Australia's coast could shift from a low-production, high biodiversity cosystem to a more productive ecosystem typical of temperate shelves.⁴ This would affect

INDUSTRY

Industries can be affected by climate change through impacts on water availability or damage to infrastructure or transport. Tourism, in particular, is likely to be directly affected by climate changes to natural environments on which the industry is largely based.

COASTAL AREAS

The IPCC projects a rise in sea-level of between 9-88 cm by 2100, depending on emission outcomes and geological conditions. Together with higher atmospheric CO2, higher sea temperatures and possible greater soil deposits from erosion, increases in infrastructure. As sea-levels are likely to continue to rise for centuries after stabilisation of greenhouse gas concentrations, coastal areas face a very long-term risk.

BIODIVERSITY

Natural systems can be especially vulnerable to climate change because of limited adaptive capacity³ and such changes maybe irreversible,⁵ particularly where there is a limited geographic or topographic range for species migration and where natural communities exist only in isolated remnants. Weed and pest invasion are further risks. Migratory birds may also be affected by changes to habitat systems. The significance of this situation is highlighted by the great biodiversity values of Western Australia.

PUBLIC AND PRIVATE INFRASTRUCTURE

Many building design standards are developed to cope with extreme demands anticipated on a locality⁶. However if extreme weather conditions spread beyond traditional areas, there could be significant consequences. The impact of extreme climate events, such as hail, floods, cyclones, and wildfire, is already very costly in Australia. Vulnerable infrastructure includes ports and coastal communities, highways, rail lines, roads, bridges and low-lying communities. Urban areas can be vulnerable to flooding from river systems

Australia's Greenhouse **Vulnerability:**

- IPCC s12.5.5 report 2 2001
- IPCC s12.4.2 report 2 2001
- ⁵ IPCC s12.6.1 report 2 2001
 ⁶ IPCC s12.6.1 report 2 2001

PART B - GREENHOUSE RESPONSE ACTION

94



Investigate and communicate potential climate change impacts

Western Australia is vulnerable to climate change in many ways.

Climate-dependent or natural resourcebased activities such as agriculture, aquaculture, tourism and forestry will be directly affected by changes to rainfall and temperature patterns and more frequent extreme weather.

Our infrastructure - such as water supply, sewerage, gas and electricity supply, housing and other buildings - could be damaged by water runoff or higher temperatures, or affected by changes to energy or water demand due to the increased heat.

Climate also affects the distribution of living organisms and could harm human health through the creation of suitable breeding areas for disease carrying insects, such as mosquitoes and pathogens. Human health may also suffer through the impacts of heat stress on vulnerable people such as the elderly. Rural and remote communities with limited communication and planning capacity could be especially vulnerable. The precise nature of these effects remains as uncertain as the climate changes projected to generate them. As better climate information becomes available from international, national or Western Australian research, the threats will become better defined.

All sectors of the State's community need information about potential impacts and how they can take personal or corporate responsibility to address likely risks. People need to take any potential hazards into account when forming plans or making decisions.

Action

5.3 Information about recent climate anomalies and new information about the potential effects of climate change will be provided to Parliament annually, publicised through meetings and seminars and maintained on the Western Australian greenhouse website.

Develop and implement adaptation strategies

Because climate changes are likely to occur even if global greenhouse emissions were reduced soon, adaptation strategies are required for community well-being and our most critically exposed industries and resources. There are several challenges to developing and implementing adaptation strategies.

- Climate change is only one of several environmental and economic stresses and opportunities facing Western Australia.
- The timing and nature of the regional and local impacts of climate change remain highly uncertain.
- The need to cope with climate change does not yet have wide community acceptance.
- The liability for losses arising from the effects of a changing climate is not yet clear.

The IPCC suggests that developing integrated regional response strategies is a useful mechanism for addressing climate change impacts. There is value in integrating climate change response consideration in regional sustainability strategies, which have been prepared under the implementation of the *Western Australian State Sustainability Strategy*.

Western Australia is already experiencing climate change with increasing temperatures, decreasing rainfall in the South-West and, in contrast, increasing rainfall in the northern regions of Western Australia. Determining strategies to manage the risks associated with climate change requires an improvement in both knowledge of drivers of Western Australia's climate and in the ability to predict future climate change, particularly at a regional or local scale. We then need

Native woylie, photo courtesy of Babs and Bert Wells, Department of Conservation and Land Management

Western Australia's vulnerability to climate change

The IPCC has declared 'regional changes in climate, particularly increases in temperature, have already affected diverse physical and biological systems in many parts of the world. Observed effects have included changes to plant and animal ranges, declines in some plant and animal populations, earlier tree flowering and the emergence of insects. The IPCC also noted that changes to



rainfall may also be important in some instances. The IPCC concluded '... from the collected evidence there is 67-95 per cent confidence that recent regional changes in temperature have had discernible impacts....'. The IPCC found there was emerging evidence that climate changes were affecting some social and economic systems, but recognised that determining precisely how was very difficult because of the complex factors involved.

Source: 'IPCC – Third Assessment Report – Climate Change 2001: Impacts, Adaptation and Vulnerability'

to be able to interpret this information so the many affected groups in society such as farmers, waste managers, coastal planners and developers, health officials and insurers can develop adaptation strategies to minimise the harm and realise opportunities brought about by climate change. Already very large investments are being made to secure water supplies in a drier climate.

To be prepared for climate change we need to both improve our abilities to predict future climate and to interpret this information to support decision-making. Using IOCI as a base institution we need to create a centre to acquire, integrate and make accessible the knowledge to underpin successful adaptation to a new climate.

Action

5.4 The Western Australian Government will build upon the IOCI to develop a centre of excellence in knowledge and expertise on climate change in Western Australia. The centre will develop strategies to successfully adapt to and mitigate the impacts of climate change.

The South-West of Western Australia is considered to be a region highly vulnerable to climate change. Following the significant reduction in rainfall since the mid 1970s, considerable climaterelated regional research has defined the changes experienced and has started to reveal some of the underlying causes,

including an apparent contribution from global climate change. During this period the region has adapted to lower water availability for communities, agriculture and industry and the environment has also been affected. While IOCI Stage Two climate research will help delineate the forces driving climate conditions in this region, future climate conditions remain speculative.

The South-West region has been recognised as a priority area for developing climate change strategies within Australia by the Australian Climate Change Adaptation Working Group. The Australian Greenhouse Office (AGO) and the Western Australian Government have agreed to cooperatively support the development of an integrated strategy for this region, both to provide a framework for adaptation there, but also to develop techniques for regional climate responses in other regions of Australia and overseas.

Action

5.5 An integrated global climate change impact and assessment strategy for the South-West of Western Australia will be prepared through collaborative action by the AGO, State Government entities, local governments, key stakeholders and the community.

Water supply and wastewater management is a large energy user and greenhouse gas producer. The objectives of the 2003 State Water Strategy are to make Western Australia one of the most water efficient communities in the world, reduce demand in all sectors by assisting installing efficient water use appliances, promoting water reuse especially in Perth, fostering innovation such as low water use plants, planning and developing new sources of water in a timely manner and protecting the value of our water resources.

Domestic water demand can be reduced by encouraging garden bores, restricting garden watering times, requiring water appliances to be efficient and sending price signals to large water users. New urban developments must follow Water Sensitive Urban Design criteria to ensure rainfall is cleaned in wetlands and infiltrated to ground water where possible rather than being channelled to drains which empty into waterways.

Regional Western Australia reuses about 40 per cent of all municipal wastewater but Perth reuses much less. The State Government has committed to achieving a 20 per cent reuse level statewide by 2012 to reduce the demands on potable supplies.

All these actions will be necessary to reduce water consumption and the energy required to provide it. Each alternative to water conservation, efficiency and reuse will require large amounts of energy.

Health

The IPCC suggests major challenges to Australia are 'border controls to prevent pathogen introduction, measures to ensure safe food and water, primary health care services that reach the most disadvantaged and vulnerable members of the community'7 and controlling the 'expansion and spread of climate responsive diseases already present, such as Ross River virus'.8 Heat stress could also affect the elderly.

Action

5.6 The Department of Health will aim to investigate the potential health impacts of projected climate conditions in Western Australia.

Water resources

Water resource planners and managers are leading Western Australia's actions on climate change research and response. The Water and Rivers Commission has revised water allocation plans and down-rated quantities available from dams and borefields. It has also closed some borefields to maintain water available for the environment. As a result the Western Australian Water Corporation has had to accelerate investigations into new water supply sources and bring forward programs of capital expenditure to harness new supply.

Action

- 5.7 The Western Australian Government will work with the community to ensure a sustainable water future for Western Australia by:
 - improving water use efficiency in all sectors;
 - achieving significant advances in water reuse;
 - fostering innovation and research;
 - planning and developing new sources of water in a timely manner; and
 - protecting the value of our water resources.

Agriculture and forestry

Agriculture and forestry have successfully adapted to climate change over the past 25 years, and might even benefit from some of the projected climate changes in Western Australia and overseas. Their success at adapting, however, requires an understanding of projected climate conditions and an integrated research and development capacity that delivers information about farm and plantation management options. The Department of Agriculture (DAWA) is active in research and providing extension/training to farmers in managing the risk of climate variability. DAWA is also involved nationally in reform of the Exceptional Circumstances Policy and the use of funding to encourage improved business risk management including that related to climate variability.

Actions

- 5.8 The Department of Agriculture will investigate possible changes in farming systems, crop production and financial *implications for projected climate* scenarios.
- 5.9 The Forest Products Commission will investigate a range of tree species for commercial plantations under projected climate conditions.
- 5.10 The Department of Agriculture will, in conjunction with industry research and development corporations, carry out research into improving climate forecasting and managing variation in climate between seasons.

⁸ IPCC s12.7.4 report 2 2001.

Fisheries

Very little is known about the likely long-term bio-physical changes to the State's marine environment. Likewise, little is known about any impacts changes to sea temperatures, or ocean currents and prevailing winds, might have on marine biota.

Action

5.11 The Department of Fisheries will monitor the impact of climate change on the State's marine environment.

Biodiversity

The potential impacts of climate change on biodiversity are poorly understood and are conditioned by the landscape. Better understanding of these impacts is essential for the formation of effective response strategies. Key issues for further research include:

- the relationship between climate and biodiversity;
- the impact of increased carbon dioxide on natural systems;
- the processes of coping with climate change in altered landscapes; and
- options for planned adaptation.

This research can be progressed through in-situ field investigation and integrated climate scenario modeling.

Actions

- 5.12 The Department of Conservation and Land Management will develop a climate change-biodiversity strategy.
- 5.13 The Department of Conservation and Land Management will undertake biodiversity response modeling to investigate the potential vulnerability of Western Australia's plants and animals to climate change.

Public and private infrastructure

Infrastructure needs to take account of projected climate impacts during its intended lifetime of 50 years or more. Professional bodies, such as engineers and planners, have been developing climate change response guidelines for more than a decade. Similarly, State Government planning bodies have integrated climate change impacts into their regional planning policies. However, further integration across disciplines and greater public awareness of these guidelines and policies is required. They also need to respond to the evolving knowledge.

Action

5.14 The Greenhouse Unit will involve professional bodies and industries in climate change seminars to ensure available information is as widely known as possible.

Greenhouse response actions

No.	Action	Responsible Department or Agency	Action timetable
5.1*	The Western Australian Government will support Stage Two of the IOCI program, a five year research partnership with the CSIRO and the Bureau of Meteorology.	IOCI Panel, DoE	2003-08
5.2*	Stage Two of the IOCI program will extend the climate research communication program to all affected sectors of the Western Australia community through more frequent publications and regular website updates.	IOCI Panel	Ongoing
5.3*	Information about recent climate anomalies and new information about the potential effects of climate change will be provided to Parliament annually, publicised through meetings and seminars and maintained on the Western Australian Greenhouse website.	Greenhouse Unit	Ongoing from 2005
5.4*	The Western Australian Government will build upon the Indian Ocean Climate Initiative (IOCI) to develop a centre of excellence in knowledge and expertise on climate change in Western Australia and in planning ways to successfully adapt to and mitigate the impacts of climate change.	Greenhouse Unit, IOCI Panel	Ongoing
5.5*	An integrated global climate change impact and assessment strategy for the South-West of Western Australia will be prepared through collaborative action by the Australian Greenhouse Office, State Government entities, local governments, stakeholders and the public.	CALM, Ago, DlgRD	From 2004-05
5.6*	The Department of Health will aim to investigate the potential health impacts of projected climate conditions in Western Australia.	Department of Health	2005-06
5.7	The Western Australian Government will work with the the community to ensure a sustainable water future for Western Australia,	DoE	Ongoing
5.8*	The Department of Agriculture will investigate possible changes in farming systems, crop production and financial implications for projected climate scenarios.	DAWA	2004-06
5.9	The Forests Products Commission will investigate a range of tree species for commercial plantations under projected climate conditions.	FPC	Ongoing
5.10	The Department of Agriculture will, in conjunction with industry programs, carry out research into improving climate forecasting and managing variation in climate between seasons.	DAWA	Ongoing
5.11	The Department of Fisheries will monitor the impact of climate change on the State's marine environment.	Fisheries WA	Ongoing
5.12*	The Department of Conservation and Land Management will develop a climate-biodiversity strategy.	CALM	2004-05
5.13*	The Department of Conservation and Land Management will undertake biodiversity response modeling to investigate the potential vulnerability of Western Australia's plants and animals to climate change.	CALM	2006
5.14*	The Greenhouse Unit will involve professional bodies and industries in climate change seminars to ensure available information is as widely known as possible.	Greenhouse Unit	Ongoing
New pr	norrams are indicated with an asterisk *		

CHAPTER 6 - WORKING WITH LOCAL GOVERNMENT AND THE COMMUNITY

WORKING WITH LOCAL GOVERNMENT AND THE COMMUNITY

CONTEXT

Effective local initiatives and individual decisions can have a fundamental impact on reducing greenhouse gas emissions. Local government has a critical leadership role in this area.

OBJECTIVE

To support the actions of local government and the community to deliver and implement effective greenhouse gas emission abatement programs and adaptation strategies.

BACKGROUND

Local government has considerable authority and influence on economic development, land use planning, transport planning, coastal management, street lighting and waste management. Through action on greenhouse abatement and impact planning, local governments can engage their communities in a shared learning process. Such corporate and community learning is the key to creating demand for lifestyles and economic opportunities in tune with the effects of climate change.

The Western Australian Government is committed to working in partnership with local governments so they can provide effective community leadership on greenhouse-related matters. Local government has already worked hard to build partnerships to achieve greenhouse abatement outcomes. With their communities, local governments are making significant investments (direct financial and in-kind) in combating greenhouse causes and impacts. These initiatives will also generate other community and environmental benefits, such as better air quality, water conservation, sustainable transport, less traffic congestion, more efficient energy use, biodiversity protection and local economic development and job creation.

Local Agenda 21

Agenda 21 (the Declaration on Environment and Development) was adopted in 1992 in Rio de Janeiro by more than 178 Governments. Local Agenda 21 (LA21) is the local expression of this Declaration, involving local government commitments to partnerships with their communities, non-government organisations, business and the education sector, and with national, State and Territory Governments.

Currently, 20 local governments in Western Australia have formally committed to sustainability and LA21 programs. Many others have informal commitments in place. Often, a commitment to address climate change issues has been a key driver for the broader adoption of sustainability principles. Pursuing greenhouse abatement with sustainability principles will open opportunities for simultaneously improving environmental, social and economic conditions.



Cities for Climate Protection

The Cities for Climate Protection (CCPTM) campaign established and facilitated by the International Council for Local Environmental Initiatives (ICLEI) helps local governments cut greenhouse gas emissions from their own operations and within their communities. The Commonwealth Government has assisted in the funding of CCP. To date, 32 local governments in Western Australia, covering 72 per cent of the State population, have joined CCP. They have committed to corporate and community emission reduction targets from 10-30 per cent over 10-15 years. Greenhouse gas abatement for all Western Australian local governments participating in the CCP campaign from 1999-2003 has been calculated to be in excess of 133,000 tonnes of CO₂ over the four year period¹.

The CCP campaign gives local governments a strategic milestone framework, helping them identify their area-specific greenhouse gas emissions. It helps them set reduction targets, and to develop and implement plans to reach them. Recommended actions focus on reducing emissions from local government (corporate) activities, and on helping the community to make more greenhousefriendly choices.

The CCP campaign is primarily concerned with urban local governments, with little focus on regional rural communities.

Local government (corporate) activity

Some local governments have retro-fitted existing corporate facilities or designed and constructed new corporate buildings to reduce energy use. Some have also specified energy and water efficient measures through new building project briefs to promote greenhouse gas emission abatement in the construction, use and disposal phases of new buildings. Some have constructed energy efficient demonstration buildings to increase public awareness of this type of design and construction. The City of Melville's Piney Lakes Centre is one such example, as is the Rockingham Environment Centre and the proposed Atwell South Community Centre.

Residential activity

Recent changes to the Building Code of Australia incorporating energy efficiency measures will mean further interaction between local governments, the community, the State Government and the residential building sector. Some local governments are already exploring the design and construction of sustainable houses as part of their broader environmental commitments. Examples include the Ellenbrook Eco Home, the Subiaco Sustainable Demonstration Home and the proposed demonstration house in the City of Mandurah, due to be completed in December 2004. Local governments are making significant investments in combating greenhouse causes and impacts

¹ From CCP Australia Measures Evaluation Report 4th Edition Nov 2003

The State-local government sustainability partnership agreement

Climate change is a core issue in sustainability. Protecting climate integrity on a global and regional basis is fundamental to sustainable development. With the September 2003 release of the *State Sustainability Strategy*, the Western Australian Government endorsed the establishment of a State - Local Government Sustainability Round Table to work through the Strategy and to develop a sustainability partnership agreement.

STRATEGIC DIRECTIONS

Strengthen the capacity of local government to respond to climate change

A significant number of local governments in Western Australia have already joined international and national greenhouse gas reduction initiatives. However many local governments located outside the Perth metropolitan area have found it difficult to participate in such programs.

In other jurisdictions, assistance programs that allocate funds to proposals which deliver the greatest reduction in emissions per dollar spent, have proven to be very effective on reducing greenhouse emissions.

Action

- 6.1 The State Government will seek to expand Commonwealth funding for the Cities for Climate Protection campaign to enable all local governments, including those in rural and regional areas, to participate in greenhouse initiatives.
- 6.2 The State Government will seek to establish a fund for cost effective abatement initiatives by local governments and community groups for greenhouse emission reduction projects.

Street lighting uses a large proportion of most of local government's energy consumption and generates significant greenhouse gas emissions.

Action

6.3 SEDO will work with the Western Australian Local Government Association (WALGA) and Western Power to identify and implement strategies to overcome barriers to improving the energy efficiency of street lighting. This could include the evaluation of street lighting trials, analysis of best available technologies and determination of institutional barriers to change.

Promote community information and awareness

Household activities are directly or indirectly responsible for producing almost 20 per cent of Australia's greenhouse gas emissions. An average household can save at least one tonne of greenhouse gases per year through basic changes to heating, cooling, lighting, refrigeration and hot water use. How people travel and manage waste can also help.

Effort by a well informed community, knowledgeable about the impact of consumer choices on climate change and aware of the many benefits from initiating greenhouse friendly actions is required to achieve reductions in household generated emissions.



Cool Communities

This program is a Commonwealth Government program delivered in partnership with non-government environment organisations from each State and Territory. It is designed to cut community greenhouse gas emissions by supporting householders to take simple, cost-effective actions to reduce their energy use.

Dr Cool-it

Initiated by the Eastern Metropolitan Regional Council, this project has a greenhouse consultant who visits homes in a specially equipped van to conduct home energy audits and to provide advice on products to reduce energy and water consumption.

Green Houses

This project, initiated by the Southern Metropolitan Regional Council in partnership with Murdoch University and partly funded by the Western Australian Government, focuses on behaviour change. The community is engaged in goal setting to reduce greenhouse emissions associated with energy use, water use and waste produced in the home. In March of 2004 the first stage of the Green Houses Pilot Program drew to a successful close. By attending either a community workshop or visiting the Green Houses website, participants in the pilot project learnt how to reduce their household's energy consumption. In the first five months of the pilot project the 100 participants saved 53.5 tonnes of

CO₂ equivalents. Visit http://www.smrc.com.au/greenhouses for further details on Green Houses and their successful pilot project.

Greenskills

This South-West community-based environment organisation promotes energy conservation and efficiency.

The Warren Districts Renewable Energy Group

This Group promotes community involvement in greenhouse initiatives by identifying and supporting local greenhouse 'champions' in each town. The Group is planning self audits and promotes recycling, more efficient transport, hot water boiler blankets, pipe lagging and switching to gas heating. It also wants to build on *Cool Communities* to develop fuel switching industries.

Switch your thinking!

Switch your thinking! is a campaign that aims to engage the community's participation in a series of actions to reduce greenhouse gas emissions in the south-east region of the Perth metropolitan area. The Cities of Gosnells and Armadale and the Shire of Serpentine-Jarrahdale are working towards a community greenhouse gas emissions reduction target of 15 per cent by the year 2010. Further information on this program can be found at www.switchyourthinking.com.



Photo courtesy of Sustaina Energy Development Off Local government has the capacity to achieve significant outcomes from local and direct action

Western Australian Government support for community awareness

The Western Australian Government provides services and tools to the community to promote climate change awareness and knowledge. It points to opportunities available to individuals and the community to reduce their greenhouse emissions.

The Western Australian Greenhouse website (www.greenhouse.wa.gov.au) provides core state-based materials about climate change and links to relevant science, technology and policy information. This site is an excellent starting point for school students and others seeking to learn what is known and uncertain about greenhouse, the views of various organisations and experts, and international agreements.

Action

6.4 The Western Australian Greenhouse website will be continually updated and upgraded.

<u>AirWatch</u>

AirWatch is a comprehensive national air quality program that examines the causes and effects of air pollution and investigates social aspects such as attitudes and behaviour towards improving air quality in our communities. More than 450 schools are involved on *AirWatch* WA.

The program educates primary and high school students through curriculumlinked activities, experiments and air quality monitoring activities using scientific equipment, to highlight the impact that an individual's actions have on their environment.

Along with air quality monitoring to illustrate the problem, students learn about issues such as traffic flow, wood heaters and public transport to explain the air quality in our city. Results are then kept in a national database, allowing students to communicate with scientists and other students around Australia. Students can also enter their data results on the *AirWatch* homepage to build up a picture of local air quality.

For more information visit the website http://www.airwatch.gov.au/.

104



Greenhouse response actions

No.	Action	Responsible Department or agency	Action timetable
		on DLGRD	2004-07
		DLGRD	2004-07

PART B - GREENHOUSE RESPONSE ACTION

106

RESEARCH

CONTEXT

Global climate change presents Western Australia with challenges that are uncertain in nature and timing and different from any experienced in recorded history.

OBJECTIVE

To ensure Government, the community and industry have the information necessary to support effective actions to reduce Western Australia's contribution to global climate change and address opportunities and threats arising from it.

BACKGROUND

Almost two centuries ago the Industrial Revolution signalled human's ability to harness the energy contained in fossil fuels. Since this period anthropogenic greenhouse gas emissions have steadily increased, fuelling global climate change to the point where scientists now suggest that even if greenhouse gas emissions decreased dramatically within the next 10 years, the climate would continue to change for a century.

Good information will be critical for Western Australia to effectively and efficiently form and implement climate change response strategies.

For Western Australia, climate change will present both risks and opportunities. To be in a position to take advantage of opportunities and to meet unavoidable risks, we must use available information and generate further information where necessary to form realistic and effective actions.

Many issues, such as reducing emissions from electricity generation or improving domestic or transport energy efficiency, can be substantially informed from interstate and overseas research as well as local knowledge and innovation. Some issues, such as maintaining Western Australia's biodiversity, agriculture, forestry and fisheries, require detailed local knowledge and information.

STRATEGIC DIRECTIONS FOR RESEARCH

Information management and research initiatives are fundamental to this Strategy. This section brings those activities together in themes and outlines how ongoing information management research will be coordinated. Further information about current and proposed research activities is provided in the relevant sections.
Photo courtesy of Department of Agriculture

Good information will be critical for WA to effectively form and implement climate change response strategies

Climate change monitoring, analysis, and modeling

Effective climate change impact and mitigation strategies require sound climate change monitoring, analysis, and modeling. Research on regional climate needs to address the following questions:

- How is Western Australia's climate changing in relation to historical and pre-historical conditions?
- How much recent and emerging climate change can be attributed to natural variability?
- What are the indicators of a changing climate, and how should they be measured and monitored?
- What climatic scenarios should be used for short, medium and long term planning purposes?
- What will be the frequency and severity of future extreme events?
- What abrupt climate changes could occur?

Many of the questions will be addressed by Stage Two of the Indian Ocean Climate Initiative (IOCI) which will improve our knowledge about the forces underlying Western Australia's climate conditions, variability and change. It will be important to build on this research program as it generates further climate knowledge. Refer to Part B, Chapter 5, for further information.

Responding to climate change

This Strategy is predicated on a philosophy of 'informed adaptation', which in itself is based on a recognition that our actions can become more focused and effective as we learn more about the issues we are seeking to manage. Research on responding to climate change needs to address the following questions:

- What elements of Western Australia's industries, environment and social well-being are likely to be most severely affected by climate change?
- To what extent could these elements successfully adapt to changed climate conditions?
- What strategies are available to safeguard values that are at risk of climate change?

This Strategy proposes actions to investigate risks to agriculture, forestry and biodiversity and potential adaptation responses. As more is known about future climate scenarios, further research will be required into potential risks for health, tourism, coastal areas and infrastructure. Refer to Part B, Chapter 5, for further information. Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Bureau of Meteorology are recognised as major global climate research organisations.

Research by the CSIRO and other similar groups overseas is improving our capacity to understand the causes and implications of global climate change. We will need to continue our climate research and analysis to develop the information required to form and implement effective regional adaptation strategies and efficient emission reduction strategies.

The information we require includes:

- the relationship between global climate models and regional and local climate forecasting;
- future levels of greenhouse gas emissions;
- whether climate impacts are incremental or abrupt; and
- how to distinguish between natural climate variability and human induced climate change.



Carbon sequestration

Organic and geological carbon sequestration activities raise important technical and policy issues, many of which are still unresolved:

- How much carbon can be sequestered in different types of sinks, and at what relative cost?
- What areas are best for carbon sequestration?
- What are the options for long-term monitoring of sequestered carbon?
- What are the potential social, economic and environmental impacts and risks associated with carbon sequestration activities?
- How could long-term liability for geological carbon sequestration be addressed?
- How can other benefits from organic carbon sequestration be promoted?

Issues associated with organic sequestration in plantations have been relatively well considered over the past decade, but further research on other organic sequestration options is outlined in Part B Chapter 3.1. Photo courtesy of Tourism Western Australia

Increased research into geological sequestration is being undertaken within Western Australia, Australia and overseas to provide information about this sequestration option. Critical geological sequestration questions are defined in Part B Chapter 3.2.

Developing and promoting good agricultural practice guidelines

Our capacity to develop cost-effective emission reduction actions for the agricultural sector is constrained by a lack of good information about baseline emissions. Some of the critical research questions are:

- How can agricultural nitrous oxide emissions be measured and reduced?
- How can livestock methane emissions be reduced?

This Strategy contains research actions designed to improve baseline greenhouse emission data for agricultural activities. Refer to Part B, Chapter 2.5, for further details on Strategy response actions related to agricultural emissions.

No.	Action	Responsible Department or Agency	Action timetable
7.1*	The Greenhouse Unit will monitor international, national and Western Australian climate research and		
	recommend further research activities where these will	Greenhouse	
	enhance the State's capacity to effectively respond to	Unit,	
	climate change.	IOCI Panel	Ongoing

Future research activities and information sharing

As Western Australia receives information generated by current and proposed greenhouse-related research outlined above, further information and knowledge gaps will become apparent. The State will benefit from an ongoing focus on ensuring the availability of information required for effective climate responses. Future information management options should include mechanisms for information generated by the public to be included in the common information base.

Action

7.1 The Greenhouse Unit will monitor international, national and Western Australian climate research and recommend further research activities where these will enhance the State's capacity to effectively respond to climate change. Organic carbon sequestration needs to deliver natural resource and biodiversity benefits

CHAPTER 7 - RESEARCH

CHAPTER 8 - REPRESENTING WESTERN AUSTRALIA'S INTERESTS NATIONALLY AND INTERNATIONALLY

REPRESENTING WESTERN AUSTRALIA'S INTERESTS NATIONALLY AND INTERNATIONALLY

CONTEXT

- Global responses to the enhanced greenhouse effect are guided by international agreements, such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, which were developed through negotiations with many nations including Australia. Australia has also established bilateral arrangements with countries including the United States, New Zealand, China and Japan.
- Australia's international commitments will affect our national and State responses to climate change.

OBJECTIVE

• To ensure that Western Australia's circumstances are recognised when international agreements and national strategies are formed and implemented.

BACKGROUND

The UNFCCC and the Kyoto Protocol guide cooperative international responses to global climate change, as outlined in Part A. Australia argued strongly and successfully that our nation's economic and industrial circumstances should be recognised when emission targets were determined for the first Kyoto Protocol reporting period (2008–12) as Australia's greenhouse emission commitments are substantially different from those of other major developed nations. Western Australia's circumstances are also unique.

- A significant proportion of the State's electricity generation has changed to natural gas from coal.
- Broadscale land clearing has been significantly reduced since 1988.
- There are huge opportunities for organic carbon sequestration on cleared agricultural lands and on degraded woodlands and pastoral lands.
- Massive hydrocarbon-based industries are being developed and proposed.
- Western Australia's gas resources can reduce emissions where they replace coal or oil.

Much of this Strategy is concerned with contributing and responding to international and national issues and agreements. Throughout this Strategy, actions have been identified that will help ensure Western Australia can effectively advocate for international and national arrangements which recognise the State's circumstances. Several further initiatives will enhance this capacity.

The establishment of a Greenhouse Unit (Action 1.1) will enable Western Australia to develop integrated policy advice and coordinate the implementation of this Strategy. The Greenhouse Unit will also help ensure the Western Australian Government, industry and community are aware of emerging climate change issues and initiatives and can contribute to related State policy positions.

Other initiatives will significantly improve the capacity of Western Australia to form and promote effective greenhouse policy outcomes.

STRATEGIC DIRECTIONS Meeting Australia's Kyoto targets

Although the Federal Government has indicated that Australia will meet its target for the first reporting period, it has not revealed its view about how these targets are to be achieved. At the same time, Australia continues to increase exports of fossil fuels, fossil fuel-related materials and fossil fuel-derived materials and other energy-intensive industries increase their production and export activities.

Western Australia is vulnerable to inappropriate national policies and decisions about how Australia's net greenhouse emissions are to be limited and reduced. It is important that the State be well represented where national policies and decisions are being created.

Action

8.1 The Greenhouse Unit will coordinate the development of Western Australia's greenhouse emission abatement and adaptation policies in consultation with the Western Australian Government, industry and the community.

International agreements for the 2008–12 period and for action after 2012

The level of international activity seeking solutions to greenhouse questions is certain to remain high. Western Australia needs to maintain a close understanding of the international context as it evolves over the coming years. We also need to develop appropriate policy responses and advocate them effectively to the Commonwealth and internationally through the Commonwealth or through regional or bilateral partnerships.

8.2 The Greenhouse Unit will monitor emerging trends in international climate change policy and develop and promote policies supporting Western Australia's interests, through interaction with the Commonwealth, industry and the community. The Western Australian Greenhouse Unit will ensure effective policy and advocacy 111



Bilateral and multilateral collaboration between Australia and other nations

The Commonwealth Government has established a bilateral climate change collaboration with the United States of America relating to research, reporting methodologies and other matters. Other bilateral and multilateral arrangements are being developed in relation to geosequestration and other specific issues. Such cooperative activities are more likely to deliver useful outcomes for Western Australia if our particular needs are understood and communicated.

8.3 The Greenhouse Unit will promote Western Australia's research and management priorities in existing and evolving national and international arrangements.

Whole of Government approach

National polices and programs are being developed incorporating both short-term undertakings and initiatives designed to shape the country's emissions profile during the next 20 to 30 years. Over the longer term, emissions abatement on the scale thought to be necessary is likely to generate significant challenges for the State's economy. Rigorous whole of Government policy development and thorough planning will be necessary to ensure Western Australia's interests and possible opportunities are recognised and promoted.

- 8.4 The Greenhouse Unit will aim to facilitate a whole of Government position on greenhouse and climate change issues, taking into account broad public debate, and use this to influence relevant national policies and programs.
- 8.5 The Greenhouse Unit will advocate the development of genuine national consultation between the Commonwealth and the States and Territories in the development of greenhouse policies, strategies and actions for Australia.

Photo courtesy of lourism western Australi

Bilateral agreements between Western Australia and other States

While Western Australia's circumstances are unique, the State does share some important concerns and opportunities with other sub-national jurisdictions, both within Australia and overseas. Western Australia is already a member of an international sustainability partnership, involving states from European and American nations. Developing bilateral agreements or partnerships on greenhouse related matters would enhance our capacity to advocate for appropriate positions in international negotiations through our national governments. Similarly, Western Australia will be better able to negotiate effective national policy with the Commonwealth where the States and Territories act in concert. Such arrangements might also lead to more effective research or adaptation initiatives.

8.6 Western Australia will aim to establish bilateral agreements with Australian and overseas jurisdictions where these will help this State achieve its greenhouse objectives.

113

Greenhouse response actions

No.	Action	Responsible Department or Agency	Action timetable
8.1*	The Greenhouse Unit will coordinate the development of Western Australia's greenhouse emission abatement and adaptation policies in consultation with Government, industry and the community.	Greenhouse Unit	Ongoing
8.2*	The Greenhouse Unit will monitor emerging trends in international climate change policy and will develop and promote policies supporting Western Australia's interests, through interaction with the Commonwealth, industry and the community.	Greenhouse Unit	Ongoing
8.3*	The Greenhouse Unit will promote Western Australia's research and management priorities in existing and evolving national and international arrangements.	Greenhouse Unit, Office of Science and Innovation	Ongoing
8.4*	The Greenhouse Unit will aim to facilitate a whole of Government position on greenhouse and climate change issues, taking into account broad public debate, and use this to influence relevant national policies and programs.	Greenhouse Unit	Ongoing
8.5*	The Greenhouse Unit will advocate the development of genuine national consultation between the Commonwealth and the States and Territories in the development of forward greenhouse policies, strategies and actions for Australia.	Greenhouse Unit	Ongoing
8.6*	Western Australia will aim to establish bilateral agreements with Australian and overseas jurisdictions where these will help this State achieve its greenhouse objectives.	Greenhouse Unit	Ongoing
New pr	ograms are indicated with an asterisk *		

REFERENCES AND FURTHER READING

REFERENCES AND FURTHER READING

ACIL Tasman (2004), Greenhouse Gas Abatement - Impacts on Western Australian industry and industrial development, http://www.greenhouse.wa.gov.au

AGO (1998), The National Greenhouse Strategy - Strategic Framework for Advancing Australia's Greenhouse Response, http://www.greenhouse.gov.au/pubs/ngs/pubs/ngs.pdf

AGO (1998), Australia's State and Territory Greenhouse Gas Inventory 1990 and 1995 - Western Australia (National Greenhouse Gas Inventory Committee), http://www.greenhouse.gov.au/inventory/stateinv/pubs/wa/wa95.pdf

AGO (2002), Australia's Third National Communication on Climate Change - A Report under the United National Framework Convention on Climate Change, http://www.greenhouse.gov.au/international/third-comm/pubs/third-comm.pdf

AGO (2002), Australia's National Greenhouse Inventory Report 2002 (National Greenhouse Gas Inventory Committee), http://greenhouse.gov.au/inventory/2002/index.html

Alan Pears, Sustainable Solutions (1998), Rating Energy Efficiency of Non-Residential Buildings: A path forward for New South Wales

AGO (1997), Safeguarding the future: Australia's response to climate change, http://greenhouse.gov.au/ago/safeguarding.html

Allen Consulting Group (2003), Meeting the Kyoto Targets: Impact on the Western Australian Economy.

Cabinet Office of NSW (2003), Report of the Kyoto Protocol Ratification Group - A Risk Assessment, http://www.cabinet.nsw.gov.au/pdfs/kyoto.pdf

CSIRO (2001), Climate Change Projections for Australia, http://www.dar.csiro.au/publications/projections2001.pdf

DAWA (2002), Greenhouse, Land Management and Carbon Sequestration in Western Australia, http://www.agric.wa.gov.au

Energy Efficiency Victoria (2000), Building Energy Brief for Commercial and Public Buildings.

EPA (2002), Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986) No. 12 October 2002 Guidance Statement for Minimising Greenhouse Gas Emissions, http://www.epa.wa.gov.au/docs/1016_GS1202.pdf

IPCC (2001), IPCC Third Assessment Report - Climate Change 2001; Impacts, Adaptation and Vulnerability, http://www.ipcc.ch/

Mandyczewsky, R. Dr, (2004) Western Australian Renewable Energy Projects, Estimates of Greenhouse Benefits.

Western Australian Government Delegation to Europe and North America (2004), Geo-sequestration of Carbon Dioxide – Key Technical, Legislative and Policy Issues.

World Wide Web

Australian Greenhouse Office website - http://www.greenhouse.gov.au/

IPCC (2003), presentations and graphics website - http://www.ipcc.ch/present/present.htm

Sustainable Energy Authority Victoria and Sustainable Energy Development Authority NSW website - http://www.greenhousegases.gov.au/ Victorian Greenhouse website - http://www.greenhouse.vic.gov.au/

ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS

ABGR	Australian Building Greenhouse Rating	DOIR	Depai and R
ACRE	Australian Cooperative Research Centre for Renewable	DPC	Depar and C
AGO	Energy Australian Greenhouse Office	DPI	Depar Infrast
APPEA	Australian Petroleum Production and Exploration	DTF	Depar and Fi
DCA	Association Limited	EPA	Enviro
CALM	Department of Conservation and Land Management	FESA	Fire an Autho
CCP™	Cities for Climate Protection	FPC	Forest
CFCs	Chlorofluorocarbons	GDP	Gross
CNG	Compressed natural gas	HIA	Housi
COAG	Council of Australian	ΙΟΟΙ	Indiar
	Governments	IPCC	Interg
CO2	Carbon dioxide		Clima
CRC	Cooperative Research Centre	LA21	Local
CSIRO	Commonwealth Scientific and	LNG	Liquic
	Industrial Research	LPG	Lique
CSLE	Carbon Sequestration	LUC&F	Land
5	Leadership Forum	LULUC&F	Land and fo
DAWA	Department of Agriculture	MBA	Maste
DHW	Department of Housing and Works	MRET	Mand
DLGRD	Department of Local		Energ
	Development	NAEEEC	Natio
DoCEP	Department of Consumer and Employment Protection		Equip Comr
DoE	Department of Environment	NAFA	North Abate

DOIR	Department of Industry and Resources
DPC	Department of the Premier and Cabinet
DPI	Department for Planning and Infrastructure
DTF	Department of Treasury and Finance
EPA	Environmental Protection Authority
FESA	Fire and Emergency Services Authority
FPC	Forests Products Commission
GDP	Gross domestic product
HIA	Housing Industry Association
ΙΟΟΙ	Indian Ocean Climate Initiative
IPCC	Intergovernmental Panel on Climate Change
LA21	Local Agenda 21
lng	Liquid natural gas
LPG	Liquefied petroleum gas
LUC&F	Land use change and forestry
luluc&f	Land use, land use change and forestry
MBA	Master Builders Association
MRET	Mandatory Renewable Energy Target
NAEEEC	National Appliance and Equipment Energy Efficiency Committee
NAFA	Northern Australian Fire Abatement (NAFA)

NAP	National Action Plan for Salinity and Water Quality
NatHERS	Nationwide House and Energy Rating Scheme
NGGI	National Greenhouse Gas Inventory
NGS	National Greenhouse Strategy
NPI	National Pollutant Inventory
NRM	Natural resource management
OoE	Office of Energy
ppm	parts per million
ΡΤΑ	Public Transport Authority
RECs	Renewable Energy Certificates
RRG	Carbon Dioxide Geosequestration Regulatory Reference Group
RRPGP	Renewable Remote Power Generation Program
SEDO	Sustainable Energy Development Office
STEP	Sustainable Transport Energy Program
TDM	Travel demand management
TIAC	Technology and Industry Advisory Council
UNFCCC	United Nations Framework Convention on Climate Change
WALGA	Western Australian Local Government Association
WAPC	Western Australian Planning Commission



MEMBERS OF THE GREENHOUSE TASK FORCE

- Mr Francis Logan MLA, Chair
- Ms Louise Pratt, MLC
- Office of the Minister for the Environment
- Office of the Minister for State Development
- Office of the Minister for Agriculture, Forestry and Fisheries
- Office of the Minister for Local Government and Regional Development
- Department of the Premier and Cabinet
- Department of Agriculture
- Department for Planning and Infrastructure
- Office of Energy
- Department of Treasury and Finance
- Department of Environment
- Department of Conservation and Land Management

FURTHER INFORMATION

For further information on the *Western Australian Greenhouse Strategy* and related issues, please contact the Western Australian Greenhouse Unit:

Email Address:	info@greenhouse.wa.gov.au
Telephone:	(08) 9222 9438
Facsimile:	(08) 9222 9509
Mail Address:	Western Australian Greenhouse Unit Department of the Premier and Cabinet 197 St Georges Terrace PERTH WA 6000

A copy of this document can be viewed at www.greenhouse.wa.gov.au

PRINTED ON RECYCLED PAPER