

# ACT State of the Environment Report 2011

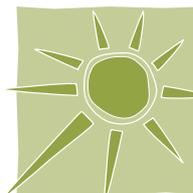
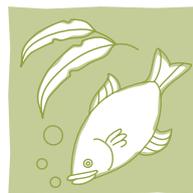
## Volume 3

Theme and Indicator Cluster papers:

- Climate
- People



Office of the Commissioner for  
Sustainability and the Environment



©ACT Government 2011  
ISBN 978 0 642 60575 7

ACT Government publication number: 11/1704

Published by the Office of the Commissioner for Sustainability and the Environment,  
Canberra

This work is copyright. It may be reproduced in part or whole for study or training purposes subject to an inclusion of an acknowledgment of the source and no commercial usage or sale. Reproduction for purposes other than those listed above requires the written permission of the Office of the Commissioner for Sustainability and the Environment, PO Box 356 Dickson ACT 2602

Office of the Commissioner for Sustainability and the Environment

PO Box 356 Dickson ACT 2602  
Telephone: 02 6207 2626  
Facsimile: 02 6207 2630  
Email: [envcomm@act.gov.au](mailto:envcomm@act.gov.au)  
Web: [envcomm.act.gov.au](http://envcomm.act.gov.au)

**Citation**

Commissioner for Sustainability and the Environment (2011), *ACT State of the Environment Report 2011*. ACT Government. Canberra.

# ACT State of the Environment Report 2011

## Contents

### Volume 1

#### Overarching papers

<b>Executive Summary</b> .....	i
<b>Acknowledgements</b> .....	xxxiii
<b>Headline Indicators</b> .....	1-3
<b>Progressing Sustainability</b> .....	4-19
<b>Sustainability Stories</b> (12 Stories) .....	20-32
<b>Driving Forces</b> .....	32-49

#### Appendix: Expert papers

- ◆ 2008-09 ACT Ecological Footprint
- ◆ Canberra's Ecological Footprint: What does it mean?
- ◆ Buying Choices for a More Sustainable Canberra
- ◆ Exploring Individual Values and Attitudes for a More Sustainable Canberra
- ◆ Horizon Scan: Issues for Future Sustainability and Environmental Management in the ACT & Region
- ◆ Weather and climate of the ACT 2007-11 and Decadal Trends

### Volume 2

#### Land & Water, Biodiversity and Air Theme and Indicator Cluster papers

##### Land and Water Theme

Theme paper .....	50
Land Health .....	64
Rivers Lakes and Wetland Health .....	84
Water Quality .....	126
Water Supply .....	146
Groundwater .....	170

# ACT State of the Environment Report 2011

## Biodiversity Theme

Theme Paper .....	179
Flora .....	195
Fauna.....	209
Ecological Communities.....	245
Threatening Processes .....	275

## Air Theme

Theme Paper .....	320
Local Air Quality .....	327
Indoor Air Quality.....	346

## Volume 3

### Climate and People Theme and Indicator Cluster papers

#### Climate Theme

Theme Paper .....	353
Emissions.....	367
Mitigation.....	382
Climate Vulnerability.....	403
Adaptation .....	416
Climate as a Resource .....	426

#### People Theme

Theme paper .....	438
Urban Quality.....	463
Transport.....	492
Waste .....	520
Heritage.....	546
Natural Hazards .....	558
Community Engagement .....	578

# ACT State of the Environment Report 2011

## THEME: Climate

### Introduction to theme

Human use of resources has changed our climate and will continue to do so. However, not all climatic variability and severe weather events can be attributed to human actions. Nevertheless, there is strong scientific evidence that humans are changing the climate and we need to take action to address this situation.

The ACT Government has committed to respond to the climate change challenge through two main approaches: mitigation to reduce future emissions of greenhouse gases (by both reducing the sources of greenhouse gas emissions and enhancing sinks that store carbon); and adaptation to the expected changes, to moderate potential damage and to benefit from opportunities. Adaptation and mitigation actions can differ significantly, but they need to be aligned and actively supported by business and the wider community if they are to achieve an overall effective response to climate change.

Five Indicator clusters are drawn on for the *Climate* theme:

- Emissions;
- Mitigation;
- Climate vulnerability;
- Adaptation; and
- Climate as a resource.

### Context

Only greenhouse gas emissions levels and energy use have been reported in previous State of the Environment Reports. Across the last two reporting period, while recommendations regarding the implementation of climate change strategies have been largely implemented, greenhouse gas emissions and energy use have continued to rise. Despite increases in GreenPower usage, it remains less than 5% of ACT energy use.

This issue remains relevant in this reporting period and recommendations are provided at the end of this paper to assist progress on both mitigation and adaptation actions.

### Theme summary: Key issues and outcomes

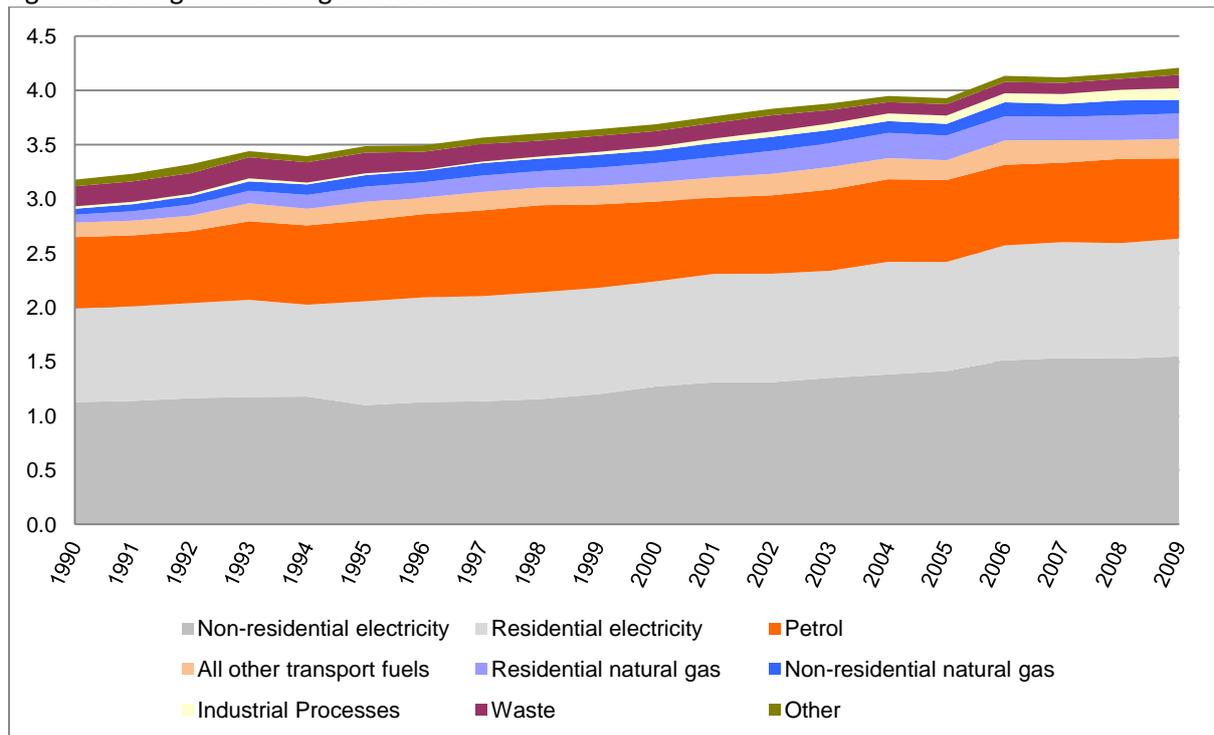
Atmospheric concentrations of global greenhouse gases are increasing globally at an unprecedented rate. Atmospheric carbon dioxide concentrations have never increased by

# ACT State of the Environment Report 2011

more than 30 parts per million (ppm) over a 1000 year period according to studies, yet that is the rate of increase that has been observed over the 17 years to 2007 (IPCC 2007).

This global increase in greenhouse gas concentrations has been paralleled in the ACT, where calculated long-term trends indicate a continuing increase in our greenhouse emissions (Figure 1).

Figure 1: ACT greenhouse gas emissions



Source: ICRC 2011.

Electricity produced from burning fossil fuels is the largest contributor to ACT greenhouse gas emissions, followed by use of petrol (Figure 2). The ACT imports and consumes goods and services produced by transport through other states, and electricity generated elsewhere provides most of the stationary energy used within the ACT. The ACT Government has accepted accountability for emissions generated from those external sources. It is clear that significant emission reduction efforts need to focus on these sectors if the ACT is to meet the Government’s greenhouse gas reduction target of zero net emissions by 2060 without being heavily reliant on offset strategies.

## Climate vulnerability

In the coming decades impacts from climate change are likely to become increasingly prevalent in the ACT. The most likely future climate scenario for the ACT includes (Webb 2011):

# ACT State of the Environment Report 2011

- the strong likelihood of mean temperatures continuing to increase, along with more frequent and severe heatwaves for the ACT and region; and
- a high probability of changes in the pattern of rainfall from that observed during the period of instrumental records, with some risk of a decline in long-term average rainfall; and in addition, the likelihood of an increase in rainfall intensity with more extreme rainfall events.

Small changes in average values of climate characteristics such as air temperature and rainfall can lead to large changes in the frequency and intensity of extreme events such as heatwaves, storms and fires.

Climate change is likely to put additional pressure on the Territory's water resources and biodiversity, and may significantly change the patterns of bushfire and extreme weather events. These in turn will have impacts on our health, biodiversity and food availability as well as other indirect impacts on our society.

## **Water resources**

Water security has been, and will continue to be the key water issue facing the ACT. There is increasing pressure on the Territory's three main catchment areas because the water supply is almost entirely rainfall dependent. Changes to rainfall patterns since the 1990s have resulted in a decrease in surface runoff feeding the ACT's supply reservoirs. Projections indicate the trend towards warmer conditions in the ACT will almost surely continue, coupled with a risk of continuing drier conditions, although there is much uncertainty surrounding rainfall projections.

## **Bushfires**

The risks of bushfires and the number of days of high fire danger are predicted to increase as a result of the projected hotter and drier conditions. Many ACT residents live on the border of, or close to, bushland, putting them at increased risk of being affected by bushfire. Changes to fire risk may also affect our biodiversity through changes to species distribution and populations (Webb 2011).

# ACT State of the Environment Report 2011

## Extreme heat events

The average number of days above 35°C and 40°C is also expected to increase (Table 1).

Table 1: Mean annual number of days above 35°C or above 40°C in 2050 if there is a 2°C global warming

	Current climate*	Most likely future climate	Worst case scenario
Mean annual number of days above 35°C	5 days	20 days	21.5 days
Mean annual number of days above 40°C	Around 0.1 day	2 days	2.7 days

Source: AECOM 2010

\*Note: The “current climate” annual number of days >35°C and >40°C is the 1939-2010 mean for Canberra Airport

Increases in average temperatures and heatwaves increase the consumption of potable water, placing additional pressure on our water resources. Heatwaves can exacerbate existing health vulnerabilities. The greatest threat from heatwaves arises when there are consecutive days that are much hotter than usual, with hot nights, occurring early in the summer period (McInnes et al. 2008).

## Renewable energy in the region

The ACT has the opportunity to take a regional approach to planning for climate change, and for using climate as a resource. The Australian Capital Region (which comprises the ACT and 17 nearby local government areas in NSW) has significant potential for solar, hydro- and particularly wind-generation of power. Much of the region experiences high wind-speeds that cannot often be matched within the ACT itself. A number of renewable energy power stations, particularly using the wind, have been developed across the Australian Capital Region during the reporting period, and the construction of a number of further stations is either approved or underway (NSW Planning and Infrastructure 2011).

The level of solar radiation in the ACT area means that around 0.6 hectares of solar cells would produce enough electricity to meet the yearly demand of a small office building<sup>1</sup>. The close proximity of the city centre to potential large-scale solar-power generation sites is an advantage for Canberra compared to other capitals, because transmission losses would be minimised.

---

<sup>1</sup> Based on an ACT building with 2000 m<sup>2</sup> of office area and a 3-star NABERS energy rating

# ACT State of the Environment Report 2011

The ACT Government has encouraged expansion of the solar industry in the ACT through a feed-in tariff scheme to encourage micro- and medium-scale generation of solar energy. The tariff is designed to encourage investment in renewable electricity generation by paying small-scale generators a premium rate for the gross amount of electricity they generate (Engineers Australia 2009). The popularity of this scheme indicates the ACT's support for renewable energy options. However, a recent report by the Grattan Institute found that rebate programs such as this have lifted sales in some products, while only reducing emissions a little and expending large amounts of government money. Further, the resulting boom-bust cycles can disrupt development of industry capacity and undermine investor confidence (Grattan Institute 2010). Although the feed-in tariff is not government-funded, the benefits to emission reduction as well as the benefits to the renewable energy industry should be assessed before future renewable energy policy initiatives are approved.



Source: ACT Government

The ACT Government has also been exploring opportunities for a solar power facility in the ACT. The Government's current position is that any such facility will be privately developed. Those proponents interested in establishing large-scale renewable energy facilities in the ACT can bid for access to a feed-in tariff for a total of up to 40 MW. Bidders will be responsible for financing, constructing, owning and operating any proposed facility. Under this arrangement the ACT Government will be responsible for developing appropriate legislation to provide a supported price payment for generated electricity.

Community groups in the ACT are also increasingly focused on climate change; for instance, SEE-Change and Canberra ♥ 40% are taking on community leadership in solar energy and emission reduction activities.

# ACT State of the Environment Report 2011

## Responses and effectiveness

### Mitigation

In 2010, the ACT Government legislated the following targets to reduce greenhouse gas emissions in the ACT (ACT Government 2010):

- 40% below 1990 emissions by 30 June 2020;
- 80% below 1990 emissions by 30 June 2050; and
- 0 net emissions by 2060.

In May 2011, the ACT Government also legislated the following renewable energy targets for the ACT (ACT Government 2010): renewable sources to provide:

- 15% of total electricity usage by 2012; and
- 25% of total electricity usage by 2020.

To date, no pathway for reaching these targets has been set out. The second action plan under *Weathering the Change* - the ACT climate change strategy, is currently being developed and is expected to outline this path. The targets are ambitious, and significant action and behaviour change will be needed to reach them.

Latest figures indicate that ACT greenhouse gas emissions continue to rise (ICRC 2011). Over 90% of electricity sold in the ACT is still sourced from non-renewable energy sources (ICRC 2011, ORER 2011), from beyond the ACT border. Less than 5% of ACT energy use comes from GreenPower, which is renewable energy purchased voluntarily by households, businesses and other organisations (ICRC 2011). To reduce emissions from use of fuels in transport, the ACT Government has set targets to encourage people to change their mode of travel for work trips. Even if the ACT is on track to achieve the targets, greenhouse gas emissions from the transport sector are still projected to increase to 50-60% above the emissions in 1990 from this sector by 2020 (ICRC 2011, Heuris Partners 2010)<sup>2</sup>. This suggests that transport policy will have to be seriously reassessed if offsetting and disproportionate emissions reductions in other sectors are to be avoided.

In 2007 the ACT Government committed to achieving carbon neutrality in its own buildings and services. It is of concern that the framework for achieving this target is not expected to be released until 2012, four years after the commitment was made. ACT Government

---

<sup>2</sup> Calculations based on ICRC transport emissions data from the 2009 Greenhouse Gas Emissions Inventory (ICRC 2011) and ACT Government-commissioned research into existing policy baseline projections to 2050 (Heuris Partners 2010), as well as estimates of a 3% reduction based on changes in mode of work transport detailed in the *Draft Sustainable Energy Policy 2010-2020* (DECCEW 2011).

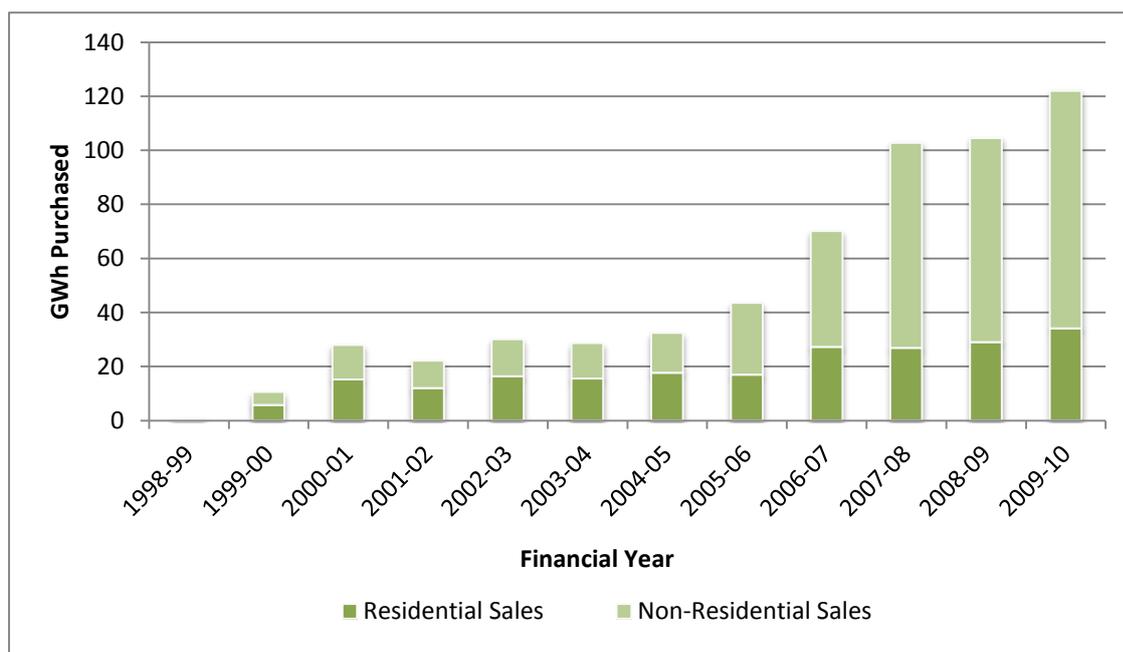
# ACT State of the Environment Report 2011

agencies have nevertheless taken steps to improve their energy efficiency. Meanwhile, a report on ACT Government Agencies' Environmental Performance Reporting (OCSE 2010) has indicated that to achieve carbon neutrality, agencies need to significantly strengthen and coordinate their collection of data on energy use, and their management reporting and implementation of resource management plans.

Over the reporting period, the ACT Government has introduced initiatives to both reduce electricity consumption and increase renewable energy uptake. Although it is taking action to improve public transport; the initiatives are not fully implemented, and are yet to demonstrate significant results in terms of a reduction in cars commuting each day. For energy efficiency in office buildings, the Government has introduced mandated building energy efficiencies. However, even with these changes it will take decades to achieve significant improvements in the energy efficiency of housing, infrastructure and buildings in the Territory. Numerous older buildings are still operating at efficiency levels well below the standards set for new projects.

There has been an increase in total sales of GreenPower over the reporting period for both residential and non-residential consumers, despite it being sold at a premium (Figure 2). During 2009 the total amount of Greenpower sold was 118.99 GWh, or just over 4% of the total energy consumption (2914.78 GWh) for the ACT. This may be attributed in part to efforts to make GreenPower relatively more affordable through a number of government initiatives and rebates. ACT electricity retailers offer a range of accredited green energy products (ICRC 2009).

Figure 2. GreenPower energy sales in the ACT



Source: TAMS 2010a

# ACT State of the Environment Report 2011

The feed-in tariff scheme associated with solar photovoltaic (PV) installation generated an extremely high level of interest and uptake of small- and medium-scale PV installations by residents in the ACT. Despite its popularity, the total installed capacity of renewable generators at 30 June 2011 was only about 14 MW - a third of the capacity of the planned large-scale solar plant (ICRC 2011).

It was announced in November 2010 that the Government would be proceeding with a large-scale solar plant with a capacity of up to 40 MW. There is some evidence that the high demand from the community to generate their own solar power has overwhelmed the solar PV supply market and governance structures for its installation in recent years, and may require further attention if the initiative is reinstated in the future.

## Adaptation

The *ACT Climate Change Strategy - Action Plan 1, 2007-2011* (ACT Government 2007) lists 43 actions relating to climate change, of which 13 specifically focus on adapting to current and future climate change. Adaptation efforts have mostly been focused on understanding and building knowledge. For example, ACTPLA has commissioned a number of vulnerability assessments for the urban area, which are aimed at recommending and developing important types of adaptation. Examples include: stormwater harvesting, planning for bushfire risk, improving adaptive capacity and reducing the impact of localised extreme air temperatures through building design and planning (ACTPLA 2010). The ACT Spatial Plan (ACT Government 2004) is currently under review, a process that should consider the implications of future climate change for the urban form of the ACT.

Adaptation actions have been undertaken in response to other situations, such as water security. With a target of reducing overall water consumption within the ACT by 12% by 2013 (Engineers Australia 2010), water management strategies have been implemented throughout the ACT to reduce demand. During the reporting period, these have included education and advertising, permanent water conservation measures, effluent reuse, stormwater harvesting, greywater reuse and water-efficiency programs. A combination of these efforts has been successful in reducing water consumption per person in the ACT (Engineers Australia 2010). Table 2 shows consumption levels in the ACT per person between 2007 and 2009.

Table 2. ACT water consumption, 2007-2009

	2007	2008	2009
Total consumption (kL)	51,060	43,556	44,955
Consumption per person per year (kL)	136	115	116
Consumption per person per day (L)	373	315	318

Source: Engineers Australia 2010

# ACT State of the Environment Report 2011

A number of commissioned reports have expanded understanding of the implications of predicted climate change effects for ecosystems in the ACT. The reports have addressed issues such as nature park vulnerability (Webb 2010), ecological connectivity (Manning et al. 2010) and the need for effective management of green infrastructure to build the resilience of the ACT's natural environment (OCSE 2011). For more information see the *Adaptation* indicator cluster paper.

Adaptive action in relation to urban form - that is, the physical layout of Canberra - can often achieve benefits in both mitigation and adaptation. For example, passive solar design and energy efficiency can reduce energy use and its associated emissions because the resulting buildings are more likely to provide comfortable temperatures for the occupants in hot or cold weather.

## Emerging issues

The future population of the ACT is projected to be older, on average, than it is currently (ACT CMD 2010). This ageing is an emerging issue in terms of vulnerability to extreme events. The proportion of inhabitants older than 65 years of age was one of the factors considered in the vulnerability assessment; it is particularly relevant in extreme heat and during bushfire. Elderly people are a vulnerable group because they tend to have limited mobility and chronic health conditions.

# ACT State of the Environment Report 2011



Source: ACT Government

A key emerging issue is the need to plan and manage transport and urban structure for the ACT in an integrated way, particularly when there are additional pressures from increased population and the predicted variability of future climate. The interconnectedness of the ACT with the surrounding region and other major cities, as well as the uncertainty surrounding the role of new technologies and modes of transport in addressing both emission reduction and Canberra's future form are complex and challenging emerging issues that will need to be addressed.

The technology of renewable energy is advancing and becoming more efficient. As a result, households and businesses are finding that energy from renewable resources is an increasingly effective option. The renewable energy industries, along with industries such as tourism and agriculture, are making the most of opportunities presented by the need to reduce our greenhouse gas emissions in order to reduce the dangerous effects of climate change. However, the effectiveness of renewable energy technologies is still maturing and yet to reach its potential. Many of the governance structures are not able to respond quickly; for example, inspections to ensure timely and safe connection and installation of private solar panels could not keep pace with demand during the reporting period. The

# ACT State of the Environment Report 2011

development of effective regulatory and governance systems will have implications for future take-up of renewable energy and energy efficiency technologies.

Planning of adaptation and government coordination, remain the two largest challenges in implementing a response to the predicted impacts of climate change on the ACT. Particular issues surround the capacity of vulnerable communities to proactively adapt. Cooperation and collaboration between research, policy and the application of adaptive action is important and not always integrated effectively (Nelson et al. 2010).

Emerging issues exist for different economic sectors around the reliance on the stability of current climate conditions. For example, tourism and agriculture rely on particular current climate characteristics, such as snow conditions, or temperatures for viticulture. Under climate scenarios, these and other sectors represent potential vulnerability that will vary depending on the extent and nature of climate change.

The ACT water supply is heavily dependent on rainfall, and is therefore vulnerable to the combined pressures of an increasingly dry climate and a growing population. Water security in the ACT has been the subject of much attention, and the community responded by using less water. However, for as long as the population continues to grow, there will need to be ongoing efforts to secure alternative sources and enhance reuse, so the ACT can have secure future water supplies.

## Recommendations

1. As a priority the ACT Government develop and implement a pathway to achieve carbon neutrality in ACT Government buildings and services. This should be implemented through the second Action Plan of *Weathering the Change* and include monitoring, evaluation of actions and annual public reporting on progress.
2. The ACT Government develop and implement a pathway to achieve the legislated climate change emission reduction and renewable energy targets. This should be implemented through the second Action Plan of *Weathering the Change* and include:
  - a. a focus on reducing emissions from transport and buildings (especially improving energy efficiency of old building stock);
  - b. responsive regulatory, governance and investment arrangements for renewable energy;
  - c. continued engagement with the ACT community; and
  - d. regular monitoring, evaluation of actions and public reporting on progress against the targets.
3. Develop an climate change adaptation planning and implementation response through:

# ACT State of the Environment Report 2011

- a. building on existing, and undertaking additional, sector vulnerability risk assessments;
  - b. establishing a monitoring, evaluation, reporting and improvement methodology and framework as a consistent guide for Government, to develop, progress and report against adaptation planning; and
  - c. integrating adaptation planning outcomes into existing ACT planning and management frameworks.
4. Develop a regional approach to planning for climate change. This needs to be done in partnership with NSW Government, local councils and regional organisations. Key areas of focus should include opportunities for renewable energy development, water security, urban and regional planning, transport management and adaptation of ecosystem services to climate change.

## References

- ACT CMD 2010. *Population and Ageing in the ACT - Issues and Analysis*. Chief Ministers Department. Act Government. Canberra.  
[http://www.cmd.act.gov.au/\\_\\_data/assets/pdf\\_file/0008/154475/population-ageing-ACT.pdf](http://www.cmd.act.gov.au/__data/assets/pdf_file/0008/154475/population-ageing-ACT.pdf) (accessed 15/8/11)
- ACT Government 2004. *Canberra Spatial Plan*. Canberra.  
<http://apps.actpla.act.gov.au/spatialplan/introductory/index.htm>.<http://apps.actpla.act.gov.au/spatialplan/introductory/index.htm> (accessed 25/8/11)
- ACT Government 2007. *Weathering the Change. ACT Climate Change Strategy – Action Plan 1*. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/144527/Climate\\_Change\\_Action\\_Plan.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0005/144527/Climate_Change_Action_Plan.pdf) (accessed 28/11/11)
- ACT Government 2010. *Climate Change and Greenhouse Gas Reduction Act 2010*. Current at 5 November 2011. Canberra. <http://www.legislation.act.gov.au/a/2010-41/current/pdf/2010-41.pdf> (accessed 15/11/11)
- ACTPLA 2010. *Urban Form Analysis. Canberra's Sustainability Performance: Technical Report*. ACT Planning and Land Authority. Canberra.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0013/21046/ACTPLA\\_Urban\\_Form\\_Scenarios\\_Final\\_Report\\_WEB.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0013/21046/ACTPLA_Urban_Form_Scenarios_Final_Report_WEB.pdf) (accessed 21/4/11)
- AECOM 2010. Human Settlement Vulnerability and Adaptive Capacity Assessment, Spatial Plan Evaluation. Report for ACT Planning and Land Authority. ACT Government. Canberra.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/20410/2010\\_09\\_08\\_ACTPLA\\_CC\\_Vulnerability\\_v2\\_complete\\_revised\\_water\\_LowResolution.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0007/20410/2010_09_08_ACTPLA_CC_Vulnerability_v2_complete_revised_water_LowResolution.pdf) (accessed 19/6/11)
- DECCEW 2011. *Sustainable Energy Policy: Energy for a Sustainable City 2010-2020*. Department of the Environment, Climate Change, Energy and Water. ACT Government. Canberra.

# ACT State of the Environment Report 2011

[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0003/232284/EDS\\_ACT\\_Sustainable\\_Energy\\_Policy\\_FA\\_web\\_A.PDF](http://www.environment.act.gov.au/__data/assets/pdf_file/0003/232284/EDS_ACT_Sustainable_Energy_Policy_FA_web_A.PDF) (accessed 7/11/11)

Engineers Australia 2009. *ACT Infrastructure Report Card - Energy*. Canberra.  
[http://www.engineersaustralia.org.au/sites/default/files/shado/Infrastructure%20Report%20Cards/ACT/part4\\_energy.pdf](http://www.engineersaustralia.org.au/sites/default/files/shado/Infrastructure%20Report%20Cards/ACT/part4_energy.pdf) (accessed 10/6/11)

Engineers Australia 2010. *ACT Infrastructure Report Card: Water*. Canberra.  
[http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file\\_uuid=C8F26346-DB84-45EF-E104-B53E726D4A61&siteName=ieaust](http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file_uuid=C8F26346-DB84-45EF-E104-B53E726D4A61&siteName=ieaust) (accessed 20/6/11)

Grattan Institute 2010. *Learning the Hard Way: Australia's Policies to Reduce Emissions*. Melbourne.  
[http://www.grattan.edu.au//publications/077\\_report\\_energy\\_learning\\_the\\_hard\\_way.pdf](http://www.grattan.edu.au//publications/077_report_energy_learning_the_hard_way.pdf) (accessed 14/10/11)

Heuris Partners 2010. *ACT Greenhouse Gas Emissions: Existing Policy Baseline Projections to 2050 - Research Report*. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0008/187217/ACT\\_Greenhouse\\_Gas\\_Emissions.pdf#ACT%20Greenhouse%20Gas%20Emissions](http://www.environment.act.gov.au/__data/assets/pdf_file/0008/187217/ACT_Greenhouse_Gas_Emissions.pdf#ACT%20Greenhouse%20Gas%20Emissions) (accessed 7/11/11)

ICRC 2009. *Electricity Feed-in Renewable Energy Premium: Determination of Premium Rate, Report 9 2009*. Independent Competition and Regulatory Commission. Canberra.  
[http://www.icrc.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/172629/Report\\_9\\_of\\_2009\\_November\\_2009.pdf](http://www.icrc.act.gov.au/__data/assets/pdf_file/0009/172629/Report_9_of_2009_November_2009.pdf) (accessed 11/11/11)

ICRC 2011. *ACT Greenhouse Gas Inventory Report for 2008-09*. Independent Competition and Regulatory Commission. Canberra.  
[http://www.icrc.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/235719/ACT\\_Greenhouse\\_Gas\\_Inventory\\_Report\\_2009\\_Final.pdf](http://www.icrc.act.gov.au/__data/assets/pdf_file/0009/235719/ACT_Greenhouse_Gas_Inventory_Report_2009_Final.pdf) (accessed 11/10/11) Intergovernmental Panel on Climate Change (IPCC). 2001. *IPCC Third Assessment Report* (IPCC, 2001 a,b,c): Annex B Glossary of Terms, <http://www.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf> (accessed 19/6/11)

IPCC 2007. *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. 2007: The Physical Science Basis*. Intergovernmental Panel on Climate Change.  
[http://www.ipcc.ch/publications\\_and\\_data/publications\\_ipcc\\_fourth\\_assessment\\_report\\_wg1\\_report\\_the\\_physical\\_science\\_basis.htm](http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm) (accessed 1/10/11)

Manning, A.D., Shorthouse, D.J., Stein, J.L. and Stein, J.A. 2010. *Technical Report 21: Ecological Connectivity for Climate Change in the ACT and Surrounding Region*. Fenner School of Environment and Society. Australian National University. Canberra

McInnes, J., Ibrahim, J. and Loughnan, M. 2008. *Reducing Harm to Older Persons in Victoria from Extreme Hot Weather*. Centre of Research Excellence in Patient Safety. Literature Review April 2008.  
[http://www.health.vic.gov.au/environment/downloads/reducing\\_harm\\_monash.pdf](http://www.health.vic.gov.au/environment/downloads/reducing_harm_monash.pdf) (accessed 5/6/11)

Nelson, R., Kokic, P., Crimp, S., Martin, P., Meinke, H., Howden, S.M., de Voil, P. And Nidumolu 2010. The Vulnerability of Australian Rural Communities to Climate Variability and Change: Part II – Integrating Impacts with Adaptive Capacity. *Environmental Science & Policy*. 13:18-27

# ACT State of the Environment Report 2011

NSW Planning and Infrastructure 2011. *NSW Wind Farms*. NSW Government. Sydney.  
<http://www.planning.nsw.gov.au/LinkClick.aspx?fileticket=HC-K5QijVsM%3d&tabid=394&language=en-US> (accessed 17/10/11)

OCSE 2010. *Report on an Audit/Assessment of ACT Government Agencies' Environmental Performance Reporting*. Office of the Commissioner for Sustainability and the Environment. Canberra. unpublished

OCSE 2011. *Report on the Investigation into the Government's Tree Management Practices and the Renewal of Canberra's Urban Forest*. Office of the Commissioner of Sustainability and the Environment. Canberra  
[http://www.envcomm.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/219354/OCSE\\_TreeInvestigation\\_Part1\\_ReportV5\\_28February2011.pdf](http://www.envcomm.act.gov.au/__data/assets/pdf_file/0006/219354/OCSE_TreeInvestigation_Part1_ReportV5_28February2011.pdf) (accessed 26/8/11)

ORER, 2011. *Renewable Power Percentage*. Office of the Renewable Energy Regulator. Australian Government. Canberra. <http://www.orer.gov.au/For-Industry/Liable-Entities/Renewable-Power-Percentage/rpp#interim> (accessed 11/11/11)

Webb, B. 2011. *Impacts of Climate on the Canberra Nature Park: Risks and Responses*. Report for the ACT Office of the Commissioner for Sustainability and the Environment. ANU Climate Change Institute and Fenner School of Environment and Society. Australian National University. Canberra.  
[http://www.envcomm.act.gov.au/\\_\\_data/assets/pdf\\_file/0004/220477/OCSE\\_ANU\\_paper\\_climate\\_CNP.pdf](http://www.envcomm.act.gov.au/__data/assets/pdf_file/0004/220477/OCSE_ANU_paper_climate_CNP.pdf) (accessed 13/11/11)

## Other data sources

In addition to these published reports, data for this paper was also sourced from:

ACT Department of Territory and Municipal Services (TAMS) - now Territory and Municipal Services Directorate (TAMSD)

Environment and Sustainable Development Directorate (ESDD)

Independent Competition and Regulatory Commission (ICRC)

# ACT State of the Environment Report 2011

## THEME: Climate

### Indicator cluster: Emissions

The indicators for this cluster are:

- *Atmospheric concentration of carbon dioxide* in parts per million (ppm) (C);
- *Atmospheric concentration of methane* in parts per billion (ppb) (C);
- *Atmospheric concentration of nitrous oxide* in parts per billion (ppb) (C);
- *Energy use* (P) - energy use by type and by sector, energy use per \$1000 GDP, and discussion of trends;
- *Carbon dioxide emissions* (P) - CO<sub>2</sub> emissions per year, per sector and per person;
- *Methane emissions* (P) - including from landfill sites and water bodies;
- *Nitrous oxide emissions* (P); and
- *Ozone layer* (I) - Extent of the ozone layer and impacts.

**Condition indicators (C)** present data that tell us the state of the environment at any particular time.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

## Summary

Globally, atmospheric concentrations of greenhouse gases, emitted both via human activities and from natural sources, continue to increase, and the trend is generally reflected in the ACT. The calculated annual greenhouse gas emissions for the ACT totalled approximately 4.18 megatonnes (Mt) of CO<sub>2</sub>-e in 2009, including emissions removal through land use, land-use change and forestry (LULUCF) as required under the Kyoto protocol.

The burning of fossil fuels to produce electricity is the largest contributor to greenhouse gas emissions, followed by use of natural gas and petrol. It is clear that emission reduction efforts need to focus on these sectors.

Carbon dioxide made up 95% of the ACT's total greenhouse gas emissions in 2008. Methane emissions in the ACT were reported to be 149 kilotonnes (kt) in 2008. These emissions were

# ACT State of the Environment Report 2011

attributed to the energy, agriculture and waste sectors, with the waste sector contributing 64% of total emissions. Nitrous oxide emissions for the ACT amounted to 49 kt in 2008.

## Introduction

This paper provides an overall assessment of emissions generated by various sectors in the ACT throughout the 2007-2011 reporting period, within the context of global and historical emissions.

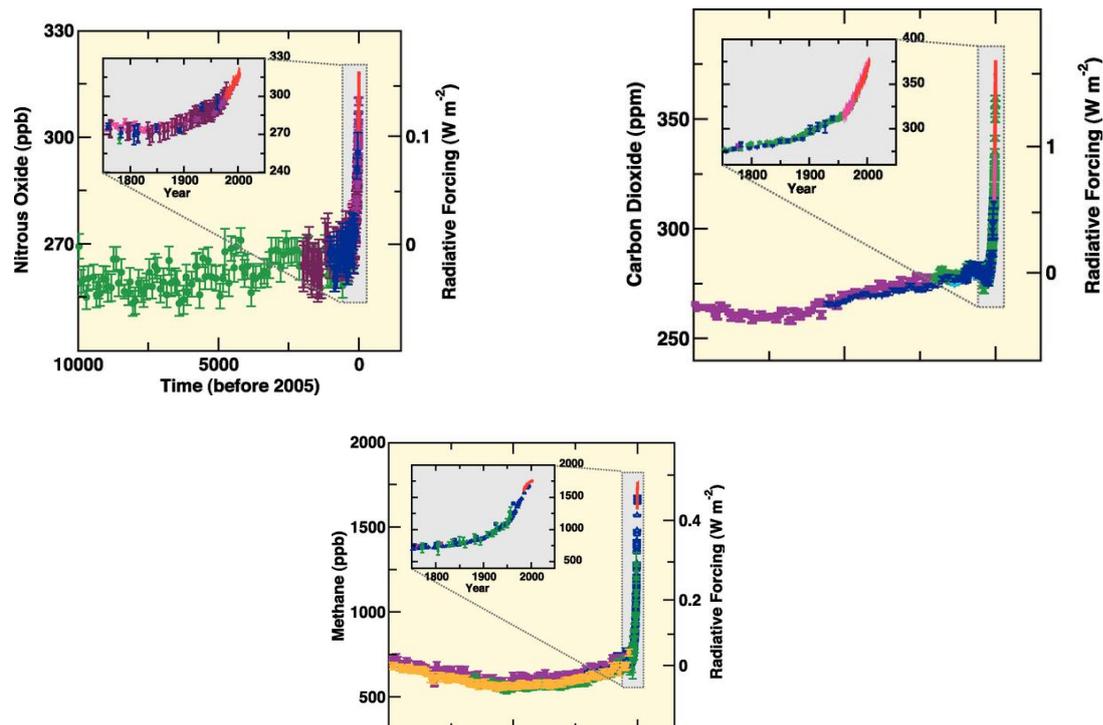
## Condition indicators

### Global greenhouse gas emissions

Measurements and calculations of atmospheric concentrations of greenhouse gas emissions add to understanding of current atmospheric conditions and potential future climate change. Carbon dioxide, methane and nitrous oxide are the three principal greenhouse gases, and their concentrations have been directly affected by human activity.

Figure 1 shows that the recent rate of change in atmospheric greenhouse gas concentration since the mid 1900s is both dramatic and unprecedented. Until the industrial era, the range of atmospheric concentrations of CO<sub>2</sub> increased by only 10 ppm (275-285 ppm). Since industrialisation however, atmospheric concentrations have increased by approximately 100 ppm - ten times the pre-industrial era variations - and in the 17 years to 2007 atmospheric CO<sub>2</sub> concentrations have increased by 30 ppm (Denman et al. 2007).

Figure 1. Atmospheric concentration of three greenhouse gases over time



# ACT State of the Environment Report 2011

Source: Denman et al. 2007

Over the reporting period 2007-2011, global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have continued to increase. Average annual atmospheric concentrations for the reporting period are shown in Table 1.

Table 1. Global atmospheric concentration of greenhouse gas emissions

Annual average	CO <sub>2</sub> (ppm)	Increase from previous year average CO <sub>2</sub> (ppm)	Methane (ppb)	Nitrous oxide (ppb)
2007	380.57	1.87	1733.11	319.52
2008	382.69	2.12	1741.53	320.76
2009	384.26	1.57	1743.92	321.41
2010	386.09	1.83	1750.52	322.44

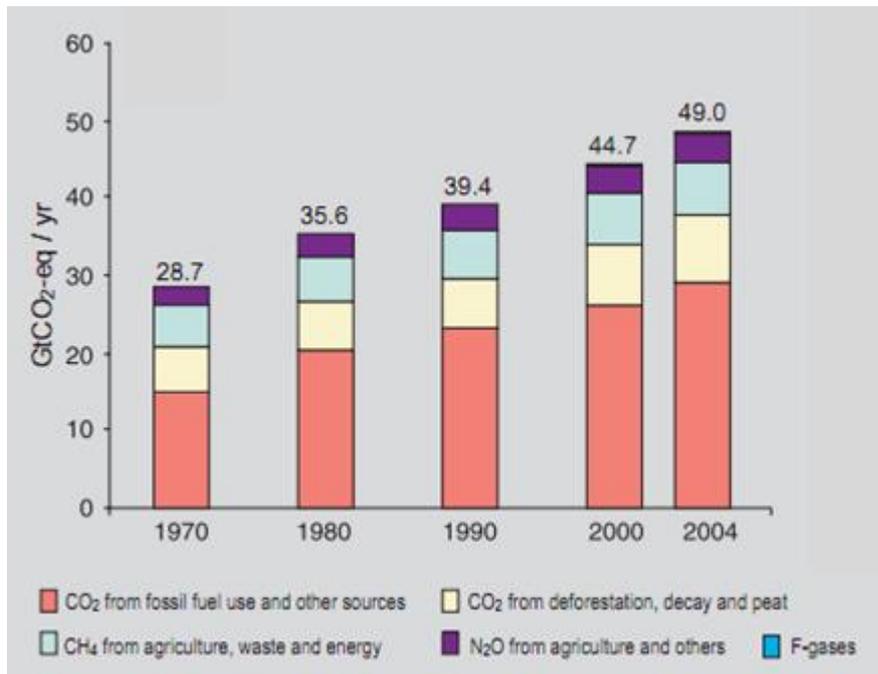
Source: BOM . (Note: Cape Grim, on Tasmania's west coast, is one of the three premier Baseline Air Pollution Stations in the World Meteorological Organization-Global Atmosphere Watch (WMO-GAW) network. Baseline stations are defined by the WMO to meet a specific set of criteria for measuring greenhouse and ozone depleting gases and aerosols in clean air environments.)

Each of these gases has a different potential to trap heat, and each remains in the atmosphere for a different period of time. Global warming potential expresses the heat-trapping power of a gas relative to carbon dioxide over a particular time period. For example, over a 100-year period, a methane molecule has 25 times the warming potential of a carbon dioxide molecule, while a nitrous oxide molecule has 298 times the warming potential of a carbon dioxide molecule. Other gases are hundreds or thousands of times more powerful. However, carbon dioxide is a more stable molecule and lasts longer in the atmosphere than most of the other greenhouse gases (McKeown 2009). It is also emitted in much higher quantities than any other greenhouse gas. As Figure 2 shows, despite the higher global warming potential of methane and nitrous dioxide, most by far of global warming potential from emissions is due to carbon dioxide.

A standardised measure called carbon dioxide equivalents (CO<sub>2</sub>-e) is often used to measure total greenhouse gas emissions, with global warming potential commonly calculated for a 100-year time period (McKeown 2009). CO<sub>2</sub>-e expresses the global warming potential of all greenhouse gases as a single figure based on the potential warming of carbon dioxide, allowing for a quick understanding of the threat presented by particular emission levels.

# ACT State of the Environment Report 2011

Figure 2. Global greenhouse gas emissions by sector 1970-2004



Source: Metz et al. 2007

Note. Emissions called F-gases are too small to appear. CO<sub>2</sub> from fossil fuel use and other sources (bottom segment in each bar) contributes the most gigatonnes of CO<sub>2</sub>-e per year.)

In 2005, global carbon dioxide concentrations were 379 parts per million (ppm), methane concentrations were around 1774 parts per billion (ppb) and nitrous oxide 319 ppb (Denman et al. 2007) (Figure 1). From the most recent calculations, global atmospheric carbon dioxide occupies more than 385 ppm of air, which is 38% more than the highest value recorded in the last 800,000 years (NOAA 2011).

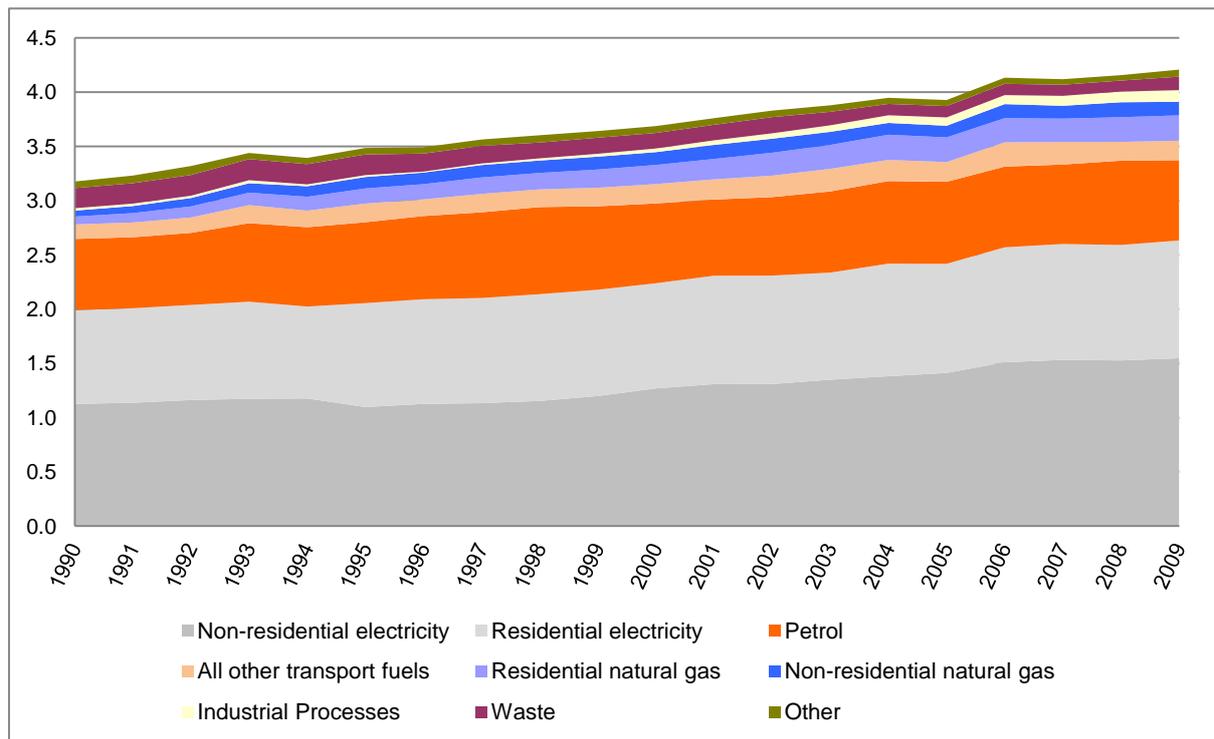
The fifth Assessment Report by the Intergovernmental Panel on Climate Change, due to be completed in 2013-14, will provide an updated assessment of global scientific, technical and socio-economic information about climate change, its potential effects, and options for adaptation and mitigation.

## ACT greenhouse gas emissions

Since 1990, ACT greenhouse gas emissions have also increased (Figure 3).

# ACT State of the Environment Report 2011

Figure 3: ACT greenhouse gas emissions in megatonnes of carbon dioxide equivalents, 1990-2009



Source: ICRC 2011

The calculated annual greenhouse gas emissions for the ACT totalled approximately 4.18 Mt of CO<sub>2</sub>-e in 2009, including emissions removal through land use, land-use change and forestry (LULUCF) as required under the Kyoto protocol (ICRC 2011).

When measured on a per capita basis, emissions in Australia have stabilised and slightly decreased over the last decade, while per capita emissions in the ACT have only begun to decrease more recently (DECCEW 2010). Emissions per person in ACT were calculated at 11.2 t CO<sub>2</sub>-e in 2009, while in the same year Australia's per capita CO<sub>2</sub>-e emissions were calculated at 24.9 t (ICRC 2011 and unpublished). This large disparity reflects the contribution from industries such as energy generation, mining and agriculture occurring across the country, of which there is minimal activity in the ACT. However, Canberrans import and consume goods and services produced by these sectors. The ACT Government accepts accountability for emissions from stationary energy (electricity) generated elsewhere for use within its borders (ICRC 2011) and the data here include those additional emissions.

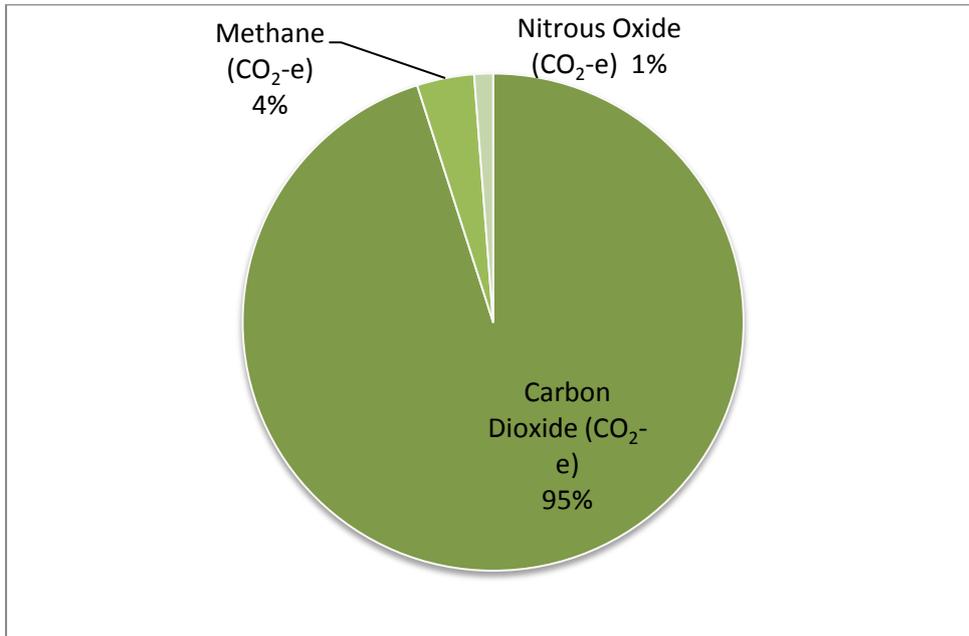
## Pressure indicators

### Greenhouse gas emissions by type

Carbon dioxide made up 95% of the ACT's total greenhouse gas emissions as CO<sub>2</sub>-e in 2008 (Figure 4).

# ACT State of the Environment Report 2011

Figure 4. ACT greenhouse gas emissions by type for 2008



Source: Based on data from DECCEW 2010

## Carbon dioxide emissions

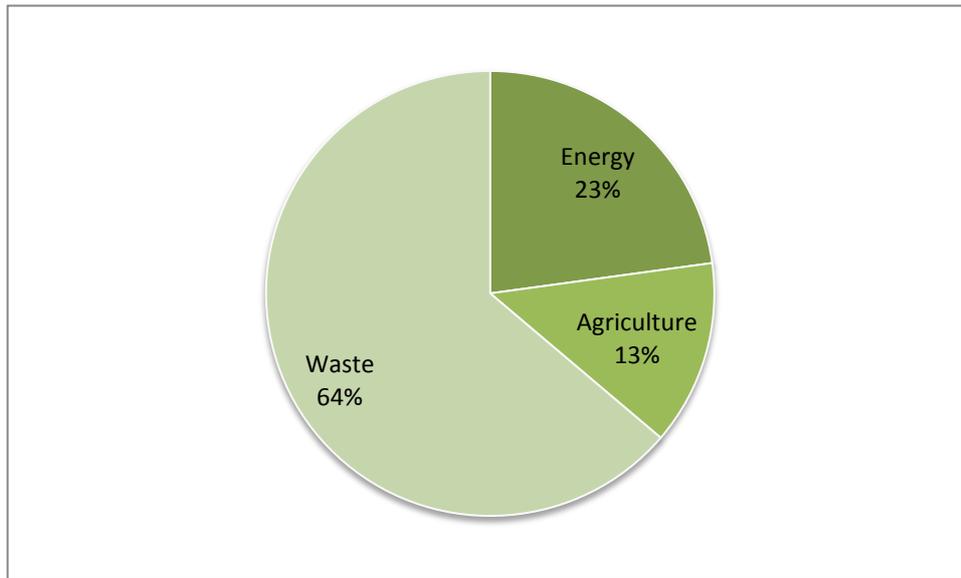
In the ACT, almost all carbon dioxide is emitted during use of energy, predominantly as electricity, in heating, cooling and lighting buildings. Petrol used in transport emits the second largest amounts of CO<sub>2</sub>.

## Methane emissions

Methane, as previously discussed, is a naturally occurring atmospheric gas that has been increasing in abundance in the atmosphere, particularly since the industrial revolution (Figure 1) (IPCC 2007). At a global scale, methane largely comes from particular land-use practices, such as irrigated rice cultivation and cattle production and landfill sites. In Australia, the digestive processes of livestock (enteric fermentation) and fugitive emissions from coal mining together account for more than two-thirds of methane emissions (ABS 2010).

# ACT State of the Environment Report 2011

Figure 5. Sources of methane emissions in the ACT in 2008



Source: Based on data from DECCEW 2010

Methane emissions in the ACT were reported to be 149 kt in 2008 (DECCEW 2010). These emissions were attributed to the energy, agriculture and waste sectors, with the waste sector contributing 64% of total emissions (Figure 5).

The ACT incorporates a number of artificial lakes, such as Lake Burley Griffin, as well as stormwater control ponds and wetlands. At times, these water bodies may cause an increase in the Territory's methane emissions as a result of decomposing materials, methane-producing algae and anaerobic conditions. This contribution will need to be considered in future State of the Environment reports, but there are insufficient data on methane production from water bodies at present for comment to be made in the current report.

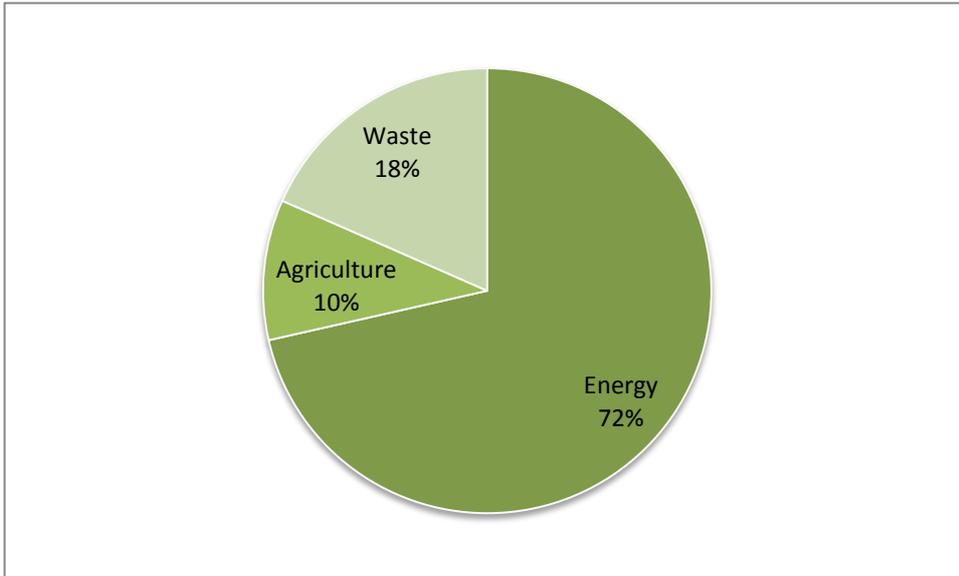
## Nitrous oxide emissions

Globally there has been a dramatic rise in atmospheric concentrations of nitrous oxide since the 1750s (IPCC 2007) (Figure 1). Nitrous oxide is of concern because it is a very stable gas and in the atmosphere it is 310 times more effective at trapping heat than carbon dioxide in a given time period (US EPA 2011).

Reporting of ACT emissions of nitrous oxide for the current period is limited to the information contained in the 2008 ACT Greenhouse Gas Inventory (released in 2010; DECCEW 2010). The inventory reports that 49 kt of nitrous oxide were added to the atmosphere in 2008 as a result of activity in the ACT. Most of the ACT's nitrous oxide emissions came from energy production, and some were attributable to the agricultural and waste sectors (Figure 6).

Figure 6. Sources of nitrous oxide emissions for the ACT in 2008

# ACT State of the Environment Report 2011

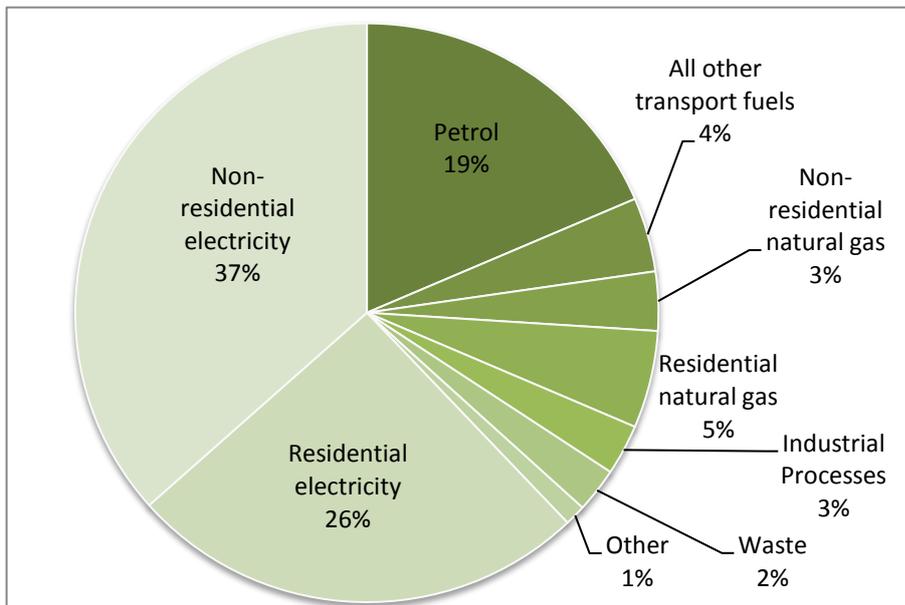


Source: Based on DECCEW 2010

## ACT greenhouse gas emissions by sector

Greenhouse gases are released into the atmosphere by activities such as burning of fossil fuels for energy production, broadscale land clearing and land-use changes (indirect impacts) (Figure 7).

Figure 7. Sources of greenhouse gas emissions in the ACT for 2009



Source: ICRC 2011

# ACT State of the Environment Report 2011

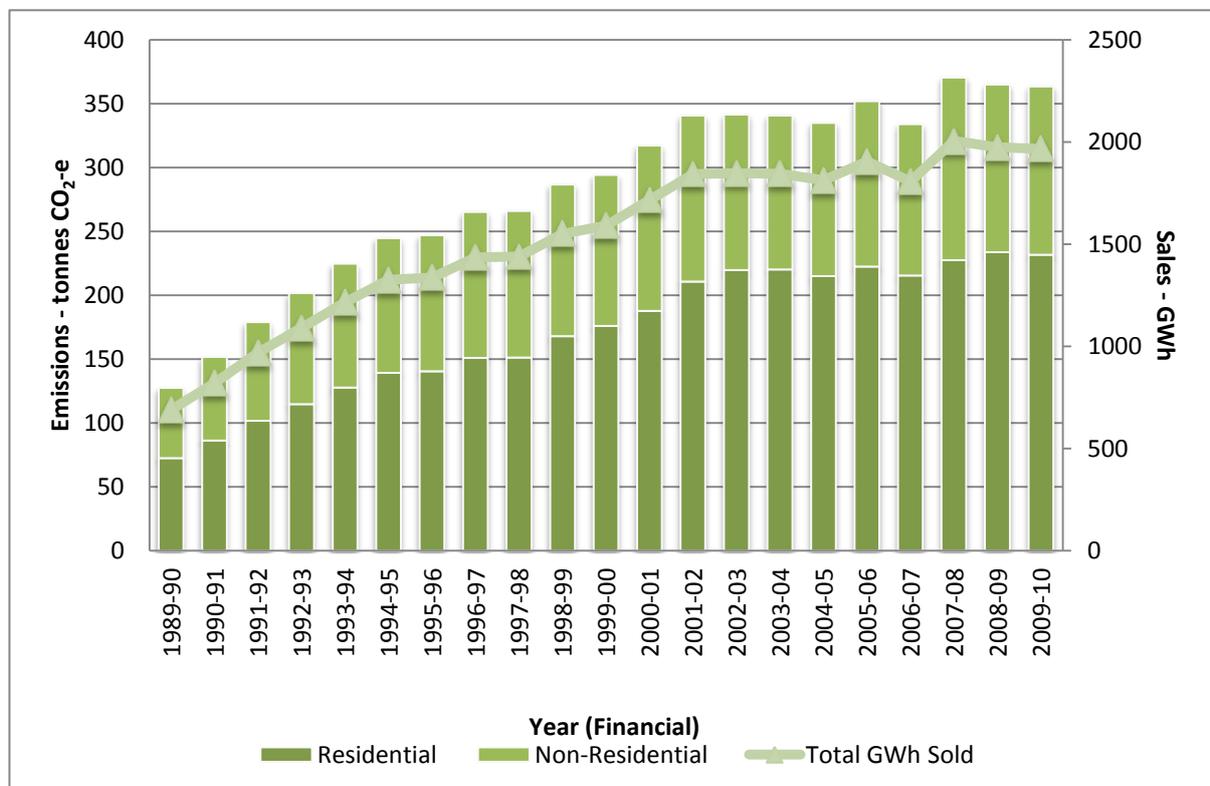
## Electricity and gas

Electricity accounts for 62.6% of the Territory’s greenhouse gas emissions (Figure 7), but less than 2% of the electricity consumed within the ACT is generated within the ACT itself (ICRC 2009, Engineers Australia 2010).

Stationary energy use contributes over two thirds of the ACT’s greenhouse gas emissions; it comes from electricity and gas use for lighting and heating (Figure 7). A significant reduction in the emissions from the stationary energy and transport sectors will be needed if the ACT is to meet its greenhouse gas reduction targets without heavy reliance on offset strategies.

For more information on emissions reduction see the *Mitigation* indicator cluster.

Figure 8. Natural gas emissions and purchasing trends in the ACT



Source: ICRC unpublished 2010 and DECCEW 2010

Over the reporting period, total gas use and emissions decreased slightly. However, total emissions in 2009-10 were more than double those in 1990. Most emissions attributable to the natural gas sector come from household use of energy, which has increased much more over the last few decades than use in the non-residential sector (Figure 8).

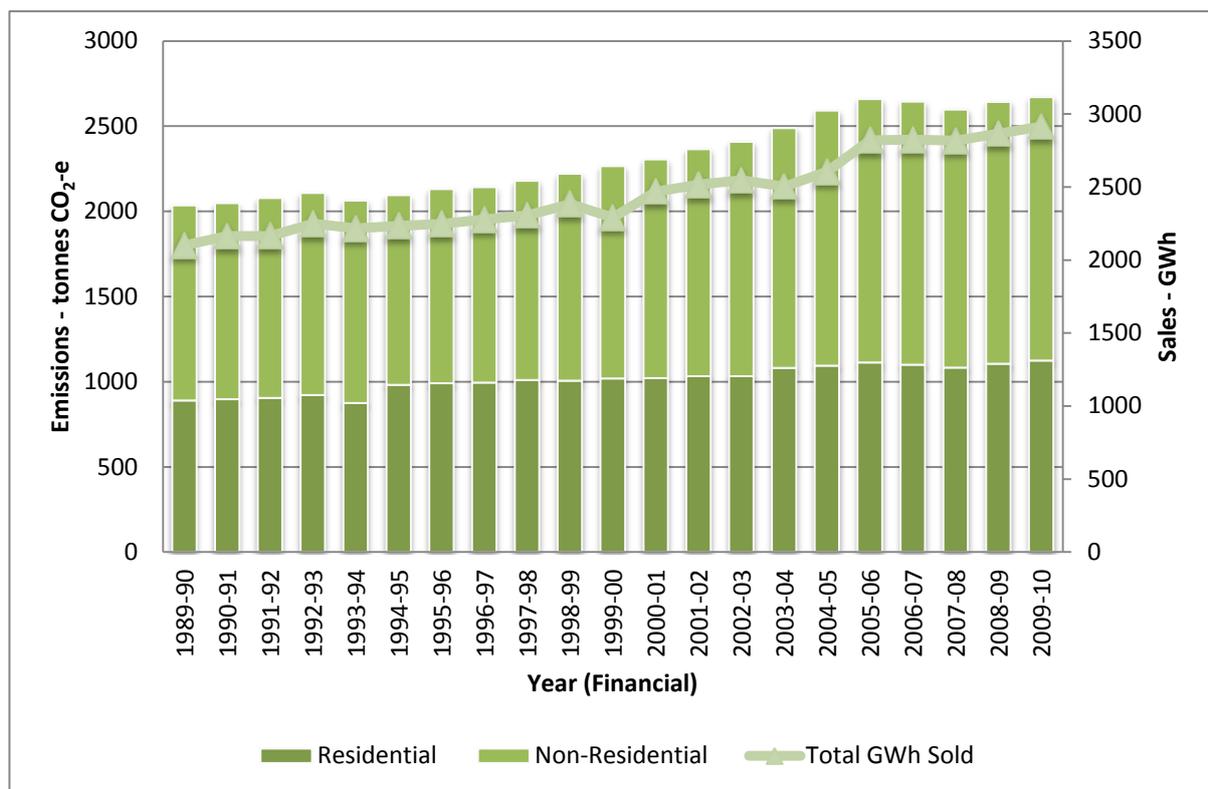
Natural gas is a fossil fuel energy source but it produces significantly less emissions than other non-renewable sources of energy, particularly coal (DECCEW 2010). Given the significantly higher share of emissions attributable to the electricity sector in the ACT,

# ACT State of the Environment Report 2011

choosing electricity generated from gas instead of coal may be beneficial for overall emissions reduction in the short to medium term.

Unlike natural gas, sources of electricity vary in emissions intensity and as over 98% of the ACT's electricity is sourced from NSW estimates have to be made based on the composition of the NSW power sector. An additional variable is the increasing quantity of renewable energy being both purchased and produced by ACT customers, which is further discussed in the Mitigation indicator cluster paper.

Figure 9. Electricity emissions and purchasing trends in the ACT



Source: ICRC unpublished 2010 and DECCEW 2010

Estimates of the emissions from electricity use in the ACT are shown in Figure 9. While emissions due to the ACT's electricity consumption have remained at 8.3 t of CO<sub>2</sub>-e per person over the reporting period (ICRC unpublished), it is the total emissions caused by the ACT as a whole that contribute to climate change, irrespective of population size. Note that the reduction in emissions observed early in the last reporting period has since reversed, with electricity sector emissions increasing again (Figure 9).

Household use of electricity per person in the ACT remains well above the national average (ACT Government 2007). Conversely, total average energy consumption (residential and non-residential) is low relative to other States because of the small amount of industry in

# ACT State of the Environment Report 2011

the ACT. The high residential consumption has been attributed to Canberra’s relatively cold winters and to the high disposable incomes of Canberrans (Engineers Australia 2010).

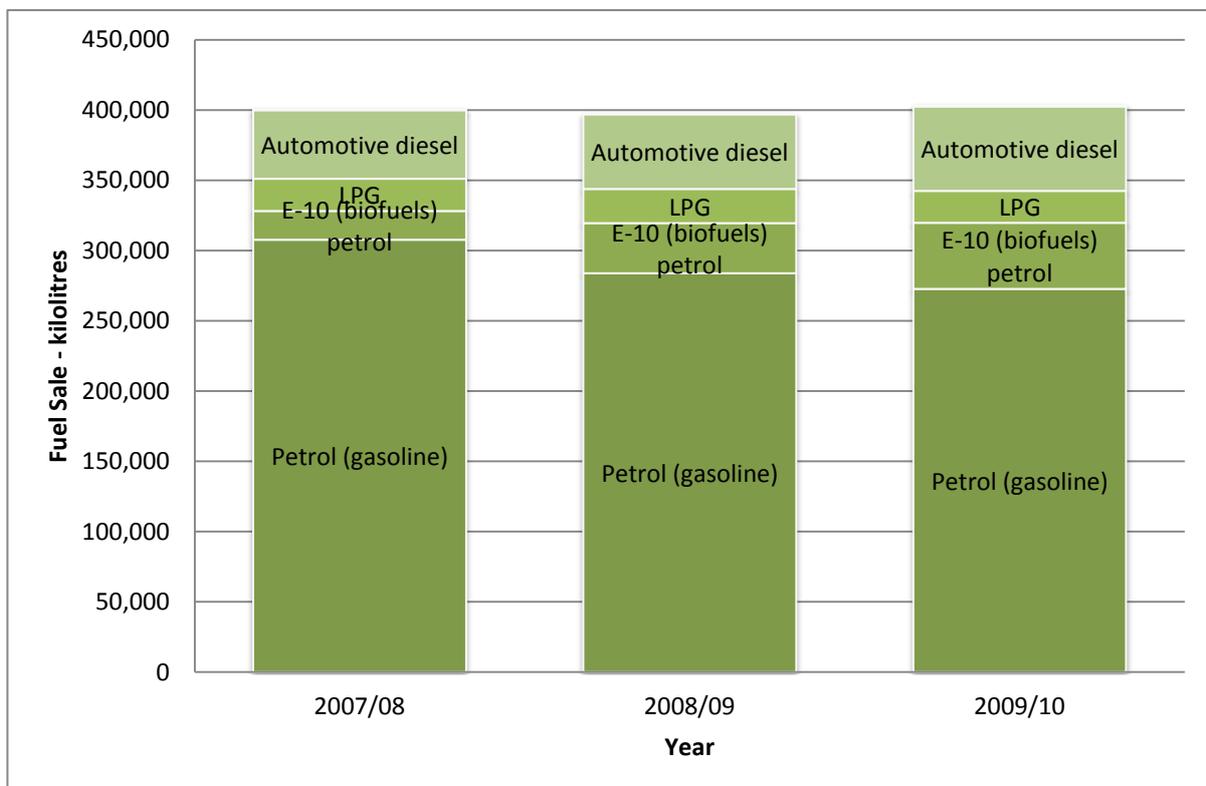
## Transport

Based on available data for Australia, the ACT’s energy consumption in road transport was the lowest per capita (averaging just over 40 gigajoules) when compared with other Australian States and Territories. However, as with other emissions, the ACT’s total footprint for transport emissions is larger. The ACT has limited industry and imports most of its goods (and services) from interstate. Reported ACT transport emissions do not really include the emissions generated in transporting these goods because energy use by the sector was calculated from purchases of fuel by type and from consumption of fuel in terajoules.

Transport fuel use has varied slightly over the reporting period: with an increase in total sales from 399,855 kL in 2007-08 to 402,547 kL in 2009-10 (TAMS).

Petrol (Automotive Gasoline) was main fuel used, followed by Automotive Diesel Oil (ADO) and then LPG, as shown in Figure 10.

Figure 10. Fuels used by the transport sector in the ACT, 2007-2009



Source: TAMS

# ACT State of the Environment Report 2011

## Impact indicators

### Ozone layer

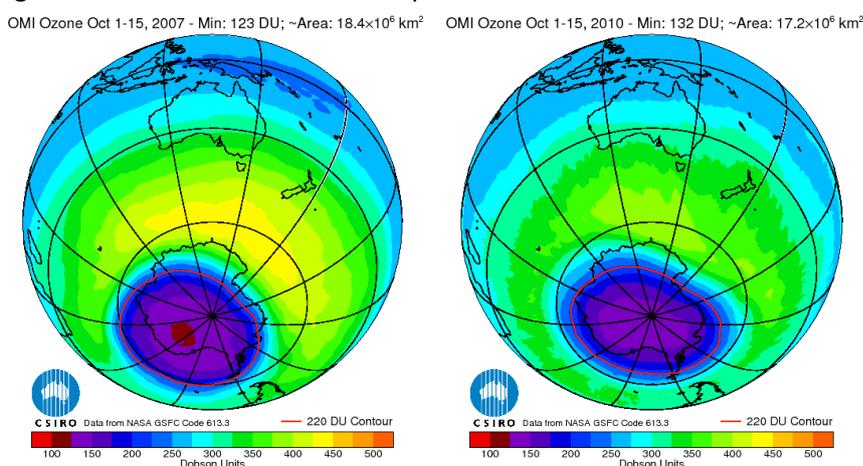
The *Ozone layer* impact indicator refers to ozone depletion in the upper layer (or stratospheric layer) of the atmosphere, acknowledged since measurements of the hole over Antarctica were first published in the early 1980s (Fahey 2006; UNEP 2011). The ozone layer is an indicator of impact rather than pressure because its condition results from human use of ozone-depleting gases and aerosols.

The ozone layer makes up a very small amount of the atmosphere but is vital for human well-being. Although local impacts relating to stratospheric ozone depletion are limited, the global issue of ozone depletion has the potential to dramatically change the earth's atmosphere.

A slight thinning of the ozone layer has also been observed over other regions of the globe, such as the Arctic and southern middle latitudes, including Australia. The area of the hole in the ozone layer fluctuates with atmospheric cycles and earth rotations, which are linked with seasonal changes. According to data from the WMO, the area of ozone-depleted atmosphere peaked in 2003 and 2006, when it extended over 28 million square kilometres. The ozone hole is still present during August-December in the southern hemisphere, although primarily located over Antarctica and the surrounding Southern Ocean. During the reporting period the ozone hole was always largest during August, September and October (WMO 2010).

Figure 11 demonstrates how the ozone hole (the area with darkest shading, purple and red, over Antarctica) has changed over 2007-2010.

Figure 11. Antarctic ozone hole maps for 2007 and 2010



Source: SEWPaC

# ACT State of the Environment Report 2011

The monitoring and management of the ozone layer is an example of world co-operation through the Montreal Protocol of 1987. The protocol is an international treaty establishing the phasing out of substances known to be ozone-depleting, such as chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs) (WMO 2010). Global agreements now have led to the production of CFCs and HCFCs being phased out in most countries across the globe, but we are still living with the legacy of past chemical and production practices.

There are no other impact indicators for this indicator cluster for the ACT. Impacts of climate change on the ACT are outlined and discussed in the *Climate vulnerability* indicator cluster.

The most likely future climate scenario for the ACT includes (Webb 2011):

- the strong likelihood of mean temperatures continuing to increase, along with more frequent and severe heatwaves for the ACT and region; and
- a high probability of changes in the pattern of rainfall from that observed during the period of instrumental records, with some risk of a decline in long-term average rainfall; and in addition, the likelihood of an increase in rainfall intensity with more extreme rainfall events.

## Response indicators

There are no response indicators for this indicator cluster. It is clear that emission reduction efforts need to focus on improving efficiency in electricity and transport use and the sourcing of renewable energy for electricity and transport fuels.

Responses to greenhouse gas emissions and climate change in the ACT are outlined in the *Mitigation* and *Adaptation* indicator clusters.

## Glossary

**Stationary energy:** Stationary energy includes emissions from fuel consumption for electricity generation, fuels consumed in the manufacturing, construction and commercial sectors, and other sources like domestic heating. The stationary energy sector makes up 53.9% of Australia's emissions. Electricity generation is by far the largest source of emissions in this sector, contributing close to 50% of all energy emissions. The remainder of emissions from stationary energy come from direct combustion of fuels.

# ACT State of the Environment Report 2011

## References

- ABS 2010. *Year Book Australia, 2009-10. Air. Greenhouse gas Emissions*.cat.no. 1301.0 . Australian Bureau of Statistics.  
<http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/1301.0Chapter3052009%E2%80%9310>  
(accessed 7/9/11)
- ACT Government. 2007. *Weathering the Change, The ACT Climate Change Strategy 2007-2025*.  
[http://www.environment.act.gov.au/climate\\_change/weathering\\_the\\_change/Climate\\_Change\\_Strategy.pdf](http://www.environment.act.gov.au/climate_change/weathering_the_change/Climate_Change_Strategy.pdf) (accessed 20/6/2011)
- Denman, K.L., Brasseur, G., Chidthaisong, A., Ciais, P., Cox, P.M., Dickinson, R.E., et al. 2007. Couplings Between Changes in the Climate System and Biogeochemistry. in S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller. eds. *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, USA. <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter7.pdf> (accessed 7/8/11)
- DECCEW 2010. *ACT Greenhouse gas inventory 2008*. Department of the Environment Climate Change, Energy and Water. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0015/200175/ACT\\_Greenhouse\\_Gas\\_Inventory\\_2008.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0015/200175/ACT_Greenhouse_Gas_Inventory_2008.pdf) (accessed 5/9/11)
- Engineers Australia 2010. *Infrastructure report card: Energy*. Canberra.  
[http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file\\_uuid=C8F2B446-9590-AF36-78D3-A33AB1073CD0&siteName=ieaust](http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file_uuid=C8F2B446-9590-AF36-78D3-A33AB1073CD0&siteName=ieaust), accessed 19/06/2011.
- Fahey, D.W. 2006. *Twenty Questions and Answers About the Ozone Layer: 2006 Update*.  
[http://ozone.unep.org/Assessment\\_Panels/SAP/Scientific\\_Assessment\\_2006/Twenty\\_Questions.pdf](http://ozone.unep.org/Assessment_Panels/SAP/Scientific_Assessment_2006/Twenty_Questions.pdf) (accessed 17/6/2011)
- ICRC 2009. *Licensed Electricity, Gas and Water and Sewerage Utilities: Compliance and performance reporting for 2007-08*. Independent Competition Regulatory Commission. Canberra.  
[http://www.icrc.act.gov.au/\\_\\_data/assets/pdf\\_file/0019/156016/Compliance\\_and\\_Performance\\_Report\\_2007-08\\_Web.pdf](http://www.icrc.act.gov.au/__data/assets/pdf_file/0019/156016/Compliance_and_Performance_Report_2007-08_Web.pdf) (accessed 5/8/11)
- ICRC 2011. *ACT Greenhouse Gas Inventory Report for 2008-09*. Independent Competition and Regulatory Commission. Canberra.  
[http://www.icrc.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/235719/ACT\\_Greenhouse\\_Gas\\_Inventory\\_Report\\_2009\\_Final.pdf](http://www.icrc.act.gov.au/__data/assets/pdf_file/0009/235719/ACT_Greenhouse_Gas_Inventory_Report_2009_Final.pdf) (accessed 11/10/11)
- Metz, B., Davidson, O.R., Bosch, P.R., Dave, R. And Meyer, L.A. 2007. Greenhouse gas emission trends. *Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK and

# ACT State of the Environment Report 2011

New York, NY, USA. [http://www.ipcc.ch/publications\\_and\\_data/ar4/wg3/en/figure-1-3.html](http://www.ipcc.ch/publications_and_data/ar4/wg3/en/figure-1-3.html)  
(accessed 23/8/11)

McKeown, A. and Gardner, G. 2009. Climate Change Reference Guide. In: *State of the World 2009: Into a Warming World*. Worldwatch Institute. <http://www.worldwatch.org/files/pdf/CCRG.pdf>  
(accessed 7/9/2011)

NOAA 2011. *NOAA Mauna Loa CO2 Data*. National Oceanic and Atmospheric Administration. <http://co2now.org/Current-CO2/CO2-Now/noaa-mauna-loa-co2-data.html> (accessed 15/6/2011)

U.S Environmental Protection Agency, 2011. Nitrous Oxide: Science. <http://www.epa.gov/nitrousoxide/scientific.html> (accessed 16/6/2011)

United Nations Environmental Programme 2011. *Ozone Secretariat*. <http://ozone.unep.org/>,  
(accessed 17/6/2011)

Webb, B. 2011. *Impacts of Climate on the Canberra Nature Park: Risks and Responses*, Report for the ACT Office of the Commissioner for Sustainability and the Environment. ANU Climate Institute and Fenner School of Environment and Society. Canberra

World Meteorological Organization 2010. *Antarctic Ozone Bulletin, No1/2010*. <http://www.wmo.int/pages/prog/arep/documents/ant-bulletin-1-2010.pdf> (accessed 7/6/11)

World Meteorological Organization 2010. *Antarctic Ozone Bulletin. No. 2/2010*. <http://www.wmo.int/pages/prog/arep/documents/ant-bulletin-2-2010.pdf> (accessed 7/6/11)

World Meteorological Organization 2010. *Antarctic Ozone Bulletin. No. 3/2010*. <http://www.wmo.int/pages/prog/arep/documents/ant-bulletin-3-2010.pdf> (accessed 7/6/11)

## Other data sources

In addition to these published reports, data for this paper were also sourced from:

ACT Department of the Environment, Climate Change Energy and Water (DECCEW) - now Environment and Sustainable Development Directorate (ESDD)

Bureau of Meteorology - Atmospheric concentration of Greenhouse Gas emissions, Cape Grim (BOM)

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), Antarctic ozone hole

ACT Department of Territory and Municipal Services (TAMS) – now Territory and Municipal Services Directorate (TAMSD)

# ACT State of the Environment Report 2011

## THEME: Climate

### Indicator cluster: Mitigation

The indicators for this cluster are:

- *Energy supply (R)* - energy sources and trends, fuel sales, ACT Government purchase of renewable energy, and effectiveness of renewable energy and energy efficiency programs;
- *Emission reduction in waste and transport (R)* - effectiveness of initiatives to reduce emissions in Waste and Transport sectors; and
- *Emissions reduction by infrastructure, buildings and industry (R)* - effectiveness of initiatives to reduce emissions in Infrastructure, Buildings and Industry sectors.

**Condition indicators (C)** present data that tell us the state of the environment at any particular time.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

### Summary

In the ACT, households use more energy per person than households in most of the other Australian States or Territories. Most (98%) of the energy used in ACT comes from outside its borders. Coal is the main source of the Territory's energy. Although electricity sourced from renewable energy is increasing in popularity, voluntary purchases of GreenPower still makes up less than 5% of total electricity bought.

In 2010, the ACT Government set out in legislation the most ambitious greenhouse gas emission targets of any state or territory. However, to date no pathway for reaching these targets has been developed. The second action plan under *Weathering the Change* (the ACT climate change strategy) is currently being developed and is expected to outline a proposed path.

The primary focus in the ACT to date has been on strategies to reduce greenhouse gas emissions. Of the 43 actions identified in *ACT Climate Change Strategy - Action Plan 1, 2007-2011* (ACT Government 2007), 30 are specifically focused on mitigation. Community groups also make an important contribution to emissions reduction in the ACT. However, ACT greenhouse gas emissions have increased.

# ACT State of the Environment Report 2011

## Introduction

Addressing the challenges of climate change will require both mitigation of emissions and action to help adapt to potential impacts. Mitigation refers to human intervention to reduce the sources or enhance the sinks of greenhouse gases (IPCC 2001). Adaptation and mitigation actions can differ significantly, but they need to be aligned if they are to achieve an overall effective response to climate change. This paper focuses on mitigation actions undertaken in the ACT to reduce emissions.

## Condition indicators

There are no condition indicators for the Mitigation indicator cluster.

Globally, greenhouse gases continue to increase. This has been reflected in ACT greenhouse gas emissions which have also largely increased since 1990.

Further information and discussion on ACT greenhouse gas emissions is included in the *Emissions* indicator cluster.

Information on ACT weather patterns in recent decades can be found in the *Driving Forces* paper.

## Pressure indicators

There are no pressure indicators for the Mitigation indicator cluster.

Carbon dioxide is the most significant contributor to greenhouse gas emissions in the ACT. In particular, carbon dioxide is emitted when electricity used for heating, cooling and lighting buildings is generated using fossil fuels. The second largest emission sources in ACT are petrol and other transport fuels.

Further information on the sources of greenhouse gas emissions in the ACT is provided in the *Emissions* indicator cluster.

## Impact indicators

There are no impact indicators for the Mitigation indicator cluster.

The most likely future climate scenario for the ACT is warmer temperatures which may affect human health, infrastructure, biodiversity and fire risk, among other aspects of life. Changes to total rainfall are uncertain, but storm events are likely to become more frequent, leading to water and infrastructure impacts. In addition, the distribution of seasonal rainfall throughout the annual cycle is expected to alter.

# ACT State of the Environment Report 2011

Expected key impacts of climate change on the ACT are outlined in the *Climate vulnerability* indicator cluster. Information on ozone depletion can be found in the *Emissions* indicator cluster.

## Response indicators

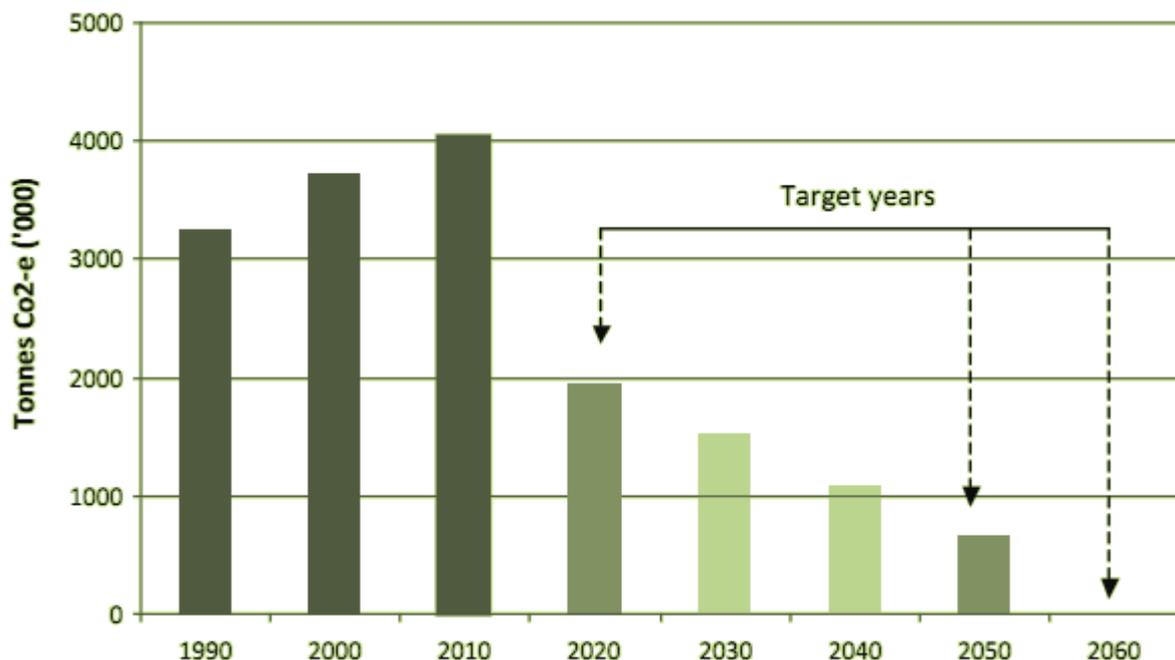
### Strategic framework

In 2010, the ACT Government legislated the following targets to reduce greenhouse gas emissions in the ACT (ACT Government 2010):

- 40% below 1990 emissions by 30 June 2020;
- 80% below 1990 emissions by 30 June 2050; and
- 0 net emissions by 30 June 2060.

These targets would require greenhouse gas emissions to be significantly reduced from current levels (Figure 1).

Figure 1. The ACT's greenhouse gas emissions targets



Source: DECCEW 2011

These are the most ambitious greenhouse gas emissions reduction targets of any State or Territory. To date, no pathway for reaching these targets has been developed. The second action plan under *Weathering the Change*, the ACT climate change strategy (ACT Government 2007), is currently being developed and is expected to outline such a path.

# ACT State of the Environment Report 2011

In May 2011, the ACT Government also legislated the following renewable energy targets for the ACT (ACT Government 2010): renewable sources to provide

- 15% of total electricity usage by 2012; and
- 25% of total electricity usage by 2020.

There is a lag in reporting against renewable energy levels. Latest figures indicate that for 2009-10, 91.1% of electricity sold in the ACT was sourced from non-renewable energy sources (ICRC 2011a, ORER 2011). Recent increases in renewable energy generation resulting from the Feed-in Tariff schemes and the ACT Government's commitment to increasing its use of GreenPower (that is, power from renewable sources; GreenPower 2011) to 100% will assist in meeting the 2012 target.

The Australian Government's Clean Energy Future package (CEF 2011) is also likely to stimulate homes and businesses in the Territory to buy GreenPower, by ensuring that greenhouse gas savings associated with GreenPower are counted as additional to the national emissions reduction target.

To date, there is no pathway developed to achieve the ACT renewable energy targets, but such a pathway for the 2020 target is expected to be in either the *Climate Change Action Plan 2* or the ACT's *Sustainable Energy Policy* (e.g. DECCEW 2009), both currently being developed.

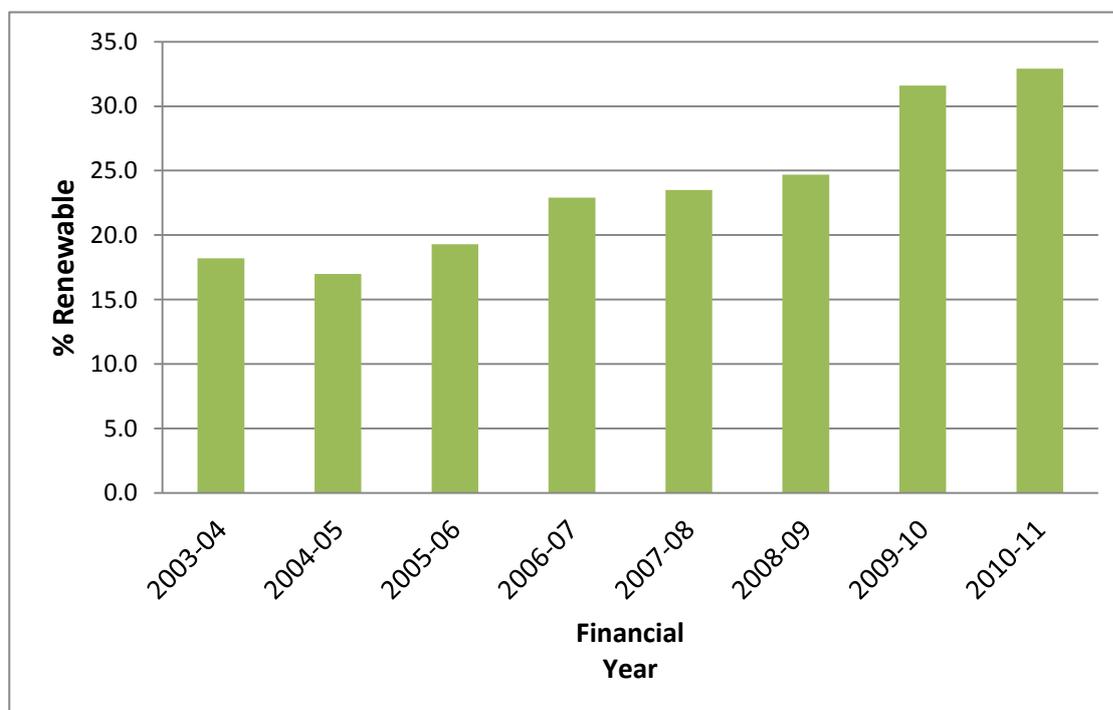
In 2007 the ACT Government committed to achieving carbon neutrality in its own buildings and services. No strategic pathway to achieve this has been published. A report on ACT Government Agencies' Environmental Performance Reporting (OCSE 2010) has indicated that to achieve carbon neutrality, agencies need to significantly strengthen and coordinate their collection of data on energy use, and their management reporting and implementation of resource management plans. Agencies have taken steps to improve energy efficiency, although a draft framework for ACT Government carbon neutrality is not expected to be released until 2012, four years after the commitment was made. Over the reporting period, the ACT Government has allocated funding for action by individual agencies. For example, during 2007 Housing ACT was allocated \$20 million over a 10-year period to improve the energy efficiency of its stock (Spotless 2011). In the 2011-12 ACT Budget a further \$8 million was announced for further energy efficiency improvements to ACT Housing properties over four financial years (Spotless 2011). To date, significant work has included actions such as draught-sealing, and installation of pelmets, water-efficiency improvements and wall insulation in 216 houses, ceiling insulation in 765 houses and photovoltaic panels in 2 houses (Spotless 2011).

During the reporting period, the ACT Government's use of renewable energy increased from 22.9% in 2006-07 to 32.9% in 2010-11. This is in line with longer term trends in increasing

# ACT State of the Environment Report 2011

use of renewable energy (Figure 2). Total energy use has remained relatively steady throughout the reporting period.

Figure 2. ACT Government consumption of renewable energy



Source:TAMS

The primary focus of the ACT Government climate change strategy to date has been on reducing greenhouse gas emissions. Of the 43 actions identified in *ACT Climate Change Strategy – Action Plan 1, 2007-2011* (ACT Government 2007), 30 are specifically focused on mitigation. A review of Action Plan 1 in 2010 identified that for many actions, there was insufficient data to quantify the emissions abated (DECCEW 2010). Only 12 of the actions were of a type that could be quantitatively assessed for their cost effectiveness and efficiency in reducing emissions (Table 1). For the other 31 actions, quantitative assessment of emissions reductions was not applicable. They included the development of policies, strategies and frameworks (e.g. development of an energy policy, undertaking a carbon sequestration audit and developing a connectivity map).

Table 1. Effectiveness and efficiency of climate change mitigation actions

Action	Effectiveness: Absolute metrics of CO <sub>2</sub> abated	Efficiency: Marginal cost of abatement (\$/tonne)
Pursue carbon neutrality in	Insufficient data to quantify CO <sub>2</sub>	Insufficient data to quantify the

# ACT State of the Environment Report 2011

Action	Effectiveness: Absolute metrics of CO <sub>2</sub> abated	Efficiency: Marginal cost of abatement (\$/tonne)
Government buildings	abated.	marginal cost of abatement
Establish a \$1million Energy Efficiency Fund for ACT Government agencies	Insufficient data to quantify CO <sub>2</sub> abated.	Insufficient data to quantify the marginal cost of abatement.
Legislate for GreenPower to be offered to all new electricity customers	Based on 1.19% of all electricity used in the ACT being GreenPower. Annual abatement = 35,036 tonnes of CO <sub>2</sub> -e per year.	GreenPower has an abatement cost of approximately \$45 - \$70 per tonne.
Implement energy efficiency improvements in government housing	Insufficient data to quantify CO <sub>2</sub> abated.	Insufficient data to quantify the marginal cost of abatement.
Provide a solar hot water rebate	The approximate greenhouse abatement of 50 solar electric water heaters = 175 tonnes of CO <sub>2</sub> -e per year.	The estimated cost of abatement to the ACT Government based on \$1000 grant per water heater = \$29 per tonne.
Assist schools become carbon neutral	Some schools have recorded a 25% reduction in their energy use since their audits were conducted.	Insufficient data to quantify the marginal cost of abatement.
Undertake ACTION CNG bus fleet replacement	The average diesel bus in the ACTION fleet emits 1.079 kg of CO <sub>2</sub> -e per kilometre. The 16 CNG buses purchased for Action 12 emit 1.22 kg of CO <sub>2</sub> -e per kilometre.	According to departmental advice the new CNG buses cost \$525,942 plus GST compared to \$478,100 plus GST for the latest M.A.N. Euro 5 clean diesel buses.
Undertake energy efficient street light replacement	According to departmental advice Action 13 has resulted in the following emissions abatement: 2007-08 = 1075 tonnes CO <sub>2</sub> -e 2008-09 = 3016 tonnes CO <sub>2</sub> -e 2009-10 = 157 tonnes CO <sub>2</sub> -e	Insufficient data to quantify the marginal cost of abatement.
Introduce a feed-in tariff for renewable micro generation	The feed-in tariff supported 1.56 MW of renewable energy in January 2010. The annual abatement is 2285 tonnes CO <sub>2</sub> -e.	Department advises abatement cost = \$500 per tonne.
Pursue an urban forest replacement program	Insufficient data to establish a base year	Insufficient data to quantify the marginal cost of abatement
Plant one million new trees	An average tree will capture 268 kg of	Based on the existing budget

# ACT State of the Environment Report 2011

Action	Effectiveness: Absolute metrics of CO <sub>2</sub> abated	Efficiency: Marginal cost of abatement (\$/tonne)
	CO <sub>2</sub> -e over its lifetime. 61,000 trees are to be planted in the Murrumbidgee River corridor by September 2009. The annual abatement of these trees is 884 tonnes of CO <sub>2</sub> -e per year. If the ACT reaches its goal, 14 486 tonnes of CO <sub>2</sub> -e will be sequestered per year.	information provided the marginal cost of abatement for this Action is approximately \$1903 per tonne.
Showcase renewable and energy efficiency technologies.	Insufficient data to quantify the CO <sub>2</sub> abatement of all projects. Solar array on Tidbinbilla Visitor's Centre saves approximately 4.9 tonnes CO <sub>2</sub> -e per year	Insufficient data to quantify the cost of abatement of all projects. Marginal cost of abatement for solar array on Tidbinbilla Visitor's Centre is approximately \$273 per tonne.

Source: DECCEW 2010

Many of the strategies have not been, or cannot be, monitored or assessed, so it is difficult to comment on which strategies have been most effective in achieving emissions reduction. Further, there is usually a lag in climate change emissions measurements, with data not available for two years. This means evaluation of action within the reporting period is even more difficult.

## Energy supply

A very small portion (approximately 2%) of energy consumed within the ACT is produced within the Territory. These internal sources include (Engineers Australia 2010):

- Belconnen Landfill Gas Power Plant (1 MW capacity);
- Mugga Land Landfill Gas Power Plant (3.45 MW capacity);
- Mt Stromlo Water Treatment Plant (0.7 MW capacity);
- Googong Dam mini hydro power plant (0.6 MW capacity); and
- an increasing number of small, private renewable generators (e.g. solar panels).

It is noted that capacity does not equate to output and it is understood that the hydro plant in particular has not been operating for some time.

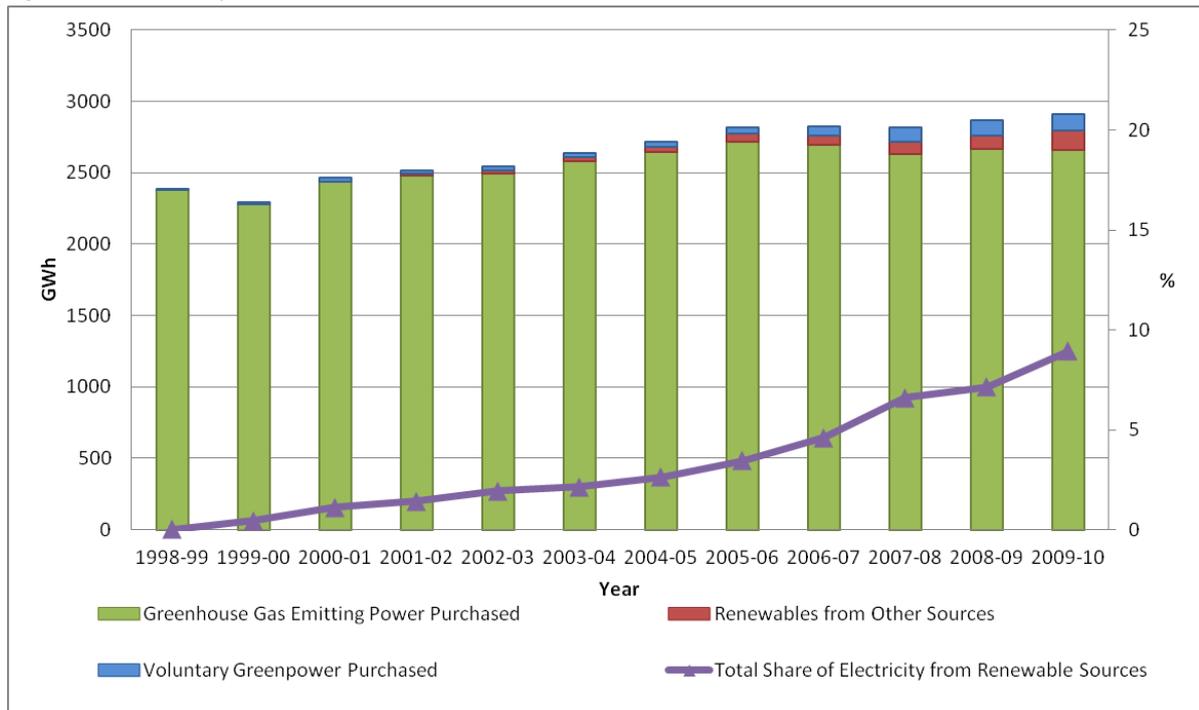
# ACT State of the Environment Report 2011

The remainder of the ACT's electricity supplies are sourced from various power plants across the east coast of Australia (Engineers Australia 2010).

## Electricity

Over 90% of electricity sold in the ACT is sourced from non-renewable energy sources (Figure 3).

Figure 3. Electricity sales in the ACT



Source: ICRC 2011a, ORER 2011

Household consumption of energy per person is relatively high in the ACT, possibly because of high average disposable incomes and cold winters. However, the overall (combined residential and non-residential) average is low because the ACT has little industrial activity (Engineers Australia 2010). Further information on energy use can be found in the *Emissions* indicator cluster.

A number of actions have been put in place to increase use of renewable sources of energy.

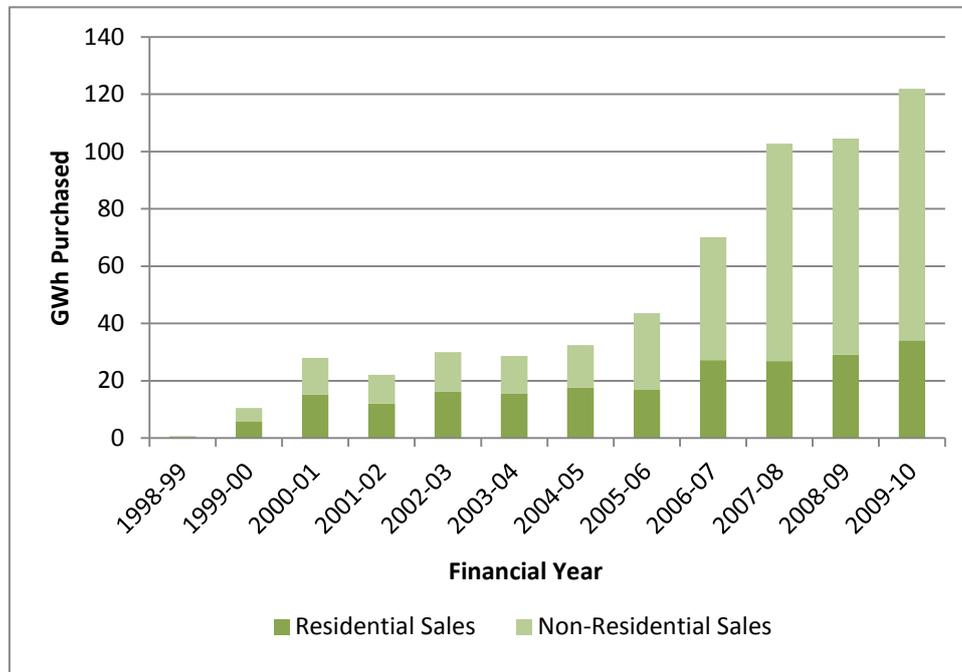
### Green power

The population of the ACT has been encouraged to purchase green (renewable) energy, and there has been a substantial increase in the total sales of GreenPower to both non-residential and residential consumers between 2006 and 2009 (Figure 4), and a steady increase in numbers of new customers choosing GreenPower through the same period. However, GreenPower still only makes up less than 5% of total energy sales in the ACT and

# ACT State of the Environment Report 2011

most is bought by non-residential purchasers (Figure 4). Residential sales have fluctuated, but increased little.

Figure 4: Sales of GreenPower in the ACT



Source: TAMS 2010a

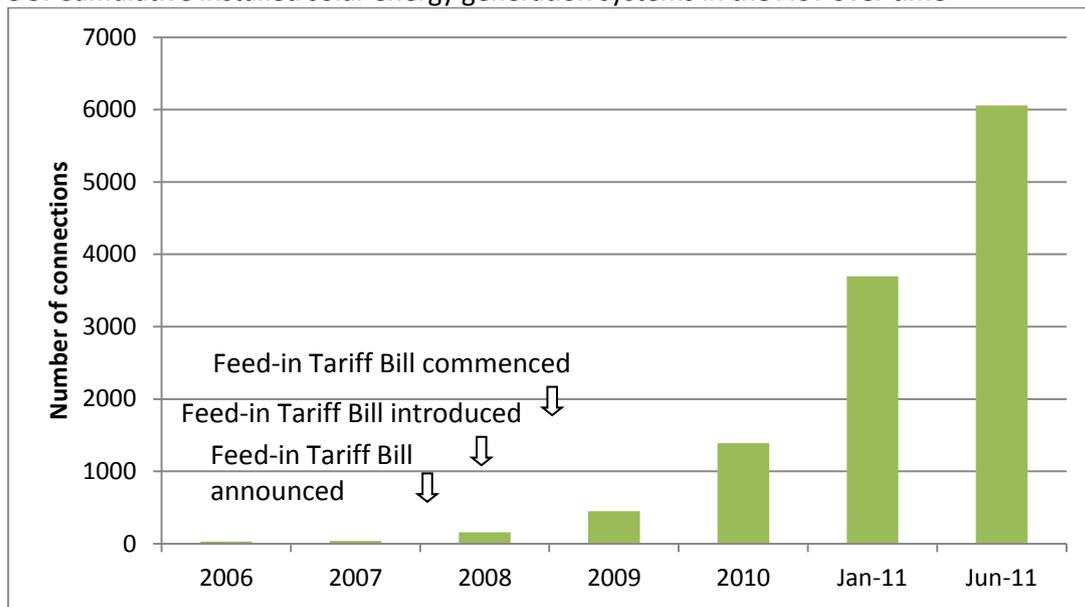
From April 2009 all ACT electricity retailers have offered all customers access to accredited GreenPower products (ICRC 2009). Increases in green energy purchases translated into a reduction in the per capita emission of greenhouse gases over the same period. The cost of green energy is higher than alternative 'non green sources' within the ACT, which has been identified as a factor restricting uptake of green energy by ACT residents and businesses.

## *Feed-in Tariff*

The ACT Government commenced a feed-in tariff scheme in March 2009 to encourage small-scale renewable energy generation to feed into the grid. The tariff is designed to encourage investment in renewable electricity generation by paying small-scale generators a premium rate for the gross amount of electricity they generate (Engineers Australia 2009). The prices set for connected systems made the ACT's feed-in tariff arrangements among the most generous in Australia, resulting in a high rate of installations, as shown in Figure 5.

# ACT State of the Environment Report 2011

Figure 5: Cumulative installed solar energy generation systems in the ACT over time



Source: TAMS

The Government set a cap on the total installed capacity of micro- and medium-scale generators which would be funded under the scheme, and on 31 May 2011 the micro-scale cap was reached. A medium-scale generator category was introduced in March 2011, for installations greater than 30 kW and up to 200 kW. In June 2011 the medium-scale scheme was revised to incorporate users producing less than 30 kW, with a cap of 30 MW. The scheme officially commenced on 12 July 2011, but the 30 MW cap was fully committed by midnight on the 13 July 2011. Despite its popularity, the total installed capacity of renewable generators at 30 June 2011 was about 14 MW (ICRC 2011b). Total metered output by renewable electricity generation from 1 March 2009 to 30 June 2011 was 11,840 MWh (ICRC 2011b).

A recent report by the Grattan Institute has questioned the effectiveness of rebate programs such as the ACT Feed-in Tariff. The report indicated that rebate programs have lifted sales in some products but they have also created boom-bust cycles which can disrupt the development of industry capacity and undermine investor confidence (Grattan Institute 2010). Further, such programs only reduced emissions a little. The benefits to emissions reduction as well as the benefits to the renewable energy industry should be assessed before future renewable energy policy initiatives are determined.

Despite action to increase the use of renewable sources of energy, total ACT greenhouse emissions from electricity and gas have not yet seen a discernible reduction. For more information on emissions trends in the ACT see the *Emissions* indicator cluster paper.

# ACT State of the Environment Report 2011

## Firewood

Firewood is used in the ACT to heat some homes. Sales of firewood within the ACT have been declining since 2001. The primary identified cause for this decline is households switching to alternative energy sources for heating.

In 2009, total firewood sales increased, to 15,126 tonnes (TAMS 2010b). Nevertheless, burning of firewood is estimated to contribute only 0.3% of the total ACT greenhouse gas emissions (DECCEW 2010).

Compared with other non-renewable sources, firewood is generally preferable for limiting net greenhouse gas emissions in domestic heating (Paul et al. 2003). In principle, firewood is a renewable energy source because the carbon dioxide emitted when it burns is taken up by other trees. Forestry management practices play a role in this renewal as well. Domestic burning of firewood can have adverse effects if a wood heater is operating inefficiently. Air pollution can result from incomplete combustion of volatile substances that are then released from the wood (Hamilton 2008). See the *Local air quality* indicator cluster for more information.

## Emission reduction in waste and transport

### Transport

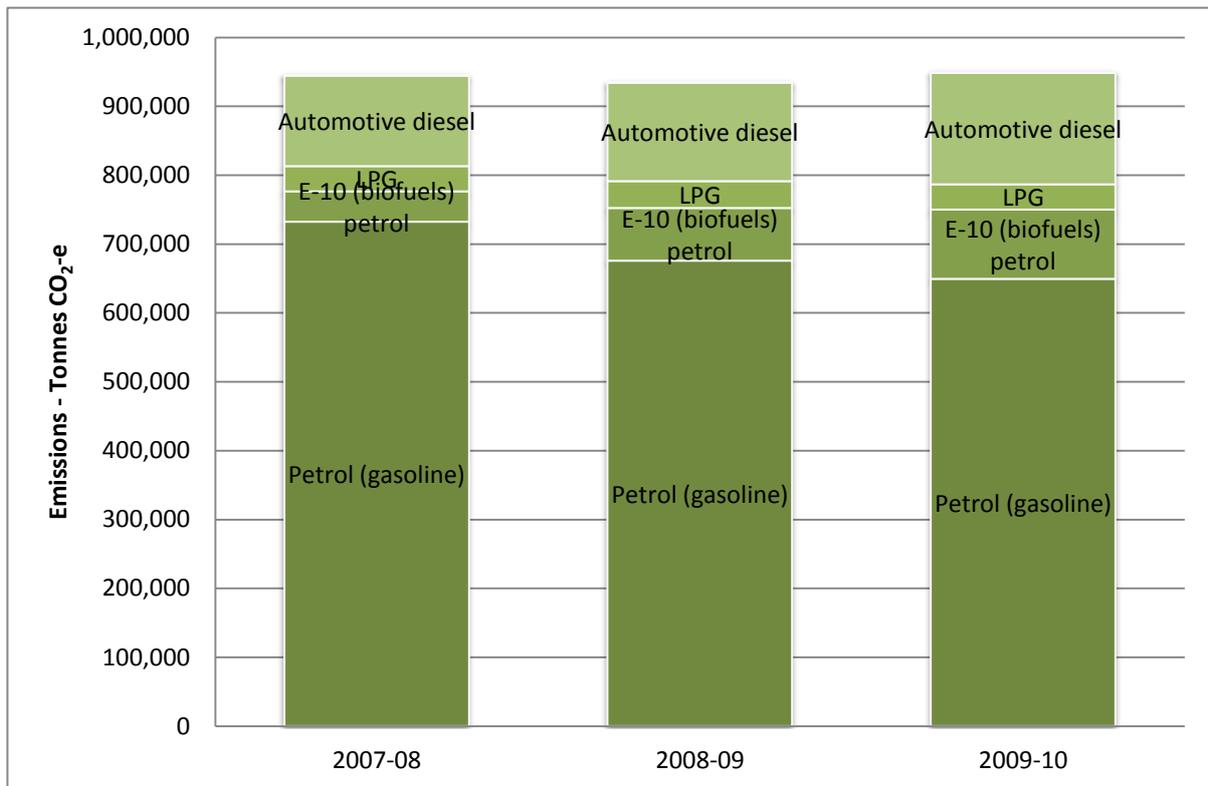
The most commonly sold fuel in the ACT is petrol (gasoline), followed by automotive diesel and liquid petroleum gas (LPG) (TAMS 2010c). The distribution of sales between the various sources has remained fairly constant over the years 2007-2010, with an increase in total sales from 399,855 kL in 2007-08 to 402,547 kL in 2009-10 (TAMS 2010c).

Use of biofuels such as E-10 (90% petrol and 10% ethanol) more than doubled over the reporting period, from 20,512 to 46,896 kL. The ACT has no biofuel policies, but because ACT's fuel comes through NSW, the NSW Government's *Biofuel (Ethanol Content) Act 2007* and *Biofuel (Ethanol Content) Amendment Act 2009* determine biofuel content in the ACT. The Biofuel Act establishes mandated minimum ethanol content per total volume of petrol sales. The minimum amount has increased over the reporting period from 2% in 2007 to 4% by January 2010 and 6% by January 2011. The increase could also indicate that more E-10-compatible cars are in use, or that drivers are more aware of the impacts of greenhouse gas emissions.

Fuels differ in the amount of carbon and energy they contain, and therefore in their emissions of greenhouse gases. The total emissions for the various fuel types in the ACT are shown in Figure 6.

# ACT State of the Environment Report 2011

Figure 6. Emissions by fuel type, ACT



Source: TAMS 2010c

Note: Aviation gasoline and aviation turbine fuel figures are too small to appear on the figure

During the reporting period, emissions from transport (calculated from fuel purchases in the ACT) have largely remained steady (Figure 6). Transport contributes 23% of the emissions directly attributable to the ACT, in addition to a significantly larger share when interstate travel and freight are considered. Reducing transport emissions will be fundamental in achieving the ACT Government’s greenhouse gas reduction targets.

The ACT Government has no specific targets for reducing the greenhouse gas emissions attributable to the transport sector, but it has focused on actions to increase use of sustainable transport options (cycling, walking and public transport) in an effort to reduce emissions. The ACT Government’s Sustainable Transport Plan (TAMS 2006) sets targets to change the mode of travel used for work trips, from car to public transport and walking and cycling. Even if the ACT is on track to achieve these targets, transport sector emissions are still projected to increase to 50-60% above 1990 transport sector emissions levels (ICRC 2011a, Heuris Partners 2010)<sup>1</sup>. This suggests that transport policy will have to be seriously

<sup>1</sup> Calculations are based on ICRC transport emissions data from the 2009 Greenhouse Gas Emissions Inventory (ICRC 2011) and ACT Government-commissioned research into existing policy baseline projections to 2050

# ACT State of the Environment Report 2011

reassessed if offsetting and disproportionate emissions reductions in other sectors are to be avoided.

No targets have been set for non-work modes of travel, or for total vehicle kilometres travelled. A number of initiatives, such as the development of additional park'n'ride facilities, expanded buslanes and rechargeable MyWay cards, have been implemented over the reporting period, and are expected to increase use of sustainable transport options. There is some evidence of an increase, although to date there has been little change in public transport patronage. For information on modes of transport used in the ACT see the *Transport* indicator cluster.

National legislation governs standards for vehicular emissions from vehicles, which include reduced emissions of carbon dioxide. Under this legislation, national average carbon dioxide emissions for passenger and light cars have reduced from 252.4 g/km in 2002 to 212.6 g/km in 2010 (NTC 2011).

The *Green Vehicle Guide* is a national website developed to provide information about the environmental performance of new light vehicles<sup>2</sup> sold in Australia since mid-2004. It is updated regularly as new models come onto the market.

In 2008, the ACT Government introduced incentives for ACT drivers to switch over to low emission cars. The Green Vehicles Duty Scheme prices stamp duty according to the car's emissions, based on a combination of greenhouse gas and particulate emissions. It is difficult to assess the effectiveness of this scheme because there have been significant socio-economic changes over the reporting period: for example, significant petrol price increases, and the global financial crisis. There was an increase in sales of 'environmentally leading cars' from 2% to 4% between 2008 and 2010. However, vehicles with above-average environmental performance still make up less than 20% of the total ACT fleet in 2009-2010. See the *Local air quality* indicator cluster for more information.

Emissions from motor vehicles are affected not only by the emissions emitted per vehicle but also by the number of vehicles, the total distance travelled and the age of vehicles. The total number of vehicles registered in the ACT continued to rise, with an increase of 15.6% between 2005 (219,552) and 2010 (253,848) (ABS 2011a). The total distance travelled had decreased during the last reporting period (from 3234 million km in 2004 to 3014 million km in 2006) but has increased further during this reporting period (to 3539 million km in 2010)

---

(Heuris Partners 2010), as well as estimates of a 3% reduction based on mode-share shifts detailed in the *Draft Sustainable Energy Policy 2010-2020* (DECCEW 2009).

<sup>2</sup> up to 3.5 tonnes gross vehicle mass

# ACT State of the Environment Report 2011

(ABS 2011b). This increase in number of vehicles and distance travelled does not appear to be reflected in fuel sales data which increased by less than 1% over the period.

The ACT Government has commissioned research to identify opportunities and gaps, to find effective options for reaching the greenhouse gas emission targets (Heuris Partners 2010). The report indicated that investments in urban form and integrated community planning, road pricing and public transport will require further work and engagement with the community (Heuris Partners 2010).

## Waste

Although waste makes little contribution to the ACT's carbon dioxide emissions, it makes up a large percentage of the ACT's emissions of two other important greenhouse gases: methane (13%) and nitrous oxide (18%) (DECCEW 2010b). Methane is not retained in the atmosphere for as long as carbon dioxide or nitrous oxide, but it is more effective at trapping heat and therefore has a larger impact over a shorter period of time.

Three strategies have been employed by the ACT Government to reduce waste emissions: reductions in total waste to landfill; recycling of waste materials; and methane capture and subsequent burning for electricity generation.

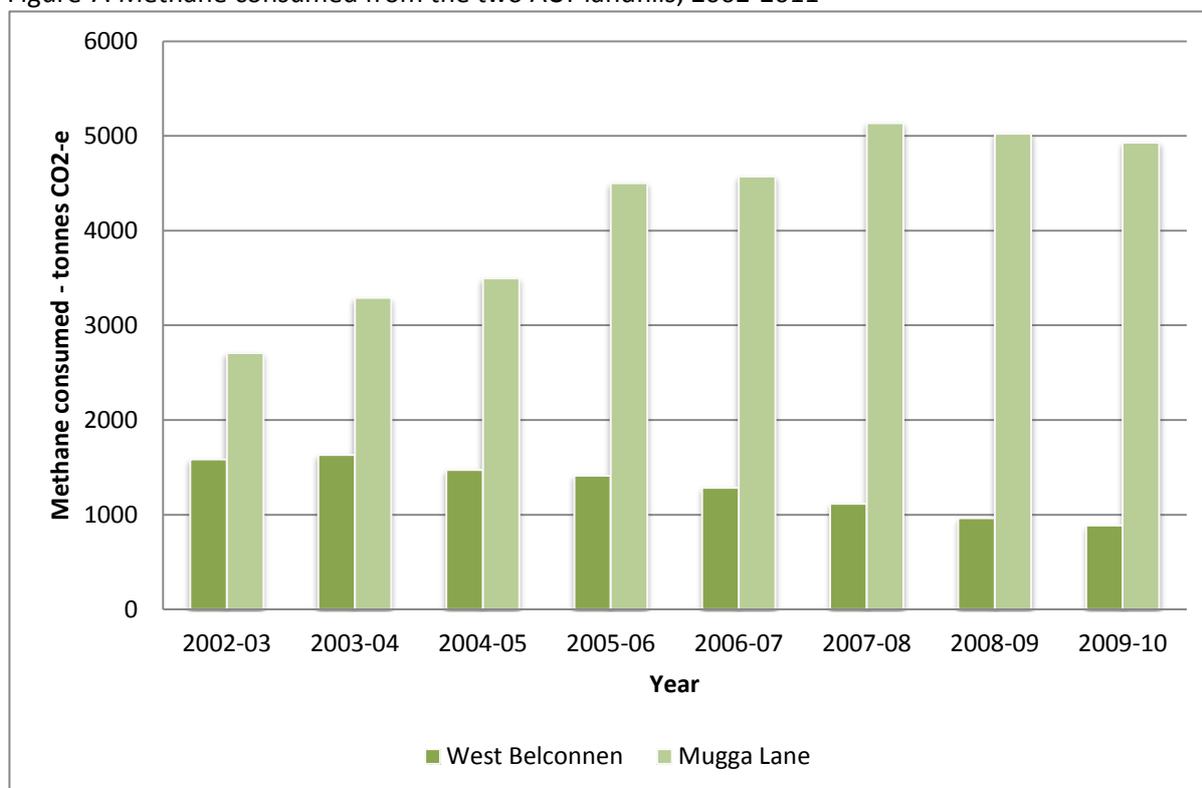
Some years ago, the ACT Government set a goal of achieving no waste going to landfill, through the *No Waste by 2010 - Waste Management Strategy for Canberra* (ACT Government 1996). Despite the gains achieved by this Strategy, the total amount of waste generated by the ACT has increased by 276,092 tonnes (34.7%) during the period from 2007-08 to 2010-11. Over this period, the amount of waste to landfill increased by 29.1% and the amount of resource recovery increased by 36.7%. The ACT is currently considering the *Draft Sustainable Waste Strategy 2010-2025*. The draft strategy has a focus on managing organic waste (a key contributor to methane emissions in landfill) and incorporates targets of over 80% resource recovery by 2015 and over 90% resource recovery by 2025 (DECCEW 2010b). For more information see the *Waste* indicator cluster paper.

In 2008, 13% of the ACT's methane emissions came from landfill. The West Belconnen and Mugga Lane landfills have implemented facilities to capture methane and transform it into a renewable source of energy, rather than burning it as a waste gas. The equivalent quantity of carbon dioxide abated from methane capture in the two facilities is shown in Figure 7. Total methane consumed at the Mugga Lane facility has increased over the last decade (from 2706 tonnes in 2002-03 to 5115 tonnes in 2009-10), providing an increasing waste-to-energy source (from 12,527 MWh in 2002-03 to 22,808 MWh in 2009-10). However, methane capture and use fell slightly over the reporting period. At the West Belconnen site

# ACT State of the Environment Report 2011

methane capture and power generation have declined over the same period, probably because the site has been decommissioned for active waste disposal (DECCEW 2010b).

Figure 7: Methane consumed from the two ACT landfills, 2002-2011



Source: TAMS 2009

Table 2 shows estimates of the total greenhouse gas emissions mitigated by the recycling of various waste materials in the ACT. For further information on recycling in the ACT see the *Waste* indicator cluster.

Table 2. Greenhouse gas savings from recycling

Material	Tonnes recycled 2008-09	Greenhouse gas emissions savings (CO <sub>2</sub> -e tonnes)
Paper	57 000	88 000
Timber	31 000	5000
Glass	16 000	5000
Aluminium	2000	30 000
Steel cans	1000	1000

Source: DECCEW 2010b

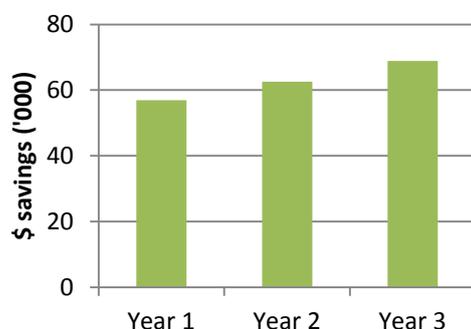
# ACT State of the Environment Report 2011

## Emissions reduction by infrastructure, buildings and industry

### Infrastructure emissions reductions

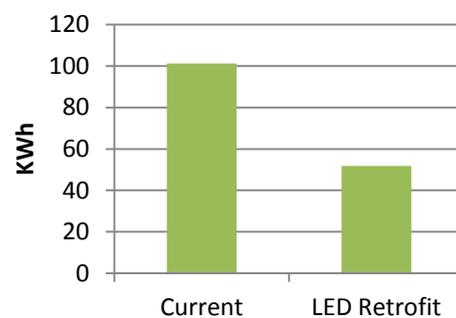
Infrastructure typically has a life-span of several decades, and is an important component of a government's budget. Consequently, the ACT Government has invested in emissions reduction schemes such as energy efficient lighting, which has projected cost savings of \$187,446 over three and a half years (Figure 8) and energy savings of 50 kWh (Figure 9).

Figure 8. Projected savings from street lamp retrofit



Source: TAMS 2010d

Figure 9. Comparison of energy use pre- and post-retrofit



Source: TAMS 2010d

In addition, the ACT Government has implemented initiatives to both reduce electricity consumption and increase renewable energy uptake, including mandating building energy efficiency. The effectiveness of these actions has not been measured, but with emissions from electricity consumption being the largest contributor to total greenhouse gas emissions, it is important to assess the effectiveness of emission reduction actions in this sector.

### Building emission reduction

There are a number of voluntary systems for measuring the sustainability of new buildings. Some, such as the National Australian Built Environment Rating System (NABERS), measure the actual performance of the building, and can include behaviour and appliances. Others, such as Green Star, which is used to rate buildings in the ACT, predict performance at the building-design stage.

Since 2006 the Australian Government has required that all new government office leases comply with Green Lease Schedules, which stipulate a NABERS energy rating of at least 4.5 stars energy (exclusive of GreenPower) for all new leases. This has resulted in an incremental upgrading of commercial buildings in Canberra, for

# ACT State of the Environment Report 2011

example when Australian Government departments have changed tenancies or constructed purpose-built facilities.

There are 24 green-star buildings in the ACT (Green Building Council 2011), of which 2 are 6-star, 12 are 5-star and 10 are 4-star, and there are 6 buildings registered for green-star education design, office design or office interiors. The 6-star buildings in the ACT are 9/31 City West Offices and AEI Premises in Trevor Pearcey House.

In 2011 the ACT Government released draft amendments to the Territory Plan which aim to improve solar efficiency of houses through aspects of their design and position on a block. The amendments have been implemented in the new suburbs of Coombs and Wright, and multi-unit developments there will have to meet a 7-star energy rating under the Nationwide House Energy Rating Scheme (NatHERS).

For more information see the *Urban quality* indicator cluster paper.

A recent report has identified a number of opportunities for emission reductions in the ACT in the buildings in the residential and commercial sectors (Heuris Partners 2010). This work should be considered in the development of the new Climate Change Action Plan as well as in relevant planning documents.

## Community engagement

The ACT Government runs a number of programs to support the community in energy, waste and transport efficiency (Table 3). As Table 3 shows, programs have ranged in their levels of uptake.

Table 3. ACT Government programs with a community environmental focus

Type	Name and date commenced	Uptake
Commercial / Business resource efficiency programs	CitySwitch, 2009	<ul style="list-style-type: none"> <li>16 organisations participating</li> </ul>
Residential energy efficiency programs	HEAT program, 2005	<ul style="list-style-type: none"> <li>Inquires – 32,308</li> <li>Audits – 5217</li> <li>Rebates – 2416</li> </ul>
Low income energy efficiency programs	Outreach, 2010	<ul style="list-style-type: none"> <li>1002 individuals</li> </ul>
	WEST Plus program, 2011	<ul style="list-style-type: none"> <li>Audits – 54</li> <li>Education Sessions – 16</li> <li>Retrofits - 20</li> </ul>
Waste reduction programs	ACT Smart Business & Office, 2009-10	<ul style="list-style-type: none"> <li>52 organisations accredited</li> <li>281 organisations participating</li> </ul>

# ACT State of the Environment Report 2011

Type	Name and date commenced	Uptake
Transport	TravelSmart, 2007	<ul style="list-style-type: none"> <li>11,000 household pilot (not ACT-wide)</li> </ul>
Schools	AuSSI ACT School Program, 2007-08	<ul style="list-style-type: none"> <li>Registration - 120 schools</li> <li>Energy Audits - 67 schools</li> </ul>
Renewable energy	Solar feed-in tariff, 2009 (closed 2011)	<ul style="list-style-type: none"> <li>6057 connections</li> </ul>

Source: DECCEW, ICRC 2011b

Amounts of emissions reduced by such programs are not available and are difficult to quantify. In 2010-11, the ACT Government also provided a grants program targeting climate change action. Eight community organisations received grants for actions, such as the 2011 Canberra International Electric Vehicle Festival, and the Residential Greenhouse Gas Reduction Awards. It is likely that the climate change grants will be incorporated into wider environmental grants in the future.

Community groups also make an important contribution to emissions reduction in the ACT through activities to encourage sustainable transport, energy efficiency and education and awareness. Community groups in the ACT are also increasingly focused on climate change; for instance, SEE-Change, and Canberra ♡ 40% are taking on community leadership in solar energy and emission reduction activities.

More information on community engagement to reduce emission is provided in the *Community engagement* indicator cluster paper.

## Glossary

**GreenPower:** GreenPower is a voluntary government accredited program that allows electricity retailers to purchase renewable energy on behalf of customers. For details see <http://www.greenpower.gov.au/> **Carbon neutrality:** Carbon neutrality, or having a net zero carbon footprint, refers to achieving net zero carbon emissions by balancing a measured amount of carbon released with an equivalent amount sequestered or offset, or buying enough carbon credits to make up the difference. It is used in the context of carbon dioxide releasing processes, associated with transportation, energy production and industrial processes

**CO<sub>2</sub>-e:** carbon dioxide equivalents - they express the global warming potential of all greenhouse gases as single figure based on the potential warming of carbon dioxide

# ACT State of the Environment Report 2011

## References

- ABS 2011a. *Motor Vehicle Census, Australia*. Cat.no. 9309.0. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/03CFF66BA0471A68CA257829001168D6/\\$File/93090\\_31%20Mar%202010.pdf](http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/03CFF66BA0471A68CA257829001168D6/$File/93090_31%20Mar%202010.pdf) (accessed 17/11/11)
- ABS 2011b. *Survey of Motor Vehicle Use, Australia, 12 months ended 31 October 2010*. Cat.no. 9208.0 Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/4576F71CCF2E9F65CA2578F4001E5E98/\\$File/92080\\_12%20months%20ended%2031%20october%202010.pdf](http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/4576F71CCF2E9F65CA2578F4001E5E98/$File/92080_12%20months%20ended%2031%20october%202010.pdf) (accessed 4/9/11)
- ACT Government 1996. *No Waste by 2010 – A Waste Management Strategy for Canberra*. Canberra.  
[http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0013/12460/nowasteby2010strategy.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0013/12460/nowasteby2010strategy.pdf) (accessed 3/5/11)
- ACT Government 2007. *Weathering the Change. ACT Climate Change Strategy – Action Plan 1, 2007-2011*. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/144527/Climate\\_Change\\_Action\\_Plan.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0005/144527/Climate_Change_Action_Plan.pdf) (accessed 28/11/11)
- ACT Government 2010. *Climate Change and Greenhouse Gas Reduction Act 2010*. Current on 5 November 2011. Canberra. <http://www.legislation.act.gov.au/a/2010-41/current/pdf/2010-41.pdf> (accessed 15/8/11)
- CEF 2011. *Working Together for a Clean Energy Future*. Clean Energy Future. Australian Government. Canberra. <http://www.cleanenergyfuture.gov.au/> (accessed 1/12/11)
- DECCEW 2009. *Draft Sustainable Energy Policy 2010-2020*. Department of the Environment, Climate Change, Energy and Water. Act Government. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/174687/Draft\\_Sustainable\\_Energy\\_Policy\\_FINAL.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0006/174687/Draft_Sustainable_Energy_Policy_FINAL.pdf) (accessed 7/11/11)
- DECCEW 2010. *ACT Climate Change Strategy: Weathering the Change - Action Plan 1 Review*. Department of the Environment, Climate Change, Energy and Water. ACT Government. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/201110/Kinesis\\_review\\_Action\\_Plan\\_1.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0005/201110/Kinesis_review_Action_Plan_1.pdf) (accessed 5/9/11)
- DECCEW 2010b. *Draft Sustainable Waste Strategy 2010-2025*. Department of the Environment, Climate Change, Energy and Water. ACT Government. Canberra  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/210501/SustainableWaste\\_Strategy\\_WEB.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0009/210501/SustainableWaste_Strategy_WEB.pdf) (accessed 1/10/11)

# ACT State of the Environment Report 2011

- DECCEW 2011. *Sustainable Energy Policy: Energy for a Sustainable City 2010-2020*. Department of the Environment, Climate Change, Energy and Water. ACT Government. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0003/232284/EDS\\_ACT\\_Sustainable\\_Energy\\_Policy\\_FA\\_web\\_A.PDF](http://www.environment.act.gov.au/__data/assets/pdf_file/0003/232284/EDS_ACT_Sustainable_Energy_Policy_FA_web_A.PDF) (accessed 7/11/11)
- Engineers Australia 2010. *ACT Infrastructure Report Card*. Canberra.  
[http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file\\_uid=C8F26346-DB84-45EF-E104-B53E726D4A61&siteName=ieaust](http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file_uid=C8F26346-DB84-45EF-E104-B53E726D4A61&siteName=ieaust) (accessed 20/6/11)
- Grattan Institute 2010. *Learning the Hard Way: Australia's Policies to Reduce Emissions*. Melbourne.  
[http://www.grattan.edu.au//publications/077\\_report\\_energy\\_learning\\_the\\_hard\\_way.pdf](http://www.grattan.edu.au//publications/077_report_energy_learning_the_hard_way.pdf) (accessed 14/10/11)
- Green Building Council 2011. *Green Star Project Directory*. Sydney.  
<http://www.gbca.org.au/greenstar-projects/> (accessed 19/06/11)
- GreenPower 2011. *GreenPower: Accredited Renewable Energy*. Green Power. Australian Government. Canberra. <http://www.greenpower.gov.au/> (accessed 28/11/11)
- Hamilton, L. 2008. *Firewood and Woody Biomass and their Role in Greenhouse Gas Reduction*. Department of Primary Industries. Australian Government.  
[http://www.homeheat.com.au/pdf/Heating\\_Greenhouse\\_Gas.pdf](http://www.homeheat.com.au/pdf/Heating_Greenhouse_Gas.pdf) (accessed 27/7/11)
- Heuris Partners 2010. *ACT Greenhouse Gas Emissions: Existing policy baseline projections to 2050 - Research Report*. Heuris Partners. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0008/187217/ACT\\_Greenhouse\\_Gas\\_Emissions.pdf#ACT%20Greenhouse%20Gas%20Emissions](http://www.environment.act.gov.au/__data/assets/pdf_file/0008/187217/ACT_Greenhouse_Gas_Emissions.pdf#ACT%20Greenhouse%20Gas%20Emissions) (accessed 7/11/11)
- ICRC 2009. *Electricity Feed-in Renewable Energy Premium: Determination of Premium Rate, Report 9 2009*. Independent Competition and Regulatory Commission. Canberra.  
[http://www.icrc.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/172629/Report\\_9\\_of\\_2009\\_November\\_2009.pdf](http://www.icrc.act.gov.au/__data/assets/pdf_file/0009/172629/Report_9_of_2009_November_2009.pdf) (accessed 11/11/11)
- ICRC 2011a. *ACT Greenhouse Gas Inventory Report for 2008-09*. Independent Competition and Regulatory Commission. Canberra.  
[http://www.icrc.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/235719/ACT\\_Greenhouse\\_Gas\\_Inventory\\_Report\\_2009\\_Final.pdf](http://www.icrc.act.gov.au/__data/assets/pdf_file/0009/235719/ACT_Greenhouse_Gas_Inventory_Report_2009_Final.pdf) (accessed 11/10/11) Intergovernmental Panel on Climate Change (IPCC). 2001. *IPCC Third Assessment Report* (IPCC, 2001 a,b,c): Annex B Glossary of Terms, <http://www.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf> (accessed 19/6/11)
- ICRC 2011b. *ACT Electricity Feed-in Scheme Activity Summary: 1 March 2009 to 30 June 2011*. Independent Competition and Regulatory Commission. Canberra.

# ACT State of the Environment Report 2011

[http://www.icrc.act.gov.au/\\_\\_data/assets/pdf\\_file/0015/230208/Electricity\\_Feed-in\\_Summary\\_Report\\_JuneQ11\\_Final.pdf](http://www.icrc.act.gov.au/__data/assets/pdf_file/0015/230208/Electricity_Feed-in_Summary_Report_JuneQ11_Final.pdf) (accessed 1/8/11)

IPCC 2001. *Climate Change 2001: Synthesis Report - A Contribution of Working Groups I, II, III to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Intergovernmental Panel on Climate Change. Cambridge and New York.

<http://www.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf> (accessed 19/6/11)

NTC 2011. *Carbon Dioxide Emissions from New Australian Light Vehicles 2010 - Information Paper*. May 2011. National Transport Commission, Melbourne.

<http://www.ntc.gov.au/DocView.aspx?DocumentId=2135> (accessed 18/11/11)

OCSE 2010. *Report on an Audit/Assessment of ACT Government Agencies' Environmental Performance Reporting*. Office of the Commissioner for Sustainability and the Environment. Canberra. unpublished.

ORER, 2011. *Renewable Power Percentage*. Office of the Renewable Energy Regulator. Australian Government. Canberra. <http://www.orer.gov.au/For-Industry/Liable-Entities/Renewable-Power-Percentage/rpp#interim> (accessed 11/11/11)

Paul, K., Booth, T., Elliot, A., Jovanovic, T., Polglase, P. and Kirschbaum, M. 2003. *Life Cycle Assessment of Greenhouse Gas Emissions for Domestic Woodheating - Greenhouse Gas Emissions from Firewood Production Systems*. Australian Greenhouse Office. Australian Government. Canberra. <http://utting.net.au/doc/lifecycle.pdf> (accessed 12/3/11)

Spotless 2011. *Energy Efficiency and Climate Change Strategy 2011 to 2017*. Report by Spotless to Department of Housing and Community Services. ACT Government. Canberra

TAMS 2006. *Sustainable Transport Plan for the ACT*. Department of Territory and Municipal Services. ACT Government. Canberra. [http://www.tams.act.gov.au/move/sustainable\\_transport/sustainable\\_transport\\_plan\\_actions/sustainable\\_transport\\_plan](http://www.tams.act.gov.au/move/sustainable_transport/sustainable_transport_plan_actions/sustainable_transport_plan) (accessed 13/4/11)

## Other data sources

In addition to these published reports, data for this paper were also sourced from:

ACT Department of the Environment, Climate Change, Energy and Water (DECCEW) - now Environment and Sustainable Development Directorate (ESDD)

ACT Department of Territory and Municipal Services - now Territory and Municipal Services Directorate (TAMSD)

Independent Competition and Regulatory Commission (ICRC)

# ACT State of the Environment Report 2011

## THEME: Climate

### Indicator Cluster: Climate vulnerability

The indicators for this cluster are

- *Climate and water resources (P)* - the pressures from a changing climate on water resources including rainfall, inflows into dams, and evaporation;
- *Climate and fire (P)* - the pressures from a changing climate;
- *Climate and human health (I)* - including heat related illness and death, food and water shortages, malnutrition and disease; and
- *Climate and native species (I)* - major challenges to native species and ecosystems from a changing climate.

**Condition indicators (C)** present data that tell us the state of the environment at any particular time.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

## Summary

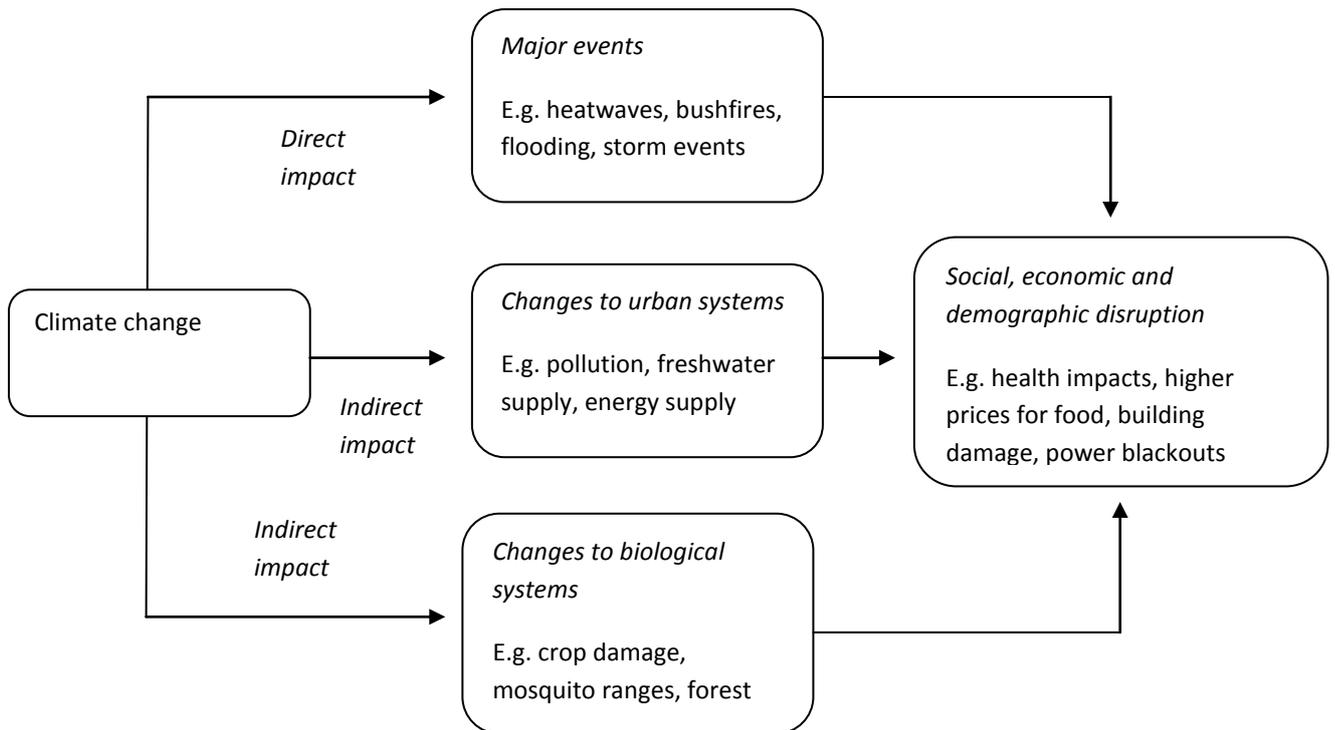
In the coming decades impacts from climate change are predicted to become increasingly prevalent in the ACT. Climate change could bring additional pressures to bear on the Territory's water resources and biodiversity, and may significantly change the patterns of bushfire and extreme weather events. Predicted climate change impacts are likely to place additional pressure on the existing burden of disease and add to existing health risks (and therefore to the demand on health facilities).

## Introduction

Climate change will have direct and indirect impacts on the urban, social and natural environment of the ACT (Figure 1). This indicator cluster paper investigates the likely consequences for the ACT's water resources and bushfire sensitivity, and assesses potential impacts on human health and native species.

# ACT State of the Environment Report 2011

Figure 1. Potential climate change impacts



Source: based on ACT Government 2007

## Condition indicators

There are no condition indicators for this indicator cluster.

The most likely future climate scenario for the ACT includes (Webb 2011):

- the strong likelihood of mean temperatures continuing to increase, along with more frequent and severe heatwaves for the ACT and region; and
- a high probability of changes in the pattern of rainfall from that observed during the period of instrumental records, with some risk of a decline in long-term average rainfall; and in addition, the likelihood of an increase in rainfall intensity with more extreme rainfall events.

In terms of the physical impacts, expected changes in climate are likely to lead to (Webb 2011):

- increased evaporation (especially in spring and summer), which, combined with potential changes in rainfall, is likely to result in reduced soil moisture (particularly in winter and spring if autumn rainfalls also remain historically low);

# ACT State of the Environment Report 2011

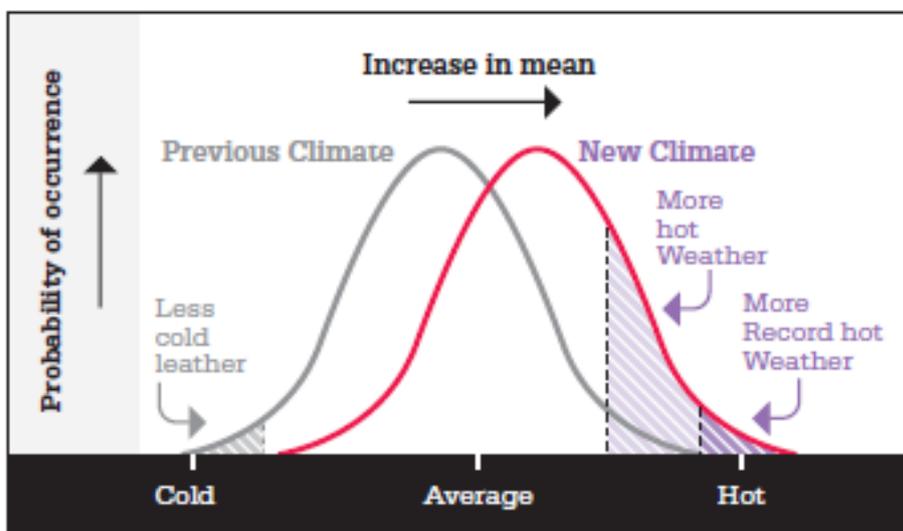
- changes in run-off and streamflows, with higher evaporation in spring and summer tending to reduce run-off during those periods;
- an increase in the severity of drought because of higher temperatures;
- more frequent and intense bushfires overall, because of higher temperatures, drier conditions and lower humidity, with extension of the fire season into spring; changes in fuel availability will add significant uncertainty in projections; and
- more intense flood-producing rainfall events with impacts depending in part on the prevailing catchment conditions (i.e. soil moisture and levels in major water storages).

For more information on weather and climate see the *Driving Forces* paper.

## Pressure indicators

Small changes in average values of climatic parameters such as temperature and rainfall can lead to large changes in the frequency and intensity of extreme events such as heatwaves, storms and fires (see Figure 2).

Figure 2. Relationship between means and extremes



Source: Commonwealth of Australia 2011

Thinking forward to the year 2050, Table 1 shows the projected mean number of days above 35°C and 40°C for two modelled scenarios, in comparison to the current climate.

# ACT State of the Environment Report 2011

Table 1: Mean annual number of days above 35°C or above 40°C if a 2°C global warming by 2050

	<i>Current climate*</i>	<i>Most likely future climate</i>	<i>Worst case scenario</i>
Mean annual number of days above 35°C	5 days	20 days	21.5 days
Mean annual number of days above 40°C	Around 0.1 day	2 days	2.7 days

Source: AECOM 2010 (based on work by BOM and CSIRO)

\*Note: The “current climate” annual number of days >35°C and >40°C is the 1939-2010 mean for Canberra Airport.

## Climate and water resources

Over the past decade the ACT has experienced long periods of drought which have resulted in water stress. The ACT draws its potable water supply from three catchments and four reservoirs. See the *Water supply* indicator cluster for more information.

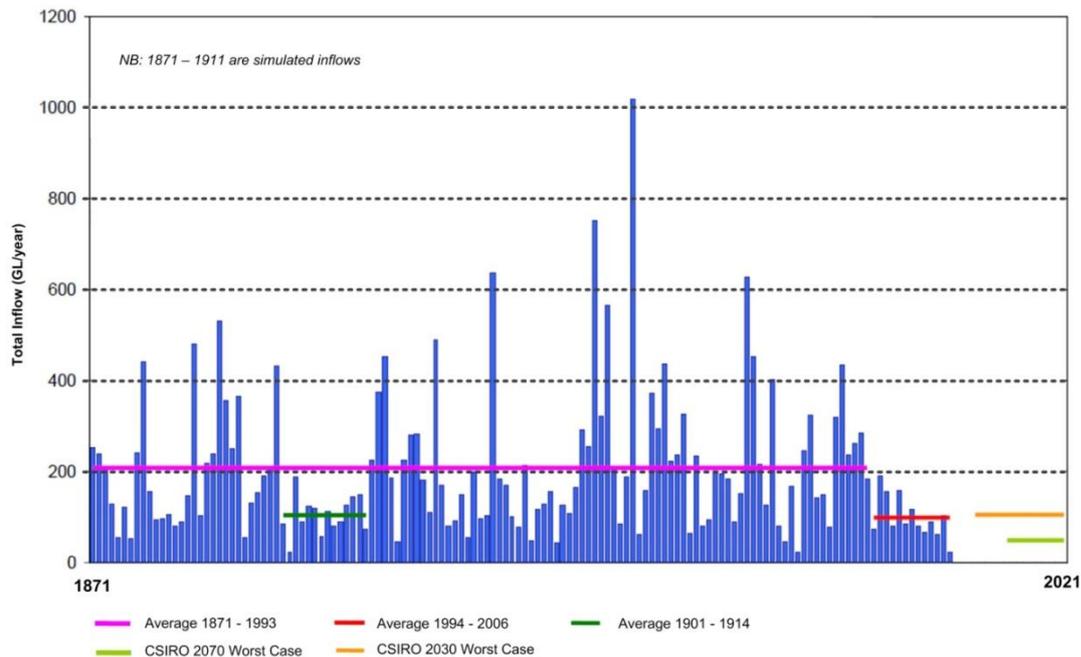
Urban water consumption in the ACT tends to increase in the summer months when residents give more water to their gardens (Engineers Australia 2010). Consequently, increases in average temperatures lead to increases in potable water consumption. Work commissioned by ACTPLA indicates that some of the older suburbs in Canberra use more water because the house blocks are large and the gardens were mostly designed during wet decades, with little consideration given to outdoor water use (AECOM 2010). Such areas are likely to be more vulnerable to cuts in water supply.

Regardless of changes in rainfall, the predicted rise in average temperatures in the region is likely to increase the demand for water in the ACT, increasing the pressure on overall water storage. In planning for future water availability, ACTEW is assuming average annual total inflows to the three main reservoirs will be around 105 GL per year (ACTEW 2007). This is significantly less than the average annual inflows estimated by CSIRO research in 2005 (132 GL per year) and than the previous average annual inflows (approximately 200 GL per year).

All three of the ACT’s water supply catchments are dependent on rainfall to fill the storages, resulting in a water supply that is highly sensitive to changes in rainfall patterns. Studies by ACTEW show that the surface runoff feeding the dams has decreased since the 1990s. The decline in historic flows to ACT reservoirs is shown in Figure 3. The major damage caused by the 2003 bushfire in the Cotter catchment resulted in increased runoff in the short term because of the loss of vegetation, and reduced runoff in the long term because of the rapid rate of vegetation regrowth (Engineers Australia 2010).

# ACT State of the Environment Report 2011

Figure 3. Annual inflows to Corin, Bendora and Googong reservoirs 1871-2006



Source: ACTEW 2007

Note: 1871-1911 are simulated inflows

Reporting in *Climate Change Impacts on Australia and the Benefits of Early Action to Reduce Global Greenhouse Gas Emissions* (Hennessy 2006) shows that inflows to reservoirs in NSW have been projected to decrease by up to 15% for every 1°C increase in temperature. Mean rainfall is expected to show little change.

For more information on water supply and condition of water bodies see the *Water supply and River, lakes and wetlands health* indicator clusters.

## Climate and fire

### Climate and fire in urban areas

Much of the ACT population lives on the border of, or close to, bushland, putting these residents at increased risk from bushfire. Furthermore, a percentage of the ACT's urban environment is situated on vegetated mid slopes and in valley bottoms - areas at increased risk from bushfire. The greater the slope, the higher the potential for high-speed fire movement (Bradstock et al. 1998). The risk that fire poses to the ACT urban population became apparent in 2003 when bushfires burned 500 homes and around 70% of the Territory's forests and pasture land.

Historically, fire managers have used fire danger indices. Examples include the Forest Fire Danger Index (FFDI) and Grassland Fire Danger Index (GFDI) that provide an indication of fire risk based on various combinations of weather variables, including daily temperature,

# ACT State of the Environment Report 2011

precipitation, relative humidity and wind-speed. These indices are also used to raise awareness and set up prevention measures, by being displayed on boards across the Territory. They have been used in combination with other indicators to represent overall exposure to bushfire under a changing climate (see Table A1 in the Annex to this paper).

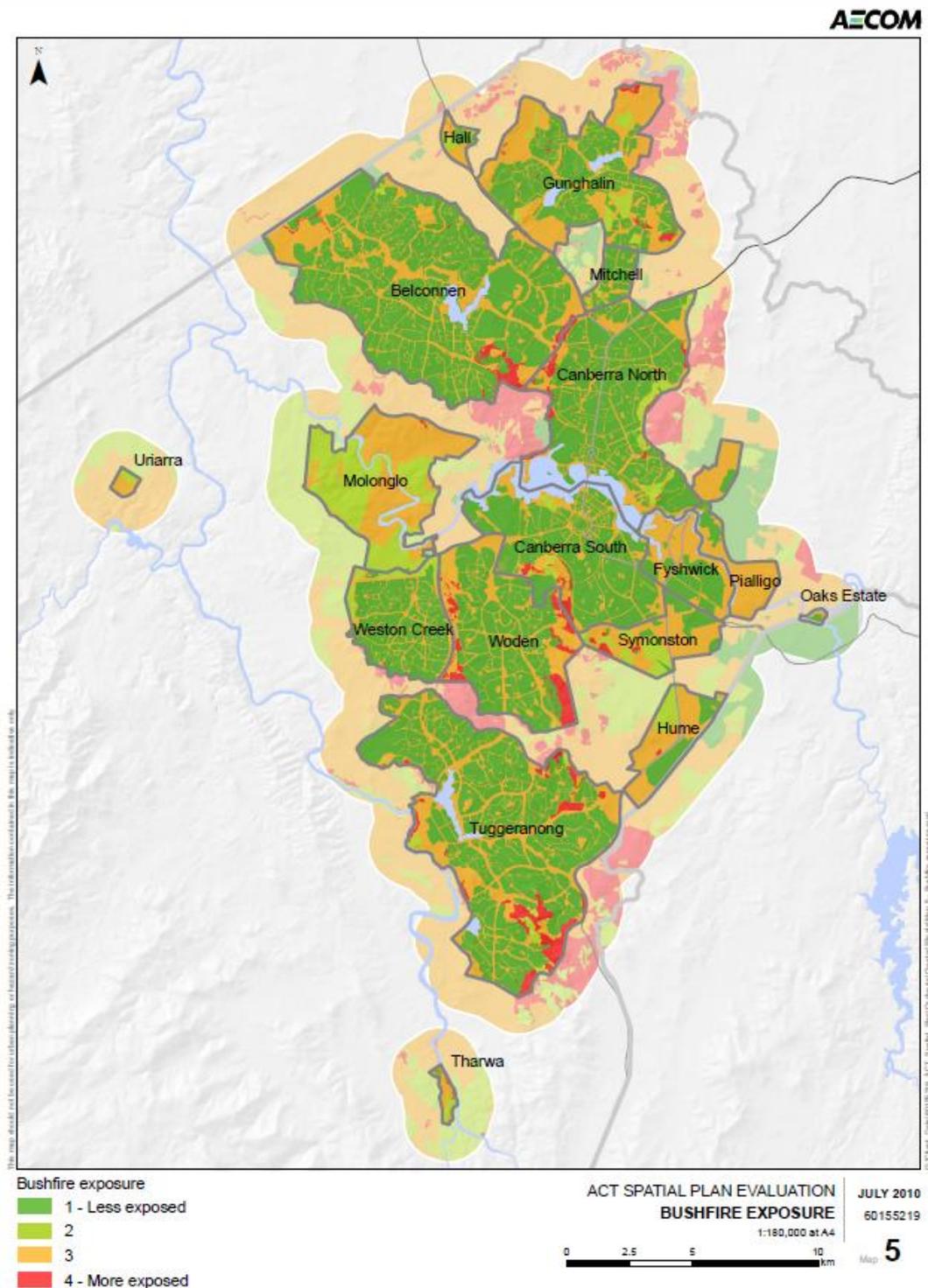
As a result of potentially hotter and drier conditions, it is expected that bushfire risk will increase. The average number of days when the FFDI is rated very high or extreme under present conditions, and for the year 2050, are (Hennessy et al. 2006):

- Present conditions - 23 days;
- 2050 (low level) - 28 days; and
- 2050 (high) - 36 days.

Figure 4 shows the exposure to bushfire as a result of predicted climate change (in 2050 after mean warming of 2°C) across ACT suburbs, based on the factors presented in Table A1 (Annex). The map is useful to show where more exposure to bushfire may exist as a result of overlapping of influential factors affecting vulnerability levels.

# ACT State of the Environment Report 2011

Figure 4: Exposure to bushfire



Source: AECOM 2010

If fire patterns change, that will not only affect humans and the urban area but biodiversity as well. Changes to fire regimes can change species distribution and populations (Webb 2011). However, the interdependencies between ecosystems and fire regimes are complex. Some modelling of the impacts of climate change on fire regimes has been undertaken for

# ACT State of the Environment Report 2011

the ACT, and it predicted that a 2°C increase in mean annual temperature would increase the landscape measure of fire intensity by 25%, and increase the area burnt, and reduce the intervals between fires (Webb 2011).

## Impact indicators

### Climate and human health

Climate change impacts on human health could be both direct (e.g. heatwaves) and indirect (e.g. extreme weather events such as fires and floods have consequences for food availability, which can have health implications). Predicted climate change impacts are likely to place additional pressure on the existing burden of disease, and add to existing health risks (and therefore to the demand on health facilities) (Rotstein and Webb 2009). In the ACT and region, more frequent heatwaves, bushfires and drought are likely to increase health risks, especially for vulnerable population groups such as the aged, and rural communities, and people with low income (Rotstein and Webb 2009).

Likely health impacts from climate change include (Garnaut 2008 in Rotstein and Webb 2009):

- temperature-related illness and death;
- food and water-borne diseases resulting from changes in water quality and the range of bacteria and pests;
- respiratory disease;
- mental health disorders because of social disruptions;
- vector-borne disease because of a change in the ranges of types of mosquitoes and other disease-carrying species; and
- injury, trauma and related effects from an increase in extreme weather events.

### Heatwaves

The more frequent and intense heatwaves that are predicted as a result of changing climatic conditions in the ACT are likely to exacerbate existing health conditions. The highest risks will be faced by the most vulnerable groups of society, including the elderly, the very young, and those dealing with other health, social and economic factors (McInnes et al. 2008). Existing stresses in the health system are also likely to be worsened by climate change.

As climate patterns change, days of extreme heat are likely to become more common. Factors listed in Table 2 help indicate groups that will be sensitive to more frequent and intense heatwaves (Table 2).

# ACT State of the Environment Report 2011

Table 2: Factors used for a measure of extreme heat sensitivity

Factors	Description
Daily extreme temperature	Characterises the pattern of daily extreme temperature in the ACT based on gridded data from the Bureau of Meteorology
Changes in annual number of days >35°C and days >40°C	Based on CSIRO projections, this factor shows changes in hot and very hot days for the ACT compared to historical data
Relevant health conditions in the population	Combines information on the prevalence of conditions in the population from major diagnostic categories that may influence sensitivity to extreme heat events. These include diseases and disorders of the respiratory system, circulatory system, hepatobiliary system and pancreas, kidney and urinary tract, newborns and other neonates and mental diseases or disorders
Number of general practitioners per 10,000 inhabitants in each area	Provides an indirect measure of the access to health practitioners within each area during heatwave events

Source: AECOM 2010

Historically there are strong correlations between extreme heat events, heat-related morbidity and vulnerable groups of people. The International Federation of Red Cross and Red Crescent Societies reported that during the record-breaking heatwave of August 2003 in Europe, between 22,000 and 35,000 excess deaths occurred in a two-week period (Walter, 2004). Not all of these deaths are attributed directly to the heatwave. Some were because the heat exacerbated pre-existing illnesses, 'particularly cardiovascular and respiratory diseases, and diseases of the nervous system' (McInnes et al. 2008). A 2008 study of the relationship between heatwaves and hospital admissions in Adelaide in South Australia (Hansen et al. 2008) found a correlation between renal disease and acute renal failure and heatwaves. The increasing mean age of the Australian population is compounding the risks to human health from predicted climate change, because the elderly are generally more susceptible to poor health.

The greatest threat from heatwaves arises when there are consecutive days of maximum day-time temperatures much hotter than usual for the location, with hot nights, early in the summer (McInnes et al. 2008). People are more at risk if they live in a city, if they live in housing that does not have insulation, and if there are bedrooms located directly under the roof. Fans are not considered effective in times of high humidity and temperature, and may in fact be harmful in enclosed hot environments (McInnes et al. 2008).

# ACT State of the Environment Report 2011

## Climate and native species

More than 1700 species and ecological communities in Australia are known to be threatened and at risk of extinction (NRMMC 2010). Climate change is predicted to be a contributing factor adding to the risk of native species extinction. Direct impacts are likely to result from changes in the number, abundance and range and genetic traits of species, changes in the phenology and seasonal occurrence of key processes and change in species' vegetal productivity and morphology. Further indirect impacts are expected in relation to water availability, fire and pest distribution (AECOM 2009).

A 2011 comprehensive review of climate change implications for the ACT Nature Reserves included some information on the vulnerability of ACT native species, drawn from earlier work (Sharp et al. 2008 in Webb, 2011) which indicated that:

- Natural Temperate Grassland and Snow Gum / Candlebark tableland woodland are potentially vulnerable lowland ecosystems dependent on low temperature conditions for their distribution; higher temperatures could also support invasion by other species;
- reduced water availability will potentially affect fish through their migration and spawning patterns, as well as other aquatic vertebrates, macroinvertebrates and macrophytes as well as adjacent riparian systems; and
- riparian systems with less flow and flooding are potentially vulnerable to non- riparian weed invasion.

Climate change will increase the vulnerability of species directly through: heat stress and changes to growth and water use in plants; concentration of nutrients and toxins in leaves; timing of seed germination and flowering in plants; and egg laying and hatching in birds, reptiles and insects (Webb 2011). Those at most risk from climate change are species that are sensitive to physiological tolerances, reliant on symbiotic relationships with other species, limited in their capacity to move and dependent on habitat that is likely to disappear (DECCW 2010). Some hardy generalists and invasive species are expected to persist and spread. The ecosystems of the ACT are already being affected by climate change, as indicated by a number of extinctions, functional extinctions and threatened species; changes in relative abundance, diversity, distribution and range of species; and in an increased presence of introduced species in the ACT (Webb 2011).

During the reporting period, a multidisciplinary team analysed at national level the interactions between climate change, fire regimes and biodiversity in Australia (Williams et al. 2009). The two biomes of relevance to the ACT were temperate / cool sclerophyll forests of south-eastern Australia (similar to the south-west of the ACT in Namadgi National Park) and the temperate grassy woodlands of inland eastern Australia (similar to the north-east

# ACT State of the Environment Report 2011

area of the ACT including the nature reserves). The study concluded that climate impacts on bushfire risk are significant in forest, grassy woodland and grassland areas. However, these impacts may be greater in forested areas in the ACT and region (Williams et al. 2009). Further research is needed on the impacts of climate change on fuel loads and the potential rates of fire spread (Williams et al. 2009).

For more information on climate change impacts on biodiversity see the *Threatening processes* indicator cluster in the *Biodiversity* theme.

## References

- ACT Government 2007. *Weathering the Change - The ACT Climate Change Strategy 2007-2025*. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/144529/Climate\\_Change\\_Strategy.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0007/144529/Climate_Change_Strategy.pdf) (accessed 13/11/11)
- ACTEW Corporation 2007. *Water Security for the ACT and Region, Recommendations to the ACT Government*. Canberra.  
[http://www.bom.gov.au/water/nwa/2010/canberra/files/pdfs/1\\_Water\\_security\\_\\_recommendations\\_to\\_ACT\\_Govt\\_Jul\\_20071.pdf](http://www.bom.gov.au/water/nwa/2010/canberra/files/pdfs/1_Water_security__recommendations_to_ACT_Govt_Jul_20071.pdf) (accessed 12/9/11)
- AECOM 2009. *Identifying Climate Change Adaptation Strategies to inform Wetland and Floodplain Management Along the River Murray in SA*. South Australia Murray-Darling Basin Natural Resources Management Board. unpublished
- AECOM 2010. Human Settlement Vulnerability and Adaptive Capacity Assessment – Spatial Plan Evaluation. Report for ACT Planning and Land Authority. AECOM.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/20410/2010\\_09\\_08\\_ACTPLA\\_CC\\_Vulnerability\\_v2\\_LowResolution.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0007/20410/2010_09_08_ACTPLA_CC_Vulnerability_v2_LowResolution.pdf) (accessed 19/9/11)
- Bradstock, R. A., Bedward, M., Kenny, B. J. and Scott, J. 1998. Spatially-explicit simulation of the effect of prescribed burning on fire regimes and plant extinctions in shrublands typical of south-eastern Australia. *Biological Conservation*. 86: 83-95
- Commonwealth of Australia (Department of Climate Change and Energy Efficiency) 2011. *The Critical Decade Climate science, risks and responses*. Climate Commission, Canberra.  
[http://climatecommission.gov.au/wp-content/uploads/4108-CC-Science-WEB\\_3-June.pdf](http://climatecommission.gov.au/wp-content/uploads/4108-CC-Science-WEB_3-June.pdf)
- CSIRO 2010. *Climate Futures for Canberra*. Report for AECOM. Commonwealth Scientific and Industrial Research Organisation. Canberra
- DECCEW 2010. *Review of the Nature Conservation Act 1980, Enhancing nature conservation in the Australian Capital Territory*. Department of the Environment, Climate Change, Energy and Water  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/209984/Review\\_of\\_the\\_Nature\\_Consevation\\_Act\\_Discussion\\_Paper\\_WEB.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0005/209984/Review_of_the_Nature_Consevation_Act_Discussion_Paper_WEB.pdf) (accessed 02/8/2011)
- Engineers Australia 2010. *Infrastructure Report Card*. Canberra Division, 13 July 2010.  
[http://www.engineersaustralia.org.au/sites/default/files/shado/Infrastructure%20Report%20Cards/ACT/entire\\_report.pdf](http://www.engineersaustralia.org.au/sites/default/files/shado/Infrastructure%20Report%20Cards/ACT/entire_report.pdf) (accessed 7/9/11)

# ACT State of the Environment Report 2011

- Hansen, A., Peng, L., Ryan, P., Nitschke, M., Pisaniello, D., and Tucker, G., 2008. The effect of heat waves on hospital admissions for renal disease in a temperate city of Australia. *International Journal of Epidemiology*. 37:1359–1365  
<http://ije.oxfordjournals.org/content/37/6/1359.full.pdf+html> (accessed 18/10/11)
- Hennessy, K., Lucas, C., Nicholls, N., Bathols, J., Suppiah, R., Ricketts, J. 2006. *Climate change impacts on fire-weather in south-east Australia*. CSIRO, Australia
- McInnes, J., Ibrahim, J. and Loughnan, M. 2008. *Reducing harm to older persons in Victoria from extreme hot weather*. Centre of Research Excellence in Patient Safety. Monash University. Final Report to the Department of Human Services, Victoria. Melbourne.  
[http://www.health.vic.gov.au/environment/downloads/reducing\\_harm\\_monash.pdf](http://www.health.vic.gov.au/environment/downloads/reducing_harm_monash.pdf) (accessed 15/9/11)
- Natural Resource Management Ministerial Council (NRMMC) 2010. *Biodiversity, A Summary of Australia's Biodiversity Conservation Strategy 2010-2030*.  
<http://www.environment.gov.au/biodiversity/publications/strategy-2010-30/pubs/biodiversity-strategy-2010-brochure.pdf> (accessed 16/6/2011)
- Rotstein, J. and Webb B. 2009. Australian Capital Territory and Region Climate Change Vulnerability and Adaptation Project; Knowledge status and future issues report – Human Health. Report to the Department of Environment, Climate Change, Energy and Water. unpublished
- Walter, J. 2004. *World Disasters Report: Focus On Community Resilience*. International Federation of Red Cross and Red Crescent Societies. Switzerland
- Webb, B. 2011. *Impacts of Climate on the Canberra Nature Park: Risks and Responses*. Report for the ACT Office of the Commissioner for Sustainability and the Environment. Canberra.  
[http://www.envcomm.act.gov.au/\\_\\_data/assets/pdf\\_file/0004/220477/OCSE\\_ANU\\_paper\\_climate\\_CNP.pdf](http://www.envcomm.act.gov.au/__data/assets/pdf_file/0004/220477/OCSE_ANU_paper_climate_CNP.pdf) (accessed 1/12/11)
- Williams R.J., Bradstock R.A., Cary G.J., Gill A.M., Liedloff A.C., Lucas C., Whelan R.J., Andersen A.N., Bowman D.M.J.S., Clarke P.J., Cook G.D., Hennessy K.J. and York A. 2009. *Interactions between Climate Change, Fire Regimes and Biodiversity in Australia: A Preliminary Assessment*. Report to the Commonwealth Department of Climate Change and Department of the Environment, Water, Heritage and the Arts, Canberra.  
<http://climatechange.gov.au/~media/publications/adaptation/fire-report.pdf> (accessed 21/9/11)

# ACT State of the Environment Report 2011

## Annex

Table A1: Factors used for a measure of bushfire exposure

Factors	Description
Grassland Fire Danger Index	A relative measure of the difficulty of fire suppression for grassland fuel type
Forest Fire Danger Index	A relative measure of the difficulty of fire suppression for forest fuel type
Fuel load	Overall fuel hazard based on the range of vegetation communities occurring in the ACT. Considers the entire fuel complex (bark, elevated, near surface and surface fine fuels). These representations of fuel load are presented for the years 2009, 2014, and 2019, and assume no intervention or hazard reduction activities.
Likelihood of ignition	An estimate of the likelihood of a fire starting and spreading based on historical pattern of ignition (human and natural causes)

Source: Hennessy et al. 2006

# ACT State of the Environment Report 2011

## THEME: Climate

### Indicator cluster: Adaptation

This cluster has only one indicator:

- *Climate adaptation (R)* - covering infrastructure, buildings, water and energy resources, and transport in terms of climate impacts and responses.

### Summary

The ACT Climate Change Strategy to date has focused on strategies to reduce greenhouse gas emissions. However, there has been adaptive action in response to other events, particularly to improve water security. This has been largely in response to the recent drought experienced in the Territory.

The ACT Government has also been looking into possible adaptation in relation to urban form (the physical layout and design of Canberra), and aspects of natural habitats and connectivity between them.

### Introduction

Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices and structures to moderate potential damage or to benefit from opportunities associated with climate change (IPCC 2001).

Adaptation and mitigation activities can differ significantly, but they need to be aligned and reinforce each other if the ACT is to achieve an overall effective response to climate change.

This paper focuses on adaptation in relation to the natural and urban environment. Adaptation in other sectors, such as health, emergency management, tourism, primary industry, food and recreation, while important, is beyond the focus of the State of the Environment Report.

**Condition indicators (C)** present data that tell us the state of the environment at any particular time.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

# ACT State of the Environment Report 2011

## Condition indicators

There are no condition indicators for this indicator cluster. Weather patterns over recent decades are presented in the *Driving Forces* paper.

## Pressure indicators

There are no pressure indicators for this indicator cluster.

The most likely future climate scenario for the ACT includes (Webb 2011):

- the strong likelihood of mean temperatures continuing to increase, along with more frequent and severe heatwaves for the ACT and region; and
- a high probability of changes in the pattern of rainfall from that observed during the period of instrumental records, with some risk of a decline in long-term average rainfall; and in addition, the likelihood of an increase in rainfall intensity with more extreme rainfall events.

Predicted pressures from climate change on the built and natural environments are outlined in the *Climate vulnerability* indicator cluster.

## Impact indicators

There are no impact indicators for this indicator cluster. Potential impacts of climate change on human health and native species are outlined in the *Climate vulnerability* indicator cluster.

## Response indicators

The primary focus of the Action Plan 1 of the ACT Climate Change Strategy, *Weathering the Change* (ACT Government 2007) has been on strategies to reduce greenhouse gas emissions as a way of working towards a low carbon economy; that is, one that emits minimal carbon dioxide. Of the 43 actions identified in Action Plan 1, only 13 are specifically focused on adapting to current and future climate change. One in particular, Action 28, required all ACT Government agencies to have assessed their vulnerability to climate change by 2010.

Although some work has been completed in this area, vulnerability assessments have not been completed for all ACT Government agencies.

To date, the ACT has made some progress in adapting to future climate change, by trying to understand in more detail the changes that are likely to be faced and how they will impact on society and the region. Key principles related to adaptation in the strategy in *Weathering the Change*, include these:

# ACT State of the Environment Report 2011

- adaptation to future climate change is where the greatest change at the local-government level can be effected; and
- adaptation and abatement efforts are more effective when they are applied together.

The second action plan under *Weathering the Change* is currently being developed and is expected to have a focus on adaptation actions.

Integrating climate change-related activities into existing plans and strategies is an effective means of delivering action by government agencies. In general terms, adaptation strategies that can achieve 'win-win' or 'no-regret' outcomes should be given priority. 'Win-win' refers to strategies that address the climate change risks in addition to having social, economic or environmental benefits. 'No regret' refers to decisions that are positive from a developmental perspective, regardless of whether the climate threat materialises (e.g. restricting development on a floodplain).

This is the first time climate change adaptation has been included in the ACT State of the Environment Report. It is expected that future reporting can focus on the application of these principles in the ACT. For the purposes of the current report, distinction has been made between a planned or anticipatory approach to adaptation (i.e. risk prevention, or research) and an approach that relies on unplanned or reactive adjustments.

## **Vulnerability assessments**

In 2010 the ACT Planning and Land Authority (ACTPLA) commissioned research into climate change risk and vulnerability in the ACT and associated adaptation and mitigation options.

The research (AECOM 2010) modelled a 2°C average temperature rise by approximately the year 2050, which is considered to be a likely future scenario. The project assessed the exposure, sensitivity and adaptive capacity of Canberra to the probable threats of extreme heat, bushfire, flash flooding and water scarcity. This project's analyses of vulnerability were made at a finer scale than previous research about Canberra. It was able to draw conclusions about the risks posed by climate change, although significant data gaps made comprehensive assessment difficult. Climate change is likely to exacerbate existing risks and vulnerabilities in the ACT in relation to water security, bushfire, biodiversity and some aspects of human health.

In 2008, the governments of ACT and NSW agreed to cooperate in analysis of climate change vulnerability and adaptation for the ACT and south-eastern NSW. The agreement resulted in a series of papers intended to act as phase one in assisting the two governments towards the next steps in climate change adaptation (Whan and Webb 2009).

# ACT State of the Environment Report 2011

## Water security

The need for a secure supply of water through the drought has driven much of the recent adaptation action in the ACT - rather than climate change itself. Nevertheless, the relationship between the recent droughts and the phenomenon of climate change is an area of intense research activity.

Management of water resources in Australia has a history of incorporating management techniques for climate variability, and planning for scarcities at certain periods (Whan and Webb 2009). In other words, the Australian water sector has demonstrated it can adapt to climate variability and apply precautionary approaches when necessary.

Water supply in the ACT is highly sensitive to changes in rainfall patterns. An infrastructure network including four reservoirs (Corin, Bendora, Cotter and Googong) and two water treatment plants (Molonglo and Googong) distributes potable water to Canberra (see the *Water supply* indicator cluster). The whole network is supplied by three water supply catchments, all of which are dependent on rainfall. During the severe drought conditions of the last decade, inflows into the ACT reservoirs dwindled: for example, in 2006 inflows were down by almost 90% on historical averages.

The ACT Government established a water security taskforce to consider future water security options for the ACT. Among the resulting water supply improvements have been three major projects initiated during the reporting period: the enlargement of Cotter Dam; the Murrumbidgee River to Googong Reservoir water transfer; and transfer of water from Tantangara Reservoir (see the *Water supply* indicator cluster for more information).

During much of the reporting period 2007-2011, high-level water restrictions were in place in the ACT, and extensive community awareness programs encouraged the community to reduce water use. A number of new initiatives helped the ACT towards achieving a target to reduce overall water consumption by 12% by 2013 (see *Water supply* indicator cluster). The combination of these initiatives and policies is said to have resulted in very strong community awareness of the value of water, and its scarcity as a resource.

Population numbers have a direct impact on water demand and the vulnerability of vital water resources (Engineers Australia 2010). While augmentation projects and diversification of water sources are important, they need to be supported by management tools for increasing a region's overall adaptive capacity to supply its population. *Think water, act water* (ACT Government 2004a) outlines the ACT Government's strategies for sustainable water resource management. Examples implemented throughout the ACT to reduce demand during the reporting period have included:

# ACT State of the Environment Report 2011

- advertising, and education initiatives such as the WaterRight Gardens, a webtool that allows gardeners to develop watering schedules tailored to their garden (ACT Government 2011);
- permanent water conservation measures;
- effluent reuse;
- stormwater harvesting;
- support for rainwater tank installation, via the Rainwater Tank Rebate for connecting rainwater tanks to domestic plumbing for toilets and washing machines;
- greywater reuse; and
- support for installation of water-efficient appliances and fittings, such as the ToiletSmart rebate for replacing single-flush toilet cisterns with water-efficient dual-flush cisterns.

These and other strategies also benefit water quality; for example, stormwater harvesting ‘filters’ stormwater before it reaches lakes and rivers. For further information see the *Water supply* and *Rivers, lakes and wetlands health* indicator clusters.

In combination, these efforts have reduced water consumption per person in the ACT (Engineers Australia 2010), as Table 1 shows for 2007-2009.

Table 1. ACT water consumption, 2007-2009

	2007	2008	2009
Total consumption (kL)	51 060	43 556	44 955
Consumption per person per year (kL)	136	115	116
Consumption per person per day (L)	373	315	318

Source: Engineers Australia 2010

Substantial efforts are being made to ensure water security within the ACT through the adaptation of water resource management in response to observed climatic conditions. Even so, future climate projections indicate the need for further coordinated actions to be implemented. These management approaches include further consumption reductions, decreases in response-time to reduce consumption levels through water restrictions, further diversification of water sources including non-rainfall dependent infrastructure, improved recycling facilities and usage and catchment-level water management with cross-jurisdiction coordination (AECOM 2010).

The *Think water act water* strategy is currently under review and it is recommended that the implications of climate change should inform the future direction of water policy in the ACT.

# ACT State of the Environment Report 2011

## Adaptation of the urban form

Urban form, which is the physical layout and design of an urban area, affects a city's vulnerability to issues such as climate change. Urban form modifies the options available for adaptation and mitigation of climate change effects. Following the vulnerability assessment of the ACT urban area discussed above, ACTPLA commissioned work to recommend and develop adaptation actions. Key recommendations included (SGS 2010):

- *Focusing on stormwater harvesting.* Local stormwater harvesting has the potential not only to reduce, detain and retain stormwater during extreme weather events, it could also provide an additional supply for watering open space areas and street trees, and help in mitigating localised extremes of air temperature. Harvesting and appropriately treating stormwater can have the added benefit of improving water quality before it reaches lakes or rivers.
- *Planning for bushfire risk.* CSIRO climate simulations indicate that ACT fire seasons are likely to start earlier and end slightly later, while generally being more intense throughout their duration (ACT Government 2009). The vulnerability of areas on the urban edge could be reduced by the introduction of edge-roads where they do not exist at present, the reconfiguration of open space, and use of vegetation with lower fire risk. Strategic burning is an important tool for reducing bushfire risk; however, burning plans are often constrained by weather conditions (ACT Government 2009). Other challenges include the need to balance ecosystem benefits and drawbacks and protect vulnerable species; these issues are considered in the *Strategic Bush Fire Management Plan for the ACT 2009* (ACT Government 2009).
- *Improving adaptive capacity.* Intensifying the density of dwellings in urban centres increases the number of households in particular locations, and can be coordinated through an affordable housing policy. Actions that reduce car ownership should help lower emissions of greenhouse gases from transport in the ACT. Freeing up ACT residents' financial resources could mean money might be redirected to adaptive infrastructure such as the retrofitting of houses. The *Canberra Spatial Plan* (ACT Government 2004b) can support the strengthening of adaptive capacity by locating future developments in or near existing town and group centres (thereby possibly reducing household transport costs), and away from vulnerable locations such as those prone to bushfires and flooding.
- *A threefold strategy to reduce the impact of localised extreme temperatures:*
  1. increase the reflective capacity of roofing and roads;
  2. improve self-shading of building facades with awnings and eaves and by street planting; and

# ACT State of the Environment Report 2011

3. make more use of evaporative cooling though increased irrigation of the public domain (although droughts and water restrictions will affect this strategy).

The Canberra Spatial Plan is currently under review, a process that should consider the implications of future climate change for the urban form of the ACT.

The ACT Government has already drafted amendments to the Territory Plan that are intended to improve the solar efficiency of houses, and there are a number of voluntary programs in place to encourage energy efficiency in buildings (see the *Mitigation* indicator cluster for more information). These are moves that should help reduce emissions from the urban environment, and help the ACT adapt to potential climate impacts.

## **Ecosystem adaptation**

A recent report (Webb 2011:5-6) on the implications of climate change for nature reserves in the ACT identified the main human challenges for adaptation as:

- better understanding of areas of potential conflict between competing values;
- choosing investment priorities in the context of limited resources;
- doing effective research and monitoring; and
- developing and implementing adaptive management processes that respond to new information as it becomes available.

The report also identified key strategies humans could use to improve adaptation by local ecosystems, including:

- maintaining and enhancing fundamental ecosystem processes and services, including improving landscape function, vegetation and habitat, through facilitating natural regeneration and active restoration;
- enhancing the resilience of ecosystems and species by maintaining diversified habitats and refuges and improving connectivity on a 'whole of landscape' basis;
- facilitating ecosystems and species development;
- land-use planning and fire management that balance protection of humans and natural assets, backed up by progressive monitoring and learning; and
- effective and integrated governance and adaptive management approaches for the reserves; these should be backed up by greater understanding of community values through enhanced communication and engagement with the community; and restatement of the values of, and objectives for, the reserves, to be more appropriate to a changing and, to some extent, an unpredictable environment.

# ACT State of the Environment Report 2011

For further information on ecosystems and climate change see the *Threatening processes* indicator cluster.

## Connectivity

The existing separation of habitats across the landscape makes it difficult for many organisms to respond and adapt to a changing climate and environment by moving to somewhere else. Climate change and land use change combined are having a far more detrimental effect on biodiversity than either factor in isolation. As well as maintaining and expanding the reserve system, humans can link habitats to help organisms adapt to climate change. Better connectivity can be achieved by managing off-reserve lands in a manner that recognises the need for wildlife to move across the whole landscape, and the degree of connectivity required for each species to achieve this movement (Manning et al. 2010).

Corridors are increasingly regarded as particularly important for protecting the ecological systems in Canberra's reserves. Corridors are links, in the form of bands or clumps of vegetation, connecting larger patches of habitat. It is important that managers arrange connectivity so it takes into account the specific needs of different species, and is not applied with a 'one-size-fits-all' approach.

In 2007, recognising the importance of connectivity in terms of maintaining biodiversity, especially in the event of climate change, the ACT Government commissioned a report to identify key issues involved in enhancing connectivity through planning and land management in the ACT. Issues identified by the report include, but are not limited to:

- linking existing ACT nature reserves to each other and to those in NSW;
- maintaining and enhancing, especially for aquatic biota, the integrity of the Murrumbidgee River as a key connectivity feature crossing the ACT and linking into NSW;
- maintaining and enhancing connectivity; for example, planning and building urban developments in a way that allows multiple types of organisms to use them; and
- considering species-specific responses of organisms to climate change.

The report also delivers a suite of recommendations designed so that planning in the ACT and surrounding region can maximise the effectiveness of connectivity. The recommendations highlight the need for careful analysis of the aims of enhancing connectivity and the likely responses of species. Modelling identifies high priority areas within and adjacent to the ACT, where re-planning or suitable management could maintain or improve connectivity (Manning et al. 2010).

Further information on connectivity is outlined in the *Threatening processes* and *Ecological communities* indicator clusters.

# ACT State of the Environment Report 2011

## Canberra's treed landscape

Green infrastructure is defined as a city's natural features, such as its vegetation, parks, and waterways. Green Infrastructure can improve the quality of the urban environment for present and future human communities. It helps soften the physical and psychological effects of pressures such as increased urbanisation, population growth, pollution and climate change (OCSE 2011). Green infrastructure is an example of a 'win-win' strategy which provides social, economic or environmental benefits as well as assisting in addressing climate change impacts.

Climate change and the prolonged drought have had detrimental effects on the health of Canberra's trees, which have continued in 2011. The Office of the Commissioner for Sustainability and the Environment has reported on the management of Canberra's treed landscape, encouraging a 'care and maintenance' approach. The report also recommends that the treed landscape should be accepted as essential green infrastructure for Canberra, in the ACT Government's strategic planning (OCSE 2011). The ACT Government is yet to respond to the report's recommendations.

## References

- ACT Government 2004a. *Think Water, Act Water - Summary*. Canberra  
[http://www.thinkwater.act.gov.au/permanent\\_measures/the\\_act\\_water\\_strategy.shtml](http://www.thinkwater.act.gov.au/permanent_measures/the_act_water_strategy.shtml)  
(accessed 20/6/11)
- ACT Government 2004b. *The Canberra Spatial Plan*. Canberra  
<http://apps.actpla.act.gov.au/plandev/sp-pdf/spatialplan.pdf> (accessed 22/9/11)
- ACT Government 2007. *Weathering the Change - The ACT Climate Change Strategy 2007-2025*. Canberra  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/144529/Climate\\_Change\\_Strategy.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0007/144529/Climate_Change_Strategy.pdf) (accessed 13/11/11)
- ACT Government 2009. *Strategic Bushfire Management Plan for the ACT: Factors Contributing to Bushfire Risk*. Canberra. <http://www.esa.act.gov.au/wp-content/uploads/2011/08/act-sbmp-version-two-supporting-info-1.pdf> (accessed 4/4/11)
- ACT Government 2011. *ACTSmart: the WaterRight Gardens Webtool for Canberra*. Canberra.  
[http://www.thinkwater.act.gov.au/water\\_calculators/watertool.shtml](http://www.thinkwater.act.gov.au/water_calculators/watertool.shtml) (accessed 17/7/11)
- AECOM 2010. *Human Settlement Vulnerability and Adaptive Capacity Assessment - Spatial Plan Evaluation*. Report for ACT Planning and Land Authority.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/20410/2010\\_09\\_08\\_ACTPLA\\_CC\\_Vulnerability\\_v2\\_LowResolution.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0007/20410/2010_09_08_ACTPLA_CC_Vulnerability_v2_LowResolution.pdf) (accessed 19/9/11)
- Engineers Australia 2010. *Australian Capital Territory Infrastructure Report Card 2010*. Canberra.  
[http://www.engineersaustralia.org.au/sites/default/files/shado/Infrastructure%20Report%20Cards/ACT/entire\\_report.pdf](http://www.engineersaustralia.org.au/sites/default/files/shado/Infrastructure%20Report%20Cards/ACT/entire_report.pdf) (accessed 20/6/11)

# ACT State of the Environment Report 2011

- IPCC 2001. *IPCC Third Assessment Report: Annex B Glossary of Terms*. Intergovernmental Panel on Climate Change. World Meteorological Organisation. Geneva.  
<http://www.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf> (accessed 19/6/11)
- Manning, A.D., Shorthouse, D.J., Stein, J.L. and Stein, J.A. 2010. *Technical Report 21: Ecological Connectivity for Climate Change in the ACT and Surrounding Region*. Fenner School of Environment and Society. Australian National University. Canberra .
- OCSE 2011. *Report on the Investigation into the Government's Tree Management Practices and the Renewal of Canberra's Urban Forest*. Office of the Commissioner of Sustainability and the Environment. Canberra  
[http://www.envcomm.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/219354/OCSE\\_TreeInvestigation\\_Part1\\_ReportV5\\_28February2011.pdf](http://www.envcomm.act.gov.au/__data/assets/pdf_file/0006/219354/OCSE_TreeInvestigation_Part1_ReportV5_28February2011.pdf) (accessed 26/8/11)
- SGS 2010. *Spatial Plan Evaluation - Urban Form Scenarios - Adaptation and Mitigation Interventions*. Report for the ACT Planning and Land Authority. Canberra.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0013/21046/ACTPLA\\_Urban\\_Form\\_Scenarios\\_Final\\_Report\\_WEB.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0013/21046/ACTPLA_Urban_Form_Scenarios_Final_Report_WEB.pdf) (accessed 19/6/11)
- Webb, B. 2011. *Impacts of Climate on the Canberra Nature Park: Risks and Responses*. Report for the ACT Office of the Commissioner for Sustainability and the Environment. Canberra.  
[http://www.envcomm.act.gov.au/\\_\\_data/assets/pdf\\_file/0004/220477/OCSE\\_ANU\\_paper\\_climate\\_CNP.pdf](http://www.envcomm.act.gov.au/__data/assets/pdf_file/0004/220477/OCSE_ANU_paper_climate_CNP.pdf) (accessed 1/12/11)
- Whan, K. and Webb, R.J. 2009. *ACT and Region Climate Change Vulnerability and Adaptation: Climate Knowledge Status Report*. Report for the Department of Environment, Climate Change, Energy and Water. ACT Government. Canberra

# ACT State of the Environment Report 2011

## THEME: Climate

### Indicator cluster: Climate as a resource

This cluster has only one indicator:

- *Climate as a resource* (R) - discussion of climate as a resource for renewable energy, agriculture, tourism and other production

### Summary

The use of climate change as a resource in the ACT can be seen in recent industrial market shifts, such as the growth of renewable energy (renewables) in the energy sector. In particular, the contribution of renewables to the energy industry has steadily been increasing throughout the reporting period. The climatic and environmental conditions of the Australian Capital Region<sup>1</sup> are highly suited to a number of renewable energy industries. The region has one of the oldest and largest renewable energy sources in Australia in the Snowy Mountains Hydroelectric Scheme, and it has favourable climatic conditions for wind and solar technologies, and established and planned renewable power generation stations.

Sectors experiencing the effects of climate change are agriculture and tourism. Winter tourism and the wine industry have been increasingly challenged by climate change (Hennessy et al. 2003). However, coastal tourism and activities such as wildlife watching, trekking, camping, climbing and fishing may have extended seasons, longer than the traditional summer holiday period, because of predicted drier and warmer conditions. On the other hand, the tourism industry may also be at risk from increased extreme weather events such as storms and fires.

### Introduction

The *Climate as a resource* indicator cluster looks at how current and future climatic conditions of the ACT, and adaptation and mitigation actions, are being put to use.

**Condition indicators (C)** present data that tell us the state of the environment at any particular time.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

---

<sup>1</sup> The Australian Capital Region includes the 17 local government areas surrounding Canberra: Bega Valley, Boorowa, Bombala, Cooma-Monaro, Cootamundra, Eurobodalla, Gundagai, Goulburn-Mulwaree, Harden, Palerang, Queanbeyan City, Tumbarumba, Tumut, Snowy River, Upper Lachlan, Yass Valley and Young.

# ACT State of the Environment Report 2011

Opportunities and challenges include those associated with sectors reliant on climate, such as the renewable energy, tourism and primary industries.

## Condition indicators

There are no condition indicators for this cluster.

The most likely future climate scenario for the ACT includes (Webb 2011):

- the strong likelihood of mean temperatures continuing to increase, along with more frequent and severe heatwaves for the ACT and region; and
- a high probability of changes in the pattern of rainfall from that observed during the period of instrumental records, with some risk of a decline in long-term average rainfall; and in addition, the likelihood of an increase in rainfall intensity with more extreme rainfall events.

While this may not seem a significant change, small differences in average values of climatic parameters such as temperature and rainfall can lead to large changes in the frequency and intensity of extreme events such as heatwaves, storms and fires.

For more information on weather patterns see the *Driving Forces* papers.

## Pressure indicators

There are no pressure indicators for this cluster. However, it is expected that changes in climate in the ACT will lead to (Webb 2011):

- increased evaporation (especially in spring and summer), which, combined with potential changes in rainfall, is likely to result in reduced soil moisture (particularly in winter and spring if autumn rainfalls also remain historically low);
- changes in run-off and streamflows, with higher evaporation in spring and summer tending to reduce run-off during those periods;
- an increase in the severity of drought because of higher temperatures;
- more frequent and intense bushfires overall, because of higher temperatures, drier conditions and lower humidity, with extension of the fire season into spring; changes in fuel availability will add significant uncertainty in projections;
- more intense flood-producing rainfall events with impacts depending in part on the prevailing catchment conditions (i.e. soil moisture and levels in major water storages).

For more information on weather and climate see the *Driving Forces* papers.

# ACT State of the Environment Report 2011

## Impact indicators

Climate change is predicted to have direct and indirect effects on urban, social and natural environments in the ACT, including:

- more frequent heatwaves, bushfires and storms, and decreased water availability (direct impacts); and
- effects on human health and the availability of water, and modifications to ecological and agricultural systems (indirect impacts).

For more information on climate change impacts see the *Climate vulnerability* indicator cluster.

## Response indicators

The ACT sources most of its stationary energy (that is, electricity) from interstate. The ACT is also heavily reliant on interstate industry and freight for the production and transport of goods and services used here, as well as many other services. It is therefore vital that the ACT takes a regional approach to planning for, and using, climate as a resource. A number of renewable energy power stations, particularly wind-powered, have been developed across the Australian Capital Region during the reporting period, and construction of further stations is either approved or underway (NSW Planning and Infrastructure 2011).

### Renewable energy

The renewable energy sector has been steadily growing in response to the need for alternative low-emission sources of energy. The Australian Capital Region has significant potential for solar, hydro- and particularly wind-generation of electricity because of the often high wind speeds in much of the region. The environment of the region is suitable for a strong renewable energy industry. It supports the Snowy Mountains Hydroelectric Scheme, one of the oldest and largest renewable energy sources in Australia, and a growing number of renewable energy power stations (e.g. solar, water, wind, biomass).

#### Solar power

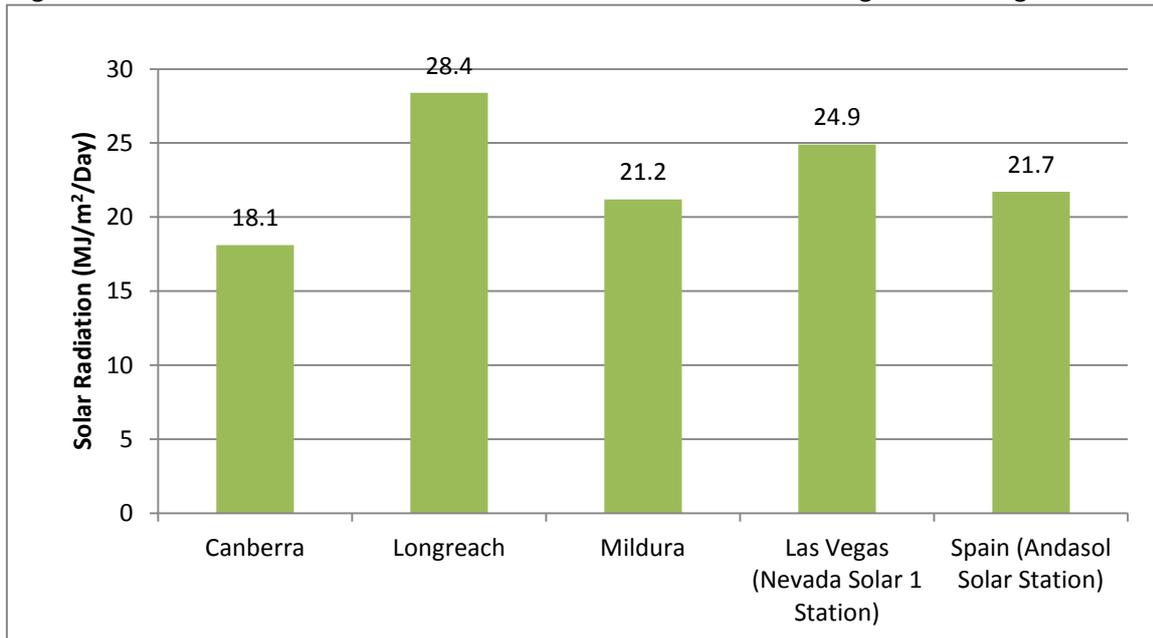
While the ACT presents fewer potential solar resources than some other cities (as shown in Figure 1) the close proximity of the city centre to potential large-scale solar-power generation sites is an advantage for Canberra compared to other capitals, because transmission losses would be minimised. The level of solar radiation experienced in the area means that around 0.6 hectares of solar cells would produce enough electricity to meet the yearly demand of a small office building<sup>2</sup>.

---

<sup>2</sup> Based on an ACT building with 2000 m<sup>2</sup> of office area and a 3-star NABERS Energy rating

# ACT State of the Environment Report 2011

Figure 1: Potential solar resources in Canberra and other locations using sun-tracking data



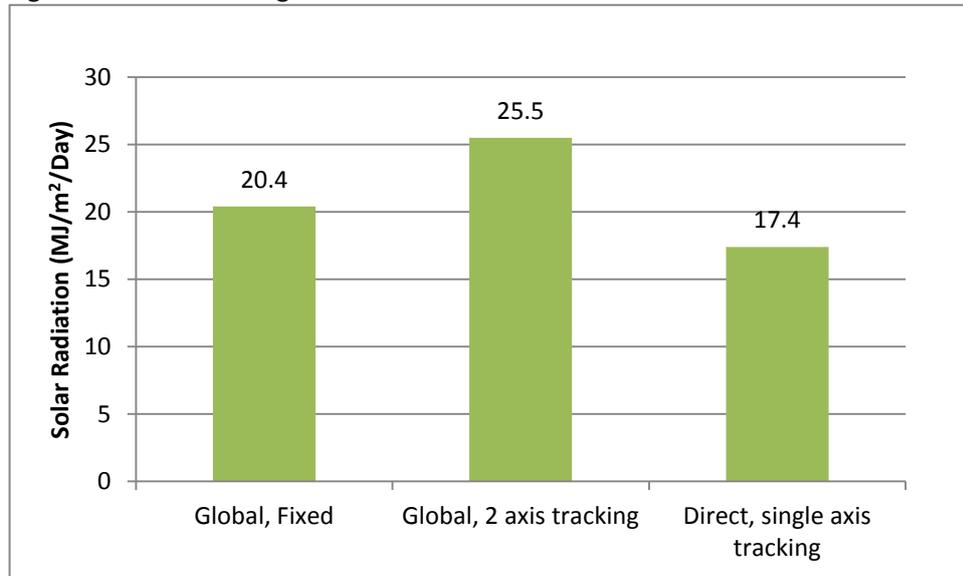
Source: PB 2008

The amount of solar power that can be generated from a solar cell is directly linked to the potential solar resources (including parameters such as radiation and duration) at the location. In 2008 a pre-feasibility study was prepared to estimate the potential and preferred technology for a solar power plant in the ACT (PB 2008). The study determined that the ACT has a relative abundance of solar energy resources because of the high level of solar radiation and the large number of annual sunshine hours, and identified a 22 MW project using solar thermal-trough technology as the preferred option for an ACT solar farm, based on cost and development constraints.

The specific data of interest are Global (fixed), Global (tracking) and Direct (single North-South axis). The solar radiation in the ACT for each of these measures is shown in Figure 2. It is estimated that the average total solar radiation received in the ACT each day is approximately 10 times greater than the ACT's daily electricity consumption (ABS 2002).

# ACT State of the Environment Report 2011

Figure 2: Annual average solar radiation in Canberra



Source: ASES 2006

In 2009, the ACT Government consulted with the community about two potential sites for a solar power facility in the ACT. However, in 2010 the ACT Government changed their approach to a solar power facility following the expansion of the electricity Feed-in Tariff Scheme. The Government's current position is that any such facility will be privately developed, with those proponents interested in establishing large-scale renewable energy solar facilities in the ACT able to bid for access to a feed-in tariff for a total of up to 40 MW. Bidders will be responsible for financing, constructing, owning and operating any proposed facility. Under this arrangement the ACT Government will be responsible for developing appropriate legislation to provide a supported price payment for generated electricity. The ACT Government has identified benefits solar energy could bring to the ACT:

- generation of renewable energy that makes a significant contribution to meeting the ACT's greenhouse gas emission targets;
- economies of scale to reduce the cost of renewable energy generation in the ACT; and
- support for a clean energy industry in the ACT.

The ACT Government also began a feed-in tariff scheme in March 2009 to encourage small-scale renewable energy generation to feed into the grid. The tariff was designed to encourage investment in renewable electricity generation by paying small-scale generators a premium rate for the gross amount of electricity they generate (Engineers Australia 2009). The ACT Government set a cap on the total installed capacity of micro- and medium-scale generators that would be funded under the scheme, and on 31 May 2011 the micro-scale cap was reached. The total installed capacity of renewable generators at 30 June 2011 was about 14MW (ICRC 2011). See the *Mitigation* indicator cluster for more information.

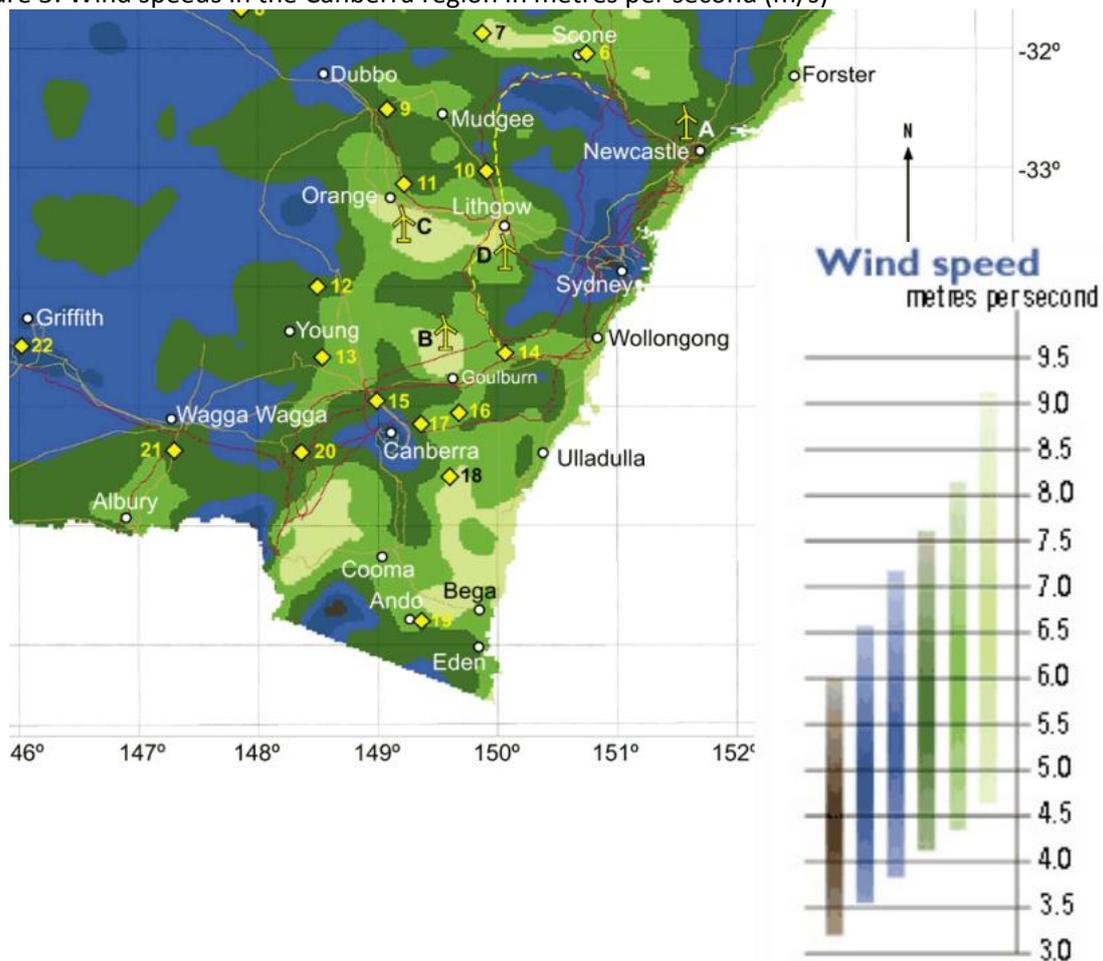
# ACT State of the Environment Report 2011

## Wind energy

Wind energy can be converted to electrical energy through the use of turbines. Effects such as fluctuations in the wind result in around 40-60% of available wind energy being transferred to the turbine blades. Inefficiencies in the turbines means that only around 35% of the captured wind energy can then be turned into electrical energy (AGL Energy Limited 2009, Wind Prospect Ltd 2011a, b). Despite these limits, wind energy, compared with other emerging sustainable sources, is the most mature technology, with numerous commercial wind farms installed around the country.

Urban development and large nature reserves create turbulence and greatly limit the potential sites available for the development of a wind farm in the ACT. As with solar, the Australia Capital Region has less potential for wind-generation of power than other areas, such as those offshore and in the north of Australia. However, there is still considerable potential in the areas of NSW around the ACT (see Figure 3) and significant investment in wind energy has already been made in the region.

Figure 3: Wind speeds in the Canberra region in metres per second (m/s)

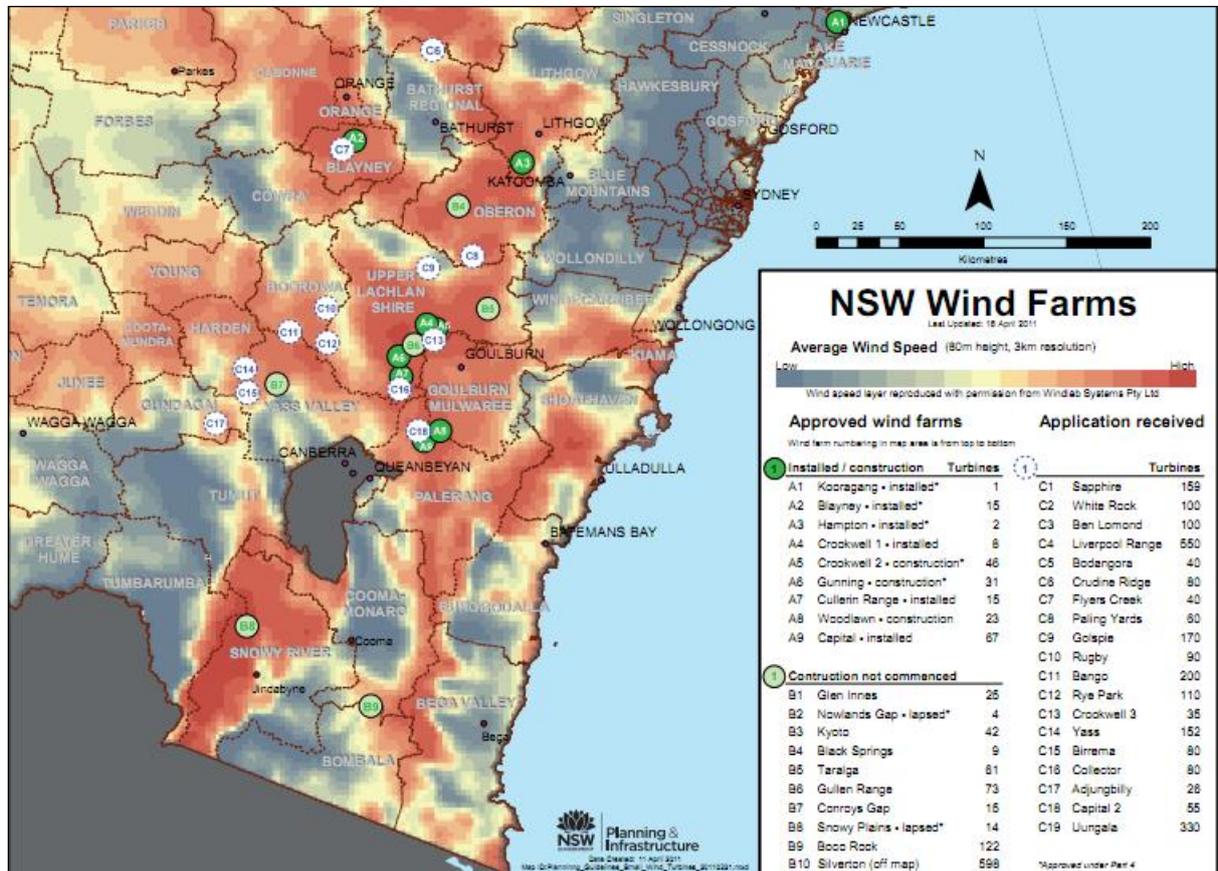


Source: CSIRO 2003

# ACT State of the Environment Report 2011

As of April 2011, the Australian Capital Region (comprising the ACT and 17 local government areas in NSW) has 11 wind farms (with a total 475 turbines) approved; applications for a further 11 wind farms (with a total of 1058 turbines) have been received by the NSW Government (see Figure 4 and Table 1).

Figure 4. Wind farms in south-eastern NSW



Source: NSW Planning and Infrastructure 2011

# ACT State of the Environment Report 2011

Table1. Windfarms in the Australian Capital Region on the map in Figure 4

Windfarm	Number on map	Status	Number of turbines
Crookwell 1	A4	installed	8
Crookwell 2	A5	Under construction	46
Gunning	A6	Under construction	31
Cullerin Range	A7	installed	15
Woodlawn	A8	Under construction	23
Capital	A9	installed	67
Taralga	B5	Approved, construction not commenced	61
Gullen range	B6	Approved, construction not commenced	73
Conroys Gap	B7	Approved, construction not commenced	15
Snowy Plains	B8	Approved but lapsed	14
Boco Rock	B9	Approved, construction not commenced	122
Paling Yards	C8	Application received	60
Golspie	C9	Application received	170
Rugby	C10	Application received	90
Bango	C11	Application received	200
Rye Park	C12	Application received	110
Crookwell 3	C13	Application received	35
Yass	C14	Application received	152
Birrema	C15	Application received	80
Collector	C16	Application received	80
Adjungbilly	C17	Application received	26
Capital 2	C18	Application received	55

Source: NSW Planning and Infrastructure 2011

# ACT State of the Environment Report 2011

## Tourism

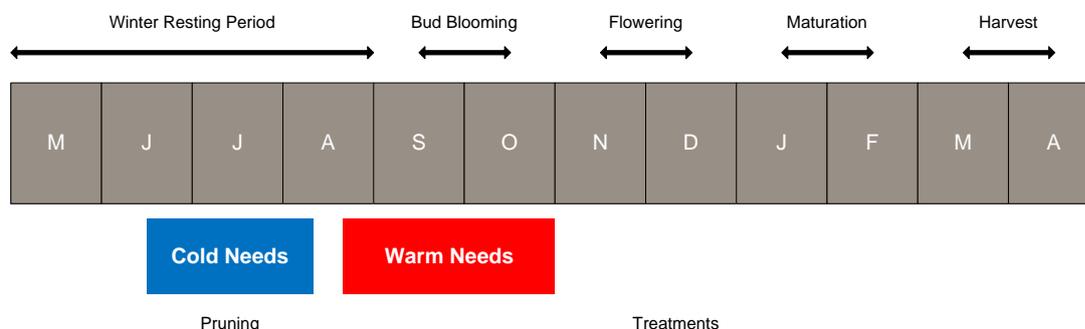
Climatic conditions are important for the health of Canberra’s tourism industry, providing seasonal snow to the alpine region and seasonal dry times for the coast and the Canberra wine regions. Canberrans enjoy relative proximity and easy access to these amenities (ACT Government 2007).

Snow sports, recreational tourism and wineries are clearly dependent on climate. Climate conditions over the past 40 years indicate that the winter tourism industry has been increasingly challenged by reduction in snow cover (Hennessy et al. 2003). However, coastal activities, wildlife watching, trekking, camping, climbing and fishing could benefit from the predicted drier and warmer conditions, and there could be a longer traditional peak summer holiday period. There are also risks to tourism from increased extreme weather events such as storms and fires (Garnaut 2008).

With more than 140 cool climate vineyards in the Canberra District, the wine industry has become an important tourist attraction in the region, apart from its contribution to the agricultural sector. Commercial vineyards are mostly located in areas outside the ACT, such as at Murrumbateman and Lake George. Thirty-three wineries are within 35 minutes drive of Canberra (CDWIA 2010). These businesses are highly sensitive to climate conditions for productivity, as is, in turn, the tourism generated by the viticulture (Belliveau et al. 2006).

Temperature is a key driver of vine phenology (the cycle of dormancy, growth and fruiting). To break from their winter dormancy, vines need a warm period following cold or cool periods to be “sure” that winter is over; shoots that develop during winter do not survive. Usually 12 days of air temperatures above 5-10°C initiates circulation within the plant. The vine also needs particular levels of warmth during the bud blooming and flowering phases as shown in Figure 5 (ONERC 2006).

Figure 5: Vine biological cycle *Vitis vinifera*



Source: ONERC 2006

The range in temperatures, vineyard elevations and varying soil types in the region makes it possible to produce a wide range of grape varieties. Grape varieties are grouped into four

# ACT State of the Environment Report 2011

main classes: cool, intermediate, warm and hot. Most of the varieties grown in the ACT region are in the cool class (13 to 15°C average temperature during the growing season) and intermediate class (15 to 17°C average temperature during the growing season). The most commonly produced grape varieties in the ACT are Sangiovese, Riesling, Chardonnay, Pinot Noir and Shiraz.

## Agriculture

While climate is a defining factor in agricultural land use patterns and production generally, it does not dominate vulnerability for the ACT agricultural sector which is more affected by soil types and conditions, topography and water availability. Agricultural practices are a legacy of land use before the Territory's conception rather than a reflection of current industry practice of the Region. Agricultural operations represented just 3% of registered businesses in the ACT in 2007 (ABS 2009). Wider trends across Australia appear to mirror industry shifts in the ACT, as observed in the 2009-10 financial year with the value of Australian agricultural production decreasing by 5% from the previous year (ABS 2011). These results were explained as a reflection of the strong exchange rates for the Australian dollar, decreased crop sizes and number of stock (because viable farming areas were taken for urbanisation at city fringes), and increased external competition.

## General

Climate as a resource shares direct links with pressure indicators such as energy use, CO<sub>2</sub> emissions and methane emissions, as well as other response indicators such as energy supply and reduction of emissions in waste and transport. Further, climate as a resource is closely linked to the ACT's mitigation response. Responses associated with this indicator over the 2007-11 reporting period stretch beyond the ACT boundaries. Although this is beyond the scope of the report, it is an indication of some of the mobility and transport dependencies apparent in the ACT.

## References

- ACT Government 2007. *Weathering the Change - The ACT Climate Change Strategy 2007-2025*. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/144529/Climate\\_Change\\_Strategy.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0007/144529/Climate_Change_Strategy.pdf) (accessed 13/11/11)
- AGL Energy Limited, 2009. *AGL Hallett Wind Farm Portfolio Equity Investor Tour*. South Australia.  
<http://www.agl.com.au/Downloads/AGL%20Hallett%20Wind%20Farm%20Portfolio%20Equity%20Investor%20Tour.pdf> (accessed 17/6/11)
- ASES 2006. *Australian Solar Radiation Data Handbook*. 4<sup>th</sup> Edition. Australian Solar Energy Society Ltd. Frenchs Forest. NSW

# ACT State of the Environment Report 2011

- ABS 2002. *4649.0.55.001 - Energy Statistics, Australia 2001-02*. Australian Bureau of Statistics. Australian Government. Canberra. <http://www.abs.gov.au/ausstats/abs@.nsf/0/1DD46A713657BA33CA256E000075736B?OpenDocument> (accessed 1/11/11)
- ABS 2009. *1379.0.55.001 – National Regional Profile, Australian Capital Territory, 2005-2009*. Australian Bureau of Statistics. Australian Government. Canberra. <http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&nrp%202004-2010%20csv%20file.csv&1379.0.55.001&Data%20Cubes&72FA2883275E0F35CA25793D000CAC8B&0&2006%20to%202010&04.11.2011&Latest> (accessed 4/9/11)
- ABS 2011. *7503.0 – Value of Agricultural Commodities Produced, Australia, 2009-10*. Australian Bureau of Statistics. Australian Government. Canberra. <http://www.abs.gov.au/ausstats/abs@.nsf/products/824FCFDA36C8825ECA2578A00014F3DB?OpenDocument> (accessed 9/6/11)
- Belliveau, S., Smit, B., Bradshaw, B. 2006. Multiple exposures and dynamic Vulnerability: Evidence from the grape in the Okanagan Valley, Canada. *Global Environmental Change*. 16:364-78
- CDWIA 2010. *Welcome to the Canberra District Wines*. Canberra District Wine Industry Association. <http://www.canberrawines.com.au> (accessed 10/6/11)
- CSIRO 2003. *Wind Resource Assessment in Australia – A Planners Guide*. Wind Energy Research Unit. CSIRO Land and Water. Canberra. <http://www.csiro.au/files/files/pis7.pdf> (accessed 17/6/11)
- Engineers Australia 2009. *Energy*. [http://www.engineersaustralia.org.au/sites/default/files/shado/Infrastructure%20Report%20Cards/ACT/part4\\_energy.pdf](http://www.engineersaustralia.org.au/sites/default/files/shado/Infrastructure%20Report%20Cards/ACT/part4_energy.pdf) (accessed 10/6/11)
- Garnaut, R. 2008. *The Garnaut Climate Change Review – Final Report*. Cambridge University Press. Port Melbourne. [http://www.garnautreview.org.au/CA25734E0016A131/WebObj/GarnautClimateChangeReview-FinalReport-30September2008\(Fullversion\)/%24File/Garnaut%20Climate%20Change%20Review%20-%20Final%20Report%20-%2030%20September%202008%20\(Full%20version\).pdf](http://www.garnautreview.org.au/CA25734E0016A131/WebObj/GarnautClimateChangeReview-FinalReport-30September2008(Fullversion)/%24File/Garnaut%20Climate%20Change%20Review%20-%20Final%20Report%20-%2030%20September%202008%20(Full%20version).pdf) (accessed 12/10/11)
- Hennessy, K., Whetton, P., Smith, I., Bathols, J., Hutchinson, M. and Sharples, J. 2003. *The Impact of Climate Change on Snow Conditions in Mainland Australia*. CSIRO Atmospheric Research. Aspendale
- ICRC 2011. *ACT Greenhouse Gas Inventory Report for 2008-09*. Independent Competition and Regulatory Commission. ACT Government. Canberra. [http://www.icrc.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/235719/ACT\\_Greenhouse\\_Gas\\_Inventory\\_Report\\_2009\\_Final.pdf](http://www.icrc.act.gov.au/__data/assets/pdf_file/0009/235719/ACT_Greenhouse_Gas_Inventory_Report_2009_Final.pdf) (accessed 17/11/11)
- NSW Planning and Infrastructure 2011. *NSW Wind Farms*. NSW Government. Sydney. <http://www.planning.nsw.gov.au/LinkClick.aspx?fileticket=HC-K5QijVsM%3d&tabid=394&language=en-US> (accessed 17/10/11)
- ONERC 2006. *Impacts du Changement Climatique sur les Activites Viti - Vinicoles*. Observatoire National sur les Effets du Rechauffement Climatique. Paris. [436](http://www.developpement-</a></p></div><div data-bbox=)

# ACT State of the Environment Report 2011

[durable.gouv.fr/IMG/ecologie/pdf/note\\_technique\\_no3\\_version\\_Internet.pdf](http://durable.gouv.fr/IMG/ecologie/pdf/note_technique_no3_version_Internet.pdf) (accessed 20/6/11)

PB 2008. *Solar Power Plan Pre-feasibility Study*. Parsons Brinckerhoff Australia Pty Limited. Brisbane. [http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0019/154054/Solar\\_Power\\_Plan\\_Pre-feasibility\\_study.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0019/154054/Solar_Power_Plan_Pre-feasibility_study.pdf) (accessed 20/6/11)

Webb, B. 2011. *Impacts of Climate on the Canberra Nature Park: Risks and Responses*. Report for the ACT Office of the Commissioner for Sustainability and the Environment. Canberra. [http://www.envcomm.act.gov.au/\\_\\_data/assets/pdf\\_file/0004/220477/OCSE\\_ANU\\_paper\\_climate\\_CNP.pdf](http://www.envcomm.act.gov.au/__data/assets/pdf_file/0004/220477/OCSE_ANU_paper_climate_CNP.pdf) (accessed 1/12/11)

Wind Prospect Ltd 2011a. *Boco Rock Wind Farm: Facts and Figures*. Newcastle. [http://bocorockwindfarm.com.au/facts\\_figures](http://bocorockwindfarm.com.au/facts_figures) (accessed 17/6/11)

Wind Prospect Ltd 2011b. *Sapphire Wind Farm: Facts and Figures*. Newcastle. [http://sapphirewindfarm.com.au/facts\\_figures](http://sapphirewindfarm.com.au/facts_figures) (accessed 17/6/11)

## Other data sources

In addition to these published reports, data for this paper were also sourced from:

Environment and Sustainable Development Directorate (ESDD)

# ACT State of the Environment Report 2011

## THEME: People

### Introduction to the Theme

The way we design and use our urban areas, infrastructure and green spaces, can significantly affect the quality of the environments we inhabit. Conversely, the state of the natural environment impacts urban quality and our living conditions. Community engagement and levels of environmental awareness can also have a major influence on our resource use and the amount of waste we produce.

In 2013 Canberra will celebrate its centenary; 100 years since the establishment of the city as the Nation's capital. With a population now of over 350 000, Canberra is Australia's largest inland city, a Bush Capital, which continues to grow in population and size. ACT residents enjoy lifestyles that bring together the best of city living with the benefits of open-space and easy access to rural and bush landscapes. As the centre of national government and a major regional centre for south-east New South Wales, Canberra provides employment, education, health and retail services along with cultural, entertainment and recreational facilities for residents of the ACT and surrounding areas.

Six indicator clusters for the *People* theme:

- *Urban quality;*
- *Transport;*
- *Waste;*
- *Heritage;*
- *Community engagement;* and
- *Natural hazards.*

### Context

As identified in the previous two State of Environment (SoE) Reports, our urban area continues to increase. In both the 2007 and current reporting periods there has been a greater focus on urban infill however most development has been in greenfield sites. The implementation of housing affordability actions continues, as recommended in the 2003 SoE Report, yet an adequate supply of housing to meet the changing needs of the population at a price newcomers to the market can afford, remains a challenge.

# ACT State of the Environment Report 2011

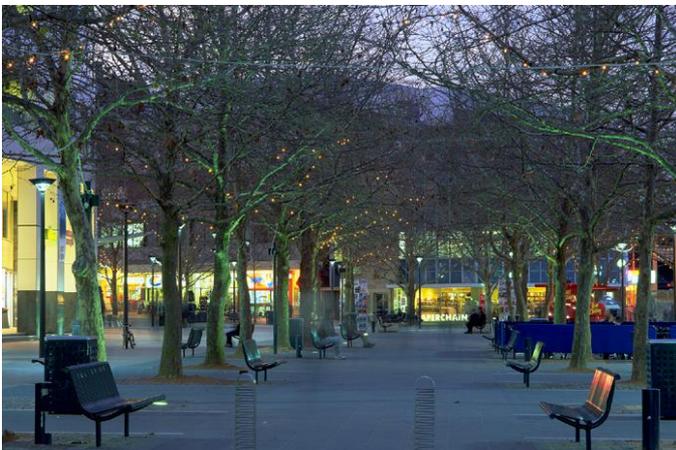
As identified in the previous two SoE Reports, private motor vehicles remain the dominant mode of transport in the ACT despite relative high levels of cycling and walking. The modest shift away from private car use seen in the last reporting period has not continued.

Recommendations regarding sustainable transport from the 2007-8 SoE Report have only been partially implemented. A pedestrian action plan is yet to be finalised and targets for reductions in transport related greenhouse gas emissions have not been developed. While the Time to Talk consultation stimulated much discussion on transport issues, delays in developing the Sustainable Transport Action Plan (2010-2016) (recently re-titled Transport for Canberra 2011-31) mean that long-term innovative sustainable transport options have yet to be realised.

Waste generation in the ACT continues to increase at a faster rate than population growth. Waste to landfill has significantly increased this reporting period, largely driven by rises in construction and commercial waste. This is a reversal of the decrease in waste to landfill seen in the last two reporting periods. Efforts in recycling continue, with progress in public-place and e-waste recycling along with business waste reduction programs as identified in 2007-08 State of the Environment Report recommendations. However, those regarding organic waste collection, promoting waste minimisation and waste minimisation/avoidance action plans have yet to be implemented. Further work is needed in all these areas.

Progress has been made in identifying and managing Aboriginal heritage places and objects since the 2003 State of the Environment Report, however information on existing Aboriginal heritage places needs to be updated.

While action in response to upcoming changes in heritage legislation, noted in 2007, has been undertaken, this is yet to be finalised. A more strategic approach to heritage identification outside the Development Application process is warranted. In view of the centenary in 2013, there are opportunities to promote the ACT's rich heritage as part of celebrating 100 years since the capital was founded.



Source: ACT Government

As noted in 2003 and 2007-08 State of the Environment Reports, many ACT residents are concerned with and involved in protecting the environment, however there is a disconnect between awareness and actions, particularly around consumption and transport use. Government and community responses to dealing with natural hazards in the wake of the 2003 bushfires are heartening, in particular the

# ACT State of the Environment Report 2011

development of the *Strategic Bushfire Management Plan for the ACT* which integrates attention to ecological and community needs.

Many issues discussed in previous years remain relevant and recommendations are provided at the end of this paper to assist progress.

## Theme summary: Key issues and outcomes

*Time to Talk: Canberra 2030* (ACT Government 2010a) was an opportunity for extensive community consultation, which found that Canberrans love the city's liveability, environment and open space. Most want a green and sustainable city that limits urban sprawl. There was support for strategic urban infill development that maintains its green spaces and enhances the character and amenity of the city, rather than detracting from it. However, the ACT is facing many challenges in maintaining its urban quality and increasing its sustainability into the future.

### Urban quality

About a quarter of the total land in the ACT is used for urban development, with Canberra having a relatively low urban density compared to other Australian capital cities (Table 1).

Table 1. Comparison of densities of the populations of Australian cities

City	Population	Density (per ha)
Canberra	368,129	10.8
Sydney	4,119,189	20.4
Melbourne	3,592,592	15.7
Brisbane	1,763,129	9.2
Perth	1,445,073	12.1
Adelaide	1,105,839	13.8
Hobart	200,524	10.3
All cities	12,594,475	n/a

Source: based on Mees, Sorupia and Stone 2007

Suburbs that have undergone new housing development have seen an increase in their population during the reporting period. Examples of these growth areas include Gungahlin in the north, as well as areas of increasing infill development such as Braddon and Turner in North Canberra. Total population has declined slightly in areas with ageing populations and decreasing household size, such as Weston Creek and Tuggeranong (ACTPLA 2011).

Some community concern has been expressed (ACT Government 2010a) about altering the character of the city through replacing single detached houses with higher density

# ACT State of the Environment Report 2011

developments such as townhouses and apartments. However, during the reporting period, by far the majority of new residential development was in Greenfield sites, on land previously used for agricultural or other non-urban land uses (Table 2).

Table 2. Greenfield and infill development in the ACT, 2006 to May 2011

Year	Infill (number of new housing units approved)	Greenfield (number of new housing units approved)
2006–07	156 (7.4%)	1966 (92.6%)
2007-08	828 (23.9%)	2642 (76.1%)
2008-09	791 (18.8%)	3417 (81.2%)
2009-10	1893 (46.6%)	2168 (53.4%)
2010 to May 2011	1110 (22.2%)	3890 (77.8%)

Source: LAPS

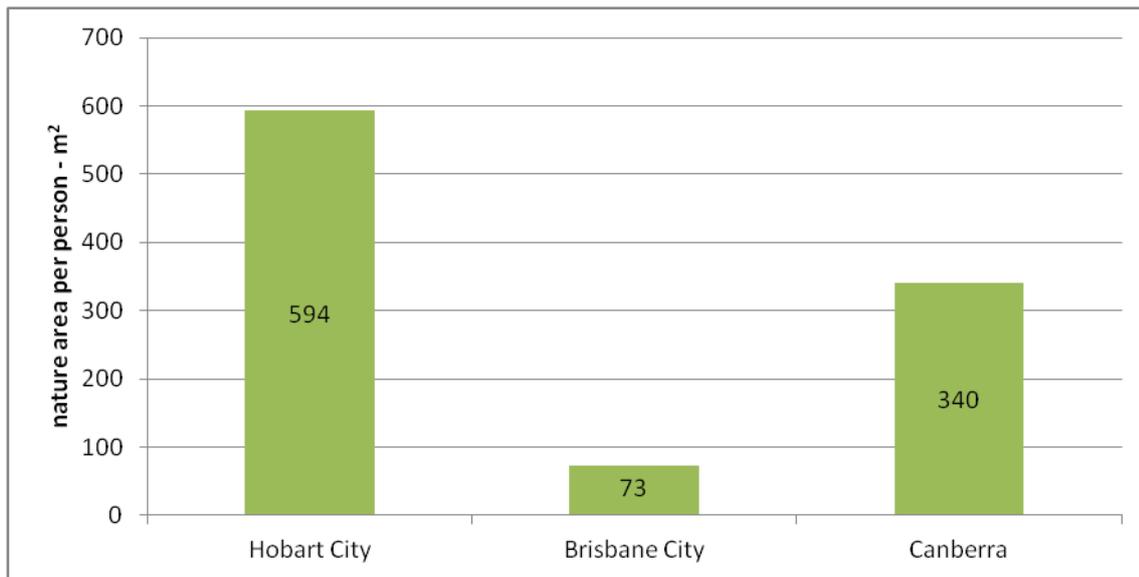
Australian houses are now reported to be, on average, the largest in the developed world (CommSec 2009). However, in the ACT, both detached and other dwelling types built over the reporting period have for the first time, had average floor areas below the Australian average (ACT Government 2011). Larger houses are likely to be associated with higher rates of consumption related to construction, furnishing, renovation, maintenance and, notably, heating and cooling. Larger houses are also associated with greater areas of hard surfaces which decrease capacity for water retention within the building lot. Houses that are large relative to lot size also have little land available for gardens and outdoor recreational purposes. The social, health and environmental implications of these trends in housing and lot sizes need to be considered in future planning for a more sustainable city.

The city's environment, liveability and amenity depend in considerable measure on green infrastructure - features of the natural environment such as vegetation, parks and waterways. Urban open space and the Canberra Nature Park comprise less than 3% and 4% respectively of the ACT's total land area (PCL 2009). However, these areas are integral to the health and wellbeing of Canberra residents and contribute to Canberra's image as the Bush Capital. These spaces also perform a utilitarian function in stormwater management (ACTPLA 2008).

Canberra has an estimated 794 268 trees in streets, parks and open space (OCSE 2011a). Trees help ameliorate the effects of hot and cold weather, offer visual amenity, habitat and connectivity for biodiversity, and provide a physical link with Canberra's past and future. Compared with other Australian cities, the area of urban nature park or conservation area per person is high in Canberra (Figure 1). Yet, while Canberra's urban trees, parks and open spaces are a major asset, they are also a management challenge for the ACT Government (OCSE 2011b).

# ACT State of the Environment Report 2011

Figure 1. Area of nature or conservation reserve per person



Source: OSCE 2011b

Note: The figure for Canberra does not include Namadgi National Park, Tidbinbilla Nature Reserve and Googong Foreshores

## Transport

Transport patterns and trends in the ACT reveal a mixed picture; high automobile dependence and low public transport usage, but higher rates of cycling than the Australian average. Overall, rates of cycling and walking continue to increase, though they account for only a small share of work trips. Walking is more common than the national average for work trips but less common for non-work or school trips. Although in the five years to 2006 there was a modest shift away from the private car to public transport, the trend appears to have reversed since 2006. Public transport patronage has stagnated. Both total and per capita distance travelled by private vehicle is now growing at a faster rate than for any other Australian capital city. Although travel-to-work data are collected in the *Census of Population and Housing*, the last comprehensive travel survey of the ACT was conducted in 1997 and is now out of date, limiting our understanding of non-work travel.

Higher residential densities, of themselves, have not been associated with higher usage of sustainable transport options, with areas such as Gungahlin having even higher levels of car use than the ACT average (ABS 2008a). However, proximity to work appears to encourage sustainable transport use with workers employed in Civic and the town centres having much higher rates of cycling and walking to work than Canberrans employed in locations such as business parks and industrial areas (ABS 2008a). It will not be known if travel to work targets set out in the *ACT Sustainable Transport Plan* for 2011 were met until the release of ABS census data in 2012.

# ACT State of the Environment Report 2011

During the reporting period, 381 km of new road lanes were constructed with the length of bus lanes increased only slightly, though on-road cycle paths increased by 131 km (TAMS 2011). An additional 150km of footpaths and 10 km of off-road cycle paths were also built during the reporting period (TAMS 2011). Over the last 10 years, \$700 million of transport infrastructure investment has been spent on roads and parking (ESDD 2011), with approximately \$200 million of this spent on the Gungahlin Drive Extension. \$300 million has been spent on public transport over the same period, as well as \$80 million on cycling and walking infrastructure (ESDD 2011).

## Waste

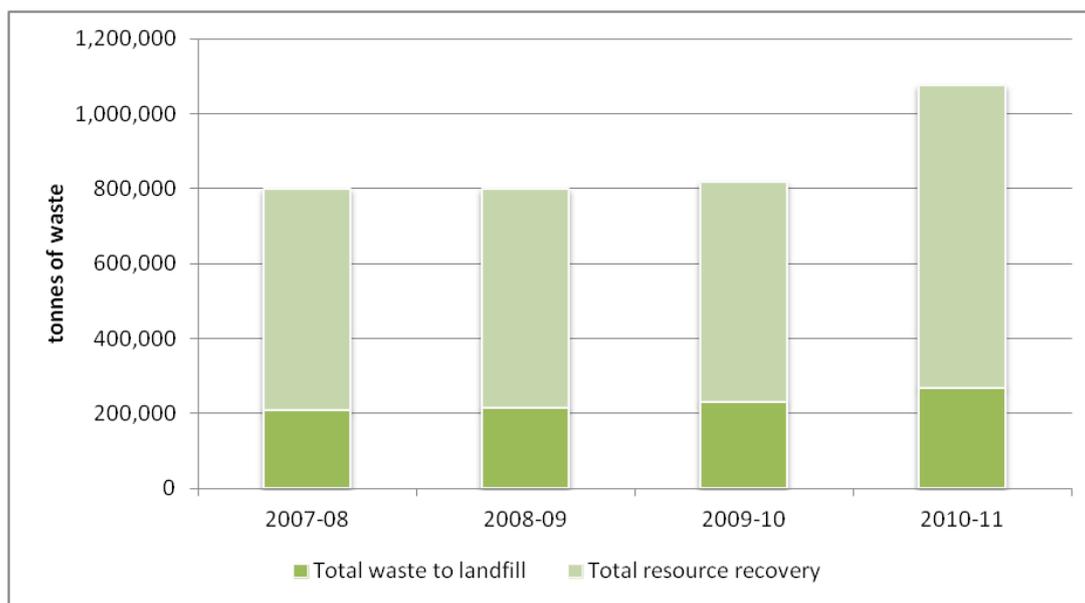
Continuing the trend identified in the previous reporting period, the total amount of waste generated in the ACT from 2007-08 to 2010-11 increased by almost 35%. Despite achieving large increases of almost 37% in the share of waste recycled, the volume of waste to landfill increased by 29% (Figure 2).

Increased waste generation is directly linked to increased consumption. In 2009 the ACT's ecological footprint was 13% higher than the national average. It has increased by 25% in the last 10 years (Dey 2010), probably as a result of high average incomes and resulting capacity to purchase large quantities of goods and services. This consumption behaviour, coupled with population growth, leads to increased waste generation.

Data indicate that construction and demolition, as well as commercial and industrial wastes (in particular additional deliveries of contaminated soil from the West Molonglo pond cleanup and elsewhere), have largely been driving the increase in waste to landfill over the reporting period (TAMS 2011). This in turn is likely to be due to increased construction and given predicted population growth and associated need for additional housing, suggests that reducing and managing these waste sources will be particularly challenging.

# ACT State of the Environment Report 2011

Figure 2. Waste Generation in the ACT, 2007-08 to 2010-11



Source: TAMS

Although Australian governments have limited control over individual purchasing behaviours, they need to encourage and support behaviour change if waste reduction is to be achieved. Action at a policy and program level can raise awareness of the links between high levels of consumption and waste generation as well as influence expectations and set standards for residential and commercial construction.

## Heritage

Canberra is a very young city. However, the ACT has a rich heritage of natural, Aboriginal, and historic places and objects. In March 2013, Canberra will celebrate its centenary. Preparations are in progress for a year-long program to highlight Canberra's role as the capital of Australia.

Table 3 shows numbers of historic heritage places listed on the ACT Heritage Register as registered, provisionally registered or nominated.

Table 3. Number of ACT historic heritage places or objects

Activity	2007-08	2008-09	2009-10	2010 to date
Registered places and objects	112	129	134	142
Provisionally registered places / objects	15	6	7	10
Nominated places and objects	237	226	222	207

Source: ACT Heritage

Currently there is a large backlog in processing relating to the ACT Heritage Register, despite some reduction since the last reporting period. The capacity to reduce the backlog depends

# ACT State of the Environment Report 2011

on numerous factors. These include levels of resourcing, the complexity of issues involved, the quality and age of information in some old nominations, the increasing level of documentation required for nominations. The number of new high priority nomination that arise is also a factor.

Heritage places and objects in the ACT are at risk because of limited funding for registration and for management of the pressures of development. Heritage protection legislation is in a period of transition: there is a new Heritage Council, and the *Heritage Act 2004* is being reviewed. The review included a community consultation process, and has been completed. The ACT Government is preparing its response to the findings and recommendations.

Since its establishment Canberra has had various stages of development, including a surge of residential development in the post-war years that resulted in rapid construction of many low-cost housing units. Buildings from this era are currently common subjects of renovation and replacement. Care needs to be taken to protect places and objects which, in other locations might not be considered for heritage protection. According to results from the *Time to Talk* consultation, the sense of place Canberrans have resides as much with the landscape – the mountains, ridges, bush and grasslands of the ACT as it does with the architectural elements of the city. It follows that protecting the natural heritage of the ACT is equally as important as conserving parts of the built environment.

## Natural hazards

The ACT features rugged timbered mountains, hill country, grasslands and a network of river systems with just over half the Territory comprising conservation areas. This, and the close proximity of bushland reserves to urban areas, increases the level of risk of property damage resulting from natural hazards such as floods, storms and fire. New greenfield and peri-urban developments extend the area of the ACT that is vulnerable to natural hazards such as fires.

The ACT has experienced relatively few serious natural disasters; a recent exception being the 2003 bushfire. Significant research undertaken following the 2003 fires has improved understanding of the nature and behaviour of fires. Lessons learned from changes to fire management has informed the development of the *Strategic Bushfire Management Plan for the ACT* (ACT Government 2009b) and should continue to inform emergency plans for other natural disasters.

Under climate change predictions (Webb 2011), a heightened risk of natural hazards and disasters is expected to result from increased extreme events, higher average temperatures, more heat waves, storms and periods of intense rain. Governments at all levels are recognising the need to develop resilience and capacity within the community, to prepare for, and deal with, the impacts of natural hazards. Territory-wide risk assessment and planning are currently in progress (Commonwealth of Australia 2011).

# ACT State of the Environment Report 2011

## Community engagement

Compared to the Australian average, ACT residents have a relatively high level of environmental concern (ABS 2008b, 2010a).. People living and working in the ACT, along with residents of surrounding rural areas and towns, are active in various environmental groups. They engage in regeneration, protection and research activities, many demonstrating their commitment over long periods of time and to multiple projects. For example, the Canberra Ornithologists Group provides much of the data on native birds in the ACT. Catchment management groups, Parkcare, Waterwatch and various 'friends' groups continue to work to control weeds and monitor and maintain local waterways, wetlands and ecological communities. Welcome funding and other resources for many of these initiatives is provided through government and business partnerships.



Source: ACT Government

Along with these community-based actions, Government initiatives and programs aim to raise awareness and educate the ACT community on issues relating to the local and wider environment. A particular focus has been on increasing resource efficiency, especially via water and energy efficiency audits and rebates. In general, ACT residents are reducing their water and energy use and are actively recycling waste. However, levels of awareness do not always correlate with action. For example, 66% of Canberra people are aware of GreenPower (well above the Australian average of 47%), but the percentage of people who actually purchase GreenPower in the ACT is 4.9% which is slightly below the Australian average of 5.3% (ABS 2010). Current and emerging challenges facing the ACT include making more use of sustainable transport options, and reducing present high levels of consumption and associated waste generation.

# ACT State of the Environment Report 2011

The *Time to Talk Canberra 2030* community consultation (ACT 2010a), conducted during 2010 by the ACT Government, involved thousands of Canberrans in face-to-face and online forums. The aim was to canvas community opinions about land-use planning, transport, climate change, water and energy, in order to help inform the review and development of strategic government policy.

Despite Canberra's highly educated, environmentally aware, and engaged population, the ACT ecological footprint is large and increasing. Waste generation maintains an upward trend, and both distance travelled by car and our urban area continue to grow, as does our use of energy and water.

## Responses and effectiveness

The ACT Government has responded to many of the environmental issues identified above and in the last State of the Environment Report. Responses have included a number of separate initiatives, designed to address issues in particular components of the natural and built environment (see *Sustainability Stories*). These initiatives and programs are an essential component in efforts to achieve environmental protection and enhanced sustainability. However, they need to be part of a strategic, ongoing approach to sustainability which recognises the complexity of the issues and works to better integrate the protection of the ACT natural environment, the development of Canberra as a city and the enhancement of the population's wellbeing.

### Urban quality

A sustainable city is, arguably, one that balances environmental, social and economic needs. Within this framework, environmental and heritage values are protected; residents also have access to appropriate, affordable housing, with proximity to work and recreational opportunities along with community facilities such as schools, shops, medical and other services. Furthermore, a sustainable city offers an integrated transport network allowing people to move between energy efficient residential and commercial buildings.

The *Canberra Spatial Plan* (ACTPLA 2004) seeks to capitalise on Canberra's polycentric city structure by achieving strategically located pockets of medium-density development around town centres. The aim is to support more distributed employment and services, linked by rapid and frequent bus services. Denser housing in established areas, such as town centres, can mean residents have better access to places of work, leisure and community facilities, as well as public transport.

The *Canberra Spatial Plan* (ACTPLA 2004) also sets out objectives based on a concentric model that restricts all urban growth to within 15 km of Civic, and intensifies residential development so that 50% of it occurs within a 7.5 km radius of Civic (ACTPLA 2004).

# ACT State of the Environment Report 2011

Performance against these objectives has improved over the reporting period, with residential development within the 15km range increasing from 92.2% to 96.7% (Table 1). However, the urban intensification boundary target has not been met since 2006-07 and development occurring within a 7.5 km radius of Civic fell to 28.5% in 2009-10 (Table 4).

Table 4. Trends in urban development location relative to ACT Spatial Plan 2004 objectives during the current and previous reporting periods

	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Residential development within 7.5 km of Civic	43.6%	40.5%	53.3%	48.5%	37.8%	28.5%
Residential development within 15 km of Civic	93.0%	92.1%	91.4%	92.2%	95.4%	96.7%

Source: ACTPLA 2011

ACT Government strategies to enhance these urban qualities and their outcomes over the reporting period are detailed in the *Urban quality* indicator cluster paper. Initiatives in use in ACT have included:

- draft amendments to the Territory Plan (ACTPLA 2008) to improve solar efficiency of houses, released in 2011;
- mandatory disclosure of energy efficiency ratings for commercial buildings;
- development of greenfield land primarily through the Land Development Agency, with objectives including meeting demand, providing affordable land and housing and establishing an inventory of serviced land;
- a 5-year infrastructure program, *Building the Future* (ACT Government 2008), established in the 2008-09 Budget, increased the ACT's infrastructure asset base by 10%.

There are currently no measures or targets in place for defining or assessing urban quality. Determining these in the near future would allow for assessment against a consistent set of indicators and permit comparison over time.

Following rezoning through the Territory Plan, there has been a shift towards redeveloping commercial land for residential uses and creating higher density developments around transport corridors and existing infrastructure. As a result, residential population densities have increased in Canberra's town centres and in the suburbs of Bruce and Kingston and along Northbourne Avenue.

# ACT State of the Environment Report 2011

Despite these developments, Canberra is considerably less self-contained than the Y-Plan<sup>1</sup> envisaged. Substantially more employment is located in Civic and surrounds than was anticipated, with the result that Civic has been growing at the expense of other town centres. More office parks have been built; an example being the Brindabella Business Park at the airport. The location of such business parks away from residential centres exacerbates the need for travel, primarily by car, between residential locations and these more remote employment and service areas, reducing self-containment as a result.

Recent investigations of urban trees and nature parks in the ACT have also identified the benefits of green infrastructure to our city but also highlighted the management challenges. This has been echoed by the community in the *Time to Talk* consultations.

## Transport

The ACT Government's response to the environmental impacts of the transport system relies on reducing emissions from individual vehicles through technological change, and reducing travel to work by private car. Actions for implementing the *Sustainable Transport Plan* were to be set out in the *Sustainable Transport Action Plan 2010-2016*, however as of the end of this reporting period this plan had not yet been released, with a draft due to be available for public comment in late 2011, re-titled *Transport for Canberra 2011-2031*. Instead, individual actions have been undertaken by ACT Government to increase patronage of sustainable transport options, including:

- raising parking costs in Civic and town centres;
- designing and initial rolling out of a new bus network;
- expanding park'n'ride facilities;
- identification of priority sections of cycle paths for capital works; and
- releasing the *Strategic Public Transport Network Plan*.

---

<sup>1</sup> The 1967 Y-Plan was the key strategic plan for Canberra until the 2004 ACTPLA Spatial Plan. The Y-Plan provided for Canberra to grow through the creation of separate districts in the form of a 'Y'

# ACT State of the Environment Report 2011



Source: ACT Government

Available evidence suggests that despite these actions and relatively high operating costs, Canberra's public transport remains under-utilised, with current rates of usage per person barely half those of two decades ago. Current public transport policies have not yet been successful in returning usage of public transport to the levels of the late 1980s, when annual patronage was almost 50% higher than it is today, and 200% higher on a per capita basis.

Small improvements in the environmental performance of individual vehicles appear to have been seriously undercut by rapid growth in car and truck travel overall. Substantial improvements to the ACT's already-extensive road system have increased the attractiveness of travel by car, with more large projects underway and planned (ESDD 2011). Although parking costs have increased in Civic and town centres, the *ACT Parking Strategy*, which was released in draft form for public comment in 2007, has not been completed, and large commercial and employment centres continue to have free parking, increasing the incentive to travel by car. Free parking in the parliamentary triangle, although outside of the ACT Government's jurisdiction, remains particularly problematic, as recognised in previous ACT State of the Environment Reports.

Further, travel-to-work targets alone are not expected to reduce the environmental impact of the transport sector, with emissions from transport expected to increase by 50-60% above 1990 levels by 2020, even if these targets are achieved (see the *Climate* theme paper for further information). This suggests that hard questions need to be asked about the gap between the aspirations of both the ACT Government and the community for sustainable transport and on-ground outcomes.

# ACT State of the Environment Report 2011

## Waste

The ACT *No Waste by 2010 Waste Management Strategy* was the guiding waste policy over the reporting period. Its successor, the *Draft Sustainable Waste Strategy 2010-2025* (DECCEW 2010a), was open for public comment until the end of February 2011 and is currently being considered by the ACT Government for possible adoption by the end of 2011. The draft strategy focuses on managing organic and business/construction waste. Further, it incorporates targets of “over 80% resource recovery by 2015 and over 90% resource recovery by 2025” (DECCEW 2010a).

Initiatives put in place for waste management in the ACT over the reporting period have included:

- business and industry programs: ACTSmart Business, ACTSmart Office and ACTSmart Public Event programs, School Programs and community programs;
- methane gas capture, to produce electricity at landfill sites;
- *Plastic Shopping Bags Ban Act (ACT) 2010* passed in December 2010, and commenced on 1 November 2011 (DECCEW 2010b);
- action on electronic waste (E-waste); in 2010 the ACT became the first jurisdiction to divert televisions and computers from landfill;
- waste harvesting and thermal conversion research, at the Fenner School of Environment and Society at the Australian National University; and
- in 2010, the ACT Government’s pre-feasibility assessment of a thermal conversion facility for the ACT.

As in previous reporting periods, the largest component of the increase in waste to landfill is waste from construction, demolition, commercial and industrial enterprises. Despite recommendations in the 2007-08 State of the Environment Report, there has been little action to increase the diversion of organic materials from landfill. These two sectors require particular focus in the future.

The ACT has led the way nationally in the diversion of electronic waste to landfill. In 2010, the ACT became the first jurisdiction to divert televisions and computers from landfill. A National Television and Computer Product Stewardship Scheme is expected to commence at the end of 2011 (DSEWPaC 2011)

Despite extensive educational programs, provision of well-supported waste disposal and recycling facilities and the adoption of innovative technologies, waste generation, including both waste to landfill and resource recovery, has increased. Increasing rates of consumption

# ACT State of the Environment Report 2011

challenge the aim of reducing waste in the ACT. To date there has been little focus on this aspect of waste management.

Other waste management challenges include enhancing data collection systems, extending waste recovery and recycling initiatives particularly in relation to green and food waste, and developing methods for carbon-neutral waste management. To develop and implement such strategies the ACT Government needs to work collaboratively with the community, businesses and government agencies.

## Heritage

Initiatives developed by the ACT Government to protect heritage values and manage registered historic heritage places in the ACT include:

- free heritage and architectural guidance on renovating or extending a heritage building;
- guidelines for assessing development applications; and
- environmental impact assessment for heritage-listed places or objects subject to development proposals.

However, resourcing capacity limits ACT Heritage in its monitoring of compliance so there is little assessment of the effectiveness of these initiatives. In addition, many services are advisory in nature or enacted in response to development, rather than providing proactive and strategic direction to heritage protection and conservation. The Marshall Report (Marshall 2010) found that audit, compliance and enforcement are weak elements of the Heritage Act.

In February 2012 the *Register of the National Estate* becomes obsolete (DSEWPaC 2008). If nationally listed heritage places within the ACT are to be protected, they will need to be incorporated into the ACT Heritage Register. The Government has been in discussion with the National Capital Authority regarding this issue. A strategic approach needs to be taken to identify and protect heritage places and objects prior to development, rather than in response to it, which has largely been the case in the past.

## Community engagement

Available data indicate that while many people are making changes to reduce resource use, action is less likely where a change involves a direct cost to individuals. This is evident in the low take-up rate of GreenPower and the increase in the ecological footprint as mentioned above. Reducing the impacts of individual consumption of resources is one of the key challenges in making the ACT more sustainable into the future.

Transport is another area in which a relatively low proportion of ACT residents is adopting sustainable practices. The *Time to Talk* community engagement project conducted in 2010 by

# ACT State of the Environment Report 2011

the ACT Government found that ACT residents who responded are looking for transport options that are more sustainable than private vehicles; they are supportive of the development of bus shuttle services, transport corridors, light rail, and safe walking and cycling options (ACT Government 2010a).

## Natural hazards

In the ACT, the Department of Territory and Municipal Services (TAMS), through its Parks, Conservation and Lands Branch, is responsible for managing 73% of the land area and for providing fire suppression capability through the Parks Rural Fire Brigade (ACT Government 2009b).

Over this reporting period considerable progress has been made in improving planning and systems for managing natural resources and mitigating potential hazards.

Nationally, in 2009, the Council of Australian Governments (COAG) adopted a "whole-of-nation resilience-based approach to disaster management, which recognises that a national, coordinated and cooperative effort is needed to enhance Australia's capacity to withstand and recover from emergencies and disasters" (COAG 2009:ii). This is reflected in the ACT Natural Resource Management (NRM) Plan, produced by the ACT NRM Council (ACTNRM 2009). The Council is a partnership comprising representatives of ACT communities and the ACT and Australian governments.

As mentioned above, the *Strategic Bushfire Management Plan for the ACT* (ACT Government 2009b), prepared under the *Emergencies Act 2004*, provides the framework for fire management in the ACT. It integrates ecological needs and the safety of the community. The Plan defines guidelines for managing bushfire fuel, and for fire management zones and mapping.

The ACT Planning and Land Authority also has a plan for managing bushfire at the urban interface with bushland and in new urban growth areas. This plan aims to balance bushfire risk mitigation and the planning tradition of Canberra, in particular noting the large non-urban space in the ACT.

The 2006-07 ACT State of the Environment Report recommended determining the long-term land use of all forestry land burned in the 2003 bushfire where that use was not already defined (ACT 2008). Some of this land has been rezoned for water catchment, residential or recreation use; for example, the National Arboretum Canberra, and the new suburbs along the Molonglo River. The areas where land use is still undecided have been replanted with pine to retard erosion until the ACT Government determines the future of forestry and the land it occupies. At present there are no proposals to change the existing uses of land currently zoned for forestry (OCSE 2010).

# ACT State of the Environment Report 2011

Strategies for managing urban flooding include detention basins and wetlands, located near recreational playing fields in new and some older suburbs, and a growing use of water sensitive urban design. Water sensitive urban design is intended to reduce the negative impacts of stormwater on waterbodies, and protect aquatic ecosystems through collecting, filtering and using stormwater close to where it falls as rain.

During the reporting period a number of wetlands were constructed in the urban area with the aim of providing a range of benefits including enhanced wildlife habitats, and with a particular focus on flood and stormwater protection and water quality improvements (see *Water quality* indicator cluster paper). New constructed wetlands are planned for Gungahlin in 2010-2012. It is too early to assess the wetlands' effectiveness in relation to flood protection. In 2010, an analysis rated the ACT's stormwater infrastructure at C+, an improvement from its C rating in 2005 (Engineers Australia 2010).

## Emerging issues

Despite the many positive aspects contributing to Canberra's rating as a highly liveable city, the ACT is facing a number of future challenges. Further information on future scenarios and implications for sustainability can be found in the *Driving Forces* and *Horizon Scanning* papers.

The population of the ACT is predicted to rise to over 450,000 by 2030. Further, while the population of the ACT is currently younger than the national average, it is ageing more rapidly (Table 5). This demographic change is expected to be spread unevenly across the ACT. Populations in areas such as Tuggeranong, currently with a relatively young population, are projected to decline by 2016. Areas such as Woden Valley are projected to experience minor growth but a loss of people under 45 years of age (Jackson 2008).

Table 5. Comparison of ACT population projections for 2011 and 2030

Year	Male	Female	Total persons	Aged 0-14 years	Aged 15-64 years	Aged 65+ years	Median age (years)
2011	181,133	182,631	363,764	18.3%	71.0%	10.7%	33.9
2030	229,410	223,933	453,343	18.0%	65.3%	16.7%	37.5

Source: ACT Government 2010e

With this population growth and demographic changes, there will be increased demand for housing, government and other services. More flexible options in housing various forms will be needed to suit the diverse needs of young families, Canberra's large student population, older people and the growing number of one-person households. Greater numbers of apartment blocks are being built in Civic and the town centres, but a gap remains in the supply of intermediate-level smaller free-standing dwellings and town-house developments. With the increasing costs of land development and housing, the challenge to provide affordable

# ACT State of the Environment Report 2011

housing in close proximity to employment, shops, medical, recreational and other community facilities will continue.

In addition, alternatives to private vehicles to link people to retail, employment, recreational and other services will be essential for promoting a sustainable and liveable Canberra of the future. Such changes will require collaborative strategic planning that brings together knowledge and expertise across a wide range of public, private and community sectors to address the social, environmental and economic challenges these changes will bring. Few forums currently exist for this kind of ongoing collaboration across sectors.



Source: ACT Government

The ageing of the population also has implications for employment. There will be fewer people at labour-market entry age (15-64 years) relative to those at or approaching retirement. Against this background, it is of concern that ACT Government budget projections include only modest (2%) increases in spending on transport, recreational facilities, housing and community amenities and social and welfare services, although spending on health is understandably projected to increase by 4% by 2050 (ACT Government 2010d).

Population growth will also increase rates of consumption of products and services, which are closely related to Canberra's large and growing ecological footprint and associated levels of waste generation. While recycling appears to be largely embedded in Canberrans' behaviour, reducing consumption and waste generation is increasingly important if waste to landfill and demand for recycling services are to be contained.

Populations in the nearby NSW local government areas of Cooma-Monaro, Palerang, Queanbeyan, Yass Valley and Goulburn-Mulwaree are also projected to increase from a total

# ACT State of the Environment Report 2011

of 465 700 persons in 2011 to 577 900 in 2031 (ACT Government 2010c). One aspect of that growth will be the numbers of people travelling into Canberra from these regional centres for work and to access various services. In 2010, 25 000-30 000 people travelled from interstate to Canberra each day to work. More than 75% of these workers live in the commuter belt that includes Queanbeyan and the semi-rural areas surrounding Canberra (RDA ACT 2010). With the expectation that commuting numbers will continue to trend upwards, the demand for transport and other infrastructure can also be expected to increase

The need to reduce greenhouse gases by encouraging less reliance on motor vehicles will become even more important into the future. Rising fuel prices could stimulate development of a more environmentally sustainable city - one where efficient and economically attractive alternative transport options are integrated with the private motor vehicle. However, such price rises will place additional burdens on the more vulnerable sections of the community. Creative thinking is needed, to find ways of connecting appropriate and affordable public transport options with non-work travel as well as employment-related travel. Cities such as Copenhagen have demonstrated the effectiveness of increasing investment in cycling and walking infrastructure (Infrastructure Australia 2009). The key to the success of these international 'best practice' cities has been the development of specific measurable policies, cross-integration of relevant government agencies, and major investments into infrastructure and education (Infrastructure Australia 2009:2).

The capacity of a community to respond to the impacts of extreme weather events depends on its resilience. Although historically the ACT has suffered relatively few natural disasters, climate change is predicted to result in more frequent and intense bushfires, heatwaves and storms. These are likely to bring greater risk to community safety and the security of infrastructure. Potential impacts need to be factored into planning for urban development, green infrastructure management, provision of emergency and healthcare services. Community education programs to build awareness, capacity and resilience will also be needed.

Regional planning initiatives need continued and increased support. ACT border does not delineate potential vulnerabilities which are likely to be increased by the predicted climate change. These, and other cross-border issues, can be addressed effectively by close liaison, cooperation and strategic planning between the ACT Government and the planners and decision-makers in surrounding regional jurisdictions as well as the NSW and Commonwealth Governments. Extended use of electronic and other media to inform, educate and build cooperative, supportive and resilient communities that are able to deal with such events will become increasingly important.

A key determinant of Canberra developing as a sustainable city will be the capacity of the people to work cooperatively with one another and to build greater resilience to be able to

# ACT State of the Environment Report 2011

respond to future changes and challenges. With its highly educated and well-resourced population, numerous teaching and research institutions and active environmental groups, the ACT is well placed for this kind of collaboration to occur across the community.

## Recommendations

1. Finalise and implement the draft ACT Planning Strategy to provide an integrated approach to future landscape planning. Particular attention should be paid to:
  - a. determining indicators and measures for urban quality in the ACT that includes the benefits provided by green infrastructure and access to open space; and
  - b. developing greenfield and infill targets, which take into account both the need for public open space and the passive benefits of green infrastructure, as well as strengthening a sense of community and self containment.
2. Develop adaptable housing strategies to address the needs of changing population demographics into the future.
3. Finalise and implement the draft *Sustainable Transport Action Plan* to provide an integrated approach to transport and urban planning. In doing so:
  - a. obtain additional non-work related travel data, similar to the annual Sydney *Household Travel Survey*, to ensure a more complete understanding of Canberra's transport habits;
  - b. focus on strategies and targets to improve access to sustainable forms of transport outside of transport corridors;
  - c. develop targets for:
    - i. reducing greenhouse gas emissions from transport;
    - ii. increasing sustainable transport usage for non-work travel to complement the existing targets for work travel; and
  - d. track progress towards Sustainable Transport targets on an annual basis.
4. Finalise and implement a new ACT Waste Management Strategy with a focus on reducing waste generation; in particular:
  - a. examine and implement options for diverting wastes from landfill to higher order beneficial reuse opportunities. These actions should be measured, recorded and reported publicly.
  - b. focusing community education on the link between consumption and waste; and
  - c. targeting specific programs to reduce waste from the construction and demolition sector, and commercial and industrial sectors.
5. Strengthen heritage protection in the ACT by:

# ACT State of the Environment Report 2011

- a. Developing an action plan for heritage which addresses the backlog of heritage nominations and recognises key future places for protection;
  - b. Strengthening audit, compliance and enforcement processes in line with recommendations of the Marshall report;
  - c. Developing a memorandum of understanding with the Australian Government to protect assets, subject to Australian Government planning approvals, on the ACT Heritage Register;
  - d. Promote ACT heritage values as a part of the Canberra 2013 Centenary celebrations.
6. Align and integrate climate adaptation planning and disaster risk management where appropriate. This should include lessons learned from changes to fire management.
7. In collaboration with NSW Government and local councils, develop a regional approach to planning and risk management to address future challenges of population and climate change.
8. Strengthen community engagement in sustainability by:
- a. Undertaking research on attitudes to sustainability and consumption patterns and behaviours. This could be done through regular, comparable, community surveys similar to the annual NSW *Who cares about the environment?* with the outcomes informing focus areas for community engagement.
  - b. Fostering behavioural change through community engagement to reduce our ecological footprint with a particular focus on:
    - i. sustainable transport; and
    - ii. impacts of consumption.

## References

- ABS 2008a. *Canberra: A Social Atlas, 2006 Census of Population and Housing. Cat.No. 2030.8* - Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&20308\\_2006.pdf&2030.8&Publication&F084CC2518A2F7C3CA25740E0079DE65&&2006&17.03.2008&Latest](http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&20308_2006.pdf&2030.8&Publication&F084CC2518A2F7C3CA25740E0079DE65&&2006&17.03.2008&Latest) (accessed 21/7/11)
- ABS 2008b. *Multi-Purpose Household Survey: Environmental Views and Behaviour Study. Cat. No. 4626.0.55.001*. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4626.0.55.001Explanatory%20Notes1207-08%20\(2nd%20issue\)?OpenDocument](http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4626.0.55.001Explanatory%20Notes1207-08%20(2nd%20issue)?OpenDocument) (accessed 25/8/11)
- ABS 2010a. *Australian Social Trends - December 2010*. Cat. No. 4102.0. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.abs.gov.au/ausstats/SUBSCRIBER.NSF/log?openagent&41020\\_housing\\_indicators\\_2010.xls&4102.0&Data%20Cubes&6F6EA92192980447CA2577F80010DCA0&0&Dec%202010&14.12.2010](http://www.abs.gov.au/ausstats/SUBSCRIBER.NSF/log?openagent&41020_housing_indicators_2010.xls&4102.0&Data%20Cubes&6F6EA92192980447CA2577F80010DCA0&0&Dec%202010&14.12.2010) (accessed 7/11/11)

# ACT State of the Environment Report 2011

- ABS 2010b. *Environmental Awareness and Action*. Cat No. 4102.0. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/3FC4355B8BA3308BCA2577510019F919/\\$File/41020\\_environmentalawareness.pdf](http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/3FC4355B8BA3308BCA2577510019F919/$File/41020_environmentalawareness.pdf) (accessed 26/8/11)
- ACT Government 2004a. *The Sustainable Transport Plan for the ACT*. Canberra.  
[http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0010/167941/Sustainable\\_Transplan\\_Plan.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0010/167941/Sustainable_Transplan_Plan.pdf) (accessed 5/6/11)
- ACT Government 2004b. *Think Water, Act Water*. Canberra.  
[http://www.thinkwater.act.gov.au/more\\_information/publications.shtml#strategy](http://www.thinkwater.act.gov.au/more_information/publications.shtml#strategy) (accessed 11/4/11)
- ACT Government 2009. *Strategic Bushfire Management Plan for the ACT. Version 2*. Canberra.  
[http://www.esa.act.gov.au/ESAWebsite/content\\_esa/bushfires/before\\_a\\_bushfire/act\\_sbmp/sbmp\\_downloads/act\\_sbmp\\_plan\\_text\\_web.pdf](http://www.esa.act.gov.au/ESAWebsite/content_esa/bushfires/before_a_bushfire/act_sbmp/sbmp_downloads/act_sbmp_plan_text_web.pdf) (accessed 14/1/11)
- ACT Government 2010a. *Time To Talk: Canberra 2030 Outcomes Report*. Canberra.  
<http://timetotalk.act.gov.au/storage/78d10e40d957379825347909b6e2bfd9.Time%20to%20talk%20-%20web%20version.pdf> (accessed 26/8/11)
- ACT Government 2010b. *Time to Talk: Canberra 2030 – Getting Around*. Canberra.  
<http://timetotalk.act.gov.au/files/download/?id=158> (accessed 21/11/11)
- ACT Government 2010c. *Time to Talk: Canberra 2030 - Population*. Canberra.  
<http://timetotalk.act.gov.au/storage/bf77c700a50698a0a623f9ab9c7d2310.31-08%20Population.pdf> (accessed 9/8/11)
- ACT Government 2010d. *Population Ageing in the ACT: Issues and Analysis*. Canberra.  
[http://www.cmd.act.gov.au/\\_\\_data/assets/pdf\\_file/0008/154475/population-ageing-ACT.pdf](http://www.cmd.act.gov.au/__data/assets/pdf_file/0008/154475/population-ageing-ACT.pdf) (accessed 18/9/11)
- ACT Government 2010e. *ACT Population Projections: 2009 to 2059*. Canberra.  
<http://www.cmd.act.gov.au/policystrategic/actstats/projections/act> (accessed 25/8/11)
- ACT Government 2011. *Draft ACT Planning Strategy – Planning for a Sustainable City*. Canberra.  
[http://timetotalk.act.gov.au/storage/1222\\_PLANNING\\_STRATEGY\\_TAGGED\\_PDF\\_FINAL.pdf](http://timetotalk.act.gov.au/storage/1222_PLANNING_STRATEGY_TAGGED_PDF_FINAL.pdf) (accessed 17/11/11)
- ACTPLA 2004. *Canberra Spatial Plan*. ACT Planning and Land Authority. Canberra.  
<http://apps.actpla.act.gov.au/spatialplan/index.html> (accessed 17/11/11)
- ACTPLA 2007. *Canberra At the 2006 Census: Population and Housing*. ACT Planning and Land Authority. ACT Government. Canberra.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/7675/Canberra\\_at\\_2006\\_Census.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0007/7675/Canberra_at_2006_Census.pdf) (accessed 15/8/11)
- ACTPLA 2008. *Territory Plan – Part B9*. ACT Planning and Land Authority. ACT Government. Canberra. <http://apps.actpla.act.gov.au/tplan/index.htm> (accessed 5/7/11)
- ACTPLA 2011. *Population and Residential Density in Canberra*. ACT Planning and Land Authority. ACT Government. Canberra.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/23648/Population\\_Density\\_2011.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0005/23648/Population_Density_2011.pdf) (accessed 18/11/11)
- COAG 2009. *National Strategy for Disaster Resilience: Building Our Nation's Resilience to Disasters*. Council of Australian Governments. Canberra.

# ACT State of the Environment Report 2011

- [http://www.coag.gov.au/coag\\_meeting\\_outcomes/2011-02-13/docs/national\\_strategy\\_disaster\\_resilience.pdf](http://www.coag.gov.au/coag_meeting_outcomes/2011-02-13/docs/national_strategy_disaster_resilience.pdf) (accessed 23/8/11)
- Commonwealth of Australia 2011 *Australian Capital Territory Implementation Plan – 2011-2012*. National Partnership Agreement on Disaster Resilience.  
[http://www.federalfinancialrelations.gov.au/content/national\\_partnership\\_agreements/environment/natural\\_disaster\\_resilience/ACT\\_11-12\\_2.pdf](http://www.federalfinancialrelations.gov.au/content/national_partnership_agreements/environment/natural_disaster_resilience/ACT_11-12_2.pdf) (accessed 18/9/11)
- CommSec 2009. *Australian Homes Are Biggest In the World 30 November*. Economic Insights.  
<http://images.comsec.com.au/ipo/UploadedImages/craigjames3f6189175551497fada1a4769f74d09c.pdf> (accessed 9/11/11)
- DECCEW 2010a. *Draft Sustainable Waste Strategy 2010-2025*. Department of the Environment, Climate Change, Energy and Water. ACT Government. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/210501/SustainableWaste\\_Strategy\\_WEB.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0009/210501/SustainableWaste_Strategy_WEB.pdf) (accessed 18/9/11)
- DECCEW 2010b. *Media Release -Plastic Bag Ban Passed by Assembly*. Department of Environment, Climate Change, Energy and Water. ACT Government. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/214296/MIN\\_187\\_1210\\_Plastic\\_bag\\_ban\\_passed\\_by\\_Assembly.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0006/214296/MIN_187_1210_Plastic_bag_ban_passed_by_Assembly.pdf) (accessed 27/5/11)
- DECCEW 2010c. *Executive Summary: An Evaluation Report of the Australian Sustainable Schools Initiative ACT 2010. June/July 2010*. Department of the Environment, Climate Change, Energy and Water. ACT Government. Canberra.  
[http://www.sustainableschools.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/222809/Attachment\\_4\\_-\\_Evaluation.pdf](http://www.sustainableschools.act.gov.au/__data/assets/pdf_file/0005/222809/Attachment_4_-_Evaluation.pdf) (accessed 25/8/11)
- Dey, C. 2010. *The 2008-09 Ecological Footprint of the Population of the ACT*. Integrated Sustainability Analysis Research Group. The University of Sydney. Sydney.  
[http://www.environmentcommissioner.act.gov.au/\\_\\_data/assets/pdf\\_file/0015/211182/ACT\\_Ecological\\_Footprint\\_08-09\\_final\\_report.pdf](http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0015/211182/ACT_Ecological_Footprint_08-09_final_report.pdf) (accessed 17/11/11)
- DSEWPac 2008. *Register of the National Estate*. Department of Sustainability, Environment, Water, Population and Communities. Australian Government. Canberra.  
<http://www.environment.gov.au/heritage/places/rne/index.html> (accessed 17/9/11)
- DSEWPac 2011. National Television and Computer Product Stewardship Scheme. *National Waste Policy Fact Sheet*. Department of Sustainability Environment, Water, Population and Communities
- Engineers Australia 2010. *Infrastructure Report 2010: Water*. Canberra.  
[http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file\\_uuid=C8F26346-DB84-45EF-E104-B53E726D4A61&siteName=ieaust](http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file_uuid=C8F26346-DB84-45EF-E104-B53E726D4A61&siteName=ieaust) (accessed 18/4/2011)
- ESDD 2011. *Transport for Canberra 2011-2031- Draft for Public Comment*. Environment and Sustainable Development Directorate. ACT Government. Canberra.  
<http://www.timetotalk.act.gov.au/storage/Transport%20Policy%2014%20October%20Full.pdf> (accessed 10/11/11)
- Heuris Partners 2010. *ACT Greenhouse Gas Emissions: Existing Policy Baseline Projections To 2050 - Research Report*. Heuris Partners. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0008/187217/ACT\\_Greenhouse\\_Gas\\_Emissions.pdf#ACT%20Greenhouse%20Gas%20Emissions](http://www.environment.act.gov.au/__data/assets/pdf_file/0008/187217/ACT_Greenhouse_Gas_Emissions.pdf#ACT%20Greenhouse%20Gas%20Emissions) (accessed 7/11/11)
- ICRC 2011. *ACT Greenhouse Gas Inventory Report for 2008-09*. Independent Competition and Regulatory Commission. Canberra.

# ACT State of the Environment Report 2011

- [http://www.icrc.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/235719/ACT\\_Greenhouse\\_Gas\\_Inventory\\_Report\\_2009\\_Final.pdf](http://www.icrc.act.gov.au/__data/assets/pdf_file/0009/235719/ACT_Greenhouse_Gas_Inventory_Report_2009_Final.pdf) (accessed 11/10/11) Intergovernmental Panel on Climate Change (IPCC). 2001. *IPCC Third Assessment Report* (IPCC, 2001 a,b,c): Annex B Glossary of Terms, <http://www.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf> (accessed 19/6/11)
- Infrastructure Australia 2009. *Cycling Infrastructure for Australian Cities*. Major Cities Unit. Australian Government. Canberra.  
[http://www.infrastructureaustralia.gov.au/publications/files/Cycling\\_Infrastructure\\_Background\\_Paper\\_16Mar09\\_WEB.pdf](http://www.infrastructureaustralia.gov.au/publications/files/Cycling_Infrastructure_Background_Paper_16Mar09_WEB.pdf) (accessed 17/11/11)
- Jackson. N. 2008. *Population Change and Sustainable Futures: Imagining the ACT*. Paper commissioned by the ACT Government. Canberra.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0011/12431/Paper\\_-\\_Natalie\\_Jackson.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0011/12431/Paper_-_Natalie_Jackson.pdf) (accessed 12/10/11)
- Maddew.R. 2011. *Could Canberra be Australia's Greenest City?* Australian Broadcasting Corporation. Canberra. <http://www.abc.net.au/environment/articles/2011/03/31/3178495.htm> (accessed 20/9/11)
- Marshall, D. 2010. *ACT Heritage Act Review*. ACT Heritage. ACT Government. Canberra.  
[http://www.cmd.act.gov.au/\\_\\_data/assets/pdf\\_file/0019/154315/reduced\\_ACT\\_Heritage\\_Act\\_Review\\_4Aug10.pdf](http://www.cmd.act.gov.au/__data/assets/pdf_file/0019/154315/reduced_ACT_Heritage_Act_Review_4Aug10.pdf) (accessed 3/5/11)
- Mees, P., Sorupia, E. and Stone, J. 2007. *Travel to Work in Australian Capital Cities 1976-2006: An Analysis of Census Data*. Australasian Centre for the Governance and Management of Urban Transport. University of Melbourne. Melbourne.  
<http://www.abp.unimelb.edu.au/gamut/pdf/travel-to-work.pdf> (accessed 17/11/11)
- OCSE 2010. *Annual Report 2009-10*. Office of the Commissioner for Sustainability and the Environment. Canberra.  
[http://www.environmentcommissioner.act.gov.au/\\_\\_data/assets/pdf\\_file/0015/205125/OCS\\_E\\_annual\\_report\\_2009-10\\_final.pdf](http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0015/205125/OCS_E_annual_report_2009-10_final.pdf) (accessed 28/08/2011)
- OCSE 2011a. *Report on the Investigation into the Government's Tree Management Practices and the Renewal of Canberra's Urban Forest*. Office of the Commissioner of Sustainability and the Environment. ACT Government. Canberra.  
[http://www.environmentcommissioner.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/219354/OCS\\_E\\_TreeInvestigation\\_Part1\\_ReportV5\\_28February2011.pdf](http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0006/219354/OCS_E_TreeInvestigation_Part1_ReportV5_28February2011.pdf) (accessed 17/11/11)
- OCSE 2011b. *Report on Canberra Nature Park (Nature Reserves); Molonglo River Corridor (Nature Reserves) and Googong Foreshores Investigation*. Office of the Commissioner for Sustainability and the Environment. Canberra.  
[http://www.envcomm.act.gov.au/investigations/nature\\_reserves\\_investigation](http://www.envcomm.act.gov.au/investigations/nature_reserves_investigation) (accessed 23/8/11)
- PCL 2009. *Facts at a Glance 2009*. Parks, Conservation and Lands. ACT Government. Canberra.  
[http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0020/166061/PCLFacts\\_2009web.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0020/166061/PCLFacts_2009web.pdf) (accessed 18/8/11)
- RDA ACT 2010. *ACT Strategic Regional Plan 2010*. Regional Development Australia ACT. Canberra.  
[http://rdaact.org.au/wp-content/uploads/2011/03/RDA\\_ACT\\_regional\\_plan\\_20102.pdf](http://rdaact.org.au/wp-content/uploads/2011/03/RDA_ACT_regional_plan_20102.pdf) (accessed 18/8/11)
- TAMS 2011. *Annual Report 2010-2011*. Territory and Municipal Services. ACT Government. Canberra.  
[http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/233179/Volume\\_1\\_10-11.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0007/233179/Volume_1_10-11.pdf) (accessed 21/10/11)

# ACT State of the Environment Report 2011

Webb, B. 2011. *Impacts of Climate on the Canberra Nature Park: Risks and Responses*. Report for the ACT Office of the Commissioner for Sustainability and the Environment. Canberra.  
[http://www.envcomm.act.gov.au/\\_\\_data/assets/pdf\\_file/0004/220477/OCSE\\_ANU\\_paper\\_climate\\_CNP.pdf](http://www.envcomm.act.gov.au/__data/assets/pdf_file/0004/220477/OCSE_ANU_paper_climate_CNP.pdf) (accessed 1/12/11)

## Other data sources

In addition to these published reports, data for this paper were also sourced from:

ACT Department of Land and Property Services (LAPS) - now part of the Economic Development Directorate (EDD)

ACT Department of Territory and Municipal Services - now Territory and Municipal Services Directorate (TAMSD)

ACT Heritage -formerly part of Chief Minister's Department, now part of the Environment and Sustainable Development Directorate (ESDD)

# ACT State of the Environment Report 2011

## THEME: People

### Indicator cluster: Urban quality

The indicators for this cluster are:

- *Urban density* (C) - covers urban density across the ACT and changes over time;
- *Housing types* (C) - includes housing stock, type, and size;
- *Community facilities* (C) - number, type and use of community facilities;
- *Open space, amenity and recreation areas* (C) - includes open space, parks and recreational areas in terms of area, distribution, standards, use and distance to access;
- *Urban trees* (C) - the number and distribution of urban trees;
- *Urban development* (P) - greenfield and infill split;
- *Housing demand* (P) - housing demand, changes in household composition and other social influences on housing type and size;
- *Community safety* (P) - safety statistics relating to people and property, and perceptions of safety;
- *Noise complaints* (P) - details on type and number of noise complaints;
- *Urban areas and human health impacts* (I) - includes obesity rates and other urban health problems;
- *Green star development* (R) - type, number and location of green star development;
- *Inner city and higher density developments* (R) - includes diversification of town centres;
- *Efficiency of development* (R) - includes commentary on efficiency of development; and
- *Open space management* (R) - covers management of open space and recreational areas, including connectivity, accessibility and quality.

**Condition indicators** (C) present data that tell us the state of the environment at any particular time Condition indicators.

**Pressure indicators** (P) present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators** (I) present data on the effect that environmental changes have on environmental or human health.

**Response indicators** (R) present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

## Summary

Residential development in Canberra is still characterised predominantly by single detached houses, although the housing mix is becoming more diversified

# ACT State of the Environment Report 2011

with many townhouses and apartments being built recently. In the past 20 years the average residential dwelling size has increased, while the average number of occupants has decreased. The ageing population, together with a growth in one-person households, is increasing the demand for a range of types of housing in the ACT.

The ACT offers a range of community and recreational facilities, and compared with other major Australian cities it maintains a large network of open space, recreation areas and urban trees. Despite this, the ACT, like many other Australian communities, is experiencing human health problems such as an increase in obesity which may be, in part, related to the form of the city and the way that interacts with people's lifestyles.

Challenges facing the ACT Government in maintaining the urban quality of Canberra include its ageing population, and the relatively high costs of fuel and of developing land and housing, along with the effects of warming temperatures, lower rainfall and more extreme weather events predicted to accompany climate change. All levels of government in Australia are increasingly facing similar challenges in managing cities. There is an appreciation that the planning and organisation of cities affects the national economy, as well as the social well-being of residents and the environment in general.

The Council of Australian Governments (COAG) has established nine criteria for future strategic planning of capital cities, and it is developing measures for use in reporting achievements. They will guide the ACT Government's management of Canberra's urban form during the next State of the Environment reporting period.

## Introduction

The ACT is approximately 2352 km<sup>2</sup> in area, with about one quarter of the land area under urban development (ACT Government 2010). This indicator cluster considers the provision and maintenance of land for urban purposes, including residential and commercial land, as well as facilities for the amenity and wellbeing of residents and workers, such as open space and recreation areas, community facilities and urban trees. Urban quality also refers to the sustainability of urban growth, including the efficiency of urban development.

## Condition indicators

### Urban density

The density of housing in a city affects the city's sustainability and liveability. When residential areas are near to employment, shopping and other services and infrastructure, people tend to do more walking and cycling and the amount of land required to support a growing population reduces. Increased housing density compared to that in suburbs comprising single detached houses

# ACT State of the Environment Report 2011

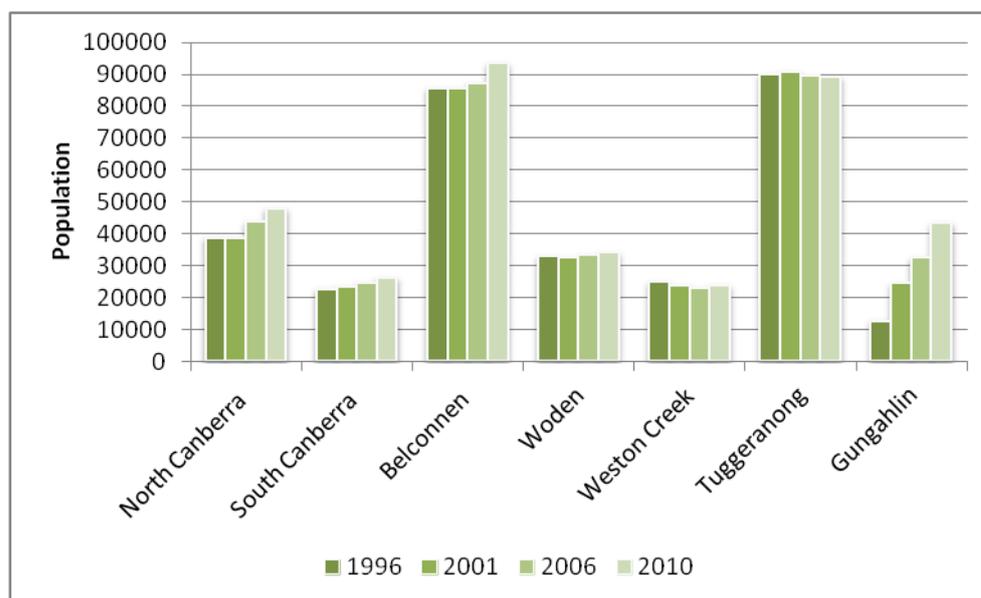
generally means there will be a wider choice of types of housing available, such as townhouses and apartments as well as free-standing houses. That mix can generally better meet the changing needs of the population. The amenity of suburbs is maintained through including adequate green space, urban trees and sustainable transport infrastructure. The 2007-08 ACT State of the Environment Report recommended continuing to implement the Canberra Spatial Plan, particularly focusing on achieving higher densities and maintaining ecological corridors.

The several methods for calculating urban density do not necessarily give comparable figures, and that needs to be noted when making comparisons across locations or when looking at trends through time.

Gross population density is calculated by dividing the area of a given tract of land by the known population of that area.

Between 2001 and 2010, the gross population density of Canberra increased from 12.9 to 13.5 persons per hectare (ACTPLA 2011a). In North Canberra, the population density increased in all suburbs with the most marked increases being in Braddon and Turner, reflecting urban renewal and the redevelopment of commercial land for residential and mixed use. In contrast, districts such as Weston Creek and Tuggeranong experienced a gradual decline in population (Figure 1), reflecting an ageing demographic and shrinking household sizes.

Figure 1. District population change, 1996-2010



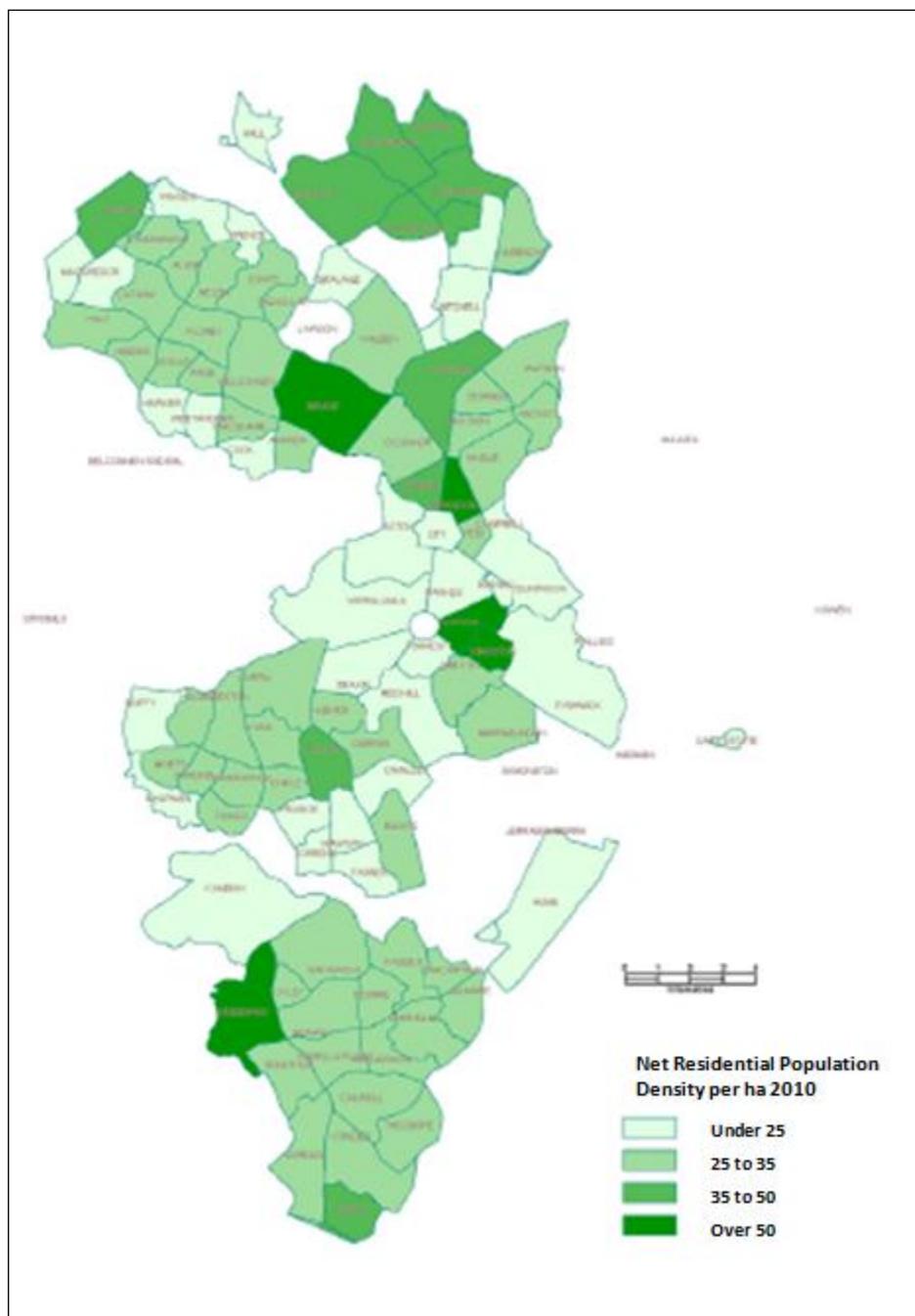
Source: ACTPLA 2007, 2011a

Net residential density is a measure of the population density in the residential areas only. For Canberra, ACTPLA calculates the net residential density at 29.2 persons per hectare in 2010, based on ABS data. Again, there were relatively high residential population densities in the town centres and the suburbs of Bruce, Kingston and the suburbs along Northbourne Avenue, reflecting the shift

# ACT State of the Environment Report 2011

towards redeveloping commercial land for residential uses and creating higher density developments around transport corridors and existing infrastructure. Figure 2 illustrates the net population by suburb for Canberra in 2010.

Figure 2. Net residential population density in Canberra in 2010



Source: ACTPLA 2011a

Using a different method, the ABS also produces density figures for 'urban centres' at each census (ABS 2006:32-33). The ABS figures enable comparisons between different Australian cities, although the ABS method results in slightly lower density estimates than the ACTPLA method (Table 1).

# ACT State of the Environment Report 2011

Table 1. Comparison of densities for Australian cities, 2006

City	Population	Density (per ha)
Canberra	368,129	10.8
Sydney	4,119,189	20.4
Melbourne	3,592,592	15.7
Brisbane	1,763,129	9.2
Perth	1,445,073	12.1
Adelaide	1,105,839	13.8
Hobart	200,524	10.3
All cities	12,594,475	n/a

Source: based on Mees, Sorupia and Stone 2007

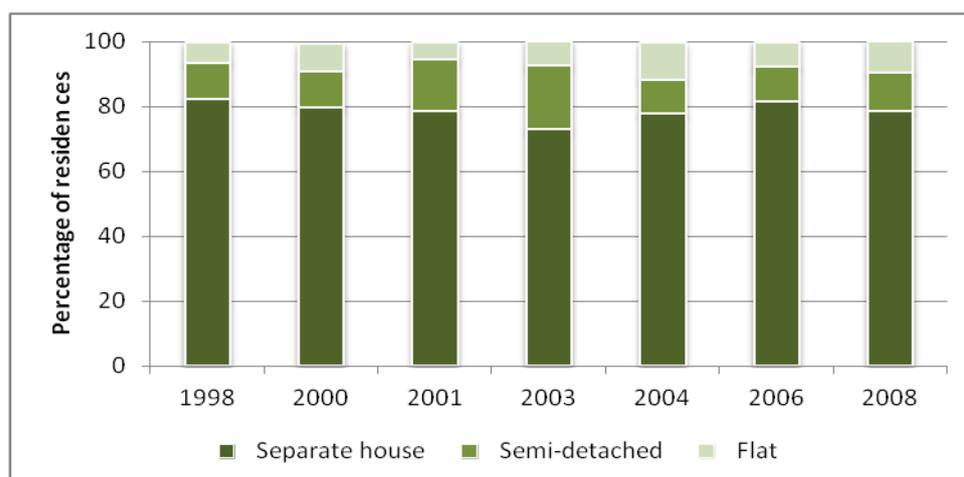
Note: the ABS defines urban land to include industrial as well as residential areas, unlike the ACTPLA definition

## Housing types

Separate houses remain the dominant form of residential dwelling in the ACT (Figure 3). Between 1991 and 2011, the average size of houses in ACT increased from 149 m<sup>2</sup> to 213 m<sup>2</sup>. During the same period the dwelling occupancy (average number of persons per dwelling) continued to decrease with an average occupancy rate now of 2.54 people (CMD 2010b).

The ACT provides twice as much public housing as the national average; public housing is the major source of low-cost rental stock. Compared to other major Australian cities, Canberra has the lowest rate of homelessness (0.4% of the population at the 2006 census). However, the rate of homelessness rose marginally from 40 to 42 people per 10,000 between 2001 and 2006 (CMD 2010b).

Figure 3. Types of private dwellings in the ACT, 1998-2008



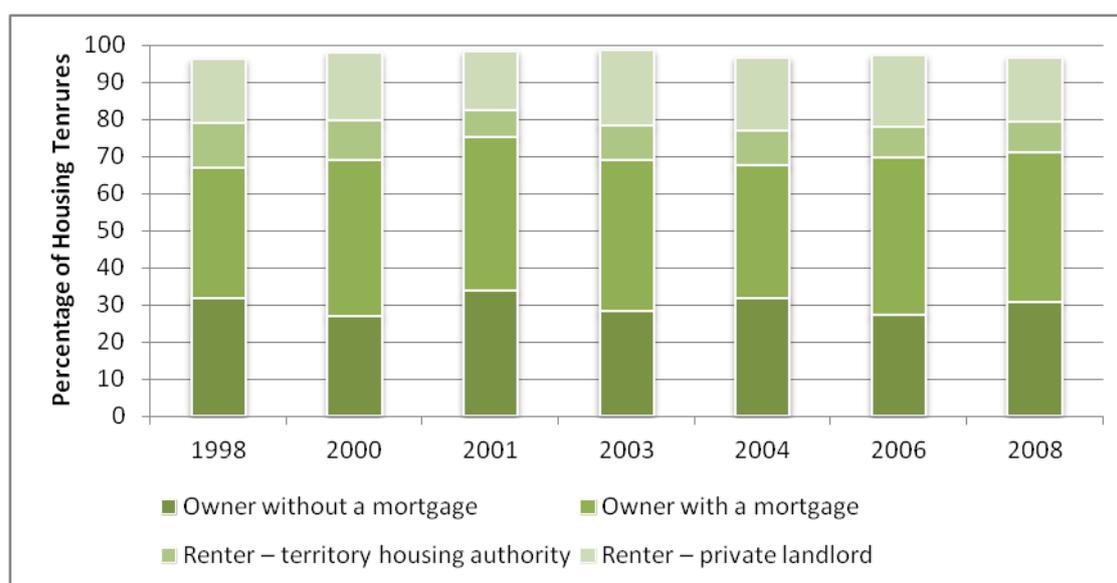
Source: ABS 2010a

Note: Components do not total 100% because 'other' dwellings are not included

# ACT State of the Environment Report 2011

In the ACT, home ownership rates are generally higher on the outskirts of Canberra than in areas closer to the city centre (ABS 2008). Between 1998 and 2008 the proportion of households renting in Canberra declined. Rates of outright ownership also declined between 2001 and 2008, and home purchase rates increased (Figure 4).

Figure 4. ACT housing tenure, 1998-2008



Source: ABS 2010a

Note: Components do not total 100% because 'other renters' and those with 'other tenure' are not included

## Community facilities

In 2011, 1409 ha in the ACT were designated for community facilities by the Territory Plan; that amounted to 0.5% of the total land use in the ACT (ACTPLA 2005 cited in ACTPLA 2011a). Community facilities play an important role in bringing people together, developing social capital, maintaining quality of life and community wellbeing, and enhancing the skills and resilience essential to strong communities. They can encompass a wide range of sectors including education, health, culture and recreation. Community facilities also provide venues for service delivery, special events and meeting spaces.

Over the reporting period the ACT Government undertook a number of building and enhancement projects including 15 new social housing developments. These were jointly funded through the national Economic Stimulus Plan (Social Housing Initiative) (Australian Government 2011) and provided 421 dwellings. In addition, photovoltaic cells were installed at 20 community facilities.

At 30 June 2011 there were 84 schools in the ACT (DET 2011). As part of the ACT Government's *Towards 2020: Renewing our Schools* program (DET 2006), 23 government schools and preschools either closed at the end of 2006 or over the next two years (Purdon 2008). The future use of most of the school sites has

# ACT State of the Environment Report 2011

been determined. Many remain owned by the ACT Government and are now used for community purposes. For example, Flynn, Melrose and Cook primary schools are now used as community hubs, Village Creek (Kambah) Primary has been converted to a health hub, and Rivett Primary houses aged-care and supportive-housing facilities. A small number, including Giralang and McKellar preschools, have been sold for use by community organisations.

From 1996 to 2011 the ACT has had a steady increase in the number of licensed long-daycare childcare centres: from 80 centres and 3952 places in 1998, to 126 centres and 7766 places in 2011. The ACT has the highest percentage of children aged 0-12 using childcare, of any jurisdiction. In June 2005, 58.2% of children aged 0-12 in the ACT used childcare compared with the national average of 45.8%.

The West Belconnen Child and Family Centre, another ACT Government project, jointly funded by the Australian and ACT governments, opened on 2 May 2011. The Centre is an example of incorporating environmental sustainability features into new community facilities. Designed with community input from children and Aboriginal and Torres Strait Islander families, the Centre features a rainbow serpent, an Indigenous Garden with yarning pit, and mosaic art by local artist Dira Horne. The Centre also features a Sustainable Energy Showcase that includes five solar panels, a small wind turbine, green walls and rainwater tanks.

The *ACT Social Plan* (CMD 2011) recognises there are a number of key challenges with future provision of community facilities, including more flexible use of schools, libraries and civic places, and investing in community infrastructure that promotes connection and allows for diverse activities. Since the earlier 2004 Social Plan was released, the ACT has continued to allocate more than two-thirds of all ACT Government expenditure to human and community services (CMD 2011).

The ACT Government has also arranged to compensate for its services being used by people who live in NSW but work in the ACT. It is developing more detailed data in this area so it can plan for and manage these demands on services and infrastructure.

## Open space, amenity and recreation areas

A city's environment, including its liveability and amenity, depends in considerable measure on its green infrastructure. Green infrastructure is the city's natural features such as vegetation, parks, waterways and assets, designed to help improve the quality of the urban environment. The health benefits provided by green infrastructure include positive physical, social, mental and spiritual health outcomes. Canberra enjoys an extensive network of reserves connected by open spaces and urban trees. Open space can be urban open space, wilderness areas, national park and reserves, and water catchments.

As in previous reporting periods, conservation remains the main land use in the ACT with over 50% of the ACT consisting of national park, nature reserves and

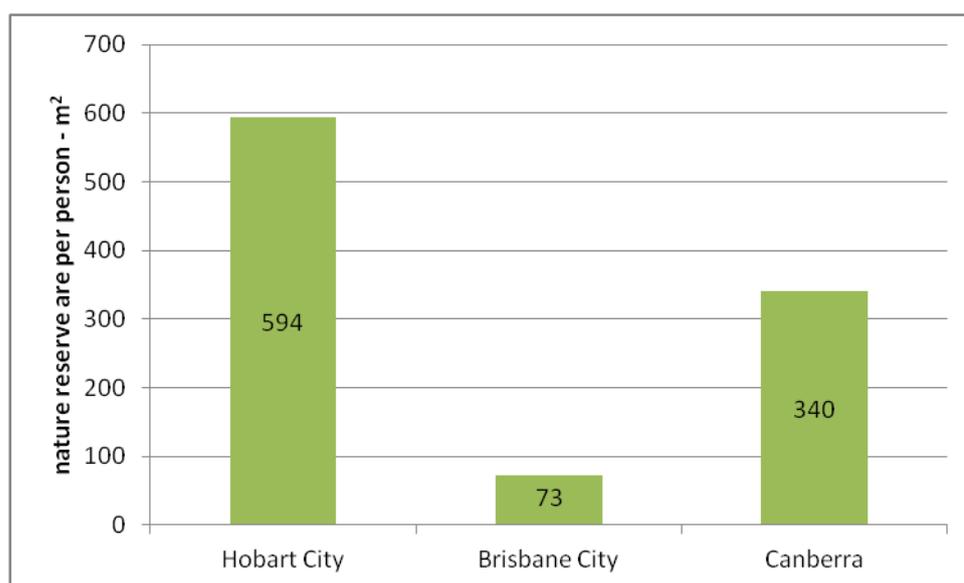
# ACT State of the Environment Report 2011

water catchments including the Namadgi National Park, Tidbinbilla Nature Reserve and Cotter River water catchment area. Urban open space and Canberra Nature Park comprise less than 3% and 4% respectively of the ACT's total land area (PCL 2009).

Canberra Nature Park areas are primarily native grass and bushland, and also the district and town parks, local parks and lakes and ponds. These spaces are important to the health and wellbeing of Canberra residents and their sense of place. Compared to some other Australian cities, the area of nature reserve or conservation area per person in Canberra (340 m<sup>2</sup>) is high (Figure 5). That figure does not include Namadgi National Park or Tidbinbilla Nature Reserve, nor the Googong Foreshores. However, if all park areas are included, the area of nature or conservation reserve rises to around 794 m<sup>2</sup> per resident, compared (on the same basis) with 61 m<sup>2</sup> in Melbourne and 133 m<sup>2</sup> in Brisbane City (OCSE 2011a).

Canberra's area of parks and open space is a major asset, as well as a management challenge (OCSE 2011b). The urban open-space system contributes to Canberra's image as the bush capital and provides an attractive environment and opportunities for active and passive recreation. It also performs a utilitarian function as community paths, stormwater drainage and minor public utilities (ACTPLA 2008).

Figure 5. Area of nature reserve or conservation reserve per person



Source: OCSE 2011b

Note the figure for Canberra does not include Namadgi National Park or Tidbinbilla Nature Reserve, nor Googong Foreshores

Recreational areas include facilities such as sports grounds and swimming pools. The ACT Government is responsible for the maintenance of sports grounds distributed across about 80 locations throughout Canberra, in nearly every suburb. Facilities range from small neighbourhood ovals about 2 ha in area with one or two marked fields, usually adjoining primary schools, through to large

# ACT State of the Environment Report 2011

district playing fields up to 12 ha with 10 or more marked fields. Convenient access to these facilities for residents and visitors is a major factor in the ACT's high levels of participation in physical activity.

During the reporting period the sports grounds have been in fairly consistent use except when affected by factors such as weather, water restrictions and changes to sporting clubs. Since the lifting of water restrictions in late 2010, all the major sports grounds are in full use again; a small number remain as low maintenance sports grounds.

The National Arboretum Canberra has been progressively established since 2005. The area (250 ha) was formerly a pine plantation. Since the pines were destroyed by bushfires in 2001 and 2003 the area has been transformed into a mosaic of 100 forests of rare and endangered tree species and other tree species that have particular ethnic, botanical or symbolic values (EDD 2011). The ACT Government has spent or committed approximately \$50 million in capital since 2004-05 to this arboretum, which overlooks Lake Burley Griffin and the Parliamentary Triangle. The aim is to open the National Arboretum Canberra officially in 2013, as the centrepiece of the National Capital's centenary celebrations.

One of the recommendations made by the 2003 Bushfire Recovery Taskforce was to develop a world-class multi-use, recreational sporting facility available to both recreational and professional users at the base of Mt Stromlo in the central west of the ACT. In response, the Stromlo Forest Park has been established with a purpose-built event pavilion, criterium cycling circuit, grass cross-country running track, equestrian tracks and mountain bike tracks, and various other trails suitable for runners and walkers. In 2008 and 2009 the ACT Economic Development Directorate estimates there were 216,000 visitors to Stromlo Forest Park (SGS 2010), an average of 590 visitors per day, which is 35% more people than in the equivalent period in 2007-08 (SGS 2010). Ongoing visitor counts and surveys guide the future strategic management of the park, which is continuing to be developed.

For other areas of plantation forestry burnt in the 2003 bushfire, the determination of long-term land use agrees with the recommendation of the 2007-08 ACT State of the Environment Report. Land in the lower Cotter catchment and west of the Murrumbidgee River has been set aside for water catchment and is being replanted with native vegetation (see the *Land health* indicator cluster paper). Other areas have been reassigned to residential, community or recreation use, including the National Arboretum and the valley of the Molonglo River downstream of Scrivener Dam on Lake Burley Griffin. Areas for which the future land use has not yet been determined have been replanted or allowed to regenerate naturally with pine trees to retard soil erosion, pending a decision. At present there are no proposals to change the existing uses of land currently zoned for forestry.

# ACT State of the Environment Report 2011

## Urban trees

Urban trees are important in Canberra. They are pleasant to the eye and give summer shade and winter shelter for people and habitat for wildlife. They are also a physical link between Canberra's past and its future. Canberra has an estimated 734,268 trees in streets, parks and open space (OCSE 2011a).

Urban-tree management is primarily the responsibility of the ACT Government, but there are also around 20,000 trees located on the national capital estate managed by the Australian Government's National Capital Authority (NCA).

Overall, there are a large number of trees to be managed: 1.6 urban street and park trees per resident compared with 0.7 trees per resident in Melbourne (OSCE 2011a). Like Canberra's open-space assets, the large number of trees in urban areas creates management challenges.

## Pressure indicators

### Urban development

Urban development is primarily driven by population growth and changes in household size, and it commonly takes place both in greenfield areas (land not previously urban) and as infill development in spaces within the urban area. Although infill development often reduces existing urban green infrastructure, greenfield development is generally seen to be less sustainable, environmentally. Greenfield development takes over existing natural habitat (even on agricultural land) and can reduce ecological connectivity (see also the *Threatening processes* indicator cluster paper), and the larger the urban area the more the transport required, with associated greenhouse gas emissions and embodied infrastructure energy.

Trends in greenfield and infill development in the ACT over the reporting period are shown in Table 2. Continuing the trend identified in the 2007-08 ACT State of the Environment Report, there has been more greenfield development than infill.

Table 2. Greenfield and infill development in the ACT, 2006 to May 2011, number and proportion of dwellings approved

Year	Infill	Greenfield
2006 -2007	156 ( 7.4%)	1966 (92.6%)
2007 -2008	828 (23.9%)	2642 (76.1%)
2008 -2009	791 (18.8%)	3417 (81.2%)
2009 -2010	1893 (46.6%)	2168 (53.4%)
2010 to May 2011	1110 (22.2%)	3890 (77.8%)

Source: LAPS

There are specific targets for urban infill in Sydney, Melbourne, Perth and Adelaide, as well as in south-east Queensland, but there is no such target for

# ACT State of the Environment Report 2011

the ACT. Nonetheless, the ACT Government's indicative land release program for 2011-12 to 2014-15 shows that it expects urban infill to provide 45% of new dwellings over that period (Table 3), representing a significant shift from previous land release patterns.

Table 3. Proposed greenfield and infill development in the ACT, 2011-12 to 2014-15

	Detached dwellings	% of total greenfield or infill	Attached dwellings	% of total greenfield or infill	Apartments	% of total greenfield or infill	Total dwellings	% of total dwellings
Greenfield	7110	70%	2950	29%	100	1%	10160	55%
Infill	220	3%	2230	26%	5890	71%	8440	45%
Total	7330		5180		5990		18500	

Source: ESDD 2011

The current urban development policy in the ACT, as set out in the *Canberra Spatial Plan* (ACT Government 2004a), is based on a concentric model that restricts all urban growth to within 15 km of Civic, and intensifies residential development so that 50% of it occurs within a 7.5 km radius of Civic (ACT Government 2004a). The policy does not specify whether the urban intensification should use previously developed areas or be in urban open space.

Table 4. Trends in urban development location relative to the Canberra Spatial Plan objectives

	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Residential development within 7.5 km of Civic	43.6%	40.5%	53.3%	48.5%	37.8%	28.5%
Residential development within 15 km of Civic	93.0%	92.1%	91.4%	92.2%	95.4%	96.7%

Source: ACTPLA

As shown in Table 4, performance against the objective to contain residential development within 15 km of the city centre (Civic) has improved over the reporting period, though some development has occurred outside that area. More significantly, the share of development occurring within a 7.5 km radius of Civic fell to 28.5% of total development in 2009-10.

Figure 6 shows the various dwelling types approved in each state or territory for 2009-10. More townhouses and apartments were built in Canberra in that year than in the other jurisdictions. The trend towards more townhouses and apartments was also noted in the previous reporting period, and is in line with the targets of the Canberra Spatial Plan.

# ACT State of the Environment Report 2011

Figure 6. Proportion of various types of dwellings approved, 2009-10, Australia



Source: ABS 2010b

Land was released in the ACT for 4297 dwelling sites in 2009-10. For 2010-2012, land releases for housing are projected to provide for 5000 dwellings per year. After that, releases for dwellings are expected to drop to 3500 per year (AG 2011). By comparison, land releases in 2004-05 and 2005-06 catered for 468 and 780 dwellings.

Faster releases of land can make housing more affordable and accessible, but they can also add to the challenges posed by increased urban sprawl and impacts on natural resources.

## Housing demand

By 2031, it is estimated that around 49,000 additional residential dwellings will be needed in the ACT.

Consistent with Australia as a whole, the population in ACT has been ageing: from 2001 to 2006 the proportion of ACT people aged 65 years or more increased from 7.8% to 9.5% (ACTPLA 2007). If this trend continues there will be an increase in the demand for housing that caters for elderly people.

The mix of people in households (household composition) in the ACT is also changing. Statistical projections of household composition in 2026 are shown in Table 5. Family households are still expected to be the most numerous, but the number of one-person households is projected to increase by 48-114% above the number that there were in 2001, while one-parent households are projected to increase by 21-43% (ABS 2004). The projections suggest the ACT will need a wider range of housing choices than exists now.

# ACT State of the Environment Report 2011

Table 5. Household composition projections 2006-2031

Household composition	2006	2031	% Increase
One-person households	29,000	43,000-62,000	48-114
One-parent households	14,000	17,000-20,000	21-43
Family households	87,000	100,000-109,000	15-25

Source: ABS 2004

In 2007 the ACT Government adopted an *Affordable Housing Action Plan* (Phase 1 and 2) to address the shortage of affordable rental and home ownership options. There are over 80 policy recommendations, which include: increasing the supply of affordable land to the market; expanding the supply of community housing; making more effective and targeted use of public housing; and introducing land rent and shared equity schemes (AHURI 2009).

The ACT Government is tracking progress of delivery on the *Affordable Housing Action Plan* through regular reporting against milestones with the most recent publicly available report documenting the following examples of outcomes:

- the Land Development Agency is on track to deliver the land releases as programmed for 2009; the land release program has been expanded from 3014 dwelling sites to 4061; the targets for 2010-11 and 2011-12 are now 5000 dwelling sites;
- the ACT Government and Community Housing Canberra have entered into an agreement for a \$50 million revolving-finance facility to enable 1000 new affordable dwellings within 10 years; and
- procedures have been reviewed to ensure top priority applicants are now being housed within 3 months.

## Community safety

Community safety refers to the perception of safety as well as actual threats to the safety of an individual in the community, particularly in relation to crime.

In 2006 in the ACT, 5.1% of individuals said they felt unsafe or very unsafe at home alone after dark, compared with 6.7% of individuals in Australia as a whole. In 2005-06, 9.9% of individuals were victims of physical or threatened violence (compared with 10.8% in Australia as whole) and 12.8% of individuals were victims of actual or attempted break-ins (compared with 9.4% in Australia as whole) (ACT Health 2010).

These figures show that Canberra people generally felt safer in the community in 2006 than Australians felt as whole, even though actual or attempted break-ins were affecting more people in the ACT than the Australian average.

During 2010-11, the ACT recorded significantly fewer of most types of reported crime than in the previous financial year. There were 37.3% fewer reported motor vehicle thefts, and 32.4% fewer burglaries, and 21.5% fewer offences relating to property damage. Crimes against people also decreased: 14% fewer

# ACT State of the Environment Report 2011

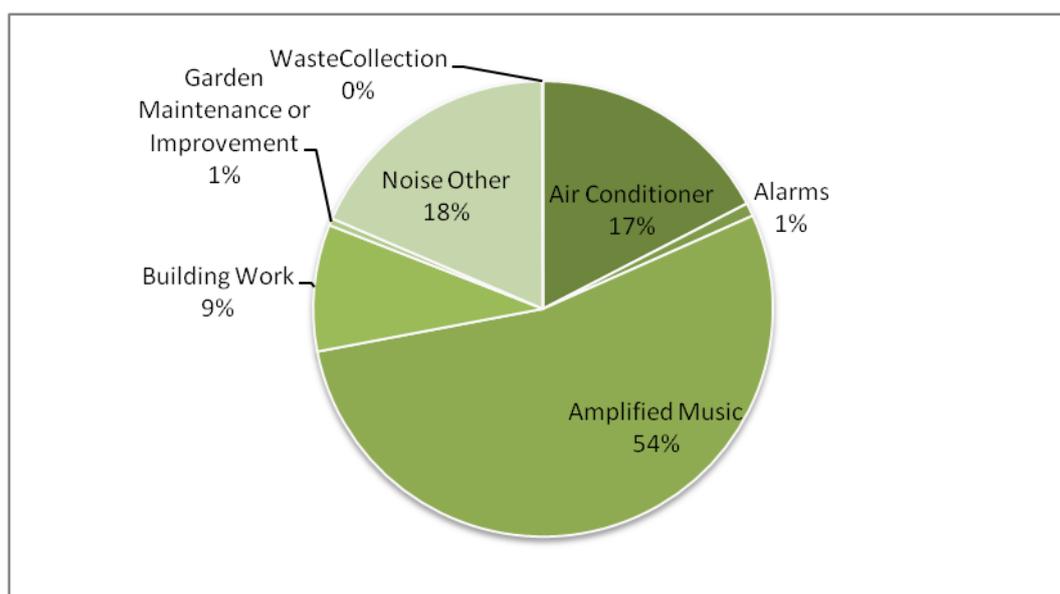
weapons and assault offences than in the previous quarter, and there were 20% fewer robberies than in the 12 months to June 2010 (JCSD 2011).

## Noise complaints

Environmental noise is defined as unwanted sound that may cause annoyance, disturb communication, or interfere with sleep and mental tasks (AIHW 2011). One measure of the impact of environmental noise is the type and number of noise complaints occurring in a community.

Over the reporting period, noise complaints averaged 1432 per year, about noises from a range of sources (Figure 7). Most complaints were about amplified music from commercial and licensed premises and entertainment venues in commercial-residential mixed-use areas. Complaints mainly related to venues set up in existing commercial buildings that had not been built to enclose noise (ORS). There were also complaints about amplified music from neighbours in residential areas. Advances in the technology of modern sound systems are giving people a greater capacity to amplify music in their homes.

Figure 7. Noise complaints received between 2007 and 2010



Source: DECCEW

Other types of environmental noise in the ACT (18% in Figure 7) include car and aircraft noise. Under its environmental responsibilities, Airservices Australia has established a Noise and Flight Path Monitoring System (NFPMS) at Canberra airport. Airservices Australia reports quarterly on aircraft noise relative to a threshold sound volume of 70 decibels (dB). While not an 'exceedance level', 70 dB provides a guide to noise levels from aircraft (Table 6). In general, external sounds quieter than 70 dB should not inconvenience people listening to radio, television or conversational speech in a typical room with windows open. There is no curfew at Canberra airport, but there is a noise abatement area. Aircraft will normally be routed to avoid the noise abatement area, which

# ACT State of the Environment Report 2011

includes Gungahlin, North Canberra, Belconnen, South Canberra, Woden, Tuggeranong and Queanbeyan.

Table 6. Number of aircraft noise events above 70 dB

Year	Number of aircraft noise events above 70 dB
2007 (from 1 July)	4689
2008	12,232
2009	14,588
2010	13,902
2011 (to June 30)	5807
Total	51,218

Source: Airservices Australia

Note: 2009 noise events are for two locations: Jerrabomberra and Hackett

## Impact indicators

### Human health impacts

Increasingly, connections are being made between the design and layout of urban areas and aspects of human health such as obesity, mental health and respiratory problems such as asthma. Potential impacts on adult health are being monitored via both positive (exercise and vegetable intake) and negative indicators (such as bodyweight and asthma) in people aged 18 years or more.

Table 7. Human health indicators for the ACT, 2007-08

Indicator	Proportion of adults
Overweight or obese	57.8%
Sufficient physical activity	57.0%
Sufficient vegetable consumption	7.2%
Adults reporting asthma	9.6%

Source: ACT Health 2010

At the start of the reporting period in 2007-08, nearly 58% of adults were considered to be either overweight or obese in the ACT (Table 7; ACT Health 2010). Two years later, in 2009, 64.9% of men and 50% of women were considered overweight or obese; that is, 42.1% of people over 18 were classified overweight and 25.6% were classified obese (ACT Government 2011c).

The walkability<sup>1</sup> of the built environment can play a role in obesity rates. Recent studies of American cities and Australian cities other than Canberra have found

---

<sup>1</sup> Walkability is a measure of how conducive an area is to walking for either leisure, exercise or transport

# ACT State of the Environment Report 2011

a relationship between neighbourhood walkability, physical exercise taken, and obesity rates (AIHW 2011). While Canberra's liveability and health indicators compare favourably with other jurisdictions, reliance on car travel is likely to contribute to overweight and obesity.

Fresh vegetables are readily accessible to Canberra people, with locally produced fresh food available through various farmers' markets and supermarkets. In addition, the Canberra Organic Growers Society (COGS n.d.) operates 12 community gardens in the ACT region, at Charnwood, Cook, Cotter, Dickson, Erindale, Holder, Kaleen, Kambah, Mitchell, Oaks Estate, O'Connor, and Queanbeyan. COGS is currently exploring the opportunity to develop a city farm/community hub (COGS n.d).

With regard to respiratory problems, in 2007 approximately 9.6% of adults reported having asthma, a decrease from 12.3% in 2001. The reduction may indicate an improvement in air quality, among other possible reasons (ACT Health 2010).

## Response indicators

### Sustainable development and buildings

The sustainability and energy efficiency of buildings can be measured in multiple ways using rating tools that can be grouped into two broad types:

- predictive - those that predict performance at the building design stage, including house energy-rating tools such as AccuRate, and commercial building-rating tools such as Green Star;
- performance - those that measure the actual performance of the building, and can include behaviour and appliances, such as the National Australian Built Environment Rating System (NABERS).

For residential buildings, the ACT has required the mandatory disclosure of house energy rating at the point of sale since 1999, and until recently it was the only jurisdiction to do so. It is expected that disclosure of energy-efficiency ratings for residential buildings will soon be mandatory throughout Australia.

The Building Code of Australia in 2003 set mandatory requirements for the energy efficiency of Class 1 residential buildings, and in 2010 it increased the energy-efficiency requirements from 5 stars to 6 stars for all new Class 1 buildings. Class 1 buildings contain a single dwelling unit. Class 2 buildings (multi-dwelling units such as apartment blocks) have also been required to achieve 6 stars since 2010, compared to 3.5-4 stars in 2005.

For commercial buildings, since 2006 the Australian Government has required that all its new government office leases comply with Green Lease Schedules as a key component of its Energy Efficiency in Government Operations policy. The Green Lease Schedule stipulates a NABERS energy rating of at least 4.5 stars energy (exclusive of GreenPower) for all new leases. As a result, there has been an incremental upgrading of many of the commercial buildings in

# ACT State of the Environment Report 2011

Canberra as Australian Government departments have changed tenancies or constructed purpose-built facilities. The ACT Government is also examining implementation of Green Lease Schedules.

Since 1 November 2011, the energy efficiency of all large commercial office buildings must be disclosed<sup>2</sup> to potential buyers or lessees, these buildings must also have a current Building Energy Efficiency Certificate. It is anticipated that this will also contribute to a gradual improvement in the energy efficiency of Canberra's commercial buildings, although it is too early to determine the impact of this program.

Voluntary systems for measuring the sustainability of new buildings include the Green Star environmental rating system, which was established by the Green Building Council of Australia (GBCA) in 2002 (GBCA 2011a). In Canberra currently there are 24 Green-Star-accredited buildings, with all but one being office buildings (Table 8). This is a further illustration of the commitment by some businesses to use sustainable practices (see also the *Community engagement* indicator cluster) to reduce environmental impacts.

The Green Star environmental rating system is only one way of identifying commitments to reducing the environmental impact of buildings, and additional response indicators can also be considered.

Table 8. Green Star developments in the ACT, 2011

Type	Registered for accreditation	4 star	5 star	6 star
Office	2	10	11	2
Education	4	0	1	0

Source: GBCA 2011b

For precinct-level development, sustainability can also be measured by voluntary rating tools. The Loop community precinct in Belconnen is the first GBCA community-rated project in Australia. Precinct rating tools include EnviroDevelopment, which has been used to rate the sustainable development precinct at Wright, a new suburb in the Molonglo Valley. The ACT Land Development Agency facilitates display houses in its new estates that showcases affordable and practical sustainability features at display houses in its new housing estates.

In 2011 the ACT Government released draft amendments to the Territory Plan that aim to improve the solar efficiency of houses by defining and limiting a building's envelope and by improving the design and orientation of new lots. In a solar efficient subdivision (ACTPLA 2011b:31):

---

<sup>2</sup> under the Commercial Building Disclosure program managed by the Australian Government (Australian Government 2010)

# ACT State of the Environment Report 2011

Residential blocks should be oriented and proportioned so that a house can be designed with daytime living areas facing north and sunlit private open space, while limiting the overshadowing of adjoining residential blocks.

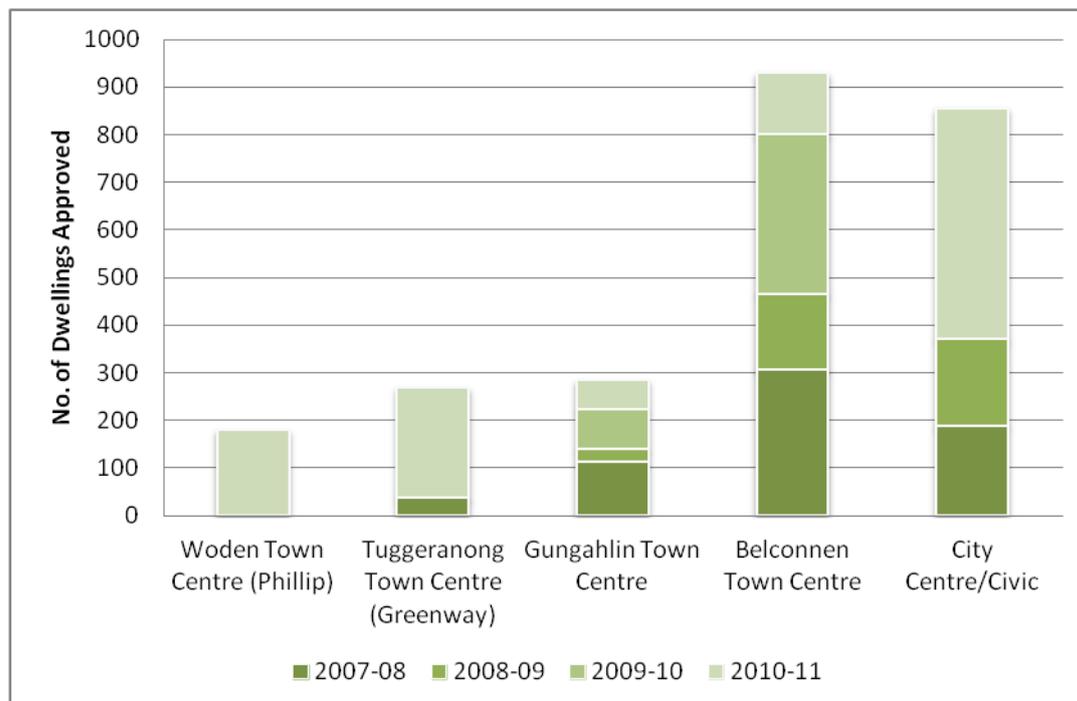
## Inner city and higher density developments

Increasing housing densities in established areas such as town centres can make it easier for residents to reach places of work, leisure and community facilities, as well as public transport.

Under the Canberra Spatial Plan (ACT Government 2004a) the ACT planning strategy seeks to capitalise on Canberra's polycentric city structure, by achieving strategically located pockets of medium-density development around town centres. The aim is to support more distributed employment and services, linked by rapid and frequent bus services.

Figure 8 shows the change in the number of dwellings approved in each of Canberra's town centres from 2007-08 to 2010-11. Approvals for apartments have increased in 2010-11 in Woden, Tuggeranong and Civic, while fewer dwellings (about 100) have been approved in Belconnen in 2010-11 than in previous years. Gungahlin is an emerging town centre, and it has had a steady number of apartments approved in most years since its establishment.

Figure 8. Dwelling approvals in Canberra's town centres, 2007-2011



Source: LAPS

# ACT State of the Environment Report 2011

## Efficiency of development

### ACT as part of a region

The ACT is near to urban growth areas in NSW. As a consequence there are cross-border issues in relation to water supply, land release, service and infrastructure. As well as the ACT, the region comprises 17 different local government bodies in NSW, which means that there are multiple jurisdictions administering the region's urban quality.

It is estimated that more than 20,000 people live in the surrounding region and travel to work in the Territory each day. NSW residents in the region use the range of public and private services that are located in the ACT. These include schools and other educational facilities, hospital and other medical treatments, entertainment, leisure, and air travel (ACT Government 2011).

In the opposite direction, Canberra people enjoy proximity and easy access to coastal and mountain areas in the region, particularly for recreation, and they make use of regional infrastructure and services.

The 2004 Spatial Plan recommended a Regional Management Framework be prepared between the ACT and NSW governments to ensure fiscal responsibility. The aim of the recommendation was also to achieve co-operation on vital issues such as the location and sequencing of development, and co-ordination and cost effective delivery of essential services and infrastructure. Although numerous regional strategies, agreements and forums addressing sector-specific issues are in evidence, to date this recommended framework has not been delivered.

However, the ACT Government has given support to regional development by administering Australian Government funding to Regional Development Australia (ACT) and in providing important documents that assisted in informing the development of two ACT Strategic Regional Plans (2010 and 2011-12). The support is a welcome indication of progress towards comprehensive regionally-based planning.

### ACT land development (cost and supply)

Development of greenfield land is primarily the responsibility of the ACT Government, through the Land Development Agency. Land development and infrastructure development have been subject to two evaluations recently.

The Auditor General has inquired into land development (AG 2011) and found that supplying and developing residential land within the ACT is a complex activity that involves several ACT Government agencies and methods. Further, the inquiry found that, to date, the process and programs for land supply and release have not been achieving the Government's stated objectives. Those objectives include: meeting demand for land; providing affordable land and housing; and establishing an inventory of serviced land.

# ACT State of the Environment Report 2011

The inquiry also found that the accelerated land-release programs of recent years have significantly escalated land supply and release activity. The extra workload has placed increased pressure on existing agency resources as well as on inter-agency relationships and protocols. It is hoped that the recent reconfiguration of the ACT Public Service will address some of these issues (AG 2011).

The Auditor General also noted that the true cost of land development has not been recognised and that ongoing benchmarking of land-development costs needs to be established as a practice. The extra land release and development has significant impacts on ecosystems and natural resources in the ACT. Currently, those impacts are not effectively measured and monitored (see *Threatening processes* indicator cluster and *Biodiversity* theme paper for more discussion).

For infrastructure in the ACT, the ACT Government *Infrastructure Plan* provides an overview of planned investment. In the 2008-09 Budget, the ACT Government established the \$1 billion *Building the Future Fund*. This five-year infrastructure program will increase the ACT's infrastructure assets base by 10% (ACT Government 2011).

The Engineers Australia annual *Infrastructure Report Card for 2010* (Engineers Australia 2010) found that most of the ACT's infrastructure is in a good condition. Three exceptions were noted: rail, which is considered inadequate for both current and anticipated future purposes, and wastewater and stormwater, both of which are rated as only adequate. The ACT's stormwater infrastructure is currently being improved through the development of constructed urban wetlands (see *Water quality* and *River, lakes and wetlands health* indicator cluster papers).

These findings are good when compared to other Australian jurisdictions. However, it will be challenging to maintain or improve these ratings in the future, for several reasons. First, the ACT infrastructure needs expansion to meet growing demand. Also, climate change is predicted to lead to water shortages and high energy consumption for cooling, in the future (Engineers Australia 2010). The impacts of predicted climate change on the ACT are discussed in the *Climate Vulnerability* indicator cluster paper.

## Self-containment of development - Travel

Urban planning and development influence travel patterns within a city. Canberra has a planned hierarchy of centres based on the original planning principle that every household would be within an easy, safe walking distance of a local or group centre with schools, shops and commercial and community services (CMD 2010c). The original Y-Plan in 1967 (ACTPLA 2007) aimed for this self-containment - that is, people living near the places where they work and shop - reducing the need to travel.

Canberra is currently considerably less self-contained than the Y-Plan envisaged. It has a substantially higher share of jobs in its central parts than was

# ACT State of the Environment Report 2011

anticipated. This proportion has been growing, at the expense of more dispersed locations, except in the period since the 2006 census during which there has been rapid growth in office parks, particularly those associated with Canberra airport.

In 2006, 195,440 people were employed in the ACT (Table 9). Central Canberra provided 49% of the employment in that year, a significant increase over the proportion in 2001 (46%). The share of workers employed in town centres and other locations dropped slightly, but remained around 20%.

Table 9. Employment distribution in the ACT, 2001-2006

Employment zones	2001		2006	
	No.	%	No.	%
Central Canberra incl. Civic (Civic only)	78,665 (17,858)	46.0 (10.4)	95,260 (25,792)	48.7 (13.2)
Town centres	35,120	20.5	38,075	19.5
Secondary zones	21,845	12.8	23,230	11.9
New town local zones	35,370	20.7	38,875	19.9
<b>Total</b>	<b>171,000</b>	<b>100.0</b>	<b>195,440</b>	<b>100.0</b>

Source: ACTPLA 2009

To support lower car use it is desirable for workers to be located close to places of employment. Journey to work data can indicate the level of self-containment by establishing the number of residents employed in districts where they live. Table 10 shows the change in ACT self-containment levels since 1991. North and south Canberra have the highest level of self-containment, reflecting the high job availability relative to the number of residents. Belconnen, Queanbeyan and Woden-Weston Creek have containment levels of around 30%.

This topic is also discussed in the *Transport* indicator cluster paper.

Table 10. Change in self-containment levels

Self-containment	1991	1996	2001	2006
North Canberra	57.1	50.3	54.5	55.9
South Canberra	32.6	44.6	40.3	47.4
Woden/Weston	24.0	28.5	37.8	31.4
Belconnen	29.2	32.6	32.2	31.8
Tuggeranong	17.3	22.2	24.1	23.7
Gungahlin	N/A	10.9	13.7	15.6
Queanbeyan	32.4	34.5	30.4	29.6

Source: ACTPLA 2009

# ACT State of the Environment Report 2011

The Draft ACT Planning Strategy (ACT Government 2011b), open for community input until mid-December 2011, uses the common planning approach that it is good for people to live close to employment, facilities and services. The availability of jobs in town centres reduces pressure on the external road system and Civic, the centre of the city. The achievement of substantial employment in Gungahlin for example, which is planned to accommodate some 90,000-95,000 residents, is an important part of a strategy to reduce overall travel. Shorter trips to work use less fuel and energy, cause less air pollution and less traffic congestion, and allow more leisure time.

In line with this approach, the ACT Government's Sustainable Transport Plan for the ACT (ACT Government 2004b) sets out targets for improving the share of work trips made by sustainable modes of travel. See the *Transport* indicator cluster for more information.

## **Sustainable performance of development**

In 2010, the ACTPLA undertook an analysis of the sustainability of four suburbs in Canberra (ACTPLA 2010). The study measured environmental and social characteristics of the suburbs and compared them to three international sustainability exemplars: Kronsberg in Hannover, Germany; Vauban near Freiburg, Germany; and Dockside Green in Victoria, British Columbia, Canada (Table 11).

In 2010, Canberra's suburbs all had a lower population density, used more land, and had larger areas of road, water use and carbon dioxide emissions per person than the three exemplars (ACTPLA 2010). This comparison highlights some of the challenges that Canberra's urban form will face in becoming a more environmentally sustainable city.

# ACT State of the Environment Report 2011

Table 11. Social and environmental performance of suburbs in Canberra

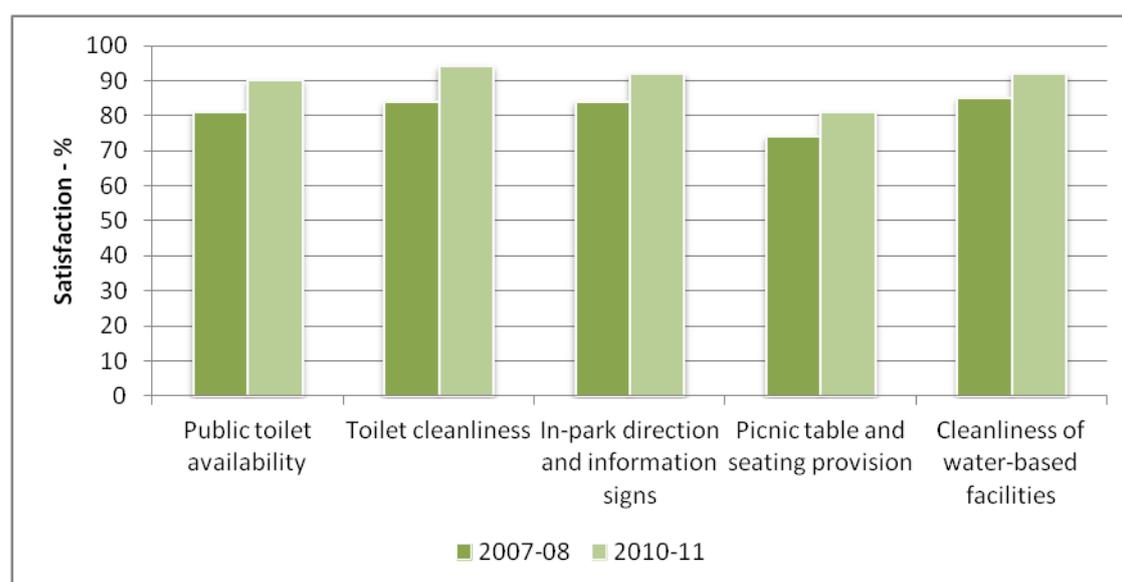
Indicators	Reid ACT	Kingston ACT	Gungahlin ACT	Weston ACT	Vauban Germany	Kronsberg Germany	Dockside Green Canada
People per hectare of urban area	48	47	33	13	134	85	288
Land-take per person (m <sup>2</sup> )	206	214	303	796	75	117	35
Public open space per person (m <sup>2</sup> )	14	9	13	204	34	27	14
Road per person	32	71	36	70	3	11	4
Water use per person (kL)	86	66	76	111	29	51	37
CO <sub>2</sub> emission per person (tonnes/yr)	5.4	3.6	3.6	6.4	0.5	0.9	0.2
Low income households	9	2	12	0	10	37	10

Source: ACTPLA 2010

## Open space management

Overall, Canberra residents express strong satisfaction with the amount of open space in Canberra and the value created by Canberra's street and park trees. Satisfaction with the amenity of Canberra's town and district parks and provision of facilities has markedly increased (Figure 9) between 2007-08 and 2010-11 (TAMS 2011).

Figure 9. Increase in satisfaction with town and district park facilities



Source: TAMS 2011

# ACT State of the Environment Report 2011

Recent investigations (OCSE 2011a, 2011b) concerning Canberra's urban trees and nature parks have identified that although the city's green infrastructure is vast and a major asset, it is also a management challenge.

The investigation into nature parks has shown that 80% of them are in satisfactory condition, but localised areas in these reserves are in, or approaching, critical condition. Key factors adversely affecting the condition of some nature reserves were:

- native vegetation clearance;
- grazing pressure and soil disturbance from herbivores;
- weed infestations;
- erosion and bare soil;
- impacts from fire events (operational burns and wildfires) and other bushfire operations;
- visitor use impacts; and
- impacts caused by maintenance of infrastructure within nature reserves.

Some of the challenges currently confronting the nature reserves are being addressed; others are not. There are many opportunities to enhance the management in ways that could improve the reserves' resilience.

The investigations (OCSE 2011b) also identified the importance of ecological corridors in Canberra in counteracting the separation of the nature reserves by urban development. Habitat connectivity is increasingly being recognised as a key element in planning and management for wildlife conservation, and landscape connectivity is a key aesthetic element in the planning of Canberra. Work on connectivity has been undertaken by the government in recent years (see the *Ecological communities* indicator cluster paper for further information).

## Future directions

The Canberra Spatial Plan (ACT Government 2004a), which guides long term planning for the ACT, is being reviewed and will incorporate findings from the Time to Talk Canberra 2030 project as well as future impacts such as changing demographics, changes to climate regime and economic structure of the city.

Time to Talk Canberra 2030 discussions highlighted the importance of the form of the city to the future of the Canberra community. Canberra people identified the relationship between being a more compact and a more accessible city. Attitudes to the future form of Canberra were mixed. A small survey indicated that 28% support a more compact city, 58% a mix of housing in existing suburbs and on the fringe, and 13% a more sprawling city (ACT Government 2010). The new Canberra Spatial Plan will direct the location of new development and the shape of the urban form.

COAG will also require all Australian governments to report on the performance of their cities against 9 indicators (COAG 2009:20):

# ACT State of the Environment Report 2011

To ensure Australian cities are globally competitive, productive, sustainable, liveable and socially inclusive and are well placed to meet future challenges and growth.

Each of the nine indicators will have quantifiable measurements, and achieving these targets may be tied to future funding agreements. The reporting against the 9 indicators may influence the format for the next State of the Environment Report.

However, any new strategic planning initiatives, policies or regulations will take some time to be put into effect on the ground.

## References

- ABS 2003. *4102.0 - Australian Social Trends*. Cat. No. 4102.0. Australian Bureau of Statistics. Australian Government. Canberra.  
<http://www.abs.gov.au/ausstats/abs@.nsf/2f762f95845417aeca25706c00834efa/3176be0eaf1bd1aca2570ec0000eadf!OpenDocument> (accessed 15/8/11)
- ABS 2004. *3236.0 - Household and Family Projections 2001 to 2026*. Cat. No 3236.0. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/DF2989BFFA7392E1CA256EB6007D63F4/\\$File/32360\\_2001%20to%202026.pdf](http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/DF2989BFFA7392E1CA256EB6007D63F4/$File/32360_2001%20to%202026.pdf) (accessed 18/11/11)
- ABS 2006. *1216.0 - Statistical Geography: Volume 1*. Cat. No. 1216.0. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&12160\\_2006.pdf&1216.0&Publication&3E15ACB95DA01A65CA2571AA0018369F&0&Jul%202006&14.07.2006&Latest](http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&12160_2006.pdf&1216.0&Publication&3E15ACB95DA01A65CA2571AA0018369F&0&Jul%202006&14.07.2006&Latest) (accessed 18/11/11)
- ABS 2008. *2030.9 - Canberra: A Social Atlas, 2006 Census of Population and Housing*. Cat. No. 230.8. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&20308\\_2006.pdf&2030.8&Publication&F084CC2518A2F7C3CA25740E0079DE65&&2006&17.03.2008&Latest](http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&20308_2006.pdf&2030.8&Publication&F084CC2518A2F7C3CA25740E0079DE65&&2006&17.03.2008&Latest) (accessed 21/11/11)
- ABS 2010a. *4102.0 – Australian Social Trends: Housing*. Cat. No. 4120.0. Australian Bureau of Statistics. Australian Government. Canberra.  
<http://www.abs.gov.au/ausstats/abs@.nsf/mf/4102.0> (accessed 2/9/11)
- ABS 2010b *8731.0 - Building Approvals, Australia, Aug 2010*. Cat. No. 8731.0. Australian Bureau of Statistics. Australian Government. Canberra.  
<http://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/8731.0Main%20Features2Aug%202010?opendocument&tabname=Summary&prodno=8731.0&issue=Aug%202010&num=&view=> (accessed 4/9/11)
- AG 2011. *Residential Land Supply and Development Report No. 2 /2011*. ACT Auditor General's Office. ACT Government. Canberra.

# ACT State of the Environment Report 2011

[http://www.audit.act.gov.au/auditreports/reports2011/Report\\_2-2011\\_Residential\\_Land\\_Supply\\_and\\_Development.pdf](http://www.audit.act.gov.au/auditreports/reports2011/Report_2-2011_Residential_Land_Supply_and_Development.pdf) (accessed 14/7/11)

ACT Government 2004a. *Canberra Spatial Plan*. Canberra.  
<http://apps.actpla.act.gov.au/spatialplan/introductory/index.htm>.<http://apps.actpla.act.gov.au/spatialplan/introductory/index.htm> (accessed 25/8/11)

ACT Government 2004b. *Sustainable Transport Plan*. Canberra.  
[http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0010/167941/Sustainable\\_Transplan\\_Plan.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0010/167941/Sustainable_Transplan_Plan.pdf) (accessed 18/11/11)

ACT Government 2008. *Affordable Housing Action Plan Progress Report*. Canberra.  
<http://www.actaffordablehousing.com.au/index.html> (accessed 23/8/11)

ACT Government 2010. *Time to Talk: Canberra 2030 – Outcomes Report*. Canberra.  
<http://timetotalk.act.gov.au/storage/78d10e40d957379825347909b6e2bfd9.Time%20to%20talk%20-%20web%20version.pdf> (accessed 2/9/11)

ACT Government 2011. *ACT Government Infrastructure Plan 2011-2021*. Canberra.  
[http://www.cmd.act.gov.au/\\_\\_data/assets/pdf\\_file/0013/220306/infrastructur\\_eplan2011.pdf](http://www.cmd.act.gov.au/__data/assets/pdf_file/0013/220306/infrastructur_eplan2011.pdf) (accessed 23/8/11)

ACT Government 2011b. *Draft ACT Planning Strategy*. Canberra.  
[http://timetotalk.act.gov.au/storage/1222\\_PLANNING\\_STRATEGY\\_TAGGED\\_PDF\\_FINAL.pdf](http://timetotalk.act.gov.au/storage/1222_PLANNING_STRATEGY_TAGGED_PDF_FINAL.pdf) (accessed 11/9/11)

ACT Government 2011c. *Time to Talk: Background Paper 6 – Health and Wellbeing*. Canberra.  
[http://timetotalk.act.gov.au/storage/Planning\\_Background06\\_Health.pdf](http://timetotalk.act.gov.au/storage/Planning_Background06_Health.pdf) (accessed 20/11/11)

ACT Health 2010. *Chief Health Officer's Report*. ACT Government. Canberra.  
<http://www.health.act.gov.au/c/health?a=sendfile&ft=p&fid=1285049820&sid=> (accessed 18/11/11)

ACTPLA 2007. *Canberra at the 2006 Census: Population and Housing*. ACT Planning and Land Authority. ACT Government. Canberra.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/7675/Canberra\\_at\\_2006\\_Census.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0007/7675/Canberra_at_2006_Census.pdf) (accessed 18/11/11)

ACTPLA 2008. *Territory Plan – Part B9 Urban Open Space Land use Policies*. ACT Planning and Land Authority. ACT Government. Canberra.  
<http://apps.actpla.act.gov.au/tplan/b/B9.pdf> (accessed 18/11/11)

ACTPLA 2009. *Employment Location in Canberra*. April 2009. ACT Planning and Land Authority. ACT Government. Canberra.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0004/14269/Employment\\_distribution.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0004/14269/Employment_distribution.pdf) (accessed 18/11/11)

ACTPLA 2010. *Urban Form Analysis. Canberra's Sustainability Performance: Technical Report*. ACT Planning and Land Authority. ACT Government. Canberra.

# ACT State of the Environment Report 2011

[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0013/21046/ACTPLA\\_Urban\\_Form\\_Scenarios\\_Final\\_Report\\_WEB.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0013/21046/ACTPLA_Urban_Form_Scenarios_Final_Report_WEB.pdf) (accessed 21/4/11)

ACTPLA 2011a. *Population and Residential Density in Canberra*. ACT Planning and Land Authority. ACT Government. Canberra.

[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/23648/Population\\_Density\\_2011.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0005/23648/Population_Density_2011.pdf) (accessed 18/11/11)

ACTPLA 2011b. *Planning and Development (Draft Variation Number 306) Consultation Notice 2011*. ACT Planning and Land Authority. ACT Government. Canberra.

<http://www.legislation.act.gov.au/ni/2011-273/current/pdf/2011-273.pdf> (accessed 10/11/11)

AHURI 2009. *ACT Affordable Housing Action Plan: Phase II*. Australian Housing and Urban Research Institute for ACT Government. Canberra.

[http://www.economicdevelopment.act.gov.au/affordable\\_housing/affordable\\_housing/pdfs/PhaseII\\_Affordable\\_Housing\\_Action\\_Plan.pdf](http://www.economicdevelopment.act.gov.au/affordable_housing/affordable_housing/pdfs/PhaseII_Affordable_Housing_Action_Plan.pdf) (accessed 18/11/11)

AIHW 2011. *Health and the Environment: A Compilation of Evidence*. Australian Institute of Health and Welfare. Canberra.

<http://www.aihw.gov.au/publication-detail/?id=10737418534> (accessed 22/04/11).

Australian Government 2010. *Commercial Building Disclosure: A national energy efficiency program*. Canberra. <http://www.cbd.gov.au/> (accessed 16/10/11)

Australian Government 2011. *Nation Building – Economic Stimulus Plan*. Canberra.

<http://www.economicstimulusplan.gov.au/pages/default.aspx> (accessed 6/6/11)

COAG 2009. *Communiqué. 28<sup>th</sup> COAG Meeting. Brisbane. 7 December 2009*. Council of Australian Governments. Australian Government. Canberra.

[http://www.coag.gov.au/coag\\_meeting\\_outcomes/2009-12-07/docs/20091207\\_communique.pdf](http://www.coag.gov.au/coag_meeting_outcomes/2009-12-07/docs/20091207_communique.pdf). (accessed 18/9/11)

COGS n.d. *Community Gardens*. Canberra Organic Grower's Society Accessed at

<http://www.cogs.asn.au/community-gardens/> (accessed 23/08/11).

CMD 2010a. *Land Use and Planning - Canberra 2030*. Chief Minister's Department. ACT Government. Canberra. <http://timetotalk.act.gov.au/2030-outcomes-report/>

(accessed 24/11/11)

CMD 2010b. *Housing – Canberra 2030*. Chief Minister's Department. ACT Government.

Canberra. <http://timetotalk.act.gov.au/2030-outcomes-report> (accessed 24/11/11)

CMD 2010c. *City Form – Canberra 2030*. Chief Minister's Department. ACT

Government. Canberra. <http://timetotalk.act.gov.au/> (accessed 24/11/11)

# ACT State of the Environment Report 2011

- CMD 2011. *Canberra Social Plan*. ACT Chief Minister's Department. Canberra.  
[http://www.cmd.act.gov.au/\\_\\_data/assets/pdf\\_file/0010/216559/2011CanberraSocialPlan\\_Print\\_Version.pdf](http://www.cmd.act.gov.au/__data/assets/pdf_file/0010/216559/2011CanberraSocialPlan_Print_Version.pdf) (accessed 26/10/11)
- DET 2006. *Towards 2020: Renewing our Schools*. Department of Education and Training. ACT Government. Canberra.  
<http://activated.act.edu.au/2020/pdf/Towards2020.pdf> (accessed 2/3/11)
- DET 2011. *ACT School Census February 2011*. Department of Education and Training. ACT Government. Canberra.  
[http://www.det.act.gov.au/\\_\\_data/assets/pdf\\_file/0020/204284/ACT\\_Schools\\_Census\\_February\\_2011.pdf](http://www.det.act.gov.au/__data/assets/pdf_file/0020/204284/ACT_Schools_Census_February_2011.pdf) accessed (accessed 27/10/11)
- Engineers Australia 2010. *Australian Capital Territory Infrastructure Report Card 2010*. Canberra.  
<http://www.engineersaustralia.org.au/sites/default/files/shado/Divisions/Canberra%20Division/Infrastructure%20Report%20Card.pdf> (accessed 18/11/11)
- ESDD 2011. *Australian Capital Territory Indicative Land Release Programs 2011-12 to 2014-15*. Environment and Sustainable Development Directorate. ACT Government. Canberra.  
[http://www.economicdevelopment.act.gov.au/\\_\\_data/assets/pdf\\_file/0010/205021/Final\\_Print\\_Ready\\_Land\\_Release\\_Text\\_6\\_May\\_2011.pdf](http://www.economicdevelopment.act.gov.au/__data/assets/pdf_file/0010/205021/Final_Print_Ready_Land_Release_Text_6_May_2011.pdf) (accessed 18/7/11)
- EDD 2011. *National Arboretum Canberra – Background*. Economic Development Directorate. ACT Government. Canberra.  
<http://www.nationalarboretum.act.gov.au/background> (accessed 11/6/11)
- GBCA 2011a. *About: Green Building Council of Australia*. Green Building Council of Australia. Sydney. <http://www.gbca.org.au/about/> (accessed 28/6/11)
- GBCA 2011b. *Green Star Building Directory*. Green Building Council of Australia. Sydney. <http://www.gbca.org.au/greenstar-projects/> (accessed 31/5/11)
- JCSD 2011. *ACT Criminal Justice Statistical Profile*. Justice and Community Safety Directorate. ACT Government. Canberra.  
[http://www.justice.act.gov.au/resources/attachments/ACT\\_CJSP\\_Sept\\_2011\\_FINAL\\_PDF.pdf](http://www.justice.act.gov.au/resources/attachments/ACT_CJSP_Sept_2011_FINAL_PDF.pdf) (accessed 17/10/11)
- Mees. P. Sorupia. E. & Stone. J. 2007. *Travel to Work in Australian Capital Cities. 1976-2006: An Analysis of Census Data*. Australasian Centre for the Governance and Management of Urban Transport (GAMUT).  
<http://www.abp.unimelb.edu.au/gamut/pdf/travel-to-work.pdf> (accessed 18/11/11)
- OCSE 2011a. *Report on the Investigation into the Government's Tree Management Practices and the Renewal of Canberra's Urban Forest*. Office of the Commissioner for Sustainability and the Environment. Canberra.  
[http://www.envcomm.act.gov.au/investigations/canberras\\_urban\\_forest](http://www.envcomm.act.gov.au/investigations/canberras_urban_forest) (accessed 24/4/11)

# ACT State of the Environment Report 2011

OCSE 2011b. *Report on Canberra Nature Park (Nature Reserves); Molonglo River Corridor (Nature Reserves) and Googong Foreshores Investigation*. Office of the Commissioner for Sustainability and the Environment ACT Government. Canberra.

[http://www.envcomm.act.gov.au/investigations/nature\\_reserves\\_investigation](http://www.envcomm.act.gov.au/investigations/nature_reserves_investigation) (accessed 23/8/11)

SGS Economcs 2010. *Stromlo Forest Park Master Plan Business Case*. Prepared for Territory and Municipal Services. ACT Government. Canberra.

PCL 2009. *Facts at a Glance 2009*. Parks Conservation and Lands.

[http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0020/166061/PCLFacts\\_2009web.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0020/166061/PCLFacts_2009web.pdf) (accessed 18/8/11)

Purdon 2008. *Future Uses for Public Schools*. Purdon Associates. Canberra.

<http://www.purdon.com.au/formerschoolsites/> (accessed 18/8/11)

TAMS 2011. *ACT Sportsgrounds, Parks and Open Spaces Usage and Satisfaction Survey – June 2010/11*, Department of Territory and Municipal Services. ACT Government. Canberra.

## Other data sources

In addition to these published reports, data for this paper were also sourced from:

ACT Department of the Environment, Climate Change, Energy and Water (DECCEW) - now Environment and Sustainable Development Directorate (ESDD)

ACT Department of Land and Property Services (LAPS) - now part of Economic Development Directorate (EDD)

ACT Emergency Services Authority (ESA)

ACT Office of Regulatory Services (ORS)

ACT Planning and Land Authority (ACTPLA) - now part of the Environment and Sustainable Development Directorate (ESDD)

AirServices Australia

Community Services Directorate (CSD)

# ACT State of the Environment Report 2011

## THEME: People

### Indicator cluster: Transport

The indicators for this cluster are:

- *Transport assets (C)* - includes length of busways and cycle paths, and land area used for roads;
- *Transport modes and use (C)* - includes modal split and trends in transport use and vehicle size;
- *Transport accessibility (C)* - includes pedestrian access to shops;
- *Commuting and congestion (P)* - includes time spent commuting and levels of congestion;
- *Transport and human health impacts (I)* - includes health impacts from transport infrastructure and use, such as noise, pollution, accidents, safety, obesity; and
- *Transport management (R)* - effectiveness of transport management responses.

**Condition indicators (C)** present data that tell us the state of the environment at any particular time. Condition indicators.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

## Summary

Transport is a major contributor to the environmental footprint of urban areas, particularly in the ACT where road provision and use are extensive. Roads comprise around 7.5% of our built area, while the transport sector is the ACT's second-largest source of greenhouse gas emissions - a share that is projected to increase significantly.

Transport patterns and trends in the ACT reveal a mixed picture: high dependence on cars and low usage of public transport, but higher rates of cycling than the Australian average. Walking appears to be more common than the national average for work trips but less common for non-work or school trips. Although in the 5 years to 2006 there was a modest shift away from the private car to public transport, this trend has reversed since 2006. Public transport patronage has stagnated while motor vehicle travel has begun to grow again. On the positive side, cycling continues to increase, although it accounts for only a small share of work related travel.

As environmental awareness has increased, different transport goals have emerged. Traditional concerns about traffic congestion have been joined by concerns about greenhouse gas emissions, air pollution and the health effects of sedentary lifestyles. In 2010, the *Time to Talk* phase of the Canberra 2030 planning process revealed strong and widespread support for a change in transport priorities, with a focus on improved public transport and reduced greenhouse gas emissions.

A key challenge for increasing the use of more sustainable transport modes in the ACT is to bridge the disconnection between Government and community goals for greater use of

# ACT State of the Environment Report 2011

sustainable transport options, as identified in the *Sustainable Transport Plan* and the *Time to Talk: Canberra 2030* process, and the on-ground reality of Canberrans' transport behaviour.

## Introduction

Transport assets, systems and transport choices have significant impacts on the ACT community and Canberra, as well as on the quality of the environment. Different transport modes such as private vehicles, public transport and walking, have different impacts on the environment and human health. The amount of travel by each form of transport is influenced by land use and transport policies as well as by individual behaviours and choices.

## Condition indicators

### Transport assets

The ACT road system, which is extensive in relation to its population and in comparison to other Australian cities, comprises a connected network of toll-free freeway-standard roads (parkways). There is no heavy or light urban rail infrastructure beyond an interstate rail connection at Kingston and, following closure of the short Belconnen busway in 2009, no fully segregated roadways for buses. However, there is a modest but growing network of on-road bus lanes, and the ACT also has the nation's most extensive (relative to population) network of bicycle paths and on-road cycle lanes.

In June 2011 there were approximately 3319 km of roads, 16 km of bus or transit lanes and 2120 km of footpaths in the ACT. There were also around 377 km of on-road cycle lanes and 342 km of off-road cycle paths (Table 1). Accurate data are not available on the total area of land covered by roads in the ACT but, based on a minimum lane width of 3.5 m, the 6397 km of lanes in the ACT are likely to cover at least 22.39 km<sup>2</sup> (TAMS 2011a). This is equivalent to roughly 7.5% of the 300 km<sup>2</sup> occupied by the Canberra urbanised area at the 2006 census. Housing blocks also contain driveways and garages and some of the lanes on roads in the ACT are significantly wider than 3.5 m, so the area of land devoted to vehicular transport is likely to be larger than this estimate.

From 2007 to 2011 the length of bus lanes increased by 3.85 km, or 32%, and the length of footpaths increased by 150 km, or 7.6% (Table 1). Over the same period 131.14 km of on-road cycle paths and 10.19 km of off-road cycle paths were built, representing increases to existing cycle-path infrastructure of 53.5% and 3% respectively, while 381 km of new road lanes were also built, an increase of about 13% (Table 1).

Table 1. Transport assets (accumulated), 2007-2010

Infrastructure type	2007-08	2008-09	2009-10	2010-11
Road length (km)	2937.64	no data	3203.96	3,318.90
Bus/transit lane length (km)	12.15	12.15	12.3	16
On-road cycle lane length (km)	245.86	312.06	338.69	377
Off-road cycle lane length (km)	331.9	336.76	339.35	342
Footpath length (km)	1970	2045	2078	2120

# ACT State of the Environment Report 2011

Source: TAMS 2011a, TAMS

## Parking

The *ACT Parking and Vehicular Access Guidelines* (Urban Services 2000) and the yet-to-be-finalised *Draft ACT Parking Strategy* (TAMS 2007) aim to provide an adequate supply of convenient and reasonably priced car parking to support economic and social activities (TAMS 2007). A comprehensive parking inventory and use survey for the Canberra central business district (CBD, i.e. Civic and surrounds) and the town centres in 2001 recorded almost 57,000 off-street public and tenant-only parking spaces, with an average usage rate of 58%, well below that of other Australian capital cities (TAMS 2007). In 2009, there were 22,000 off-street parking spaces in Canberra's CBD and 24,467 spaces in total, of which around a third were vacant at the time of survey. This represents two parking spaces for every three CBD workers (ACT Government 2010a:17, 7).

The largest employer in the ACT is the Australian Government; it is also the largest supplier of employee parking. Most of this parking, particularly in the Parliamentary Triangle, is provided free, reducing the effectiveness of incentives to use alternate forms of transport.

## Public transport vehicles and services

Canberra's sole bus operator, ACTION, had 458 buses in service at 30 June 2011, similar to the 1991 fleet of 463 vehicles (ACTION 1992). Of the 2011 fleet, 200 are wheelchair-accessible buses, 155 are low-emission vehicles compliant with or better than Euro 3 standards, and 257 are fitted with bike racks. ACTION is the only public transport operator in Australia with a significant number of buses carrying bike racks. ACTION's bus fleet travelled 19.2 million km in 2010-11, representing a 10% increase in five years and a reversal of service cuts made in response to reduced funding in 2006 and 2007. However, the figure is still below the 20 million km run in 1990-91, when Canberra's population and area were around a quarter smaller than now.

Canberra's bus services operate at different frequencies, different stopping distances, in differing directions and over varying daily and weekly time periods. The most high frequency service is the Blue Rapid limited-stop route, which connects the town centres of Belconnen, Civic, Woden and Tuggeranong (formerly called the intertown route), with services every 5 minutes or better on weekdays and every 15 minutes during evenings and weekends. The Red Rapid service between Gungahlin, Civic and Fyshwick, introduced as a trial in 2009 and now made permanent, provides services every 15 minutes until 7 pm on weekdays, but does not operate during evenings or weekends. Most local routes operate at 20-30 minute intervals in peak period, with half-hourly or hourly off-peak services and hourly evening services. A separate network operates on weekends, with hourly and occasionally 2-hourly service intervals in some areas. A third Expresso network provides peak-period connections to the CBD and other major employment nodes such as Barton and Fyshwick, while a separate school bus network is available only to students. Demand-responsive Flexibus services were introduced for evening travel in 2005, but withdrawn following negative feedback from passengers.

# ACT State of the Environment Report 2011

## Transport modes and use

The last comprehensive travel survey in the ACT was conducted in 1997 and is now out of date. More up-to-date information is available from the most recent *Survey of Motor Vehicle Use* (ABS 2011c), which covers the 12 months to 31 October 2010, and the 2009 survey of national transport usage patterns (ABS 2009)<sup>1</sup>. There are also data from the 2006 national census (2011 census data will not be released until 2012) and other sources such as bus patronage estimates from ACTION and bicycle commuter counts by Pedal Power ACT.

For non-work travel, the 2009 survey (ABS 2009) asked people aged over 18 which transport modes they used for “day to day trips other than to work or full-time study”. Respondents could nominate more than one transport mode. Although the small sample size suggests results should be treated with caution, Canberra had:

- the highest rate of car use of the seven capitals, at 94% (Sydney was lowest with 82%);
- the lowest rate of public transport usage, at 10% (Hobart was second-lowest at 13%, Sydney highest with 29%);
- the highest cycling rate, 11% (followed by Perth, 8%); and
- the second-lowest walking rate, 38% (Brisbane was lowest with 31%; Melbourne highest with 49%).

In 2006 Canberra had the second-lowest usage of public transport (after Hobart), for travel to work, of the Australian state and national capital cities<sup>2</sup> (ABS 2008a). Approximately 82% of Canberra people travelled to work by car or truck - either as drivers or passengers, a percentage considerably higher than the national urban average (76%), but lower than in Hobart, Perth or Adelaide. The proportion of people travelling as car or truck drivers, around 73%, was also slightly lower than in Melbourne (Figure 1). However, this is not necessarily an indicator of rates of car-pooling: some car passengers will be chauffeured (e.g. by another family member), in which case the chauffeur may be making two car trips to serve the single trip made by the passenger.

The most recent comparable statistical data (ABS 2007) showed that more people cycle to work in Canberra than in any other Australian capital city, though walking to work in Canberra is twice as popular as cycling (the national ratio is closer to 4:1) (Figure 1). The total proportion of people walking and cycling, the most sustainable modes of travel, is the second-highest nationally, after Hobart. The finding partly results from the smaller physical size of both cities compared with cities such as Sydney and Melbourne. It may also mean that a large proportion of the workforce live within a short distance of the CBD.

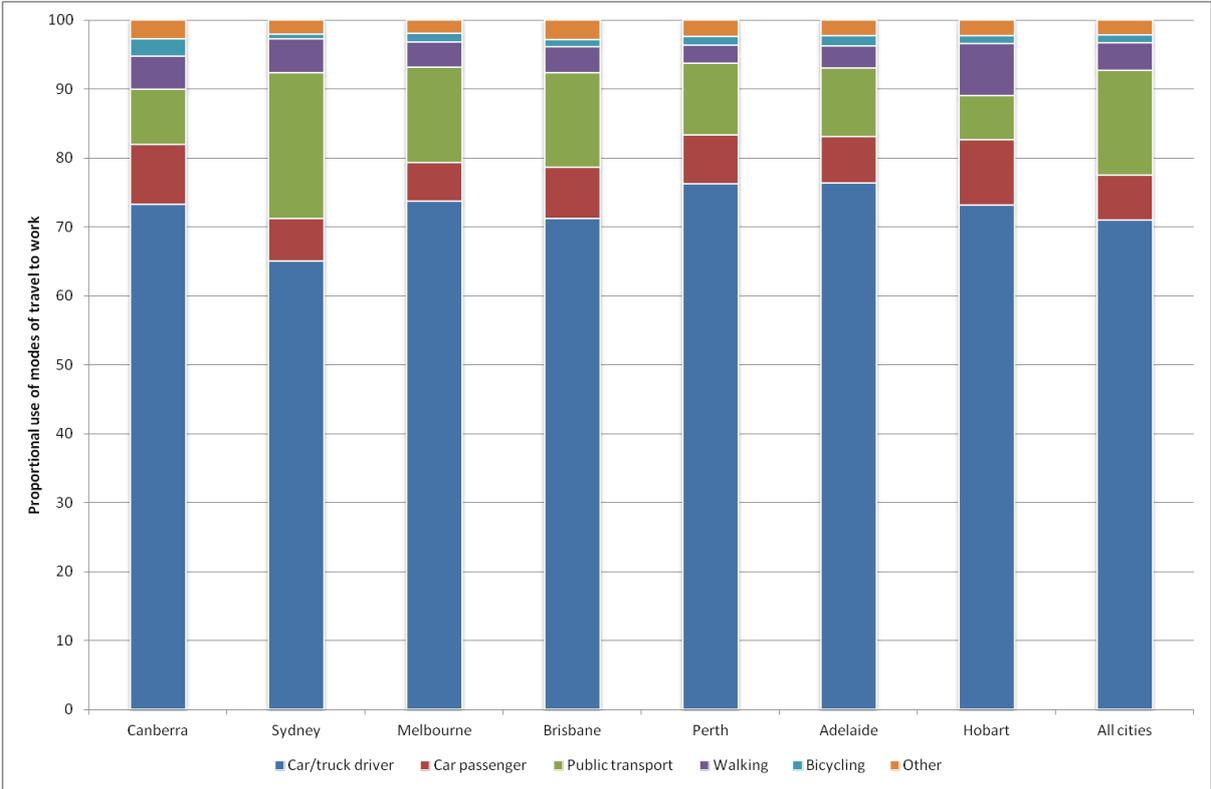
---

<sup>1</sup> The small sample size for this survey means that the results for the ACT, which has less than 2% of Australia's population, have a high margin of error.

<sup>2</sup> Darwin is commonly excluded from ABS capital city comparisons because of its significantly smaller population.

# ACT State of the Environment Report 2011

Figure 1. Mode of travel to work in Australian capital cities, 2006

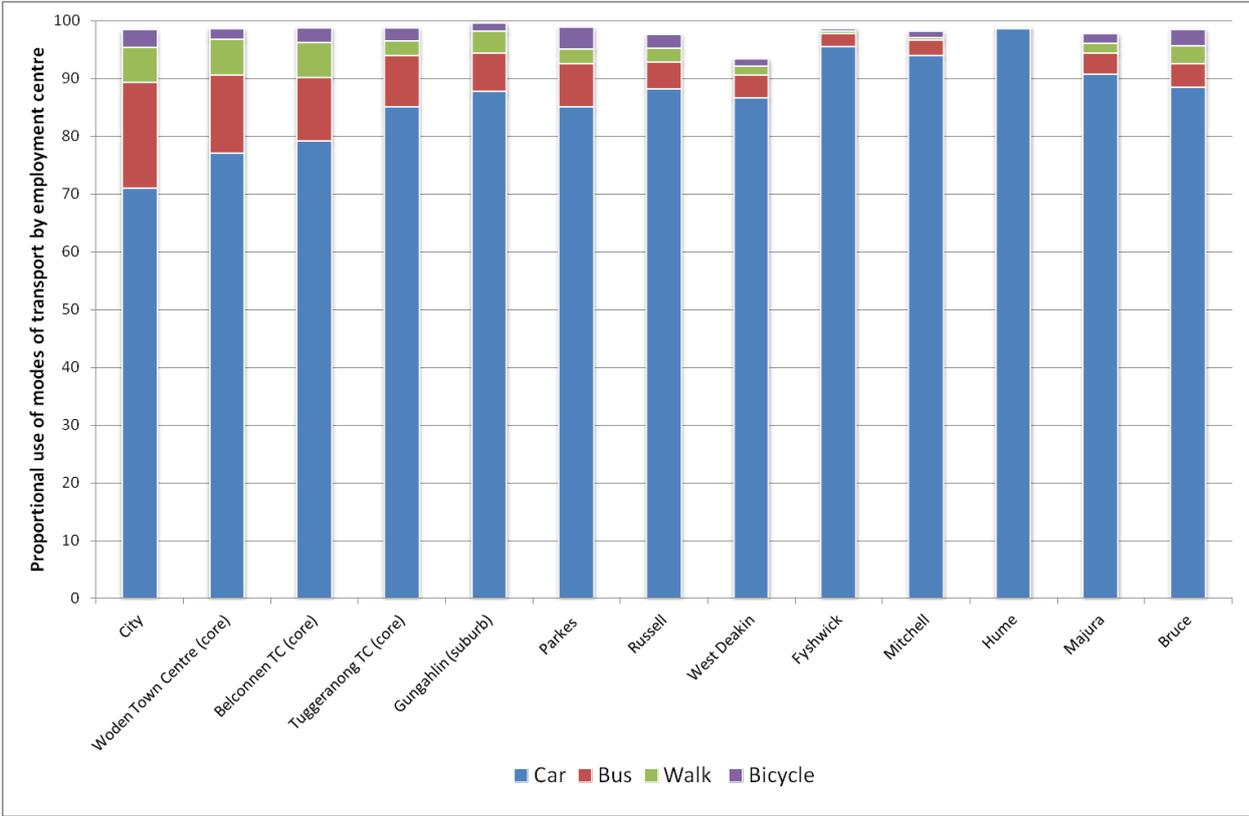


Source: based on Mees, Sorupia and Stone 2007

Figure 2 shows modes of travel to work at several centres of employment in the ACT in 2006, based on Table A1 (Annex). While the car was the dominant mode for trips to all centres, the extent of its dominance varies from a low of 71% in Civic to 100% in Hume. Conversely, use of sustainable modes of travel is highest for Civic, Woden, Belconnen and Tuggeranong.

# ACT State of the Environment Report 2011

Figure 2. Modes of travel for work trips to major centres of employment, ACT 2006



Source: based on ACTPLA 2009a

Travel distance influences the mode of transport used to travel to work. People who live close to their work location are most likely to commute by foot or bicycle. Where there has been significant residential development in inner-city locations, such as in Turner and Braddon, more people now walk to their jobs. Table 4 shows that between 2001 and 2006 the number of residents of Turner walking to work more than doubled (from 167 to 433), while the number of people cycling jumped from 83 to 110. However, these increases resulted more from a large increase in the total number of Turner residents travelling to work, from 700 to 1569, than from a rise in the share of Turner residents using sustainable modes of travel: in fact, the proportion of people cycling decreased by nearly 50% (ABS 2007)<sup>3</sup>. This finding suggests that proximity to workplaces, rather than increased residential densities of themselves, may be the most important factor in promoting walking.

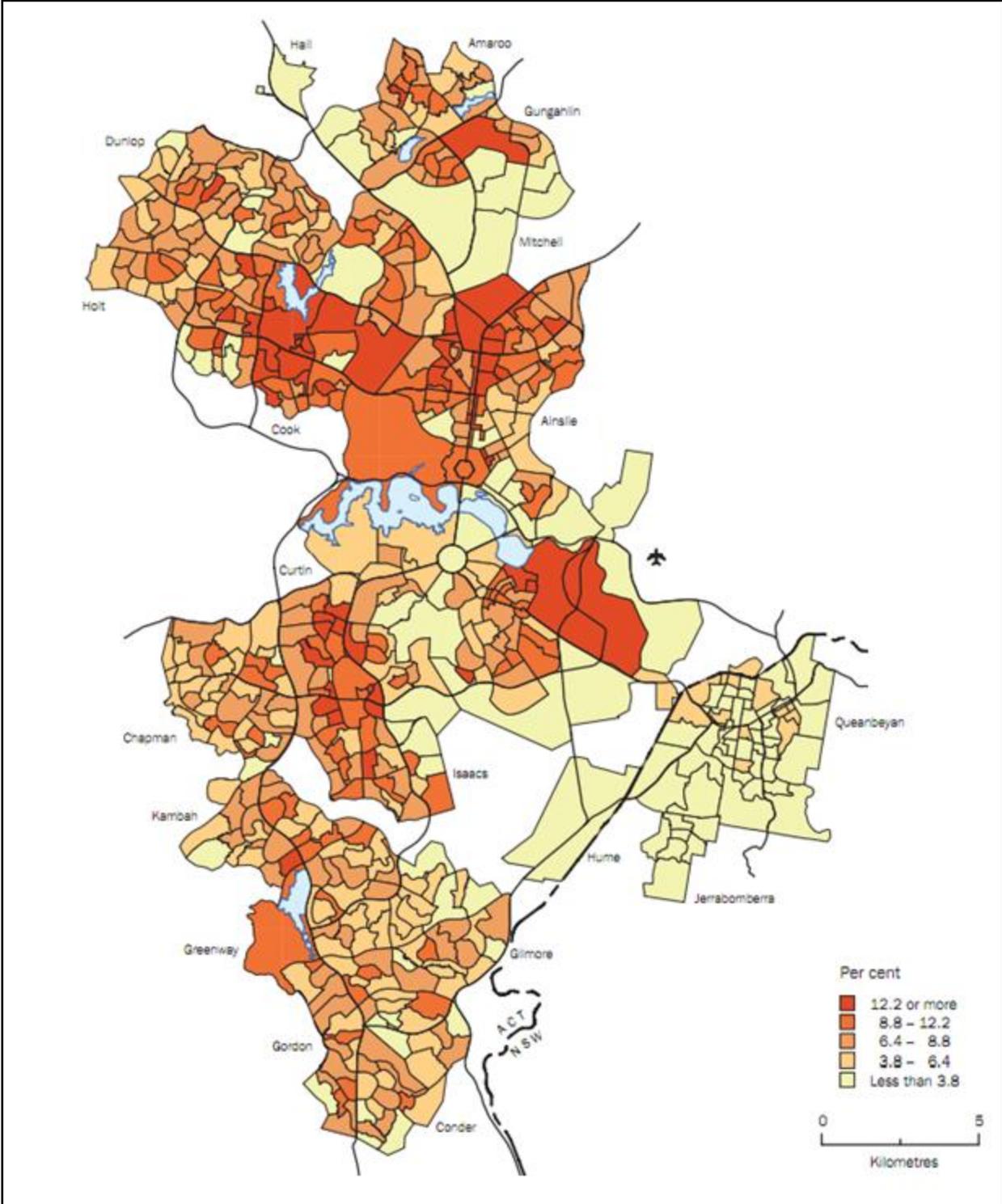
Across Canberra generally, the proportion of workers travelling by public transport varied significantly depending on residential location (Figure 3). Low public transport shares in inner-city areas such as Turner are influenced by the high proportion of walkers, but in most other areas public transport’s competitor is the car. The highest usage of public transport is found among people who live in areas where the bus services are very good (e.g. near Belconnen

<sup>3</sup> The suggestion in the 2009 report *Employment Location in Canberra*, of a 10-fold increase in the share of Turner residents walking to work (ACTPLA 2009a:18) appears to be based on a data error.

# ACT State of the Environment Report 2011

and Woden town centres) and/or where large numbers of the residents work in Civic (e.g. people living in Cook, Dickson and Lyneham), regardless of housing density. (See also Figure 2 in the *Urban quality* indicator cluster).

Figure 3. People who travelled to work by public transport in Canberra, 2006



Source: ABS 2008b

# ACT State of the Environment Report 2011

## Employment location

Employment location has a strong influence on travel patterns, at least for the journey to work. Employment location was a major focus of the *Y-Plan* in 1967 (ACT Government 2004; ACTPLA 2007) and subsequent plans for Canberra, with dispersal of employment to new town centres designed to promote self-containment - that is, people working near to home - and reduce traffic congestion. The *Urban quality* indicator cluster paper shows changes in employment distribution between 2001 and 2006, and in self-containment between 1991 and 2006. The long-term trend has been toward higher self-containment.

The growth in jobs in Civic has been particularly striking, with a 44% increase in the 5 years to 2006. This was accompanied by an increase in the share of Civic workers using public transport, from 12.5% to 18%; the share walking also increased, from 3.9% to 6.4%. As a result, Civic accounted for 82% of the growth in public transport work trips between 2001 and 2006, and around half the growth in walking trips (Stone and Mees 2011). The number of jobs in other in town centres remained roughly constant over the same period.

## Motor vehicle registrations and usage

In 2010, there were 253,848 motor vehicles registered in the ACT (ABS 2011a). From 2005 to 2010 the number of motor vehicle registrations grew by 15.6% and from 2009 to 2010 registrations grew by 2.8% (ABS 2011a). The growth in motor vehicle registrations was higher than the average annual population growth rate, which increased by 1.7% over the same period (ABS 2011b).

Passenger vehicles accounted for 84% of all motor vehicle registrations in the ACT, which was the highest proportion of any state or territory in Australia (ABS 2011a), reflecting the lack of heavy industry and associated freight transport. Car ownership in the ACT has increased from 541 cars per 1000 people in 1998 to 596 per 1000 in 2009 (ABS 2011a). Transport was the second highest-household expenditure, after housing, for Canberrans (ACT Government 2010b). In 2003 car travel in the ACT was estimated to cost the community \$1.8 billion annually, including ownership, operating and other associated costs (ACT Government 2010b).

Total travel by ACT-registered vehicles increased steadily between 2001 and 2004, from 3048 million km to 3234 million km, and then declined to 3014 million km in 2006 (Table 2). This trend, which was noted in the *2007-08 State of the Environment Report*, was at least partly due to rising petrol prices, although it also matches increases in the share of trips made by public transport (see below). However, the trend has reversed since 2006: rising car use has been accompanied by falling patronage of public transport, despite continuing high petrol prices. Cuts to public transport services in 2006 and 2007 (Figure 7), and major road improvements, are likely to have played a part in these changes. In 2010, motor vehicles registered in the ACT travelled 3539 million km in total, including interstate trips. This represents an increase of more than 17% since 2006, more than double the Australia-wide increase of 8.2%, and the second-highest highest rate of growth in the nation (after Western Australia).

# ACT State of the Environment Report 2011

Table 2. Population, motor vehicle ownership and usage trends for ACT, including interstate trips, 2004-2010

	2004	2005	2006	2007	2010
ACT population	327,475	330,164	334,119	341,054	358,600
ACT motor vehicle ownership	215,581	217,036	220,827	227,031	252,771
Motor vehicle travel (million km)	3234	3104	3014	3160	3539
Travel per capita (km)	9876	9401	9021	9265	9869
Vehicles per capita	0.658	0.657	0.661	0.666	0.705

Source: ABS 2011c, ABS (various years)

Based on the *Survey of Motor Vehicle Use* (ABS 2011c), although the distance travelled per person in Canberra (7387 km per resident, excluding interstate travel) is increasing, it remains the lowest of any Australian capital city. Melbournians travel the furthest (9244 km). Reasons for the smaller distances include Canberra's small size compared with the mainland capitals, the relative absence of heavy industry and accompanying freight travel, and the fact that commuters from NSW are excluded. It is also likely that the relatively high rates of self-containment arising from Canberra's longstanding planning policies (see the *Urban quality* indicator) have played a part.

## Public transport patronage

Bus patronage was virtually static at the end of the last reporting period (Table 3), although the 2006 census results showed a slight increase in the proportion of work trips made on public transport in the ACT since 2001. Over the current reporting period, 2007-2011, bus patronage has remained approximately the same when measured as total number of boardings, but has fallen in terms of boardings per capita (Table 3). This pattern matches changes in motor vehicle travel over the same period, suggesting that people are choosing to travel by car rather than bus. Difficulties with ACTION's ticketing system in recent years mean that it is not possible to assess how much of this recent shift has been for work and how much for non-work travel.

# ACT State of the Environment Report 2011

Table 3. Total and per capita bus boardings in Canberra, 1983-84, 1989-90, and 2002-2011

Financial year	Annual boardings (million)	Canberra population (30 June)	Per capita boardings
1983-84	23.2	245,000	95
1989-90	25.1	273,000	92
2002-03	16.3	323,004	50
2003-04	16.3	323,468	50
2004-05	16.8	325,405	52
2005-06	17.1	333,715	51
2006-07	16.8	340,561	49
2007-08	16.9	345,999	49
2008-09	17.6	351,766	50
2009-10	16.9	357,931	47
2010-11	16.7*	(est) 365,000	46

Source: TAMS, ABS (various years), ACTION 1992

\* Patronage figures affected by partial failure of the bus ticketing system

1983-84 was the year of ACTION's highest per capita usage, and annual boardings peaked in 1989-90 (Table 3). Bus patronage fell by around a third during the 1990s, down to 16-17 million annual trips by the end of the decade. Patronage has remained around this figure ever since, despite continued growth in population, with the result that public transport usage rates are now barely half those achieved in the mid to late 1980s (Table 3).

Comparison of per capita boardings (Table 3) and census data reaffirm the findings from the 2009 ABS travel survey that Canberra has by far the lowest usage of public transport nationally for non-work/non-school trips (ABS 2009). In the mid-1980s, Canberra had the third-highest overall public transport usage rate in Australia, following Sydney and Melbourne. The share of work trips made by public transport was higher than in Adelaide in 1991, but is now second-lowest nationally after Hobart (Figure 1).

## Walking and cycling trends

More people cycle to work in Canberra than in any other Australian capital<sup>4</sup> (Figure 1), and the 2009 survey suggests that the same holds true for non-work and non-school trips as well (ABS 2009). Nevertheless, in comparison to cities in Europe and on some other continents, few people cycle in Canberra. For example, Victoria, capital city of British Columbia in Canada, is of similar size and population density to Canberra but has twice as many people cycling and walking to work (Table 4). Canberra's percentage of cyclists approximates more to that seen in Ottawa, Canada, which has a much denser population and public transport usage rates three times that of Canberra (Table 4).

<sup>4</sup> Not including Darwin which is commonly excluded from ABS capital city comparisons because of its significantly smaller population.

# ACT State of the Environment Report 2011

Table 4. Density and method of travel to work in selected Australian and Canadian cities, 2006

City	Population	Density (per ha)	Public transport (%)	Walk (%)	Bicycle (%)
Canberra	368,129	10.8	7.9	4.9	2.5
Victoria, BC	330,088	11.1	10.2	10.4	5.7
Ottawa	846,802	17.2	21.2	7.6	2.2

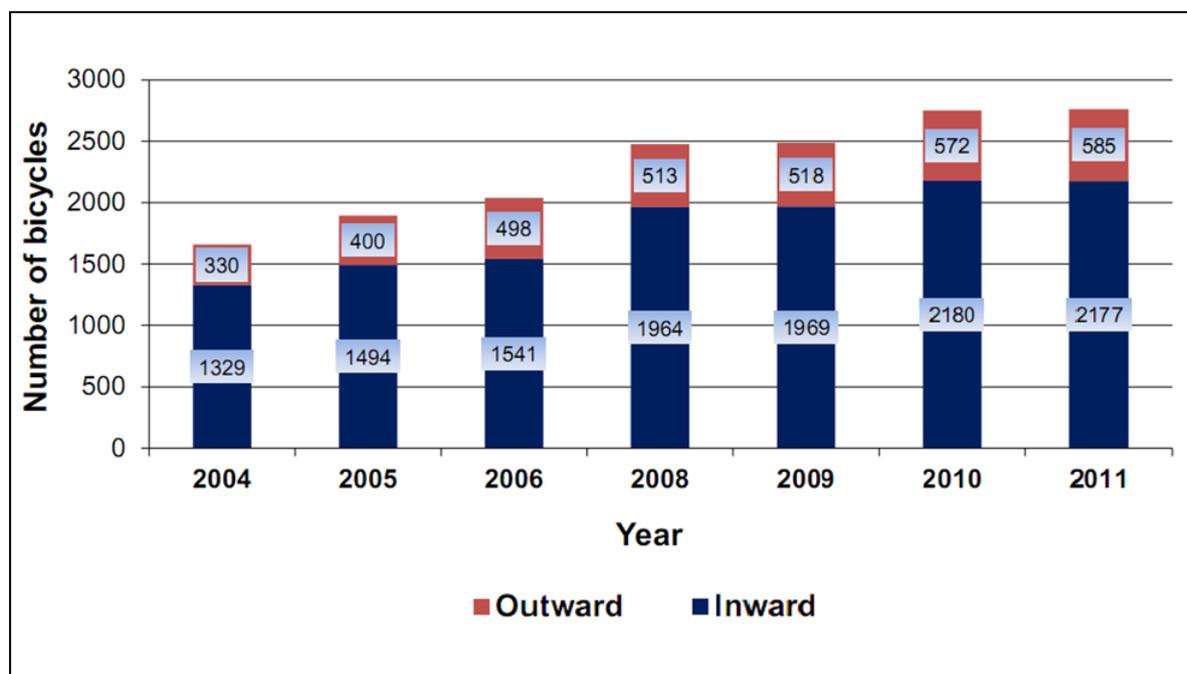
Source: Australian and Canadian censuses 2006

The cycling advocacy group Pedal Power ACT has conducted cordon-counts of cyclists entering the Civic-Acton area annually since 2004 (except for 2007). The Pedal Power counts give higher figures than the census (1541 cyclists for 2006, compared with census count of 1255), because they include all cyclists, not just workers; that is particularly important because Acton includes the Australian National University. Weather conditions may also be a factor, because the cordon-counts are conducted in summer, February-March, while the census is in winter, in August. Despite these limitations, the Pedal Power survey provides a useful account of cycling trends in inner Canberra. The results (Figure 4) show that in-bound cycling numbers during morning peak-hour have increased by two-thirds during the 7 years between 2004 and 2011, and by 41% since 2006, the year of the last census.

Information about people walking to work is more difficult to obtain, possibly because it lacks dedicated advocacy organisations to promote it. The 2006 census found that walking was twice as prevalent as cycling, on work trips, and the 1997 household survey found walking was six times as prevalent as cycling for all trip types. In 2009, walking was twice as prevalent as cycling and public transport combined, for non-work or non-school trips. Even so, Canberra people walked less than the Australian average (ABS 2009). A survey conducted in the ACT in 2010 found that respondents thought they would walk more if the routes were greener and had more trees, and if there were more amenities (such as cafes and shops) along them, as well as improved lighting and security (SKM 2010).

# ACT State of the Environment Report 2011

Figure 4: Inward and outward bicycle counts for Civic and Acton, 2004-2011



Source: Pedal Power ACT 2011

## Freight, business and air travel

The total amount of freight transport in the ACT (489 million tonne-kilometres) is small compared to other states and territories (56,918 million tonne-kilometres in NSW, for example), even when population size is taken into account. The ACT's small physical size and lack of heavy industry, mining and agriculture are the main factors here. The second lowest road freight travel for an Australian state or territory is in the Northern Territory, where the tonne-kilometres travelled (2710 million) are more than five times that of the ACT (ABS 2011c).

Air travel has not been included in most systems of monitoring for reducing greenhouse gas emissions, but it is an important and growing source of greenhouse gas emissions globally. The Australia Institute (2008) estimated that flights to and from Canberra airport in 2005 were responsible for 117,000 tonnes of greenhouse gas emissions as carbon dioxide equivalent, or approximately 3% of total ACT emissions. If current plans for airport growth are successful, the Institute estimates that aviation will account for 9% of the Territory's total allowance under the ACT Climate Change Strategy by 2025, and that by 2050 aviation emissions will be twice as large as the ACT's total emissions allowance under the strategy.

## Transport accessibility

Accessibility has been defined as "the proportion of households that can access main facilities and services (e.g. employment, education, health and cultural facilities) by public transport within 60 minutes" (Infrastructure Australia 2010:94). It is not possible to estimate how many of Canberra's residents enjoy this level of accessibility but it is worth noting that, outside peak period, many bus services only run every 60 minutes.

For people with disabilities, accessibility also means being able to travel to, and get onto and off, public transport vehicles. As indicated above, 43% of ACTION's current fleet is wheelchair-

# ACT State of the Environment Report 2011

accessible, and the organisation plans to increase this to 55% by the end of 2012. However, as the ACT Auditor-General notes in her 2010 report on ACTION's services, accessible buses need to be complemented by accessible bus stops, and many bus stops lack facilities such as connecting footpaths (AG 2010:57-58).

The Auditor-General also noted that some parts of Gungahlin, Woden and Tuggeranong do not satisfy the objective in the Territory Plan that all residences should be within a 500 m walk of a bus stop; and rural areas such as Hall and Tharwa are not served by buses at all (AG 2010:59-60). However, it is estimated that currently around 95% of ACT residents live in areas that do meet this standard. The Auditor-General also expressed concern at unequal service frequencies between areas near to and far from shopping and business centres. Faraway suburbs often have higher proportions of disadvantaged residents (AG 2010:58). However, note that differing service frequency standards between inner and outer areas of Canberra are an expressly adopted policy under ACTION's draft *Strategic Public Transport Network Plan* (see Transport management, below).

Canberra's small suburban shopping centres may include a small supermarket and some have other services such as a pharmacy (ACTPLA 2009b,c). Local centres such as these are readily accessible, potentially reducing car use and encouraging active travel such as walking or cycling. It is important that transport and planning policies support the continuing viability of these centres.

## Pressure indicators

### Commuting and congestion

Time spent commuting (both in vehicles and between the vehicles and ultimate destinations) has impacts on the Territory's economy, as well as on the community's health and well-being and available leisure time.

It takes almost twice as long on average, door-to-door, to travel by public transport as by car in peak period in Canberra (ACT Government 2004); at other times, the difference is even greater. A number of ACTION bus services have become progressively slower over the years, particularly on the intertown high-usage routes. For example, in 1994 the intertown service from Belconnen to Tuggeranong was timetabled to take 44 minutes in peak period and 42 minutes on weekends. By contrast, in 2011 the Blue Rapid is allowed 62 and 64 minutes respectively for the trip, with the longer weekend time allowing the bus to service an additional local centre.

The costs and benefits of time spent travelling by walking or cycling are difficult to calculate, but the physical exercise involved in these modes of travel means the additional time should be seen as a net benefit.

Traffic congestion is difficult to measure and value because comparison with a non-congested scenario is always hypothetical, and because commuters are responsive to changes in the ease of their travel route, tending to travel further by car in low-congestion areas. The Bureau of Infrastructure, Transport and Regional Economics (formerly the Bureau of Transport and Regional Economics) has estimated the costs of congestion in Australian capital cities to be about \$9.4 billion in 2005. It has projected that costs will increase to \$20.4 billion by 2020 (BTRE 2007). The Bureau estimated congestion costs for Canberra to be \$118 million in 2005,

# ACT State of the Environment Report 2011

rising to around \$200 million by 2020. Costs included time, additional fuel consumption and reduced air quality.

The ACT Government estimates that by 2030 about 80 km of roads in Canberra will suffer congestion in peak periods. The government expects the congestion to extend travel times, reduce productive work hours, and increase the health risks associated with air pollution and reduced amounts of physical activity and increased stress (ACT Government 2010b). However, Australian researchers have compared data from a range of world cities and have found no relationship between traffic speeds and overall time spent travelling, although the study found that higher traffic speeds were associated with less travel by active transport, and therefore less physical activity (Newman and Kenworthy 1999).

## Impact indicators

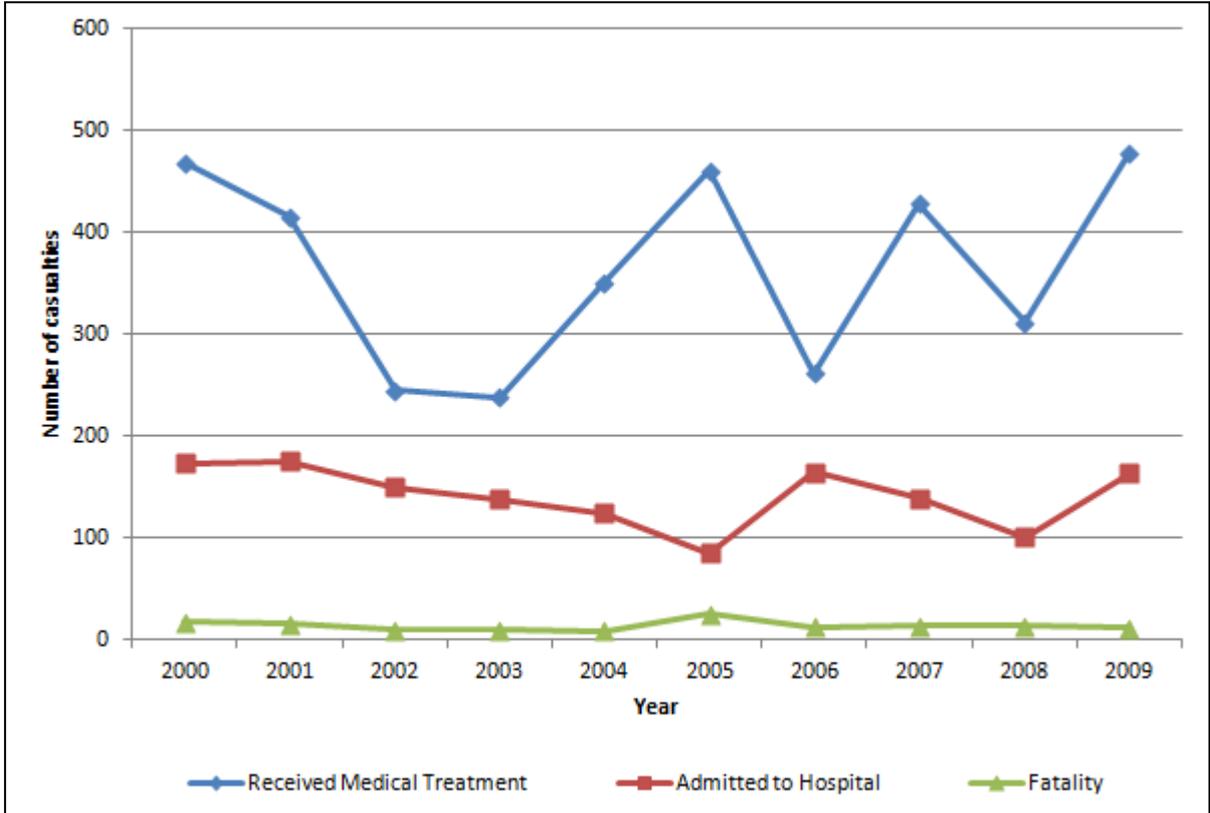
### Transport and human health impacts

#### Transport accidents

Road traffic crashes have a direct impact on people's health and often cause injuries and fatalities. Between 2000 and 2009 there were a total of 5220 casualties from motor vehicle accidents: 70% of the people required medical treatment, 27% required admission to hospital and 3% died (Figure 5).

# ACT State of the Environment Report 2011

Figure 5. Trends in traffic accident casualties, 2000-2009

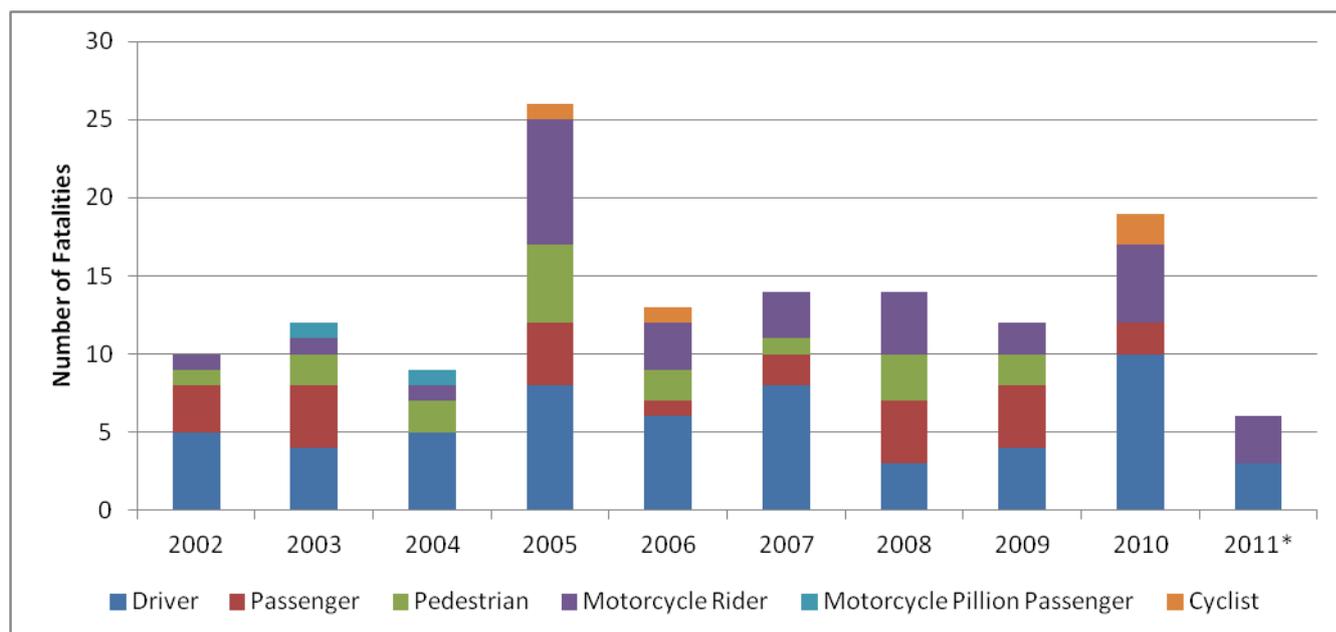


Source: TAMS 2010

The number of accidents involving fatalities has generally remained constant over this period, although the number of people requiring medical treatment has fluctuated considerably. As a small jurisdiction, ACT has crash statistics (particularly fatalities) that can be expected to vary from year to year. These fluctuations may also result from difficulties with reporting crashes involving injury, and from the recent introduction of new reporting systems.

# ACT State of the Environment Report 2011

Figure 6. Trends in traffic accident fatalities, 2002-2011



Source: BITRE 2011

\* Data for 1 January to 30 June 2011

In 2007, transport accidents and injuries comprised 7% of all leading underlying causes of mortality for ACT residents (ACT Health 2010). From 1999-00 to 2007-08, there were 1308 admissions to hospital involving injury from bicycle accidents. Of these, nearly 80% involved males, with the most common age group being 10 to 19 years (ACT Health 2010). Between 2007 and 2011, 28 drivers, 12 passengers, 6 pedestrians, 17 motorcycle riders and 2 cyclists received fatal injuries in the ACT (Figure 6). The mode of travel involved in these fatalities, as well as the number of fatalities, varied significantly from year to year. However, motorcycle riders consistently represented a disproportionate share of fatalities; 26.2% while only accounting for 1.38% of total vehicle kilometres (ABS 2011a, BITRE 2011).

## Physical inactivity

The health impacts of physical inactivity are discussed under the *Urban quality* indicator and include obesity, cardiovascular disease, diabetes and possibly some cancers (AIHW 2011). Walking and cycling are the healthiest modes of travel, and walking to and from public transport or car parks is also a form of incidental exercise. In one study (Infrastructure Australia 2010) it was found that, on average, Brisbane commuters walk an extra 2 km per day to and from public transport. A study from Victoria found that public transport users walk five times more than car drivers, who on average walk for only 8 minutes per day (VDoT 2009).

## Air pollution

Common pollutants from car and truck transport include nitrogen dioxide (NO<sub>2</sub>), carbon monoxide (CO), sulphur dioxide (SO<sub>2</sub>), ozone (O<sub>3</sub>) and particulate matter (PM); these have substantial health effects, especially chronic and acute respiratory and cardiovascular disorders (AIHW 2011).

Long-term exposure to elevated concentrations of particulate matter has been found to increase mortality, and SO<sub>2</sub>, which is a by-product of diesel fuel, is also associated with

# ACT State of the Environment Report 2011

increased mortality (AIHW 2011). Reducing air pollution may improve life expectancy and quality of life. For more information on the impacts of air pollution, see the *Local air quality* indicator cluster paper.

## Greenhouse gas emissions and energy efficiency

Road transport is a significant source of greenhouse gas emissions, and passenger vehicles account for the largest proportion of these emissions. The prevalence of car use and the relative lack of heavy industry in the ACT mean that around 22% of the total greenhouse gas emissions in the ACT are transport related (ICRC 2011) - a significantly higher proportion than in other states and territories. Greenhouse gas emissions are closely associated with energy used, except where energy is produced from low-emissions sources such as hydroelectricity (in Tasmania, for example).

As discussed in the *2007-08 State of the Environment Report*, local data regarding transport energy efficiency are poor, and therefore national and international information has been used to assess the efficiency of different transport modes in the ACT. The most efficient forms of transport are walking and cycling, which for practical purposes can be regarded as emissions-free. Public transport, such as buses, is usually more efficient than the passenger car (ABS 2010, ACT Government 2010b), but the efficiency depends on how many people are in each vehicle; one passenger travelling by bus will be associated with more emissions than the same passenger travelling by car. Bus occupancies need to rise beyond 4 before public transport is more efficient (calculated from IPCC estimates, using a car-occupancy rate of 1.5). ACTION bus average occupancy rates were calculated at 7.4 passengers per bus in 2007-08, the second-lowest figure nationally after Perth (6.9). The highest rate (15.8 passengers per bus) was in Brisbane, followed by Sydney (13.9) (BITRE 2009:Tables 2, 3). If 'dead running' is included - because empty buses still produce emissions - ACTION bus occupancy rate is only 5.6 passengers, not far above the critical threshold of 4 passengers.

Over the last 50 years the average fuel economy of the Australian passenger car fleet has remained roughly constant; the average car used 11.3 L of fuel to travel 100 km in 2010, compared with 11.4 L at the time of the first survey in 1963 (ABS 2011c; Mees 2010:43). Engines have become more efficient but vehicles have not, because engine improvements have been offset by larger vehicle sizes (especially four-wheel-drives) and the addition of accessories such as air conditioning. While bus occupancies have been roughly stable for at least a decade, car occupancy rates continue to fall: the fastest-declining mode of travel on journeys to work in Canberra is as a passenger in a car (Mees, Stone and Sorupia 2007).

For more information on transport and greenhouse gas emissions, see the *Emissions and Mitigation* indicator cluster papers, in the *Climate* theme.

## Response indicators

The *2007-08 ACT State of the Environment Report* recommended that the Office of the Commissioner for Sustainability and the Environment should annually assess progress made in implementing the *Sustainable Transport Plan* (ACT Government 2004). In response, the ACT Government agreed to provide information on progress so that such an assessment could be made (OCSE 2009). This *Transport* indicator cluster paper provides the most comprehensive assessment of sustainable transport in the ACT since that agreement.

# ACT State of the Environment Report 2011

The ACT Government’s actions in response to the environmental impacts of the transport system have two prongs: reducing emissions from individual vehicles through technological change, and shifting travel-to-work from the private car to less polluting modes.

## Reducing emissions from individual vehicles

From 1 July 2010, new cars in Australia were required to comply with Euro 4 emission standards that lowered the maximum outputs allowed per car as carbon monoxide, hydrocarbons, oxides of nitrogen, and particulates. Euro 4 standards came into force for light diesel vehicles in 2007 and for heavy diesel vehicles in 2008. Australia is lagging behind the European Union, where tougher Euro 5 standards have been in place since 1 January 2011, but the adoption of the Euro 4 standard should gradually reduce local air pollution as the national car fleet is renewed, even if traffic volumes continue to increase.

The ACT Government has introduced Australia’s first stamp duty discount scheme for fuel-efficient vehicles. The Green Vehicles Duty Scheme (Australian Government 2010) charges differential duty rates on new cars depending on the environmental performance of the vehicle. There are four categories, ranging from D (below-average performance, e.g. four-wheel-drives) to A (environmental leading-edge, e.g. the Toyota Prius), and vehicles in category A pay no duty. Over the first two years of the scheme’s operation, the percentage of registrations in category A roughly doubled, from 2% to 4% of the total, creating a small overall improvement in the ACT vehicle fleet’s performance. It is unclear if this improvement was a result of the scheme, or whether other factors (e.g. petrol prices, or environmental awareness) were more significant. The scheme is being reviewed by the ACT Government in late 2011.

## Travelling by more sustainable modes: transport policies

The *ACT Sustainable Transport Plan*, released in 2004, sets out long-term strategic policy targets for improving the share of work trips made by sustainable modes of travel in the ACT (Table 5). Although these targets are a step in the right direction, it should be noted that the 2001 baseline used in the *Sustainable Transport Plan* was the lowest recorded since the census began, with the 2011 public transport target still lower than the 9.9% achieved in 1991 (ACTPLA 2009a:15).

Table 5. *Sustainable Transport Plan* targets: percentage of work trips by walking, cycling and public transport

Mode	2001	2011	2026
	%	%	%
Walking	4.1	6.0	7.0
Cycling	2.3	5.0	7.0
Public transport	6.7	9.0	16.0
Total	13.1	20.0	30.0

Source: ACT Government 2004

While these are targets against which to measure travel to work, they do not relate to the sustainability of the ACT’s transport sector as a whole. It is possible for motor vehicle travel, and therefore greenhouse gas emissions and other emissions, to increase even if some work

# ACT State of the Environment Report 2011

trips are shifted to sustainable modes. Targets and data inclusive of non-work trips would provide greater understanding of travel patterns, as well as direction for reductions in total transport sector emissions.

The *2007-08 State of the Environment Report* recommended that the ACT Government amend the *Sustainable Transport Plan* to include greenhouse gas emissions, energy efficiency and/or carbon neutrality targets for the transport sector. Although the ACT Government agreed to this recommendation (OCSE 2009), there is no available evidence that it has been addressed within this reporting period. Outcome 6 of the *Draft Sustainable Energy Policy 2010-2020*, which was released in 2009, suggests that the travel-to-work targets will continue to provide the basis of the sector's emissions reductions, and no whole-of-sector emissions reduction targets are set out.

If, by 2020, the ACT is on track to meet a target of 30% of work journeys by modes other than car by 2026, it is calculated that the transport sector will (by 2020) have achieved a 10% reduction in emissions from business-as-usual levels (DECCEW 2009). However, in relation to 1990 levels, this would still represent an increase in transport-sector emissions of either 50% or 58%, depending on the incorporation of autonomous energy efficiency improvements into business-as-usual calculations<sup>5</sup> (Heuris Partners 2010, ICRC 2011). This presents a key challenge if the legislated greenhouse gas emissions reduction targets of 40% by 2020, based on 1990 levels, are to be achieved without disproportionate reductions in other emission areas (for more information see the *Mitigation* indicator cluster, in the *Climate* theme).

In order to implement the Sustainable Transport Plan targets, the ACT Government intended to release a *Sustainable Transport Action Plan for 2010-2016* in 2009. A draft of the plan was re-titled *Transport for Canberra: 2011-2031*; however, as of the end of this reporting period (30 June 2011) it is yet to be released for public comment. In the interim a number of individual initiatives have been undertaken, including construction of bus and transit lanes, installation of bike rails at bus stops, launch of the MyWay rechargeable ticketing system, and expanded park'n'ride facilities.

Although these initiatives are a step in the right direction, the total investment in sustainable transport options, particularly cycling and walking, is modest when compared to investment in car-based infrastructure. As of 30 June 2011, combined bicycle and walking paths comprised \$48.8 million of the Territory and Municipal Services (TAMS) Directorate's \$6.1 billion in infrastructure assets, while roads and bridges made up over \$3 billion (TAMS 2011:61). In contrast the city of Copenhagen, which has a population of 500,000 and a significantly smaller built area, has over \$792 million of existing cyclepath infrastructure assets, with an ongoing annual investment of \$9 million (Infrastructure Australia 2009). Between 2001 and 2011, over \$700 million has been invested in roads, parking and freight, with \$300 million invested in public transport, and only \$80 million in active travel options and infrastructure (ESDD 2011). As stated in a recent Infrastructure Australia report, those countries that have successfully increased cycling rates have: specific measureable policies; cross-integration of relevant

---

<sup>5</sup> Calculations based on ICRC transport emissions data from the 2009 Greenhouse Gas Emissions Inventory (ICRC 2011) and ACT Government-commissioned research into existing policy baseline projections to 2050 (Heuris Partners 2010).

# ACT State of the Environment Report 2011

government agencies; and have made major investments into cycling-related infrastructure and education (Infrastructure Australia 2009:2).

The TAMS Directorate exceeded its targets for construction of new on-road cycle paths and community paths (including off-road cycle paths) in 2008-09 (TAMS 2009). In 2009-10 and 2010-11, construction of on-road cycle paths fell short of the 50 km per year target by approximately 50%. However, construction of community paths again exceeded annual targets with 40 km and 54 km built in 2009-10 and 2010-11, compared to targets of 20 km and 35 km (TAMS 2010, 2011). Targets for constructing bus-priority lanes remained at a modest 1 km per year during the last three years of the reporting period. That target was met; however the length of transit lanes continues to represent less than 1% of the total road length in Canberra. If the ACT is to create a genuinely sustainable transport system, investment in, and construction of infrastructure for more sustainable travel options must be seriously reconsidered.

A *Strategic Public Transport Network Plan* (ACT Government 2011b) was released during the reporting period, but many of its components (for example, development of a City West Interchange and a Frequent Service Network for higher-density areas), have not yet been implemented, and the network is not intended to be completed until 2031. It therefore remains to be seen whether shifting to a two-tier network in which denser areas receive frequent bus services (every 15 minutes or better), while most of Canberra receives hourly bus services, will lead to a return to higher public transport commuter levels. Notably, the high usage of buses in 1991 was achieved with services every 15 minutes in peak periods and 30 minutes in off-peak periods to nearly all built up areas, not just those with high residential densities.

The *2007-08 State of the Environment Report* recommended development of an ACT Walking Plan to ensure that walking as a mode of transport was encouraged wherever possible. One response has been that in 2010 the ACT signed up to the International Charter for Walking. More significantly, in 2009 a *Cycling and Walking Feasibility Study* was completed for the ACT Government, identifying priority actions that should help Canberra people achieve the ACT's 2011 and 2026 cycling and walking targets (SKM 2009). These included:

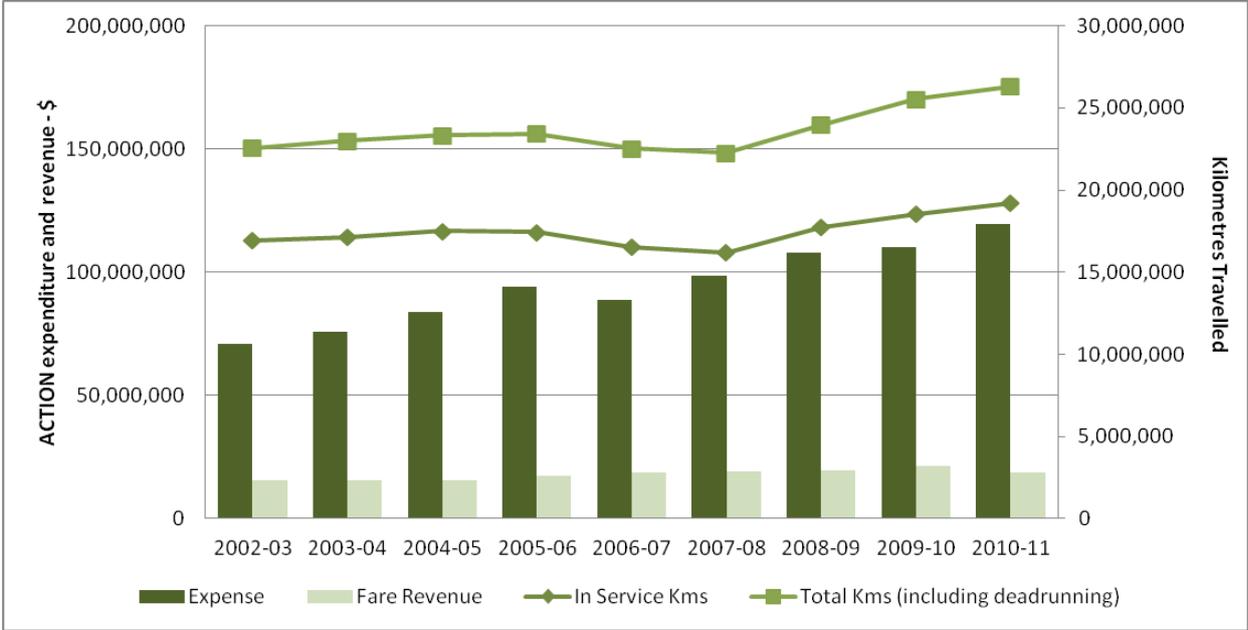
- cycling training and education programs;
- standardisation, mapping and linking of cycling and walking infrastructure;
- connectivity with public transport for multi-modal travel;
- provision of cyclist facilities (such as showers and secure lockers) at all employment centres;
- marketing programs; and
- improved data collection and policy coordination.

It is recommended that all of these components be incorporated into the upcoming *Transport for Canberra* plan.

# ACT State of the Environment Report 2011

Although non-government research indicates that more people may be cycling, the apparent reduction in public transport patronage, coupled with the increased distances now being travelled by car, are particularly problematic if the *Sustainable Transport Plan* travel-to-work targets are to be achieved. These observations suggest that the transport policies operating to date may not be sufficient to reduce car-based travel overall, for work and non-work trips.

Figure 7. ACTION expenditure and kilometres travelled, 2002-03 to 2010-11



Source: TAMS

Over the last three reporting periods, revenue raised from public transport has remained static whereas expenditure relative to revenue raised has increased significantly. In 2010-11, revenue raised from bus fares was only \$18.5 million, relative to total expenses of almost \$120 million (Figure 7). Although the increased in-service kilometres travelled is a positive sign, the amount of ‘dead running’ (out-of-service travel) has increased disproportionately, to over 27% of the total distance travelled in 2010-11 (TAMS 2011a).

An assessment of the new ACTION network (introduced at the end of the last reporting period) was to have been made in this report, but problems with bus ticketing machines, changes to eligibility for fares for concession, student and free travel, and the transfer to the new MyWay ticketing system have meant that accurate detailed data are not available for the current reporting period. For the next reporting period, a more comprehensive assessment of the new network should be possible using MyWay data and data from the 2011 census. It should then be possible to assess whether the network has allowed the ACT to meet its travel-to-work public transport targets.

## Travelling by more sustainable modes: land-use and transport planning

Land use and transport policies are major influences on the forms and patterns of use of transport within any given area. Planning and transport policies are not always aligned, which can lead to contradictory outcomes. For example, the *Central City Area Action Plan* (ACT Government 2010a) combines conflicting goals, namely to: reduce car reliance; provide 17,000 publicly accessible parking spaces (currently 12,000); and complete road network

# ACT State of the Environment Report 2011

improvements. The most recent ACT Government *Infrastructure Plan* continue to promote car travel over other transport options, allocating \$144.5 million between 2011-12 and 2014-15 for major road projects and only \$4 million for major public transport improvements, of which most is allocated to feasibility and design work (ACT Government 2011a:82).

The central land-use planning target for the ACT under the current *Canberra Spatial Plan* is promotion of a more compact city, with residential intensification occurring within 7.5 km of the city centre, and other development restricted to a 15 km radius. Higher populations in areas close to the CBD and town centres have led to significantly more people walking, but there is no evidence of similar effects from increased housing density in other less central locations, such as Gungahlin. Additionally, data on the influence of population or housing densities on usage of public transport in cities indicate that density is not necessarily the most significant factor (Currie 2008; ACT Government 2010c). Brisbane, as noted above, has Australia's highest bus occupancy rates; its loadings are more than double those in Canberra, and full-fare-paying patronage per bus is around four times the level in Canberra. Yet Brisbane has the lowest gross population density in Australia; the figure being around 15% below that of Canberra (see the *Urban quality* indicator for more information).

The *Canberra Spatial Plan* also encourages growth in Civic and the town centres, and along a series of north-south and east-west transport corridors. These corridors include many locations for which the car is currently the most common choice of transport, such as Hume (the most car-intensive destination in Figure 2, with an effective share of zero workers using sustainable transport) and Canberra airport. The growth of employment and retailing in airport-related business parks is also of particular concern, because people are more likely to travel there by car than if these parks were in town centres or Civic. If sustainable transport policy is to be effective, land-use planning must encourage employment and other major Canberra destinations to be located in Civic and the town centres, and continue to encourage diverse housing options, including higher-density housing, to be developed within walking distance of these centres (ACTPLA 2009:18-21). This approach should be included in the new *ACT Planning Strategy*, which is currently under development.

In 2010-11, the ACT Government began integrated studies into transport and land use in the Erindale-Tuggeranong corridor. The outcome of those studies is likely to assist in better understanding of opportunities to integrate transport and land-use. New housing developments planned for Molonglo, in the west-central area of Canberra, and East Lake on Lake Burley Griffin, are also being designed with sustainable transport as a focus from the outset of the planning process. For example, the main local and group centres in the Molonglo Valley will be located adjacent to the major transit corridor of the development, to create easy access for residents. Park'n'ride, bike'n'ride, and cycle and pedestrian infrastructure are also being planned early in the development process, to make sustainable travel choices the easy option for these new residential areas.

Land-use policies that support people to use public transport will work more effectively if backed by parking policies that discourage use of private cars. The *2007-08 State of the Environment Report* noted that a *Draft ACT Parking Strategy* had been released in March 2007, and recommended that it be finalised and implemented. The strategy aimed to discourage parking on both ACT Government land and in the Parliamentary Triangle (in partnership with the Australian Government). The ACT Government agreed to this recommendation, however to date no ACT Parking Strategy has been released. The ACT

# ACT State of the Environment Report 2011

Government has increased parking charges in Civic and in some town centres, but substantial free parking is provided in private business parks, for short-stay in town centres and by the Australian Government. An important aspect in achieving more sustainable transport outcomes in the ACT will be a commitment to greater cooperation by the Australian Government.

## References

- ABS 2007. *Census of Population and Housing Fact Sheets. Cat.No. 2914.0 – 2006*. Australian Bureau of Statistics. Australian Government. Canberra.  
<http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/2914.02006?OpenDocument>  
(accessed 15/6/11)
- ABS 2008a. *Australian Social Trends, 2008. Cat.No. 4102.0* Australian Bureau of Statistics. Australian Government. Canberra.  
<http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Chapter10102008> (accessed 20/9/11)
- ABS 2008b. *Canberra: A Social Atlas, 2006 Census of Population and Housing. Cat.No. 2030.8*. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&20308\\_2006.pdf&2030.8&Publication&F084CC2518A2F7C3CA25740E0079DE65&&2006&17.03.2008&Latest](http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&20308_2006.pdf&2030.8&Publication&F084CC2518A2F7C3CA25740E0079DE65&&2006&17.03.2008&Latest) (accessed 11/7/11)
- ABS 2009. *Environmental Issues: Waste Management and Transport Use, Mar 2009. Cat.No. 4602.0.55.002*. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.abs.gov.au/ausstats/subscriber.nsf/log?openagent&4602055002\\_Mar%202009.pdf&4602.0.55.002&Publication&3E3CECBAC078860CA257673001C024B&&Mar%202009&09.12.2009&Latest](http://www.abs.gov.au/ausstats/subscriber.nsf/log?openagent&4602055002_Mar%202009.pdf&4602.0.55.002&Publication&3E3CECBAC078860CA257673001C024B&&Mar%202009&09.12.2009&Latest) (accessed 21/9/11)
- ABS 2010. *Australia's Environment Issues and Trends. Special issue: Climate Change. Cat.No. 4613.0*. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/41D729B432E03FA0CA2576B800164E89/\\$File/46130\\_2010.pdf](http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/41D729B432E03FA0CA2576B800164E89/$File/46130_2010.pdf) (accessed 15/8/11)
- ABS 2011a. *Motor Vehicle Census, Australia, 31 Mar 2010. Cat.No. 9309.0*. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&93090\\_31%20Mar%202010.pdf&9309.0&Publication&03CFF66BA0471A68CA257829001168D6&&31%20Mar%202010&23.03.2011&Latest](http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&93090_31%20Mar%202010.pdf&9309.0&Publication&03CFF66BA0471A68CA257829001168D6&&31%20Mar%202010&23.03.2011&Latest) (accessed 17/11/11)
- ABS 2011b. *Regional Population Growth, Australia, 2009-10. Cat.No. 3218.0*. Australian Bureau of Statistics. Australian Government. Canberra.  
<http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3218.02009-10?OpenDocument>  
(accessed 21/11/11)
- ABS 2011c. *Survey of Motor Vehicle Use, Australia, 12 months ended 31 October 2010. Cat.No. 9208.0*. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&92080\\_12%20months%20ended%2031%20october%202010.pdf&9208.0&Publication&4576F71CCF2E9F65CA2578F4001E](http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&92080_12%20months%20ended%2031%20october%202010.pdf&9208.0&Publication&4576F71CCF2E9F65CA2578F4001E)

# ACT State of the Environment Report 2011

5E98&&12%20months%20ended%2031%20October%202010&23.08.2011&Latest (accessed 21/11/11)

ACT Government 2004. *Sustainable Transport Plan*. Canberra.

[http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0010/167941/Sustainable\\_Transplan\\_Plan.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0010/167941/Sustainable_Transplan_Plan.pdf) (accessed 18/11/11)

ACT Government 2010. *Making Walking Count – Canberra*. SKM. Canberra.

<http://www.transport.act.gov.au/references-docs/Making%20Walking%20Count.pdf> (accessed 3/11/11)

ACT Government 2010a. *Canberra City Area Action Plan 2010-2016*. Canberra.

[http://www.laps.act.gov.au/\\_\\_data/assets/pdf\\_file/0011/161867/Canberra\\_City\\_Area\\_Action\\_Plan\\_2010-2016.pdf](http://www.laps.act.gov.au/__data/assets/pdf_file/0011/161867/Canberra_City_Area_Action_Plan_2010-2016.pdf) (accessed 2/11/11)

ACT Government 2010b. *Time to Talk: Canberra 2030 – Getting Around*. Canberra.

<http://timetotalk.act.gov.au/files/download/?id=158> (accessed 5/7/11)

ACT Government 2010c. *Time to Talk: Outcomes report*. Canberra.

<http://timetotalk.act.gov.au/files/download/?id=147> (accessed 23/9/11)

ACT Government 2011a. *Infrastructure Plan 2011-2021*. Canberra.

[http://www.cmd.act.gov.au/\\_\\_data/assets/pdf\\_file/0013/220306/infrastructureplan2011.pdf](http://www.cmd.act.gov.au/__data/assets/pdf_file/0013/220306/infrastructureplan2011.pdf) (accessed 23/8/11)

ACT Government 2011b. *Public Transport Planning: Strategic Public Transport Network Plan*. Canberra.

[http://www.transport.act.gov.au/public\\_transport\\_planning.html](http://www.transport.act.gov.au/public_transport_planning.html) (accessed 23/10/11)

ACT Health 2010. *Chief Health Officer's Report*. ACT Government. Canberra.

<http://www.health.act.gov.au/c/health?a=sendfile&ft=p&fid=1285049820&sid=> (accessed 18/11/11)

ACTION 1992. *Annual Report 1991-92*. ACT Internal Omnibus Network. ACT Government. Canberra.

ACTPLA 2007. *The Canberra Spatial Plan – 1C New Structure*. ACT Planning and Land Authority. Act Government. Canberra.

[http://apps.actpla.act.gov.au/spatialplan/1\\_future/1C\\_new\\_structure/index.htm](http://apps.actpla.act.gov.au/spatialplan/1_future/1C_new_structure/index.htm) (accessed 1/5/11)

ACTPLA 2009a. *Employment Location in Canberra*. ACT Planning and Land Authority. Canberra.

[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0004/14269/Employment\\_distribution.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0004/14269/Employment_distribution.pdf) (accessed 18/11/11)

ACTPLA 2009b. *Retailing in Canberra*. ACT Planning and Land Authority. Canberra.

[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/15838/Retailing\\_in\\_Canberra.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0007/15838/Retailing_in_Canberra.pdf) (accessed 21/10/11)

ACTPLA 2009c. *Supermarket Retailing in the ACT*. ACT Planning and Land Authority. Canberra.

[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/15837/Retailing\\_in\\_the\\_ACT.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0006/15837/Retailing_in_the_ACT.pdf) (accessed 9/11/11)

# ACT State of the Environment Report 2011

- AG 2010. *Delivery of ACTION Bus Services*. ACT Auditor General's Office. Canberra.  
<http://www.audit.act.gov.au/auditreports/reports2010/Final%20ACTION%20report%20for%20website%2026%20Aug.pdf> (accessed 15/9/11)
- AIHW 2011. *Health and the Environment: a Compilation of Evidence*. Australian Institute of Health and Welfare. Australian Government. Canberra. <http://www.aihw.gov.au/publication-detail/?id=10737418534> (accessed 24/11/11)
- Australia Institute 2008. *Aviation and Greenhouse Gas Emissions in the ACT*. Research Paper 50. Canberra. [https://www.tai.org.au/file.php?file=web\\_papers/WP109.pdf](https://www.tai.org.au/file.php?file=web_papers/WP109.pdf) (accessed 6/8/11)
- Australian Government 2010. *Green Vehicle Guide*. Canberra.  
<http://www.greenvehicleguide.gov.au/GVGPublicUI/Home.aspx> (accessed 26/5/11)
- BITRE 2009. *Urban Public Transport: Recent Bus Statistics, Information Sheet 33*. Bureau of Infrastructure, Transport and Regional Economics. Australian Government. Canberra.  
[http://www.bitre.gov.au/publications/45/Files/BITRE\\_IS33.pdf](http://www.bitre.gov.au/publications/45/Files/BITRE_IS33.pdf) (accessed 16/8/11)
- BITRE 2011. *Fatal Road Crash Database*. Bureau of Infrastructure, Transport and Regional Economics. Australian Government. Canberra.  
[http://www.infrastructure.gov.au/roads/safety/road\\_fatality\\_statistics/fatal\\_road\\_crash\\_data\\_base.aspx](http://www.infrastructure.gov.au/roads/safety/road_fatality_statistics/fatal_road_crash_data_base.aspx) (accessed 21/11/11)
- BTRE 2007. *Estimating Urban Traffic and Congestion Cost Trends for Australian Cities, Working Paper 71*. Bureau of Transport and Regional Economics. Australian Government. Canberra.  
<http://www.btre.gov.au/publications/56/Files/wp71.pdf> (accessed 8/7/11)
- Currie, G. 2008. *Sustainable Transport and Canberra – Challenges and Opportunities*. Supplementary paper for the ACTPLA Transport Workshop, 24 September. Canberra.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0015/10383/Graham\\_Currie\\_paper.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0015/10383/Graham_Currie_paper.pdf) (accessed 21/6/11)
- DECCEW 2009. *Draft Sustainable Energy Policy 2010-2020*. Department of the Environment, Climate Change, Energy and Water. ACT Government. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/174687/Draft\\_Sustainable\\_Energy\\_Policy\\_FINAL.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0006/174687/Draft_Sustainable_Energy_Policy_FINAL.pdf) (accessed 7/7/11)
- ESDD 2011. *Transport for Canberra 2011-2031- Draft for Public Comment*. Environment and Sustainable Development Directorate. ACT Government. Canberra.  
<http://www.timetotalk.act.gov.au/storage/Transport%20Policy%2014%20October%20Full.pdf> (accessed 10/11/11)
- Heuris Partners 2010. *ACT Greenhouse Gas Emissions: Existing policy baseline projections to 2050 – Research Report*. Canberra.  
[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0008/187217/ACT\\_Greenhouse\\_Gas\\_Emissions.pdf#ACT%20Greenhouse%20Gas%20Emissions](http://www.environment.act.gov.au/__data/assets/pdf_file/0008/187217/ACT_Greenhouse_Gas_Emissions.pdf#ACT%20Greenhouse%20Gas%20Emissions) (accessed 17/10/11)
- ICRC 2011. *ACT Greenhouse Gas Inventory Report for 2008-09*. Independent Competition and Regulatory Commission. Canberra.  
[http://www.icrc.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/235719/ACT\\_Greenhouse\\_Gas\\_Inventory\\_Report\\_2009\\_Final.pdf](http://www.icrc.act.gov.au/__data/assets/pdf_file/0009/235719/ACT_Greenhouse_Gas_Inventory_Report_2009_Final.pdf) (accessed 11/10/11)

# ACT State of the Environment Report 2011

- Infrastructure Australia 2009. *Cycling Infrastructure for Australian Cities*. Major Cities Unit. Australian Government. Canberra.  
[http://www.infrastructureaustralia.gov.au/publications/files/Cycling\\_Infrastructure\\_Background\\_Paper\\_16Mar09\\_WEB.pdf](http://www.infrastructureaustralia.gov.au/publications/files/Cycling_Infrastructure_Background_Paper_16Mar09_WEB.pdf) (accessed 17/11/11)
- Infrastructure Australia 2010. *State of Australian Cities 2010*. Major Cities Unit. Australian Government. Canberra.  
[http://www.infrastructureaustralia.gov.au/publications/files/MCU\\_SOAC.pdf](http://www.infrastructureaustralia.gov.au/publications/files/MCU_SOAC.pdf) (accessed 18/4/11)
- Mees, P. 2010. *Transport for Suburbia: Beyond the Automobile Age*. Earthscan. London
- Mees, P., Sorupia, E. & Stone, J. 2007. *Travel to Work in Australian Capital Cities. 1976-2006: An Analysis of Census Data*. Australasian Centre for the Governance and Management of Urban Transport (GAMUT). <http://www.abp.unimelb.edu.au/gamut/pdf/travel-to-work.pdf> (accessed 18/6/11)
- Newman, P. and Kenworthy, J. 1999. *Sustainability and Cities*. Island Press. Washington DC
- OCSE 2009. *Annual Report 2008-09*. ACT Office of the Commissioner for Sustainability and the Environment. Canberra.  
[http://www.environmentcommissioner.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/169290/OCSE\\_Annual\\_Report\\_2008-09\\_web.pdf](http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0009/169290/OCSE_Annual_Report_2008-09_web.pdf) (accessed 18/9/11)
- Pedal Power ACT 2011. *Cycling Cordon Count: Civic and Acton, 2011 Update*. Canberra.  
<http://www.pedalpower.org.au/documents/cordon%20count%20report%202011.pdf> (accessed 16/11/11)
- SKM 2009. *Cycling and Walking Strategy Feasibility Study*. Sinclair Knight Merz. Canberra.  
<http://www.transport.act.gov.au/references-docs/SKM,%202009,%20ACT%20Government%20Cycling%20and%20Walking%20Stategy%20Feasibility%20Study.pdf> (accessed 3/6/11)
- Stone, J. and Mees, P. 2011. *Spatial Distribution of the Journey to Work by Sustainable Modes in Australian Cities*. 34<sup>th</sup> Australasian Transport Research Forum. Adelaide.  
[http://www.atrf11.unisa.edu.au/Assets/Papers/ATRF11\\_0042\\_final.pdf](http://www.atrf11.unisa.edu.au/Assets/Papers/ATRF11_0042_final.pdf) (accessed 21/11/11)
- TAMS 2007. *Draft ACT Parking Strategy*. Territory and Municipal Services. ACT Government. Canberra.
- TAMS 2010. *2009 Road Traffic Crashes in the ACT, Traffic Management and Safety*. Territory and Municipal Services. ACT Government. Canberra.  
[http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0014/190031/ACT\\_CRASH\\_Report\\_2009.pdf#ACT%20Crash%20Statistics%202009](http://www.tams.act.gov.au/__data/assets/pdf_file/0014/190031/ACT_CRASH_Report_2009.pdf#ACT%20Crash%20Statistics%202009) (accessed 14/10/11)
- TAMS 2011. *Annual Report 2010-2011 Volume 2*. Territory and Municipal Services. ACT Government. Canberra. [http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0017/233180/Volume\\_2\\_10-11.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0017/233180/Volume_2_10-11.pdf) (accessed 21/10/11)
- Urban Services 2000. *ACT Parking and Vehicular Access Guidelines*. Department of Urban Services. ACT Government. Canberra. <http://www.legislation.act.gov.au/ni/2002-246/20020404-2972/pdf/2002-246.pdf> (accessed 8/8/11)

# ACT State of the Environment Report 2011

VDoT 2009. *Victorian Integrated Survey of Travel and Activity*. Department of Transport. Victorian Government. Melbourne

## Other data sources

In addition to these published reports, data for this paper was also sourced from:

ACT Department of the Environment, Climate Change, Energy and Water (DECCEW) - now Environment, Sustainability and Development Directorate (ESDD)

ACT Department of Territory and Municipal Services (TAMS) - now Territory and Municipal Services Directorate (TAMSD)

Australian Bureau of Statistics (ABS)

Australian Year Book

Department of Infrastructure and Transport

European Commission, Enterprise and Industry

Statistics Canada

# ACT State of the Environment Report 2011

## Annex

Table A1. Proportions of various modes of travel used to access major employment centres, ACT 2006

Centre	Car (%)	Bus (%)	Walk (%)	Bicycle (%)
City	71.0	18.3	6.0	3.1
Woden Town Centre (core)	77.0	13.5	6.2	1.9
Belconnen TC (core)	79.2	10.9	6.1	2.6
Tuggeranong TC (core)	85.1	8.9	2.5	2.3
Gungahlin (suburb)	87.7	6.6	3.8	1.5
Parkes	85.0	7.6	2.4	3.9
Russell	88.1	4.7	2.4	2.4
West Deakin	86.6	3.9	1.6	1.3
Fyshwick	95.5	2.2	0.5	0.4
Mitchell	93.9	2.7	0.4	1.2
Hume	98.6	0.0	0.0	0.2
Majura	90.7	3.7	1.7	1.6
Bruce	88.5	4.0	3.1	2.9

Source: ACTPLA 2009a

# ACT State of the Environment Report 2011

## THEME: People

### Indicator cluster: Waste

The indicators for this cluster are:

- *Waste (P)* - waste totals and trends by sector;
- *Movement of controlled waste (P)* - includes packaging;
- *Waste and human health (I)* - includes any pollution incidents; and
- *Waste management (R)* - effectiveness of implementation of waste policy by ACT Government and includes volume of recycling and treatment of controlled and hazardous waste (including regulations).

### Summary

In 1996, the ACT Government set a goal of achieving a waste-free society through the adoption of the *No Waste by 2010* Waste Management Strategy. Despite the gains achieved through this strategy, the total amount of waste processed in the ACT increased by 276,945 tonnes (34.7%) during the reporting period. Over this period, the amount of waste to landfill increased by 29.1% and the amount of resource recovery increased by 36.7%. Increases in construction and demolition wastes as well as commercial and industrial wastes (in particular additional deliveries of contaminated soil from the West Molonglo pond cleanup and elsewhere) have largely been the sources of the increase in waste to landfill.

While there has been progress in waste management programs for business, public place recycling and e-waste (electronic equipment), these remain important areas for future focus. Also, there has been little action towards diverting organic materials from landfill. Previous State of the Environment reports identified these as areas for future focus of waste reduction efforts.

The ACT is currently considering the *Draft Sustainable Waste Strategy 2010-2025*, successor to the *No Waste by 2010* Waste Management Strategy. It is expected that the draft strategy may be approved by the end of 2011.

### Introduction

The amount of urban waste generated and disposed of is an indication of the pressure that cities and consumption impose on the environment. Wastes potentially contaminate soils and groundwater and the land at their disposal sites.

The waste streams described in this report are from:

**Condition indicators (C)** present data that tell us the state of the environment at any particular time.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

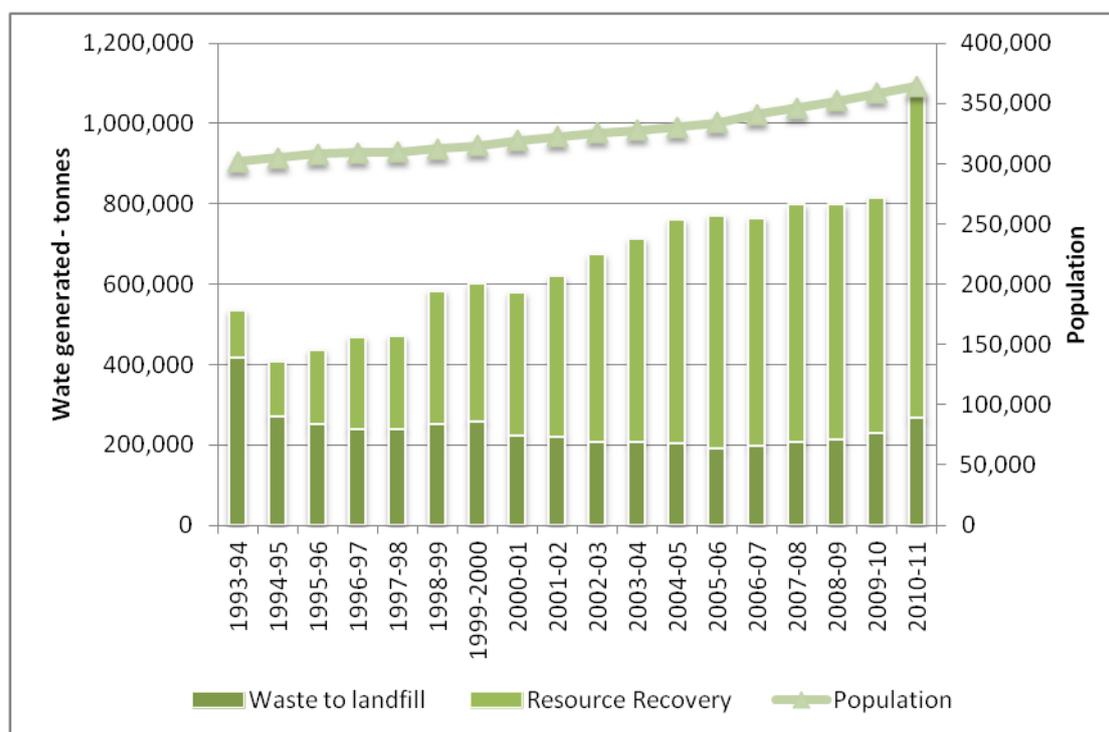
# ACT State of the Environment Report 2011

- construction and demolition;
- households;
- commercial and industrial sources;
- gardens and landcare; and
- controlled waste.

## Condition indicators

There are no condition indicators for this indicator cluster. Long-term trends demonstrate that the amount of waste being generated in the ACT continues to increase and at a faster rate than population growth (Figure 1; and Table A1 in the Annex to this paper).

Figure 1. Total ACT population and total waste generated, 1993-94 to 2010-11

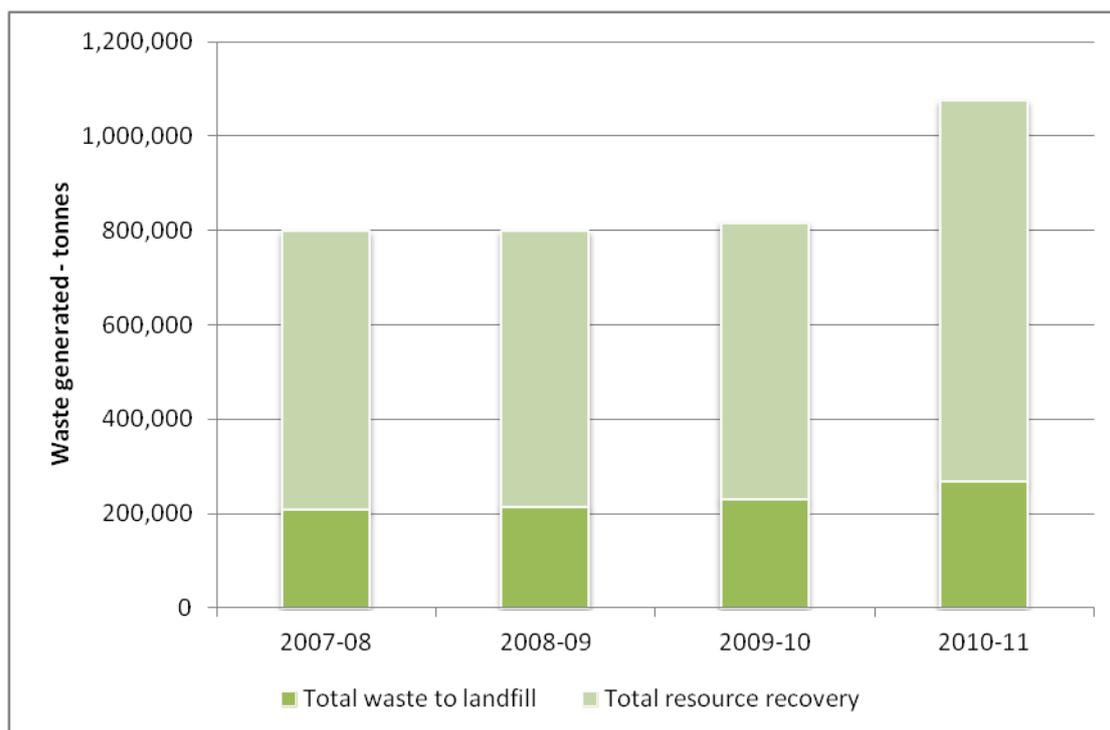


Source: TAMS 2011b

During the reporting period, the total amount of waste generated in the ACT (Figure 2) increased by 276,945 tonnes (34.7%). Both waste to landfill and resource recovery increased between 2009-10 and 2010-11.

# ACT State of the Environment Report 2011

Figure 2. Waste generation in the ACT, 2007-08 to 2010-11

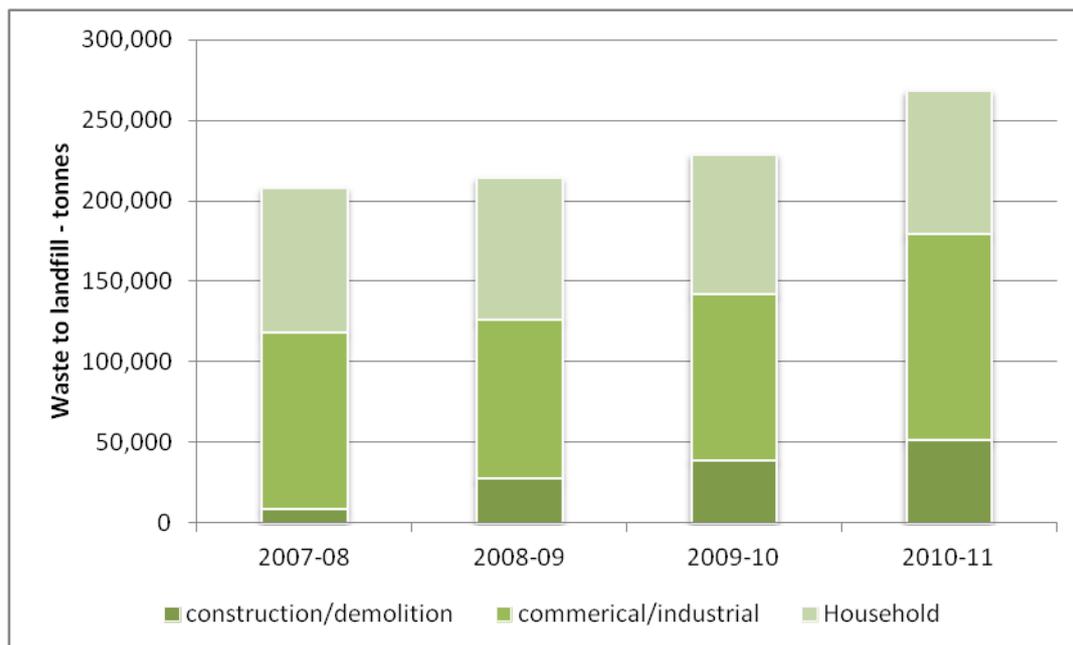


Source: TAMS 2011b

The amount of waste taken to landfill increased by 29.1% (Figure 3) during the reporting period. The large increase in waste to landfill in 2010-11 compared to 2009-10 resulted from increases in commercial and construction waste, and from additional deliveries of contaminated soil from the West Molonglo pond cleanup and elsewhere (TAMS 2011b).

# ACT State of the Environment Report 2011

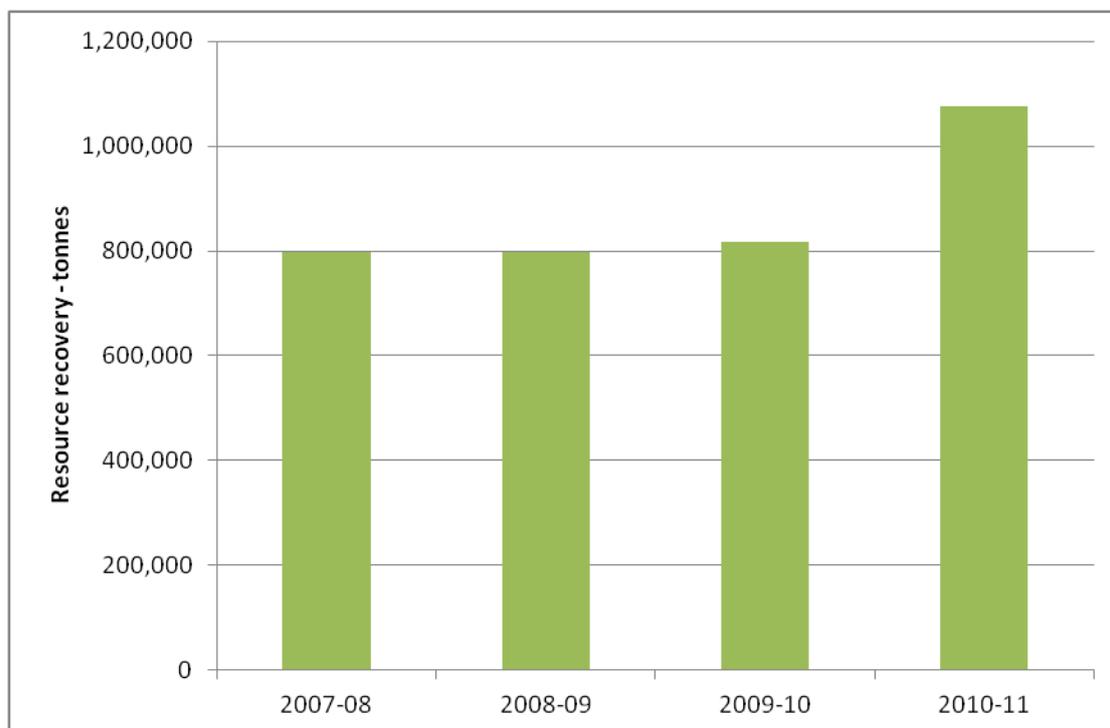
Figure 3. Waste to landfill



Source: TAMS 2011b

Total resource recovery increased by 36.7% during the reporting period (Figure 4). Resource recovery increased substantially in 2010-11 driven by additional garden waste (and other plant material) and recycling of building waste (TAMS 2011b).

Figure 4. Total resource recovery



Source: TAMS 2011b

# ACT State of the Environment Report 2011

Data on waste are collected differently, according to the waste type. The ACT Department of Territory and Municipal Services (TAMS) itself collects the data on total tonnes of waste to landfill. However, data on resource recovery are collected by the contracted recycling companies, by type of resource recovered (e.g. glass, wood); and the data are kept and maintained by TAMS. This means that, for example, 'demolition resource recovery' may omit some material recycled in demolition activities, and 'private and commercial/industrial resource recovery' may include some material recycled outside those sectors. Analysis of resource recovery by sector is based on interpretation of available data by the Office of the Commissioner for Sustainability and the Environment.

While recycling data may not be as accurate as data on waste to landfill, both categories - waste to landfill and resource recovery - increased over the reporting period.

## Pressure indicators

### Construction and demolition sectors

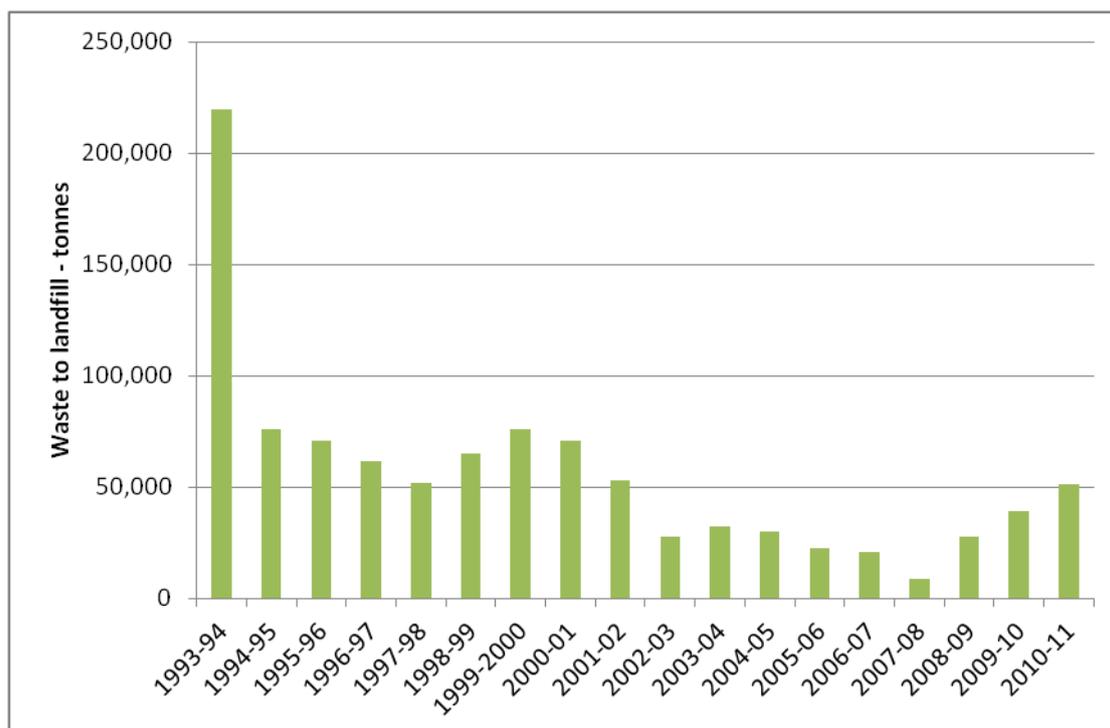
During the reporting period the total amount of waste generated by the construction and demolition sector rose by 87.9% from 223,633 tonnes in 2007-08 to 420,227 tonnes in 2010-11 (Table A1; Figures 5 and 6). This is a reversal of the generally decreasing levels of construction and demolition waste to landfill measured in the previous reporting periods.

This sector's contribution to the total amount of waste processed in the ACT rose from 24% in 2007-08 to 36% in 2010-11. Meanwhile, the value of the construction completed during 2007-08 to 2009-10 is estimated to have risen from \$1.7 billion to \$2.3 billion (ABS 2011a). This result suggests that the increase in overall waste production from this sector is due to a significant rise in building and development activity in the ACT during the reporting period.

The improvement in recycling rates from 2009-10 to 2010-11 (Figure 6) results from the entry of an additional construction and demolition recycling business and existing recyclers working through stockpiles (TAMS 2011b). However, as indicated above, significant amounts of recyclable construction and demolition waste continue to be sent to landfill, leaving further opportunities to improve recycling rates in this sector (TAMS 2011b).

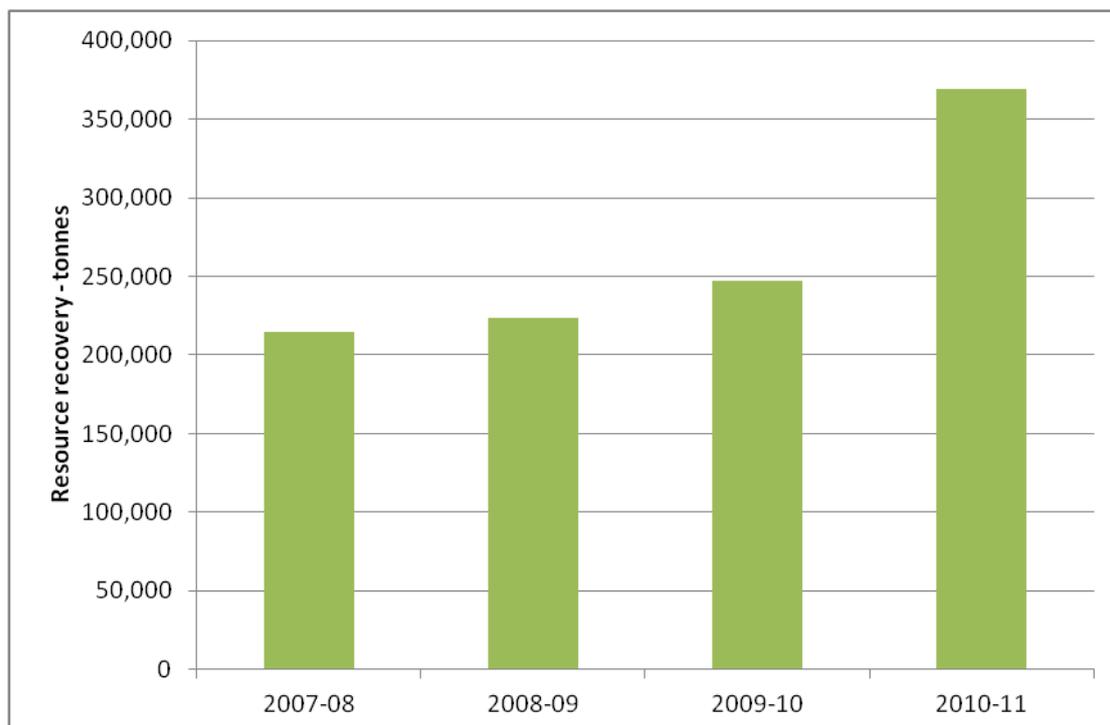
# ACT State of the Environment Report 2011

Figure 5. Construction and demolition waste to landfill, 1994-95 to 2010-11



Source: TAMS 2011b

Figure 6: Total demolition waste resource recovery in the ACT, 2007-08 to 2010-11



Source: TAMS

Note: As indicated above this figure has been derived from data provided by TAMS but collected by the recycling contractors.

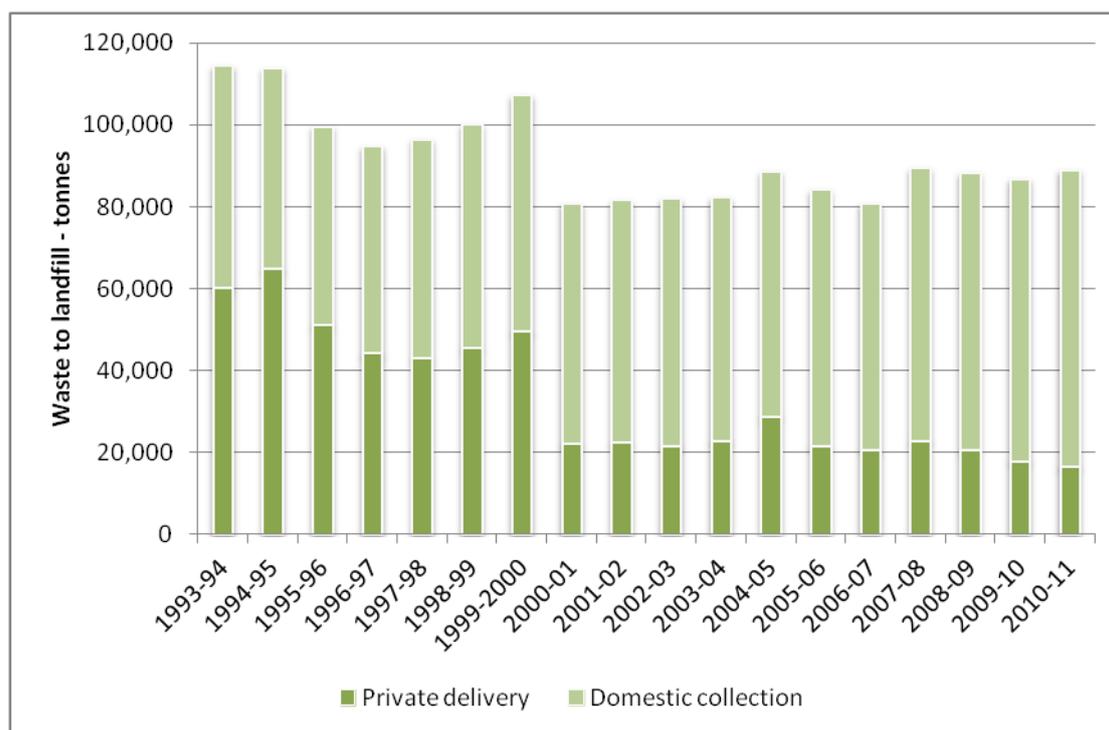
# ACT State of the Environment Report 2011

## Household and commercial and industrial sectors

During the reporting period, there was little change in the total amount of household waste sent to landfill; overall, it decreased by 424 tonnes or 0.5% (Figure 7).

Although the total weight of household waste sent to landfill has decreased significantly over the last two decades, the amounts of domestic waste collected have steadily increased. Most of the overall reduction is because there is now less private delivery of waste to landfill sites.

Figure 7. Household waste to landfill, 1994-95 to 2009-10



Source: TAMS

Much of the increase in domestic collection is a result of the population of the ACT having grown by an estimated 5.4% during the reporting period (ABS 2011b). Also, on a per capita basis, domestic collection of household waste has increased by approximately 5.5 kg, or approximately 3.2% per capita, over the reporting period (TAMS 2011b). This suggests increased rates of consumption, a factor closely linked with affluence and, in turn, waste generation (Dey 2010).

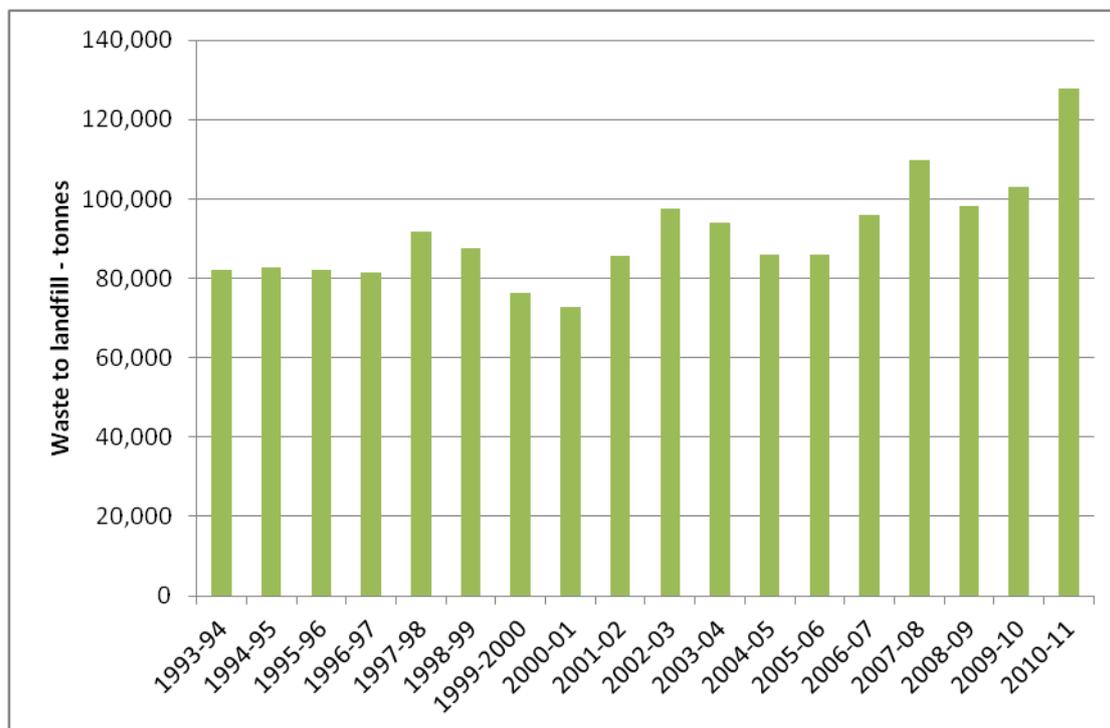
The decrease in the private delivery of domestic waste to landfill is attributed to recycling programs, such as the trial implemented by TAMS at the Mitchell transfer station (ACT Government 2011). These programs have resulted in the diversion from landfill of approximately 40% of the material received (ACT Government 2011).

Commercial and industrial waste has continued to increase, as noted in the previous reporting period. The amount of commercial/industrial waste sent to landfill increased by 16.6% (18,183 tonnes) over the reporting period, in spite of decreasing by 6640 tonnes (6.1%) during 2007-08 to 2009-10.

# ACT State of the Environment Report 2011

Figure 8 illustrates that in the long-term the amount of commercial/industrial waste sent to landfill has been gradually increasing. It is not clear whether this is due to changes in waste management practices or to greater commercial/industrial activity or both.

Figure 8. Commercial and industrial waste to landfill

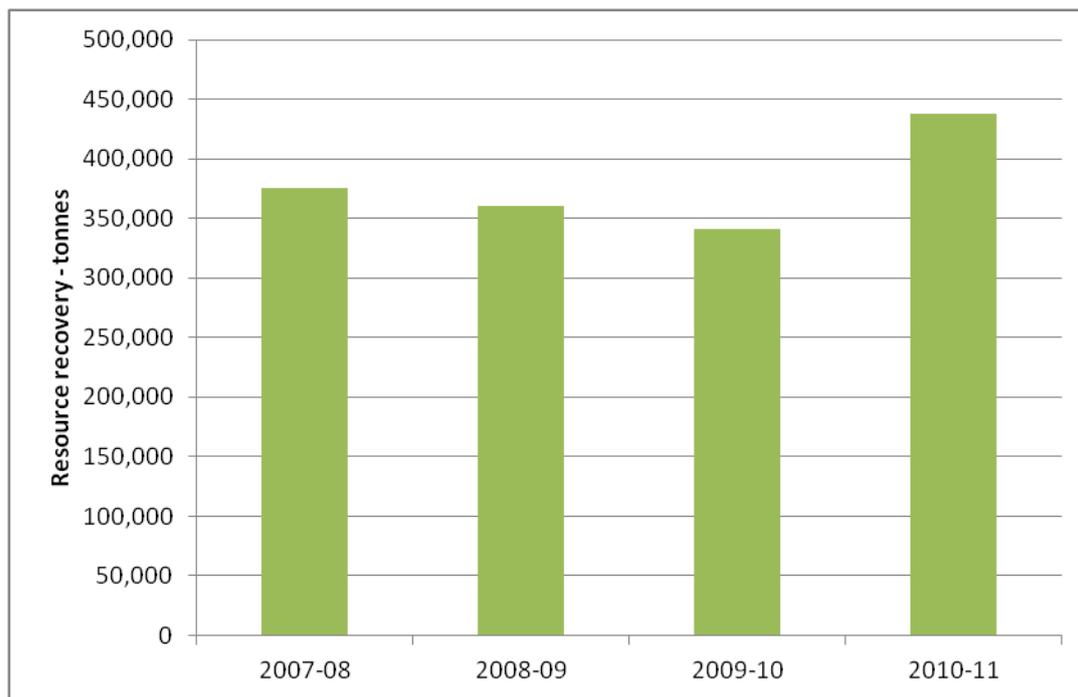


Source: TAMS

Statistics for recycled waste in the ACT are not separated into household and commercial/industrial sectors and therefore they can only be reported as aggregates. The percentage of recycling by these sectors decreased marginally between 2007-08 and 2009-10 before rising again in 2010-11 (Figure 9). Factors that may have contributed to these fluctuations include the liquidation of a major recycling company in 2010 and changes to material acceptance practices and fee structures for other recyclers (ESDD 2011).

# ACT State of the Environment Report 2011

Figure 9. Household and commercial/industrial resource recovery, 2007-08 to 2010-11



Source: TAMS

Note: As indicated above this figure has been derived from data provided by TAMS but collected by the recycling contractors.

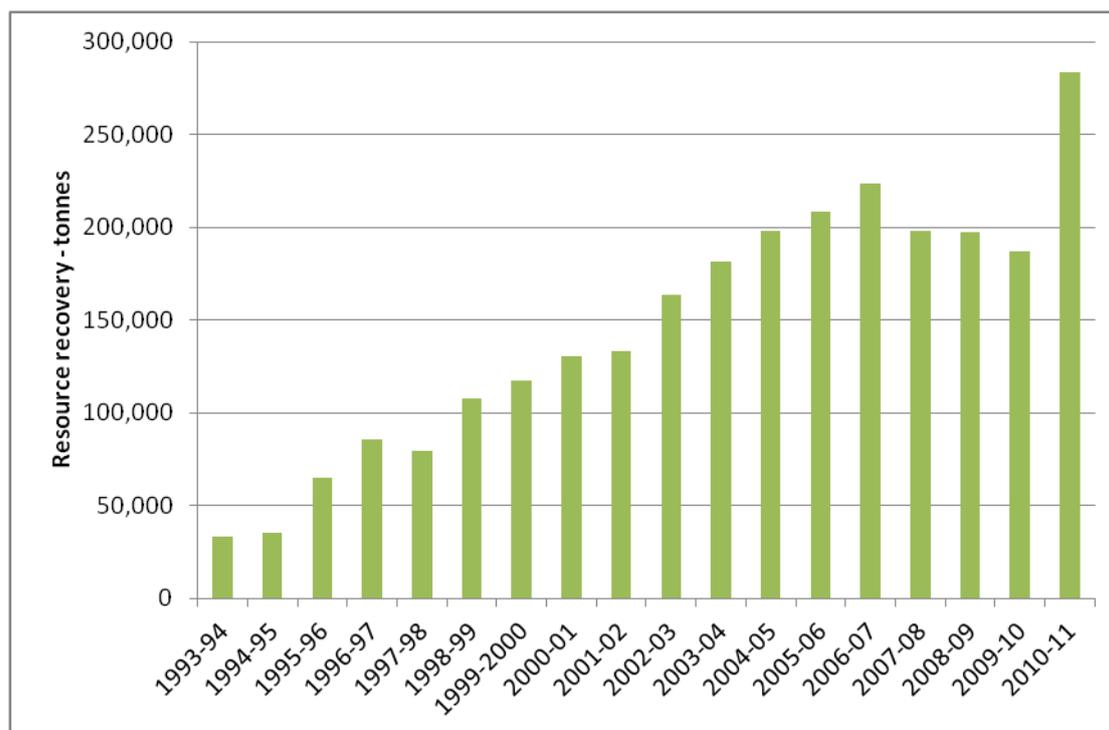
## Green waste

During the reporting period rates of recycling of green waste and compost steadily decreased from 2007-08 to 2009-10, but significantly increased in 2010-11 (Figure 10). This increase was largely attributable to additional plant growth caused by wet conditions in the spring and summer of 2010 (ACT Government 2011).

Rates of green waste recycling are excellent in the ACT with over 90% of material being recovered. Part of the explanation for this is the fact that ACT contractors accept green waste at no cost whereas other jurisdictions may charge up to \$50 per tonne (ACT Government 2011).

# ACT State of the Environment Report 2011

Figure 10. Resource recovery of green waste/compost, 1994-95 to 2010-11



Source: TAMS 2011b

## Movement of controlled waste

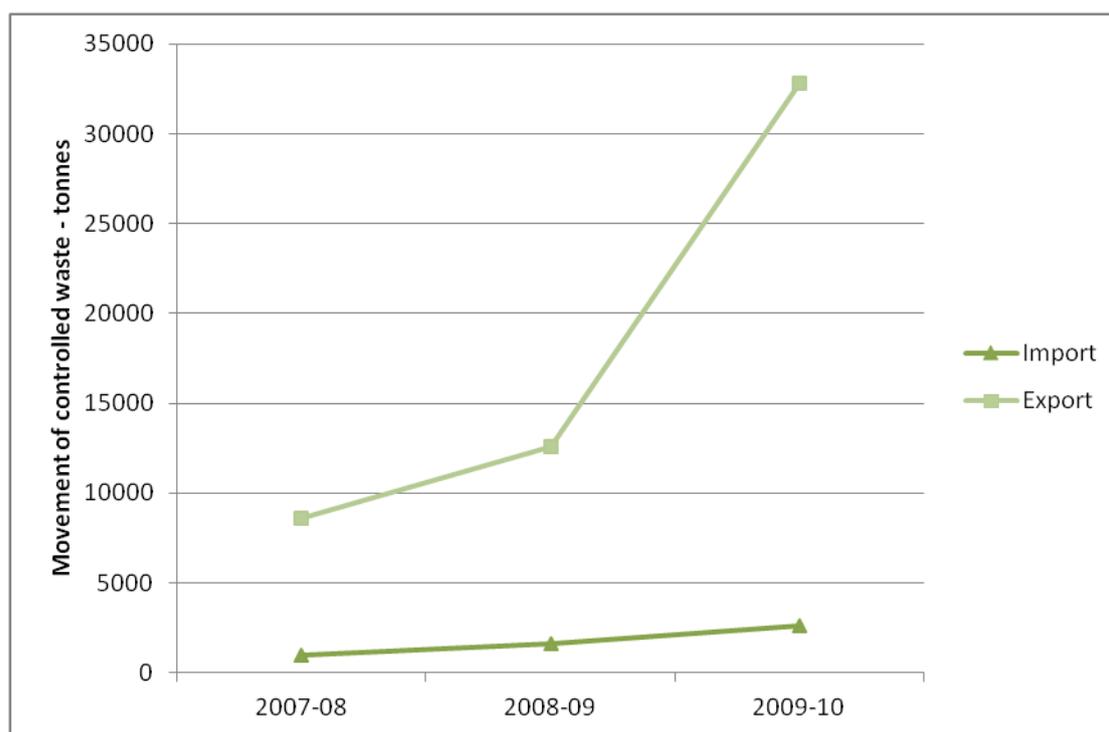
Controlled wastes are those that are considered to be a danger to humans because they are explosive, flammable, infectious, corrosive, exotoxic (toxic substances produced by micro-organisms such as bacteria or fungi), or perceived to have the potential to cause significant harm in some other way (EPA 2009).

The movement of controlled waste between states and territories is regulated by the *National Environment Protection (Movement of Controlled Waste between States and Territories) Measure* (Australian Government 1998). The National Environment Protection Council (NEPC) provides a management framework that enables the licensing and regulation of waste movements. An analysis of NEPC annual reports (NEPC 2008, 2009, 2010) reveals that both imports and exports of controlled waste have increased during the reporting period (Figure 11).

Controlled waste moving out of the ACT during the reporting period comprised liquid wastes, tyres and contaminated soil, being transported mainly into NSW for treatment or disposal. In July 2008 a decision was made to divert used tyres from landfill and transport them interstate for appropriate treatment or recycling. An increased amount of contaminated soil has been exported in 2009-10, primarily originating from Australian Government redevelopment projects in the ACT. The extra soil and the tyres contribute to the sudden increase in exports at 2008-09 in Figure 11.

# ACT State of the Environment Report 2011

Figure 11. Movement of controlled waste, 2007-08 to 2009-10



Source: Adapted from NEPC 2008, 2009, 2010

## Imported waste

Between 2007-08 and 2009-10 imports of controlled waste increased by 158.7% (Table 1). The increase was largely because 1675.5 tonnes of soil and sludge were brought into the ACT in 2009-10, mainly as asbestos-contaminated soil from roadworks on the Kings Highway (see Table A2 in the Annex to this paper). No data are yet available for 2010-11.

The three types of controlled waste (oils, organic chemicals and clinical and pharmaceutical waste) imported into the ACT are sourced from New South Wales, Victoria and Queensland (Table 1).

Table 1. Movement of controlled waste into the ACT (tonnes)

State	2007-08	2008-09	2009-10
NSW	1006.6	1222.0	2583.3
VIC	0	63.6	21.2
QLD	11.9	363.2	30.1
Total	1018.5	1648.8	2634.5

Source: NEPC 2008, 2009, 2010

# ACT State of the Environment Report 2011

## Exported waste

Between 2007-08 and 2009-10 exports of controlled waste increased by 283% (Table A3).

Overall movement during the reporting period, resulted in a net export of 48,687 tonnes of waste out of the ACT. Marked increases from 2007 to 2010 occurred in the export of:

- putrescible/organic waste (39.3%);
- soil/sludge (798.2%); and
- miscellaneous (2983.2%).

The increase in the amount of soils/sludge being exported from the ACT occurred predominantly in 2009-10 and resulted from Australian Government redevelopment projects within the ACT transporting waste to NSW (ESDD 2011). The export of individual waste types is set out in Table A3 in the Annex.

Various controlled wastes are also collected from households in the ACT by the ACT Government as a free of charge service (Table 2). The amount of waste collected has risen from 954.0 kg in 2007-08 to 1112.0 kg in 2009-10 (NEPC 2008, 2009 and 2010).

Table 2. Controlled waste (kg) from household-chemical pick-up program, 2007-08 to 2009-10

Waste type	2007-08	2009-10
Acids/bases	148.5	150.5
Banned chemicals	39.0	18.0
Lab chemicals	11.0	34.0
Solvents	72.0	124.5
Pesticides/herbicides	325.5	301.0
Photo chemicals	58.0	143.0
Other/unknown	300.0	341.0
<b>Total</b>	<b>954.0</b>	<b>1112.0</b>

Source: ACT NoWaste

## Intra-state transported waste

Contaminated waste is also transported within the ACT. The movement of this waste is monitored by the ACT Environment Protection Authority (EPA). The main movements of contaminated waste during the reporting period included:

- the delivery of 20,000 tonnes of contaminated soil to the Mugga Lane Landfill from the West Molonglo pond cleanup; and
- delivery of contaminated soil from the hydrocarbon plume present in groundwater to the east of the intersection of the Bunda and Mort streets in Civic, to a landfarming facility established at the former West Belconnen landfill. This facility provides sustainable remediation of the soil for the

# ACT State of the Environment Report 2011

developers of the construction sites while ensuring the highest level of environmental control over the activity.

## Used packaging materials

The ACT Government's Used Packaging Materials Industry Waste Reduction Plan (IWRP), under the *Waste Minimisation Act 2001*, was approved in November 2006 and updated in April 2010. The goal of the plan is to encourage waste avoidance, reuse and recycling and thereby avoid environmental degradation from the disposal of used packaging and the sourcing of virgin materials.

Most of the materials collected now by kerbside recycling are sold or sent for secondary reuse (Table 3). Overall the amount of material collected has fallen by 1425.3 tonnes (4.0%) between 2007-08 and 2009-10 (NEPC 2008, 2009 and 2010).

In 2009-10, the weight of non-recyclables collected in recycling bins (known as contamination) and sent to landfill, began to be reported. The 2589 tonnes collected are shown in Table 3 but not included in the total at the bottom of the column for 2009-10 .

Table 3. Recyclable materials collected at the kerbside, sent for secondary use or energy recovery and contamination (waste) disposal to landfill 2007-08 to 2010-11

	2007-08		2008-09		2009-10	
	Amount collected (tonnes)	Sold*	Amount collected (tonnes)	Sold*	Amount collected (tonnes)	Sold*
Total packaging paper, i.e. cardboard and liquid paper board	23,601.0	98.6 %	8013.0	98.0 %	6979.2	100.0 %
Total non packaging paper, i.e. paper mixed, paper white office, newspaper and magazines	No breakdown between packaging and non-packaging paper		16,950.0	98.0 %	13,744.0	100.0 %
Total glass	9726.0	92.2 %	11,225.0	91.7 %	10,988.7	100.0 %
Total plastics	1188.0	82.2 %	450.0	82.0 %	1246.2	100.0 %
Total aluminium (cans)	124.0	86.3 %	95.0	86.3 %	152.8	100.0 %
Total steel (cans, tins, etc.)	571.0	93.9 %	614.0	93.5 %	672.8	100.0 %
Contamination	Not reported		Not reported		2589.2	0.0 %
<b>Total</b>	<b>35,209.0</b>	<b>96.2 %</b>	<b>37,347.0</b>	<b>95.8 %</b>	<b>33,783.7</b>	<b>92.9 %</b>

\* Includes sold or sent for secondary use including energy recovery by material type

Source: NEPC 2008, 2009, 2010

# ACT State of the Environment Report 2011

## Impact indicators

### Waste and human health

Limited data are available on connections between waste and human health in the ACT. The following types of waste can potentially affect human health and may require further investigation:

- clinical waste items used outside the formal health system; examples include used needles, syringes and other injecting equipment discarded in parks, playgrounds, toilets and other public places; people receiving a needlestick injury from these 'sharps' risk contracting blood-borne infections such as Hepatitis B or C, or HIV;
- organic waste materials such as food and animal faeces which can be washed into streams and lakes and contribute to the formation of algal blooms by adding nutrients to the water; see the *Water quality* indicator cluster for information about the potential threats to human health posed by blue-green algal blooms and faecal bacteria in recreational waters;
- waste items (litter) discarded in the public domain can have direct and indirect impacts on community health. For example, broken glass can have a direct impact by causing injury or fire; discarded cigarette butts can be a direct threat to human health if they start a bushfire; also, cigarette filters contain toxic chemicals and heavy metals including cadmium, lead, arsenic and zinc, which can enter the food chain by leaching into waters or the soil, or by being eaten by animals (Clean Up Australia 2006). Litter also has indirect impacts, as visual pollution degrading civic places and undermining community pride and well being.

Waste at all ACT Government health sites is managed via waste streaming and Clinical Waste Disposal practices. Clinical waste is managed within strict guidelines and in accordance with the *ACT Clinical Waste Act 1990*. Waste streams include mixed recyclables (plastic and cans), paper and cardboard, clinical and related waste (cytotoxins, sharps and so on), radioactive waste relating to nuclear medicine, general waste (landfill) and dangerous substance waste.

Waste substances can contaminate groundwater. Spilt oils, chemicals, pathogens and other pollutants can seep into the soil and enter aquifers. As outlined in the *Groundwater* indicator cluster, the quality of groundwater in aquifers considered to be at risk is monitored under Authorisations and site assessments where contamination has been identified, mainly at landfill sites and former service station.

### Pollution incidents

The ACT Government has identified the following types of pollution by waste: illegal dumping of solid or liquid waste; littering from vehicles; and contaminated sites (ESDD).

Volumes of solid or liquid waste illegally dumped have been unpredictable in comparison to general litter during the reporting period. The volume increased in

# ACT State of the Environment Report 2011

2007-08, decreased significantly in 2008-09 and again in 2009-10, and increased again to a 3-year high in 2010-11 (KABNA 2008, 2009, 2010, 2011).

The National Litter Index is a project managed by the Keep Australia Beautiful group, which conducts a yearly survey to estimate litter trends throughout Australia. The survey has found that both the number of items and the volume of litter in the ACT have decreased steadily since 2006-07, apart from a small increase in the volume (0.4 litres) in 2010-11. However, the number of items illegally dumped continued to decrease in 2010-11. In 2010-11 the ACT was found to have a comparatively small amount of littering compared to the national average (KABNA 2011). Cigarette butts remain the most common litter item within the ACT; their frequency has decreased yearly over the reporting period (KABNA 2008, 2009, 2010, 2011).

## Response indicators

### Waste management

#### National Waste Policy

Through the National Waste Policy (DSEWPaC 2011), the ACT Government is working to improve the system for the identification, classification, collection, treatment, disposal and monitoring of hazardous substances and waste.

The Australian Packaging Covenant (APC) was introduced in 1999. It is a voluntary partnership between government and industry aimed at reducing the effect packaging has on the environment. The objectives of the framework for the life-cycle-management of packaging are to reduce the impacts from the disposal of packaging, improve resource use through better design and production of packaging and encourage reuse and recycling (NEPC, 2008, 2009 and 2010). ACT-based signatories to the APC have increased from 13 to 15 during the period 2007-08 to 2009-10.

The Australian Government has attempted to encourage the building industry to achieve or maintain high levels of resource recovery, through funding agreements under the National Building Economic Stimulus Plan. For example, the Social Housing component of the Plan (2008-09 to 2011-12) requires a minimum of 90% of all construction and demolition waste to be reused (ACT Government 2011). However, figures are not available to determine whether or not this has been achieved.

In 2010, the ACT became the first jurisdiction to divert televisions and computers from landfill; the policy added to the mandatory recycling of computers - a policy that was introduced in 2005. From 1 July 2010 until 30 June 2011, around 11,100 televisions and around 4500 computers have been recycled under this diversion scheme. A National Television and Computer Product Stewardship Scheme is likely to commence in 2010-11.

#### ACT waste strategy

In 1996, the ACT Government set a goal of achieving no waste going to landfill, through the adoption of the *No Waste by 2010* Waste Management Strategy for

# ACT State of the Environment Report 2011

Canberra. The aspirational goal of the *No Waste by 2010* strategy was a waste-free society.

Key positive outcomes of the *No Waste by 2010* Waste Management Strategy have included:

- more construction demolition waste being recycled, increasing from 39.0% in 1994-95 to a high of 96.1% in 2007-08, since followed by a slight decrease to 87.8% in 2010-11;
- more recycling overall, increasing from 33.4% in 1994-95 to a high of 75.1% in 2005-06 and again in 2010-11; and
- a steady decrease in private deliveries to landfill, from 64,640 tonnes in 1994-95 to 16,536 tonnes in 2010-11 (74.4%), driving an overall decrease of 21.8% in the amount of household waste sent to landfill since the mid 1990s.

Despite the positive outcomes, waste generation and waste to landfill in the ACT are once again increasing, while recycling rates have begun to plateau. A recent kerbside audit conducted by TAMS found that there are still many opportunities to recover material from domestic collection (ACT Government 2011).

As identified in the previous *State of the Environment Report*, waste minimisation and/or avoidance needs to be the fundamental first step (before re-use, recycling or disposal) in effective waste management.

With the end of the *No Waste by 2010* Waste Management Strategy, there is currently no waste management strategy in place in the ACT. The *Draft Sustainable Waste Strategy 2010-2025* was open for public comment until the end of February 2011 and is currently being considered by the ACT Government, for possible adoption by the end of 2011.

The draft strategy has a focus on managing organic and business/construction waste. Further, it incorporates targets of “over 80% resource recovery by 2015 and over 90% resource recovery by 2025” (DECCEW 2010). Figure 12 is a graphical depiction of the priorities driving the *Draft Sustainable Waste Strategy 2010-2025*.

Figure 12. Waste management hierarchy



Source: ACT Government 2011

# ACT State of the Environment Report 2011

## ACT Waste management programs

ACT NOWaste manages the domestic waste and recycling collections from more than 130,000 households in Canberra, as well as the Territory's waste and resource recovery facilities (ACT Government 2011).

That team also supports resource recovery by collecting and analysing data and using it to inform waste policy and deliver public education programs. These programs help the community and businesses to recycle more effectively (ACT Government 2011).

## ACT Government programs

Since 2009, the ACT Government has provided support and training to the business and commercial waste sectors through the delivery of the ACTSmart Business, ACTSmart Office and ACTSmart Public Event programs. The programs encourage participants to direct waste away from landfill, improve sustainability and reduce the Territory's carbon footprint.

Over 281 different sites have participated in these programs, including shopping centres, fast food outlets, sporting venues and healthcare providers. Of these, 50 have been accredited. The ACTSmart Business and Office programs have reached over 20,000 staff in the participating organisations and diverted 12,399 m<sup>3</sup> of waste from landfill to recycling (ESDD 2011). Sustainable Procurement practices have been included in the ACTSmart programs; they have been implemented throughout ACT Government agencies to encourage the use of more sustainable packaging and to avoid packaging where possible.

These programs are in line with recommendation in the *2007-08 ACT State of the Environment Report*: namely, to develop and implement a business waste-reduction strategy. However, as indicated by the continuing increase of commercial/industrial waste to landfill, a focus needs to be kept on this area of management.

Given the increase in construction waste disposed of over the reporting period, that sector should also be targeted for future action.

ACTSmart Schools is a similar program that addresses the specific needs of schools. It has been introduced under the Australian Sustainable Schools Initiative (AuSSI), and during 2011 it reached all 128 ACT schools. To date, waste audits have been conducted in 53 schools (41.4%) in the ACT. Nine schools have conducted a second audit following the introduction of changes identified earlier, and 22 schools have received ACTSmart Waste-Wise accreditation. It is estimated that the changes implemented in these schools have resulted in the diversion of 808,000 litres of recyclable waste from landfill. The ACT Government has prioritised waste education for young people through its continuing support of the Australian Sustainable Schools Initiative and TAMS No Waste programs.

The ACT Government operates a wide suite of community education programs, with the aim of reaching every resident and visitor to the Territory. Additionally, TAMS

# ACT State of the Environment Report 2011

provides information at community fairs and festivals, develops recycling games and products, and operates tours through the Materials Recovery Facility.

In line with recommendations made in the 2007-08 ACT State of the Environment Report, the most recent ACT Government budget (2011-12) has provided funding for public place recycling (PPR) which is planned for Civic by 2012. The Public Place Recycling Program will be evaluated by 2014 with the view of expanding it by 2015.

A 12-month trial was initiated by Smart Public Events in 2011, providing recycling facilities at public events. Manuka Oval and Canberra Stadium (both members of the ACTSmart Business program) have implemented recycling for all sporting events held at these grounds (OCSE 2011).

## Community programs

OzHarvest Canberra collects excess food from restaurants and re-distributes it to vulnerable people in need. In 2006 the organisation was established in the ACT and in 2010 OzHarvest Canberra recovered in excess of 95 tonnes of food and diverted it to charities in the Canberra and Queanbeyan regions (OzHarvest 2010). It is estimated that re-distribution of food rather than sending it to landfill will "avoid 2 kg of greenhouse emissions (kg CO<sub>2</sub>-e), and the consumption of 143 litres of water" for each kilo of food collected (OzHarvest n.d.). Other community organisation such as UC Environment and Sustainability Society and ANUgreen also promote waste minimisation and management in the community (see *Community engagement* indicator cluster for further information).

## Methane gas capture

Organic waste in landfill decomposes under anaerobic conditions to produce a mixture of carbon dioxide and methane with trace amounts of volatile organic compounds, volatile fatty acids and hydrogen sulphide. This gas is collected through a network of pipes, extracted, cleaned and dried and used to produce electricity at the current landfill at Mugga Lane and the former landfill at West Belconnen. In 2010-11, methane captured from both landfills was used to produce more than 28,000 MWh of electricity (TAMS 2011b).

## Plastic shopping bag legislation

In December 2010, the *Plastic Shopping Bags Ban Act (ACT) 2010* was passed. It came into force on 1 November 2011, and is due for review after 2 years of operation. The main focus of the ban is non-biodegradable bags, wholly or partly made of polyethylene with a thickness of less than 35 microns (typically those used for packing groceries and take-away food).

The ban recognises the need for behaviour change, by individual households and businesses, to reduce the use plastic bags that contribute to visual and other pollution as litter, in waterways and in waste to landfill. Education and awareness programs have been conducted to raise awareness of the new ban (DECCEW 2010). It is too early to determine what effect this legislation will have on litter or waste generation in the ACT.

# ACT State of the Environment Report 2011

## Waste harvesting and thermal conversion research

In 2010, the ACT Government began investigating the feasibility of using energy from waste technologies in the ACT. It is also funding a large trial at the Fenner School of Environment and Society at the Australian National University (ANU) to assess the potential to make biochar from the ACT's waste stream. Biochar is a form of charcoal produced by heating organic materials to high temperatures in a low oxygen environment. It can sequester carbon and potentially create valuable soil additives for use in agriculture or horticulture.

In 2010, the ACT Government conducted a pre-feasibility assessment of a thermal conversion facility for the ACT. The assessment found that a range of environmental, social and economic considerations must be investigated before progressing.

Products which may be produced by the facility include:

- charcoal/biochar (soil productivity improvers and sustainable carbon sequestration products);
- bio-oils; and
- syngas (petrochemical industry precursors for liquid fuels or sustainable heat/posser generation) (DECCEW 2010).

## Future directions

In April 2011, the ACT Government began trialling a bulky waste household collection service. The trial is offering one free collection per dwelling to eligible Concession Card holders. Other groups can access the service for a fee. One of the key aims of the trial is to test the ability of the operator to recover most of the material collected, preventing the bulk of the waste going to landfill (TAMS 2011a).

Plans are progressing towards introducing a permanent recycling system into the operations of the Mitchell waste transfer station. It is expected that this initiative will provide a better service for the north side of Canberra in addition to increasing recycling to at least 40%.

A tender process is also underway to build a Material Recovery Facility for dry mixed commercial waste within the Hume Resource Recovery Estate. It is expected that the new facility will recover in excess of 40,000 tonnes of material each year.

While significant improvements have been made in waste reduction and recycling rates improvements can be made in a number of areas, in particular:

- there has been little action towards diverting organic waste materials from landfill - an area that was identified in the previous State of the Environment Report as an important focus for future waste reduction efforts;
- the ACT Government recognises that for the foreseeable future there is no alternative way of disposing of some waste other than via landfill. Consequently, options are being investigated to enable more efficient and environmentally responsible use of landfill cells at the Mugga Lane Resource Management Centre to meet the Territory's needs beyond 2015-16 (DECCEW 2010).

# ACT State of the Environment Report 2011

## Glossary

**Contaminated land:** Contaminated land is land (including buildings and structures on land and surface and underground water) on and/or in which a contaminating substance is present at a concentration which exceeds that normally present (commonly referred to as the background level), and the presence of that contaminating substance presents, or would be likely to present, a risk of harm to human health and/or a risk of environmental harm. However if the contaminating substance are managed in an appropriate manner the site would not pose a significant risk of harm to human health or the environment and would not be considered contaminated. (Based on the Act)

**Controlled waste:** Waste as defined in the National Environment Protection (Movement of Controlled Wastes between States and Territories) Measure 1998

**E-Waste:** Waste electrical and electronic equipment that is dependent on electric currents or electromagnetic fields for its function (including all components, subassemblies and consumables which are part of the original equipment at the time of discarding)

**Hazardous waste:** Listed waste having a characteristic described in schedule A list 2 of the *National Environment Protection (Movement of controlled waste between States and Territories) Measure*. "A hazardous waste refers to a substance or object that exhibits hazardous characteristics, is no longer fit for its intended use and requires disposal. Some of these hazardous characteristics include being toxic, flammable, explosive and poisonous." (Source: National Waste Policy Fact Sheet: Hazardous substances and hazardous waste, page 1).

**Illegal dumping:** "For the National Litter Index illegal dumping is defined as the unlawful deposit onto land of waste larger than litter, or in other words, waste materials dumped, tipped or otherwise deposited onto private or public land where no licence or approval exists to accept such waste. Illegal dumping varies from small bags of rubbish in an urban environment to larger scale dumping of materials in isolated areas, such as bushland."

**Landfill:** A waste disposal site used for the controlled deposit of solid waste onto or into land.

**Litter:** Rubbish left in an open or public place

# ACT State of the Environment Report 2011

## References

- ABS 2011a. *8752.0 - Building Activity. Cat. No. 8752.0*. Australian Bureau of Statistics. Australian Government. Canberra. <http://www.abs.gov.au/ausstats/abs@.nsf/mf/8752.0> (accessed 10/8/11)
- ABS 2011b. *3101.0 - Australian Demographic Statistics. Cat. No. 3101.0*. Australian Bureau of Statistics. Australian Government. Canberra. <http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0> (accessed 10/8/11)
- ACT Government 2010. *Draft Sustainable Waste Strategy 2010-2025*. Canberra. [http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0009/210501/SustainableWaste\\_Strategy\\_WEB.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0009/210501/SustainableWaste_Strategy_WEB.pdf) (accessed 11/6/11)
- Australian Government 1998. *NEPC National Environment Protection (Movement of Controlled Waste between States and Territories) Measure*. ComLaw. Canberra. [http://www.comlaw.gov.au/Details/F2007B01119/Html/Text#\\_Toc1182129234073](http://www.comlaw.gov.au/Details/F2007B01119/Html/Text#_Toc1182129234073) (accessed 14/8/11)
- Clean Up Australia 2006. *Cigarette Butts*. Glebe. <http://www.cleanup.org.au/PDF/au/cua-cigarette-butts-fact-sheet.pdf> (accessed 20/8/11)
- DECCEW 2010. *Plastic Bag Ban passed by Assembly - Media Release*. ACT Department of Environment, Climate Change, Energy and Water. Canberra. [http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/214296/MIN\\_187\\_1210\\_Plastic\\_bag\\_ban\\_passed\\_by\\_Assembly.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0006/214296/MIN_187_1210_Plastic_bag_ban_passed_by_Assembly.pdf) (accessed 27/5/11)
- Dey, C. 2010. *The 2008-09 Ecological Footprint of the Population of the ACT*. Integrated Sustainability Analysis Research Group. University of Sydney. Sydney. [http://www.environmentcommissioner.act.gov.au/\\_\\_data/assets/pdf\\_file/0015/211182/ACT\\_Ecological\\_Footprint\\_08-09\\_final\\_report.pdf](http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0015/211182/ACT_Ecological_Footprint_08-09_final_report.pdf) (accessed 21/11/11)
- DSEWPac 2011. *National Waste Policy: Less Waste, More Resources*. Australian Government Department of Sustainability, Environment, Water, Population and Communities, Canberra. <http://www.environment.gov.au/wastepolicy/index.html> (accessed 23/11/11)
- EPA 2009. *Waste Guidelines*. South Australian Environment Protection Authority. Adelaide. Australia. [http://www.epa.sa.gov.au/xstd\\_files/Waste/Guideline/guide\\_waste\\_definitions.pdf](http://www.epa.sa.gov.au/xstd_files/Waste/Guideline/guide_waste_definitions.pdf) (accessed 18/11/11)
- ESDD n.d. *Reporting Pollution*. Environment and Sustainable Development Directorate. ACT Government. Canberra. <http://www.environment.act.gov.au/?a=230598#waste> (accessed 12/10/11.)
- ESDD 2011. *Annual Report 2010-11*. Environment and Sustainable Development Directorate. ACT Government. Canberra. [http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/233286/1027-DECCEW\\_AnnualReport2011\\_web.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0006/233286/1027-DECCEW_AnnualReport2011_web.pdf) (accessed 9/10/11)

# ACT State of the Environment Report 2011

- KABNA 2008. *National Litter Index Annual Report 2007/2008*. Keep Australia Beautiful National Association. Canberra. <http://www.kab.org.au/litter-research/what-we-do/national-litter-index/> (accessed 9/8/11)
- KABNA 2009. *National Litter Index Annual Report 2008/2009*. Keep Australia Beautiful National Association. Canberra. <http://www.kab.org.au/litter-research/what-we-do/national-litter-index/> (accessed 9/8/11)
- KABNA 2010. *National Litter Index Annual Report 2009/2010*. Keep Australia Beautiful National Association. Canberra. [http://www.kab.org.au/files/NLI/NLI%20homepage/0910%20Reports/100923\\_4\\_mtr\\_nli\\_0910\\_report.pdf](http://www.kab.org.au/files/NLI/NLI%20homepage/0910%20Reports/100923_4_mtr_nli_0910_report.pdf) (accessed 9/8/11)
- KABNA 2011. *National Litter Index Annual Report 2010/2011*. Keep Australia Beautiful National Association. Canberra. [http://www.kab.org.au/files/NLI/NLI%20homepage/1011%20Reports/2\\_nli\\_1011\\_report\\_final.pdf](http://www.kab.org.au/files/NLI/NLI%20homepage/1011%20Reports/2_nli_1011_report_final.pdf) (accessed 9/8/11)
- NEPC 2008. *Annual Report 2007-08*. National Environment Protection Council. Canberra. <http://www.environment.gov.au/about/councils/nepc/publications/pubs/nepc-annualreport-0708.pdf> (accessed 12/8/11)
- NEPC 2009. *Annual Report 2008-09*. National Environment Protection Council. Canberra. [http://www.ephc.gov.au/annual\\_report?q=annual\\_report\\_previous](http://www.ephc.gov.au/annual_report?q=annual_report_previous) (accessed 21/11/11)
- NEPC 2010. *Annual Report 2009-10*. National Environment Protection Council. Canberra. [http://www.ephc.gov.au/annual\\_report](http://www.ephc.gov.au/annual_report) (accessed 21/11/11)
- OCSE 2011. *Annual Report 2010-11*. Office of the Commissioner of Sustainability and the Environment. Canberra. [http://www.envcomm.act.gov.au/\\_\\_data/assets/pdf\\_file/0016/233260/2010-11\\_OCSE\\_annual\\_report\\_for\\_Web.pdf](http://www.envcomm.act.gov.au/__data/assets/pdf_file/0016/233260/2010-11_OCSE_annual_report_for_Web.pdf) (accessed 17/8/11)
- OzHarvest 2010. *Annual Report 2010*. Sydney. <http://www.ozharvest.org/media/page/2010%202011%20OzHarvest%20Annual%20Report.pdf> (accessed 15/8/11)
- OzHarvest nd. *About Oz Harvest, Our Impact*. Oz Harvest. Sydney. <http://www.ozharvest.org/ourimpact.asp?pageID=609> (accessed 9/8/11)
- TAMS 2011a. *Bulky Waste Collection Service Trial*. Territory and Municipal Services. ACT Government. Canberra. [http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/224861/Bulky\\_Waste\\_Collection\\_Brochure.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0005/224861/Bulky_Waste_Collection_Brochure.pdf) (accessed 6/8/11)
- TAMS 2011b. *Annual Report 2010-11 Volume 1*. Territory and Municipal Services. ACT Government. Canberra. [http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/233179/Volume\\_1\\_10-11.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0007/233179/Volume_1_10-11.pdf) (accessed 31/10/11)

# ACT State of the Environment Report 2011

## Other data sources

In addition to these published reports, data for this paper were also sourced from:

ACT Department of Territory and Municipal Services (TAMS) – now Territory and Municipal Services Directorate (TAMSD)

ACT Environment Protection Authority (EPA) – now part of Environment and Sustainable Development Directorate (ESDD)

ACT NoWaste – now part of Territory and Municipal Services Directorate (TAMSD)

Australian Bureau of Statistics (ABS)

# ACT State of the Environment Report 2011

## Annex

Table A1. Summary of waste totals and trends by sector

Waste to landfill site in the ACT	2007-08	2008-09	2009-10	2010-11	Change (%)
Construction/demolition waste (tonnes)	8,658	27,522	38,895	51,261	<b>492.1</b>
Commercial/industrial waste (tonnes)	109,698	98,150	103,058	127,881	<b>16.6</b>
Household waste (private delivery) (tonnes)	22,810	20,477	17,835	16,536	<b>-27.5</b>
Household waste (domestic collection) (tonnes)	66,560	67,820	68,918	72,410	<b>8.8</b>
<b>Total waste to landfill (tonnes)</b>	<b>207,726</b>	<b>213,969</b>	<b>228,706</b>	<b>268,088</b>	<b>29.1</b>
Demolition waste recycling (tonnes)	214,975	223,825	246,777	368,966	<b>71.6</b>
Household and commercial/industrial resource recovery (tonnes)	375,118	360,286	340,950	437,710	<b>16.7</b>
<b>Total resource recovery (tonnes)</b>	<b>590,093</b>	<b>584,111</b>	<b>587,727</b>	<b>806,676</b>	<b>36.7</b>
<b>Total waste generated (tonnes)</b>	<b>797,819</b>	<b>798,080</b>	<b>816,433</b>	<b>1,074,764</b>	<b>34.7</b>
Household waste to landfill per person (kg)	231.5	224.7	216.8	218.5	<b>-5.6</b>
Household waste (private delivery) (kg)	59.1	52.1	44.6	40.6	<b>-31.2</b>
Household waste (domestic collection) (kg)	172.4	172.6	172.2	177.9	<b>3.2</b>
Total resource recovery (%)	74.0	73.2	72.0	75.1	<b>1.5</b>
Demolition waste recycling (%)	96.1	89.1	86.4	87.8	<b>-8.7</b>
Private and commercial/industrial resource recovery (%)	65.3	65.9	64.2	66.9	<b>2.4</b>
Estimated resident population of the ACT	346,294	352,285	358,571	364,541	5.30%
Estimated resident population of Queanbeyan	39,777	40,661	41,551	42,464	6.80%

Note: Total waste generated does not include controlled waste exported from the ACT. Estimated resident population for Queanbeyan was not available for 2009-10 and 2010-11. An increase of 2.19% was used because that was the average increase over the previous 5 years. Estimated resident population for ACT was not available for 2010-11. An increase of 1.66% was used because that was the average over the previous 6 years. Figures for 'demolition waste recycling' and 'private and commercial/industrial resource recovery' have been derived from other data maintained by TAMS, but resource recovery is not specifically collected and maintained by TAMS against these waste streams. This means that 'demolition waste recycling' may omit some material recycled in demolition activities, and 'private and commercial/industrial resource recovery' may include some material recycled outside those sectors.

# ACT State of the Environment Report 2011

Table A2. Import of controlled waste into the ACT, 2007-08 to 2010-11

	Import (tonnes)			
	2007-08	2008-09	2009-10	Change
Plating & heat treatment	0.0	0.0	0.0	0.0%
Acids	0.0	0.0	0.0	0.0%
Alkalis	0.0	0.0	0.0	0.0%
Inorganic chemicals	0.0	0.0	0.0	0.0%
Reactive chemicals	0.0	0.0	0.0	0.0%
Paints, resin, inks, organic sludges	0.0	0.0	0.0	0.0%
Organic solvents	0.0	0.0	0.0	0.0%
Pesticides	0.0	0.0	0.0	0.0%
Oils	269.4	286.3	181.3	-32.7%
Putrescible/organic waste	0.0	0.0	0.0	0.0%
Industrial washwater	0.0	0.0	0.0	0.0%
Organic chemicals	490.2	1,094.6	516.9	5.4%
Soil/sludge	0.0	0.0	1,675.5	100.0%
Clinical & pharmaceutical	258.9	268.0	260.9	0.8%
Miscellaneous	0.0	0.0	0.0	0.0%
<b>TOTAL</b>	<b>1,018.5</b>	<b>1,648.8</b>	<b>2,634.5</b>	<b>158.7%</b>

# ACT State of the Environment Report 2011

Table A3. Export of controlled waste out of the ACT (2007-08 to 2010-11)

	Export (tonnes)			
	2007-08	2008-09	2009-10	Change
Plating & heat treatment	0.0	0.4	0.0	0.0%
Acids	9.5	4.8	2.8	-70.5%
Alkalis	50.3	4.4	4.4	-91.3%
Inorganic chemicals	174.6	143.8	100.9	-42.2%
Reactive chemicals	0.1	0.6	0.0	-100.0%
Paints, resin, inks, organic sludges	64.5	49.3	69.6	7.9%
Organic solvents	57.4	47.9	42.3	-26.3%
Pesticides	0.6	0.2	0.2	-66.7%
Oils	1,579.0	1,535.1	1,291.6	-18.2%
Putrescible/organic waste	3,588.6	4,630.4	5,000.0	39.3%
Industrial washwater	0.0	0.0	0.0	0.0%
Organic chemicals	149.9	573.3	123.0	-17.9%
Soil/sludge	2,723.6	5,225.6	24,464.0	798.2%
Clinical & pharmaceutical	118.8	115.6	110.4	-7.1%
Miscellaneous	52.6	257.2	1,621.8	2,983.3%
<b>TOTAL</b>	<b>8,569.5</b>	<b>12,588.4</b>	<b>32,830.9</b>	283.1%

# ACT State of the Environment Report 2011

## THEME: People

### Indicator cluster: Heritage

The indicators for this cluster are:

- *Historic heritage places (C)* - includes number of sites and condition;
- *Aboriginal heritage places (C)* - includes number of sites and condition;
- *Natural heritage places (C)* - includes number of sites and condition;
- *Loss of historic and Aboriginal sites (P)* - includes details on loss of sites;
- *Climate change impacts on condition of heritage sites (P)* - broad discussion on climate change impacts on heritage sites; and
- *Heritage protection management and reuse (R)* - effectiveness of protection and management of historic heritage places, protection and management of Aboriginal heritage, and protection and management of natural heritage.

**Condition indicators (C)** present data that tell us the state of the environment at any particular time.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

### Summary

The ACT has a rich heritage of places and objects valued for their natural, historic or Aboriginal character. Heritage places and objects are nominated and assessed before being provisionally and then completely registered on the ACT Heritage Register.

Heritage places and objects in the ACT are at risk because of limited funding for registration and management, ongoing pressures from development and the likely effects of forecast changes to climate (such as lower rainfall, higher temperatures, fire).

Heritage protection legislation is in a period of transition: there is a new Heritage Council and the *Heritage Act 2004* is being reviewed. The review included a community consultation process, which has been completed, and the ACT Government is preparing a response to its findings and recommendations. Statutory issues relating to Commonwealth land complicate the heritage listing of some places.

### Introduction

In March 2013, Canberra will celebrate its centenary - 100 years since the naming of Canberra. A 12-month program will highlight Canberra's role as the capital of Australia.

# ACT State of the Environment Report 2011

This indicator cluster examines the heritage management of Aboriginal, historic and natural places and objects. Heritage management aims to demonstrate and maintain the community's sense of place in the region.

## Condition indicators

### Historic heritage places and objects

Currently there are 142 registered historic heritage places or objects in the ACT - nearly 27% more than were registered in 2007-08. It is estimated that historic heritage places represent about 1.3% of the existing building stock in the ACT, of which only a small share is registered (Marshall 2010). Table 1 gives the numbers of historic places or objects listed as registered, provisionally registered or nominated on the ACT Heritage Register during the reporting period.

Table 1. Number of ACT historic heritage places or objects

Activity	2007-08	2008-09	2009-10	2010 to date
Registered places and objects	112	129	134	142
Provisionally registered places / objects	15	6	7	10
Nominated places and objects	237	226	222	207

Source: ACT Heritage

Figures for this reporting period show a significant decrease from those in the previous *ACT State of the Environment Report*, where, as at 30 June 2007, it was reported that there were a total of 283 nominated places or objects, 1 provisionally registered place or object and 178 registered places or objects. This is in large part due to the previous inclusion of natural and Aboriginal heritage registered objects (Table 2), as well as an audit of the Register in 2007, which removed a number of duplicate registrations. Of the 207 currently nominated historic places and objects, 48 are located on National Land and are controlled by the National Capital Authority. A discussion of the changes occurring in relation to National Land is included in the Statutory Issues section of this paper.

### Aboriginal heritage places and objects

All Aboriginal heritage places and objects in the ACT are protected under the *Heritage Act 2004*, regardless of their status as registered, provisionally registered or nominated. In some instances Aboriginal heritage places, or conservation zones encompassing parts of these places, are protected within urban development areas.

There are currently 51 citations on the ACT Heritage Register related to Aboriginal heritage registrations, with a further 11 places or objects nominated (Table 2). Many of these citations contain information about more than one Aboriginal site rather than discrete places or objects for historical heritage. As such, these citations to the Heritage Register currently include information on 3662 Aboriginal sites, of which 1076 have been recorded as salvaged. Many other sites, ranging from individual artefact scatters through to scarred trees, have also been identified and reported to the Heritage Council.

# ACT State of the Environment Report 2011

During the reporting period, none of the nominated Aboriginal heritage places or objects became registered. The ACT Heritage Unit and Council are in the process of reviewing the best approach for recording and registering Aboriginal places and objects. While all places and objects are protected under the Act, only significant places and objects are being registered. Other sites are being recorded and managed in accordance with Conservation Management Plans endorsed by the Heritage Council. It is expected that a number of nominations will be assessed and registered in 2011-12. Information on existing Aboriginal heritage places needs to be updated because currently available data are outdated or incomplete in some cases.

Table 2. Number of Aboriginal heritage places or objects

Activity	2007-08	2008-09	2009-10	2010 to date
Registered places and objects <sup>1</sup>	53	51	51	51
Provisionally registered places and objects	0	0	0	0
Nominated places and objects	11	11	11	11

Source: ACT Heritage

## Natural heritage places

Natural heritage places include places or objects that are considered to possess strong natural values. Currently, there are 7 registered natural heritage places or objects on the ACT Heritage Register compared to 3 registered by the end of the last reporting period. In addition, 2 places or objects are currently provisionally registered and 5 more places have been nominated for listing since the *2007-08 State of the Environment Report*. Table 3 summarises the changes in listings of natural heritage places and objects under the *Heritage Act 2004* since June 2007.

The number of nominations has remained the same over the last four years, due to a backlog with assessment. This is discussed below in the Heritage Protection Management and Reuse section of the paper.

Table 3. Number of natural heritage places and objects

Activity	2007-08	2008-09	2009-10	2010 to date
Registered places and objects	4	4	4	7
Provisionally registered places and objects	0	0	5	2
Nominated places and objects	27	27	27	27

Source: ACT Heritage

While the number of natural heritage places listed is quite small, the geographical coverage of these areas is relatively large. The natural heritage places include two

---

<sup>1</sup> The Heritage Unit reports that no registered Aboriginal places or objects have been removed from the ACT Heritage Register. It is unclear why the discrepancy in numbers listed exists.

# ACT State of the Environment Report 2011

habitats with large populations of Button Wrinklewort (*Rutidosia leptorrhynchoides*), an endangered species of wildflower in the ACT) where the purpose of protection is to ensure continued survival of the species. In addition, some significant geological sites have been included on the ACT Heritage Register to protect their intrinsic features, as identified in the citation.

## Registration of trees

To be listed as a regulated tree, certain criteria including height and canopy size must be met. Regulated trees in the ACT are protected under two separate listings. If an individual tree is within a heritage-listed place and is designated as a regulated tree, it is protected under the Heritage Act. A regulated tree outside a heritage place is registered as a regulated tree and protected under the *Tree Protection Act 2005*. This has been the case since March 2008. The ACT Tree Register under the *Tree Protection Act 2005* identifies and protects trees of exceptional value on leased and unleased urban land.

In March 2008 when these changes took place, only tree precincts and not individual trees were listed on the ACT Heritage Register. These tree precincts are now also listed on the ACT Tree Register; they include Haig Park, Glebe Park, City Hill and trees located on the verge of Torrens Street, Braddon. Additional trees and tree precincts of heritage value have also been added to the Tree Register since that time, including 3 trees at Sacred Heart Church in Calwell, 2 trees in the courtyard of Gorman House, Braddon, and trees that form streetscapes of heritage precincts such as parts of Batman St and Ainslie Ave in Braddon. The *Tree Protection Act 2005* requires approval for all tree-damaging activities for regulated trees within tree management precincts.

## Pressure indicators

### Loss of historic and Aboriginal heritage

The total number of development applications affected by heritage issues has been declining since 2006-07 (Table 4) although the percentage has remained at around 5-7% of the total number of development applications since the previous reporting period.

Table 4. Development applications related to heritage

Activity	2006-07	2007-08	2008-09	2009-10	2010-11
Development applications – heritage	300	241	169	102	94
% of development applications – heritage	6.2%	5.6%	6.8%	6.3%	7.2%
Development applications – total	4808	4282	2479	1595	1293

Source: Marshall 2010, ACT Heritage Unit

The ACT Heritage Unit reported receiving 94 development applications referred for heritage assessment during 2010-11, of which 6 applications involved the full demolition of heritage houses. Of the 6 applications for full demolition, 4 were approved. The reason for the 2 refusals was non-compliance with the mandatory

# ACT State of the Environment Report 2011

heritage requirements: both were forward of the building line and 1 also did not meet requirements for soft landscaping, driveway surface material and width.

On average, 110 development applications on registered heritage places are processed per year. There are currently no overall data available on the number of development applications that were amended or refused because of heritage values.

Changes to houses within heritage precincts are regulated by heritage guidelines prepared by the ACT Heritage Council. Works that do not comply with the mandatory requirements in the guidelines of heritage precincts are not supported.

In the case of greenfield development, the ACT Planning and Land Authority (ACTPLA) is responsible for planning and also makes cultural heritage assessments for submission to the Heritage Council. The intention of this assessment is to mitigate impacts if the development proceeds. The Marshall Report (Marshall 2010) called for a more rigorous landscape-scale approach to assessing heritage sites in the greenfields development process. This would provide developers with more timely, in-depth and comprehensive knowledge of the heritage values inherent in the landscape and facilitate an improved development process in relation to heritage protection.

There have recently been a number of reported cases of fires in significant heritage buildings in the ACT. Fires destroyed the Canberra Services Club in April 2011, and damaged Hotel Acton in June 2011. While the number of fire incidents has been low it is important to note that fire is a potential risk factor to heritage objects and places in the ACT.

## Climate change impacts on the condition of heritage sites

Key climate change impacts for the ACT have been identified as (Webb 2011):

- the strong likelihood of mean temperatures continuing to increase, along with more frequent and severe heatwaves for the ACT and region; and
- a high probability of changes in the pattern of rainfall from that observed during the period of instrumental records, with some risk of a decline in long-term average rainfall; and in addition, the likelihood of an increase in rainfall intensity with more extreme rainfall events.

There is little information on the damage climate change may be having on natural heritage places, nor have studies have been made of the effects of predicted climate change on the condition of cultural heritage sites in the ACT.

The vulnerability of cultural heritage resources in the ACT to fire damage is likely to be heightened by the more frequent and intense bushfires predicted to accompany climate change (Pearson 2008). Among heritage places affected during the 2003 ACT bushfire were Mt Franklin Ski Chalet, many huts in the Cotter catchment including Condor and Blue Range Huts, a number of sites with rock art, and Mt Stromlo Observatory.

# ACT State of the Environment Report 2011

Table 5 outlines potential impacts on heritage places from predicted climate change impacts, based on research by the World Heritage Centre and Pearson (2008).

Table 5. Possible threats to cultural heritage places from climate change

Historical buildings	Archaeological sites
<ul style="list-style-type: none"> <li>• Soil instability, heaving and cracking</li> <li>• Susceptibility to changing soil moisture in structures with poor damp-courses</li> <li>• Changed freeze/thaw cycles in highland areas</li> <li>• Increased flooding events</li> <li>• Migration of damaging pests with changing environmental conditions</li> <li>• Increased storm and wind events</li> <li>• Increased temperatures and aridity</li> <li>• Climatic zone movements impacting cultural landscapes and gardens</li> <li>• Changing economic and social patterns of settlement</li> </ul>	<ul style="list-style-type: none"> <li>• Modification of precipitation regimes and increased year-to-year variability</li> <li>• Increased droughts and floods</li> <li>• Changes in water tables and groundwater levels</li> <li>• Changes in humidity cycles</li> <li>• Changes in soil chemistry</li> <li>• Changes in soil temperature</li> <li>• Changes in wetting and drying cycles</li> </ul>

Source: Pearson 2008

Natural heritage places, while not covered in this table, are likely to be vulnerable to increased summer temperatures and decreased water availability (Webb 2011:4).

The Heritage Chairs and Officials of Australia and New Zealand (HCOANZ) has requested the governments of all jurisdictions, including the ACT, to provide details of historic sites at risk from climate change. These case studies are currently being used in the development of a paper for HCOANZ. The paper aims to raise awareness of the observed and potential impacts of climate change; it includes a proposed standard method for recording. Additional research is likely to be required and this will be progressed by HCOANZ.

During the reporting period many households have installed solar power systems to generate electricity. While currently no data are collected on solar panels on heritage buildings or places, these installations potentially pose a risk to the visual and structural integrity of heritage objects. The risk has been recognised as an emerging issue for heritage preservation in the ACT.

In response, the Heritage Council has developed a draft set of policies advising on the installation of modern services in heritage precincts, to assist users. This advice includes guidelines relating to solar panels, signage, hedges, driveways and contemporary architecture in heritage precincts. The guidelines are currently being reviewed by the Heritage Council, with a view to endorsing a final document in the near future. Other jurisdictions have policies in place which are currently used as reference documents as required.

# ACT State of the Environment Report 2011

## Impact indicators

There are no impact indicators for this indicator cluster.

The main threats to currently recognised heritage items are demolition, deterioration and development; but now new types of items are being regarded as having heritage value. For example, rapid developments and new forms of technology make it increasingly likely that objects and places such as power stations, waste facilities and communication towers will be considered worthy of heritage protection.

Aboriginal heritage places have been affected in recent years by the increasing spread of urban development into new areas of Canberra. Heritage assessments have been increasingly incorporated into early stages of the planning studies, especially in greenfield areas. Identifying and protecting heritage places at the outset is advantageous, because it both protects the heritage and identifies any constraints on development, forestalling potential conflicts.

Since 2009, to comply with new procedures for tracking heritage, the Heritage Council must be notified of development applications relevant to heritage areas. The Heritage Council then provides advice so that the impacts of development can be mitigated. The Heritage Council has provided formal advice on development applications involving Aboriginal heritage places, or in response to referrals, on 99 occasions.

## Response indicators

### Heritage protection management and reuse

The following initiatives have been developed by the ACT Government to protect heritage values and manage registered historic heritage places in the ACT:

- heritage and architectural guidance on renovating or extending a heritage house is provided by the Heritage Advisory Service to owners of heritage buildings and potential buyers;
- guidelines for assessing development applications, provided by the Heritage Council;
- draft policies for installation of modern services, provided by the Heritage Council;
- encouragement, by the Heritage Unit, to owners of heritage assets to prepare Conservation Management Plans; the plans guide the owners in effectively managing the conservation of a heritage place over a period of time (e.g. 5 years);
- heritage agreements between an owner and the Minister for Heritage, under the Act;
- cultural heritage assessments as part of greenfield development planning, by ACTPLA (ACTPLA is now part of the Environment and Sustainable Development Directorate, ESDD); and

# ACT State of the Environment Report 2011

- environmental impact assessments for heritage-listed places or objects subject to development proposals.

The ACT Government runs a Heritage Advisory Service, as mentioned above. It provides limited free technical advice to owners of heritage-listed houses and owners of commercial property with heritage value. From 2006 to 2010 the service advised on approximately 46 cases each year.

Recent structural changes to the ACT Government have led to the ACT Heritage Unit now also being part of the directorate that has responsibility for development. This provides an opportunity for heritage planning to give better guidance on protection and development processes, particularly in relation to natural and Indigenous sites. A strategic approach needs to be taken to identify and protect heritage places and objects prior to development, rather than in response to it, which has largely been the case in the past.

## Auditing

There is no program of audits of the condition of the ACT's heritage through time. It is therefore difficult to assess the ongoing effectiveness of protection measures. The information that is available tends to be based on individual cases of successful conservation or apparent failure. It has been recommended that additional resources be allocated for an ongoing compliance audits program and that both random and targeted audits should take place (Marshall 2010).

## Compliance

The Heritage Act has a range of enforcement options, but only one enforcement action has been taken in the last 5 years under the Heritage Act. In the absence of effective compliance under the Heritage Act, action has instead been undertaken under the *Planning and Development Act 2007* (for example, on two occasions in the Reid Housing Precinct).

The Marshall Report (Marshall 2010) found that administration, compliance and enforcement regarding infringements against heritage places under the *Heritage Act 2004* need strengthening and should be reviewed. The ACT Government is currently developing a response to the Marshall Report recommendations.

## Projects, grants and funding

The ACT Government provides heritage grants for conservation management plans, heritage surveys and histories, signage/interpretation/publications, and small-scale physical conservation works for places and objects (Marshall 2010) (Table 6). In 2009-10, 28 projects received grants under the Heritage Grants Program. This was similar to the number of projects that received grants in previous years. Since 2005-06, the amount of money provided under the grants program has increased by more than 30% from \$262,000 in 2005-06 to \$342,170 in 2009-10.

Table 6. Heritage Grant funding, 2005-2010

Grants	2005-06	2006-07	2007-08	2008-09	2009-10
Number of projects	26	29	28	24	28

# ACT State of the Environment Report 2011

Value	\$262,000	\$262,000	\$269,000	\$278,000	\$342,170
-------	-----------	-----------	-----------	-----------	-----------

Source: Marshall 2010

The grants program is one of the major mechanisms the ACT Government can use to support awareness of heritage within the community. Currently funding is provided primarily for research, studies, interpretation and community activity (Marshall 2010). However, to effectively support physical conservation work, overall funding would need to increase.

Over the reporting period a large number of interpretive signs were erected at a number of heritage sites in the ACT, including the Tuggeranong Schoolhouse, the ACT Pioneers Cemetery Track, Hall and Woden cemeteries and the Sydney and Melbourne Buildings (ACT Government 2010). A number of these signs were jointly funded by the Commonwealth. Signage has been awarded a significant share of overall funding by ACT Heritage: for example, \$100,000 was committed as ongoing funding by the ACT Government for continuation of the Canberra Tracks heritage interpretative signage in 2009-10 (ACT Government 2010).

Funding can be given directly for restoration projects. In 2010-11, \$730,000 was allocated in the ACT Budget for upgrades and restoration to the Ginninderra Blacksmith's Workshop, the Valley Ruin Homestead, Robertson House, Tralee and Couranga homesteads and Cargill's Cottage. ACT Heritage reports that most of these works are now complete. An additional \$150,000 was spent on restoration of a sheep shearing shed at the Mulligan's Flat Woodlands Sanctuary (to be used as an education facility and focal point for walks and tours). In January 2008, the Chief Minister also committed \$25.7 million, plus \$100,000 annually, to the conservation of Tharwa Bridge (Marshall 2010).

Complex heritage decisions are guided by more comprehensive assessments. For example, in agreement with the Heritage Council, the ACT Community Services Directorate has commissioned a heritage consultant to assess all heritage properties managed by the Directorate (including Northbourne Flats), with the intention of guiding the Council as it determines the heritage significance of these properties.

## Backlog of registrations

As identified in the *2007-08 State of the Environment Report*, the current ACT Heritage Register inherited a large backlog of 298 nominations from the previous system in 2005-06. To date the backlog has been reduced to 211 nominations, all of which are heritage places. The backlog is affected by staffing resources, time required to process applications, the complexity of issues involved, the quality and age of information in some old nominations, the increasing level of documentation required for nominations, and the registration of high priority new nominations (Marshall 2010). Typically, it is estimated that a nomination takes between 3 and 20 working days to be assessed and, where necessary, further researched. Conservation precincts tend to be more complex and require more effort than individual places or buildings (Marshall 2010).

Table 7, an overview of decisions made since 2005 in relation to the ACT Heritage Register, shows that the number of Registered places and objects has increased

# ACT State of the Environment Report 2011

during the reporting period from 167 in 2007-08 to 190 in 2009-10. There are currently 11 provisionally registered places and objects.

Table 7. Summary of registration decisions

Activity	2007-08	2008-09	2009-10
Provisional, including not to register	23	12	5
Registration	0	18	4
Cancellation of registration	0	0	1 partial
Registered places and objects	167	184	189
Provisionally Registered places and objects	15	6	12
Nominated places and objects	275	264	260

Source: ACT Heritage

## Statutory issues

A combination of statutory issues and the imminent closure of the Register of the National Estate (DSEWPaC 2008) means that some heritage places and objects in the ACT are at risk of not being protected. They are the subject of discussions between the ACT Government and the Australian Government, as outlined below.

As indicated previously, heritage objects and places in the ACT are subject to two different statutory and planning processes depending on whether they are located on Commonwealth land or are on Territory land under ACT Government control. The National Capital Plan sets out the broad planning framework for all the Australian Capital Territory, and provides detailed planning policies and guidelines for areas on Commonwealth land designated as having the special characteristics of the national capital (NCA 2011).

Under the National Capital Plan, any natural heritage or cultural heritage places in these designated areas are included on the Register of the National Estate and/or the ACT Heritage Register, and are provided with "due protection" (Marshall 2010).

However, heritage places on Territory land located in designated areas are left unprotected, for three reasons:

- they fall between the ACT and Commonwealth jurisdictions - the ACT Government does not have full heritage and planning approval authority in relation to these locations (Hawke 2009, cited in Marshall 2010); and
- the usual Commonwealth heritage-listing mechanisms and referral triggers under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) do not apply because the heritage items are not on Commonwealth land; and
- the ACT has had a policy of not registering places in designated areas because the protective provisions of the *Heritage Act 2004* do not apply (Marshall 2010).

# ACT State of the Environment Report 2011

As a separate issue, the Register of the National Estate, which is the list of protected natural, Indigenous and historic heritage places throughout Australia, will cease to be recognised as a statutory register in 2012, as reported in the previous *State of the Environment Report*. This change in legislation means that many heritage places and objects in the ACT currently on the Register of the National Estate need to be placed onto alternative registers if they are to remain protected.

In line with recommendations in the *2007-08 State of the Environment Report*, the ACT Heritage Unit and the Heritage Council have been consulted by the National Capital Authority about developments on designated land. As noted previously, 48 currently nominated historic places and objects are located on National Land and are controlled by the National Capital Authority. These places and objects are currently in the process of being removed as nominations for the ACT Heritage Register, because National Land is subject to the Commonwealth heritage provisions under the EPBC Act. The constitutional provisions relating to land management give the Commonwealth statutory power over Commonwealth and National Land, and so effectively the ACT Heritage Act has no jurisdiction over it (Marshall 2010).

For some of the National Land nominations, the ACT Heritage Council has deemed that regardless of the jurisdictional issue the places are of such high importance to the history of the ACT that they deserve recognition in the ACT Register. These places have progressed to provisional registration and/or final registration.

No action to reassign the remaining heritage places on National Land has been undertaken at this stage as this work has not been identified as a priority by the ACT Heritage Council.

The recently completed review of the *ACT Heritage Act 2004* recommends measures that may improve monitoring of the condition and health of both ACT Government and privately owned heritage places. While some auditing work has been completed, it has not yet been analysed for reporting purposes.

## Glossary

**National Land:** land in the Territory that is gazetted as National Land, which the Commonwealth has retained for its own use; it is managed by the National Capital Authority or the Department of Finance and Administration on behalf of the Commonwealth

## References

ACT Government 2010. *Budget 2010-2011 A Budget for Our Growing City*. Canberra.  
[www.treasury.act.gov.au/budget/budget\\_2010/files/press/08\\_press.pdf](http://www.treasury.act.gov.au/budget/budget_2010/files/press/08_press.pdf) (accessed 11/8/11)

DSEWPaC 2008. *Register of the National Estate*. Australian Government Dept of Sustainability, Environment, Water, Population and Communities. Canberra.  
<http://www.environment.gov.au/heritage/places/rne/index.html> (accessed 1/5/11)

# ACT State of the Environment Report 2011

Hawke, A. 2009. *The Australian Environment Act – Report of the Independent Review Of The Environment Protection and Biodiversity Conservation Act 1999*. A report to the Commonwealth Minister for the Environment, Heritage and the Arts. Australian Government. Canberra.

<http://www.environment.gov.au/epbc/review/publications/pubs/final-report.pdf>  
(accessed 12/11/11)

Marshall, D. 2010. *ACT Heritage Act Review*. ACT Chief Minister's Department. Canberra

[http://www.cmd.act.gov.au/\\_\\_data/assets/pdf\\_file/0019/154315/reduced\\_ACT\\_Heritage\\_Act\\_Review\\_4Aug10.pdf](http://www.cmd.act.gov.au/__data/assets/pdf_file/0019/154315/reduced_ACT_Heritage_Act_Review_4Aug10.pdf) (accessed 03/05/11)

NCA 2011. *Canberra, the Seat of Government*. National Capital Authority. Australian Government. Canberra.

[http://www.nationalcapital.gov.au/downloads/education\\_and\\_understanding/factsheets/8CanberraSeatofGovernment.pdf](http://www.nationalcapital.gov.au/downloads/education_and_understanding/factsheets/8CanberraSeatofGovernment.pdf) (accessed 11/08/11)

Pearson, M. 2008. Climate Change and its Impacts on Australia's Cultural Heritage, *Historic Environment*. 21.2:37-40

Webb, B. 2011. *Impacts of Climate on the Canberra Nature Park: Risks and Responses: Report for the ACT Office of the Commissioner for Sustainability and the Environment*. ANU Climate Change Institute and Fenner School of Environment and Society. Australian National University. Canberra.

[http://www.envcomm.act.gov.au/\\_\\_data/assets/pdf\\_file/0004/220477/OCSE\\_ANU\\_report\\_climate\\_CNP.pdf](http://www.envcomm.act.gov.au/__data/assets/pdf_file/0004/220477/OCSE_ANU_report_climate_CNP.pdf) (accessed 17/11/11)

## Other data sources

In addition to these published reports, data for this paper were also sourced from:

ACT Community Services Directorate (CSD)

ACT Heritage - previously part of Chief Minister's Department - now part of the Environment and Sustainable Development Directorate (ESDD)

# ACT State of the Environment Report 2011

## THEME: People

### Indicator cluster: Natural hazards

The indicators for this cluster are:

- *Flooding (C)* - includes flood risk by area and type;
- *Fire and settlement (C)* - includes fire risk relating to community;
- *Fire impacts (I)* - includes fire impacts on the community;
- *Flood impacts (I)* - includes the number and type of floods, and flood impacts on community;
- *Wind storms (I)* - includes the number and type of wind storms and impacts on community;
- *Fire management (R)* - includes fire management from a human settlement perspective; and
- *Flood management (R)* - includes effectiveness of flood management responses including structural and non-structural actions.

**Condition indicators (C)** present data that tell us the state of the environment at any particular time.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

### Summary

The ACT features rugged timbered mountains, hill country, grasslands and a network of river systems, and just over half the ACT comprises conservation areas. This, and the close proximity of bushland reserves to urban areas, increases the level of risk of property damage resulting from natural hazards such as floods, storms and fire. New greenfield and periurban developments extend the area of the ACT that is vulnerable to natural hazards such as fires. As the population of the ACT grows, and urban development extends, so the risks associated with natural hazards may increase.

Urban areas near to bushland reserves, hilly terrain or grassland are at greater risk from bushfire or grassfire than areas further away. Urban development, whether greenfield or urban infill, is associated with impervious surfaces from which water must run off, unable to soak into the soil. In heavy rainstorms impervious areas increase the chance of flash runoff and localised flooding. Climate change is predicted to lead to more frequent and more intense natural hazards associated with extreme weather conditions and events. During the reporting period there were 4 major storm events, including heavy hail in east Tuggeranong on 31 December 2007 and a tornado in Gungahlin on 22 January 2009. As well as storm, fire and flood, identified risks related to climate change include extreme heat and related public-health impacts, and vulnerability of water resources.

# ACT State of the Environment Report 2011

The ACT Government has made considerable progress since the last reporting period in improving planning and systems for managing natural resources and mitigating potential hazards. A common theme has emerged, of shared responsibility between citizens and agencies to prevent and respond to natural hazard events.

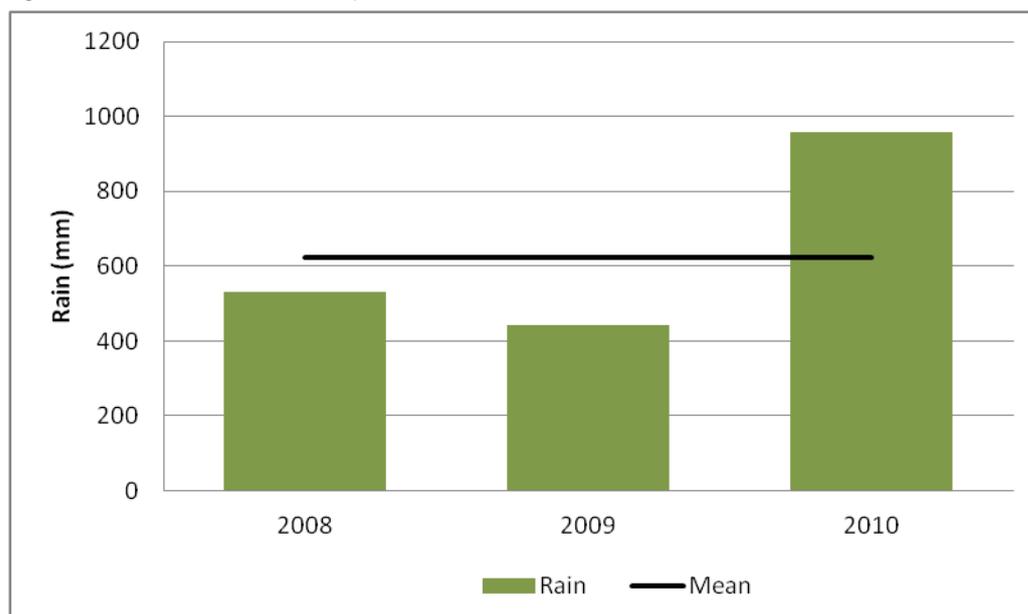
## Introduction

Natural hazards are naturally-occurring sources of potential harm, or an existing condition that may cause harm to people or damage to property or the environment. Population growth and urban development in some locations can increase exposure to natural hazards such as flood and fire, with potentially significant impacts on people, buildings and infrastructure (Geoscience Australia 2007). This indicator cluster examines the risk and management of natural hazards, particularly flood, fire and storms, in the ACT over the reporting period.

## Condition indicators

During the current reporting period, 2007-2011, unlike the previous reporting period (2004-2007), the climatic conditions ranged from drought to higher than average rainfall in eastern Australia (BoM 2011) as a result of the La Niña weather. Rainfall figures for the ACT for 2008-2010 are shown in Figure 1.

Figure 1. Rainfall at Canberra airport 2008-2010



Source: BoM 2011

## Flooding

Flooding can be broadly categorised into two groups: river flooding and urban flooding. Factors that can influence the severity of flooding, apart from intensity of rainfall, include land use, urban density, elevation, site slope, antecedent moisture conditions, soil type and the amount of water that can be stored in the catchment.

# ACT State of the Environment Report 2011

## River flooding

River flooding occurs when a river's flow exceeds the capacity of its channel. In the ACT flooding can occur when there is heavy rainfall in the catchments of the rivers and streams that pass through the ACT. Two of these, the Murrumbidgee River and the Molonglo River, have large upstream catchments within NSW. Heavy rainfall in the Queanbeyan River catchment, a tributary of the Molonglo River, resulted in a significant flood event in December 2010, with impacts that affected water quality in Lake Burley Griffin.

Hydrological studies to support Canberra's development have produced a large body of knowledge on local flooding. As a result, local rivers and many of the creeks around Canberra have flows modified by dams, flood retention basins or pollution traps.

## Urban flooding

Stormwater runoff in urban areas from heavy rainfall events can create localised flash flooding. Roads, carparks and roofs are impervious and shed water during rain events. If the rain is heavy and the impervious areas are large compared to interspersed vegetated areas such as gardens, parks, reserves and playing fields, the volume of runoff can exceed the capacity of drains and stormwater channels and result in temporary local flooding.

In low-lying or relatively flat urban areas, heavy rain can cause concrete-lined stormwater drains to overflow. If heavy rain exceeds the capacity of in-ground pipes under walkways and pavements in steep urban areas there can be overland flow, and water may accumulate as a localised flood (ACTPLA 2010).

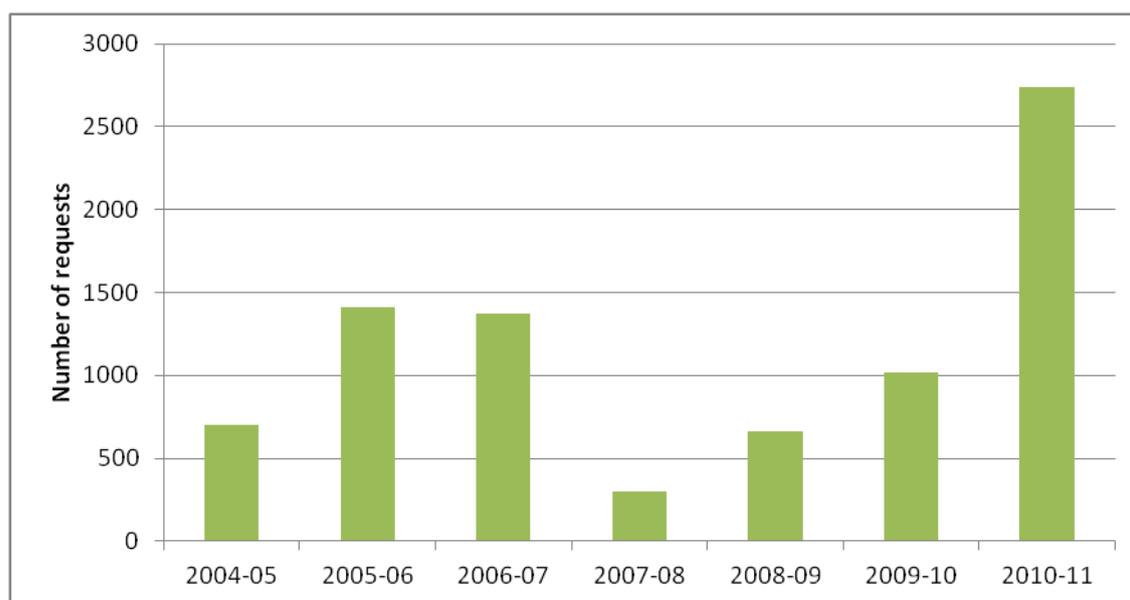
Urban areas of the ACT generally include more vegetated areas than other Australian cities. In vegetated areas, rain is often absorbed into the soil relatively quickly, mitigating flood risk.

## Storms

Data on storm numbers are limited, but a large increase in requests to emergency services for assistance with storm and flood damage (Figure 2) aligns with the increase in rainfall in 2010 (Figure 1).

# ACT State of the Environment Report 2011

Figure 2. Requests for assistance because of storm and flood damage



Source: ESA 2011

## Fire and settlement

The topography of the ACT poses challenges for fire management, especially along the western boundary of the ACT where there is a heightened risk of bushfire from the north and west. Approximately 60% of the Territory comprises hills or mountains (ACT Government 2009a).

The ACT also has extensive forest areas and grasslands. Conservation areas occupy approximately 53% of the land area and, as noted previously, within Canberra itself there is a high proportion of green space within the urban development area.

This combination of landscape and vegetation, compounded with the warm dry climate of inland Australia, exposes Canberra to a high risk of bushfire. Individual fire events combined with drought and heightened fuel loads can lead to bushfires of considerable size and ferocity, resulting in property damage and even loss of life (ACT Government 2009a).

Nine large severe fires have occurred in the ACT since the beginning of the 20th century (ACTPLA 2010). In the worst of these (January 2003), hundreds of houses were damaged or destroyed, heritage and other buildings and infrastructure were also burnt out or otherwise affected, and four lives were lost. There is now a high level of awareness of the risks posed by bushfire in the ACT (ACTPLA 2010).

These events are currently the focus of a major international collaborative research project (Fromm et al. 2010). This research, as well as other assessments, found that the 2003 fire was of a type not observed in Australia before 2001 (Dold et al. 2005, Fromm et al. 2006). It behaved in ways that were fundamentally different to previous fires, and a critical component was the ACT's rugged landscapes. Further work, via a climate modelling project that is modelling relative humidity and vertical air flow effects on wildfire, is examining increases in bushfire risk in relation to

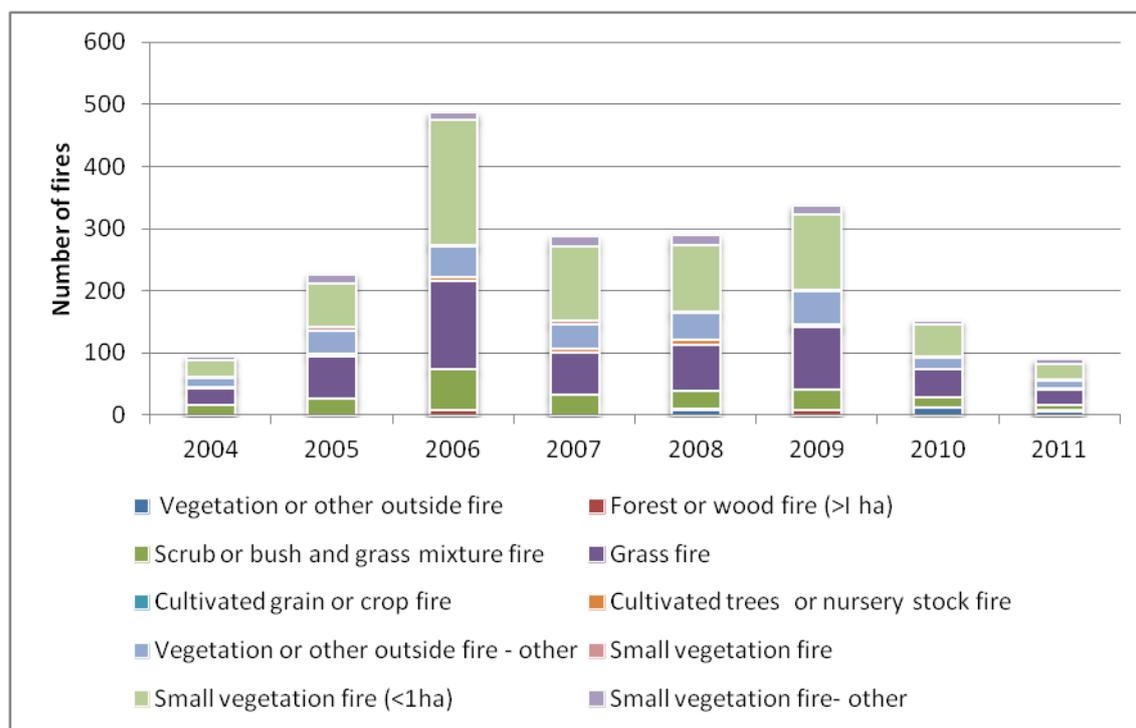
# ACT State of the Environment Report 2011

climate. The 2003 ACT fire has helped build knowledge of fire behaviour and risk (McRae and Sharples 2011), and strategies for mitigating this type of fire are still being developed through further research.

Large areas of fire-affected vegetation are prone to what is termed a re-burn fire (Pyne and Omi 1986) and this will be a significant source of risk in the next few summers in the ACT. There have been no re-burn fires in the ACT since 2003, although one occurred across the border in NSW on 25 Feb 2006.

Over the reporting period, fires across the ACT peaked in 2006 with 486 fires, which was significantly more than in any other year during the period (Figure 3). There were fewer fire events in 2010, possibly because the spring and summer had above-average rainfall (Figure 1). Most fires in the ACT occur close to urban areas, cover less than 5 hectares and are ignited by people, either intentionally or accidentally (ACT Government 2009a). Fires were largely small vegetation fires (less than 1 hectare in area), burning grassland or a mixture of scrub, bush and grassland.

Figure 3. Total bushfires and grassfires by type January 2004 - June 2011<sup>1</sup>



Source: ESA

<sup>1</sup> Note that the 2011 figure is for the six months to June only.

# ACT State of the Environment Report 2011

## Storms

Wind storm events are commonplace across the ACT, particularly between September and February. They can arise from cold fronts, thunderstorms, synoptic winds or foehn winds (dry strong winds blowing downslope).

In 2008, 26 days of strong winds were recorded, including one gale in September with wind speeds up to 98 km/hr. These were the strongest winds the ACT had experienced for nearly 3 years: trees fell on houses and several people were injured. In 2009, 25 days of strong winds were recorded and the strongest wind gust (at Canberra airport) was 106 km/hr in January; it was the strongest gust recorded since 1996. In 2010, there were 22 days of strong winds, and the speed of the highest wind gust recorded at Canberra airport was 85 km/hr in September. A gust at 109 km/hr was recorded at Mt Ginini, in the Brindabella Range, in the same month (BoM 2011).

A number of severe thunderstorms have been associated with storm damage during the reporting period. The 4 major storm events (2 in 2007 and 2 in 2009) included a heavy hail-fall event in east Tuggeranong on 31 December 2007 and a tornado in Gungahlin on 22 January 2009.

The ACT also experiences duststorms. A duststorm initially masked the ignitions of fires on 8 January 2003. During the reporting period, duststorms generated in various regions of inland Australia passed over the ACT, mainly during September and October 2009, reflecting the drought conditions at the time. There were no duststorms during the high rainfall period associated with the 2010 La Niña.

In 2009, 2 duststorms were recorded in the ACT, during which visibility was reduced to 3-4 km. These were a result of the very dry conditions across inland Australia, coupled with a cold front moving across from the west, causing dust to be raised by the strong westerly-northwesterly winds preceding the front.

For more information on long-term changes in wind speed see the *Driving Forces* paper. For more information on the predicted increase in temperatures, wind and events resulting from climate change, see the *Climate vulnerability* indicator cluster paper in the *Climate* theme.

## Pressure indicators

There are no pressure indicators for natural hazards.

## Impact indicators

### Flood impacts

Historically, flooding events in Canberra have not been frequent but have caused injury, loss of life and property, and infrastructure damage. For instance, the costs from damage caused by the storm in December 2005 were estimated at \$15 million (ACT Government 2010a). They also challenge the resources and capacity of emergency services.

# ACT State of the Environment Report 2011

The likelihood of flooding in the ACT is monitored and managed largely through use of upstream infrastructure. During the prolonged drought, there were relatively few flood events in the previous reporting period to June 2007, with some notable exceptions. For example, severe thunderstorms recorded on New Year's Eve 2006 and in February 2007 resulted in localized flood damage worth tens of millions of dollars (ACT Government 2010a).

During the current reporting period 2007-2011, river flood events occurred in December 2010 which had impacts on Lake Burley Griffin on the Molonglo River. Consequences of this flood included failures of safeguards at the Queanbeyan Sewage Treatment Works and elevated bacterial concentrations in the lake (see the *Water quality* indicator cluster paper for more information) resulting in the lake being closed to primary and secondary contact.

Although climate change modelling predicts little immediate change to the ACT's mean annual rainfall, rainfall events in the ACT are likely to be more extreme (ACTPLA 2010). This is likely to result in more frequent and severe instances of overland flooding, especially in the inner north and inner south suburbs of Canberra where pipe failures can be expected in areas with relatively old infrastructure (Engineers Australia 2010). See the *Climate vulnerability* indicator cluster and *Driving Forces* paper for more information.

## Fire impacts

Extreme fire events such as the 2003 bushfire release carbon stored in plant material and the soil in ways not previously anticipated. When extreme fires occur in the northern hemisphere their signature in the atmosphere is masked by other contaminants. In the cleaner air of the southern hemisphere the atmospheric impacts of fires such as the Canberra 2003 fire and the more recent Black Saturday fires in Victoria in 2009 are able to be studied and monitored accurately by atmospheric physicists and colleagues.

These extreme fires have behaved differently from previous fires in which lee-slopes were assumed to be protected from the peak fire severity. The ACT and Black Saturday fires burnt most severely on sheltered relatively damp slopes. This pattern of fire behaviour has direct and indirect effects on soil carbon, the soil seedbank, the forest stand recovery, the recovery of hydrology and the water quality. At present there exist no techniques for mitigating the impact. The possibility that the onset of violent pyro-convection reflects an impact of climate change on atmospheric structure is of concern.

If these events are indeed increasing in frequency, then the potential impact on sub-alpine ecosystems in the ACT could be significant. Research has identified that on approximately one night in seven, the dew-point temperature in the alpine high-country falls to very low values, which leads to drying out of the organic soils, increasing fuel flammability and altering hydrology. That the peak impacts often occur between midnight and sunrise makes the situation dangerous for fire crews working there because a fire may escape control unexpectedly (Bushfire CRC 2008). If these night-time dewpoint depression events are a new phenomenon in this

# ACT State of the Environment Report 2011

region, rather than recently recognised for the first time, they could have major ecological impacts for species and community processes in alpine regions.

While such large fires are relatively rare, they are estimated to cause more than 95% of the damage and loss to people, property and infrastructure assets in the ACT through natural hazards (ACT Government 2009b). Property losses valued between \$600 million and \$1 billion were attributed to the 2003 ACT fire (Doogan 2006). An assessment of these bushfires concluded that 50% of the house losses resulted from fire attack from suburban fuels, and nearly 60% of all houses within the first 50 m of the urban edge exposed to the fire were destroyed (ACT Government 2009a). The link between climate change and an increased risk of fires presents planning challenges as the urban footprint of the ACT expands.

In addition to the possibility of injury and death, bushfires can have a range of immediate, delayed and chronic health consequences, including burns, smoke inhalation, respiratory problems, post-traumatic stress disorder, and eye problems. Limited data are available on the impacts to physical and mental health, or the short or longer term economic implications, resulting from bushfire or grassfire (Rotstein and Webb 2009).

The long-term impact of fire is demonstrated by the ongoing recovery efforts following the 2003 ACT fires. Most houses have now been rebuilt in the affected suburbs and native vegetation is regenerating. The lower Cotter River catchment has been a focus for revegetation work from 2007-08 onwards, in an effort to protect the quality of the Territory's water supply. The bushfire destroyed the pine forest and native vegetation in this area and exposed bare soils, thereby creating prime conditions for erosion. Tens of thousands of tonnes of sediment entered the Cotter River reservoirs, adversely affecting water quality and quantity (ACT Government 2009b). For more information on recovery from the impact of the 2003 bushfire on land and water, see the *Land health* indicator cluster paper and *Rivers, lakes and wetlands health* indicator cluster paper. In the future, extreme fire events could have an impact on essential infrastructure, such as the Stromlo Water Treatment Plant. Fire-risk planning requires the preservation of essential infrastructure as an ongoing priority.

## Climate change and fire

Climate change is predicted to produce the following changes to the fire regimes of the ACT:

- more unplanned fires;
- less time between fires;
- larger areas burned by unplanned fires;
- an earlier start to the fire season every year; and
- larger total areas of forest burned by fires.

Both the frequency and the intensity of bushfires are predicted to increase in south-eastern Australia, including the ACT (Rotstein and Webb 2009). Estimates suggest

# ACT State of the Environment Report 2011

that the overall fuel hazard for the ACT will remain at or below moderate levels, even in the absence of fuel management activities. However, by 2019, fuel loads in the western half of the ACT are projected to reach very high to extreme hazard levels (ACT Government 2009a).

Climate change modelling indicates that an increase in the frequency of extreme bushfire conditions is likely by 2020, and that by 2050 extreme bushfire conditions are likely to occur more frequently than once every two years (ACT Government 2009b).

In 2005, the CSIRO conducted a study into the impact of climate change on fire risk to Canberra, based on historical fire danger indices such as the Forest Fire Danger Index (FFDI)<sup>2</sup>. The study found that from 1974 to 2003 Canberra experienced an average of 23 days per year in which the FFDI was very high or extreme (Table 1). It predicted that the FFDI will reach those levels on up to 28 days in 2020 and up to 36 days in 2050 (CSIRO 2005 cited in ACTPLA 2010). For more information see the *Climate vulnerability* indicator cluster.

Table 1. Predicted average number of days of very high or extreme fire danger, based on the FFDI

Year	Number of actual and predicted days of very high or extreme fire danger (based on FFDI)
1974-2003	23
2020	28
2050	36

Source: CSIRO 2005, ACTPLA 2010

As mentioned above, extreme fires accompanied by violent pyro-convection have not been observed in Australia prior to 2001. There have since been over 18 confirmed events (McRae and Sharples 2011). As well as the fire in the ACT on 17 and 18 January 2003, major fire events have occurred in adjacent parts of NSW: at Tantangara on 14 October 2006 and in the Tinderry Mountains on 17 December 2009. Roughly half of the major events have been in the Australian Alps.

New research suggests that this change in fire regimes may be the largest impact of climate change across Australia. The 2003 ACT fire was among the most intense fires recorded globally. The large body of fire research that has occurred as a result of the 2003 ACT fire has achieved the following (Bushfire CRC 2008; Sharples 2009; Sharples et al. unpublished, 2009):

- confirmation in Australia of the occurrence of foehn winds, eruptive fire behaviour and pre-mixed combustion;

---

<sup>2</sup> The Forest Fire Danger Index helps in estimating the exposure to risk from a bushfire. The scale ranges from an index of 1, where a fire will not burn, to more than 100, where suppression is impossible.

# ACT State of the Environment Report 2011

- detailed understanding of lee-slope eddy winds, wind channelling, mountain wind waves, low-level jet winds, and the nature of smoke in violent pyro-convective events;
- study of smoke transport around the southern hemisphere;
- discovery of fire channelling, a process new to science; and
- the first confirmed instance of pyro-tornadogenesis.

## Response indicators

### Disaster and emergency framework

In 2009, the Council of Australian Governments (COAG) adopted a “whole-of-nation resilience-based approach to disaster management, which recognises that a national, coordinated and cooperative effort is needed to enhance Australia’s capacity to withstand and recover from emergencies and disasters” (COAG 2009).

In the ACT, the disaster and emergency framework encompasses natural resources management, resilience, disaster management, and shared responsibility.

For managing the ACT’s natural resources, the ACT Natural Resource Management Council (ACTNRMC), a partnership organisation between ACT communities and the ACT and Australian governments, has developed a holistic long-term plan. The *Bush Capital Legacy - iconic city, iconic natural assets* report was published in 2009 and is a revision of the Territory’s first 2004 plan. It includes 16 targets which have been designed to assist the community and government in the management of natural resources, focusing on minimising the risk of natural hazards (ACTNRMC 2009).

Disaster management and resilience in the ACT are supported by Australian Government funds as part of the *National Partnership Agreement on Disaster Resilience*. The funds are to be spent on responses to natural hazard impacts. From 2010 to 2011, the Australian Government is providing \$1,260,000 to the ACT Government with an additional \$1,110,000 for the development of a Territory-wide natural disaster risk assessment (AG 2011).

The ACT Emergency Plan (ACT Government 2010b) describes the responsibilities, authorities and mechanisms for preventing and managing emergencies and their consequences within the requirements of the *ACT Emergencies Act 2004*. The core principles of this plan are Prevention, Preparedness, Response and Recovery (PPRR) (ACT Government 2010b).

Legislation, the *NUZ4 - River Corridor Zone Objectives*, was introduced by the ACT Government in October 2010 to guide development and improve natural resource management practices associated with river corridors. It applies a catchment management approach which includes minimising the risks of natural hazards and disasters (ACT Government 2010c).

ACT Government policy for resilience in emergency, and disaster response, focuses on the need for all sectors of the community to take responsibility and actively engage in reducing risks. Rates of volunteering by the community in emergency

# ACT State of the Environment Report 2011

services have largely increased during the reporting period (Table 2), indicating a willingness by the community to engage in emergency management.

Table 2. Volunteer levels in emergency services

	2007-08	2008-09	2009-10	2010-11
Rural Fire Service	400	400	480	374
ACT Fire Brigade Community Fire Units	950	780	795	859
State Emergency Service	205	247	228	240
Mapping and Planning Support	Not available	71	73	76

Source: JACS 2008, JCSD 2011

## Fire management

### Strategic management

The ACT Territory and Municipal Services Directorate (TAMS) is responsible for the management of 73% of the land area in the ACT and for providing fire suppression capability through the Parks Rural Fire Brigade (ACT Government 2009b).

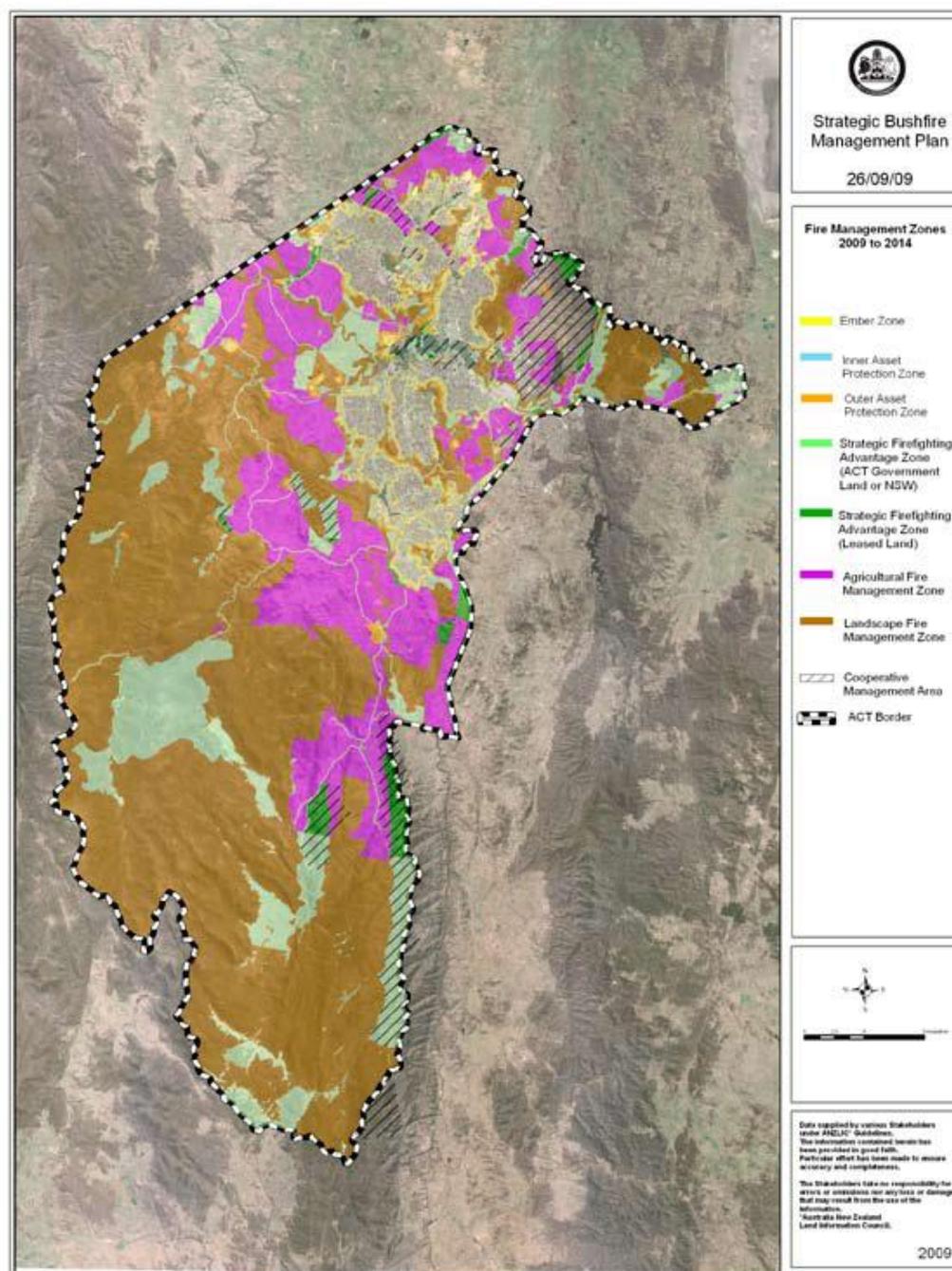
The *Strategic Bushfire Management Plan for the ACT* (ACT Government 2009b) has been prepared under the *Emergencies Act 2004* and provides the framework for fire management in the ACT. A clear objective of the Plan is to reduce bushfire risk and impacts through shared responsibility by creating a partnership between the ACT Government and an aware and educated community. The Government's role is to provide policies and programs, professional expertise and resources to implement programs and support the community. Individuals are required to take personal responsibility for reducing the threat of bushfires to themselves, their families and properties. The Plan defines guidelines for bushfire fuel management, fire management zones and mapping (Figure 4) and sets out:

- the Statutory and Planning Framework;
- the framework of Prevention, Preparedness, Response and Recovery;
- fire management zoning;
- ecological fire thresholds and fire management for flora and fauna;
- impact of fire on water catchments; and
- fuel management techniques.

The Strategic Bushfire Management Plan enables members of the community to consider their vulnerability to bushfires, and guides them in necessary steps to reduce their bushfire risk. This plan will be monitored by the ACT Emergency Services Agency (ESA) to ensure that strategies and actions in the Plan are achieved, and where necessary, are adjusted to suit changing circumstances.

# ACT State of the Environment Report 2011

Figure 4. Fire management zones 2009-2014



Source: ACT Government 2009b

During the reporting period, an improved Fire Danger Rating system measuring soil moisture deficiency, weather variability, relative humidity, wind, and recent rainfall has been developed. It will enable the ACT Government to improve strategies to prevent and manage bushfires and better alert ACT residents to fire danger.

The Bushfire Cooperative Research Centre has found the 'stay or go' policy to be appropriate advice, although there are a number of known limitations to this policy. The policy, with full name *Prepare, stay and defend your property or leave early*, was first set out in the late 1990s when it was generally accepted by fire agencies that

# ACT State of the Environment Report 2011

staying to defend a well-prepared home, or leaving for a safe place well before a fire threat appeared, were the two best survival options in a bushfire (Bushfire CRC 2011).

As a result of unpreparedness for the devastating Victorian Black Saturday bushfire in 2009 in relation to 'stay or go', the ACT and other jurisdictions have introduced a 'catastrophic' warning category into the McArthur Forest Fire Danger Meter, which indicates that affected areas may not be defensible against the threat of bushfires (Rotstein and Webb 2009).

The 2003 ACT fires revealed significant weaknesses in the emergency management of the ACT hospital system and its ability to deliver effective health care in such an emergency. Vulnerabilities were identified in the adequacy of its electricity supply, communication, transport of severely injured people, and preparedness of staff (Rotstein and Webb 2009). The *Emergencies (Emergency Plan) 2010 (No1)* (ACT Government 2010b) describes initiatives to ensure that improved systems and responses are in place if future large-scale fires occur. While improvements have been made, these will only be fully tested in the event of an emergency.

## Monitoring, evaluating and managing fire fuel

A Bushfire Operations Plan is developed each year. It sets out strategies to manage bushfire risk including (ACT Government 2009b):

- fuel management (slashing, controlled burning, grazing, physical removal and treatment of fuel by chemicals);
- access management (construction, upgrade and maintenance of trails);
- infrastructure (such as helipad development and building water tanks);
- equipment purchase;
- training;
- auditing and monitoring;
- planning and research;
- education; and
- response and standby.

In response to a recommendation in the *2007-08 ACT State of the Environment Report*, the ACT Government noted that monitoring is ongoing; annual surveys document changes in the structure and composition of vegetation. Additionally, 3 new monitoring sites were established as part of the implementation of the 2009-10 Bushfire Operations Plan and a further 5 sites are marked for development.

Landscape Function Analysis is a technique that is now included in the methods used for monitoring vegetation in the ACT. This technique has been developed for full floristic monitoring and rapid assessment, and it includes a focus on soil characteristics and function. For the newly established monitoring sites, analysis of pre and 1-year post-fire data is not yet available. The results from the previously established Potters Hill (Southern Namadgi National Park) monitoring site have

# ACT State of the Environment Report 2011

shown that “the prescribed burn had little effect on the vegetation community’s composition, but had a noticeable effect on its structure. The structure of vegetation communities is important for fauna, and can be utilised as an indicator of potential habitat” (ACT Government 2010d).

The ACT Planning and Land Authority (ACTPLA, now part of the Environment and Sustainable Development Directorate) also has a bushfire management plan for the urban interface with bushland or grassland and for new urban growth areas (ACT Government 2006). The plan notes that management of the large open space in the ACT must balance bushfire risk mitigation and the planning tradition of Canberra.

The Government has stated that the ACT Planning Strategy (ACT Government 2011) will address the future growth of the city; however, at present there are no proposals to change the existing uses of land currently zoned for forestry (ACT Government 2010d).

The *2007-08 ACT State of the Environment Report* recommended determining the long-term use of all forestry land burned in the 2003 bushfire where long-term land uses were not already defined.

See the *Threatening processes* indicator cluster in the *Biodiversity* theme, for further information on the effects of fire on biodiversity.

## Flood management

Natural and built infrastructure policies can modify the risks of urban flooding. For instance, vegetation along riverbanks can have a beneficial effect on flooding in lowland areas by slowing the rate of water movement (VDSE 2011). Willows along the Molonglo River in the ACT have been thought to help reduce the kinetic energy of flood water, while reducing bank scouring. However, in general, flood risk is reduced by *removal* of willow trees from the edges of rivers and streams<sup>3</sup>. In large floods, local flood level is controlled more by constrictions such as bridges and road embankments, that choke the flow down, than by changes to riverbank or instream vegetation (VDSE 2011).

### River flooding

The dams and reservoirs in the ACT provide flood storage and attenuation for the river catchments; in particular:

- the Googong Reservoir on the Queanbeyan River is part of the ACT and Queanbeyan water supply network and provides flood storage and attenuation from extreme rainfall in the Queanbeyan River catchment;

---

<sup>3</sup> Willows at the edges of rivers invade the bed and banks, reducing the size of the stream. This reduces the capacity of the stream to carry flood waters. The result is that willows *increase* the height of flood waters in small and moderate sized floods (VDSE 2011).

# ACT State of the Environment Report 2011

- Lake Burley Griffin will provide flood attenuation from future major flooding in the Molonglo River.
- the Cotter River's three large water supply storage reservoirs (Corin, Bendora and Cotter) continue to provide flood mitigation and storage for extreme rainfall events within that river catchment;
- areas along or immediately downstream from the Cotter River which may be affected by flooding in the Cotter River have limited urban development; however numerous associated smaller watercourses can produce localised river flooding within the ACT;
- flood storage and attenuation for the Murrumbidgee River is provided by the Tantangara Reservoir which collects runoff which is then diverted through the Snowy Mountains Scheme, used for the generation of electricity, and then released back into the Murrumbidgee River downstream of the ACT.

The *2007-08 ACT State of the Environment Report* recommended that catchment management could be improved by developing an integrated water supply catchment management policy and strategy for the ACT. While the ACT Government noted the recommendation, progress towards a governance structure based on an integrated catchment approach to managing water systems and supply has not yet been fully progressed or implemented (OCSE 2010).

## Urban flooding

Both greenfield and infill urban development inevitably increase the area covered by impervious surfaces and the chance of flash flooding from accumulated runoff. This effect is augmented by urban development on previously unallocated open space that had acted to mitigate flash flooding by capturing rainfall. Other flood impacts are associated with higher density development, such as underground car parking.

Managing urban flood risk involves identifying future rainfall patterns, identifying areas that are vulnerable to overland flooding, and changing the design specifications of stormwater systems to accommodate the changed rainfall pattern.

Urban stormwater infrastructure generally comprises minor and major systems. The minor system typically includes kerbs and channels, roadside channels, inlets, underground drainage, manholes and outlets designed manage storm events. A major network is designed to manage rare flood events, and typically includes road pavements, floodway channels and detention basins (ACTPLA 2010).

Flash flooding is mitigated by the urban stormwater system in the ACT. The stormwater system was upgraded after the Woden Valley flood in 1971 and is expected to fully absorb up to a 1-in-10-year event (the likelihood of a flood of a particular size occurring in a particular timeframe is called the average recurrence interval or ARI). This ARI is roughly equal to the return time of major events in La Niña, the climatic system most likely to produce extreme rainfall.

Infrastructure to manage stormwater is designed to safely collect, store, attenuate and discharge stormwater runoff up to a particular ARI design standard. Urban development and community infrastructure along major rivers and floodplains is

# ACT State of the Environment Report 2011

generally constructed so it should be safe relative to a flood level with a specified ARI. The Government's *ACT Design Standards for Urban Infrastructure* requires minor urban drainage systems to be designed for a:

- 5-year ARI event in urban neighbourhoods;
- 10-year ARI event for group and neighbourhood shopping centres, industrial areas and service trade areas; and
- 20-year ARI event for town centres and parliamentary areas.

All leased land must be protected against a major storm event up to and including the 100-year ARI design storm event (TAMS 2010).

As part of the ACT Government's strategy to manage urban flooding, Canberra has detention basins (commonly near recreational playing fields), located within all new and some older suburbs (ACTPLA 2010). In addition, impervious water infrastructure is increasingly being coupled with (pervious) Water Sensitive Urban Design, allowing stormwater to be managed through the integration of land-use planning and water management. Water Sensitive Urban Design is applied with the aim of reducing the negative impacts of stormwater on waterbodies and aquatic ecosystems. It involves the capture, filtering and use of stormwater in close proximity to where it falls as rain. In 2006, ACTPLA produced a draft report called *Water Sensitive Urban Design: guidelines for sustainable development in Canberra*.

During the reporting period a number of wetlands have been constructed in the urban area with the aim of providing a range of benefits including a particular focus on flood and stormwater protection and water quality improvement (see *Water quality* indicator cluster for further information). These wetlands include:

- Flemington Road Ponds, Mitchell (constructed 2009);
- Banksia St wetland, O'Connor (constructed 2010); and
- Dickson and Lyneham wetlands (construction commenced September 2010).

Further constructed wetlands are planned for Gungahlin in 2010-2012. It is too early to assess the effectiveness of these wetlands in relation to flood protection.

The ACT Infrastructure Report Card (Engineers Australia 2010) rated the ACT's stormwater infrastructure at C+ in 2010, based on a range of attributes (Table 3). The rating was an improvement from a C rating in 2005.

Table 3. Factors contributing to rating of stormwater infrastructure in ACT, 2010

Positive	Negative
Increased uptake of water sensitive urban design	Lack of a long-term stormwater strategic plan
Increased use of stormwater for irrigation	Fragmented governance arrangements for stormwater
Achieving required levels of drainage and flood protection in areas developed since the late 1960s	Inadequate levels of drainage and flood protection in older areas of Canberra

Source: Engineers Australia 2010

# ACT State of the Environment Report 2011

## Glossary

**Flash floods:** floods that occur and disappear again in a short timeframe following times of heavy rainfall

**Flood:** a great flowing or overflowing of water, especially over land not usually submerged

**Foehn wind:** a warm dry wind on the lee side of a mountain range. When humid air goes over a mountain it loses its moisture and cools down, but when it descends the slope the temperature rises because of compression. The result is a strong, warm and dry wind.

**Forest Fire Danger Index:** provides indices for exposure to risks from bushfires. The scale ranges from an index of 1, where fires will not burn, to more than 100 where suppression is impossible

**Landscape Function Analysis (LFA):** a relatively recent technique which has been developed for full floristic monitoring and rapid assessments including focusing on soil characteristics and function

**Natural hazards:** naturally occurring rapid onset events that cause disruption to a community or region by their impact; a natural hazard can escalate to a natural disaster that threatens or causes death, injury or damage to property or the environment and which requires significant and coordinated multi-agency and community response. Any one, or a combination, of the following can cause such serious disruption to communities, infrastructure and the environment: bushfire; earthquake; flood; storm; cyclone; storm surge; landslide; tsunami; meteorite strike or tornado.

**Pyro-convection:** deep convection that is triggered or enhanced by large fires, and that can transport gaseous and particulate products into the upper troposphere and lower stratosphere

**Suburban fuels:** include all of the element in suburbia that contribute to the spread and behaviour of fires through an urban area, such as gardens, mulches, buildings, fences, rubbish, woodpiles

**Urban flooding:** the result of extreme rainfall over a short duration which can produce large quantities of stormwater runoff in urban areas

## References

- ACT Government 2006. *Planning for Bushfire Risk Mitigation*. Canberra.  
[http://apps.actpla.act.gov.au/tplan/planning\\_register/register\\_docs/bushfireguidefeb06.pdf](http://apps.actpla.act.gov.au/tplan/planning_register/register_docs/bushfireguidefeb06.pdf) (accessed 29/8/11)
- ACT Government 2009a. *Strategic Bushfire Management Plan for the ACT - Factors Contributing to Bushfire Risk: Supporting Information: Part One*. Emergency Services Agency. Canberra.

# ACT State of the Environment Report 2011

[http://www.esa.act.gov.au/ESAWebsite/content\\_esa/bushfires/before\\_a\\_bushfire/act\\_sbmp/sbmp\\_downloads/act\\_sbmp\\_supporting\\_information\\_\\_part\\_one.pdf](http://www.esa.act.gov.au/ESAWebsite/content_esa/bushfires/before_a_bushfire/act_sbmp/sbmp_downloads/act_sbmp_supporting_information__part_one.pdf) (accessed 31/8/11)

ACT Government 2009b. *Strategic Bushfire Management Plan for the ACT. Version 2, 2009*. Canberra.  
[http://www.esa.act.gov.au/ESAWebsite/content\\_esa/bushfires/before\\_a\\_bushfire/act\\_sbmp/sbmp\\_downloads/act\\_sbmp\\_plan\\_text\\_web.pdf](http://www.esa.act.gov.au/ESAWebsite/content_esa/bushfires/before_a_bushfire/act_sbmp/sbmp_downloads/act_sbmp_plan_text_web.pdf) (accessed 14/1/2011)

ACT Government 2010a. *ACT Natural Disaster Resilience Program, Australian Capital Territory Program Guidelines 2010-11*. Canberra.  
[http://www.esa.act.gov.au/ESAWebsite/content\\_esa/about\\_us/who\\_we\\_are/grants/ndrp\\_program\\_guidelines.pdf](http://www.esa.act.gov.au/ESAWebsite/content_esa/about_us/who_we_are/grants/ndrp_program_guidelines.pdf) (accessed 23/8/2011)

ACT Government 2010b. *Emergencies (Emergency Plan) 2010 .No1*. Canberra.  
<http://www.legislation.act.gov.au/ni/2010-571/current/pdf/2010-571.pdf> (Accessed 26/8/2011)

ACT Government. 2010c. *NUZ4 – River Corridor Zone*. Canberra.  
<http://www.legislation.act.gov.au/ni/2008-27/copy/74275/pdf/2008-27.pdf> Accessed 28/08/2011 (accessed 28/8/2011)

ACT Government 2010d. *Annual Report 2009-10*. Office of the Commissioner for Sustainability and the Environment. Canberra.  
[http://www.environmentcommissioner.act.gov.au/\\_\\_data/assets/pdf\\_file/0015/205125/OCSE\\_annual\\_report\\_2009-10\\_final.pdf](http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0015/205125/OCSE_annual_report_2009-10_final.pdf) (accessed 28/8/2011)

ACT Government 2011. *Draft ACT Planning Strategy*. Environment and Sustainable Development Directorate (ESDD). Canberra.  
[http://www.actpla.act.gov.au/tools\\_resources/legislation\\_plans\\_registers/plans/planning\\_strategy](http://www.actpla.act.gov.au/tools_resources/legislation_plans_registers/plans/planning_strategy) (accessed 06/12/11)

ACTNRM. 2009. *Bush Capital Legacy - Iconic City, Iconic Natural Assets*. Australian Capital Territory Natural Resource Council. Canberra.  
<http://www.actnrmcouncil.org.au/nrmplan/overview/summary> (accessed 23/8/2011)

ACTPLA 2010. *Human Settlement Vulnerability and Adaptive Management Capacity Assessment: Spatial Plan Evaluation*. ACT Planning and Land Authority. Report prepared by AECOM Australia Pty Ltd for ACTPLA. Canberra.  
[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/20410/2010\\_09\\_08\\_ACTPLA\\_CCvulnerability\\_v2\\_LowResolution.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0007/20410/2010_09_08_ACTPLA_CCvulnerability_v2_LowResolution.pdf) (accessed 21/4/2011)

AG 2011. *Caring For Our Country*. Australian Government.  
<http://www.nrm.gov.au/nrm/act.html> (accessed 23/8/2011)

BoM 2011. *Annual Climate Summary 2010*. Bureau of Meteorology. Melbourne.  
[http://www.bom.gov.au/climate/annual\\_sum/2010/AnClimSum10\\_LR1.0.pdf](http://www.bom.gov.au/climate/annual_sum/2010/AnClimSum10_LR1.0.pdf) (accessed 17/11/11)

Bushfire CRC 2008. *High Fire Risk Project Stakeholder's Research Report: Evidence-Based Policy for Fire Risk Management In and Around Australia's High Country* (draft).

# ACT State of the Environment Report 2011

- Bushfire Cooperative Research Centre.  
[http://www.highfirerisk.com.au/report/hfr\\_report.pdf](http://www.highfirerisk.com.au/report/hfr_report.pdf) (accessed 5/12/11)
- Bushfire CRC 2011. *Evaluation of 'Stay or Go' Policy*. Bushfire Cooperative Research Centre.  
<http://www.bushfirecrc.com/projects/c6/evaluation-stay-or-go-policy> (accessed 5/12/11)
- COAG 2009. *National Strategy for Disaster Resilience Building Our Nation's Resilience to Disasters*. Council of Australian Governments.  
[http://www.coag.gov.au/coag\\_meeting\\_outcomes/2011-02-13/docs/national\\_strategy\\_disaster\\_resilience.pdf](http://www.coag.gov.au/coag_meeting_outcomes/2011-02-13/docs/national_strategy_disaster_resilience.pdf) (accessed 23/8/2011)
- Hennessy, K., Lucas, C., Nicholls, N., Bathols, J., Suppiah, R., Ricketts, J. 2006. *Climate change Impacts On Fire-Weather In South-East Australia*. CSIRO. Canberra.  
[http://www.cmar.csiro.au/e-print/open/hennessykj\\_2005b.pdf](http://www.cmar.csiro.au/e-print/open/hennessykj_2005b.pdf) (accessed 1/10/11)
- Dold, J., Weber, R., Gill, M., Ellis, P., McRae, R. and Cooper, N. 2005. Unusual Phenomena in an Extreme Bushfire. *5th Asia-Pacific Conference on Combustion*. The University of Adelaide
- Doogan, M. 2006. *The Canberra Firestorm – Inquests and Inquiry Into Four Deaths and Four Fires. Volume 1*. ACT Coroners Court. Canberra  
[http://www.courts.act.gov.au/resources/attachments/The\\_Canberra\\_Firestorm\\_\(VOL\\_1\).pdf](http://www.courts.act.gov.au/resources/attachments/The_Canberra_Firestorm_(VOL_1).pdf) (accessed 17/11/11)
- Engineers Australia 2010. *Infrastructure Report 2010: Water*.  
[http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file\\_uuid=C8F26346-DB84-45EF-E104-B53E726D4A61&siteName=ieaust](http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file_uuid=C8F26346-DB84-45EF-E104-B53E726D4A61&siteName=ieaust) (accessed 18/4/2011)
- Fromm, M., Tupper, A., Rosenfeld, D., Servranckx, R. and McRae, R. 2006. Violent Pyro-Convective Storm Devastates Australia's Capital and Pollutes the Stratosphere. *Geophys. Res. Lett.* 33, L05815.
- Fromm, M., Lindsey, D.T., Servranckx, R., Yue, G., Trickl, T., Sica, R., Doucet, P. and Godin-Beekmann, S. 2010. The Untold Story of Pyrocumulonimbus. *Bulletin of the American Meteorological Society*. September 2010: 1193 - 1209
- Geoscience Australia and the Department of Transport and Regional Services. 2007. *Natural Hazards in Australia, Identifying Risk Analysis Requirements*.  
[http://www.ga.gov.au/image\\_cache/GA12967.pdf](http://www.ga.gov.au/image_cache/GA12967.pdf) (accessed 19/8/2011)
- JACS. 2008. *Annual Report 2007-08*. Department of Justice and Community Safety. ACT Department of Justice and Community Safety. Canberra  
<http://www.justice.act.gov.au/publication/view/251> (accessed 6/10/11)
- JCSD. 2011. *Annual Report 2010-11*. Justice and Community Safety Directorate. Canberra  
<http://www.justice.act.gov.au/page/view/2645/title/annual-report-2010-11> (accessed 6/10/11)
- McRae, R. and Sharples, J. 2011. A Conceptual Framework for Assessing the Risk Posed By Extreme Wildfires. *Australian Journal of Emergency Management*, 26.2: 47-53
- Pyne, S.J. and Omi, P.N. 1986. *Wildland Fire and Nuclear Winter - Selected Reconstructions of Historic Large Fires Technical Report*. Defence Nuclear Agency. Washington

# ACT State of the Environment Report 2011

- Rotstein, J. and Webb, B. 2009. *Australian Capital Territory and Region Climate Change Vulnerability and Adaptation Project: Knowledge Status and Future Issues Report On Human Health*. Version 1.0a. Canberra.
- Sharples, J.J. 2009. An Overview of Mountain Meteorological Effects Relevant to Fire Behaviour and Bushfire Risk. *International Journal of Wildland Fire*. 18: 737-754
- Sharples, J.J., McRae, R.H.D., Weber, R.O. & Gill, A.M. 2009. A Simple Index for Assessing Fire Danger Rating. *Environmental Modelling and Software* 24: 764-774.
- Sharples, J., McRae, R, Wilkes, S. Wind-Terrain Effects on the Propagation of Wildfires in Rugged Terrain: Fire Channelling” *International Journal of Wildland Fire*. in press
- TAMS 2010. *ACT Design Standards for Urban Infrastructure*. ACT Department of Territory and Municipal Services. Canberra. Edition 1, Revision 4  
[http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0018/12582/ds01\\_stormwater.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0018/12582/ds01_stormwater.pdf) (accessed 28/8/2011)
- TAMS 2006. *Bushfire Operations Plan*. ACT Department of Territory and Municipal Services. Canberra. [http://www.tams.act.gov.au/play/pcl/fire\\_management/2010-11\\_bushfire\\_operations\\_plan](http://www.tams.act.gov.au/play/pcl/fire_management/2010-11_bushfire_operations_plan) (accessed 13/6/11)
- VDSE 2011. Water in the Environment – Environmental Management. Victoria Department of Sustainability and Environment.  
<http://www.water.vic.gov.au/environment/floodplains/victorian-floods-january-2011/environmental-management>
- Webb, B. 2011. *Impacts of Climate on the Canberra Nature Park: Risks and Responses*. Report for the ACT Office of the Commissioner for Sustainability and the Environment. Canberra.  
[http://www.envcomm.act.gov.au/\\_\\_data/assets/pdf\\_file/0004/220477/OCSE\\_ANU\\_aper\\_climate\\_CNP.pdf](http://www.envcomm.act.gov.au/__data/assets/pdf_file/0004/220477/OCSE_ANU_aper_climate_CNP.pdf) (accessed 1/12/11)

## Other data sources

In addition to these published reports, data for this paper were also sourced from:

ACT Environmental Protection Agency (EPA)- now part of now Environment and Sustainable Development Directorate (ESDD)

# ACT State of the Environment Report 2011

## THEME: People

### Indicator cluster: Community engagement

The indicators for this cluster are:

- *Community environmental awareness and education (C)* - includes level of community environmental awareness;
- *Community environmental participation (C)* - includes level and extent of community participation in environmental initiatives;
- *Environmental activities and events (C)* – includes number and type of environmental activities and events; and
- *Environmental education programs (R)* - includes effectiveness of environmental and sustainability education programs.

### Summary

The ACT community demonstrates a level of concern and involvement in environmental and sustainability initiatives which is above the Australian average.

Many residents are actively involved in community groups and events to protect the environment and enhance sustainability in the ACT. Government programs exist to educate the ACT community and support action to reduce environmental impacts in the home, in businesses and schools, and by increasing the use of sustainable transport options.

ACT residents continue to participate actively in forums initiated by government or by other bodies, and to voice their opinions about environmental protection and sustainability. Many are taking action to reduce their water and energy use and recycle their waste. Educational institutions and businesses are also increasingly engaged in recycling, finding innovative ways to reduce waste and improve energy efficiency.

However, gaps remain between Canberrans' levels of awareness and their actual practical action, especially where there is no economic incentive for change. Current and emerging challenges for the ACT include the need to make more use of sustainable transport options and to reduce the environmental impacts of the Territory's high levels of consumption. A strategic approach that builds on the ACT community's existing capacity and commitment should be able to extend the considerable achievements made to date.

**Condition indicators (C)** present data that tell us the state of the environment at any particular time.

**Pressure indicators (P)** present data about the main human activities that could potentially adversely affect the condition of the environment.

**Impact indicators (I)** present data on the effect that environmental changes have on environmental or human health.

**Response indicators (R)** present data about the main things we are doing to alleviate pressures, or to improve the condition of the environment.

# ACT State of the Environment Report 2011

## Introduction

A community that is aware of, and engaged with, environmental issues is likely to be taking action towards sustainability in individual households and businesses. Moreover, members of an engaged and active community can provide leadership on environmental issues to governments and others in the community. The attitudes and actions of individuals are an important factor in their impact on the environment (as individuals or as household members) because individual choices affect the community's overall consumption, waste generation, urban development and other indicators of sustainability. This indicator cluster examines community awareness of, and education about, initiatives to promote sustainability in the ACT, and the levels of participation.

Most of the available information relates to studies from 2006-07. For 2007-2011, few data are available on existing sustainability education and awareness programs, and with only a few published evaluations it is difficult to assess the programs' effectiveness. Observations below are based on the data available, and are only an indication of attitudes and actions relating to the current reporting period.

## Condition indicators

### Community environmental awareness and education

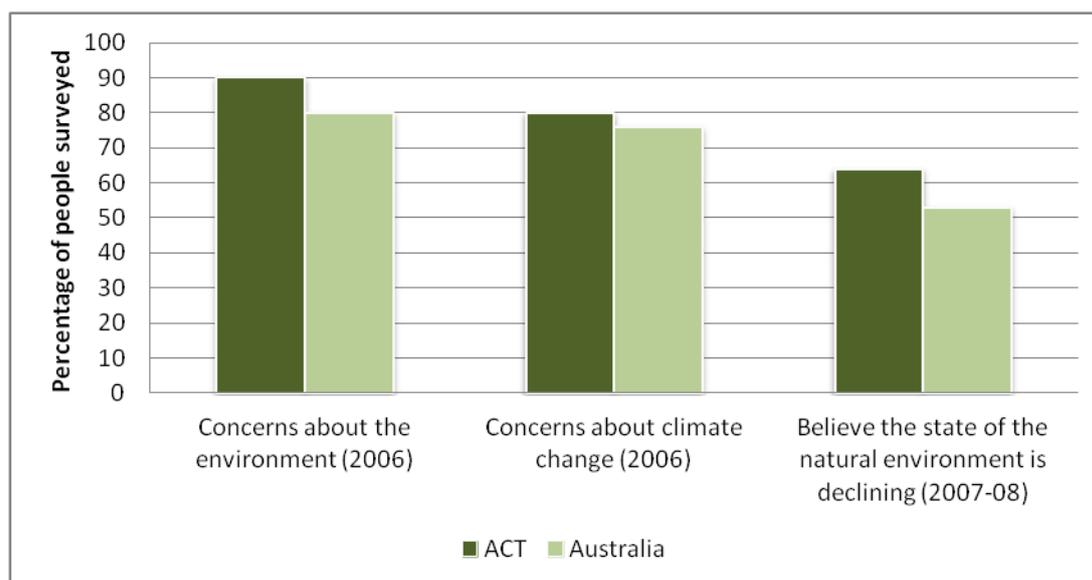
The difficulty in assessing the links between education, awareness and actual behaviour change is well documented. For this reason, efforts people make to reduce environmental impacts cannot always be directly attributed to environmental education programs. Many factors such as cost, convenience and personal values and preferences also play a role in behaviour change.

Around 2006, there was a period of increased media coverage and heightened public attention to global warming and associated environmental concerns. Then the global financial crisis in 2008 and the United Nations Climate Change Conference in Copenhagen in December 2009 shifted community priorities towards economic and employment issues, although water security remained a concern in ACT at least until the drought broke in late 2010. These examples illustrate the dynamic nature of community attitudes. Assessment of community environmental concern and action using data from the 2006 ACT surveys needs to be read in that light. In NSW there is an annual 'Who Cares' survey, which the ACT could emulate to measure community engagement and show changes over time.

The available data suggest that ACT residents have a relatively high level of environmental concern compared to other Australian states. The most recent ABS data (up to 2008) show that the proportion of ACT residents concerned about environmental issues is above the Australian average (Figure 1). The ACT also has above-average results for the proportion of people concerned about climate change, and it has the highest proportion, in any state or territory, of people who believe that the state of the natural environment is declining (64% compared to Australian average of 53%) (ABS 2008 2010b:1).

# ACT State of the Environment Report 2011

Figure 1. Concern about environmental issues: ACT and Australia



Sources: ABS 2008; 2010b

The available data show varying levels of community awareness of different government sustainability programs. In 2006, 79% of those surveyed were aware of the Rainwater tank rebate program, 52% were aware of the Bike-and-ride scheme, while only 15% were aware of the Travelsmart initiative (TAMS 2007).

In the recent Time-to-Talk phase of the Canberra-2030 planning process, Canberrans identified management of energy and water and transport and population as key priorities (ACT Government 2010). Lowering Canberra's carbon emissions, reducing consumption and generally being more environmentally responsible were also broadly supported by ACT residents (ACT Government 2010:8). High consumption levels have emerged as a key sustainability challenge for the ACT and it will be interesting to observe the community's willingness to address this over the next reporting period (Dey 2010, Murray and Dey 2011 ).

On some issues, the ACT community's high level of environmental concern translates into similarly high levels of action. For example, in 2007-08 more than 90% of ACT residents reported sorting recyclable and non-recyclable waste - a result above the Australian average (84%). These outcomes reflect the high availability of recycling services in the ACT (compared to other states which have fewer recycling services in non-urban areas) as well as positive environmental behaviour (ABS 2010:2).

However, only about 60% of ACT residents surveyed considered that they could have an effect on the climate through their choices of transport (TAMS 2007), yet the same survey showed that as many as 85% of respondents were aware of a link between household energy use and climate change. It is likely that while these people understand there is a link between transport emissions and climate change, they consider changing their transport behaviours to be an unrealistic expectation. Further investigation of this finding could be useful for aligning public transport options more closely with residents' needs and as a basis for future programs aimed at increasing the use of alternatives to motor vehicle transport.

# ACT State of the Environment Report 2011

## Community participation in environmental programs and events

All sectors of the ACT community engage in environmental programs, events, projects and activities, both as ongoing initiatives and as individual events. Often these are cooperative ventures which comprise effective partnerships within and across various sectors of the community.

### Government programs: individuals and households

The ACT Government runs programs to help the community reduce its environmental impacts. These include several different energy and water conservation programs for households, businesses and schools, as well as a travel program (Table 1).

For example, the HEAT Energy Audit (previously known as ACT Energy Wise Program) offers owners of homes built before 1996 an energy audit by the Home Energy Advice Team (HEAT). Audit participants are eligible to apply for a \$500 rebate when they spend at least \$2000 on priority energy efficiency improvements identified during the audit, plus a refund of the \$30 audit fee. As well as undertaking audits, HEAT provides advice to residents and small businesses on energy efficiency measures.

Outreach, and Water and Energy Savings in the Territory (WEST) provide household energy-efficiency audits, retrofits, efficient new essential appliances and education to low-income residents having difficulty meeting energy bills. These programs are delivered through community welfare organisations. Outreach has also provided funding to Housing ACT to accelerate ongoing work to improve the energy efficiency of public housing.

Water efficiency programs such as GardenSmart promote community environmental participation through water-efficient gardening practices. The program offers a free garden-watering consultation, and a \$50 rebate on water-efficiency measures or products taken up as a result of the consultation. Refer to the *Water supply* indicator cluster paper for more details on ACT Government water-saving programs.

The ACT community is participating in these programs to varying degrees. For example, since 2005 the HEAT program has conducted 5127 energy audits; there have been 5956 GardenSmart consultations; and since 2008 there have been 4399 rebates for water efficient toilets and 1885 free toilet installations under the ToiletSmart scheme (ESDD; ESDD 2011a). Data from 2006 show that, at that time, the HEAT advisory service had the highest participation rate of any ACT Government sustainability program, with 12% of all respondents reported as having used it (TAMS 2007:13).

# ACT State of the Environment Report 2011

Table 1: ACT Government programs with a community environmental focus

Type	Name	Date commenced	Sponsoring agency
Energy efficiency programs	HEAT program	2005	Environment & Sustainable Development Directorate (ESDD) (formerly DECCEW)
	Outreach	2010	ESDD
	WEST program	2003	ESDD
Water efficiency programs	GardenSmart Program (originally called Outdoor Tune-up program)	2005	ESDD
	WaterSmart Homes (previously known as Indoor Tune-up program)	2004 (closed 2007)	Territory and Municipal Services Directorate (TAMS)
	Rainwater Tank rebate	2004	ESDD
	ToiletSmart program	2008	ESDD
Waste reduction programs	Plastic bag ban - community education program	2010	ESDD
	Educational tours of ACT resource recovery facilities	2006	TAMS
Transport	TravelSmart	2002	TAMS / Australian Government
Renewable energy	Solar feed-in tariff	2009 (closed 2011)	ESDD
Nature conservation	Community events in national parks/ nature reserves	2006	TAMS
	Upper Murrumbidgee Demonstration Reach	2009-10	ESDD / Australian Government / non-government organisations
	Upper Murrumbidgee Waterwatch	1992	ESDD / Australian Government / Industry
	ACT Landcare	various programs *	Australian Government Dept of Agriculture, Fisheries and Forestry / ESDD
Urban wetlands / water quality	Canberra Integrated Urban Waterways - community engagement	2009	ESDD

Source: OCSE.

\*Landcare in Victoria began in 1985, and has had various iterations in the ACT

The Solar feed-in tariff operated from 2009 to 2011 and provided incentives for ACT households and other groups to install renewable energy infrastructure such as grid-connected solar panels. The scheme offered a premium price of about 3.5 times standard retail prices for each unit of electricity produced and fed into the ACT electricity grid. This scheme was closed in 2011 with some controversy, after its legislated quota was reached (ACT Government 2009:3; ESDD 2011b).

During the reporting period several new urban wetlands were constructed in the ACT (refer to the *Rivers, lakes and wetlands health* indicator cluster paper for more details). Community engagement has been a key part of these projects, through events such as volunteer planting days and the formation of wetland carer groups

# ACT State of the Environment Report 2011

who will be involved in ongoing care and monitoring of the sites. A curriculum package to educate school students about wetlands has also been developed, and is delivered as part of the Australian Sustainable Schools Initiative - ACT (AuSSI ACT) schools program; see below (ESDD 2011c).

The ACT has a large number of urban and periurban nature reserves as well as a national park (Namadgi). During the reporting period the ACT Government operated community education and engagement events and programs in these areas. Attendance at these events, as well as general visits to conservation areas, can be considered a form of environmental participation. Annual survey results for nature parks show that over the reporting period an average 44% of those surveyed visited Tidbinbilla, 26% visited Namadgi, and 46% visited the Canberra Nature Park. The only marked change indicated over the period was in visits to Namadgi, which appear to be increasing. An average of 46% of respondents reported that one reason for their visit was to “experience or learn more about the environment” (MARS 2011:2,14).

A number of programs are specifically designed for the Aboriginal community and aim to promote greater awareness of Aboriginal cultural and environmental values and knowledge. These are facilitated by the ACT Indigenous NRM Facilitator. In December 2009 a Site Awareness workshop was held covering aspects of traditional culture, life and landscape. The workshop gave the 60 participants, who were Aboriginal and non-Aboriginal, access to cultural information for the first time. As a follow-up to the workshop, Ngunnawal community members were shown how to use geographic information systems (GIS) to record other cultural values.

Aboriginal people are also participating in the Yurung Dhaura Team Cotter River Catchment Restoration project that started in March 2011 and runs until June 2013. The project supports 4 Aboriginal trainees to study for the Certificates II and III in Conservation and Land Management at Canberra Institute of Technology while also engaging in environmental restoration and regeneration work. In addition, 6 ACT Indigenous students were supported to take part in the International River Health Conference in October 2009, which was held at the Australian National Botanic Gardens, Canberra.

Ngunnawal elders and community are planning to design and establish a garden demonstrating local bush-tucker and other plants used by the traditional Ngunnawal people. Completion is expected by the end of 2012. Another initiative in progress is preparation of a field handbook, which will show plants, animals, insects, rocks and waterbodies of the Ngunnawal country in the ACT and nearby region.

## School-based programs

Government-supported environmental education programs in the ACT have a particular focus on school students. The AuSSI ACT program and the Suburban Challenge program are supported by the ACT Government and delivered in ACT schools. The focus on education programs for use in schools recognises that there is an opportunity to build sustainability by educating young people. Examples of education programs delivered during the reporting period by government and community groups are included in Table 2.

# ACT State of the Environment Report 2011

Table 2. Environmental education programs and initiatives in the ACT

Program / Initiative	Vision	Audience
Every Chance to learn 2007	Curriculum framework for ACT schools, with sustainability being highlighted as a cross-curriculum priority	Preschool to Year 10
Our Water: Source Water Protection for the ACT: Teaching Resources	Designed to link source water and catchment issues with ETD's curriculum	Preschool to Year 10
Understanding the Land through the Eyes of the Ngunnawal People	Designed to develop students' understanding of traditional care for country and natural resource management practices of the Ngunnawal people	Preschool to Year 10
Understanding Canberra's Wetlands	A school curriculum program for the study of natural and urban constructed wetlands	Preschool to Year 10
Sustaining River Life	Recognition that healthy waterways are vital to both people and wildlife, and how water quality indicates catchment health	K - 12
Frogwatch school resources and activities	How key indicator species signal catchment health	Primary and secondary students
Suburban Challenge	To educate students on how sustainable suburbs are planned and built and how they can change to reflect different challenges, including climate change	Upper primary and secondary students
AuSSI ACT	Integrated approach to environmental management involving the whole school site, whole school community and all aspects of the curriculum	Primary and secondary students
Birrigai outdoor education centre	Expand participants' knowledge and understanding of their interactions with the Australian environment	Preschool to adult

Source: compiled by OCSE

Birrigai is a residential outdoor and environmental education centre, established in 1980 and now located within Tidbinbilla Nature Reserve. The centre is designated as a 'school in special circumstances' and is operated by the ACT Government. The centre offers programs in outdoor and environmental education for students from Preschool to Year 12, as well as adult activities. The aim is to expand participants' knowledge and understanding of their interactions with the Australian environment (Tidbinbilla 2011).

In November 2009 a short series of lessons in the Gugan Galwan (Kids at Risk Program) was facilitated by ESDD on topics including Aboriginal cultural values, tools, rock art and heritage in the ACT. The sessions also gave an introduction to suburban ParkCare before and after bush fires. The five students who completed the sessions were awarded Certificates of Attainment.

The Australian Sustainable Schools Initiative (AuSSI) is a national program aiming to support government and non-government schools to become ecologically

# ACT State of the Environment Report 2011

sustainable. The program uses an integrated approach to environmental management, involving the whole school site, whole school community and all aspects of the curriculum.

The AuSSI program includes strategies such as:

- sustainability audits / development of resource management plans;
- inclusion of Education for Sustainability in the curriculum;
- development of school Environmental Leadership Teams; and
- incorporation of sustainable management practices into everyday school operations.

In the ACT, the program (AuSSI ACT) is supported by the ACT Government through the ESDD and ETD. This program was established in the ACT through a pilot program starting in 2006, and has grown substantially during the reporting period. By 30 June 2011, 120 out of the total 128 schools in the ACT (including Government and non-government primary and secondary schools) were participating in the program (ESDD 2011a). The ACT Government has also committed to the target of making all ACT Government schools carbon neutral by 2017 (DET 2008). The ESDD also manages a program called *Understanding the Land Through the Eyes of the Ngunnawal People* (ESDD 2011e) as part of AUSSI ACT. It is currently being taught in ACT schools, in line with the new national curriculum for schools.

## Business programs

Businesses operating in the ACT can play a key role in improving sustainability in the Territory. The ACT Government has increased its focus on programs helping businesses and the commercial sector to be environmentally sustainable (Table 3), during the reporting period. Some businesses have also shown significant leadership by taking independent actions for sustainability. Total participation numbers for sustainability programs run by the ESDD Sustainability Programs team are shown in Table 4.

# ACT State of the Environment Report 2011

Table 3. ACT Government environment programs for businesses and the commercial sector

Type	Name	Date commenced	Sponsoring agency
Resource efficiency programs	CitySwitch	2009	ESDD
	Tune Up Canberra	2009-10 (ended 2010-11)	ACTPLA
	Commercial Bathroom Retrofit Program	2009	ESDD
Waste reduction programs	ACTSmart Business and Office	2009	ESDD

Source: compiled by OCSE

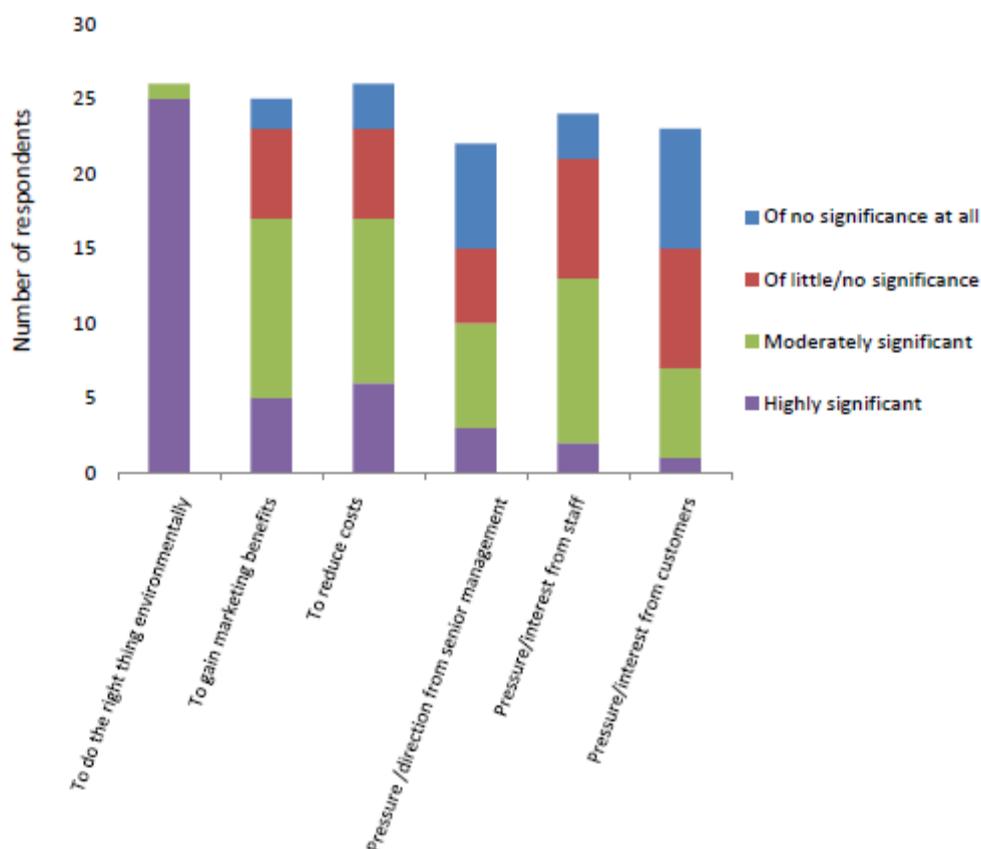
Since the Commercial Bathroom Retrofit Program started in 2009, 47 businesses have participated. The program encourages businesses to install water efficient toilets, urinals, showers and taps in bathrooms in commercial buildings by sharing the cost via matching ACT Government funding of up to \$20,000 per building.

The Tune Up Canberra Program, which has recently ended, provided matching funding up to \$8000 for assessment (Tune Up reports) and actual building works to improve the energy and/or water efficiency of large commercial office buildings in the ACT (ESDD 2011:13,15).

ACTSmart Office (and ACTSmart Business) is a free program that helps offices and businesses set up efficient recycling and waste management practices. The program offers help and advice, and recognises achievement via accreditation and awards. A review of the ACTSmart Business and Office programs found that the program resulted in overall positive responses from businesses (Blue Environment 2011). The review found that concern for the environment, rather than cost-reduction, was the key reason for participation (Figure 2) and that further support could be provided particularly for managing organic waste, recycling and e-waste.

# ACT State of the Environment Report 2011

Figure 2. Key motivators for participating in ACTSmart Business and Office



Source: Blue Environment 2011

Since 2009, 281 businesses of all sizes have participated in the ACT Government ACTSmart Business and Office program, and 52 have been accredited under the scheme. Examples include:

- Fringe Hairdressing, which has introduced a recycling system, including recycling hair (organic waste) via a worm farm;
- Tuggeranong Hyperdome, which in 2010-11 became the first major shopping centre in the ACT region to recycle its organic waste. The centre's recycling system was introduced as a pilot program and now includes all the major tenants. Together they divert approximately 5.4 tonnes of organic waste away from landfill each month. This project was one of the winners of the 2011 ACTSmart Business and Office Minister's Award for Leadership (ACTSmart 2011a 2011b).

# ACT State of the Environment Report 2011

Table 4. Participation in ESDD sustainability programs to 30 June 2011

Program	Program commenced	Total program participation
CitySwitch	2009	16
HEAT Energy Audits	2005	5217
HEAT Rebates	2005	2416
HEAT inquiries	2003	32,308
Outreach Trial	2010	895
Outreach Program <i>*Figure is for one month only</i>	2011	*121
WEST Audits	2003	278
WEST Plus Audits	2011	51
WEST Plus Education sessions	2011	22
WEST Plus Retrofits	2011	22
GardenSmart service	January 2005	6159
GardenSmart rebate	January 2005	2044
Rainwater tank + internal connection rebate	August 2004	1938
Internal connection only rebate	August 2004	63
ToiletSmart \$100 rebate	May 2008	4399
Free toilets provided to Pensioner Concession Card holders	May 2008	1885
Free ToiletSmart Plus home water audit	August 2010	718
Free ToiletSmart Plus showerheads	August 2010	288
IrrigationSmart trial	September 2009 - April 2010	210
Commercial Bathroom Retrofit program	February 2009	47
ACTSmart Business and Office programs	August 2009	281 (52 accredited)
Australian Sustainable Schools Initiative - ACT	2006	120

Source: ESDD

Businesses are also taking action for sustainability, independently of government programs.

- The international office furniture and fit-out company Schiavello, which has an ACT branch, has introduced an up-cycling program it calls e-cycle. When purchasers are ready to upgrade, Schiavello takes back the old furniture and

# ACT State of the Environment Report 2011

rather than breaking it down for recycling (which can be an energy-intensive process) it up-cycles the used products through repairs and/or upgrades, for resale. This initiative was the winner of the 2011 ACTSmart Business and Office Award for Innovation Excellence (ACTSmart 2011a, Schiavello 2010).

- In the absence of any Australian or ACT Government scheme for battery recycling, the battery retailer Battery World is voluntarily accepting domestic quantities of batteries for recycling at its stores throughout the country, including the ACT, free of charge. Batteries contain harmful substances such as lead and cadmium, and recycling ensures that these materials are safely disposed of. The company estimates that this Australia-wide recycling initiative has so far prevented 500 tonnes of batteries from entering landfill (Battery World 2010).

## Non-government environmental groups

A large number of non-government community groups are active in the ACT, working independently or supported by government, on issues relating to the environment, sustainability and climate change adaptation and mitigation. These groups engage in activities such as awareness raising, research and monitoring, and education and lobbying for change, as well as specific projects. Initiatives include action for biodiversity conservation, catchment health and water quality, sustainable transport, community gardens, renewable energy projects and energy efficiency projects.

Non-government groups in the ACT have a history of providing leadership on environmental issues such as by bringing different groups together and creating environmental strategies and plans. For example in 2004 the Molonglo Catchment Group produced the Molonglo Catchment Strategy. This trend has continued since that time, and non-government groups are creating change in institutions and households over and above that required by legislation and government policies. For example the University of Canberra recently became the first Australian university to ban sales of bottled water on campus (University of Canberra 2011).

Community groups have also been active in influencing local government in the ACT. In response to community concern and high demand for community gardens, in 2011 the ACT Government established an interagency ACT Community Gardens Policy Working Group, to develop a policy on community gardens (ACT Government 2011:2016-7).

The available data suggest that the level of participation in these groups is significant. In 2006, 41% of ACT adults surveyed reported that they took part in a practical activity to restore the local environment (e.g. native tree planting), 30% participated by writing a letter, attending a meeting or joining a group, and 34% tried to find out about a local environmental issue (TAMS 2007:8).

This level of environmental involvement is consistent with the ACT's high overall levels of volunteer participation. As reported in the last State of the Environment Report, a survey by the Australian Bureau of Statistics in 2006 showed that on a state

# ACT State of the Environment Report 2011

by state basis the ACT and Queensland had Australia's highest proportion of people volunteering (38%) compared to the national average (34%) (ABS 2006).

New groups have emerged in recent years and have achieved a high profile since the last State of the Environment Report. For example, SEE-Change, formed in 2006, aims to "inspire, inform and support action to reduce Canberra's ecological footprint" (SEE-Change n.d.). There are now four local SEE-Change groups across Canberra. They have been successful in gaining three government grants in 2010-11, for a sustainable ideas festival, a schools education program and a community solar farm feasibility study. The Canberra ♥ 40% group is another recently-formed network, which was actively engaged in encouraging the development of ACT greenhouse gas targets and which runs programs aiming to reduce the ACT's greenhouse gas emissions by 40% by 2020.

Government support is provided to community-based environmental programs through the ACT Environment Grants, which commenced in 1997. These grants are provided for environmental activities such as grassland restoration, monitoring of birds, community environmental forums and support for educational resource development.

In 2009-10 the Government provided a Community Energy Grants program under Action Plan 1 of *Weathering the Change*, the ACT's climate change strategy (ACT Government 2007). Of the incorporated not-for-profit community organisations in the ACT, 47 received grants to help pay for installation of renewable energy technology to the buildings that they occupy. Grants were for solar photovoltaic systems, solar hot water systems and solar film on windows.

Climate Change grants were announced in June 2011 to support community action on reducing greenhouse gas emissions and building community involvement and support for addressing climate change. These grants support the community in working towards the ACT's target of zero net emissions by 2060, as legislated in the *Climate Change and Greenhouse Gas Reduction Act 2010*. The Climate Change Grants generated a strong response from the community. Recipients of the 2011 ACT Climate Change Grants were (ESDD 2011e): The Living Green Festival (ACT) Inc.; SEE-Change; Australian Institute of Landscape Architects; Canberra Electric Vehicle Festival Inc.; ACT Sustainable Systems; Canberra Environment Centre; and Canberra ♥ 40%.

## *Catchment and land management groups*

Over the reporting period there were approximately 30 Parkcare or urban Landcare groups active in the ACT, with a total membership of several hundred people. These groups are supported by the ACT Government: from 2007-08 to 2010-11 the ACT Government provided approximately \$70,000 to Parkcare and related catchment groups via the ACT Environment Grants (OCSE 2011:95).

Parkcare groups conduct activities such as education, ecological monitoring, planting, weeding and track maintenance within the ACT's urban nature reserves, while urban Landcare groups are active in areas such as urban parks and wetlands. The ongoing monitoring work undertaken by these groups provides valuable data to

# ACT State of the Environment Report 2011

support government research and management programs. Over the reporting period, community group achievements have included:

- Farrer Ridge Parkcare Group's recently produced report called *Bushfire regeneration monitoring on Farrer Ridge 2003-2008*, with data from 7 years of monitoring by Parkcarers;
- Friends of Mt Majura, with Mt Ainslie Weeders and the Watson Woodland Working Group - mapping of rabbit warrens in the Mt Majura and Mt Ainslie nature reserves during summer 2009-10;
- Friends of Mt Majura - a National Tree Day Planting Party in July 2011, which attracted up to 100 community members;
- Oakey Hill ParkCare Group - extensive weed control, track maintenance work.

Voluntary work on the ACT's nature reserves has substantial financial value, as shown by the following estimates:

- number of hours of voluntary work undertaken in Canberra Nature Park, Molonglo River Corridor and Googong Foreshores in the 2009-10 financial year was approximately 14,530 hours;
- multiplied by an indicative payment rate of \$25 per hour, that amounts to \$363,250 (OCSE 2011:97-98).

Three catchment groups are active in the ACT region: Molonglo Catchment Group, Ginninderra Catchment Group, and Southern ACT Catchment Group. These umbrella groups support the work of local organisations within each catchment, such as Parkcare, Landcare, Waterwatch, Frogwatch, and more recently Platypus-watch groups. Funding to the catchment groups from the Australian and ACT Governments allows them to employ professional support staff and implement various projects.

Waterwatch has assisted in the publication of two children's books - *The Isabella Pond Rowing Regatta*, and *The Patience of the Water Scorpion* - as well as two glovebox guides focusing on frogs and water plants.

During the reporting period Upper Murrumbidgee Waterwatch groups completed activities such as ongoing water quality monitoring, training and education (ACT Waterwatch 2011). The importance of cross-border water quality monitoring is shown in the Cooma region by Waterwatch's work in erosion control in the upper Murrumbidgee. While this location is in NSW it is a major contributor to sediment loads in the Murrumbidgee River in the ACT.

Waterwatch volunteers, coordinators and staff from associated projects such as the Upper Murrumbidgee Demonstration Reach and industry worked together to track the source of the fine suspended particulates. Waterwatch report that volunteers have assisted in channelling over \$1 million into the Numeralla area for erosion control. Waterwatch has also been successful in obtaining \$250,000 in investment from ActewAGL to engage a Cooma Region Waterwatch Coordinator who has identified erosion sites by engaging the help of the local community. An *Action for Clean Water Project* has also been initiated to map and prescribe treatment for identified erosion sites in the Upper Murrumbidgee.

# ACT State of the Environment Report 2011

Linking most or all of the groups responsible for natural resources management in ACT region is the community-based Upper Murrumbidgee Catchment Coordinating Committee (UMCCC). The UMCCC brings together representatives from Australian and ACT government departments, researchers, landholders, conservation groups, community groups including catchment management groups, and the Murrumbidgee Catchment Management Authority. The UMCCC exists as a forum in which these groups can communicate readily with each other, and to coordinate policy and funding submissions, prepare educational materials, and foster capacity building (UMCCC 2011).

## Response indicators

### Effectiveness of environmental education programs

#### Individual sustainability actions

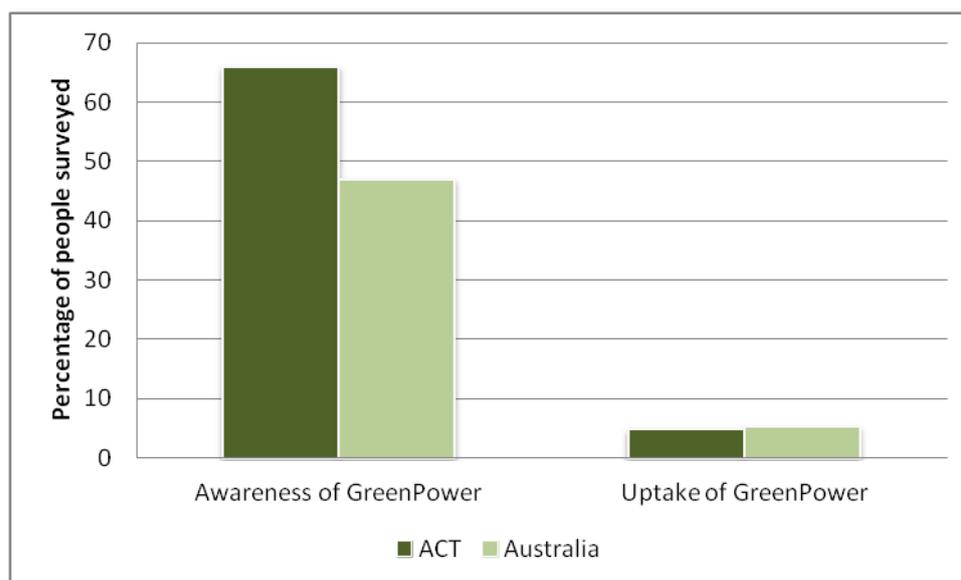
Surveys show that, consistent with their high level of environmental awareness, residents of the ACT generally report having a sense of responsibility towards the environment. In 2006, 80% of ACT residents who reported having taken steps to live more sustainably did so “because they feel they have a personal responsibility to do the right thing”. Within this group 94% had taken steps to reduce energy use, 90% claimed to have purchased energy efficient appliances, 82% avoided plastic shopping bags, and 77% reported taking shorter showers to reduce water use. Also, 61% of households reported reusing grey water from the laundry or shower (TAMS 2007:8). The high proportion of residents who reported reducing energy use is consistent with the results of the report on the 2008-09 ecological footprint of the population of ACT, which found that direct energy use by ACT residents has been static or slightly falling over the last 10 years (Dey 2010:17).

Notwithstanding the community’s high level of environmental awareness, the overall ecological footprint of the ACT has increased over the last 10 years. The reason is reported to be increased consumption (Dey 2010:17). Reducing the impacts of individual consumption will therefore be a key challenge in making the ACT more sustainable into the future.

A link between environmental education, environmental awareness and behaviour change cannot be assumed. For example, there is a significant difference between the levels of awareness of and uptake of GreenPower electricity in the ACT. While awareness of GreenPower in the ACT (66%) is well above the Australian average (47%), the percentage of people who actually purchase GreenPower in the ACT is slightly less (Figure 3).

# ACT State of the Environment Report 2011

Figure 3. GreenPower awareness and uptake in ACT and Australia



Source: ABS 2010:18

When asked what prevented them from doing more to live more sustainably, ACT residents responding to the survey mentioned cost as the strongest barrier (TAMS 2007:9). Their reluctance to spend more to reduce their environmental impacts is interesting when considered against the high (and increasing) average incomes in the ACT. It appears that to achieve actual behaviour change the ACT Government will need to do more than just provide environmental education and information to the community.

It appears that ACT residents are aware that their reliance on private vehicles is not sustainable, and are looking for alternatives. The ACT Government's Time-to-Talk community engagement project in 2010 found that community members recognise "a challenge is for Canberrans to reduce their reliance on private vehicles. A general preference is a shift to more sustainable transport options including bus shuttle services, transport corridors, light rail, and building on safe walking and cycling options" (ACT Government 2010:9). The *Transport and Urban quality* indicator cluster papers give more details on ACT transport patterns and policies.

## Effectiveness of Government programs

Program evaluations have been produced during the reporting period for a number of ACT Government programs, including AuSSI ACT, ACTSmart Business and Office, Outreach, the WEST low-income energy-efficiency programs, and the IrrigationSmart trial.

In 2010, an independent evaluator was engaged to assess the AuSSI ACT model in terms of the degree to which it:

- educates the school community to adopt more sustainable behaviours;
- reduces the schools' ecological footprint; and
- impacts on the wellbeing of the school community.

# ACT State of the Environment Report 2011

The evaluation found that the AuSSI ACT program has led to behaviour change among students and staff. Schools reported that on average 65% of students and teachers had changed their behaviour 'a lot' in relation to waste management and 37% had done so in relation to water conservation. It appears that this program has also been effective in changing students' behaviour at home: 90% of students surveyed reported that AuSSI ACT had changed what they did at home. Parents' observations of changes in student and staff behaviours supported these findings (DECCEW 2010:3-5).

The evaluation identified key structures in the AuSSI ACT program which support the reduction of schools' ecological footprint. They included:

- a leadership team and school environmental management plan;
- AuSSI ACT audit and accreditation process;
- ongoing professional development for teachers; and
- effective ongoing program support.

The evaluation recommended that AuSSI ACT teams prioritise efforts to collect and analyse data to quantify achievements in the reduction of the school's ecological footprint, and steps have been taken to address this recommendation.

Data comparing the achievements by ACT Government schools in 2010-11 and 2009-10 show that they reduced their annual water consumption by more than 20%. Their total energy use increased by approximately 3%, but there was a marginal decrease (1%) in their total greenhouse gas emissions.

AuSSI ACT officers have been visiting Government schools to discuss the recommendations of their recent energy audit reports and to deliver the AuSSI ACT Energy Best Practice Guide. Once schools have had an opportunity to implement the recommendations in the audit reports and best practice guide, which is likely to take at least 12 months, it is more likely that savings in energy consumption will be achieved (ESDD 2011a).

The evaluation of the AuSSI ACT model found that there had been a positive impact on the wellbeing of students:

- 87% of the students who participated in the evaluation agreed that "doing things for the environment made them feel better";
- 85% said they enjoyed being a part of team projects for the environment; and
- 92% responded they could learn from others and hear their ideas.

Teachers identified significant positive impacts of AuSSI ACT on their students across most dimensions of wellbeing. Most impacts were in relation to self efficacy, spirituality, self esteem, engagement and curiosity (DECCEW 2010).

An evaluation of the ACTSmart Business and Office programs by an independent evaluator was completed in June 2011 (Blue Environment 2011). The purpose of the evaluation was to assess the experience of the current participants in the program and to identify which components of the program were useful for participants, any

# ACT State of the Environment Report 2011

suggestions for improvement, and the motivation that had led participants to sign-up to the program. Participants have indicated the program has made a substantial impact on their rates of recycling, including those that believed they were already using all opportunities for recycling. The evaluation highlighted that:

- 88% of respondents have made improvement in waste management through involvement in the ACTSmart programs;
- the support provided by the government staff delivering the program was greater than participants had expected; and
- the program has rigour and is valued by participants, with 96% of respondents indicating they would recommend the program to other organisations.

A pilot IrrigationSmart program was developed and delivered in 2009-10. The pilot aimed to assess whether ACT residents would respond positively to an offer of a free review and reprogramming of automatic drip irrigation systems to improve watering efficiency. Recommendations resulting from the program's assessment in September 2010 have been incorporated into the new IrrigationSmart program.

The internal evaluation by ESDD of the trial Outreach program conducted in 2010 found that working with community welfare organisations to assist low-income households save energy and reduce greenhouse-gas emissions was effective. Annual estimated energy savings from the trial were approximately 920 MWh and greenhouse gas emissions were reduced by approximately 800 tonnes of CO<sub>2</sub> equivalent.

The CitySwitch and Commercial Bathroom Retrofit programs have recently been reviewed to develop future options for the direction of these programs. Also, the ToiletSmart and ToiletSmart Plus programs and the HEAT Energy Audit were subject to trials during April-June 2011 to assess their eligibility criteria. The results of the trials, concerning the possibility of replacing older dual-flush toilets and auditing energy efficiency in houses built before 2006 (previously 1996), will be implemented in 2011-12.

## References

- ABS 2006. *4441.0 – Voluntary Work Australia*. Australian Bureau of Statistics. Australian Government. Canberra.  
<http://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/4441.0Main%20Features22006?opendocument&tabname=Summary&prodno=4441.0&issue=2006&num=&view=>; (accessed 25/8/11)
- ABS 2008. *4626.0.55.0 - Multi-Purpose Household Survey: Environmental Views and Behaviour Study 2007-08 (2nd Issue)*. Australian Bureau of Statistics. Australian Government. Canberra.  
[http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4626.0.55.001Explanatory%20Notes12007-08%20\(2nd%20issue\)?OpenDocument](http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4626.0.55.001Explanatory%20Notes12007-08%20(2nd%20issue)?OpenDocument) (accessed 25/8/11)
- ABS 2010. *Environmental Awareness and Action*. Australian Bureau of Statistics. Australian Government. Canberra.

# ACT State of the Environment Report 2011

[http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/3FC4355B8BA3308BCA2577510019F919/\\$File/41020\\_environmentalawareness.pdf](http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/3FC4355B8BA3308BCA2577510019F919/$File/41020_environmentalawareness.pdf) (accessed 26/8/11)

ACT Government 2007. *Weathering the Change. ACT Climate Change Strategy – Action Plan 1, 2007-2011*. Canberra.

[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/144527/Climate\\_Change\\_Action\\_Plan.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0005/144527/Climate_Change_Action_Plan.pdf) (accessed 28/11/11)

ACT Government 2009. *National Capital to Solar Capital: Options for an Expanded Act Electricity Feed-In Tariff Scheme*. Canberra.

[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/174795/Electricity\\_Feed-in\\_tariff\\_WEB.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0006/174795/Electricity_Feed-in_tariff_WEB.pdf) (accessed 25/8/11)

ACT Government 2010. *Time to talk: Canberra 2030 Outcomes Report*. Canberra.

<http://timetotalk.act.gov.au/storage/78d10e40d957379825347909b6e2bfd9.Time%20to%20talk%20-%20web%20version.pdf> (accessed 26/8/11)

ACT Government 2011. *Debates - Weekly Hansard Seventh Assembly 5 May 2011*. Canberra.

<http://www.hansard.act.gov.au> (accessed 25/8/11)

ACTSmart 2011a. *ACT Smart Business and Office Awards 2011*. Canberra.

[http://www.actsmart.act.gov.au/your\\_business/actsmart\\_business\\_and\\_office\\_awards\\_2011](http://www.actsmart.act.gov.au/your_business/actsmart_business_and_office_awards_2011) (accessed 26/9/11)

ACTSmart 2011b. *Case Study – Fringe Hairdressing*. Canberra.

[http://www.actsmart.act.gov.au/\\_\\_data/assets/pdf\\_file/0008/231767/Fringe\\_A4\\_Case\\_Study\\_FA\\_Web.pdf](http://www.actsmart.act.gov.au/__data/assets/pdf_file/0008/231767/Fringe_A4_Case_Study_FA_Web.pdf) (accessed 26/9/11)

ACT Waterwatch 2011. *Welcome to Upper Murrumbidgee Waterwatch*. ACT Government. Canberra. <http://www.act.waterwatch.org.au/> (Accessed 29/10/11)

Battery World 2010. *Battery World & Recycling*. Canberra.

<http://recycling.batteryworld.com.au/> (accessed 18/11/11)

Blue Environment 2011. *ACTSmart Business and Office Programs Review*. ACT Department of the Environment Climate Change, Energy and Water. Canberra.

DECCEW 2010. *Executive Summary: An Evaluation Report of the Australian Sustainable Schools Initiative ACT June/July 2010*. ACT Department of the Environment, Climate Change, Energy and Water. Canberra.

[http://www.sustainableschools.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/222809/Attachment\\_4\\_-\\_Evaluation.pdf](http://www.sustainableschools.act.gov.au/__data/assets/pdf_file/0005/222809/Attachment_4_-_Evaluation.pdf) (accessed 21/7/11)

DET 2008. *Green Schools – An Environmentally Sustainable Future for ACT Public Schools*. Department of Education and Training. ACT Government. Canberra.

[http://www.det.act.gov.au/\\_\\_data/assets/pdf\\_file/0007/26953/GreenSchools.pdf](http://www.det.act.gov.au/__data/assets/pdf_file/0007/26953/GreenSchools.pdf) (accessed 15/7/11)

Dey, C. 2010. *The 2008-09 Ecological Footprint of the Population of the ACT*. Integrated Sustainability Analysis Research Group. University of Sydney. Sydney.

[http://www.environmentcommissioner.act.gov.au/\\_\\_data/assets/pdf\\_file/0015/211182/ACT\\_Ecological\\_Footprint\\_08-09\\_final\\_report.pdf](http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0015/211182/ACT_Ecological_Footprint_08-09_final_report.pdf) (accessed 17/11/11)

ESDD 2011a. *Annual Report 2010-11*. ACT Environment and Sustainable Development Directorate. Canberra

[http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/233286/1027-DECCEW\\_AnnualReport2011\\_web.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0006/233286/1027-DECCEW_AnnualReport2011_web.pdf) (accessed 17/11/11)

# ACT State of the Environment Report 2011

- ESDD 2011b. *Electricity Feed-in Tariff Scheme*. Environment and Sustainable Development Directorate. ACT Government. Canberra. <http://www.environment.act.gov.au/energy/fit> (accessed 1/9/11)
- ESDD 2011c. *Proposed Dickson and Lyneham Wetlands*. ACT Environment and Sustainable Development Directorate. Canberra. [http://www.environment.act.gov.au/water/constructed\\_wetlands](http://www.environment.act.gov.au/water/constructed_wetlands) (accessed 26/9/11)
- ESDD 2011d. *Annual Report 2010-11*. Environment and Sustainable Development Directorate. ACT Government. Canberra. [http://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/233286/1027-DECCEW\\_AnnualReport2011\\_web.pdf](http://www.environment.act.gov.au/__data/assets/pdf_file/0006/233286/1027-DECCEW_AnnualReport2011_web.pdf) (accessed 15/10/11)
- ESDD 2011e. *2011 Climate Change Grants*. ACT Environment and Sustainable Development Directorate. Canberra. [http://www.environment.act.gov.au/climate\\_change/climate\\_change\\_grants](http://www.environment.act.gov.au/climate_change/climate_change_grants) (accessed 12/10/11)
- MARS 2011. *2010/2011 PCL Annual Report Key Findings*. Market Attitude Research Services. Sydney.
- Murray, J. and Dey, C. 2011. *Canberra's Ecological Footprint: What Does It Mean?*. Office of the Commissioner for the Environment and Sustainability. Canberra
- OCSE 2011. *Report on Canberra Nature Park (Nature Reserves); Molonglo River Corridor (Nature Reserves) and Googong Foreshores Investigation*. Office of the Commissioner of Sustainability and the Environment. Canberra. [http://www.environmentcommissioner.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/234987/Part\\_I\\_Report.pdf](http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0006/234987/Part_I_Report.pdf) (accessed 18/11/11)
- Schiavello. 2010. *Sustainability Awards: Schiavello E-Cycle*. Canberra. <http://act.schiavello.com/assets/files/E-cycle/BPN%20Sustainability%20Press%20Release.pdf> (accessed 22/9/11)
- SEE-Change n.d. *About Us; Welcome To SEE-Change*. Canberra. <http://www.see-change.org.au/node/10> (accessed 12/4/11)
- TAMS 2007. *Report on the Sustainability: Community Attitudes Survey*. Territory and Municipal Services. Canberra
- TAMS 2011. *Bushfire Regeneration Monitoring On Farrer Ridge*. Farrer Ridge Parkcare Group. Territory and Municipal Services. Canberra. [http://www.tams.act.gov.au/\\_\\_data/assets/pdf\\_file/0015/154104/Bushfire\\_regeneration\\_monitoring\\_on\\_Farrer\\_Ridge-final\\_-\\_all.pdf](http://www.tams.act.gov.au/__data/assets/pdf_file/0015/154104/Bushfire_regeneration_monitoring_on_Farrer_Ridge-final_-_all.pdf) (accessed 17/6/11)
- Tidbinbilla 2011. *Birrigai*. ACT Government. Canberra. <http://www.tidbinbilla.com.au/learn/tidbinbilla/birrigai/> (accessed 16/8/11)
- UMCCC 2011. *Upper Murrumbidgee Catchment Coordinating Committee*. Canberra. <http://umccc.org.au/aboutumccc> (accessed 17/11/11)
- University of Canberra 2011. *UC Becomes Australia's First Bottled Water Free Uni*. University of Canberra Media Centre. Canberra. <http://www.canberra.edu.au/media-centre/2011/january/21-water> (accessed 26/8/11)

# **ACT State of the Environment Report 2011**

## **Other data sources**

In addition to these published reports, data for this paper were also sourced from:

ACT Department of the Environment, Climate Change, Energy and Water (DECCEW) - now  
Environment and Sustainable Development Directorate (ESDD)

Office of the Commissioner for Sustainability and the Environment (OCSE)

*“the future is  
not somewhere  
we are going, it  
is something we  
are creating.”*

Professor Ian Lowe



The Office is independent of, but funded by, the ACT Government

