

Energy Use in the Australian Government's Operations

2002-2003

Industry, Communities & Energy Division

Australian Greenhouse Office

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Cover photographs

The new underground home for the Australian Greenhouse Office. Located under the car park behind the John Gorton Building, this space was once the secure international communications centre for the Department of Foreign Affairs and Trade. Development of the space has been sensitive to the heritage nature of the space, retaining many original artworks, features and finishes.

Light wells, front and skylights, back cover, provide natural light and a connection to the outside. Light shelves help bring the natural light into the office space. Suspended, high efficiency dimmable light fittings wash the ceilings with light to provide even lighting levels without the gloominess associated with conventional lighting systems. Lighting controls respond to occupancy and ambient lighting levels to minimise energy consumption. Energy efficiency is enhanced by the use of a displacement air conditioning system, and solar heated hot water. Water management is a feature of the development with rainwater collection, water treatment, and flow control systems.

The Toyota Prius and Honda Insight shown parked above the new office are known as hybrid vehicles because they combine a conventional petrol engine with a powerful electric motor, achieve substantial improvements in fuel economy with lower greenhouse and noxious emissions. Both these vehicles illustrate the potential for great improvements in energy efficiency and lower environmental impact through engineering innovation.

Design by: Big Island Graphics (02) 6257 1980
Photographs by: Andrew Tatnell - Big Island Photographics

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Executive summary

Further improvements in energy efficiency of the Australian Government's own operations continue to drive reductions in energy consumption, associated greenhouse emissions and cost.

Information provided by 120 budget dependent Australian government agencies shows that in 2002/03:

- energy consumption fell by 1.2% to 8,161,567 GJ;
- greenhouse gas emissions fell by 0.8% to 1,565,596 tonnes CO₂ equivalent; and
- energy intensity declined significantly in all but one of the end-use categories where intensities could be calculated.

Since the first Australian Government energy use report in 1997/98:

- energy consumption has fallen by 15.4%;
- greenhouse gas emissions have fallen by 12.7%;
- energy intensity or consumption has declined in 11 of 12 end-use categories; and
- estimated annual energy costs have fallen by \$30 million.

While changes to activities have contributed to some changes in energy consumption, most of the reported improvement is due to better energy efficiency.

Performance targets, with a compliance period of the 2002/03 financial year, were established in three of twelve end-use categories. These three end-use categories cover almost 60% of the total Australian government energy consumption.

In aggregate, the Australian Government is operating well below both the Office-Tenant Light and Power intensity target of 10,000 MJ/person and Office-Central Services intensity target of 500 MJ/m².

The Department of Defence reduced energy consumption in its bases by a further 2.5% in 2002/03, following a reduction of 6% the previous year but it has not met the 2,500,000 GJ Defence Establishments target.

The Department of Defence is continuing its energy efficiency program and the performance improvement over the last three years is highly commendable, in light of the extra demand being placed on its services over the same period.

This report is compiled in accordance with the Australian Government energy policy, detailed in Measures for Improving Energy Efficiency in Commonwealth Operations.

Introduction

This is the sixth annual report on energy use in the Australian Government's own operations. This is an important report because it measures agency performance against the targets set by the Prime Minister in his November 1997 announcement *Safeguarding the Future: Australia's Response to Climate Change*. Performance targets were set in three energy end-use categories, to be achieved in the 2002/03 financial year - the reporting period covered by this report.

Objectives

This report has two main objectives. The first is to present a simple picture of overall energy consumption and associated greenhouse gas emissions resulting from the activities of the Australian Government during the previous financial year. The second is to measure the intensity of that consumption as a means of monitoring progress towards greater energy efficiency in government operations.

Structure

The report starts with an initial discussion on aggregate energy consumption and associated greenhouse emissions by end-use category and by energy source for the Australian Government as a whole. This is presented for the current reporting year and with trends over the six reporting years. The performance of each end-use category is then examined in detail, focussing on energy intensities where appropriate.

Case studies of energy efficiency initiatives undertaken during the year are then presented, followed by performance summaries for portfolios and agencies and then end-use category league tables. A copy of the policy document *Measures for Improving Energy Efficiency in Commonwealth Operations* concludes the report.

Data source

The report is based on end-use category summary data provided by each budget dependent agency. This level of detail is sufficient to show consumption, intensity levels and trends, and tracking agency progress toward targets. It is not sufficient, however, for any detailed analysis of processes or technologies

associated with agency performance. Agencies are best placed to determine their own responses and solutions to energy efficiency issues affecting their own organisations. The policy sets outcome based goals and uses the reporting system to monitor progress toward those goals.

Administrative structures

Energy performance is reported for agencies as they were constituted at 30 June 2003. The next report, which will be for the 2003/04 financial year, will report on agencies as they exist at June 30 2004. Where elements move from one agency to another, they carry with them the energy performance for the full financial year.

For example, during 2002/03, the functions of two previously reporting agencies, the Australian Bureau of Criminal Intelligence and the National Crime Authority were amalgamated into a new agency known as the Australian Crime Commission. All previous energy and associated data of the two agencies was aggregated and reported as if it belonged to the Australian Crime Commission. So, while the Australian Crime Commission has only been in existence for 12 months or so, it is reporting historical data based on the previous reports of the National Crime Authority and the Australian Bureau of Criminal Intelligence. These two agencies are no longer identifiable in the report.

This process of adjusting for administrative changes is more fully explained in section 3.1.9 of the policy document *Measures for Improving Energy Efficiency in Commonwealth Operations*, which is included as Annex D.

Responsibility

It is the responsibility of agencies to supply the data for inclusion in this report. Data checking and validation by both the Australian Greenhouse Office and the individual agencies follows before the report is finalised for tabling. While every effort is made to identify data anomalies and to have them addressed by the relevant agency, the final responsibility for the accuracy of the information in this report rests with the individual reporting agencies.

Agencies are required to enter and submit data by October 31 each year. The reporting system provides initial validation and raises anomalies if data varies significantly from the previous

year, or if energy intensities are outside the expected ranges of each end-use category. For example, any number entered, which is fifteen per cent higher or lower than the same data point in the previous reporting period will trigger an anomaly. Also, expected intensity ranges are set for all end-use categories where meaningful intensities can be calculated. For example, In the Tenant Light and Power category where there is a 10,000MJ/person performance target, it is expected that all agencies will report in the range of 4,000 to 20,000MJ/person.

Large data changes do not necessarily mean that the data is wrong. The functions of the agency may have changed due to changing government priorities. This may have caused increases or decreases in staff, or acquisition or disposal of buildings. And there may be many valid reasons why reported intensities are not in line with expectations. These might include a higher than average requirement for public space or a concentration of energy intensive computer equipment.

Before they can submit data agencies must acknowledge all anomalies raised by the reporting system. In doing this, they confirm that data anomalies are for valid reasons and not due to data error.

Submitted data is then reviewed by the Australian Greenhouse Office and a note sent back to each agency drawing attention to any obvious errors and omissions. In this note, agencies are encouraged to provide reasons in their comments for any remaining data anomalies and are invited to undertake a final review of their data before confirming it as a full and accurate statement of their energy performance for the year. At this time, reporting period data is locked against further change. If after a reasonable period and due warning, an agency does not confirm its data, it is locked without confirmation. A note has been added to the Agency data pages in Annex B to indicate where this has occurred.

Annex B provides a detailed summary of agency performance since the first reporting period in 1997/98. Each agency's comments on its own performance during the current reporting period are included in this annex. To further increase accountability, end-use category data is presented in Annex C as performance league tables in ascending order of energy intensity.

Relative performance and energy efficiency

Measuring energy efficiency between organisations as diverse as Australian Government agencies is not simple. Tracking changes in the overall energy consumption of an agency without accounting for the underlying activity levels of that agency would give no indication of its relative efficiency of energy use. An agency may have increased staff numbers to cope with the introduction of new programs. Accordingly, it may have increased its energy consumption without necessarily being less energy efficient.

Energy intensity

The concept of normalised energy consumption, or energy intensity, is included in the Australian Government energy efficiency policy. Simply put, normalised energy consumption provides a measure of how energy consumption is related to activity levels. Normalised energy consumption may be MJ/person, MJ/m² or MJ/km. (MJ is an abbreviation for Megajoule, a unit of energy consumption, person is an occupant of the space, m² represents a square metre of building space and km is the distance travelled by a vehicle in kilometres).

Relative movement in energy intensity is a much better indicator of relative energy efficiency because it does, to some extent, reflect activity levels. A degree of complexity to the comparison process results from this approach, as energy performance is peculiar to the type of activity being assessed. For example, it is reasonable to compare office buildings with each other in terms of energy performance, but it would be inappropriate to compare office buildings with a laboratory.

Energy Intensity

A small agency with a staff of 12 people occupies 330 m² of office space. During the year 35,681 kWh of electricity is consumed to light the space and power office equipment.

Using a conversion rate of 3.6 MJ/kWh, total consumption is 128,452 MJ.

The energy intensity of the agency is:

$128,452/12 = 10,704$ MJ/person the key indicator for Tenant Light and Power

or

$128,452/330 = 389$ MJ/m²

End-use categories

To address this, twelve end-use categories are included in the Australian Government energy efficiency policy. Each end-use category has similar energy performance characteristics and most have a defined intensity as the key indicator of energy efficiency. However, for some categories, there is no intensity that adequately represents efficiency, so total energy consumption is used.

It is reasonable to make comparisons between the year-to-year performance of an agency within a particular category, using its energy intensity. Categories like office buildings and passenger vehicles are reasonably homogeneous and therefore allow ready comparisons between agencies' performance. In other less homogeneous categories, like public buildings or laboratories, comparisons between agencies should be done with great care and with an understanding of all the factors affecting relative performance.

Public Reporting Benefits

Monitoring and reporting is a basic requirement under any energy efficiency or greenhouse abatement program. It demonstrates, at a minimum, that organisations keep records of their energy consumption and property holdings, and ideally that they have an energy management plan in place. Those that are able to measure and monitor their energy use are better able to manage their consumption and integrate commitment to improved energy efficiency into their day-to-day operations. If approached in this way, a reporting requirement is straightforward and does not impose an additional burden.

Regular public reporting of performance provides a number of benefits:

Increased awareness of energy and greenhouse issues

Energy efficiency and greenhouse issues are often distant from core business for most organisations and are generally given relatively less attention. Regular reporting focuses some attention in this area. One comment from an Australian Government agency was that reporting "focuses the mind" and

savings opportunities are often identified and realised as a result.

Measures relative performance

A consistent reporting basis that covers energy or greenhouse intensities (such as MJ/m² or tonnes/unit production) allows an organisation to compare its performance with others operating similar facilities. Such comparisons give indications of possible energy or greenhouse saving opportunities and provide the impetus for energy manager networking and cross fertilisation of ideas.

Provides a benchmarking tool

Again with sufficient normalised data over a period of time, benchmarks of good energy and greenhouse performance will become apparent. These will provide a ready performance indicator for comparison and a goal for energy and greenhouse management programs.

Tracks changes over time

Regular reporting will track changes in intensity over time and will provide a good indication of the effectiveness of existing management programs. The shorter the period between reports, the more quickly management programs can be adjusted to maximise the performance. Annual reporting is probably sufficient for external performance monitoring but at least monthly internal monitoring and reporting is required for an effective energy management program.

Identifies high intensity areas

Policy and management response can be better directed towards those activities that have the highest energy consumption or greenhouse emissions. A reporting system can provide the basis for making informed decisions, and effectively deploying resources.

Transparency encourages improvement

The knowledge that outcomes of energy and environmental management practices will be made available to public scrutiny encourages greater focus. Such transparency encourages both improved performance and improved reporting of that performance.

Public performance reporting also identifies opportunities for energy services companies by allowing them to focus on poorer performing organisations.

Performance outcomes

Energy use and greenhouse emissions

Total reported energy consumption of the Australian Government, excluding Defence Operations, for 2002/2003 was 8,161,567 GJ with associated greenhouse emissions of 1,565,596 tonnes of CO₂ equivalent. To give this some perspective, this energy consumption is about half that of the entire ACT and the greenhouse emissions are just under 0.5% of the total energy-related greenhouse emissions in Australia.

Table 1 Energy consumption and greenhouse gas emissions by end-use category

End-use category	Energy use		Greenhouse emissions		
	GJ	% total	Tonnes	% total	kg/GJ
Climate Controlled Stores	56,930	0.70	10,411	0.66	183
Antarctic Bases	74,599	0.91	5,216	0.33	70
Other Uses	78,967	0.97	12,072	0.77	153
Law Courts	96,297	1.18	21,877	1.40	227
Public Buildings	346,861	4.25	62,443	3.99	180
Office - Central Services	553,081	6.78	108,208	6.91	196
Other Transport	585,758	7.18	40,155	2.56	69
Other Buildings	679,570	8.33	155,878	9.96	229
Passenger Vehicles	672,648	8.24	44,487	2.84	66
Laboratories	955,485	11.71	184,839	11.81	193
Office - Tenant Light and Power	1,162,166	14.24	294,070	18.78	253
Defence Establishments	2,899,206	35.52	625,941	39.98	216
Total	8,161,567		1,565,596		192
Unreported Central Services	680,000	2.97	133,039	4.04	196
Defence Operations	14,059,581	61.39	979,958	36.58	70
Grand Total	22,901,148		2,678,592		117

Table 1 provides a summary of energy consumption and associated greenhouse emissions by end-use category.

Greenhouse gas emissions are calculated by applying national average greenhouse coefficients to the total consumption of each fuel type in the category. The coefficients that have been used are included on page 484. National average coefficients introduce a degree of approximation to the calculation of greenhouse emissions and the assessment in this report is based on the assumption that the profile of energy consumption in the Australian Government exactly mirrors that of the nation. The extent to which this assumption is correct determines the accuracy of the calculation. The other error factors are the accuracy of the calculation of the coefficients themselves and the accuracy of the energy data. Overall, the accuracy of the greenhouse gas emissions is considered to be within ten per cent in absolute terms, but within a few per cent in year-on-year comparisons.

Defence operations

The energy consumption of Defence Operations is appended to Table 1 to complete the picture of total Australian Government energy consumption. Despite its significant contribution, defence operational fuel consumption does not fall within the ambit of the Australian Government energy policy other than as a reporting requirement. Levels of consumption can vary widely depending on operational priorities. Consumption increased significantly during 1999/2000 as a result of activities in East Timor and fell as Australia's military commitment was reduced. This year saw defence involvement in Iraq and in the Pacific. Because it is outside the control mechanisms of the policy, defence operational fuel consumption will be excluded from subsequent analysis in this report, unless it is explicitly stated otherwise.

Government priorities

Total energy consumption varies in response to government priorities and activity levels. In the past, consumption increases were reported as a result of government responses to the Sydney Olympic Games (increased drug testing, security etc), to East Timor and to the requirements of introducing the new tax system. Consumption increased due to an increased state of alert following September 11 while the staff reductions that followed the settling in of the new tax system contributed to a reduction in consumption. This year, the SARS epidemic, the war in Iraq and the problems in the pharmaceutical industry also affected energy performance. There are many other such priority changes that affect the levels of consumption and energy intensity in each of the

reporting agencies and these are reflected in the comments provided by the agencies and included in Annex B.

Unreported energy

An important aspect of the Australian Government energy policy is that departments and agencies are expected to be responsible for, and report on, only that energy consumption over which they have direct control.

While tenants are expected to be responsible for the energy consumption of their own light and power, they are not required to be responsible for the energy consumption of the building central services unless they have agreed to this in their lease agreement.

Tenants in multi storey buildings have virtually no control over the energy consumption of building central services such as air conditioning, lifts, domestic hot water etc that are operated by the building owner and possibly shared by many tenants. The only office building central services energy consumption that is included in this report, therefore, is for office buildings that the Australian Government owns, or where the Australian Government, as a tenant, has agreed to assume responsibility for such consumption.

As Australian Government office buildings are sold, and the new private sector building owner assumes responsibility, the energy consumption of the building central services is no longer reported.

Nonetheless the policy requires that this consumption be estimated. Where building central services are reported, the rate of energy consumption is 480 MJ/m²/annum. If this figure is applied to the slightly more than 1.4 million square metres of unreported space, then there is an estimated additional 680,000 GJ of energy consumption and 133,000 tonnes of greenhouse emissions that can be added to Australian Government operations. As with defence operational fuels, this unreported energy consumption is included in Table 1 for information, but is excluded from any further analysis in this report. It should be noted also that the amount of unreported office space has hardly changed over the six years of reporting.

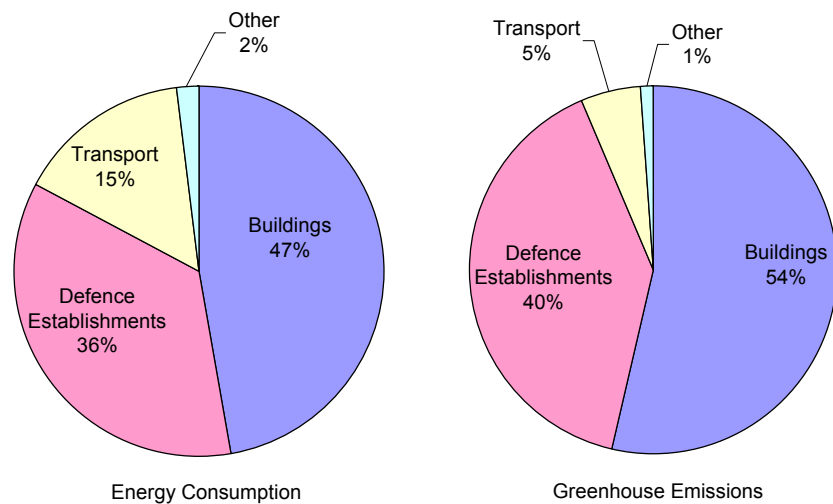
Energy end-use

Transport fuels have much lower greenhouse intensity than electricity, which accounts for more than 75% of non-transport energy use. The high greenhouse intensity of electricity arises

because nationally it is mostly generated using coal as a fuel in a relatively inefficient process. The high greenhouse intensity of coal further compounds this equation and results in electricity having a greenhouse intensity around four times higher than the main primary fuels of natural gas and petrol.

Figure 1 shows the energy use and greenhouse emissions of four broad end-use groups. This figure shows how important building energy performance is in determining overall greenhouse emissions of the Australian Government. The energy consumption of both the Defence Establishments and the Other groups are also mostly building related, giving a strong indication of the need to apply policy focus on buildings, rather than transport operations. While transport operations represent 15% of total energy consumption, they are responsible for only 5% of total energy related greenhouse emissions.

Figure 1 Energy use and greenhouse emissions by end-use group



Buildings include Office-Tenant Light and Power, Office - Central Services, Public Buildings, Law Courts, Climate Controlled Stores, Laboratories and Other Buildings.

Transport includes Passenger Vehicles and Other Transport.

Other includes Other Uses and Antarctic Bases.

Defence Establishments includes Defence Establishments only.

Energy use by agency

The goal of the energy policy is to reduce Australian Government energy consumption and associated greenhouse emissions through improving the efficiency of energy use. As the energy consumption of an agency can vary greatly depending on its underlying activities during the reporting period, its raw energy consumption says very little about its energy efficiency. Therefore, the focus of this report is on energy intensity.

Table 2 Energy use of the 20 highest energy using agencies

Agency	Total Energy Use	
	GJ	% of Total
Department of Defence	3,621,539	46.70
Commonwealth Scientific and Industrial Research Organisation	740,596	8.62
Centrelink	478,453	5.29
Australian Taxation Office	344,878	4.81
Australian Antarctic Division	324,650	3.77
Australian Broadcasting Corporation	254,967	2.87
Australian Customs Service	197,657	2.02
Australian Federal Police	163,811	1.78
Joint House Department	154,714	1.92
Health Insurance Commission	95,326	0.97
Australian Nuclear Science & Technology Organisation	94,885	1.04
Australian Sports Commission	68,429	0.73
Commonwealth Law Courts	67,745	0.77
National Gallery of Australia	60,238	0.96
Director of National Parks	57,150	0.75
Department of Foreign Affairs and Trade	56,634	0.68
Australian War Memorial	50,657	0.58
Department of Health and Ageing	47,571	0.51
Department of Immigration and Multicultural and Indigenous Affairs	46,266	0.54
Australian Institute of Marine Science	45,879	0.41
Total for top 20 agencies	6,972,046	85.4%
Total for the Australian Government	8,161,567	

While the focus on energy intensity is important, the greatest opportunities for achieving significant reductions in energy consumption tend to be with the largest energy consumers. Table 2 lists the 20 highest energy-using agencies, which together account for 85% of total Australian Government energy consumption. Full details of the energy performance of all energy reporting agencies are included in the agency data sheets in Annex B.

While it is easy to focus on the larger agencies, the contribution of smaller agencies also should not be underestimated. The Superannuation Complaints Tribunal has just over thirty staff but reported a 7% reduction in its energy consumption, despite increasing staff numbers, by making energy efficiency a management priority. The overall impact might be small, but in its effect on total operating costs, this 7% reduction is as important to the Superannuation Complaints Tribunal as it would have been to a much larger agency.

Metering

This year has seen a considerable increase in the accuracy of the data with several agencies reporting on the installation of metering systems to directly measure their consumption. Prior to meter installation, energy consumption was generally calculated by a formula that apportioned total consumption to different users typically on the basis of occupied floor area. Such formularised consumption allocation is never entirely accurate and, more importantly, acts as a disincentive to the implementation of effective energy management programs. An agency whose consumption is calculated by formula has little incentive to improve energy efficiency because, at best, they will only be credited with a portion of the savings.

With new meter technology and increasing competition between metering service providers, meter installations are becoming less costly. The accurate performance data provided by such installations brings short and long term benefits to energy management programs and the accelerating installation trend is strongly encouraged.

In the last report it was suggested that improved data handling procedures on the part of Australian Government energy managers and their property managers had improved the quality of the data being reported. However, a review of the comments provided by reporting agencies suggests that this assessment may have been a

little premature. A number of agencies have expressed dissatisfaction with the quality and accuracy of the service provided by their property managers and some have indicated that they will be assuming more direct responsibility for their data in the future.

Energy use by fuel type

This section examines the relative contribution of different energy types to overall Australian Government energy consumption and greenhouse emissions. Defence operational fuels are included in the overall total of Australian Government energy use in Table 3 and excluded from subsequent tables and comments.

Table 4 shows the fuel type split for total energy consumption without Defence operational fuels.

Table 3 Energy consumption and greenhouse gas emissions by fuel type
(including Defence Operational Fuels)

Fuel type	Energy use		Greenhouse emissions	
	GJ	% total	Tonnes	% total
Heating Oil/Fuel Oil	424	0.00	30	0.00
Greenpower	105,928	0.48	-	-
AVGAS	78,859	0.35	5,362	0.21
Special Antarctic Blend	74,060	0.33	5,184	0.20
LPG	81,774	0.37	4,857	0.19
Gas Oil	225,455	1.01	15,782	0.62
Petrol	836,237	3.76	55,192	2.17
Natural Gas	1,217,973	5.48	66,258	2.60
Electricity	5,395,365	24.28	1,402,795	55.11
Automotive Diesel	5,399,925	24.30	376,375	14.79
Aviation Turbine Fuel	8,805,149	39.63	613,719	24.11
Total	22,221,148		2,545,553	

Table 4 Energy consumption and greenhouse gas emissions by fuel type (excluding Defence Operational Fuels)

Fuel type	Energy use		Greenhouse emissions	
	GJ	% total	Tonnes	% total
Heating Oil/Fuel Oil	424	0.01	30	0.00
AVGAS	639	0.01	43	0.00
Aviation Turbine Fuel	19,337	0.24	1,348	0.09
Greenpower	105,928	1.30	-	-
Special Antarctic Blend	74,060	0.91	5,184	0.33
LPG	81,774	1.00	4,857	0.31
Automotive Diesel	205,099	2.51	14,295	0.91
Gas Oil	225,455	2.76	15,782	1.01
Petrol	836,237	10.25	55,192	3.53
Natural Gas	1,217,973	14.92	66,258	4.23
Electricity	5,394,642	66.10	1,402,607	89.59
Total	8,161,567		1,565,596	

Table 5 shows fuel use for general transport operations end-use categories of Other Transport and Passenger Vehicles while Table 6 is limited to Passenger Vehicles only.

Table 5 Transport energy consumption and greenhouse gas emissions

Fuel type	Energy use			Greenhouse emissions	
	GJ	Units	% total	Tonnes	% total
AVGAS	639	19,315	0.05	43	0.05
LPG	4,124	158,286	0.33	245	0.29
Aviation Turbine Fuel	19,337	525,453	1.54	1,348	1.59
Automotive Diesel	172,751	4,475,402	13.73	12,041	14.23
Gas Oil	225,455	5,044	17.92	15,782	18.65
Petrol	836,101	24,447,407	66.44	55,183	65.20
Total	1,258,406			84,641	

Table 6 Passenger vehicle energy consumption and greenhouse gas emissions

Fuel type	Energy use			Greenhouse emissions	
	GJ	Units	% total	Tonnes	% total
LPG	3,987	155,150	0.59	237	0.53
Automotive Diesel	31,992	828,814	4.76	2,230	5.01
Petrol	636,668	18,616,036	94.65	42,020	94.46
Total	672,648			44,487	

Automotive diesel is used in many of the light commercial vehicles, four wheel drives and mini buses that are included in the passenger vehicle category.

Trends in energy consumption and greenhouse emissions

Figure 2 illustrates the changes in total energy consumption by end-use category over the full period of reporting to date. These results are presented numerically in Table 7.

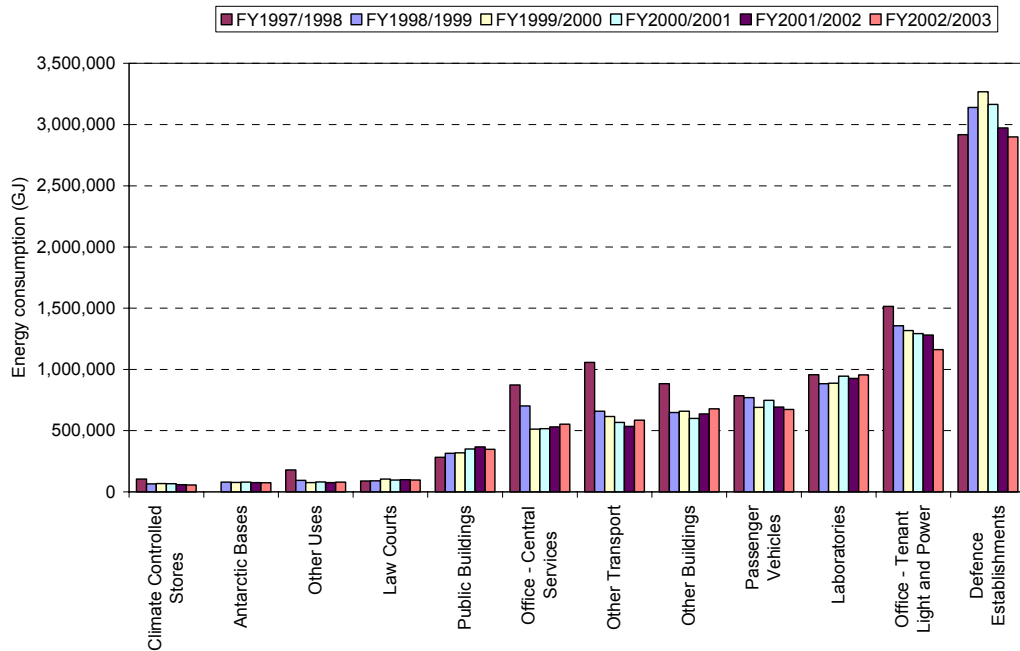
Total energy consumption has fallen for the fifth consecutive year. In the past 12 months total energy consumption fell by 1.2% resulting in a total reduction of 15.4% over the five years since the first report in 1997/1998.

While activity changes may have caused some of this reduction, much can be directly attributed to improvements in energy intensity, thereby indicating that the Australian Government is becoming more efficient in its energy use.

In the eight energy end-use categories where meaningful energy intensities can be calculated, total consumption declined by nearly 18%. If 2002/03 energy intensities in these end-use categories are applied to 1997/98 levels of occupancy, floor area and distance travelled (business as usual) then the total consumption would have declined by more than 22%. In other words, the changes in the levels of activity did not contribute to the reduction in consumption; they actually held back the improvement. This

calculation takes the reported data at face value and doesn't try to quantify the effect of improving data quality.

Figure 2 Energy consumption of each end-use category



In the end-use categories of Other Transport, Defence Establishments, Antarctic Bases and Other Uses, those categories for which no meaningful energy intensity can be calculated, consumption declined by just over 12% over the same period.

A lot of this reduction came from activity changes in the Other Transport category. Activities, such as land and sea geological surveys are less of a priority now than in the earlier years and associated energy consumption has declined accordingly. On the other hand, the energy consumption of Defence Establishments is a little less than it was in 1997/98 despite a significant increase in activity level brought on by the international tensions of recent years.

Overall, it is considered that, while there have been swings and roundabouts, activity levels have had little impact and the reported reductions in energy consumption have come almost entirely from energy efficiency improvements.

The availability of power management on computer systems, the implementation of environmental management systems and membership of the Greenhouse Challenge program have been mentioned as drivers towards this greater energy efficiency. Implementation of computer power management systems, improving efficiency of lighting systems and the introduction of lighting control systems, moving to more energy efficient premises and better monitoring and targeting systems are some of the vehicles by which agencies have achieved this improvement.

Table 7 End-use category energy consumption by financial year

End-use category	Energy use (GJ)					
	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
Climate Controlled Stores	104,800	65,054	68,209	66,466	59,798	56,930
Antarctic Bases	-	79,644	77,806	78,843	76,110	74,599
Other Uses	178,365	94,306	77,065	80,513	76,256	78,967
Law Courts	88,829	90,327	104,826	96,013	99,857	96,297
Public Buildings	282,285	316,145	319,187	350,926	368,009	346,861
Office - Central Services	874,072	702,089	513,346	516,302	530,352	553,081
Other Transport	1,057,525	658,713	615,702	567,955	534,597	585,758
Other Buildings	884,262	648,327	658,956	599,286	637,431	679,570
Passenger Vehicles	786,244	769,949	690,830	748,216	693,068	672,648
Laboratories	957,326	883,866	887,974	945,761	926,387	955,485
Office - Tenant Light and Power	1,514,954	1,355,781	1,317,335	1,292,324	1,281,307	1,162,166
Defence Establishments	2,917,752	3,139,887	3,268,480	3,164,335	2,973,059	2,899,206
Total	9,646,413	8,804,088	8,599,715	8,506,940	8,256,230	8,161,567
Year-on-year change	0.00%	-8.73%	-2.32%	-1.08%	-2.95%	-1.15%
Progressive change	0.00%	-8.73%	-10.85%	-11.81%	-14.41%	-15.39%

Passenger vehicles

The quality of data in the Passenger Vehicle category is still quite poor. The agencies rely on their fleet managers and the fleet managers, in turn, rely on drivers, service station attendants and oil companies to provide them with the raw information. In this path, there is significant opportunity for error and very little error checking or error handling. Very few agencies have adopted alternative approaches to data collection.

There is the question, however, of whether the extra effort and cost of improved data collection brings commensurate benefits. A study of passenger vehicle operations reported in the 1999/2000 energy report¹ concluded amongst other things that:

- In aggregate, reported fuel use based on fleet manager reports is reasonably accurate;
- Reported distance travelled based on odometer readings provided at the time of fuel purchase is highly inaccurate;
- Individual vehicle models typically performed close to the city cycle fuel consumption as published in the fuel consumption guide; and
- Fleet performance could reasonably be estimated based on fuel use and the fuel consumption guide figures for the individual vehicles within the fleet.

Earlier this year, a target that rates the fleet mix rather than the fleet performance was introduced. This target was based on a draft green vehicle guide that rates the environmental performance of individual vehicles. Details of this green vehicle guide target can be found on page 30.

Significant moves

Energy use in the Other Transport category increased by 9.6% this year after falling by 5.9% last year. Consumption in this category is dominated by the operation of ocean going vessels by agencies like the Australian Customs Service, the Australian Institute of Marine Science and the Australian Antarctic Division. A single voyage more or less in any reporting period can result in significant changes so overall consumption levels in this category tend to be quite volatile.

Consumption in the Tenant Light and Power category fell by 9.3% overall, driven mostly by a significant improvement in the energy intensity of operations. Better metering and more accurate recording of data also contributed. As an example of the latter, Centrelink transferred a sizable proportion of their consumption from Tenant Light and Power to Central Services after engaging in a detailed review of their energy flows.

Other Buildings consumption increased by 6.6% for two main reasons. Improved measurement and reporting methods resulted

¹ *Energy Use in Commonwealth Operations 1999-2000, Annex G*

in some consumption being more correctly attributed to this category; and there was a significant increase in the energy intensity of a number of computer centres. The Department of Employment and Workplace Relations reported a 24% increase in consumption in this category due to the installation of increased computer capacity. Computer centre operations and space conditioning also impact on Tenant Light and Power performance and a more detailed study of energy efficiency improvement options of such operations may be warranted.

There was a significant improvement in the efficiency of Public Buildings this year and this gave rise to a 5.8% reduction in energy consumption for the category. Questacon and the Australian War Memorial both benefited from strongly supported energy management programs and the National Gallery of Australia gained full benefit from their recently installed ultrasonic humidification systems. The National Gallery has provided a case study on that installation and it can be found on page 53 of this report.

Greenhouse emissions by end-use category

Overall, with the reduction in energy consumption, there is a reduction in associated greenhouse gas emissions. The relationship is not direct, however, as the level of greenhouse emissions also depends on the fuel mix.

Table 8 End-use category greenhouse emissions by financial year

End-use category	Greenhouse emission (tonnes)					
	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
Antarctic Bases	-	5,570	5,438	5,514	5,323	5,216
Climate Controlled Stores	22,248	12,718	12,777	13,239	11,484	10,411
Other Uses	22,569	13,665	13,238	14,177	12,763	12,072
Law Courts	21,691	21,879	22,628	21,910	22,405	21,877
Other Transport	72,539	44,813	42,024	38,836	36,613	40,155
Passenger Vehicles	51,980	51,017	45,747	49,490	45,880	44,487
Public Buildings	49,731	55,164	55,009	59,735	65,592	62,443
Office - Central Services	156,308	137,979	95,864	95,539	96,306	108,208
Other Buildings	214,807	145,607	143,719	133,464	143,437	155,878
Laboratories	187,966	169,387	171,032	183,951	181,715	184,839
Office - Tenant Light and Power	392,943	349,138	340,338	333,752	329,868	294,070
Defence Establishments	600,645	641,473	673,575	651,877	626,276	625,941
Total	1,793,428	1,648,410	1,621,390	1,601,483	1,577,662	1,565,596
Year-on-year change	0.00%	-8.09%	-1.64%	-1.23%	-1.49%	-0.76%
Progressive change	0.00%	-8.09%	-9.59%	-10.70%	-12.03%	-12.70%

While there was an overall reduction in energy use, electricity consumption fell at a rate slightly less than the total. As a result, electricity as a proportion of the total energy consumption rose and, with its high greenhouse intensity, limited the reduction in greenhouse emissions to just under 0.8%. The total greenhouse gas reduction since the first year of reporting in 1997/98 is now 12.7%. Table 8 shows the trends in greenhouse emissions.

Table 9 Energy consumption by source for each financial year

Fuel type	Energy use (GJ)					
	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
Heating Oil/Fuel Oil	91,799	2,615	1,994	824	1,126	424
AVGAS	6,047	5,694	1,439	1,716	1,544	639
Aviation Turbine Fuel	10,253	7,986	9,659	6,845	6,204	19,337
Greenpower	-	1,714	23,208	34,539	37,707	105,928
Special Antarctic Blend	-	79,148	76,974	78,343	75,669	74,060
LPG	77,339	123,975	89,073	97,574	115,589	81,774
Automotive Diesel	761,174	372,761	157,192	181,713	193,976	205,099
Gas Oil	-	73,751	268,454	224,829	217,633	225,455
Petrol	1,073,856	996,799	907,908	935,502	837,241	836,237
Natural Gas	1,582,511	1,550,879	1,539,205	1,489,828	1,358,024	1,217,973
Electricity	6,043,435	5,588,765	5,524,610	5,455,228	5,411,515	5,394,642
Total	9,646,413	8,804,088	8,599,715	8,506,940	8,256,230	8,161,567

Energy source

The effect of the fuel mix on greenhouse gas emissions is illustrated further in Table 9, where energy consumption of the different energy sources is shown. The share of the total consumption taken by each fuel type has been reasonably steady, with understandably greater variation in those fuels with a smaller proportion of the total consumption. The big three fuels of electricity, natural gas and petrol continue to account for more than 90% of total consumption (66% electricity, 16% natural gas and 10% petrol). As an indication of the gradual move towards electricity, the same contributions in 1997/98 were 63%, 16% and 11%. This is without adding the 1.3% of total consumption that is Greenpower to the reported electricity consumption.

A new electricity supply contract delivering an average 8% Greenpower to over two hundred sites in the ACT came into effect in September 2002. This contract, negotiated by the Australian Greenhouse Office, was one of the main reasons behind the near 200% increase in reported Greenpower consumption this year.

While the use of Greenpower is effective in reducing greenhouse emissions, it is more costly than other forms of electricity. Some agencies, like the Australian Broadcasting Corporation, have

chosen to opt out of an earlier commitment to purchase Greenpower with a view to investing the resulting savings in cost effective energy efficiency measures.

The Defence Energy Efficiency Program had a significant effect on Natural Gas and LPG consumption levels, which fell by 10.3% and 29.3% respectively. A major decline in LPG consumption in Passenger Vehicles reported by the Australian Federal Police also contributed to the reduction.

The 5.7% increase in diesel consumption is associated with the increased Other Transport activity that was discussed earlier. There was also a big increase in reported consumption of aviation turbine fuel (up over 200% from a small base). This was a result of greater research activity in Antarctica and the reporting, for the first time, of the fuel consumption of the ABC helicopter.

Table 10 Greenhouse emissions by source for each financial year

End-use category	Greenhouse emission (tonnes)					
	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
Greenpower	-	-	-	-	-	-
Heating Oil/Fuel Oil	6,398	182	139	57	79	30
AVGAS	411	387	98	117	105	43
Aviation Turbine Fuel	715	557	673	477	432	1,348
Special Antarctic Blend	-	5,540	5,388	5,484	5,297	5,184
LPG	4,594	7,364	5,291	5,796	6,866	4,857
Automotive Diesel	53,054	25,981	10,956	12,665	13,520	14,295
Gas Oil	-	5,163	18,792	15,738	15,234	15,782
Petrol	70,874	65,789	59,922	61,743	55,258	55,192
Natural Gas	86,089	84,368	83,733	81,047	73,877	66,258
Electricity	1,571,293	1,453,079	1,436,399	1,418,359	1,406,994	1,402,607
Total	1,793,428	1,648,410	1,621,390	1,601,483	1,577,662	1,565,596

Greenhouse emissions by source

Table 10 shows how greenhouse emissions associated with each fuel type have changed over the last six years. Because the greenhouse intensities of each fuel source have been kept constant in this report, these changes reflect the energy consumption variations over the same period. Greenpower, with its zero greenhouse intensity is the exception to this rule.

Energy end-use intensity

As discussed in the introduction, relative movement in energy intensity is a far better indicator of energy efficiency in operations than movement in energy consumption. Table 11 summarises the aggregate Australian Government performance for each end-use category and, where appropriate, the range and average of the energy intensity most appropriate to each category.

Table 11 End-use category energy performance indicators

End-use category	Total Energy		Target	Lower	Upper	Average	Key Indicator
	GJ	%					
Office - Tenant Light and Power	1,162,166	14.2	10,000	4,660	24,976	8,980	MJ/person/annum
Office - Central Services	553,081	6.8	500	127	818	480	MJ/m ² /annum
Public Buildings	346,861	4.2		109	2,230	1,109	MJ/m ² /annum
Law Courts	96,297	1.2		209	872	574	MJ/m ² /annum
Climate Controlled Stores	56,930	0.7		345	2,046	655	MJ/m ² /annum
Laboratories	955,485	11.7		563	2,184	1,029	MJ/m ² /annum
Other Buildings	679,570	8.3		10	6,616	846	MJ/m ² /annum
Passenger Vehicles	672,648	8.2		2.34	5.88	3.54	MJ/km
Other Transport	585,758	7.2					GJ
Defence Establishments	2,899,206	35.5	2,500,000				GJ
Antarctic Bases	74,599	0.9					GJ
Other Uses	78,967	1.0					GJ
Total	8,161,567						

The performance of all agencies in each end-use category over the six years of reporting is given in Annex B and league tables of current year agency performance in each end-use category are given in Annex C.

Some end-use categories, such as Other Transport and Other Uses, are so diverse as to make it impossible to define any single indicator of energy performance and so only total energy consumption is included in Table 11. The Defence Establishments category continues to be reported in terms of total energy

consumption, although the Department of Defence is considering options for intensity based reporting of a large proportion of this consumption.

Targets

Targets are currently set in three end-use categories as indicated in Table 11. The targets for Office-Tenant Light and Power and Office-Central Services are set in intensity terms and the Defence Establishments target is an absolute consumption level. Each agency was required to meet these targets during this current reporting period.

How each agency performed against these targets is clearly illustrated by examining the league tables of performance in Annex C. Of course, each agency's comments should be considered before drawing any conclusions on their performance. Smaller agencies are less able to address poorly performing space by having other space which performs at high levels. These agencies are usually only able to make improvements in the longer term when moving to alternative accommodation becomes viable.

Progress

Table 12 shows the progress of the Australian Government towards greater energy efficiency. The size and direction of the intensity changes for each end-use category should be considered alongside the relative contribution that the category makes to overall Australian Government performance. For example, the improvement in Tenant Light and Power intensity becomes more significant when it is appreciated that this category contributes more than 14% to total energy consumption, and nearly 19% to greenhouse emissions.

Table 12 End-use category energy intensity by financial year

End-use Category	Energy Use Intensity						Performance
	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	Indicator
Office - Tenant Light and Power	13,524	12,649	11,758	10,848	10,415	8,980	MJ/person/annum
Office - Central Services	534	481	453	459	497	480	MJ/m ² /annum
Public Buildings	1,347	1,313	1,161	1,171	1,181	1,109	MJ/m ² /annum
Law Courts	550	538	608	570	595	574	MJ/m ² /annum
Climate Controlled	1,174	663	698	686	675	655	MJ/m ² /annum
Laboratories	1,111	1,026	1,056	1,068	994	1,029	MJ/m ² /annum
Other Buildings	1,383	955	937	838	862	846	MJ/m ² /annum
Passenger Vehicles	3.78	3.66	3.33	3.87	3.90	3.54	MJ/km
Other Transport	1,058	659	616	568	535	586	'000 GJ
Defence Establishments	2,918	3,140	3,268	3,164	2,973	2,899	'000 GJ
Antarctic Bases	-	79,644	77,806	78,843	76,110	74,599	GJ
Other Uses	178,365	94,306	77,065	80,513	76,256	78,967	GJ

The importance of this relationship is illustrated in Figure 3, where the length of each bar represents the percentage change in end-use category energy intensity from 2001/02 to 2002/03 and the height of the bar represents the relative contribution of the end-use category to total energy consumption. The figure shows that the three end-use categories with increased energy intensity or consumption are responsible for only about 20% of total consumption while those with reduced energy intensity or consumption were responsible for about 80% of total consumption. The four categories labelled with the suffix (GJ), show only changes in absolute consumption.

Figure 3 Changes in energy intensity or consumption from 2001/02

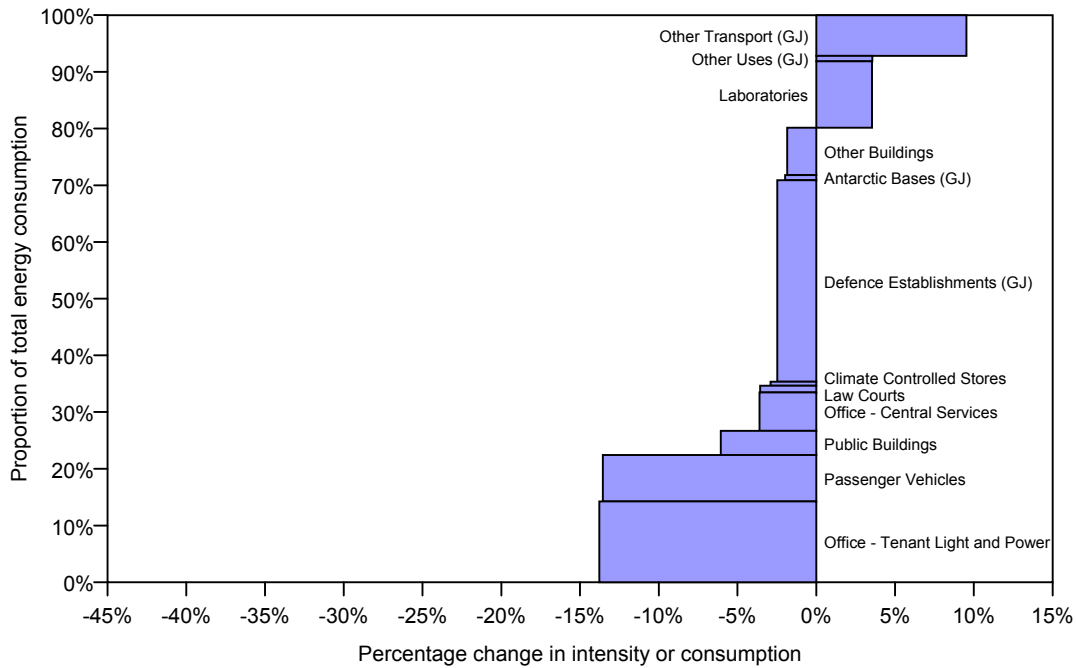
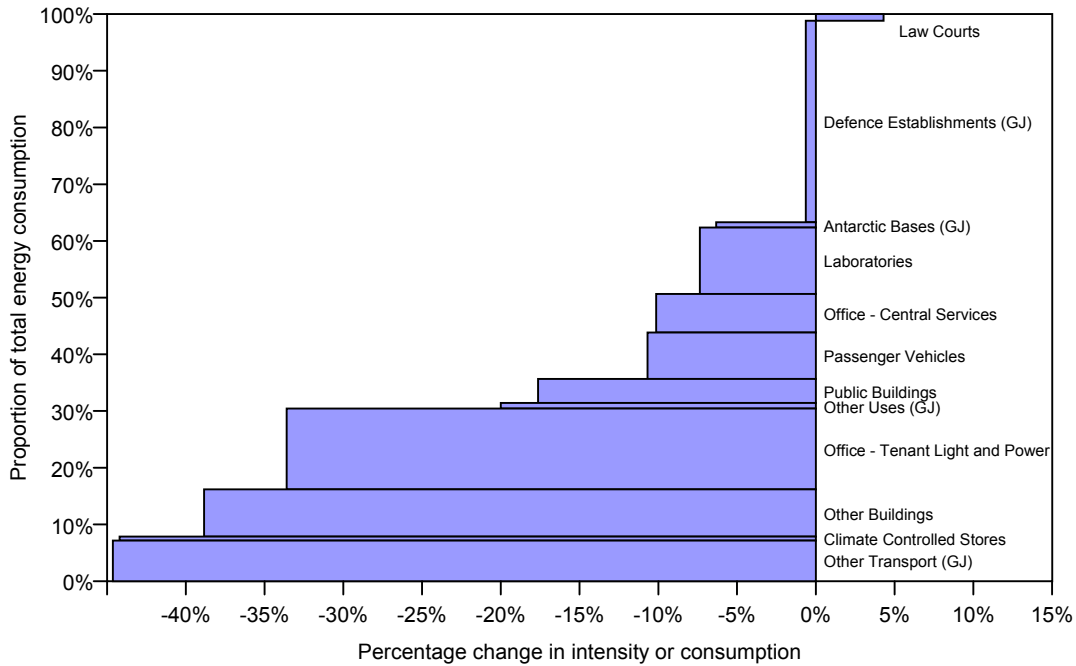


Figure 4 shows how energy intensity and energy consumption has changed since the first report in 1997/98. The only end-use category showing an increase is Law Courts, a relatively minor category representing just over 1% of total consumption. The increase is partly due to the relatively poor performance of the Commonwealth Law Courts building in Melbourne that was constructed and occupied since 1997/98. It also results from the characteristic of this category where some law court space is rented space within an office building and other space is within a dedicated law court building. In rented space, the consumption of the building services such as air conditioning is generally not included but such consumption is usually included for dedicated law court buildings. Any move from rented space to a dedicated building will cause an increase in reported energy intensity without necessarily implying a reduction in efficiency.

Antarctic Bases did not exist as an end-use category in 1997/98 and most of its energy consumption was reported as Other Uses. To give a more realistic picture of moves, Figure 4 uses the 1998/99 Antarctic Bases consumption as the basis for the percentage move in that category. The same consumption figure is deducted from

the Other Uses 1997/98 consumption figure as the basis for the percentage move in that category.

Figure 4 Changes in energy intensity or consumption since 1997/98



Performance targets

As stated earlier, energy performance targets to be met by the end of the 2002/03 financial year are set only in the three end-use categories of Office-Tenant Light and Power, Office-Central Services and Defence Establishments. While the range of targets may be limited, the three end-use categories account for almost 60% of total Australian Government consumption and more than 65% of energy related greenhouse gas emissions.

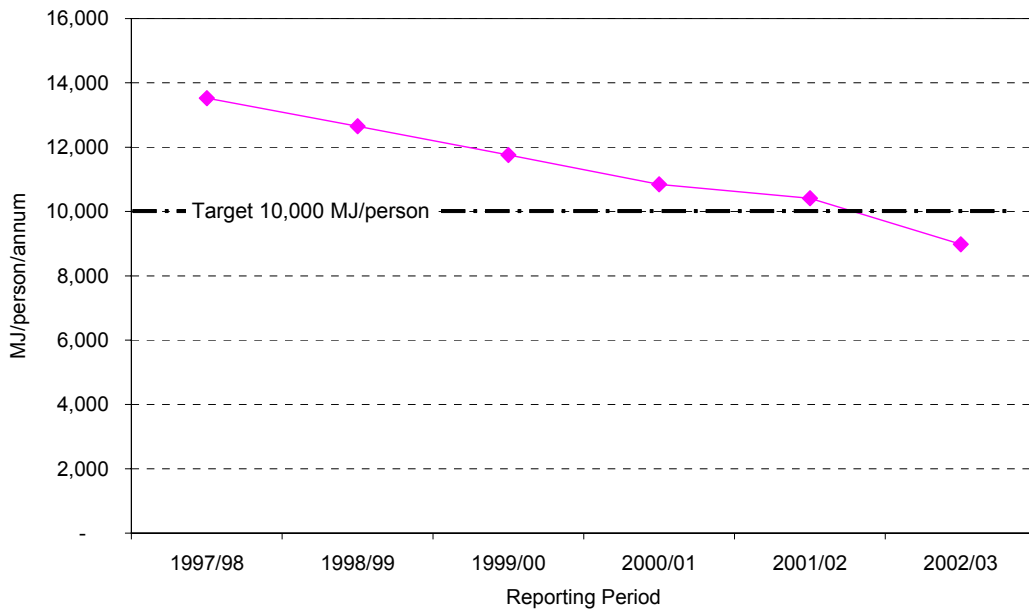
The targets are set at a level that represents a 25% reduction from the equivalent level that prevailed for Australian Government operations as a whole in 1992/93. For the two office based targets this means a 25% reduction in average energy intensity and for the Defence Establishments target a 25% reduction in energy consumption.

Office buildings

When Tenant Light and Power intensity was first measured in 1997/98, it was found that it had hardly changed from 1992/93 until the introduction of the energy policy. In effect, as illustrated in Figure 5, the Tenant Light and Power target represents a 25% improvement between 1997/98 and 2002/03 and performance actually improved by 33%.

The targets are the same for all agencies that operate in these end-use categories. Some agencies are operating below and others above target but in the Central Services and Tenant Light and Power categories, the Australian Government in aggregate has met, and indeed exceeded, the set targets.

Figure 5 Trends in Office-Tenant Light and Power energy intensity



Individual agency performance against targets can be found in the league tables in Annex C. As stated previously, such performance should be considered in conjunction with the Agency comments provided in Annex B.

Defence establishments

This year has shown the third consecutive improvement in the performance of the Defence Establishments category and, while the target has not been met, a number of efficiency measures

implemented near the end of the reporting period will ensure that the performance continues to improve. The failure to meet this target must be taken in the context of the huge increases in demand placed on the services of the department in the recent past. To have reduced energy consumption by more than 11% over three years against that background is very impressive. In other end-use categories, Defence performance has been similarly impressive.

The Green Vehicle Guide target

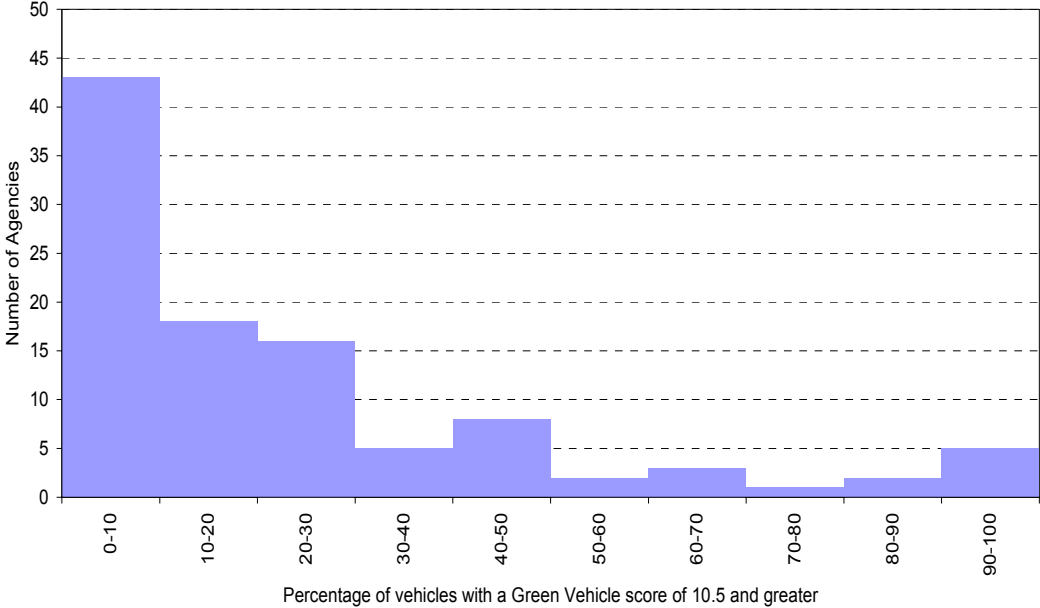
In February 2003 the Government agreed on an environmental target covering approximately 8,000 vehicles within the Australian Government Tied Contract Fleet based upon a rating scheme called the Green Vehicle Guide. The target aims to increase the proportion of vehicles with scores in the top half of the Green Vehicle Guide to 28% by 2005, while maintaining the Australian-made proportion of the fleet. At the end of 2002 it was estimated that 14% of the fleet were in the top half of the scale. The Green Vehicle Guide will rate all new light vehicles up to 3.5 tonnes gross vehicle mass on their greenhouse and noxious emissions, providing an overall score out of twenty with higher scores indicating better performance. This delivers on the Prime Minister's commitment made in his 1997 statement, *Safeguarding the Future: Australia's Response to Climate Change* for a challenging but realistic fuel efficiency target for the Australian Government fleet.

The Green Vehicle Guide is being jointly developed by the Department of Transport and Regional Services and the Australian Greenhouse Office. It will be available on the internet in 2004. Further information is available on the Department of Transport and Regional Services website:

http://www.dotars.gov.au/mve/green_vehicles_guide.htm

While the Guide is not complete as yet, government departments and agencies have provided indicative Green Vehicle Guide performance for the passenger vehicles. This performance is illustrated in the histogram in Figure 6. The draft nature of the guide militates against a more rigorous analysis of performance and individual agency performance is not identified.

Figure 6 Performance against the green vehicle guide scores



Other categories

In other end-use categories, no targets have been set because the diversity of operations in each of these categories makes a sensible uniform target impossible.

Meanwhile, the requirement for all new and upgraded office buildings to comply with strict energy performance standards and the requirement for agencies to show leadership in their approach to energy management should ensure that efficiency improvements are realised in these categories. The Australian Greenhouse Office is continuing to test several available methodologies to determine their applicability for Australian Government new and refurbished buildings

Office Buildings - Tenant Light and Power

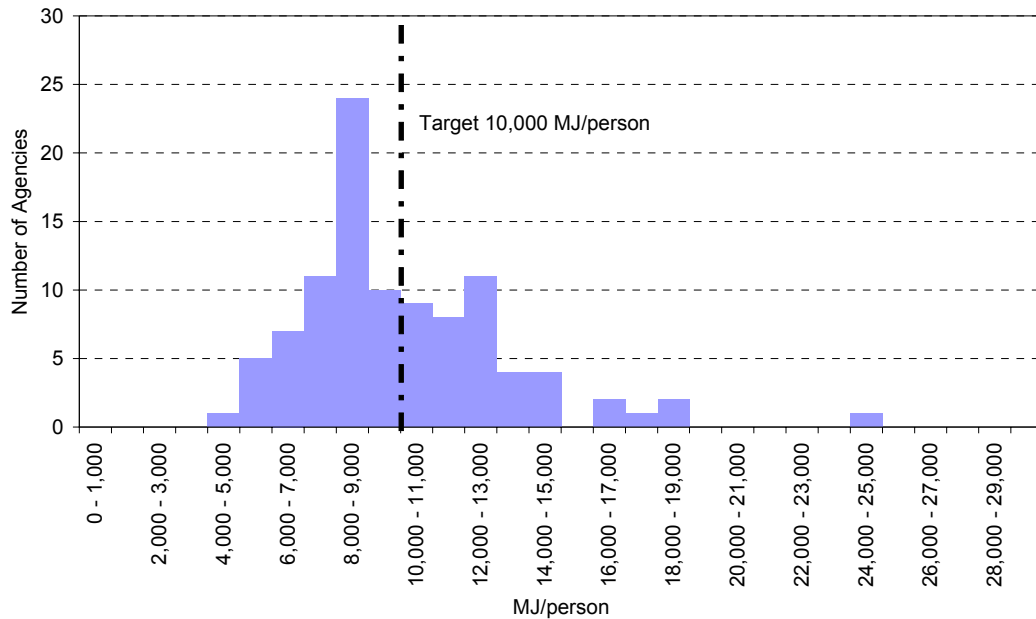
Description

This category covers energy used for tenant operations in buildings whose primary function is office space. It includes tenancy lighting, office equipment, supplementary air conditioners, boiling water units etc. However, additional building factors that contribute to higher energy consumption, such as computer server rooms, or localised areas of extended operating hours, are not separated from office consumption. Agency data is not reported on a building-by-building basis but on the aggregate performance of their entire building estate.

The key indicator in this category is MJ/person/annum, recognising that the overall energy efficiency is a combination of the efficient use of the space with the energy efficiency of the space. A mandatory performance target of 10,000 MJ/person/annum is to be achieved or bettered during 2002/03.

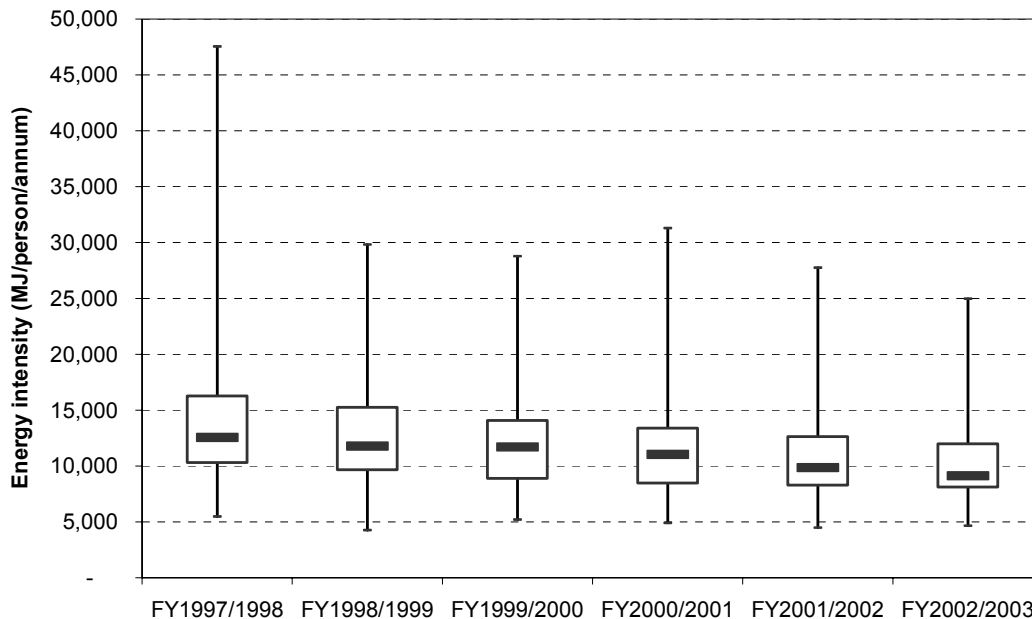
Performance against target

Average performance in the Office-Tenant Light and Power end-use category was 8,980 MJ/person. Figure 7 shows the distribution of performance about the target of 10,000 MJ/person target. The one agency reporting at the higher end of the spectrum is the Attorney General's D Branch. The D Branch reports that high rates of building use are contributing to their high intensity levels. Despite being high, the intensity is significantly less than last year.

Figure 7 Histogram of Tenant Light and Power performance

The average energy intensity has fallen by nearly 14% in the past year and has bettered the 10,000 MJ/person target. Again, this is partly due to a further improvement in building productivity, in particular, the average floor area per person, which is now below 20 m²/person (compared with nearly 28 m²/person in 1997/98). However, as for the past couple of years, the reduction in Tenant Light and Power intensity is greater than the reduction in average floor space per occupant. The phase out of Windows NT has introduced the option for power management of computer systems and where this has been implemented, significant improvements have been observed. This is particularly true in agencies where the culture had been to leave office equipment on overnight.

Figure 8 is a box plot of the Tenant Light and Power performance, showing the maximum and minimum intensity each year, the median value and the box shows the 25th and 75th percentile limits.

Figure 8 Box plot of Tenant Light and Power energy intensity**Metering again**

There are still many buildings where tenant energy consumption is not measured directly, but is calculated by formula from the total building consumption. This was referred to earlier in the report and has been a cause for concern in each of the previous five reports.

Calculation of energy consumption is most common in buildings currently or formerly owned by the Australian Government and introduces a significant level of uncertainty into the figures for both Tenant Light and Power and Central Services. Such formulae are usually agreed between the building owner and the tenants and commonly involve the building owner agreeing to accept responsibility for a fixed percentage of consumption, with the balance allocated to each tenant in the same proportion as their occupied floor space.

Calculating energy consumption by formula removes much of the incentive to introduce energy efficiency measures from both tenants and building owners. It is difficult to justify investing in efficiency measures if the energy consumption formula apportions

a significant part of your savings to other tenants, or the building owner.

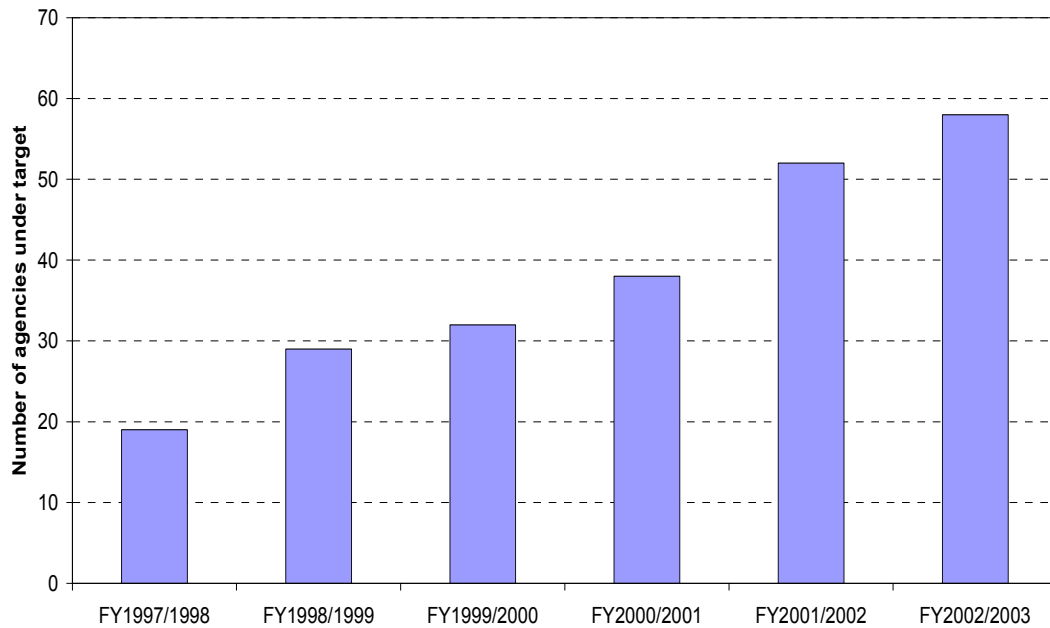
There has been a marked improvement in the provision of appropriate metering over the past year but energy contract negotiations, fitouts and upgrades continue to present opportunities for low cost meter installations where they have not yet been implemented.

Progress

To further illustrate progress, Figure 9 shows the number of agencies each year operating at or better than the target level. This year, 58 of the 100 agencies reporting Tenant Light and Power consumption are better than target. In 1997/98, only 19 of 91 agencies were operating below target.

74% of all Tenant Light and Power consumption is reported by agencies operating at a level better than the target. If all agencies currently operating worse than the target were to improve so that they were operating at 10,000 MJ/person, there would be a further reduction of only 58,000 GJ, or 5% of current Tenant Light and Power consumption.

Figure 9 Numbers of agencies operating under target



Office Buildings - Central Services

Description

This category covers energy used for services in office buildings common to all tenants. It includes building air conditioning, lifts, security and lobby lights, domestic hot water etc.

The Property Group of the Department of Finance and Administration reports the Central Services energy consumption of Australian Government-owned buildings.

Factors that might contribute to higher Central Services energy use, such as high tenancy loads, localised areas of extended operating hours or climate are not separately identified.

The key indicator in this category is MJ/m²/annum. This recognises that building central services will typically service an entire building regardless of occupancy. An agency wide performance target of 500 MJ/m²/annum has been set.

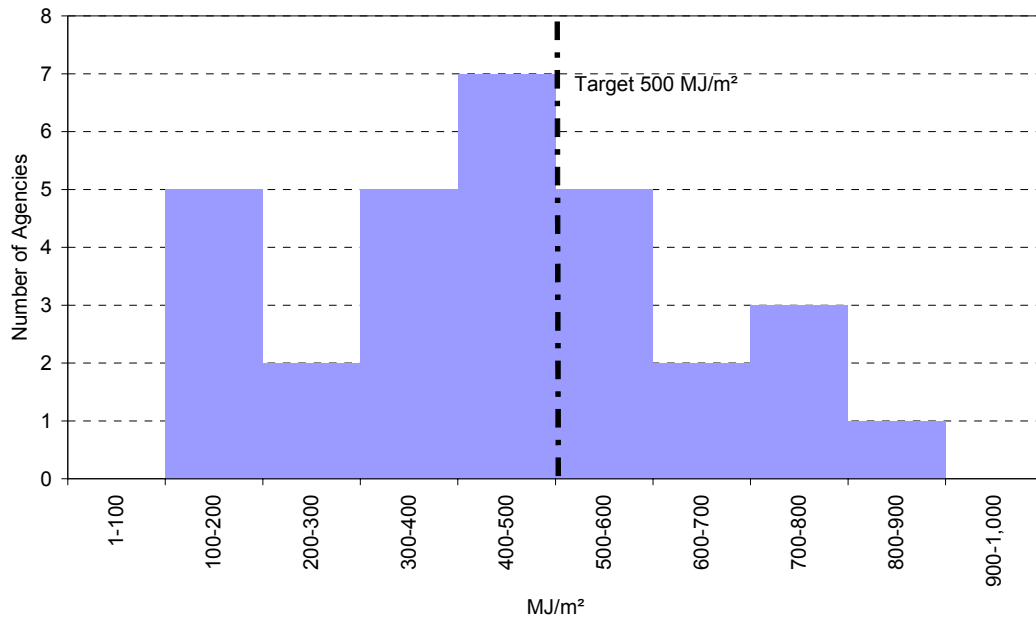
Performance against target

The reported average performance of 480 MJ/m²/annum is similar to last year and still under target, although the same cautionary note about calculated consumption referred to under Tenant Light and Power also applies here.

Figure 10 shows the distribution of performance about the 500 MJ/m² target.

Some of the agencies reporting at the higher end of the profile have special circumstances such as 24 hour operation that limit their ability to improve in the short term. Some of the extremes are also caused by inadequate metering and reliance on formulae to establish the split between Tenant Light and Power and Central Services.

The Property Group has reported an average intensity of 533 MJ/m² and is a significant reason why the Central Services category is not exhibiting the same continuous improvement as Tenant Light and Power.

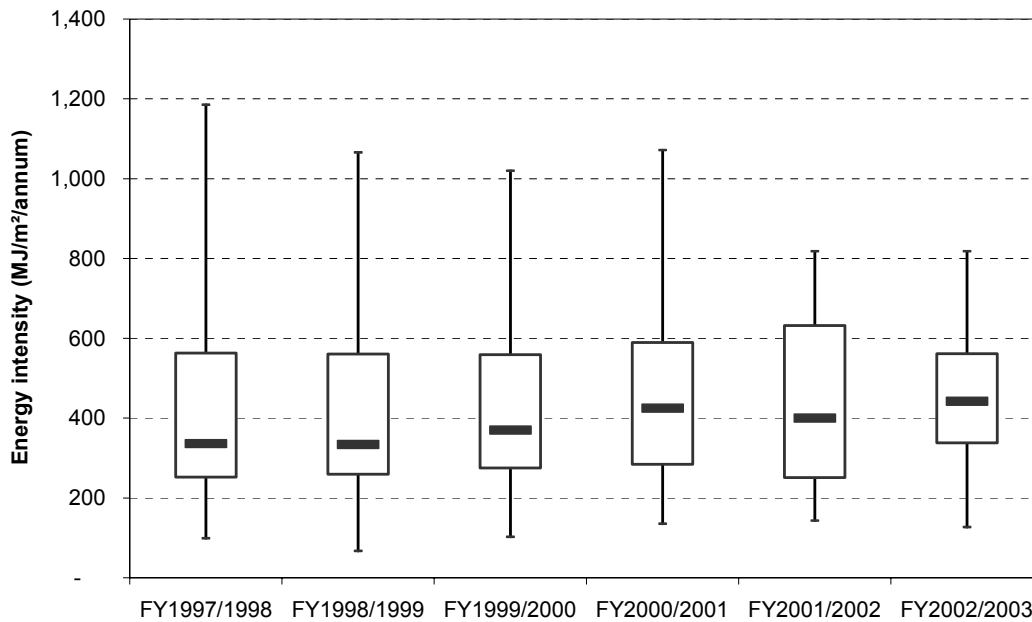
Figure 10 Histogram of Central Services performance

To some extent, the poor result could be simply a matter of inadequate metering, but there is also the possibility that poor performance has not been recognised and addressed. An option for a performance contract to improve the energy efficiency of the West Block building in Canberra has been under consideration for several years without any action being taken.

Leasing

The Australian Government energy policy requires that, as far as possible, lease agreements should ensure that all building Central Services energy consumption during normal hours should be the responsibility of the building owner. No costs associated with this consumption should be recoverable from tenants, either directly, or as an outgoing. This will ensure that building owners have an incentive to improve the efficiency of their building systems.

There is evidence to suggest that compliance with this requirement is not comprehensive. There is a marked difference between reported Tenant Light and Power floor area and the Central Services floor area, which has not diminished over the six years of reporting.

Figure 11 Box plot of Central Services energy intensity

Public Buildings

Description

This category includes energy consumed in buildings whose primary function is to be visited by the public in significant numbers. Typical buildings in this category are public libraries, museums or art galleries. Frequently, there is a requirement to maintain close control of internal environmental conditions on a 24-hour basis in these buildings.

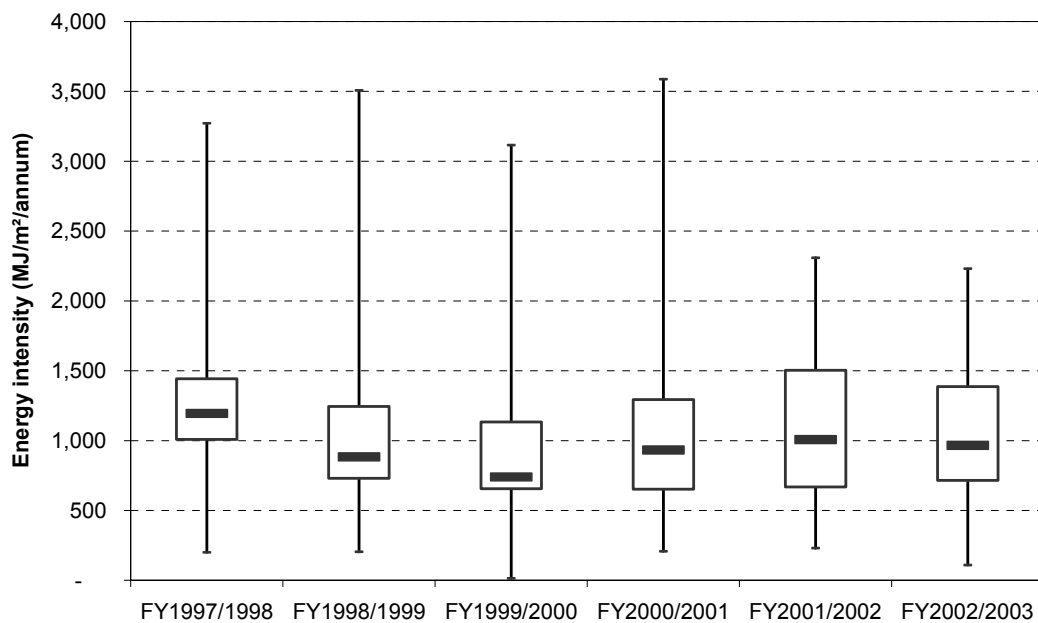
The key indicator in this category is MJ/m²/annum. No target has been set in this category because these buildings tend to be individual in their operational requirements.

Discussion

The calculated energy intensity of 1,109 MJ/m² is 6% lower than that reported last year on the back of the excellent performance of the Australian War Memorial, the National Gallery of Australia and the National Science and Technology Centre that was referred to earlier.

The intensity dip in the middle years is mostly due to data error.

Figure 12 Box plot of Public Buildings energy intensity



Law Courts

Description

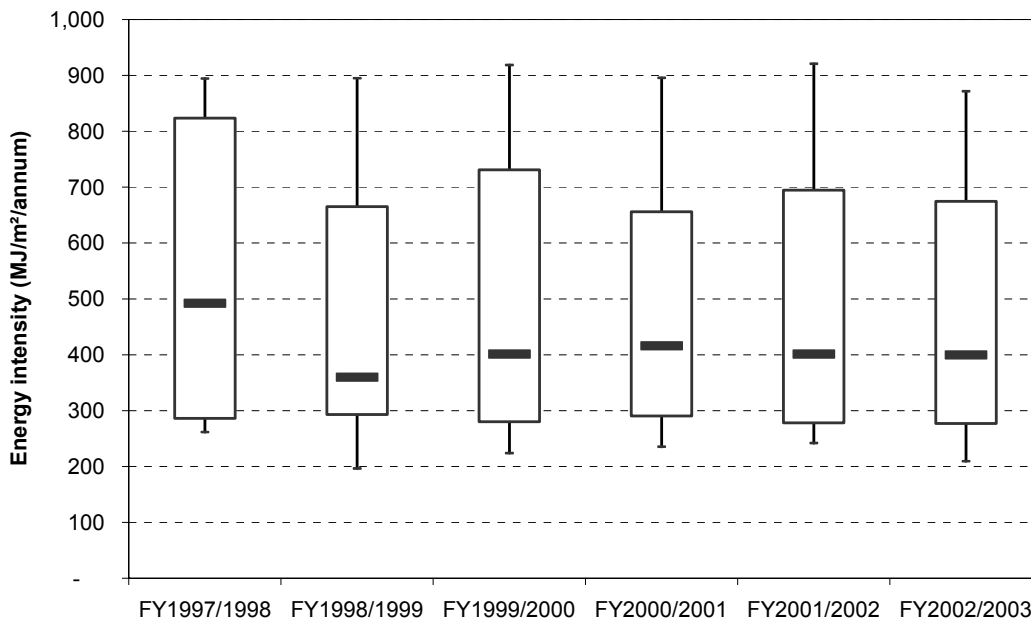
The Law Courts category includes all types of court facilities, whether a relatively small space in a larger building or a specialised building. No performance target applies to this category because of the diverse nature of the facilities.

The key indicator in this category is MJ/m²/annum.

Discussion

The average energy intensity is now 574 MJ/m², down slightly on last year (noting that the box plot shows the median and not the average). The newly constructed law courts building in Melbourne has had a detrimental effect on the average intensity of this category and it is the only category to show an increase in average energy intensity since 1997/98.

Figure 13 Box plot of Law Courts energy intensity



Climate Controlled Stores

Description

Climate Controlled Stores require close control of internal environmental conditions on a 24-hour basis to maintain the quality of the goods being stored. While cool stores and cold stores fit into this category, these buildings are more typically maintained within a tightly controlled range around 20°C and 50% relative humidity and generally have fairly large areas and low occupancy

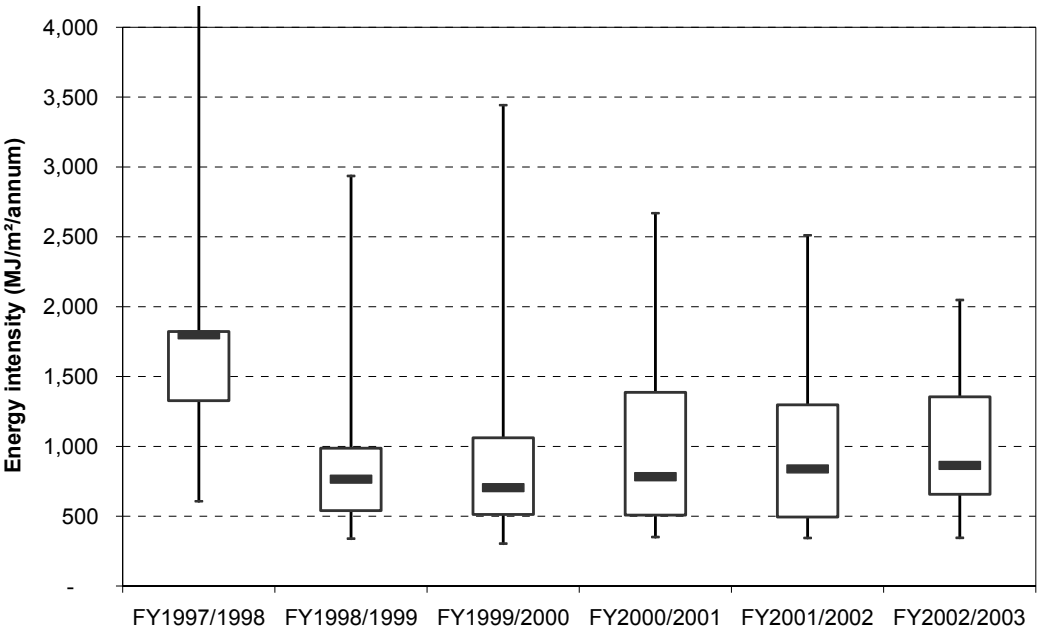
levels. Buildings in this category could be archives or storage repositories for libraries or art galleries, but not computer suites.

No target has been set in this category and the key indicator is MJ/m²/annum.

Discussion

Energy intensity in this category has dropped by 3% this year to 655 MJ/m².

Figure 14 Box plot of Climate Controlled Stores energy intensity



Laboratories

Description

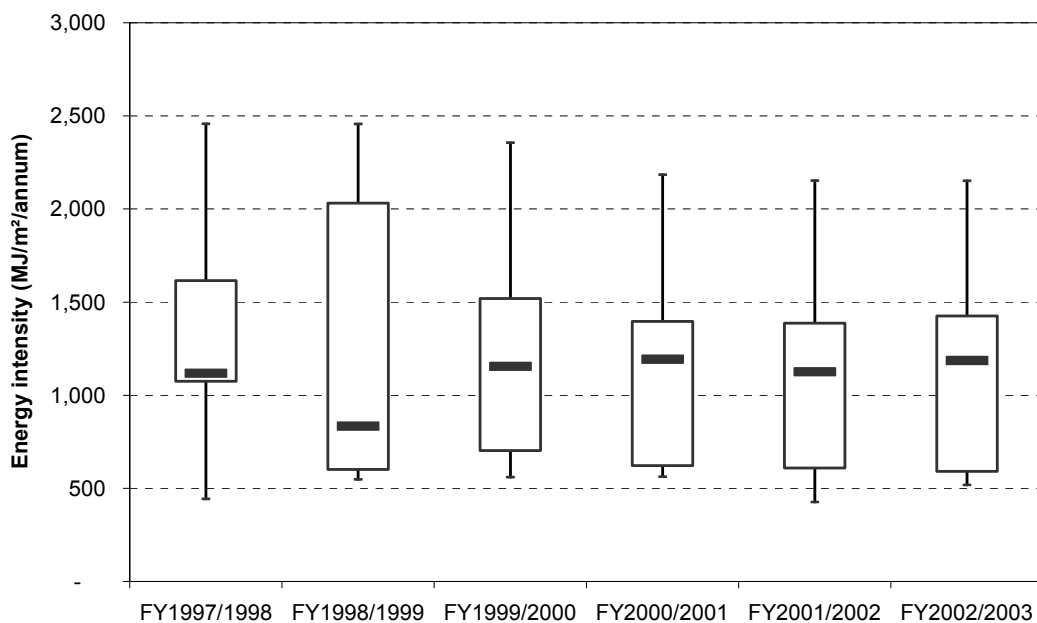
This category covers all energy use in buildings that, as their primary function, are used as laboratories. For this type of facility,

the key indicator is MJ/m²/annum and again, no target has been set for the category.

Discussion

The average intensity of Laboratories was 1029 MJ/m² in 2002/03, up 3.5% on the previous year. Some of this increase is due to additional laboratory use, but changing fume cupboard codes also seem to be causing laboratory energy intensity to increase. This latter area may merit review from an energy efficiency perspective.

Figure 15 Box plot of Laboratories energy intensity



Other Buildings

Description

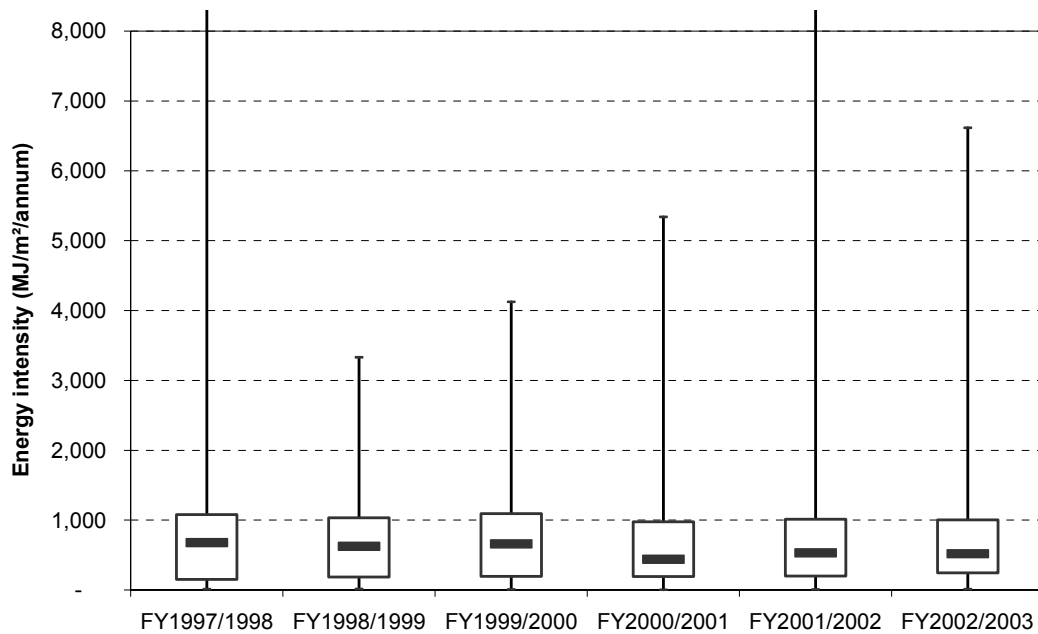
The energy performance of buildings not reported elsewhere is included in the Other Buildings category. These buildings range

from simple storage sheds through to radio transmitters. As a result, energy performances in this category cannot be compared in any meaningful way, and the key indicator of MJ/m²/annum is included more for interest than for any practical purpose.

Discussion

The energy intensity of Other Buildings was fairly steady compared with last year at 846 MJ/m²/annum. The diversity of this category can be seen clearly from the wide range of reported intensities.

Figure 16 Box plot of Other Buildings energy intensity



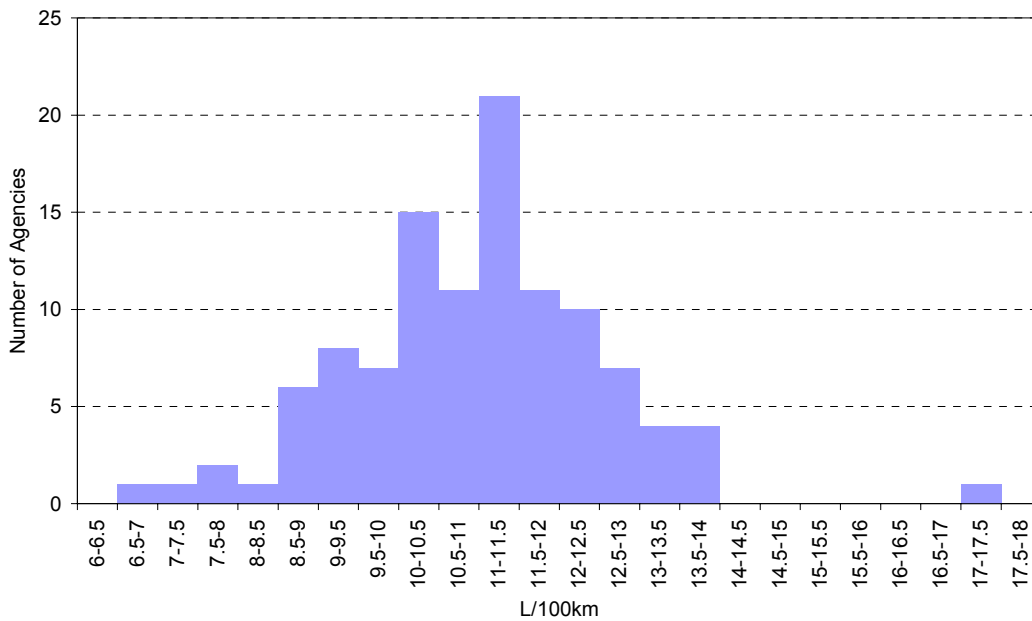
Passenger Vehicles

Description

This category includes the energy consumption of passenger cars, light commercial vehicles and mini buses. It includes the energy consumption of Senior Executive Service vehicles, but does not include short term hire cars or cars on novated leases.

The key indicator in this category is MJ/km. This indicator is used rather than the more common L/100km to account for the different fuels (petrol, diesel, LPG, natural gas) that are being aggregated in the energy consumption data. Where reference is made to L/100km, it is a close approximation derived from the MJ/km by assuming that all fuel used is petrol.

Figure 17 Histogram of Passenger Vehicle performance



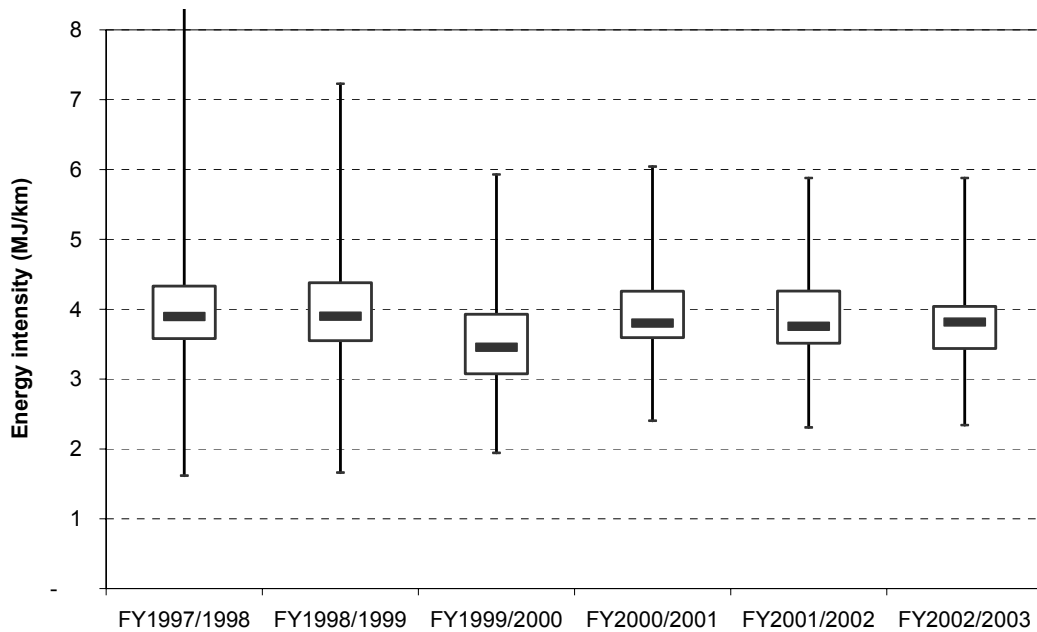
Discussion

The average fuel consumption of 3.5 MJ/km, or around 10.3 L/100km down nearly 10% on that reported last year.

The distribution of Passenger Vehicle energy performance shown in Figure 17 indicates that most agencies are operating in the range 10-12 L/100km, or around 3.5-4 MJ/km. The one exception is a small agency operating only two vehicles.

Much has been said about the lack of accuracy of this data earlier in this report and the figures reported here should be treated with caution.

Figure 18 Box plot of Passenger Vehicle energy intensity



Other Transport

Description

The energy consumption of all forms of transport, other than Passenger Vehicles, is reported in this category. Energy used for

general public transport such as airlines, trains and buses is not included, but energy consumption of transport systems engaged exclusively for operational purposes is included. For example, energy consumption of aircraft used for surveying, and ships used for customs duty or transport, and similar activities are included.

Like the Other Buildings category, this category is so diverse as to render meaningless any comparison between agencies on an energy intensity basis. Moreover, there is no single normalising factor appropriate to this category, so no key indicator is defined.

Discussion

Other Transport energy consumption increased by 7% to just under 586,000 GJ this year. As noted earlier, this increase is likely to reflect the change in operational priorities for this year not a long-term trend.

Defence Establishments

Description

This category covers energy consumption of all buildings and facilities that are within established Defence bases. It does not include office buildings and stores outside bases that are reported under the appropriate category.

Defence Establishments have a target based on aggregate energy consumption, recognising that Defence bases, which may contain many buildings of varying types, typically have only a single meter at the front gate. The Department of Defence has installed, or is planning to install, metering systems to enable activity based energy reporting and monitoring of this category.

The target is set at 2.5 million GJ.

Performance against target

The Department of Defence continued its recent improvement in this category but did not meet the target. As stated earlier, the reported performance is commendable against a background of higher demand on its services and there are many recently implemented initiatives with expected improvements that do not show in this report.

Actual consumption was just over 2,900,000 GJ, or nearly 16% above the target.

Defence Operations

Description

This category covers the fuel used in aircraft, tanks, ships, vehicles etc for Defence Operations. Energy use is reported, but there are no targets.

Discussion

Defence Operations accounted for a total consumption of just over 14 million GJ.

Other Uses

Description

This category includes the energy consumption of facilities that do not fit into any of the other categories. Typical facilities reported under this category are sporting grounds, swimming pools, fountains, street lighting etc.

Like the Other Transport category, the Other Uses category is so diverse that there is no single appropriate normalising factor and no key indicator is used.

Discussion

The reported energy consumption of Other Uses increased a little to just under 79,000 GJ this year.

Antarctic Bases

Description

This category includes all energy consumed in operating bases in Antarctica. It does not include the fuel used in supply ships, which has been included under Other Transport.

Overall consumption of just over 74,000 GJ is up slightly on last year.

Policy Administration

Introduction

The Department of Industry, Tourism and Resources (DITR) and the Australian Greenhouse Office (AGO) shared responsibility for administration of the Policy throughout 2002/2003.

Following recommendations in two reviews that year, the policy, reporting and advisory functions were consolidated in the AGO from the beginning of July and officially transferred to the AGO on 1 December 2003. Policy development and the functions identified in clause 5.1 of the policy document *Measures for Improving Energy Efficiency in Commonwealth Operations*, included at Annex D, are carried out by the Buildings, Finance and Government Team of the AGO. Reporting functions are conducted by the AGO's Reporting and Performance Monitoring Team.

The following is a summary of actions for the continued implementation of the policy during 2003/04 and an indication of future directions.

Collaborative energy procurement and electronic metering

The whole of Government ACT electricity contract involving 53 Commonwealth Agencies and over 230 sites was renegotiated in 2002 and is currently managed by the AGO. The contract includes a minimum of 5% new green energy, with options for higher amounts of green energy if agencies so choose. The Department of the Environment and Heritage and the AGO have chosen to purchase 100% new green electricity. The National Science and Technology Centre (Questacon) increased its amount of green energy to 15% in 2003.

As part of the whole of Government ACT electricity contract, electronic metering, providing half-hour readings in real time was

installed in the 230 sites from September 2002. The AGO is working with the energy retailer and the data provider to present the meter data to agencies in easily accessible ways. Better access to direct energy consumption information will increase agencies' understanding of actual energy use and assist them in identifying opportunities for improving efficiency. The AGO has also directly assisted several agencies to analyse the data from the electronic meters and advised on how this could be used, in conjunction with knowledge of the building operations, to identify opportunities for improving performance.

A pilot test of the Short Message Service capabilities of the meters was initiated on a selected energy intensive site in October 2003. The meters have been activated to transmit an SMS message to the on-site energy manager when the meter detects usage above an agreed power demand level. The pilot will be extended to three additional sites and the results will be presented to an Energy Managers forum in 2004. Providing rapid advice to building managers of unusually high demand use will assist them to respond more effectively to address problems and thus to improve overall building energy efficiency.

The AGO also facilitated inclusion of Australian Government agencies located in NSW into the NSW Government electricity procurement contract. This agreement includes an option for agencies to purchase 5% green energy.

Energy Management Advice

The AGO provided advice to the Australian Government Public Works Committee on energy efficiency and compliance with the Commonwealth Energy Policy for six proposals for construction or substantial refurbishments of Government buildings in Australia and one international project. Agencies preparing to undertake new works should note that the minimum standard under the current policy is derived from the 1994 Building Owners and Managers Association of Australia (BOMA) Energy Guidelines and this is equivalent, in most instances, to a 4.5 – 5 star Australian Building Greenhouse Rating Scheme (ABGRS) rating.

The AGO assisted in evaluation of a number of proposals and detailed facility studies undertaken as part of preparation for

Energy Performance Contracts (EPC). The Department of Health and Ageing (DHA) is proceeding with such a contract for its Woden, ACT offices, and a short overview of the process is included in the case studies on page 56. DHA has offered to further document the process and advise other agencies of the progress of this agreement. The AGO continues to liaise with agencies and the EPC industry to identify and address barriers to the uptake of energy efficiency actions.

A significant portion of the electricity consumed by agencies is used for lighting. A number of agencies were assisted to monitor the lighting intensity of work places and test a variety of means to achieve optimal lighting in a more efficient way. These included de-lamping and using more efficient fluorescent lamps. Agencies were also assisted in obtaining energy profiles for office equipment and appliances as a first step towards purchasing and using more effective equipment and usage.

Preliminary assessment was undertaken in early 2003 of the current commercial building leasing arrangements regarding energy management and the implications of these for Government agencies to implement energy efficiency improvements in new buildings and tenancies. Work is now progressing on developing model schedules that better address energy efficiency requirements in tenancy and pre-commitment leases.

All new Australian Government owned or leased houses are required to have a Nationwide House Energy Rating Scheme (NatHERS) 4 star or better in all regions.

The NatHERS is being upgraded to improve recognition of natural ventilation in energy efficient house designs. This will assist agencies in procuring energy efficient house in the tropics. The new tool will be available through the AGO website in 2004.

Communication and Education

AGO conducted two Australian Government Energy Manager Forums and one forum for Fleet Managers to highlight good experiences and help promote effective actions to all agencies.

The AGO maintained a website which has a number of products to assist agencies to improve energy management and reduce greenhouse gas emissions.

Future directions

The AGO worked closely with the Department of the Environment and Heritage to prepare the draft Green Procurement Guide for Australian Government agencies. The Guide will provide practical information on criteria to be considered and checklists to assist procurement officers take full account of sustainability factors when purchasing equipment and services. The Guide will be available on the Department and AGO websites early 2004.

The AGO is currently revising the Measures for Improving Energy Efficiency in Commonwealth Operations, including the targets that agencies were required to meet during 2002/03. Agencies should continue to report to the AGO through EDGAR for the 2003/2004 year.

Case Studies

Introduction

Each year, a number of agencies are invited to submit case studies of successful energy management outcomes. Some of the more successful agencies could provide one or more such stories every year, but every attempt is made to acknowledge the performance of different agencies.

This year:

- The National Gallery has provided an account of the benefits of ultrasonic humidification to both internal conditions and to energy efficiency.
- The Australian Customs Service has produced a list of issues and opportunities identified in a series of energy audits on its properties that are likely to be common in most Government agencies.
- The Department of Health and Ageing reports on the implementation of the first major energy performance contract in the Australian Government.
- The Australian Antarctic Division has provided a short overview of the installation and operation of wind power generators in Antarctica. The pilot system for this installation was featured on the front cover of the 1998/99 report.

These case studies are included, as provided by the relevant agency, with only a light edit to maintain consistency of style with the rest of the report.

World best practice art gallery conditions brings major energy savings

The National Gallery of Australia (NGA) which sits on the banks of Lake Burley Griffin was originally designed in 1973 and opened in

late 1982. The original building is a brutalistic concrete structure with a lightweight temporary exhibitions extension completed in 1998. The majority of the building is dedicated to the display of the nation's art treasures together with some art storage areas etc that require 24 hour maintenance of close environmental control for temperature and more importantly, humidity.

Year round internal conditions of $22^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$ and $55\% \text{RH} \pm 3\%$ RH with low rates of change, are required with minimal passive assistance from the building envelope as well as very high air quality requirements.

The NGA Facilities team identified the requirement in 2000 to thoroughly investigate the plant condition and performance with regard to air quality, internal conditions, building fabric and Health and Safety issues to ensure World's Best Practice was achieved.

Steensen Varming (Australia) was commissioned to implement the recommendations of the investigation due to their national and international expertise in critical environments and complex projects especially museums and galleries.

Steensen Varming collaborated with a number of NGA Departments especially the Facilities team to address their core requirements as well as delivering significant energy savings as an added and welcome benefit.

There are four critical zone air handling units which are built into the building structure which has put a huge constraint on the ability to maintain and replace the equipment. The air quantities for the air handling units are 19,000L/s, 38,000L/s, 48,000L/s and 58,000L/s. The original design was based on a sprayed cooling coil system of central humidity control with zone electric humidifiers and re-heaters for trimming. The zone humidifiers had long been decommissioned due to energy costs and ability to maintain acceptable control centrally via the sprays saturating the air and cooling coil used to dehumidify and control at a constant dew point (a stable but energy intensive control strategy).

A number of humidification and control options were analysed in great detail as well as modelling the building under a wide range of climatic and occupancy conditions to thoroughly test the proposals to ensure the critical conditions and rates of change could be met. A system of close control ultrasonic humidifiers, the worlds largest installation, (served by a reverse osmosis water

filtration system) together with triple redundancy controls and a central humidification control strategy to satisfy approximately 50 separate zones was implemented as the most feasible and functionally effective solution which would satisfy all of the project requirements.

Due to the sensitivity of the collection and the requirement for the Gallery to remain open throughout the project, work had to be scheduled in a very delicate manner with a team approach taken by all parties from client through to contractor.

Since commissioning of the upgraded systems in 2001 the NGA has realised natural gas consumption savings of approximately 45% and electricity consumption savings of approximately 10%. This is coupled with much improved air quality, system control, plant condition and health and safety issues.

The improvements to the NGA and energy savings are planned to continue with further enhancement work being undertaken over the next year – showing that even with a less than sympathetic building world's best practice can be achieved with a team effort based on commitment and innovation.

Energy audits at the Australian Customs Service

In the 2002/3 financial year, the Australian Customs Service commissioned an Energy Consultancy to undertake ten detailed energy audits of major sites around Australia. The audits demonstrated significant potential to save energy. Key generic findings include:

- **Lighting.** The lighting designs for most sites were based on monophosphor tube technologies that have been superseded. Opportunities were found for selective relamping with triphosphor tubes (particularly in three tube fittings), refurbishment of two-lamp fittings with reflectors and a single lamp, and installation of autotransformers. Some opportunities were also found for lighting control but current good practices generally limited the opportunities in this area.
- **Air conditioning.** The majority of Customs sites are on gross leases and so air-conditioning was not an issue. However, at one major net-leased site significant opportunities were

identified, centred on improvements to the existing variable air volume system. The issues identified highlighted the problems of net leases, including the lack of incentives to building owners to improve building efficiency and the difficulties of taking effective responsibility for the operation of a large building without access to a full-time technical skill base to protect Commonwealth interests. Some limited opportunities for reducing hours of operation were found on other sites.

- **Billing and metering.** A number of situations were found where Customs was being incorrectly billed for energy use.
- **Office equipment.** Some simple opportunities were identified in this area. However, internal operational practices within Customs mean that overnight switch off rates for office equipment are very high, and so opportunities are generally limited.

There were potential savings identified varying between 11% and 56% of site energy use, with most sites averaging between 20-30%. Paybacks were typically 1-3 years. Customs is progressively implementing those recommendations requiring no, or minimal capital outlay.

As there were no unusual Customs-specific issues leading to savings, it is reasonable to assume that such savings can be obtained across much of the Commonwealth portfolio.

Performance contract at the Department of Health and Ageing

The Department of Health and Ageing has led the way for other Commonwealth entities by being the first to carry out a major contract utilising an Energy Performance Contract (EPC). EPC's allow energy efficiency measures to be undertaken and funded by the generated costs savings. Energy service companies are contracted to improve energy efficiency, provide the technical solutions and guarantee the energy savings.

Health occupies 31 properties nationally. Four buildings in the Canberra suburb of Phillip have a combined area of 32,605 square metres, which represents 52% of total leased property. The

individual properties are Alexander and Albemarle Buildings and Fishburn and Penrhyn House. These buildings were responsible for 58% of the total departmental energy consumption in this reporting period.

Process

In September 2000, following advice from the AGO the Department called for requests for proposals primarily for the upgrading of lighting and other innovative energy reduction strategies. Following the assessment and evaluation of proposals, Energy Conservation Systems Pty Ltd (ECS) was selected to undertake a detailed facility study of the individual buildings and to develop a set of recommendations for the upgrading and modernising of the existing facilities. ECS completed and presented the study in August 2001. However, delays due to a federal election and prolonged consultations meant that the final scope of works and contract negotiations were not completed until this year. The contract was signed in May 2003 with on site works commencing in July. To ensure that the day to day activities of the department were not disrupted, all works were carried out after hours.

Implementation

Each building was assessed separately and different solutions applied depending upon the condition of the existing infrastructure and the performance outcomes required. That is, the solution and the implementation were tailored to the client's requirements.

The energy performance contract (EPC) for Alexander and Albemarle Buildings included the total replacement of all existing twin lamp fluorescent light fittings with high performance single lamp units. The new fittings incorporated extra long life, low mercury, triphosphor lamps and a superior lens designed to refract more light and to reduce glare. In conjunction with the new fittings, an ECS Managed Lighting System (MLS) advanced, occupancy based lighting control system was installed to provide optimum lighting conditions and maximum flexibility. Lighting is automatically turned on and off by staff presence ensuring lighting is always available, irrespective of the time of day. As a further energy reduction measure, the control system also varies the lighting levels, in relation to the amount of available daylight. This feature has been installed in light fittings installed around the floor

perimeters adjacent to windows. These fittings utilise state of the art electronic dimming technology.

Light level tests reveal lighting levels are higher and more uniform despite the number of lamps being reduced by 50%. By the use of premium lamps, light levels are expected to remain constant for up to five years. Electronic logging is expected to show substantial reductions in lighting energy consumption.

Lighting in Fishburn House had been refurbished over recent years, so existing light fittings were retained, but all lamps and starters were replaced and lighting diffusers cleaned to improve performance. The same high performance lamps as for Alexander & Albemarle buildings were used.

Fishburn House had no installed lighting control system and electronic logging revealed high running times suggesting lighting remained on when not required. An ECS 8000 series time based lighting control system was installed throughout the open plan areas to switch lighting off after hours. The system differentiates between workdays, weekends and public holidays ensuring lighting does not operate when not required. Enclosed offices have ceiling mounted movement sensors to switch lighting off twenty minutes after the room has been vacated.

Lighting fixtures in Penrhyn House were retained as they had been upgraded several years ago. Again, to improve performance, all diffusers were cleaned and lamps and starters were replaced with the same high performance products as the other three properties. This relamping and cleaning program substantially increased light output without increasing energy consumption.

Penrhyn House has an operating lighting control system but electronic logging of selected lighting circuits indicated that running hours were excessive. The system was retained and will be reprogrammed (to reflect working hours and holidays) to deliver greater savings.

Summary

The energy performance contract offers the department guaranteed savings in excess of 1,000,000 kWh of electricity and CO₂ greenhouse gas reductions in excess of 1,000 tonnes over the contract period of five years. The certainty provided by the contract, over the five-year period, has enabled the building owner to make a significant input to the capital costs of the lighting upgrade.

As of November 2003, works are 90% complete, and Health is already reaping the twin benefits of improved lighting quality and reduced energy consumption. Overall, the new and improved energy efficiency light fittings and improved control systems are expected to reduce the energy consumption of lighting operations by more than 30%. These consumption savings will be demonstrated in the 2003-04 report and contribute to the Department's ability to meet the 10,000 MJ/person/annum target.

Wind Power Generation in Antarctica

After 2 years of preparation work and delays due to ship besetment, two 300kW wind turbines were delivered, erected and commissioned at Mawson station, Antarctica last summer. A third turbine is on site, awaiting erection. Concurrent with the turbine installation, a major upgrade of the diesel powerhouse control and heating generation system was undertaken. This was essential for the successful integration of the turbines into the station's power and heating grids.

Since the official opening of the wind-farm on March 3rd 2003, by the Parliamentary Secretary, Dr Stone, a program of fine-tuning the turbine and powerhouse control systems has been undertaken to optimise the efficiency of the overall system. A unique boiler-grid interface (BGI) developed by the prime powerhouse supplier (Powercorp P/L of Darwin) provides grid stability as well as providing heat for the station buildings.

In the 7 months up to the end of September, the average wind penetration at Mawson has been 50% with peaks up to 91%. These penetrations have resulted in diesel fuel savings of 25% compared with the same period of the previous year and this translates to a saving of 233 tonnes of emitted CO₂. A total of 670 Renewable Energy Certificates have been generated.

The installation of an extra BGI this summer should reduce the amount of fuel consumed by the oil-fired boilers and allow the powerhouse to operate on one (rather than two) diesel generator for most of the time. These upgrades along with new high-speed switching software are expected to increase the fuel savings to around 50% from an increased wind penetration of 60%.

