

Statement by Chief Executive Officer

This Milestone 5 report marks the completion of a very important stage in the Cities for Climate Protection (CCP) program. Milestone 5 provides the opportunity to monitor, analyse and review the City's progress towards its Milestone 2 20% greenhouse gas emissions reduction target for the year 2010.

The CCP program is delivered by the International Council for Local Environmental Initiatives Australia / New Zealand (ICLEI-A/NZ) in collaboration with the Australian Greenhouse Office – Department of Environment and Heritage. The ICLEI-A/NZ has provided ongoing support with this program.

The CCP program framework has provided the City with a structured approach to implement the objectives of the City of Joondalup Strategic Plan 2003 – 2008:

2.1: "To plan and manage our natural resources to ensure environmental sustainability" and

2.2: "To manage waste effectively and efficiently in alignment with environmentally sustainable principles".

The City of Joondalup Greenhouse Action Plan (fulfilling Milestone 3) has guided the City to implement resource efficiency measures. The Milestone 5 process has highlighted energy consumption variables between corporate sectors and between baseline / re-inventory years (2000/2004).

The City of Joondalup understands its larger population and geographical size equates to high fuel consumption and significant waste generation. The City is therefore committed to undertaking energy efficiency initiatives and providing leadership and opportunities for our community to reduce greenhouse gas emissions. Given the population growth and subsequent infrastructure development that has occurred between 2000 and 2004, it is encouraging that this report indicates the City has achieved a reduction in greenhouse gas emissions, even after accounting for the corporate waste estimation differences. The City's recycling of plant debris was a major contributor to the 2004 corporate greenhouse gas abatement, highlighting the importance of this initiative.

The City will continue to participate in the CCP program and is confident that CCP Plus reporting will reveal substantial greenhouse gas emission reductions by the City due to major recent and upcoming initiatives. For example, initiatives include the switch to landfill gas recovery power for the City's main corporate buildings, geothermal heating and further energy saving initiatives for Craigie Leisure Centre, and the resource recovery facility soon to be completed.

The City recognises that in order to meet its target of 20% reduction in greenhouse gas emissions by 2010, an ongoing commitment to energy reduction measures is required across its corporate operations, including the facilitation of community sector actions. The City will foster confidence that environmentally sustainable outcomes can be achieved for 2010 and beyond.

**GARRY HUNT
CHIEF EXECUTIVE OFFICER
CITY OF JOONDALUP**

Executive Summary

The City of Joondalup (Western Australia) is situated 26 kilometres north of the Perth CBD along a 17km coastal strip. The City was formed in 1999 when it was partitioned from the City of Wanneroo. Covering almost 100 square kilometres with 22 suburbs housing approximately 158,000 residents, the City is a large and growing local government area.

The Cities for Climate Protection program provided a strategic framework for the City to implement its environmentally sustainable initiatives through fuel consumption monitoring and resource efficiency measures.

The 2004 re-inventory of greenhouse gas emissions for the City of Joondalup was constructed using the ICLEI-A/NZ CCP database. Corporate energy consumption and waste estimation data were entered for the building, public lighting, vehicle fleet/ plant, water/sewage and waste sectors. Community energy consumption is determined from ABS Census data provided as default data by ICLEI-A/NZ for the 1996 baseline year and the 2001 re-inventory year. Community data includes the residential, commercial, industrial, transportation and waste sectors.

High demand for public lighting, park reticulation and community buildings/amenities, which derives from the large population, is reflected in the City's high corporate energy consumption. Extensive residential, transport, industrial and commercial demands are also indicated by the high community energy consumption.

This report assesses energy consumption and greenhouse gas emissions arising from the City's corporate operations. The City's corporate energy consumption data from the baseline year of 2000 are compared with re-inventory data of 2004. Changes in energy consumption are analysed to determine trends, practices and the City's progress towards its 2010 greenhouse gas 20% reduction target. Quantitative and qualitative energy efficiency measures of corporate and community greenhouse gas reduction are identified. The 2004 corporate quantifiable measures are reconciled with the 2004 re-inventory year to provide an indication of corporate greenhouse gas emissions that would have occurred if those measures were not implemented. As the community sector data is derived from the CCP Default Community Data Workbook and the comparison years are from five to ten years ago, the community energy consumption greenhouse gas emission analysis only provides brief assumptions of changes and trends.

Overall, the City's 2004 corporate re-inventory greenhouse gas emissions amounted to 21,066 tonnes of carbon dioxide equivalents (CO₂e) which resulted in an 8% decrease (1725 CO₂e tonnes). The 2004 corporate greenhouse gas abatement was 3,703 CO₂e tonnes. Green waste recycling has proven to be an important greenhouse gas reduction measure as it was a major contributor to the 2004 corporate greenhouse gas abatement (3,492 CO₂e tonnes).

Examination of key reasons for the overall decrease in greenhouse gas emissions between 2000 and 2004 revealed:

- the apparent waste emission decline of 1536 CO₂e tonnes was due to the different methodology used for determining waste;
- Craigie Leisure Centre (a major recreational facility) pool closure and reduced services for redevelopments resulted in an energy consumption decrease of 1283 CO₂e tonnes;
- the City of Joondalup Administration Building, Civic Centre and Library had a 782 CO₂e tonnes reduction in 2004 due in part to energy efficiency measures.

This resulted in substantial decreases in the corporate building and waste sectors.

Key reasons for the increases in greenhouse gas emissions between 2000 and 2004 for the vehicle fleet/plant, public lighting and water/sewage corporate sectors included:

- vehicle fleet and plant fuel consumption increase of 447 CO₂e tonnes was primarily due to vehicle/plant increases and potential underestimation of energy consumption in the baseline year;
- increases in streetlighting emissions (by 660 CO₂e tonnes) and water pumping (by 596 CO₂e tonnes) were a reflection of further lighting and reticulation installation and increased consumption.

Western Power account division between 2000 and 2004 have also altered increases and decreases between sectors. That is, some Western Power meters are shared between buildings, pumps and outdoor lighting and the percentage allocated to each sector may have been different in 2000 than 2004.

This report also identifies further measures undertaken since the re-inventory year (including landfill gas recovery), and future greenhouse abatement actions.

At 2004 the City's corporate sector was 2,833 CO₂e tonnes above the 2010 reduction target of 18,233 CO₂e tonnes. At 2001 the City's community sector was 370,890 CO₂e tonnes above the 2010 reduction target of 929,987 CO₂e tonnes. The City and its community have made significant progress towards the 2010 20% reduction goals, and future measures from actions yet to be quantified will assist the City to strive towards these targets.

TABLE OF CONTENTS

Statement by Chief Executive Officer

Executive Summary

1	INTRODUCTION	1
2	INVENTORY	3
2.1	Quantified Greenhouse Gas Abatement Measures	3
2.2	Qualitative Corporate & Community Greenhouse Gas Abatement Measures	4
2.2.1	Energy Management Team (Action 6)	4
2.2.2	Activated Energy Saving Devices (Action 7)	4
2.2.3	LED Traffic Lights (Action 11)	4
2.2.4	Improving Vehicle Fleet Maintenance System (Action 19)	4
2.2.5	Recyclables other than paper (Action 20)	4
2.2.6	Securing Funding for Community Actions that Reduce Greenhouse Gas Emissions (Action 23)	4
2.2.7	Facilitating Community Education Energy Reduction Initiatives (Actions 25 & 27)	5
2.2.8	Promoting Renewable Energy (Action 26)	5
2.2.9	TravelSmart Program (Actions 30 & 32)	5
2.2.10	City of Joondalup Bicycle Plan (Action 31)	5
2.2.11	Waste Management Strategy (Action 33)	5
2.2.12	Tree Planting and Bush Care Policies (Action 35)	5
2.3	Quantitative Community Greenhouse Gas Abatement Measures	6
2.4	Inventory of Corporate Greenhouse Emissions	6
3	ANALYSIS OF CORPORATE TRENDS	8
3.1	Explanation	8
3.2	Buildings	10
3.2.1	New Buildings	10
3.2.2	Buildings with substantial increases in CO2e emissions	11
3.2.3	Buildings with substantial decreases in CO2e emissions	11
3.2.4	Other Buildings	11
3.3	Vehicle Fleet and Plant	11
3.4	Public Lighting	12
3.4.1	Public Lighting - General	12
3.4.2	Streetlights with substantial increases in CO2e emissions	13
3.4.3	Streetlights with substantial decreases in CO2e emissions	13
3.5	Water / Sewage	14
3.5.1	Water Pumps with substantial increases in CO2e emissions in 2004	15
3.5.2	Water Pumps with substantial decreases in CO2e emissions in 2004	15
3.6	Waste	15
3.7	Reconciliation of Emissions with Measures Undertaken	16
3.8	Statement of Emissions	16

4	THE CITY OF JOONDALUP'S PROGRESS TOWARDS THE 2010 CO2E EMISSIONS 20% REDUCTION TARGET	17
5	COMMUNITY ANALYSIS	19
6	ACTION PLAN PROGRESS	21
7	CONCLUSION	22
8	RECOMMENDATIONS	23
9	ABBREVIATIONS / ACRONYMS	23
10	GLOSSARY	24
11	ACKNOWLEDGEMENTS	24
12	REFERENCES	25

Tables

Table 1: Quantified Corporate Greenhouse Gas Abatement Measures for 2004	3
Table 2: Quantified Corporate Greenhouse Gas Abatement Measures for 2005	4
Table 3: CO2e Emissions per Corporate Sector 1	7
Table 4: Comparison of Top 10 Emitting Buildings – 2000 & 2004	10
Table 5: Fuel Type CO2e Emissions Comparisons – 2000 & 2004	12
Table 6: Comparison of Top 7 Emitting Public Lights – 2000 & 2004	13
Table 7: Streetlighting CO2e Emissions Comparisons – 2000 & 2004	14
Table 8: Comparison of Top 7 Emitting Water Pumps – 2000 & 2004	14
Table 9: Reconciliation of Corporate 2000 and 2004 CO2e Emissions with Abatement Measures	16
Table 10: Future Abatement Measures / Incomplete Actions	18
Table 11: Community CO2e Emissions per Sector	19

Figures

Figure 1: City of Joondalup Corporate CO2e Emissions per Sector in 2000 and 2004	8
Figure 2: City of Joondalup Relative Sector Proportions of CO2e Emissions (tonnes) in 2004	9
Figure 3: City of Joondalup Cost per Sector Comparisons between 2000 and 2004	9
Figure 4: 2004 Corporate Greenhouse Gas Emissions Compared to 2000 and 2010	17
Figure 5: 2001 Community Greenhouse Gas Emissions Compared to 1996 and 2010	21

1 Introduction

The City of Joondalup formally joined the Cities for Climate Protection CCP program on 30 October 1999. The CCP program is administered by the International Council for Local Environmental Initiatives Australia / New Zealand (ICLEI-A/NZ) in collaboration with the Australian Greenhouse Office – Department of Environment and Heritage. The program is designed to assist local governments and their communities reduce their greenhouse gas emissions via monitoring and assessing environmentally sustainable initiatives.

The CCP program framework consists of a milestone process for participating councils to achieve. The City has completed the following four milestones.

Milestone 1: Collation of an inventory of greenhouse gas emissions resulting from council (corporate) and community activities for the baseline year 2000 (corporate) & 1996 (community) and forecast year 2010. Corporate emissions for 2000 were 22,791 CO₂e tonnes and the forecast year was projected as 23,529 CO₂e tonnes. *Milestone 1 was achieved in October 2000.*

Milestone 2: Establishment of CO₂e emission reduction goals for community and corporate greenhouse gas emissions by 20% from 1996/2000 levels by 2010, with a stretch target of 35%. *Milestone 2 was achieved following community consultation Council endorsement in 2002.*

Milestone 3: Preparation and endorsement of a local action plan. The City developed a local action plan titled “The City of Joondalup Greenhouse Action Plan”. The Greenhouse Action Plan identifies prioritised corporate and community sector actions to reduce greenhouse gas emissions. *Milestone 3 was achieved in December 2003 and awarded in August 2004.*

Milestone 4: Implementation of the City of Joondalup Greenhouse Action Plan. Actions implemented to reach the Milestone 4 reduction target included a major lighting retrofit and energy audit implementation of measures. *Milestone 4 was achieved in April 2005.*

Milestone 5

Milestone 5 is an important monitoring and reviewing stage of the CCP program’s milestone framework. Progress towards the City’s greenhouse reduction target and the City’s Greenhouse Action Plan actions can be assessed. The key elements of the Milestone process include:

- Re-inventory of the City’s corporate and community greenhouse gas emissions;
- Quantification of greenhouse gas abatement measures; &
- Analysis of re-inventory results compared to the baseline year and quantification measures, and recognition of qualitative measures and future abatement actions.

Key Abatement Actions

Key 2004 corporate greenhouse gas abatement actions included plant debris recycling, the implementation of energy efficiency measures in the City’s main buildings such as installation of variable speed motor drives and triphosphor lighting retrofit. Factory installed LPG vehicle purchase and LCD computer monitor purchases have also accrued significant CO₂e abatement. The City has also achieved numerous greenhouse gas reduction measures that have not been quantified.

Significant Corporate Changes in the City of Joondalup between 2000 - 2004

Three new buildings (two community centres and a gallery) have been constructed /utilised since 2000. Craigie Leisure Centre (a major recreational facility) has undergone part closures and redevelopments resulting in a major reduction in energy consumption.

There have been 42 new water pump and 10 new streetlight accounts recorded in 2004.

Differences in reporting methodologies between 2000 and 2004 have skewed results for this report. This includes the apparent decrease in CO₂e waste emissions due to community sector bins incorporated in the corporate baseline year waste estimations. Some Western Power meters are shared between buildings, pumps and outdoor lighting and the percentage allocated to each sector may have been different in 2000 than 2004 (the percentage divisions are discussed in section 4). This may result in an apparent increase or decrease in energy consumption of a pump, small building or public light.

2 Inventory

2.1 Quantified Greenhouse Gas Abatement Measures

Table 1: Quantified Corporate Greenhouse Gas Abatement Measures for 2004

ACTION	DESCRIPTION	ABATEMENT (CO₂e tonnes)	BUDGET (above BAU)
1. Energy Audit Implementation	<i>City's Administration Bldg:</i> Installation of motion activated lighting control & cleaners lighting circuit; installation of variable speed drives (VSD) to chilled water pumps; installation of VSD to control cooling tower fan speed; Optimum start provision; static pressure reschedule; variable air volume (VAV) reschedule; <i>City's Library:</i> motion activated lighting control in store rooms; installation of VSD to air handling unit; static pressure reschedule; <i>City's Civic Centre:</i> static pressure reschedule; de-humidification mode adjustment	108	\$27,500
1. Lighting Retrofit	Changed to Triphosphor lighting in the City's Administration building	9.5	\$127,510
7. Energy Saving Devices	Purchased 125 LCD Monitors	46	\$45,000
9. Energy efficient Streetlighting	Installed metal halide lamps instead of mercury vapour at Harbour Rise	22.7	\$35,000
17. Purchase of vehicles with less greenhouse gas emissions	Purchased 13 LPG vehicles in replacement of identical petrol versions	15	\$10,000
20. Office paper recycling	Office paper recycling collection	10	\$0
20. Plant debris recycling	Mulching of greenwaste – diverted from landfill	3492	\$38,000
TOTAL		3703.2	\$283,010

Table 2: Quantified Corporate Greenhouse Gas Abatement Measures for 2005

ACTION	DESCRIPTION	ABATEMENT (CO₂e tonnes)
5 & 34	Since August 2005, Landfill Gas & Power P/L has supplied the City with renewable energy from landfill gas turbines for five high energy consuming buildings (City of Joondalup Administration, Civic & Library; Craigie Leisure Centre; Percy Doyle Community Centre.	N/A (to be quantified for CCP Plus)
20	Office paper & plant debris recycling	3,502

2.2 Qualitative Corporate & Community Greenhouse Gas Abatement Measures

2.2.1 Energy Management Team (Action 6)

The Joondalup Energy Team (JET) was established in February 2004. It comprises of a cross-section of staff with varied expertise representing different business units. The team meets periodically and provides support in managing energy efficiency initiatives.

2.2.2 Activated Energy Saving Devices (Action 7)

The City has a 'lock out' setting for computers which puts computer screens into screensaver mode. The computers are not yet Energy Star enabled.

The JET implemented an office light switch campaign for council buildings to educate staff to switch off all lights on leaving premises for the day except a blue switch for cleaner's lighting.

2.2.3 LED Traffic Lights (Action 11)

The City requests LED traffic lights from the Main Roads Department where appropriate eg east west facing settings. There are technical difficulties relating to circuit links so LED traffic lights are not always approved. This is an ongoing process.

2.2.4 Improving Vehicle Fleet Maintenance System (Action 19)

Routine servicing (as opposed to relying on drivers to advise the City of servicing due) has been implemented to improve vehicle fleet maintenance, to result in more energy efficient vehicle operations.

2.2.5 Recyclables other than paper (Action 20)

A facility for co-mingled recyclables has also been set up in the City's administration building. Cork recycling facilities have been installed at the City's main library.

2.2.6 Securing Funding for Community Actions that Reduce Greenhouse Gas Emissions (Action 23)

Funding has been secured which helped implement programs to assist community members reduce greenhouse gas emissions. These programs included Cool Schools 2004, 2005 and EcoHouse in 2005.

2.2.7 Facilitating Community Education Energy Reduction Initiatives (Actions 25 & 27)

EcoHouse & Cool Schools programs: Cool Schools proposed potential GHG abatement from actions not quantifiable for the 2004 quantitative measures. Eco Smart Programs P/L calculated GHG abatement of 93 CO₂e tonnes from community actions for the 2005 EcoHouse program however the quantification has not been approved by ICLEI-A/NZ due to inadequate indication of the basis of corresponding savings. ICLEI-A/NZ recommends the City use a different quantification method based on monitoring in future, as this program is a good energy efficiency initiative. The City and EcoSmart facilitated two free community energy efficiency events.

Great Gardens Workshop: Free workshops offered by the City to promote skill development in environmentally sustainable gardening.

Greenhouse Gazette: The City has produced this community newsletter which is dedicated to the promotion of energy efficiency strategies.

Adopt a Coastline: The City has been facilitating this project involving restoration of coastline sites by primary school groups.

School Recycling survey: this was undertaken by 4 schools in 2005 to get student feedback on the City's current recycling system with a view to reducing waste to landfill.

2.2.8 Promoting Renewable Energy (Action 26)

The City's Waste Management Strategy accessible on the City's website promotes the use of renewable energy from landfill gas recovery. Other renewable energy sources have been promoted in the City's Greenhouse Gazette.

2.2.9 TravelSmart Program (Actions 30 & 32)

The City is a participant of the TravelSmart Workplace Program (a Department of Environment & Department for Planning & Infrastructure initiative). A corporate survey was undertaken by many City of Joondalup staff members to provide an indication on how people travel to work. A community transport survey was undertaken in 2000.

2.2.10 City of Joondalup Bicycle Plan (Action 31)

A staff survey was undertaken regarding bike travel and a bike plan is being developed. The City has purchased five new bicycles; primarily for staff to travel to local meetings and other work related activities.

2.2.11 Waste Management Strategy (Action 33)

A comprehensive Waste Management Strategy has been developed to reduce waste to landfill, identifying future forecasts.

2.2.12 Tree Planting and Bush Care Policies (Action 35)

A specific policy to offset emissions has not been developed however the following related initiatives have been undertaken. The Drainage into Natural Areas Policy 2004 has been implemented involving drainage restrictions (no road water run-off) and modification (eg revegetated depressions) to conserve natural areas. Vegetation condition scales have been assessed for over 100 bushland areas. Thirty bushland sites have been recognised with priority rating. Funds have been provided by the City for revegetation and weed control in these sites. Continual coastal planting averaged 20,000 seedlings annually between 2003 – 2005.

2.3 Quantitative Community Greenhouse Gas Abatement Measures

Measures that have been quantified for community greenhouse gas abatement for 2004 and 2005 include Community Paper 6,000 CO₂e tonnes (2003/4 & 2004/5) and plant debris recycling 6,415 CO₂e (2003/4) and 7,524 CO₂e (2004/5) (totalling 19,939 CO₂e tonnes).

2.4 Inventory of Corporate Greenhouse Emissions

Corporate fuel consumption account data was obtained from Western Power, Alinta Gas, Caltex and BP. This was entered into the ICLEI-A/NZ CCP database along with waste estimations, to calculate tonnage of CO₂e emitted by the City. Table 3 provides the total amounts of CO₂e tonnes emitted by each corporate sector in 2000 and 2004, overall totals and where there have been increases or decreases between the baseline and re-inventory years.

Table 3 identifies an 8% reduction in corporate CO₂e emissions, yet the City's energy consumption increased from 84,389 GJ in 2000 to 85,134 GJ in 2004. The reduction in waste estimation identifying a 68% CO₂e emission decrease, would have influenced the overall corporate CO₂e emission reduction. Higher energy consumption accompanied by lower CO₂e emissions can also be due to emission factor (EF) fluctuations. The following explanation of this has been provided by Gabrielle Breen (WA State Manager ICLEI-A/NZ).

"It is important to note that emission coefficients, which affect the final results for tonnes CO₂e produced, may change between years. Electricity is generated from a range of energy sources. Energy sources commonly used are brown coal (lignite), black coal (anthracite), natural gas and hydroelectricity. Each state uses a different mix of these energy sources, among others. All energy sources have different greenhouse intensities. Greenhouse intensity is a measure of the equivalent tonnes of carbon dioxide (a combination of the various gases) produced per unit of energy generated. As a result, the production of the electricity used in each state emits a different amount of greenhouse gases. These are calculated into a single figure of equivalent tonnes of carbon dioxide using emission factors for each state. The emission factors are determined by an Australian Greenhouse Office (AGO) study that looks at the proportion of various sources of electricity used in any one year".

The CCP Program is focused on providing councils with up to date information that adds the most value to councils greenhouse strategies and it therefore should be expected that fluctuations in emission factors are quite normal and continuous refinement should be expected to occur. Changing emission factors may impact on Council's reported greenhouse gas emissions. Due to different years having different emission factors, two years with identical energy use may have different levels of greenhouse gas emissions. In some states the relevant emission factors will increase over time, while in others a decline is anticipated or may already be evident. The fluctuation in emission factors is quite normal and should be expected to continue to occur".

Table 3: CO₂e Emissions per Corporate Sector 1

Sector	Baseline Year (2000) tonnes CO ₂ e	Re-inventory Year (2004) tonnes CO ₂ e	Percentage increase/ decrease tonnes CO ₂ e	Key Reasons for Change in Emissions (detail in section 4.2)
Buildings	7,151	5,258	-26%	Decreased due to part closure of Craigie Leisure Centre; energy efficiency measures; variations in Western Power account division between 2000 & 2004.
Vehicle Fleet	940	1,387	48%	Increased due to rises in fuel cost and consumption & increased stock.
Street lighting	10,264	10,924	6%	Increased due to installation of more street lighting; increased consumption.
Water/ Sewage	2,183	2,779	27%	Increased due to installation of more water pumps; increased consumption; variations in Western Power account division between 2000 & 2004.
Waste	2,254	718	-68%	Decrease due to inconsistent methodology between baseline and re-inventory years.
TOTAL	22,791	21,066	-8%	

3 Analysis of Corporate Trends

3.1 Explanation

Results of the City’s corporate building, streetlighting, water/sewage, vehicle and waste sectors have been analysed and compared with the 2000 baseline year inventory to determine trends such as fluctuations in energy consumption and waste output.

Figure 1: City of Joondalup Corporate CO₂e Emissions per Sector in 2000 and 2004

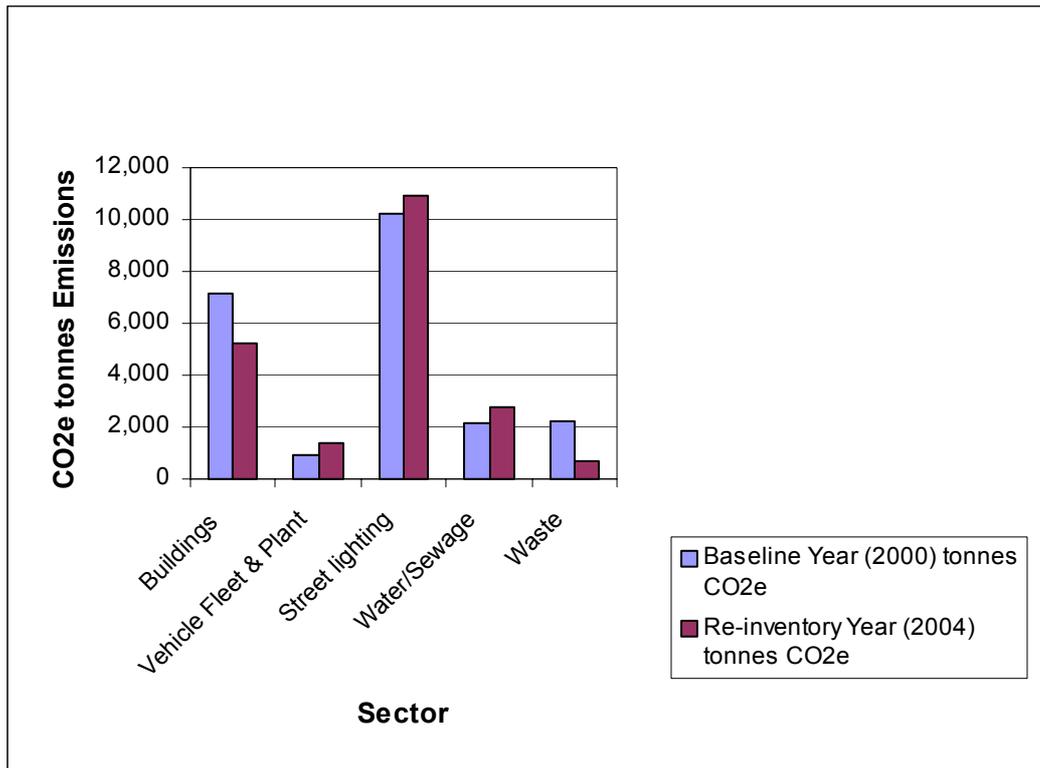


Figure 1 highlights the changes in CO₂e tonne emissions between the 2000 and 2004 corporate sectors. Reasons for changes are discussed within each sector in Section 3 to follow.

Figure 2: City of Joondalup Relative Sector Proportions of CO₂e Emissions (tonnes) in 2004

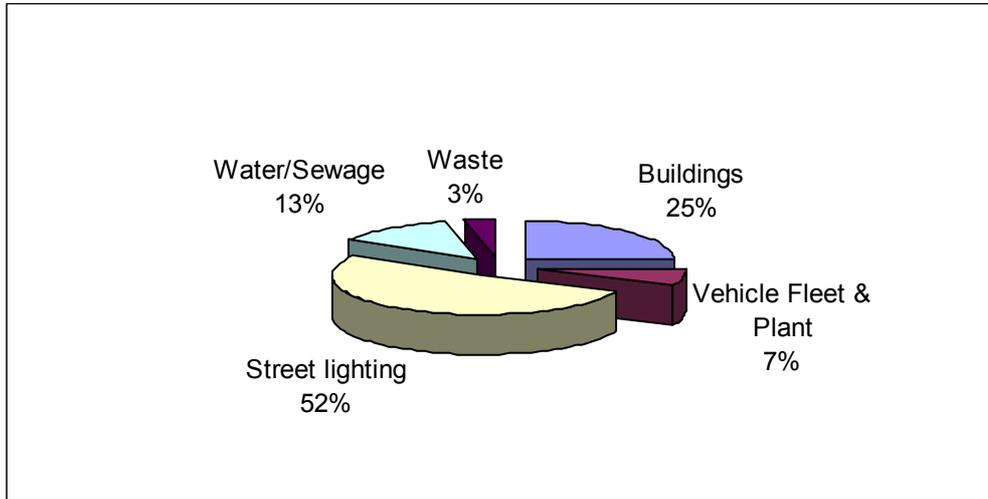


Figure 2 signifies the proportion each sector contributes to the overall corporate CO₂e emissions. Buildings account for less than a business as usual situation due to the Craigie Leisure Centre part closure. Streetlighting is a substantial contributor to CO₂e emissions.

Figure 3: City of Joondalup Cost per Sector Comparisons between 2000 and 2004

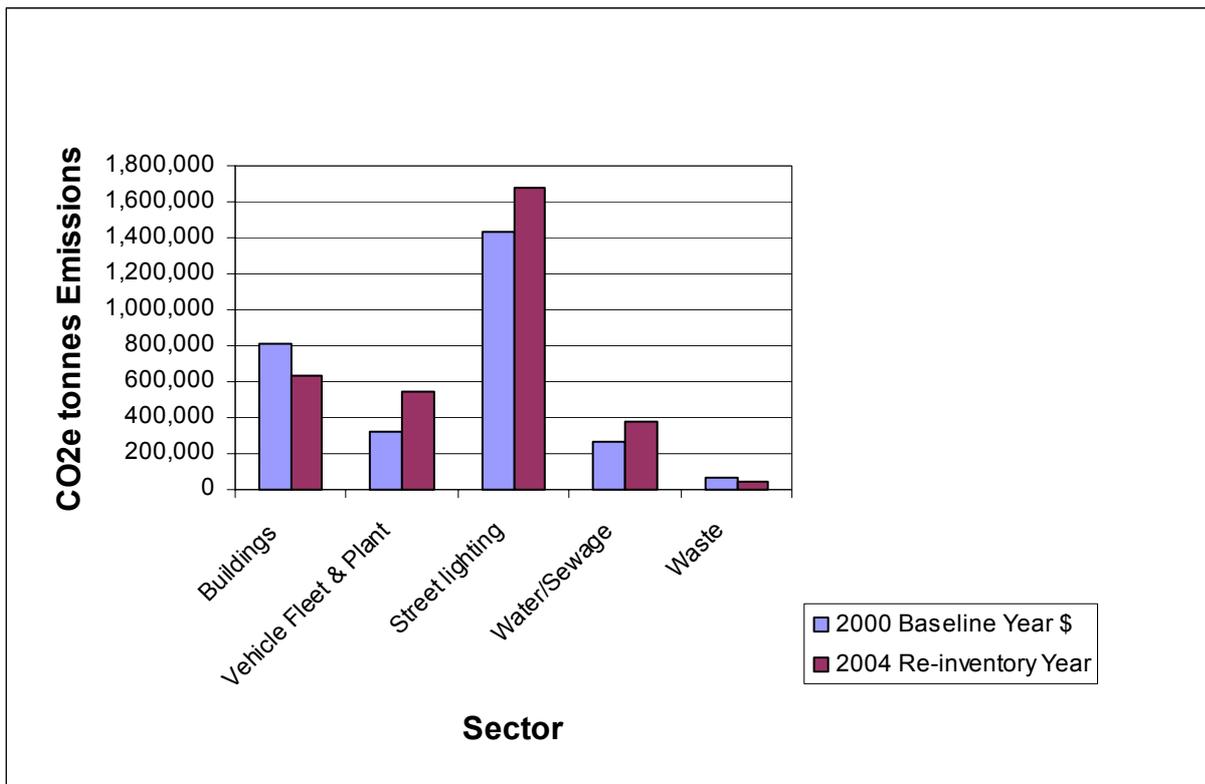


Figure 3 indicates corporate cost increases and decreases per sector between 2000 – 2004. Cost increases and decreases generally correlate with consumption fluctuations. The vehicle fleet and plant sector shows a significant cost increase (\$222,625) linked to rises in fuel costs and increased stock. Inflation should also be considered as having influenced the cost increases of 2004 compared to 2000.

3.2 Buildings

Emissions from the building sector were 1,893 CO₂e tonnes (26%) lower in 2004 than in 2000.

Key reasons for this decrease include:

- Craigie Leisure Centre part closures (*see 3.2.3 below*);
- Energy efficiency initiatives – quantitative and qualitative;
- Difference in the sector breakdown of the Western Power accounts between the baseline and re-inventory years (i.e. an account may cover more than one sector eg one meter may cover a toilet block and water pump) (*see 3.2.3 below re toilet block percentage allocation*);
- Reduced private usage (eg club rooms).

Table 4: Comparison of Top 10 Emitting Buildings – 2000 & 2004

Building	2000 Emissions CO₂e tonnes	2004 Emissions CO₂e tonnes	Difference CO₂e tonnes
City of Joondalup Administration, Civic Centre & Library (3 buildings)	3760	2978	-782
Craigie Leisure Centre	1702	419	-1283
Fleur Freame Pavilion	97	63	-34
Kingsley/Woodvale Library	79	122	43
Mullaloo SLSC	74	41	-33
Percy Doyle Community Facility	559	540	-19
Warwick Community Hall	72	71	-1
Whitfords Community Facility	60	151	91
Total	6403	4385	-2018

Table 4 provides an indication of CO₂e emissions generated from the buildings that required the most electricity in 2000 and identifies changes in 2004. Substantial increases and decreases are discussed below along with other significant changes. Percy Doyle Community Facility has high CO₂e tonne emissions as it incorporates numerous water pumps, buildings, tennis courts, toilet blocks etc. Overall there has been a 2018 CO₂e tonne emission reduction from the top emitting buildings.

3.2.1 New Buildings

The City has three new buildings since 2000; these are Blender Gallery, Connolly Community Centre and Kingsley Community Centre. These buildings totalled emissions of 229 CO₂e tonnes in 2004 (206 CO₂e tonnes contributed by Kingsley Community Centre).

3.2.2 Buildings with substantial increases in CO₂e emissions

- **Kingsley / Woodvale Library** had a 44 CO₂e tonne increase in 2004 due in part to increased usage of the attached community hall;
- **Kingsley Clubrooms** had a 35 CO₂e tonne increase in 2004 mostly due to increased usage and building remodification work;
- **McNaughton Park Clubrooms** had a 12 CO₂e tonne increase in 2004 mostly due to increased usage by more user groups;
- **Ocean Reef Boat Harbour Clubrooms** had an 11 CO₂e tonne increase in 2004 mostly due to increased usage linked to a changed building configuration; &
- **Whitfords Community Facility** had a 91 CO₂e tonne increase due to additional heating, lighting and airconditioning.

3.2.3 Buildings with substantial decreases in CO₂e emissions

- **Ocean Ridge Community Centre** had a 27 CO₂e tonne emission decrease in 2004 partly due to reduced programs;
- **Craigie Leisure Centre** had a 1,283 CO₂e tonne emission decrease in 2004 as it has undergone part closures and redevelopments. The pool closure and reduced services has been reflected in significantly lower electricity and gas consumption in 2004 compared to 2000;
- **City of Joondalup administration, library & civic centre:** It appears that an incorrect gas consumption total was entered for 2000 and there is uncertainty of the accuracy of the 2000 gas cost total. This may explain in part the reduction in gas consumption for these buildings. Less electricity used in these buildings (782 CO₂e tonnes) may also be due to more energy efficient initiatives both from quantitative measures eg lighting retrofit, and qualitative measures eg lighting turn-off procedure reminders;
- **Fleur Freame Pavilion** had a 34 CO₂e tonne decrease in 2004. Gas consumption was reduced by 24 GJ since 2000. There may have been an incorrect consumption entry in 2000 as there is no obvious explanation as to the difference in gas consumption (the 2000 consumption of 32 GJ appears disproportionate compared to similar sized facilities);
- **Toilet Blocks** appear to use more electricity in 2000 than 2004, however a higher allocation of the combined Western Power account to this sector in 2000 (possibly 20%) as compared to 2004 (10%) would explain this.

3.2.4 Other Buildings

Mullaloo Surf Life Saving Club, Guy Daniels Clubrooms, Warrandyte Park and Woodvale Tennis Courts consumed much less electricity in 2004 than in 2000, this may be due to difference in the sector breakdown of the Western Power accounts between the baseline & re-inventory years or reduced private usage. Mullaloo Surf Life Saving Club energy consumption may be reduced also in relation to redevelopments of the foreshore area. Energy reduction initiatives by community users may also have contributed to savings.

3.3 Vehicle Fleet and Plant

Emissions from the vehicle and plant sector were 447 CO₂e tonnes (48%) higher in 2004 than in 2000. The key reason for the increase in CO₂e emissions was an increase in fuel consumption between the baseline and re-inventory years and an increase in vehicle and plant stock.

The increase in vehicle and plant stock in 2004 appears much more than it is. This is due to (a) the overlap in financial year purchase (i.e. not all vehicles recorded were retained for all of 2004), and (b) only a 7 month record was used for vehicles listed in the baseline year. That means less than a full year's inventory of vehicle / plant was recorded in the ICLEI-A/NZ database for the year 2000 with fuel consumption estimations. Therefore the 2000 record of vehicle fleet may not be an accurate indicator of its full year stock and fuel consumption.

Decreases and increases in vehicle and machinery consumption is generally a reflection of increases and decreases in vehicle /plant stock (eg decrease in Ford Econovan consumption in 2004 was due to a reduced amount of Ford Econovan stock).

Table 5: Fuel Type CO₂e Emissions Comparisons – 2000 & 2004

Fuel Type	2000 CO₂e tonnes	2004 CO₂e tonnes	Increase in CO₂e tonnes	Percentage Increase
Petrol	537	623	86	16%
Diesel	403	729	326	81%
LPG	0	35	35	N/A
Total	940	1387	447	48%

Table 5 identifies CO₂e emissions from fuel sources used by the City. The use of LPG has occurred since 2000. Diesel fuel consumption has increased substantially in 2004. Baseline year fuel consumption estimations from vehicle records covering 7 months would not give as accurate an indication as 12 month consumption identified in fuel accounts used in 2004. Thus an underestimation of CO₂e emissions may have occurred for the year 2000. The fuel increase therefore may actually be less than indicated in this table.

3.4 Public Lighting

3.4.1 Public Lighting - General

Emissions from the public lighting sector were 660 CO₂e tonnes (6%) higher in 2004 than in 2000. Key reasons for this increase include:

- Ten new Western Power streetlight accounts in 2004 in the northern developing suburbs of the City including Joondalup;
- Extra streetlighting within established Western Power accounts;
- Difference in the sector breakdown of the Western Power accounts between the baseline and re-inventory years. In 2004 public lighting attributed 30% of a Western Power account if combined with water pumping (70%), or 10% if combined with water pumps and clubrooms. The 2000 Western Power account division has not been recorded.

Table 6: Comparison of Top 7 Emitting Public Lights – 2000 & 2004

Building	2000 Emissions CO₂e tonnes	2004 Emissions CO₂e tonnes	Difference CO₂e tonnes
Boas Ave / Reid Promenade	130	124	-6
Collier Pass	178	227	49
Joondalup Dve	198	215	17
Lot 535 Reid Promenade	108	137	29
Regents Park	115	107	-8
Shenton Ave / Grand Boulevard	200	178	-22
Shenton Ave / McLarty Ave Grand Boulevard	134	131	-3
Total	1063	1119	56

Table 6 provides an indication of CO₂e emissions generated from the public lighting that required the most electricity in 2000 and identifies changes in 2004. Substantial increases and decreases are discussed below along with other significant changes. Overall there has been a 56 CO₂e tonne emission increase from the top emitting public lights.

3.4.2 Streetlights with substantial increases in CO₂e emissions

- **Central** streetlighting consumption has increased in 2004 due to expansion eg University village, Lakeside Village and City North resulting in an 88 CO₂e tonnes increase;
- **Beaumaris Park** public lighting increased emissions by 16 CO₂e tonnes in 2004, but it may be due to a water pump energy consumption increase affecting the overall consumption increase;
- **Blue Lake Park** lighting has increased in emissions by 15 CO₂e tonnes due to additional walkway lighting under this account;
- **Collier Pass** increased emissions by 49 CO₂e tonnes in 2004 primarily due to an extension of a dual carriageway.

3.4.3 Streetlights with substantial decreases in CO₂e emissions

- Warwick Open Space public lighting emissions decreased in 2004 by 31 CO₂e tonnes partly due to reduced tennis court and oval lighting usage.

Table 7: Streetlighting CO₂e Emissions Comparisons – 2000 & 2004

Streetlights	2000 CO ₂ e Tonnes	2004 CO ₂ e Tonnes	Increase in CO ₂ e Tonnes	Yr 2000 Cost	Yr 2004 Cost
General City of Joondalup Streetlighting	7980	8023	43	\$1,212,179	\$1,370,902

Table 7 highlights the substantial CO₂e tonnage from general streetlighting (i.e. streetlights in the council area not park etc lights). The overall CO₂e tonnage for 2004 was 10,924 therefore general streetlighting contributes 73 % of this. As street/public lighting contributed 52% of the City's overall emissions in 2004, this is a sector where energy savings are important. Investigations into further energy savings initiatives may benefit the City (eg the WA Sustainable Public Lighting Project).

3.5 Water / Sewage

Emissions from the water/sewage sector were 596 CO₂e tonnes (27%) higher in 2004 than in 2000. Key reasons for this increase include:

- 42 new water pump accounts in 2004 since 2000 – a reflection of growing population, suburbs and developments;
- Difference in the sector breakdown of the Western Power accounts between the baseline and re-inventory years. In 2004 water / sewage attributed 70% of a Western Power account if combined with public lighting (30%), 90% if combined with a toilet block (10%) & 60% if combined with clubrooms (30%) and outdoor lights (10%). The 2000 Western Power account division has not been recorded.

Table 8: Comparison of Top 7 Emitting Water Pumps – 2000 & 2004

Pump	2000 Emissions CO ₂ e tonnes	2004 Emissions CO ₂ e tonnes	Difference CO ₂ e tonnes
Beaumaris Sports Complex	39	49	10
Blue Lake Park	71	69	-2
Central Park	408	310	-98
Chichester Park South	44	43	-1
MacDonald Park	51	93	42
Seacrest Park	53	58	5
Penistone Park	46	58	12
Total	712	680	-32

Table 8 provides an indication of CO₂e emissions generated from the water pumps that required the most electricity in 2000 and identifies changes in 2004. Substantial increases and decreases are discussed below. Overall there has been a reduction in CO₂e emissions from the top emitting pumps.

3.5.1 Water Pumps with substantial increases in CO₂e emissions in 2004

- **Mullaloo Foreshore:** Increase (43 CO₂e tonnes) due to additional irrigation (the area is undergoing redevelopment);
- **Timberlane Park:** Increase (32 CO₂e tonnes) due to expanded irrigation;
- **Warwick Open Space:** Increase (51 CO₂e tonnes) partly due to expansion of bowling club greens;
- **Neil Hawkins Park** increased emissions by 29 CO₂e tonnes;
- **Forrest Park** increased emissions by 19 CO₂e tonnes, - this may be partly due to difference in the sector breakdown of the Western Power accounts between the baseline & re-inventory years (i.e. higher allocation to water pumps) as the overall account consumption was closer in amount between 2000 and 2004 (2000: 68GJ vs 2004:79 GJ) as opposed to fuel consumption of pumps (2000: 9GJ vs 2004:77GJ);
- **MacDonald Park:** increased emissions by 42 CO₂e may be due to Fleur Freame Pavilion consuming more electricity than the allocated 40% of the shared Western Power account.

3.5.2 Water Pumps with substantial decreases in CO₂e emissions in 2004

- **Central Park:** decrease of 98 CO₂e tonnes may be due Central Park streetlighting consuming more electricity than the allocated 30% of the shared Western Power account.

3.6 Waste

The re-inventory corporate waste data revealed a substantial decrease of 1,536 CO₂e tonnes (↓68%) from the baseline year. Recycling of corporate paper and greens mulching accounts for a negligible amount of this decrease (paper 10 CO₂e tonnes emissions and plant debris 3492 CO₂e tonnes). The 2000 corporate waste was estimated based on average bin weight from City of Wanneroo data and multiplied by the number of bin empties from a City of Joondalup daily bin check sheet. All bin calculations for the 2000 data were based on same sized bins and weight where as varied bins and weights were calculated in the 2004 corporate data. The 2004 waste estimation was based on a bin empty weight estimation by frequency of bins emptied per week/year. This included corporate properties eg administration building, community libraries and community centres, depots and specific beach sites.

The 2000 bin empties encompassed substantially more bins than 2004 (75,712 bins averaging 15.1kg emptied in the year 2000); most of these bins would have been considered community waste in the 2004 waste estimation. A substantially larger amount of CO₂e emissions (2,254 CO₂e tonnes) was therefore calculated for the baseline year compared to the re-inventory year (718 CO₂e tonnes). To estimate the percentage division of food, paper, plant debris, wood textiles and other waste for the baseline year corporate waste data, community waste data percentage division was adopted. For the 2004 percentage division of waste composition, waste management knowledge estimations were applied. The waste collected from streetsweeping and the Joondalup Festival was not incorporated into the 2004 waste total, it does not appear however to have been incorporated in the 2000 estimation either.

The reduction in corporate waste between 2000 and 2004 is therefore not an accurate indicator due to different methodologies used in waste estimations between the baseline and re-inventory years. If the waste amounts for 2000 & 2004 were the same, the overall corporate 2004 CO₂e emissions would still be lower than 2000.

For example, if corporate waste CO₂e emissions for 2000 were the same as 2004 (718 CO₂e tonnes) then the 2000 total corporate CO₂e emissions would have been 21,255 CO₂e tonnes. This is 189 CO₂e tonnes more than the 2004 total of 21,066 CO₂e tonnes.

This report has highlighted a need to investigate further what is considered corporate waste by the City, and adopt a consistent approach for future corporate waste estimations.

3.7 Reconciliation of Emissions with Measures Undertaken

Table 9: Reconciliation of Corporate 2000 and 2004 CO₂e Emissions with Abatement Measures

		Tonnes CO ₂ e abated	Tonnes CO ₂ e
2000 Inventory			22,791
2004 Re-inventory			21,066
	Decrease		1,725
2004 Abatement Actions		3703	
Summary			
Decrease in emissions			1,725
Total abatement		3703	
Increase without abatement (difference between abatement and 2004 emissions decrease - business as usual scenario)			1,978
Total 2004 emissions			21,066
Total 2004 emissions increase without abatement (2004 emissions plus abatement – business as usual scenario)			24,769

3.8 Statement of Emissions

Compared to the baseline year, the City's 2004 CO₂e emissions are 1,725 CO₂e tonnes (8 %) lower. Greenhouse gas abatement is 3,703 CO₂e tonnes. This abatement added to the 2004 emissions of 21,066 CO₂e tonnes, would indicate 24,769 CO₂e tonnes in a business as usual scenario (Figure 4). Without the abatement in a business as usual scenario there would have been an increase of 1,978 CO₂e tonnes rather than a decrease of 1,725 CO₂e tonnes between the years 2000 and 2004.

The 2004 1,725 CO₂e tonnes reduction in emissions is primarily due to the different methodology used for determining waste. Given no significant changes in waste practices have changed between 2000 and 2004, if the waste estimations were approximately the same, the City's overall CO₂e emissions would still be marginally lower in 2004 than 2000 (as estimated in section 3.6).

Another factor distorting the overall CO₂e emission accuracy included the potential underestimation of vehicle fleet and plant fuel consumption in 2000 (section 3.3). The part closure of Craigie Leisure Centre does not provide a business as usual fuel consumption indication, however energy efficiency changes for this facility will translate to lower CO₂e emission than the baseline year.

4 The City of Joondalup's Progress Towards the 2010 CO₂e Emissions 20% Reduction Target

Figure 4: 2004 Corporate Greenhouse Gas Emissions Compared to 2000 and 2010

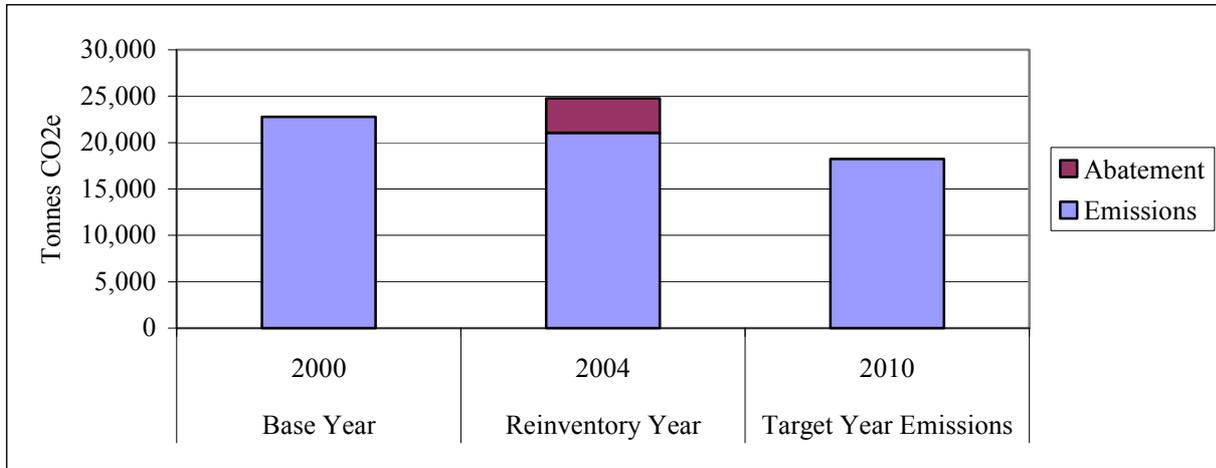


Figure 4 shows the City's progress towards the corporate reduction goal of 20% below 2000 emissions by 2010. The 2004 abatement of 3,703 CO₂e tonnes in effect lowers the potential (business as usual) re-inventory total from 24,769 CO₂e tonnes to 21,066 CO₂e tonnes. The 2004 re-inventory total is 2,833 CO₂e tonnes over the 2010 reduction target of 18,233 CO₂e tonnes.

Table 10: Future Abatement Measures / Incomplete Actions

Table 10 identifies actions from the City of Joondalup Greenhouse Action Plan that have not been completed. This table also includes a greywater recycling measure which encourages resource efficiency. These actions require monitoring and reviewing along with future planning of greenhouse gas reduction initiatives.

ACTIONS		DETAILS
Buildings		
2	Develop a selection criterion for energy efficiency to be incorporated in the assessment of tenders for new Council buildings, plant, equipment & goods supply	To be developed
3	Develop a sustainable purchasing policy	To be developed
4	Establish a reserve fund for energy reduction initiatives	To be developed
7	Enable / activate energy saving devices on all suitable corporate devices and electrical equipment	Some progress has been made. An inventory of corporate devices & electrical equipment that has, or requires energy saving activation, is to be undertaken. Energy Star enabling for computers is to be investigated.
Streetlighting		
8 & 9	8: Develop an energy efficiency decorative lighting policy & 9: Develop a general lighting policy for streets, reserves, parks & cycleways under the City's control.	Policy development is still in progress and addressed in the near complete Joondalup City Centre Lighting Strategy report. The City has also been developing an urban lighting handbook.
Water/Sewage		
12	Undertake and review water auditing of all Council's reserves and implement viable energy reduction actions identified in these audits	This is in progress and the City is yet to ascertain the final results to take action from.
13	Develop a water efficiency policy for reserves where irrigation is installed	This is in progress and is due to be completed in August 2006 in accordance with Water & Rivers Commission (DoE) instructions.
14	Continue and further develop the system of water pump maintenance to ensure energy efficiency	This is an ongoing process. Seek documentation of measures for future CCP reporting.
16	Investigate energy efficiencies of, and alternative energy options for water pumps	Landfill, Gas & Power is being investigated as an alternative energy supply for water pumps.
Vehicle Fleet		
17	Investigate using vehicles with less GHG emissions	Two petrol-electric hybrid vehicles requested and awaiting approval.
18	Continue to improve the City's car pooling system	This will be investigated as part of the Green Transport Plan (May 2006).
Residential		
21	Investigate the construction of an environmentally sustainable building project	A concept plan incorporating ESD principles is proposed for a new depot building.

22	Develop & promote energy efficiency initiatives for new & renovation projects.	To be developed.
	Greywater recycling	The City has endorsed the 50% reduction of fees associated with approved greywater reuse systems for City of Joondalup residents.
24	Review the District Planning Scheme to investigate the inclusion of policies that promote energy saving design, devices and environmentally friendly transport	A project plan is under development which will involve assessing how the District Planning Scheme incorporates sustainability policies.
Commercial & Industrial		
27	Develop educational activities that promote greenhouse gas reduction	The Cool Schools program is planned again for 2006 co-ordinated by the City's School Liaison Officer.
28	Assist & promote cleaner production and energy smart principles in businesses operating in the City	The City's EcoBusiness program (providing energy auditing and energy efficiency/cleaner production planning/assessment) is to be operated by EcoSmart Programs for CBD businesses from May 2006.
Transportation		
30	Develop a transport survey and plan for the City of Joondalup that encourages alternative transport to cars	A Green Transport Plan will be developed for the City of Joondalup corporate sector in 2006. This can be linked to a similar transport plan proposed for the community.
31	Complete and implement the City of Joondalup Bike Plan	A staff bike survey has been undertaken which will be used in the development of a Bike Plan. This can be linked with the Green Transport Plan and a community transport plan.

5 Community Analysis

Table 11: Community CO₂e Emissions per Sector

Sector	Difference in tonnes CO ₂ e	Baseline Year (1996) tonnes CO ₂ e	Re-inventory Year (2001) tonnes CO ₂ e	Forecast Year (2010) tonnes CO ₂ e
Residential	74,203	318,375	392,578	351,794
Commercial	39,756	193,427	233,183	296,022
Industrial	-48,098	154,651	106,553	133,701
Transportation	81,213	362,952	444,165	478,423
Waste	-8,681	133,079	124,398	
TOTAL	138,393	1,162,484	1,300,877	1,259,940

Community energy consumption is determined from ABS Census data provided as default data by ICLEI-A/NZ for the 1996 baseline year and the 2001 re-inventory year. Reliance on ABS Census data for community energy consumption means that the results are not a recent record and not as precise as corporate energy consumption data input.

Undertaking in depth research to analyse the community sector changes in energy consumption between 1996 and 2001 is not required as part of the Milestone 5 process. The differences in community CO₂e emissions in Table 11 do provide an indication of increases and decreases in energy consumption of the community sectors.

The consumption of electricity, natural gas and LPG increased in the **Residential sector** between 1996 and 2001, while the use of kerosene/burning oil decreased. An overall energy consumption increase of 74,203 CO₂e tonnes occurred in the residential sector. (NB detailed energy consumption data of fuel types eg kerosene is derived from the ICLEI-A/NZ Default Community Data Workbook).

In the **Commercial sector** there was an increase in electricity, natural gas and LPG consumption, creating an overall increase of 39,756 CO₂e tonnes.

A reduction in electricity, natural gas, heavy fuel oil, anthracite, LPG and diesel consumption in 2001 from 1996 resulted in an overall emission decrease of 48,098 CO₂e tonnes in the **Industrial sector**. Further analysis into reasons for fuel consumption decreases in the industrial sector may provide useful explanations for the reductions.

Transportation sector estimations were based on vehicle kilometres travelled resulting in an emission increase of 81,213 CO₂e tonnes. Trucks consumed the highest volumes of fuel.

Waste sector data for 2001 was provided by the City of Joondalup's Waste Management and was determined by net weighbridge tonnage to landfill (i.e. waste only). The percentage division of waste type is derived from DoE data. The 2001 waste estimation resulting in 124,398 CO₂e tonnes, was 8,681 CO₂e tonnes less than the 1996 estimation of 133,079 CO₂e tonnes from ICLEI-A/NZ derived from the ABS Census data.

The 2010 forecast year waste estimation was not calculated with the other community sectors. The apparent community waste reduction trend along with resource recovery facility advancements by 2010, are likely to result in a substantial reduction in waste to landfill from the community sector (eg exceeding the 20% greenhouse gas reduction target).

An overall increase of 138,393 CO₂e tonnes has been recorded for the **Community sector**. The 2001 community CO₂e tonne total of 1,300,877 is 138,393 CO₂e tonnes above the baseline year total of 1,162,484.

There was no abatement calculated towards Council's Milestone 2 Community Greenhouse Reduction Goal during the community re-inventory year of 2001, however paper recycling and greenwaste diversion by the community after the reporting period produced abatement of 9,415 CO₂e tonnes in 2003/04 and 10,524 CO₂e tonnes in 2004/05.

Figure 5: 2001 Community Greenhouse Gas Emissions Compared to 1996 and 2010

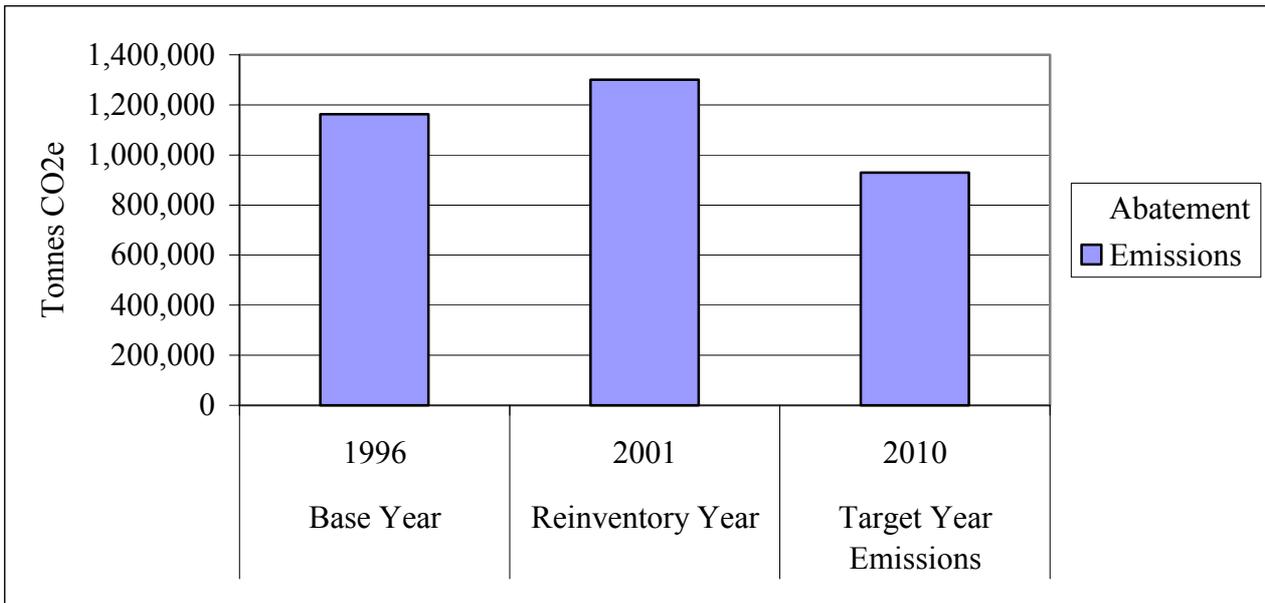


Figure 5 shows the Community Sector progress towards the community reduction goal of 20% below 1996 emissions by 2010 (929,987 CO₂e tonnes).

6 Action Plan Progress

Of the 36 actions planned in the Greenhouse Action Plan, 20 included completed initiatives. Six actions were quantifiable and 14 were discussed qualitatively but not measured to indicate greenhouse gas emissions savings. Numerous measures / initiatives may come under one action. This highlights how the City has developed a comprehensive range of initiatives to reduce corporate and community sector greenhouse gas emissions and has made good progress in achieving actions set.

Quantified corporate abatement actions totalled 3,703 CO₂e tonnes. With substantial abatement measures yet to be quantified eg CO₂e emissions saved by utilising renewable landfill power, the City's progress towards the 2010 corporate 18,233 CO₂e tonne reduction target is encouraging. The community sector's progress towards its 2010 20% reduction target of 929,987 CO₂e tonnes will be assisted by future measures such as the resource recovery facility.

The substantial amount of actions that were not quantified (discussed in section 2.2), along with future abatement measures / incomplete actions, could be investigated further to determine measurable possibilities. A further collaborative review of the City's Greenhouse Action Plan, including assessment of priorities and completed / incomplete actions discussed in this report, is required to comprehensively address the City's future direction in resource saving initiatives.

7 Conclusion

The Milestone 5 process has provided the City with the opportunity to assess and review its progress in reducing greenhouse gas emissions. Compared to the baseline year 2000, the City's corporate CO₂e emissions were 8% lower in 2004 with a total of 21,066 CO₂e tonnes. The 2004 greenhouse gas abatement was 3,703 CO₂e tonnes. The City's recycling of plant debris was a major contributor to the 2004 corporate greenhouse gas abatement (3,492 CO₂e tonnes), highlighting the importance of this initiative.

The reduction in corporate CO₂e emissions is primarily due to the different methodology used for determining waste therefore the corporate waste decrease between 2000 and 2004 is not an accurate indicator. This report has revealed however that given no significant changes in waste practices have changed between 2000 and 2004, if the waste estimations were approximately the same, the City's overall CO₂e emissions would still be marginally lower in 2004 than 2000.

Another factor distorting the overall CO₂e emission accuracy included the potential underestimation of vehicle fleet and plant fuel consumption in 2000. Craigie Leisure Centre part closure and reduced services resulted in a substantial decrease in energy consumption in the corporate building sector reflected by the 1283 CO₂e tonne emission decrease. The City's main administration, library and civic centre buildings decrease of 782 CO₂e tonnes also provided a major contribution to the building sector emission reduction. These building changes were also key influences to the City's overall decrease. As these buildings now operate on renewable energy, the City's building sector will continue to reveal further substantial greenhouse gas reductions.

The increase in the public lighting and water / sewage sectors correlate with the installation of further lighting and reticulation, particularly in the City's developing suburbs. Variations of Western Power account division between the baseline and re-inventory years have also been identified as distorting changes between the water/sewage, public lighting and building sectors. Energy costs for the City have generally reflected the consumption trends with an overall increase of \$365,362 in 2004.

ABS Census data provided by ICLEI-A/NZ for the Community Sector has enabled a brief analysis to be made of changes between 1996 and 2001. An increase of 138,393 CO₂e tonnes overall is apparent for the re-inventory year 2001. The increase in community CO₂e emissions indicated from the CCP Default Community Data Workbook, highlights a need to further investigate community quantifiable measures so greater greenhouse gas abatement can be recognised in this sector.

With a growing population in a very large council area, the City is challenged to meet its 2010 20% emission reduction targets of 18,233 CO₂e tonnes (corporate) and 929,987 CO₂e tonnes (community). However, the City's numerous greenhouse gas reduction initiatives including measures that can substantially reduce emissions, such as landfill gas recovery and further reduced waste to landfill, will make this target a realistic goal. CCP Plus will provide the City with a framework to: continue monitoring its greenhouse gas reduction progress; continue to implement and review its Greenhouse Action Plan initiatives; fulfil and achieve beyond its reduction target; and provide environmentally sustainable leadership to the City of Joondalup community.

8 Recommendations

Following this Milestone 5 Report, it is recommended that the following be implemented:

- The City proceeds with CCP Plus in 2006
- The JET team meets to assess the Greenhouse Action Plan incomplete actions and undertakes future planning during this process;
- Actions are investigated further in future to determine quantifiable possibilities.
- The City considers a collaborative approach to keeping record of the implementation of energy efficiency measures;
- During the CCP Plus process, investigation of the use of different methodologies / different electricity account division in certain sectors to determine greenhouse gas emissions is undertaken, to strive for more consistent recording in the future;
- Western Power and Alinta account arrangements are analysed and documented to ensure the City is obtaining the best value rates.

9 Abbreviations / Acronyms

AGO	Australian Greenhouse Office
BAU	Business as usual
CBD	Central Business District
CCP	Cities for Climate Protection
CO ₂ e	Carbon Dioxide equivalents
DoE	Department of Environment
EF	Emission Factors
GHG	Greenhouse Gases
GJ	Giga joule
ICLEI-A/NZ	International Council for Local Environmental Initiatives – Australia / New Zealand (also known as ICLEI - Local Governments for Sustainability)
LCD	Liquid Crystal Display
LED	Light emitting diodes
LPG	Liquid Petroleum Gas
VAV	Variable air volume
VSD	Variable Speed Drive

10 Glossary

Abatement	Reduction (in terms of a reduction amount of GHG)
Baseline year	The first inventory year that data was entered for Milestone 1 (2000 for Corporate; 1996 for Community)
CO ₂ e tonnes	Greenhouse gas emissions standardised to be measured as CO ₂ e tonnes
Geothermal heating	Heating from naturally occurring underground sources
Landfill gas recovery	Renewable energy generated by landfill gas turbines
LED traffic lights	Energy efficient traffic lights
Re-Inventory Year	The year data entered to compare with baseline year (Corporate: most recent calendar year ie 2004 to be consistent with baseline calendar year 2000; Community: 2001 from ABS Census)
Resource recovery facility	Waste facility involving recycling of waste
Triphosphor lighting retrofit	Replacement of lighting with a high efficiency lamp
Variable Speed Drives	Motor component that economises on power draw for stop/start functions
VAV	mechanism that allows for air volume regulation
Western Power	Western Australian Electricity Supplier now 'Synergy'

11 Acknowledgements

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