ZERO NET EMISSIONS BY 2020

UPDATE 2008

city of Melbourne


THE VICTORIA

FOREWORD

MESSAGE FROM THE LORD MAYOR OF MELBOURNE

In 2002, the City of Melbourne published *Zero Net Emissions by 2020 – A Roadmap to a Climate Neutral City*. Setting an ambitious target backed by innovative programs, the strategy positioned Council as a world leader.

Many of the actions outlined in *Zero Net 2003* have already been delivered but, since then, climate science, community expectations and available solutions have changed significantly.

This update provides the City of Melbourne with a range of specific strategies to deliver a reduction of emissions between 50 and 60 per cent across the municipality. It will guide the City of Melbourne's implementation of sustainability programs, ensuring we maintain our leadership position both within Australia, and internationally.

To be a liveable city, Melbourne must also be sustainable. The need for urgent action on carbon emissions has only increased. With this strategy we unite the City and its stakeholders in reducing Melbourne's carbon footprint.

Robert Doyle
Lord Mayor

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In 2003 the publication of *Zero Net Emissions by 2020 – A roadmap to a climate neutral city* (*Zero Net 2003*) positioned the City of Melbourne as a world leader in environmental sustainability by setting an ambitious target of zero net emissions by 2020.

Like *Zero Net 2003*, this report (*Zero Net Emissions by 2020 – Update 2008*) acknowledges that the City of Melbourne has comparatively very little direct control over the emissions that relate to activities within its boundaries.

To achieve the vision set out in this report, the City of Melbourne will need to build on its strong reputation and ability to facilitate initiatives; to activate partnerships with key stakeholders; to advocate and educate; and to lead by example through actions within the municipality.

This reputation and ability delivered many of the actions outlined in *Zero Net 2003*, which defined three strategies: leading edge design, greening the power supply, and offsetting. Each of these strategies included a series of supporting actions predominantly structured over a five-year timeframe to 2007. This report reviews progress against each action and sets a revised path to zero net emissions by 2020.

Since the adoption of *Zero Net 2003* the City of Melbourne has continued to develop, with high population growth rates and a robust economy delivering significant benefits to the municipality, both economically and socially.

In the last five years our understanding of climatic systems and the rate of global carbon emissions has improved, and the need for urgent action to mitigate carbon emissions has become increasingly clear. It is now widely recognised that climate change is occurring and emission rates are increasing, while the cost of early action on mitigation will be significantly less over time (compared with no action being taken and mitigation being left to later years). Early mitigation also has the potential to drive the development of new technologies and business opportunities.

The global increase in emissions has reflected a similar trend in community-generated emissions within the municipality of the City of Melbourne. Reported emissions over the period 2002 to 2005–06 have increased by 59 per cent from 3.75 million tonnes of carbon dioxide equivalents (t CO_2-e) to 5.97 million t CO_2-e.

In terms of per resident and per employee emissions within the City of Melbourne for 2005–06, each resident was responsible for on average 7.8 t CO_2-e, while each person employed in the commercial sector within the bounds of the City of Melbourne, 9.9 t CO_2-e.

This indicates that a person living and working in the commercial sector in the City of Melbourne had a carbon footprint of 17.7 t CO_2-e per year during 2005–06 which equates to an energy demand of 25.9 MWhr per year. This level of energy demand is comparable to that of a person living and working in London.[1]

1 Reported energy demand for a person living and residing in London is approximately 30 MWhr/year per person in 1997 (Greater London Authority, *Green light to clean power: The Mayor's Energy Strategy*, February 2004). London energy demand value includes transport originating and terminating in London, while the City of Melbourne comparison excludes this component.

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While the increase in emissions from 2002 is significant in terms of total emissions, comparison with another large city on a per person basis indicates emissions from the City of Melbourne are on a par with other international centres.

The underlying reason for the increase in total emissions is considered to have stemmed from:

- substantial growth within the City of Melbourne in all areas and specifically in the commercial sector and the number of residents and associated dwellings within municipal boundaries
- an ongoing change in the way we live, with the number and energy intensity of appliances continuing to increase
- an underestimation in *Zero Net 2003* of the emissions during 2002 and specifically those attributable to the residential sector.

While community emissions have increased, greenhouse gas emissions associated with the City of Melbourne's own activities have continued to decline and are on track to meet the target of zero net by 2020, as well as the interim target of a 50 per cent reduction on 1996–97 emission levels by 2010.

This *Zero Net Update 2008* reinforces the City of Melbourne's commitment to zero net greenhouse gas emissions by 2020 and realigns and updates the strategies and actions for achieving this goal. It builds on the achievements of *Zero Net 2003* and incorporates actions identified by other leading city municipalities.

The four strategies and supporting actions within *Zero Net Update 2008* have been more closely aligned with how the data is determined and comprise the following:

- commercial
- residential
- passenger transport
- decarbonising the energy supply.

These strategies and supporting actions align with the principal of reducing energy use through efficiency measures, increasing energy sourced from renewable generation, and then offsetting the remaining emissions.

Under a business-as-usual scenario it is anticipated community emissions will increase to 8 million t CO_2-e per annum in 2020. Through application of the above strategies it is believed emissions can be reduced by 2.8 million t CO_2-e per annum. This represents an approximate 35 per cent decrease in 2020 emissions and a 15 per cent decrease on 2005–06 levels.

To achieve this reduction the target for each resident is a decrease in emissions from 7.8 t CO_2-e per annum to 5.1 t CO_2-e by 2020. For each person employed within the commercial sector the target reduction in emissions is from 9.9 t CO2-e to 4.1 t CO_2-e per year by 2020. This represents an approximate reduction of 35 per cent per resident and 59 percent per commercial sector employee.

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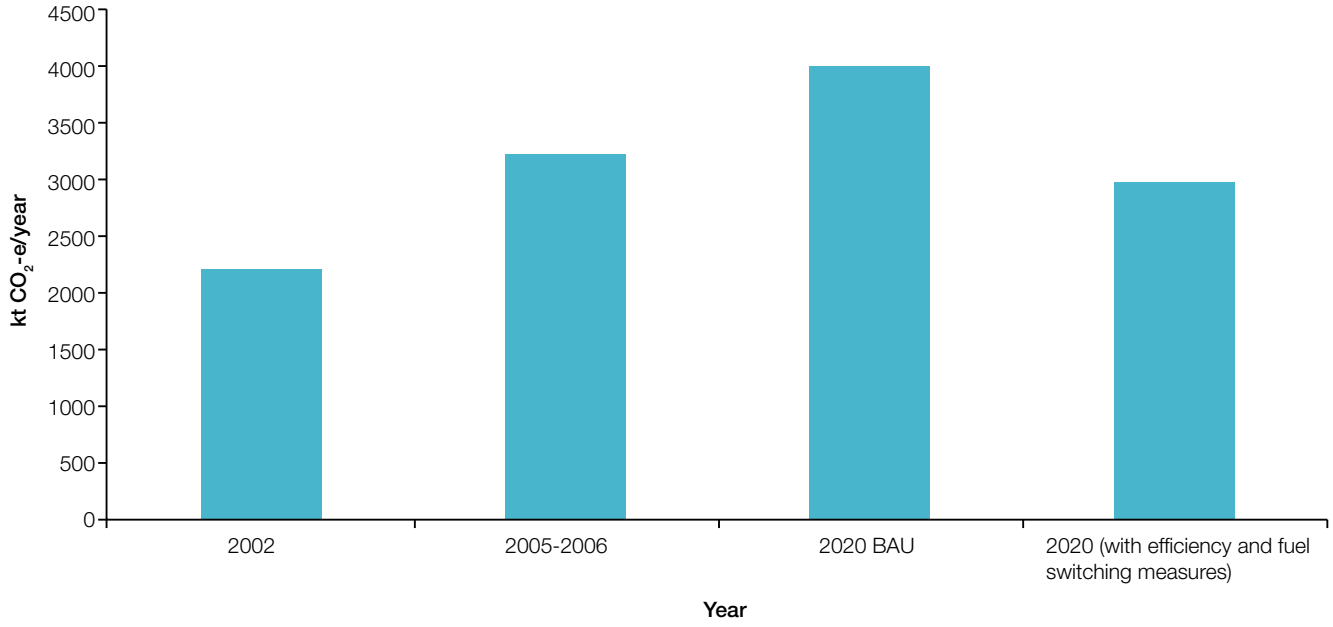
Commercial sector

An emission reduction target of 1,004 kt CO_2-e on 2020 business-as-usual emissions has been set across the commercial sector. This represents a decrease of eight per cent on 2005–06 levels and 25 per cent on 2020 business-as-usual levels as highlighted in Executive summary Figure 1.

However, achieving this reduction depends on a range of variables, making it important to also set low and medium targets. The City of Melbourne will facilitate meeting targets in each of the following sub-sectors:

- **existing office buildings** through a large-scale program to retrofit about 70 per cent or 1200 of the commercial office buildings within the City of Melbourne
- **new office buildings** by increasing greenhouse performance standards to Australian Building Greenhouse Rating Scheme (ABGR) 5 Stars or greater by 2012
- **education, health and community buildings** through facilitating this sector to establish a program to retrofit buildings
- **sales and tourism sector** by encouraging the accommodation sector and the retail and wholesale sector to retrofit buildings and by facilitating new standards for hotel, retail and wholesale developments



Executive Summary Figure 1. Commercial sector greenhouse gas emissions from 2002, 2005–06 to 2020 (under a business-as-usual and *Zero Net Update 2008* scenario)

EXECUTIVE SUMMARY

Residential sector

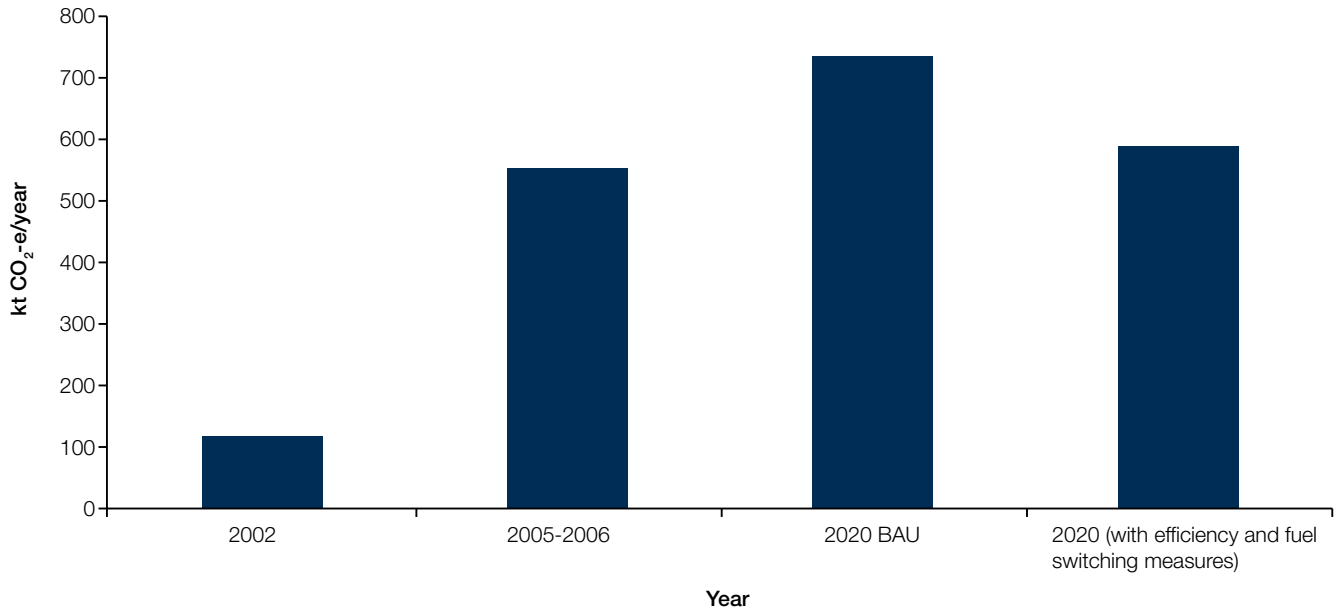
An emission reduction target of 149 kt CO_2-e on 2020 business-as-usual emissions has been set across the residential sector. This represents an increase of six per cent on 2005–06 levels and a 20 per cent decrease on 2020 business-as-usual emissions as shown in Executive summary Figure 2.

This will be achieved by focusing on the largest sources of emissions that can be reduced for the least cost, specifically:

- **space and water heating** (approximately 12,000 households)
- **common areas in high-rise developments** (75 per cent of all high-rise developments, or a total of 24,507 dwellings)
- **lighting and other measures.**

The City of Melbourne will facilitate emissions reductions in the residential sector using three strategies:

- facilitating a house-to-house audit program targeting space, water heating and insulation in approximately 12,000 households
- enabling retrofits on common areas in 75 per cent of all high-rise residential developments and communal hot water and space heating where feasible and appropriate
- a behaviour-change program to encourage resident involvement in the audit program, and the provision of broad energy efficiency advice and information to residents.

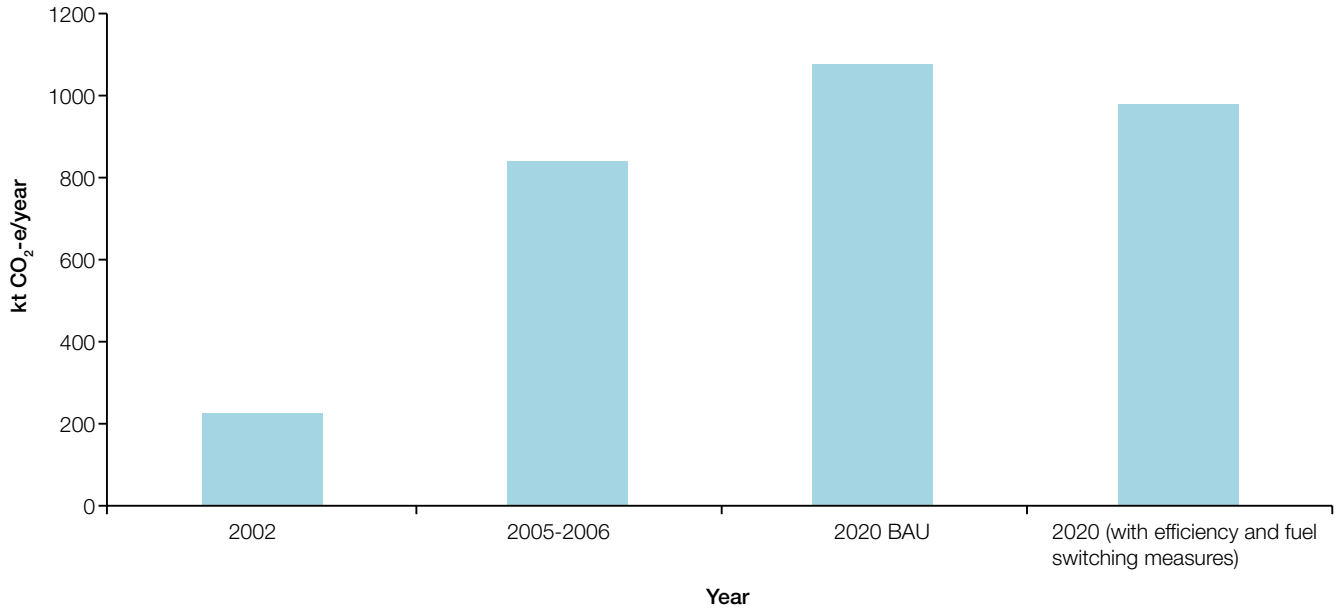


Executive Summary Figure 2. Residential sector greenhouse gas emissions from 2002, 2005–06 to 2020 (under a business-as-usual and *Zero Net Update 2008* scenario)

EXECUTIVE SUMMARY

Passenger transport

An emission reduction target of 96.5 kt CO_2-e on 2020 business-as-usual emissions has been set across the passenger transport sector. This represents an increase of 16 per cent on 2005–06 levels and a 10 per cent decrease on 2020 business-as-usual emissions as shown in Executive summary Figure 3.



Executive Summary Figure 3. Passenger transport sector greenhouse gas emissions from 2002, 2005–06 to 2020 (under a business-as-usual and *Zero Net Update 2008* scenario)

The City of Melbourne will pursue a range of measures to reduce emissions from road-based passenger transport, and the carbon intensity of the public transport system, including:

- decarbonisation of the public transport system by 20 per cent through the introduction of low-carbon or clean source energy, thereby reducing reliance on emission-intensive sources (included as part of the Decarbonising the energy supply strategy)
- implementation of a range of measures to achieve a 15 per cent reduction in car emissions by 2012 and maintained to 2020
- introduction of an integrated Cycle Melbourne scheme combining bicycle hire, expanded end-of-trip facilities and cycling infrastructure, resulting in a 100 per cent increase in bicycle use by 2015.

EXECUTIVE SUMMARY

Decarbonising the energy supply

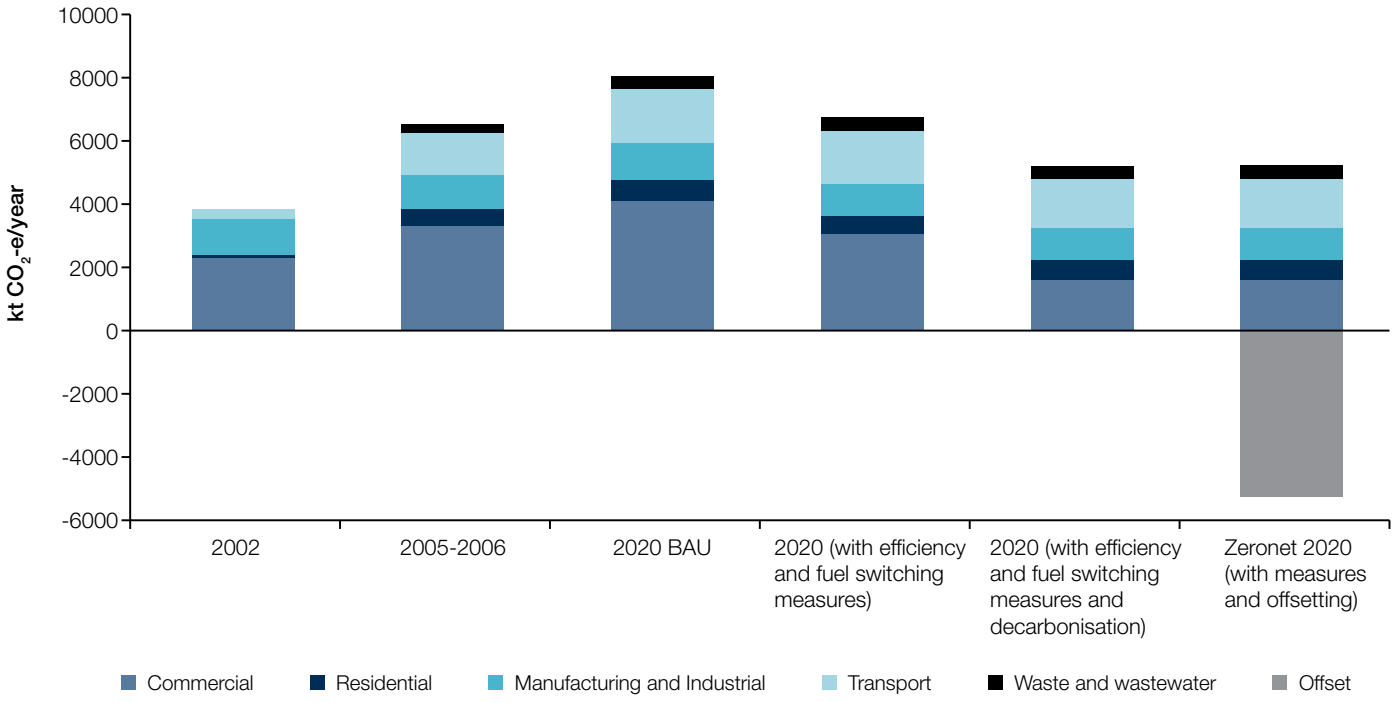
A target of 1,455 kt CO_2-e of emission reductions for 2020 has been set, which represents just over 18 per cent of total 2020 business-as-usual emissions. This target is based on an assessment of targets set by other cities, and against the technologies available to meet the target. This reduction target is expected to be achieved by:

- proven renewable technologies such as wind on a large and small scale and solar power (photovoltaic cells). It is anticipated this will represent a small proportion of emissions reductions
- heat and power systems in the commercial and passenger transport sectors.

It is highly likely new market conditions created by the National Emissions Trading Scheme and the new Mandatory Renewable Energy Target will ensure investment is realised to support the most economically viable, locally sourced, renewable and low-carbon technologies within the boundaries of the City of Melbourne.

The contribution of 'decarbonising the energy supply' to greenhouse gas reductions is highlighted in Executive summary Figure 4. This illustrates the relative contribution to emissions from the commercial, residential, manufacturing and industrial and transport sectors to 2020 under a business as usual scenario, '2020 BAU'.

Executive summary Figure 4 also shows the reduction to 2020 emissions associated with efficiency and fuel switching measures from the commercial, residential and passenger transport strategies. The additional contribution of decarbonising the energy supply to emission reduction is shown in the final column for 2020 as are the remaining emissions that will require offsetting.



Executive Summary Figure 4. Greenhouse gas emissions (kilotonnes carbon dioxide equivalents) for the City of Melbourne from 2002, 2005–06 to 2020 (under a business-as-usual, *Zero Net Update 2008* scenario without and with decarbonising the energy supply)

EXECUTIVE SUMMARY

Limitations

Baseline data for determining the emissions related to each individual sector have been sourced primarily from Australian Bureau of Agricultural and Resource Economics (ABARE) data on energy use, which is reported by Australia and New Zealand Standard Industrial Classification (ANZSIC) sectors at the Victorian scale. Energy use was then converted to emissions in terms of carbon dioxide equivalents which include the gases CO_2, N_2O and CH_4. The other Kyoto gases (HFCs, PFCs and SF_6) are generally associated with industrial process emissions. Industrial process emissions have been excluded from this strategy as they represent a very small proportion of total emissions.

The emissions calculated at the Victorian scale were apportioned to the City of Melbourne based on indicator sets that were available at both the Victorian scale and the City of Melbourne scale for both 2005–06 and 2020 projections.

This was generally limited to employment data. Emissions growth is therefore predicted to occur in proportion to the employment growth within each sub-sector.

Emissions associated with passenger transport were sourced from the City of Melbourne *Greenhouse Footprint for Transport Report*, June 2008 which was prepared concurrently with the *Zero Net Update 2008*.

Manufacturing and industrial emissions have not been included as a strategy because they will be partly addressed through the strategy of decarbonising the energy supply and are being addressed through other Victorian Government programs.

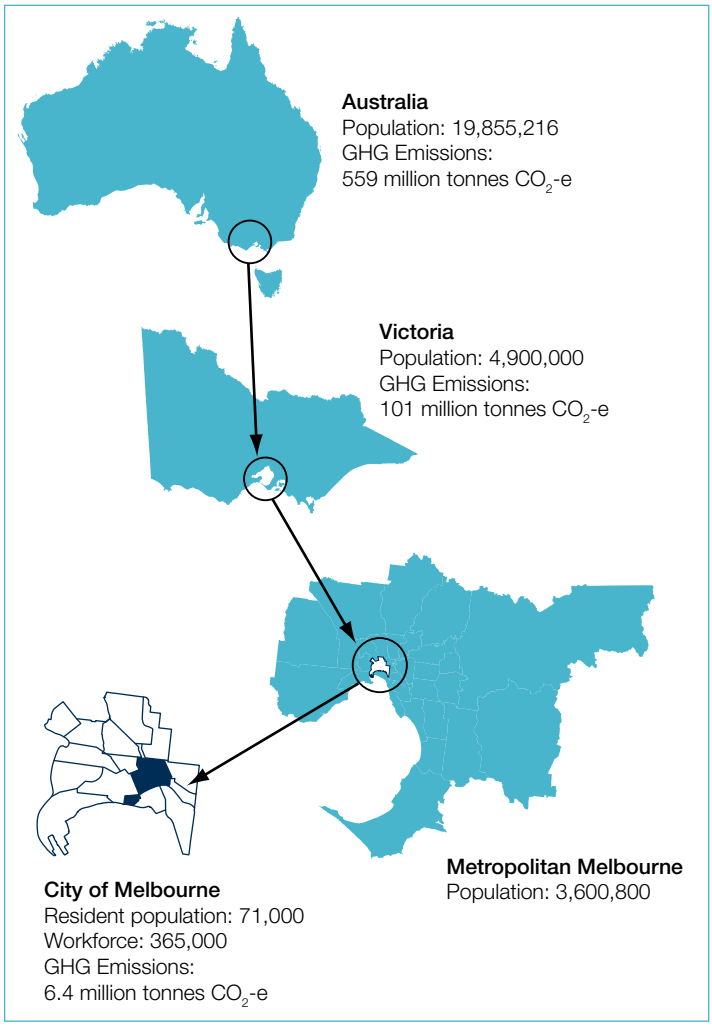
1. INTRODUCTION

1.1 Overview

Through the publication of *Zero Net Emissions by 2020 – A roadmap to a climate neutral city* (Zero Net 2003), the City of Melbourne gained a worldwide reputation as a leader in sustainable urban planning.

For the purpose of the target, emissions were defined as greenhouse gases associated with the City of Melbourne's own activities and those generated by the community within its municipal boundaries as defined in Box 1.

Box 1 City of Melbourne Context 2006



Zero Net 2003 outlined three strategies to help achieve the target by 2020: leading edge design, greening the energy supply, and offsetting – each with a series of supporting actions.

In the five years since *Zero Net 2003* was released the City of Melbourne has prospered and the debate around climate change has matured internationally and at all levels of government in Australia.

During this period, as our understanding of climate change and global emission levels has increased, the need for urgent action has become more apparent.

Key developments that shaped the climate change debate over this period were:

International

- recognition that global economic growth is driving higher emissions
- acceptance that a certain level of climate change is inevitable to 2040
- commencement in January 2005 of the European Union Greenhouse Gas Emissions Trading Scheme
- in principle agreement at the United Nations Climate Change Conference in Bali of the need to develop an international framework that moves beyond the Kyoto Protocol and engages developing countries in greenhouse gas mitigation.

Australian

- ratification of the Kyoto Protocol by the Australian Government in December 2007 at the United Nations Climate Change Conference in Bali
- a commitment by the Australian Government towards development and operation of an Australian National Emissions Trading. Scheme by 2010.

1. INTRODUCTION

Victorian

- Development and acceptance of voluntary 'green building' rating schemes within the Victorian, and particularly Melbourne's, built environment.
- introduction in 2005 of the requirement that all new residential developments have a 5 Star energy rating for building fabric.

City of Melbourne

- Opening in 2006 of the 6 Star Green Star rated City of Melbourne Council House 2 (CH_2), a flagship development in terms of environmental performance that has proven a catalyst for Melbourne's development as a hub for sustainable building design.
- Massive 41 per cent reduction in Council emissions from 1996–97 to 2006–07.
- Introduction of a mandatory energy performance requirement by the City of Melbourne through the C60 planning amendment for office developments greater than 2500 $m^{2.}$
- City of Melbourne joining the C40 Large Cities Climate Leadership Group.
- Delivery of a range of projects associated with Zero Net 2003 as detailed in Appendix A.

Within the context of these achievements, the City of Melbourne recognises the need to build on the success of Zero Net 2003 by positioning Melbourne as a centre for leading edge design and better reflecting the current political, technological and behavioural environment surrounding climate change.

There is also growing recognition that the City of Melbourne needs to align with other like-minded climate change cities. At an international level a significant number of city authorities, such as the Greater London Area, New York City and Tokyo are implementing climate mitigation strategies that move beyond those defined in the original *Zero Net 2003*.[2]

As with the City of Melbourne, these cities are members of the Large Cities Climate Leadership Group. This group of cities, backed by the William J Clinton Foundation, has committed to leadership in climate change and a reduction in greenhouse gas emissions.

This *Zero Net Update 2008* reinforces the City of Melbourne's commitment to zero net greenhouse gas emissions by 2020 and updates the actions for achieving this goal. It builds on the achievements of *Zero Net 2003* and incorporates actions identified by other leading city municipalities. It does this by:

- reviewing progress against the three strategies contained within *Zero Net 2003;*
- providing revised strategies under the headings of commercial, residential, passenger transport and decarbonising the energy supply; and
- defining pathways for implementing each strategy.

2 Greater London Area *Action Today to Protect Tomorrow The Mayor's Climate Change Action Plan 2007;* New York City *A Greener, Greater New York Plan NYC* and Tokyo *Tokyo Climate Change Strategy – A 10 Year Project for a Carbon-minus Tokyo 2007.*

2. THE CASE FOR URGENT ACTION

2.1 The global context

The case for urgent action on greenhouse gas emissions is clear. The Intergovernmental Panel on Climate Change (IPCC), Garnaut Climate Change Review and the Stern Review in the UK have identified that:

- we are now experiencing the initial stages of climate change
- the financial costs of not acting significantly outweigh that of early action
- early action has the potential to drive the development of new industries and economic prosperity
- the growth in global emissions has accelerated since the start of 2000 and the concentration of carbon dioxide in the atmosphere is at its highest level in 650,000 years
- the window of opportunity to stabilise global carbon dioxide levels is rapidly diminishing.

2.1.1 Initial stages of climate change

Since 1990 the IPCC has produced four assessments that combine and review existing scientific knowledge about the rate of climate change and the level of carbon emissions. The latest report, published in 2007,[3] noted there was now an unequivocal greater-than-90-per-cent chance that since 1950 the global net effect of human activities has been warming.

The Garnaut Review, in summarising key trends in relation to climate change, notes that over the past century the temperature of the planet has risen by about 0.7°C, a change that represents more than 10 per cent of all of the temperature change that occurred between the last Ice Age and the present.

In the Australian and Victorian context, the CSIRO and Bureau of Meteorology in 2007 built on the projections prepared by the IPCC and identified that underlying annual climatic variability in Australia has mirrored the global trend with higher temperatures towards the end of the 20th century and into the start of the 21st century, and a reduction in rainfall in areas such as south-western Victoria.

These trends are replicated in Melbourne with the average temperature increasing since 1950 by 1.30°C and average rainfall declining. These climate changes are set to continue until at least 2040 as the emissions contributing to this change have already been released into the atmosphere.

2.1.2 The financial cost of action

The economic implications of climate change have been considered in the review undertaken by the head of the UK Government Economic Service, Sir Nicholas Stern, in the *Stern Review: The Economics of Climate Change*[4] (the Stern Review).

In terms of economic impact, the Stern Review notes that as the average global temperature increases, the consequences of climate change will become disproportionately more damaging, as measured by changes in mortality, income and ecosystems. That is, an increase by 1°C in the global average from 3°C to 4°C will lead to significantly more damage, than from 1°C to 2°C.

3 IPCC, 2007
4 HM Treasury, 2006

2. THE CASE FOR URGENT ACTION

Figure 1 provides two conceptual mitigation paths taken from the Stern Review, one route illustrating the impact on income over time of early-action mitigation (path with mitigation) and the other route showing the implications of delayed mitigation (path without mitigation). The path with mitigation indicates that economic growth in the short term will be less than without mitigation, as the costs of implementing measures reduces the level of economic growth and adversely impacts the average level of income.

Over time, however, economic growth without mitigation decreases relative to the path with mitigation as the damage associated with climatic change impacts the global economy.

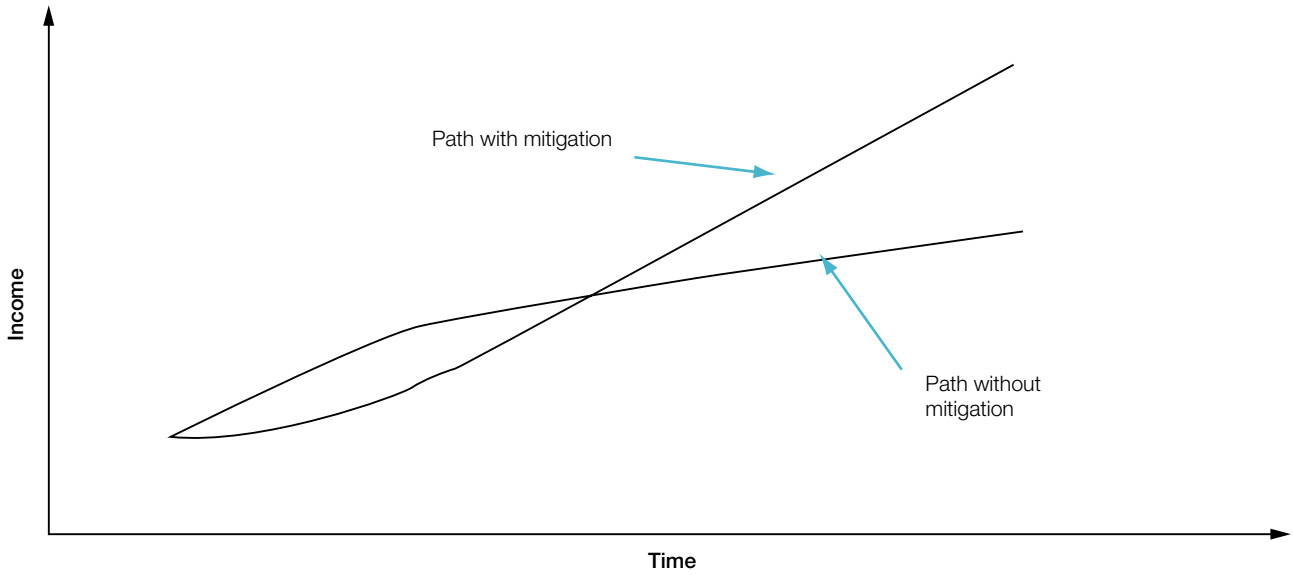


Figure 1. Conceptual approach to comparing divergent paths over the long term[5]

5 HM Treasury, 2006

2. THE CASE FOR URGENT ACTION

Underpinning Figure 1 is the concept of disproportionate damage: if action is not taken to mitigate greenhouse gas emissions and the global average temperature continues to increase beyond 1°C to 2°C, the level of financial burden will be five to 20 per cent of Gross Domestic Product (GDP) compared with the cost of acting now, which the Stern Review estimates would represent one per cent of GDP.

The extent of the financial impact of climate change will depend on the specific circumstances of a country and the ability of that country to geographically, financially and administratively withstand climate-associated damage. The Garnaut Review has identified Australia as potentially the most susceptible developed country in the world, directly due to our predominantly arid climate and historically variable rainfall and indirectly through our proximity to a range of vulnerable economies and societies. On this basis the financial burden for future generations of Australians, if action is not taken, is likely to be towards the higher end of the scale identified in the Stern Review.

The City of Melbourne, through *Zero Net 2003* and this *Zero Net Update 2008*, has placed the municipality on the path towards mitigation. The challenge is to ensure the mitigation is of a level sufficient to assist in reducing the rate and impact of climate change.

2.1.3 Early action as a driver of economic prosperity

The impacts of climate change and associated policies will result in significant macro and micro economic transformations. National economies will undergo fundamental industry-centric shifts, and individual businesses will be compelled to change by policy and price-related influences. The largest impact will most likely be on energy intensive sectors, however increasing resource scarcity and the associated costs of climate change will have ramifications for all.

Business and government are starting to see the changes ahead and the opportunities and commercial benefits associated with early action, such as the transition to a low-emissions economy.

This recognition is already driving a range of opportunities across industries and services such as the creation of alternative technologies and products, more efficient logistics and production processes, and associated marketing and branding opportunities.

In the service sector particularly, financial institutions have been swift to capture the commercial opportunities associated with climate change such as capital raising for low-carbon technologies, investment in carbon businesses, and the creation of specialist carbon-trading environments and financial instruments.

2. THE CASE FOR URGENT ACTION

Governments that are quick to recognise the opportunities inherent in the emerging carbon-constrained economy will support early movers by setting appropriate policy levers to support new carbon businesses and provide an environment to ensure they are competitive on a national and international level.

Swift commercial action to capture climate change opportunities are likely to have significant positive spin-offs such as: assisting to manage the employment 'shift' as jobs transition away from carbon-intensive activities; identification of inefficiencies and cost reductions in business processes and government policy; and the encouragement of businesses to address the broader environmental agenda.

2.1.4 Growth in global emissions

Developed countries have historically been responsible for a significant proportion of global greenhouse gas emissions. It is estimated that since 1850, North America, Europe and Australia have accounted for 70 per cent of cumulative carbon dioxide emissions from energy production. Developing countries by contrast have accounted for less than one per cent of cumulative carbon dioxide emissions over this period.

The growth in global carbon dioxide emissions from 2000 to 2006 has been close to three times that of the preceding decade. Growth in this period has been, on average, over three per cent per year compared with 1.1 per cent from 1990 to 1999. This growth has lead to a rapid increase in the concentration of carbon dioxide in the atmosphere. The concentration in 2005 was 379ppm, the highest concentration over the past 650,000 years and significantly higher than the pre industrial level of 280ppm.

In its assessment reports, the IPCC has prepared a series of carbon dioxide emission growth scenarios to 2100 that consider emission trends and how economic, social and technological drivers may influence these trends. These scenarios effectively represent plausible futures of how emission profiles may develop based on current approaches to carbon mitigation. The most extreme of these scenarios, in terms of emissions growth, represents a situation where continued strong economic growth is coupled with a heavy reliance on fossil fuels. If this scenario is continued to 2100 it is predicted the average global temperature could rise by an average of six degrees.

The Garnaut Review has identified that on the basis of actual growth, the concentration of carbon dioxide in the atmosphere will exceed the extreme scenario identified by the IPCC sometime between 2015 and 2020.

The primary reasons for this rate of growth in global emissions is the continued and sustained period of global economic growth since that has occurred since the turn of the century, the acceleration of growth in the economies of China (10 per cent per annum) and India (nine per cent per annum), the energy intensity of global growth and the carbon intensity of this energy.

This increase in emissions has been replicated by a growth in emissions from community activities within the boundaries of the City of Melbourne. In the period since *Zero Net 2003* was published, total emissions from community activities has increased from 3.75 million tonnes to 5.97 million tonnes in 2005–06, a 59 per cent increase. A discussion of the factors influencing this growth is provided in Section 4.1, including consideration of the relative contributions of different sectors to these emissions.

2. THE CASE FOR URGENT ACTION

2.1.5 Opportunity to act

A consequence of the increased rate of global growth in emissions is that the window of opportunity to act is rapidly diminishing. The target atmospheric concentration identified in the Garnaut Review and discussed at the Climate Change Conference in Bali in late 2007 is 450 ppm tonnes of CO_2-e.

To limit atmospheric levels to this concentration, global emission levels would need to peak in 2010, reduce to 2000 levels by 2020 and halve by 2050. The Garnaut Review also considers a target of 550 ppm tonnes of CO_2-e, which would require a peak in emissions around 2030 and then a reduction to 2000 levels by 2050.

As the concentration of carbon in the atmosphere rises from 450 ppm to 550 ppm, so too do the risks to society associated with climate change.

Given the current underlying growth in emission levels, stabilisation at 450 ppm tonnes of CO_2-e is considered highly unlikely. The focus is therefore on stabilisation at an atmospheric concentration of 550 ppm tonnes of CO_2-e. The Garnaut Review identifies that to achieve this target, urgent, large and effective policy change is required. This strategy outlines such a response.

3. LEADING BY EXAMPLE

3.1 The sustainable vision for Melbourne

The future vision for the City of Melbourne is of a thriving and sustainable city that simultaneously pursues economic prosperity, social equity and environmental quality. A key element of this vision is to encourage people to live in the city. As noted in the 2004 *Places for People* study, this vision has guided the regeneration of the City of Melbourne during the past two decades from an under-used and inhospitable location to a vibrant and exciting 24-hour destination.

The City of Melbourne's revitalisation has involved active promotion of the municipality as a great place to live, through its strategic planning process and urban design policies. The council's *Postcode 3000* program provided financial incentives, technical and street level support and city-living promotions to encourage people back to the inner city. The success of this program is evident today with 71,226 residents now living in the City of Melbourne. The number of apartments has increased 3,311 per cent in the period from 1982 to 2002 and this movement of residents is set to continue. By 2020 it is estimated there will be 109,100 residents living in the City of Melbourne.

Through active encouragement of residential development and by providing a centre of culture and entertainment, the City of Melbourne has created an attractive location for Melburnians to reside. From a whole-of-Melbourne perspective, this vision has the potential to assist in reducing overall emissions as it removes or significantly reduces the need for residents to use a motor vehicle for work, entertainment or shopping purposes.

3.2 Implementation of Zero Net by 2020 emission strategies

In late 2007 the City of Melbourne commissioned Business Outlook and Evaluation to undertake a review of progress against the three key strategies contained in *Zero Net 2003*.

The resulting report, *City of Melbourne's Zero Net Emissions by 2020 – A Brief Review*[6], indicated the council had made good progress towards its goal of zero net carbon emissions and a summary of the progress against each of the three strategies is provided below. A breakdown of progress against each of the actions contained in Zero Net 2003 is contained in Appendix A.

3.2.1 Leading edge design

The majority of the actions contained in *Zero Net 2003* have been achieved by the City of Melbourne in regard to the leading edge design strategy. Since the City adopted *Zero Net 2003*, there has been a transformation in the building sector, with Melbourne emerging as a leader in terms of green building design and performance.

While this transformation is not solely due to the actions of the City of Melbourne, its leading policies and programs are viewed as influencing this transformation. Highlights during this period include the opening in 2006 of the 6 Star Green Star CH_2. CH_2 is now considered to be a benchmark in terms of sustainability performance within Melbourne's central business district.

Also of note is the City's introduction of a mandatory requirement for developments greater than 2,500 m2 to achieve an energy performance rating of 4.5 Stars under the Australian Buildings Greenhouse Rating Scheme (ABGR). This was achieved through the C60 planning amendment.

6 Business Outlook and Evaluation, 2007

3.2.2 Greening the power supply

Greening the power supply, or decarbonising the energy supply, is identified as a longer-term objective and less progress has been made in relation to this strategy. Part of this stems from the City of Melbourne's need to have the support of a range of parties in order to progress the actions contained in this strategy.

The increasing cost of energy and the introduction of a National Emissions Trading Scheme are likely to influence decisions and improve the attractiveness of energy efficiency measures and renewable energy.

3.2.3 Sequestration

This strategy was largely built around the City of Melbourne developing and assisting in the formation of a sequestration scheme for carbon emissions in the absence of an emissions trading scheme. Sequestration is a form of offsetting and was a central part of *Zero Net 2003.* However, the commitment by the Australian Government to the development and commencement of a National Emissions Trading Scheme in 2010 has resulted in the majority of actions in this strategy now being unnecessary.

3.3 Council emissions

In addition to defining the path for reducing emissions within the municipality, *Zero Net 2003* provided the framework for the City of Melbourne to reach zero net emissions from its own operations by 2020. As with the approach for the municipality, this approach was defined through the strategies of:

- reducing energy use through efficiency measures
- increasing the purchase of energy from renewable sources
- offsetting the remaining emissions through the purchasing offsets.

On the basis of this framework, in 2006 the City of Melbourne produced the *Draft City of Melbourne Greenhouse Action Plan 2006–2010 (Council Operations)* (Greenhouse Action Plan). As well as reinforcing the *Zero Net 2003* target of zero net emissions by 2020, the *Greenhouse Action Plan* set an interim target for 2010 of a 50 per cent reduction in council emissions from the 1996–97 base year figure of 31,165 tonnes of greenhouse gases.

The most recent calculation of council emissions for 2006–07 indicated there had been a substantial reduction in emissions to 18,311 tonnes of greenhouse gases, a 41 per cent reduction on 1996–97 levels which places the city on course to meet its 2010 target. In terms of council activities that contributed to the 2006–07 emissions, over half were from the provision of street lighting, while energy for council buildings, both administrative and community, represented approximately 42 per cent of emissions.

3. LEADING BY EXAMPLE

In terms of actions over the period from 2006 to 2010, the *Greenhouse Action Plan* builds on the approach in *Zero Net 2003*. For energy efficiency it focuses on four sectors of council operations that contribute to emissions:

- buildings
- public lighting
- vehicle fleet
- waste and other emissions.

Complementing measures in these sectors, the City of Melbourne, in line with *Zero Net 2003*, has increased its uptake of renewable energy from 20 per cent in 2005–06 to 33 per cent in 2006–07. In terms of offsetting, the City of Melbourne is investigating a trial to offset the residual emissions associated with the operation of CH_2 and the Town Hall.

A key development in the *Greenhouse Action Plan* was a commitment by council to start accounting for emissions from those operations outsourced for external management or service delivery. Activities that fall within this category are:

- waste collection services provided to the City of Melbourne
- street cleaning activities
- wholly owned subsidiaries and assets in the City of Melbourne investment portfolio.

The process and reporting frameworks for tracking these emissions is still being developed and will be included in future City of Melbourne emissions calculations.

4. MELBOURNE AS A SUSTAINABLE & HEALTHY CITY – SETTING THE CONDITIONS FOR LOW-CARBON LIVING

4.1 Community emissions

4.1.1 Overview

The focus of *Zero Net 2003* and *Zero Net Update 2008* is on mitigating the level of emissions from community activities. An understanding of the contribution of each sector to these emissions is crucial to maximise the effectiveness of Zero Net strategies and supporting actions.

Zero Net 2003 estimated community emissions for 2002 were 3.75 million t CO_2-e and divided these emissions into four categories: commercial, industrial, residential, and vehicles and other. *Zero Net Update 2008* has updated the community emission inventory to 2005–06 and provides further detail by classifying emissions under the standard categories specified by the IPCC.

In addition, the consideration of transport-related emissions has been expanded to include emissions from freight transport in addition to those from passenger transport. The City of Melbourne commissioned a separate study to consider passenger transport emissions *Greenhouse Footprint for Transport Report* and this report was used to define the emissions for 2005-06 and 2020. A detailed explanation of the method used to calculate the 2005–06 financial year inventory is contained in Appendix D.

4.1.2 Current emissions

Community emissions for 2005–06 are provided in Figure 2 and show an overall total of 6.43 million t CO_2-e. If the contribution from freight transport is removed to enable direct comparison with Zero Net 2003, total emissions were 5.97 million t CO_2-e, a 59 percent increase in emissions from 2002.

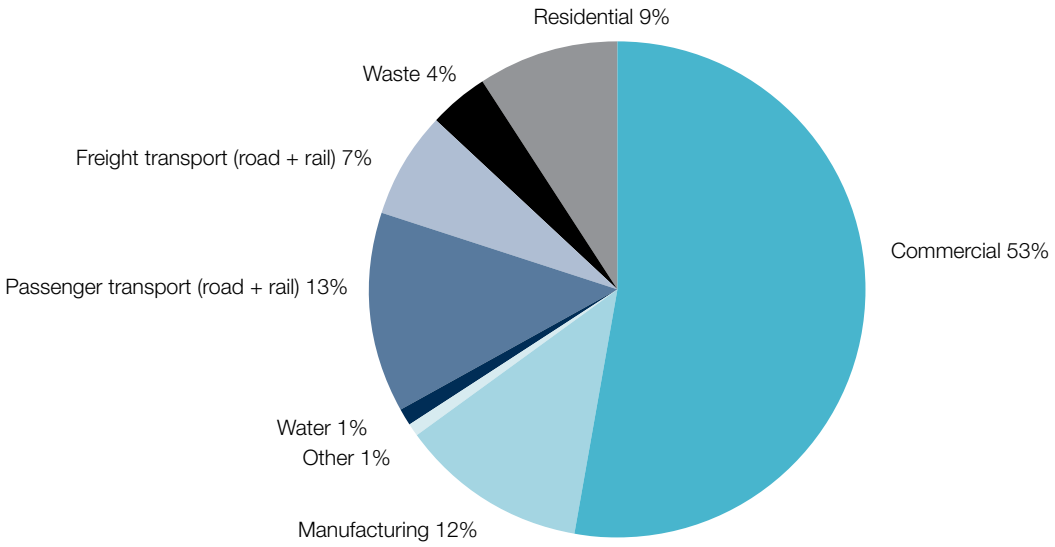


Figure 2: Greenhouse gas emissions by sector for the City of Melbourne 2005–06 total emissions estimated at 6.43 million tonnes carbon dioxide equivalents[7]

7 'Other' incorporates emissions from agriculture, construction, transport services and wastewater.

4. MELBOURNE AS A SUSTAINABLE & HEALTHY CITY – SETTING THE CONDITIONS FOR LOW-CARBON LIVING

4.1.3 Emission trends

While the increase in emissions from 2002 to 2005–06 is significant there are a number of underlying trends and changes to the way carbon emissions are calculated that have contributed to this increase.

Figure 3 illustrates the growth in emissions from 2002 to 2005-2006 by sector and highlights the significant increase in emissions associated with the commercial, residential and transport sectors.

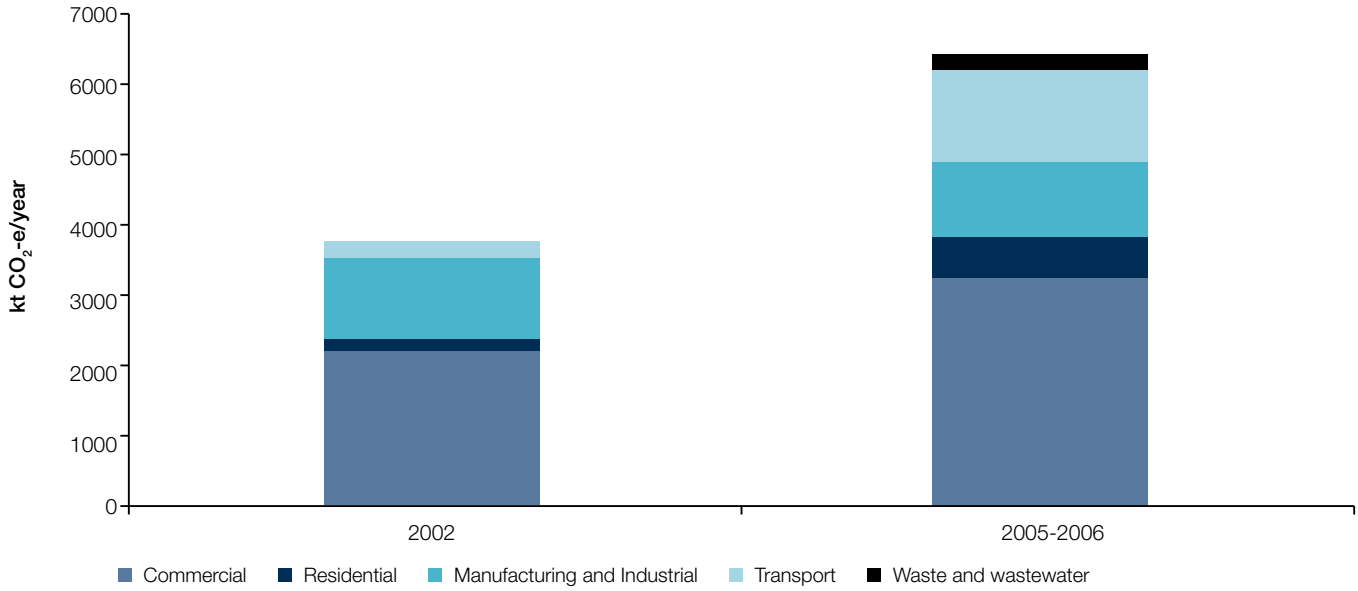


Figure 3: Greenhouse gas emissions increase by sector for the City of Melbourne for 2002 as reported by *Zero Net 2003* and 2005–06[8]

Following a review of the underlying socio economic trends and the way emissions were calculated, it was found the increase in emissions stemmed from:

- the substantial growth within the City of Melbourne in all areas and specifically in the commercial sector and the number of residents and associated dwellings within municipal boundaries
- an ongoing change in the way we live, with the number and energy intensity of appliances continuing to increase
- the inclusion of Docklands from 1 July 2007 within the administrative bounds of the City of Melbourne
- the inclusion of freight transport emissions and a more robust approach to the consideration of passenger transport emissions
- an underestimation in *Zero Net 2003* of the emissions during 2002 and specifically those attributable to the residential sector.

8 'Other' incorporates emissions from agriculture, construction, transport services and wastewater.

4. MELBOURNE AS A SUSTAINABLE & HEALTHY CITY – SETTING THE CONDITIONS FOR LOW-CARBON LIVING

A thriving city

The City of Melbourne undertakes a biennial Census of Land Use and Employment (CLUE), with the latest survey undertaken in 2005–06. Comparison with previous surveys in 2004 and 2002 reveal a municipality in a period of prosperity and expansion, with the emergence of Docklands as a residential, commercial and entertainment district providing a significant contribution to this growth. Key trends since 2002 are:

- 45 per cent increase in the number of residential apartments
- 12.8 per cent increase in the number of workers in the city
- 15 per cent increase in office floor space
- 12.6 per cent increase in the number of workers in the City of Melbourne.

Significant expansion in the number of residential apartments in the city is reflected in the residential sector's relative contribution between 2002 and 2005–06, increasing from three per cent to nine per cent of emissions.

A changing way of living

In terms of how we are living, there are a number of trends leading to an increase in the level of emissions, specifically from the residential sector. These are:

- an increasing number of household appliances and the electricity demand of non-white goods
- an increase in the number of residences with air-conditioning in response to a warmer climate.

Inclusion of Docklands

In addition to these underlying socio-economic trends, as of 1 July 2007 the City of Melbourne assumed administrative responsibility for the Docklands precinct. While the emissions reported are for the period 2005–06, the CLUE data on which the emissions were determined incorporated Docklands. As such this area was included within the calculations.

Given the level of development at Docklands over the last four years, the inclusion of this area within the boundary of the City of Melbourne is considered to have significantly influenced the level of greenhouse gas emissions.

Further boundary changes occurred on 1 July 2008 as a result of the Kensington Boundary Review, when the City of Melbourne assumed administrative responsibility for the suburbs of Kensington and a section of North Melbourne previously under the municipal authority of Moonee Valley City Council. These additional areas have not been included in the 2005–06 calculations. It is expected the inclusion of these additional areas will influence total emissions during future reporting periods.

Transport emissions

Emissions associated with passenger transport were calculated in a separate study *Greenhouse Footprint for Transport Report*. This study considered the greenhouse gas emissions associated with:

- trips to the City of Melbourne for employment by people who live outside the municipality
- trips by City of Melbourne residents to locations outside the municipality
- internal trips by residents within the City of Melbourne.

4. MELBOURNE AS A SUSTAINABLE & HEALTHY CITY – SETTING THE CONDITIONS FOR LOW-CARBON LIVING

In addition, all visitor journeys (journeys made not associated with employment), to, from and within the City of Melbourne were considered.

This *Greenhouse Footprint for Transport Report* provided a level of detail and understanding regarding passenger transport emissions that was not considered in Zero Net 2003.

Further, the original *Zero Net 2003* excluded emissions from freight movements. These emissions have been included in the 2005–06 calculations.

Residential and employee emissions (2002)

To enable a comparison between reporting years Arup has undertaken a process of normalising the emissions for 2002, 2005–06 and for the projected emissions to 2020. A detailed consideration of this is provided in Appendix B and a summary provided in Table 1. The table shows that from 2002 to 2005–06 there was a significant increase in total emissions for both the residential and commercial sectors.

In terms of normalised emissions Table 1 indicates that per commercial employee emissions have remained constant, whereas those per resident have significantly increased.

GHG Emissions					
Baseline/Target	**Residential Stationary Energy**			**Commercial Stationary Energy**	
	Total	**Per resident**	**Per dwelling**	**Total**	**Per commercial employee**
	kt CO_2-e/year	**t CO_2-e/year**	**t CO_2-e/year**	**kt CO_2-e/year**	**t CO_2-e/year**
2002	112	2.1	3.8	2,212.5	9.8
2002 (Victorian average)	≈ 350	4.1	10.47		
2005-2006 Baseline	552	7.8	11.9	3,235	9.9
2020 Target	555	5.1	9.0	1,659	4.1
Percentage change on 2005-2006	**0.4%**	**-34.5%**	**-24.8%**	**-47.7%**	**-58.2%**

Table 1: Greenhouse gas emissions for the City of Melbourne from 2002, 2005–06 to 2020 (under a business-as-usual and *Zero Net Update 2008* scenario)

The large reported increase for total residential emissions can in some part be explained by the increase in the City of Melbourne boundary. However, there is still a large increase in per resident emissions which is not explained by the increase in boundary area.

When the data sourced from the 2002 Victorian averages is compared with 2005–06 levels the following conclusions can be drawn:

- The methodology used to estimate the 2002 residential levels may have underestimated the total emissions attributable to residents.
- The emissions per dwelling for City of Melbourne in 2005–06 is slightly greater than the Victorian averages for 2002 and is likely associated with the greater emission intensity of high rise apartments which are concentrated in the City of Melbourne. It is not clear whether there has been an actual rise in emissions per dwelling since 2002.
- The emissions per resident in City of Melbourne in 2005–06 are much greater than the Victorian average for 2002. This is likely associated with lower household size in City of Melbourne compared to the rest of Victoria.

4.1.4 Projected emissions

The projected change in the contribution of each sector to emissions to 2020 is illustrated in Figure 4 and indicates an emissions total of 8 million t CO2-e without mitigation measures. If freight transport is removed to enable comparison with *Zero Net 2003*, total emissions are 7.6 million t CO_2-e or the equivalent of a 117 per cent increase in emissions on 2002 levels and a 23 per cent increase on 2005–06 levels.

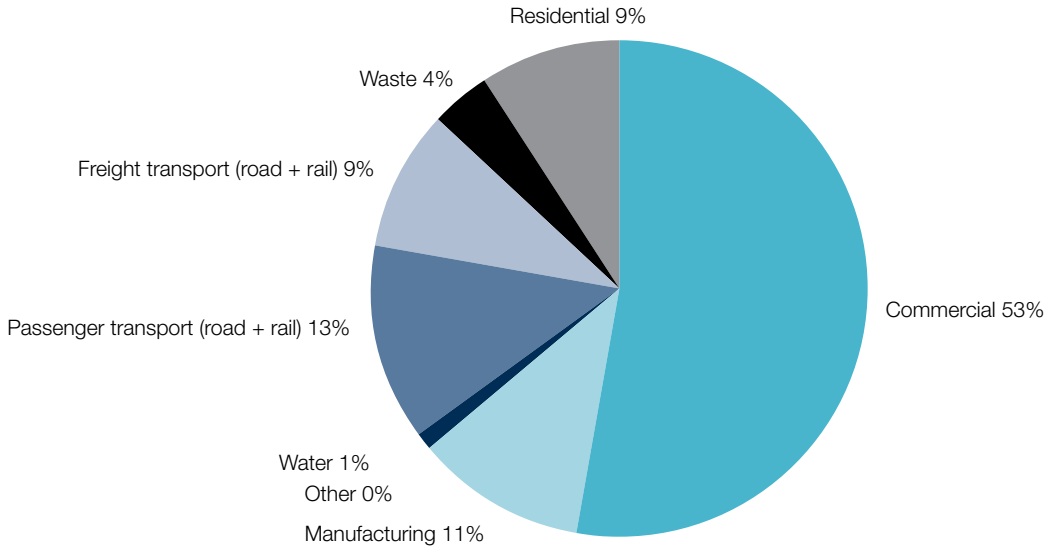


Figure 4: Projected greenhouse gas emissions by sector for the City of Melbourne 2020 – total emissions estimated at 8 million tonnes carbon dioxide equivalents

4. MELBOURNE AS A SUSTAINABLE & HEALTHY CITY – SETTING THE CONDITIONS FOR LOW-CARBON LIVING

4.1.5 Zero net emissions

Zero Net 2003 outlined how the strategies of leading edge design, greening the power supply and offsetting would enable zero net emissions by 2020 for community emissions. These strategies have been realigned to accord more closely with how the emissions data is compiled. The revised strategies are:

- commercial
- residential
- passenger transport
- decarbonising the energy supply.

Manufacturing and industrial emissions have not been included as a strategy because they will be partly addressed through the strategy of decarbonising the energy supply and are being addressed through other Victorian Government programs (Environment and Resource Efficiency Program) and Australian Government programs (Energy Efficiency Opportunities Program).

Further, as noted in the Victorian Government's Wedges: *Understanding the Potential to Reduce Victoria's Greenhouse Gas Emissions*,[9] emissions from industrial processes, of which manufacturing is a component, are likely to be sensitive to a carbon price established through the introduction of a National Emissions Trading Scheme.

This report notes that a 10 per cent reduction in emissions within the industrial sector is predicted and this figure has been applied to the emission reductions within the *Zero Net Update 2008.*

Figure 5 illustrates that with implementation of the strategies under the *Zero Net Update 2008*, it is expected there will be a reduction in commercial, residential, passenger transport and manufacturing emissions. The emission reduction expected from decarbonising the energy supply and the level of offsetting required for the remaining emissions is also provided in Figure 5.

In addition, Figure 5 illustrates the relative contribution to emissions from the commercial, residential, manufacturing and industrial and transport sectors to 2020 under a business as usual scenario.

It also shows the emissions reduction in 2020 associated with efficiency and fuel switching measures from the commercial, residential and passenger transport strategies. The additional contribution of decarbonising the energy supply to emission reduction is demonstrated in the final column for 2020.

9 Nous Group and SKM, 2008

4. MELBOURNE AS A SUSTAINABLE & HEALTHY CITY – SETTING THE CONDITIONS FOR LOW-CARBON LIVING

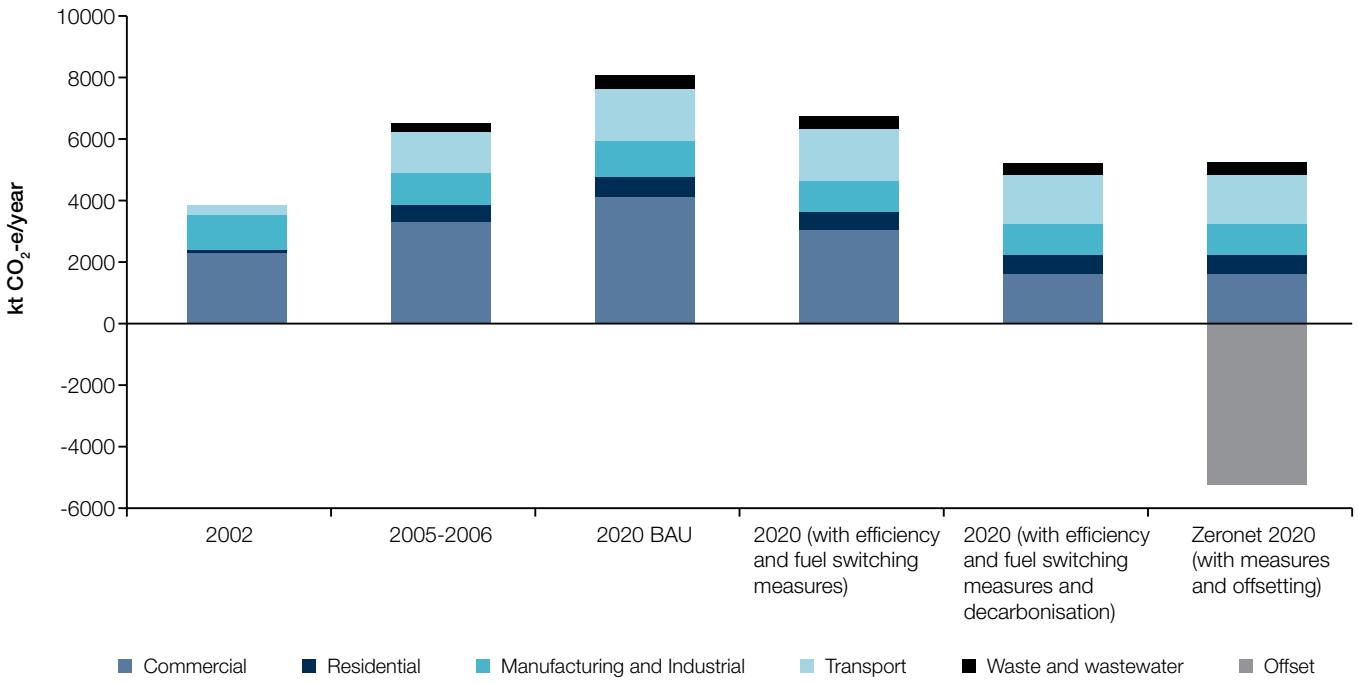


Figure 5: Greenhouse gas emissions (kilotonnes carbon dioxide equivalents) for the City of Melbourne from 2002, 2005–06 to 2020 (under a business-as-usual and *Zero Net Update 2008* scenario)

In terms of per resident and commercial employee, Table 1 presents the total emissions by the residential and commercial sector and then by resident and commercial employee. The figures are based on *Zero Net 2003*, the calculated emissions for 2005–06 and those predicted for 2020.

This highlights that each resident in 2005–06 was on average responsible for the emission of 7.8 t CO_2-e and that to achieve the overarching goal of a 35 per cent reduction in emissions by 2020 each resident will need to reduce their emissions to 5.1 t CO_2-e per year.

For each person employed within the commercial sector the percentage reduction required is greater. During 2005–06 each commercial sector employee emitted 9.9 t CO_2-e, which is roughly equivalent to the 2002 level of emission.

In order to achieve the target within Zero Net Update 2008 the emissions of each commercial sector employee will need to decline by 59 per cent to 4.1 t CO_2-e per year by 2020. Section 5 provides the roadmap for how these reductions can be achieved for each sector.

4. MELBOURNE AS A SUSTAINABLE & HEALTHY CITY – SETTING THE CONDITIONS FOR LOW-CARBON LIVING

Offsetting

Offsetting was included as a strategy in *Zero Net 2003* and was largely focused on the City of Melbourne establishing its own processes for offsetting of carbon emissions in the absence of an accepted and robust scheme for trading in carbon offsets.

As noted in the brief review of *Zero Net 2003*,[10] the need for the City of Melbourne to establish its own processes is no longer critical as a result of the Australian Government's commitment to establish a National Emissions Trading Scheme by 2010. While the National Emissions Trading Scheme is still being developed, the *Emissions Trading Scheme Discussion Paper*[11] notes that offsets[12] will be an intrinsic feature of the National Emissions Trading Scheme.

To enable offsetting of community emissions, the City of Melbourne will need to participate in the National Emissions Trading Scheme.

Figure 6 updates the City of Melbourne – the Municipality Business Strategy Map contained within Zero Net 2003 with the revised 2020 projections. To reach zero net community emissions, reductions considered achievable via the strategies contained in Zero Net Update 2008 have been determined as well as the contribution required from decarbonising the energy supply and offsetting. The relative contributions towards zero net emissions are shown in Figure 6.

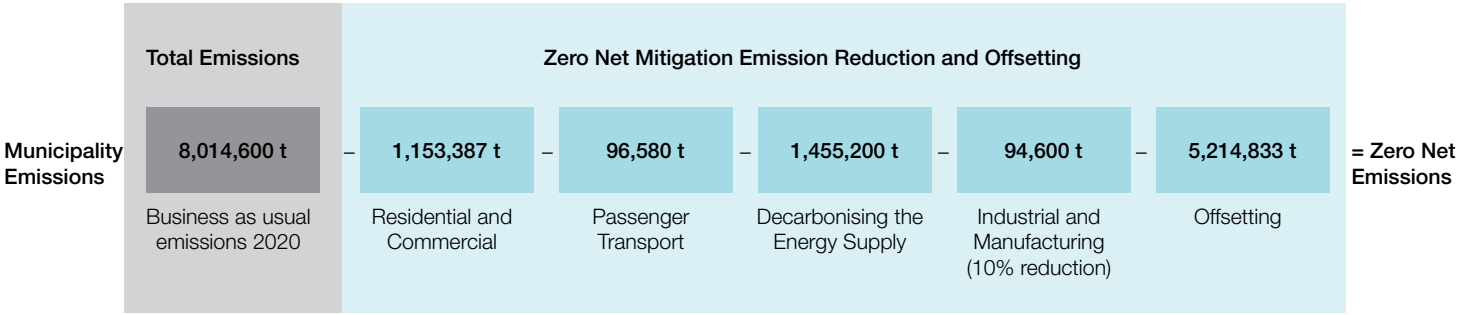


Figure 6: City of Melbourne – the municipality business strategy map

10 Business Outlook and Evaluation, 2007
11 Garnaut Climate Change Review, 2008

12 Garnaut Climate Change Review, 2008 defines 'offsets' as: '*a reduction or removal of emissions from activities in one area of the economy that can be used to counterbalance ('offset')emissions in other sectors the economy*'

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

5.1 Towards a low-carbon future

The roadmap for emissions reduction builds on the original strategies contained within *Zero Net 2003* and redefines them to account for recent developments at all levels of government. The strategies within this *Zero Net Update 2008* have been more closely aligned to a sectoral base to reflect how the emissions data was prepared.

In addition, the strategy of greening the energy supply has been renamed as decarbonising the energy supply. As previously noted, the revised strategies are:

- commercial
- residential
- passenger transport
- decarbonising the energy supply.

For each strategy the relevant contribution or target that must be achieved for each sector has been determined. In turn this target is supported by a proposed pathway or actions for implementation. The detailed calculations of emission reductions are included in Appendix B.

Determination of these pathways took place following consideration of current programs and developments at the Australian, state and local government levels, as well as through a best practice review of international, local government, regional and sector specific guidance.

The best practice review focused primarily on the strategies and actions of leading cities under the headings of residential, commercial and energy supply to align with the direction in *Zero Net Update 2008*. A summary of this review is provided in Appendix C.

5.2 The role of the City of Melbourne as a leader in climate change

The City of Melbourne has a history of innovation and has used its powers to establish legal and financial mechanisms to help meet its climate mitigation goals.

It also has a history of leveraging its strong reputation and taking a leadership role to facilitate initiatives, to activate partnerships with key stakeholders, to advocate and educate, and to lead by example through actions within the municipality. This history has also been critical in helping to meet its climate mitigation goals.

The City of Melbourne can draw on the following powers to meet the targets set in this update:

- spend funds, give grants and provide subsidies
- buy and sell land, and develop land in its own right
- invest funds
- make representations to state and federal governments on policy and regulation
- zone lands for development and other purposes
- determine development applications
- call a temporary or permanent halt to building and demolition work and to businesses trading
- create independent legal structures with the capacity to raise funds
- make new laws relating to new and existing developments
- advertise through a range of media outlets and via its own channels such as rates notices.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

Through these powers the City of Melbourne has a significant ability to influence the sustainability activities taking place within its boundaries, including carbon emissions. An example is the Sustainable Melbourne Fund which has been established to garner commercial investment in sustainable projects.

In addition to direct powers, the City of Melbourne has an equally important ability to influence sustainability outcomes through its leadership and ability to advocate and influence.

The City of Melbourne has comparatively very little direct control over the emissions that relate to activities within its boundaries. It can, however, use its influence to work with state and federal governments, private sector leaders and individuals to take the necessary action to reduce carbon emissions. It can also bring together the key players from within government, industry and community.

One example of how a combination of direct powers, leadership and advocacy has been applied is the role the City of Melbourne has played in positioning Melbourne as a hub for sustainable building design.

It has applied direct powers, through the C60 planning amendment implemented under the auspices of the *Planning and Environment Act 1987* (Vic); and leadership through the opening of CH2 and sponsorship of events such as the Sustainable Building Pathway workshop[13] in 2006.

To achieve zero net emissions by 2020, the council's powers, leadership and ability to form effective partnership will need to be fully exploited. An understanding of the current and potential role of the City of Melbourne has informed the pathways and actions identified under each sector strategy.

Climate Neutral Water Saving Schemes

The City of Melbourne is committed to reducing water consumption by 40 per cent by 2020 and intends to achieve zero net greenhouse gas emissions by the same year.

Water conservation is a high priority in Melbourne. We need to use our existing supplies wisely to avoid drawing further supplies from our waterways, causing ecological damage with the construction of dams and other infrastructure, or creating environmental consequences in the form of extra greenhouse gas emissions.

Because of this, the City of Melbourne recommends all water reuse or harvesting projects to be climate neutral. The City of Melbourne has developed a discussion paper entitled *Climate Neutral Water Saving Schemes,* which promotes the use of water saving schemes that do not result in increased green house gas emissions.

www.melbourne.vic.gov.au/climateneutralwater

13 The Sustainable Pathway for the Building Industry bought together 50 senior executives from industry and the three levels of Government in February 2006 to define seven core strategies to continue the development and promotion of sustainable building design.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

5.3 Commercial sector

The City of Melbourne's commercial sector accounts for 50 per cent of emissions, or 3,235 kt CO_2-e of total greenhouse emissions. They derive from three major types of activity:

- office work (finance, insurance, government, communications, property and business services)
- sales, accommodation, restaurants and tourism (retail and wholesale trade, cultural and personal services, accommodation)
- education, health and community services.

Between 2002 and 2005–06 emissions grew by 46 per cent in this sector and every $1 million of Gross Regional Product during 2005–06 equated to the emission of 117 tonnes of CO_2-e.

In 2005–06 each employee in the commercial sector was responsible for the consumption of 11.3MWhr of energy with a carbon footprint of 9.9 t CO_2-e.

Total emissions from this sector are expected to grow 3,981 kt CO_2-e or by 23 per cent by 2020 if no action is taken.

Increases in the amount of floor space and the number of employees in office-based activities as well as growth in the sales and tourism sub-sector reflects a booming Melbourne economy. Corresponding growth in emissions and a projected future growth rate present major challenges for the City of Melbourne which relies on a growing economy for success.

5.3.1 Target for emissions reductions

An emission-reduction target of approximately 1,004 kt CO_2-e on 2020 business-as-usual emissions has been set across the commercial sector. This represents a decrease of eight per cent on 2005–06 levels and 25 per cent on 2020 business-as-usual levels as per Figure 7.

A 2020 target for each employee in the commercial sector is set at 8.3 MWhr of energy consumption per year with a carbon footprint of 4.1 t CO_2-e per year, a 58.2 per cent decrease on 2005–06 levels.

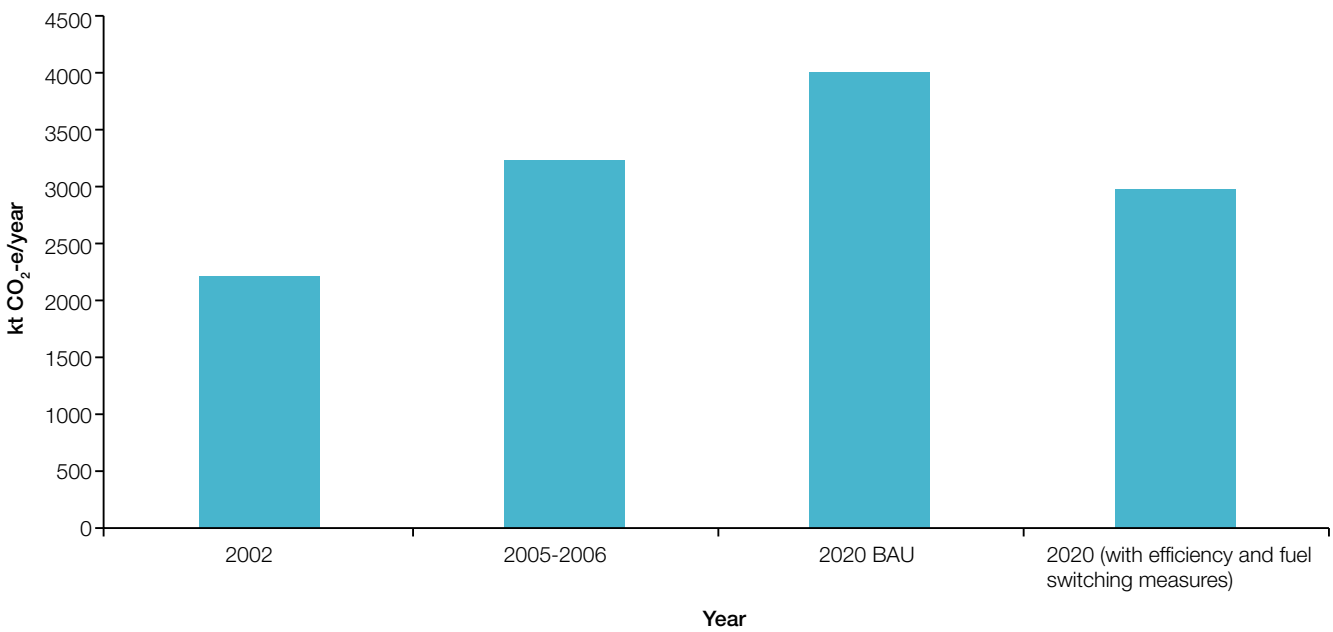


Figure 7: Commercial sector greenhouse gas emissions from 2002, 2005–06 to 2020 (under a business-as-usual and *Zero Net Update 2008* scenario)

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

Table 2 provides a summary of where emissions reductions are planned in the commercial sector and the expected level of greenhouse gas reduction. However, achieving the optimum 2020 target depends on a range of variables. Therefore low and medium targets have also been set as highlighted in Table 2. The City of Melbourne will facilitate achieving targets in each of the sub-sectors. Existing office buildings

Commercial reduction strategies	Scale of reductions (kt CO2-e)		
	Lower	Medium	High
Existing office buildings	193	285	383
New building office buildings	0	134	163
Education, health and community	29	43	57
Retail and wholesale (existing)	26	52	78
Retail and wholesale (new)			137
Hotels (existing)			83
Hotels (new)			103
Total	**248**	**514**	**1004**

Table 2: Combined emission reduction strategies in the commercial sector

There is approximately 7.7 million square metres devoted to office space within approximately 1800 commercial office buildings across the City of Melbourne. When benchmarked against the Australian Building Greenhouse Rating Scheme (ABGR), renovated buildings typically achieve a 4.5 Star rating.[14] Using this typical improved performance as a benchmark, unrenovated office buildings in the City of Melbourne are to be progressively retrofitted to improve their energy performance with an expected overall greenhouse saving of 383 kt CO_2-e.

This represents a retrofit program of approximately 5.2 million square metres within 1,200 commercial office buildings over a period of eight years with an average improvement in performance of 38 per cent. Lower and medium targets are based on retrofitting 50 per cent or 75 per cent of unrenovated buildings respectively

New office buildings

The City of Melbourne will increase greenhouse performance standards for new commercial developments requiring them to meet an ABGR rating of 5 stars or greater – to come into force by 2012 (a common international target for tougher energy performance in new buildings).

This will deliver approximately 163 kt CO2-e savings by 2020. The most recent enhancement to standards, which requires all buildings over 2,500m^2 to achieve a 4.5 Star ABGR rating, will achieve the medium target.

14 The Australian Government through its Energy Efficiency in Government Operations Policy has set a standard of 4.5 Star ABGR for all new build and major refurbishment.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

The London Borough of Merton became a world leader when it required all new developments to achieve a 10 per cent contribution to final energy demand from renewable on-site sources. The City of Melbourne will consider this approach, known as the 'Merton Rule', to reduce the footprint of new developments and help to decarbonise the energy supply.

Education, health and community buildings

The City of Melbourne will encourage this sub-sector to retrofit 230 buildings to 2020, with an average reduction of 15 per cent in emissions. This is expected to result in savings of up to 57 kt CO_2-e if all 230 buildings are retrofitted, 29 kt CO_2-e if 50 per cent of buildings are retrofitted or 37 kt CO_2-e if 75 per cent of buildings are retrofitted.

This target of 15 per cent reduction in emissions excludes the potential impact of in-building or district combined heat and power schemes which are addressed under Section 5.6.

Sales and tourism sector

The City of Melbourne already facilitates a program of retrofitting hotel accommodation in the city. Evidence based on retrofits of 30 hotels suggests that a total of 83 kt CO_2-e could be saved if this were applied to the entire hotel sector.

The City of Melbourne will work with the Victorian Government to introduce a greenhouse performance standard for the hotel sector, with the aim of achieving minimum carbon savings of 83 kt CO_2-e by 2020.

The introduction of this standard will be informed by a recently commissioned study to determine the carbon footprint of tourist activities within, and to and from, the City of Melbourne.

Greening Your Building

Greening Your Building: A Toolkit for Improving Asset Performance Is a guide for building owners and facility managers. It contains over seventy management environmental performance, while at the same time reduce operating costs.

Included in the toolkit is a summary of each initiative with information about potential benefits, risks, the process of implementation, payback periods and approximate coasts as well as directions on where you can find more detailed information.

Whether you are retrofitting your entire building, replacing plant and equipment or perhaps simply looking for ways to incorporate green practises into your ongoing maintenance and management strategies, this toolkit is for you.

To download your free copy of the Greening Your Building Toolkit please visit:

www.melbourne.vic.gov.au/greeningyourbuilding

For the retail and wholesale sector, the City of Melbourne will consider available regulatory mechanisms to set greenhouse performance standards in new retail and wholesale developments to achieve a 15 per cent reduction on current performance, or 137 kt CO_2-e by 2020. Further, the City will also encourage energy efficiency and the adoption of low-carbon approaches in the retail and wholesale sector to achieve a 15 per cent reduction in emissions by 2020, or 78 kt CO_2-e.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

5.3.2 Pathway to reductions

Existing office buildings

The City of Melbourne will take a three-pronged approach to improving building energy performance in existing commercial developments: incentives, awareness raising and sanctions (among building owners and tenants) by:

- *Incentives* – facilitating a large-scale retrofit program that would complement and incorporate the existing Clinton Carbon Initiative (CCI). The program should, in conjunction with CCI, provide the necessary support to facilitate the matching of Energy Performance Contractors with building owners, targeting those buildings which are unrenovated in the first instance.
- *Promotion* – establishing a sophisticated and highly targeted public relations and marketing campaign drawing on Melbourne's appeal as a world-class city and the individuals who make it so. The campaign should aim to recognise individuals' actions and commitments, as well as create a space for Melbourne's business owners to differentiate themselves by agreeing to participate in the program.
- *Sanctions* – exploit the range of regulatory options available to encourage building owners to improve energy performance. Options to be explored will include the potential for requiring disclosure of building energy performance at the time of lease and sale, and the potential of a special levy or stepped rates according to building energy performance.

The potential roll-out of the program is illustrated in Figure 8. A suitable ramp-up period will be required to provide sufficient time for building owners to be signed up and the energy performance contracting industry to be prepared for significant increases in workload.

Building Improvement Partnership Program

This pilot program focuses on improving the performance of commercial office buildings with regards to waste, energy and water use.

Participants receive an initial base building assessment to identify the actions and costs of improving the building's energy, water and waste efficiency. This is complemented with technical assistance, funding options, training and recognition for the buildings.

The experiences of these buildings will be used to inform a wider sustainable office buildings program incorporating tenants, owners, property managers and other important industry players.

Finance for these retrofits is made available through the Sustainable Melbourne Fund. The project is funded by the Victorian Government's Sustainability Fund.

For more information please visit

www.melbourne.vic.gov.au/bipp

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

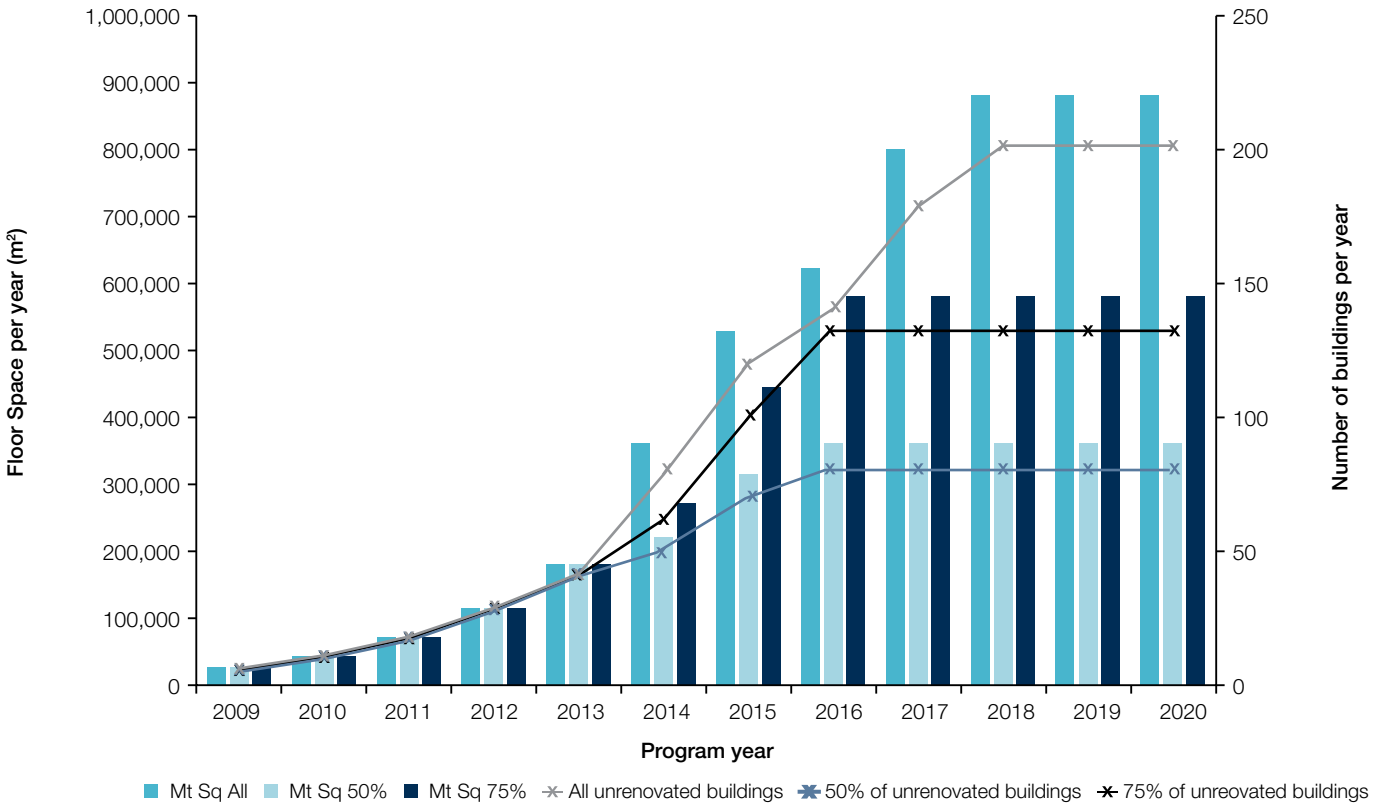


Figure 8: Options for a program to retrofit City of Melbourne unrenovated buildings

New office buildings

The City of Melbourne will increase greenhouse performance standards for new commercial developments to require them to meet an ABGR rating of 5 Stars or greater, with a potential start date of no later than 2012. This will ensure that new developments are achieving the current maximum greenhouse performance standard.

Education, health and community centre buildings

The City of Melbourne will facilitate development of an appropriate mechanism to commission and retrofit the larger buildings in this sector.

As a first step, the City will convene an education, health and community facility committee including Chief Executive Officers and Vice-Chancellors to devise a collective approach to reducing carbon emissions from this sector. The potential for a retrofit program to be rolled out to this sector is demonstrated in Figure 9.

Management and ownership of these facilities is largely at a State level and as such the success of such a program will depend on active participation and commitment by the Victorian Government.

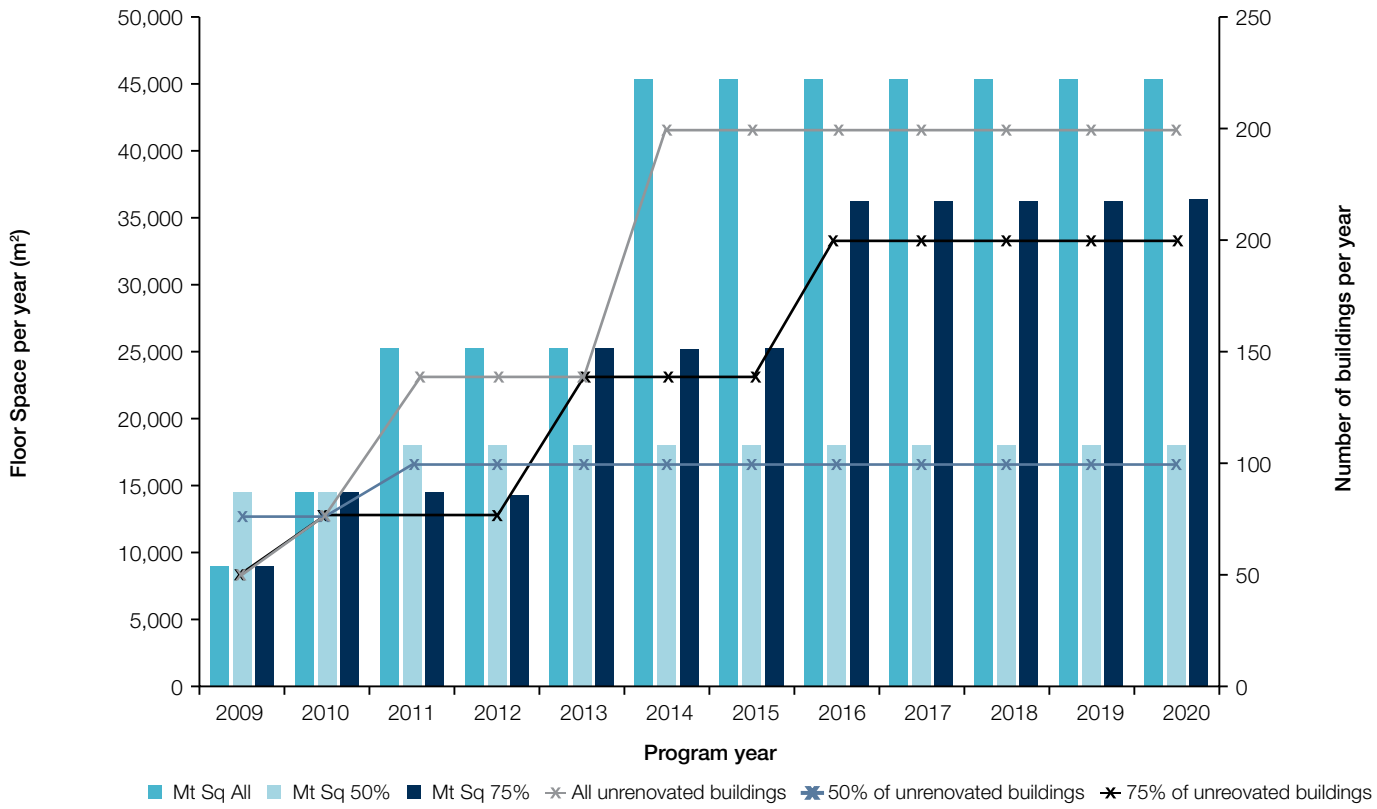


Figure 9: Options for a retrofit program for education, health and community buildings

Sales and tourism sector

The City of Melbourne will carry out a three-fold strategy for the sales and tourism sector:

- lobby the Victorian Government for energy performance regulation of retail and wholesale, accommodation and cultural/sporting new developments
- explore the use of existing regulatory powers to curb high-energy-consuming equipment such as lighting and chillers in existing developments
- develop a campaign to encourage operators and business owners to reduce energy and save on operating costs, drawing on the evidence gathered from its innovative program to retrofit hotels for energy and water efficiency.

Savings in the City

'Savings in the City has helped us dovetail into some important global issues, putting us ahead of the game' Hotel Ibis Little Bourke St

A finalist of the 2008 UNAA World Environment Day Awards, *Savings in the City* began as a 3 year pilot programme in 2005. To date, the program has assisted 30 hotels achieve significant reductions in their energy, waste and water consumption.

Savings from the program include:

- energy saved by the 30 hotels over the first two years of the program equates to **24,769 tonnes of greenhouse gas emissions;**
- total saving over two years for all hotels equates to **628 truckloads** of waste;
- an average reduction in water use of 15.3. Litres per guest per night leading to a total savings over two years of some **45 Olympic swimming pools; and**
- the average reduction in waste going to landfill from each hotel was **31 per cent.**

An *Energy Wise Hotel Toolkit* has been developed to help the accommodation sector to reduce their greenhouse emissions whilst improving their hotel performance.

The project has been delivered in partnership with Sustainability Victoria, Smart Water Fund, and EC3 Global.

For more information please visit:

www.melbourne.vic.gov.au/greenhotels

Non emission-based impact of measures

The scale of the approach outlined above for the City of Melbourne is unequalled in the past 50 years. It will represent one of the biggest investments in energy efficiency ever undertaken worldwide, with the number of office buildings being retrofitted peaking at about 200 per year in the latter half of the program.

With potentially three parallel streams of energy retrofitting occurring (residential, office buildings, and health, education and community buildings) the logistical impact is unprecedented.

This will require considerable logistical resources including long lead times to enable the energy performance contracting industry to scale up to meet the challenge. A number of co-benefits would derive from this approach, including:

- a boost in employment in the City of Melbourne
- Melbourne being acknowledged as an international hub for expertise on commercial building retrofits
- increased demand for locally-sourced energy efficiency technology and applications
- resulting economic and social benefits for Melbourne.

5.3.3 Next steps for implementation

Retrofit program for existing office buildings

The City of Melbourne will develop a business case to support the establishment of a large-scale retrofit program for Melbourne's office buildings using private energy performance contractors. The business case will:

- confirm the number of buildings included in the program and the total floor area;
- model the anticipated supply chain impact in terms of additional energy efficient products and technologies that will be required;

- scope the number of energy performance contractors required to manage the number of retrofit projects at program peak;
- consult with the energy performance contracting industry over the steps needed to prepare the industry for the program;
- scope the size of the administrative resource necessary to establish the program and provide the coordination services required to link building owners with energy performance contractors;
- consult with CCI to determine how best to accommodate it in the program structure; and
- provide options for funding the administrative program structure.

The business case will also scope the cost of a sophisticated promotional campaign designed to encourage building owners to sign up to the program, taking into consideration:

- how the program can link strategically to other public relations and behaviour change campaigns targeted at the residential sector;
- what role employees and tenants can play in influencing building owners to sign up;
- what incentives are required to persuade building owners to sign up (eg. rates holidays, awards and recognition mechanisms);
- communication methods such as peer group roundtables, one-to-one meetings, letters to the editor and opinion pieces, use of industry and peak groups; and
- the duration and level of intensity of the program.

Finally, the business case will explore options to impose sanctions on building owners to encourage them to sign up to the new program, including:

- a special levy on building owners who have not met minimum greenhouse performance standards by a set date;
- a stepped rates system according to greenhouse performance; and
- mandatory disclosure of greenhouse performance at point of lease and of sale.

The business case will be prepared by February 2009 and the new program will be ready to be implemented from July 2009.

New office buildings and regulatory requirements for retail buildings

The City of Melbourne will, in liaison with the Victorian Government, consider amendments to the Planning Scheme to increase greenhouse performance standards for new office buildings greater than 2,500 m^2 from 4.5 to 5 Stars as soon as practical, but with a start date of no later than 2012.

The City of Melbourne will liaise with the Victorian Government on appropriate energy performance regulation for lighting and chillers in retail development, and seek a commitment from the Victorian Government to develop comprehensive energy performance standards for retail development and other buildings supporting Victoria's tourism industry.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

Education, health and community centre buildings

The City of Melbourne will facilitate the development of an appropriate mechanism to commission and retrofit the larger buildings in this sector. As a first step, the City will convene an education, health and community facility committee including Chief Executive Officers and Vice-Chancellors to devise a cooperative approach to reducing carbon emissions from this sector. The committee will be encouraged to:

- identify what initiatives, if any, are occurring in the sector to reduce emissions
- identify the barriers to carrying out retrofits. For example, can financial savings derived from energy reductions be retained by the institutions from year to year?
- agree to a collective approach to reducing emissions and set a deadline and a target for reductions
- call on, where necessary, the City of Melbourne to provide some support for the agreed approach.

Information will be shared with the committee on other approaches to support energy performance contracting that are being explored with respect to commercial developments.

The first meeting of the committee will be held no later than December 2008.

Supporting information

The activities that take place in a building in part determine its type and resultant emissions. This in turn impacts on the nature of emission reduction strategies. A summary of the building types and consumption characteristics is contained in Table 3.

Building type	Energy consumption characteristics
Offices	Generally open plan format. Main sources of energy consumption from computers and other equipment, lighting, heating, cooling and ventilation and lifts
Sales, accommodation, restaurants and tourism	In sales areas, high lighting load, high chiller load from cool display units and resultant high air-conditioning load (to compensate for excess heat from lights and chillers). Other key loads include those from kitchen and other back-of-house activities, and entertainment loads such as poker machines, televisions, DVDs
Education, health and community services	Education facilities include a combination of large communal spaces and smaller office areas. Lighting and computing loads, lifts and air-conditioning. Health facilities include more intensive air-conditioning loads, ancillary activities such as cooking and laundry and significant load from hospital equipment (bedside, operating theatres, refrigeration)

Table 3: City of Melbourne building types consumption characteristics

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

Existing office buildings

The City of Melbourne's development began in earnest after the 19th century Gold Rush. Many of Melbourne's finest buildings were completed before 1900 and are still used as major locations for office and retail activity. More recent development is typified by prestigious towers such as Eureka Tower. There are approximately 1,800 office buildings in the City of Melbourne and about one third of these have been renovated in the past 30 years.

Action Energy, a UK Government funded body, undertook an analysis of office buildings against office building typology as follows:

- Naturally ventilated (cellular – typically 100m^2 to 3,000m^2)
- Naturally ventilated (open plan - typically 500m^2 to 4,000m^2)
- Air conditioned (standard – typically 2,000m^2 to 8,000m^2)
- Air conditioned (prestige – typically 4,000m2 to 20,000 m^2).

The analysis shows that energy consumption increases dramatically from naturally ventilated cellular offices through to the largest prestige offices, with average consumption in a prestige office, per metre squared, being up to three times that of a naturally ventilated cellular office building. In all cases, heating, hot-water and cooling are the largest consumers of energy.

Energy use for building managers typically breaks down into:

- heating and hot water (gas or heating oil)
- cooling (chillers, air-conditioning equipment, condensers and cooling towers)
- fans, pumps and controls
- humidification
- lighting.

Energy use for tenants typically breaks down into:

- office equipment
- catering
- other electricity such as print rooms
- computer communications rooms.

Innovations in heating, lighting, equipment, building techniques and design now mean significant energy savings can be made in typical office environments. These savings can be as high as 70 per cent but typically are between 30 to 50 per cent.

For example, a typical renovation of a building to improve its greenhouse performance from average to best practice under the ABGR Scheme (the national scheme to rate the energy performance of commercial buildings) would deliver a 38 per cent improvement in performance.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

Typical savings can be achieved by:

- improving air-conditioning systems - through careful attention to running times, volumetric capacity and operating pressure
- using more efficient office appliances and reducing standby losses
- better insulation and improved heating and ventilation, including use of building energy management systems and other building shell measures, and heat recovery and perimeter heating instead of ventilation systems for preheating
- using energy efficient lighting fixtures, timers and linear fluorescent lights for interior, exterior and parking lighting
- more efficient water heating systems and technologies, including solar heating.[15]

Most buildings that have not been renovated in the past five years could perform more efficiently as the rate of energy efficiency innovation has been rapid over that time. In order to make significant in-roads on emissions in the City of Melbourne, a large-scale retrofit of existing office buildings needs to occur.

New office buildings

The City of Melbourne's current growth rate suggests that by 2020, total office space will have increased by about 23 per cent. The City has already moved to curb emissions from this sector by requiring all new buildings with a gross floor area of 2,500 m^2 or greater to meet a 4.5 Star ABGR standard.

This is an improvement in performance of 35 per cent on the average performance for Victorian commercial development. Most new commercial developments will be captured by this new requirement, which will deliver a maximum total benefit of 79.5 kt CO_2-e in greenhouse savings by 2020.

However, this new requirement will not be sufficient to offset the impact of growth in new development on emissions for the City of Melbourne.

Education, health and community sub-sector

Unlike other commercial sub-sectors, this sub-sector is not experiencing significant growth. The potential greenhouse savings are greater in this sector as hospitals, in particular, contain large and energy hungry equipment. However, the barriers are also potentially more difficult to overcome, as hospitals and education providers balance service provision with retrofitting for building performance, and other essential refurbishment.

Sales and tourism sub-sector

Melbourne's city centre is a magnet for tourists and Melburnians alike. Sporting facilities, hotels, restaurants, shops, bars and cafés make up a substantial proportion of the commercial sector.

A range of carbon-related activities occur within this sub-sector including catering, laundering, cleaning, entertainment and packaging. This sub-sector is comparatively difficult to influence because businesses are wary of losing their competitive edge as a result of costly retrofitting, or a perceived loss of amenity.

As with the education, health and community sector, there is currently no building rating scheme under which this sub-sector falls. Therefore nearly half the emissions produced by Melbourne's commercial sector are effectively unregulated. The issue here is twofold:

- emissions will continue to grow unchecked in these sub-sectors
- market distortions will be created between the development of new office buildings and development of buildings for the sales and tourism sector.

15 CIE, 2007

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

Intervention points in the commercial sector

The three sub-sectors in the commercial sector have quite different characteristics. The City of Melbourne's influence and capacity to regulate is a common factor for energy performance across the sector and hinges around life-stages in the built form. There are a number of life-stages at which there are opportunities for intervention in building management and fabric, as summarised in Table 4.

Authorities worldwide, faced with similar structural barriers, tend to use a range of levers to encourage, require or publicise building energy performance.

These levers include:

- requiring mandatory disclosure of building energy performance at the time of sale or lease
- providing a subsidy for improving performance
- setting a levy on buildings that have poor energy performance
- encouraging building owners through voluntary programs
- facilitating market mechanisms via energy performance contracting (where building owners engage a third party to retrofit the building in return for a share of the cost savings resulting from lower energy bills).

Intervention point	Primary consent authority	Role
Renovation	City of Melbourne	Development approval
New plant installed	City of Melbourne	Health/safety inspection
Leased/sold	City of Melbourne/Victorian Government	Health/safety inspection/ approval of sale – stamp duties
Demolition	City of Melbourne	Approval of DA to demolish. Site inspections
Inspections	City of Melbourne/Victorian Government	As defined by range of Acts
Rates – taxation	City of Melbourne	To apply rates in accordance with council policy and Victorian Government approval
Licence to operate	City of Melbourne/State Govt	As defined by range of Acts

Table 4: Intervention points for existing buildings

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

The City of Melbourne is fortunate to have CCI working within its boundaries, which has a similar focus on working with building owners to improve energy efficiency. CCI also aims to work with the supply chain to create a buyers' group for energy efficient products.

Measures that complement the CCI and provide a strategic framework for action have the potential to be highly beneficial, particularly where additional resources are required.

Barriers

Barriers to implementing energy efficiency measures within commercial buildings are linked to the disconnection between building ownership and building tenancy. Not only are running costs a small proportion of the overall rent in a building, often tenants have no direct incentive to seek changes because these costs are absorbed into the rent. Building owners have little incentive because the savings tend to be minor on total rent earned.

5.4 Residential sector

In 2005–06 this sector comprised 8.6 per cent or 552 kt CO_2-e of the total greenhouse emissions in the City of Melbourne. Emissions grew by 390 per cent in this sector between 2002 and 2005–06 CO_2-e.[16]

Growth in emissions is due to an increase in new residential development and to increases in energy consumption related to appliances and lighting. A portion of the increase is also due to the inclusion of Docklands within the City of Melbourne's boundaries.

In 2005–06 each resident was responsible for the consumption of 14.6 MWhr of energy with a carbon footprint of 7.8 t CO_2-e.

Each dwelling was responsible for the consumption of 22.5 MWhr of energy with a carbon footprint of 11.9 t CO_2-e.

Total emissions from this sector are expected to grow to 737 kt CO_2-e by 2020, or by 33 per cent if no action is taken.

A substantial proportion of dwellings are high-rise apartments (about 70 per cent, or 32,677 dwellings) and this market is expected to continue to expand. Low-rise and single dwellings account for the remaining 30 per cent (6,483 dwellings) and are fairly evenly split.

A high proportion of energy demand is met by natural gas, reflecting Melbourne's cool winter climate and the associated winter-time heating demand. The three prime contributors to residential emissions overall are appliances, heating and cooling demands of dwellings and water heating, as illustrated in Figure 10.

16 It is likely that Zero Net 2003 underestimated emissions attributable to the residential sector. The actual increase is therefore likely to be less than the reported percentage increase.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

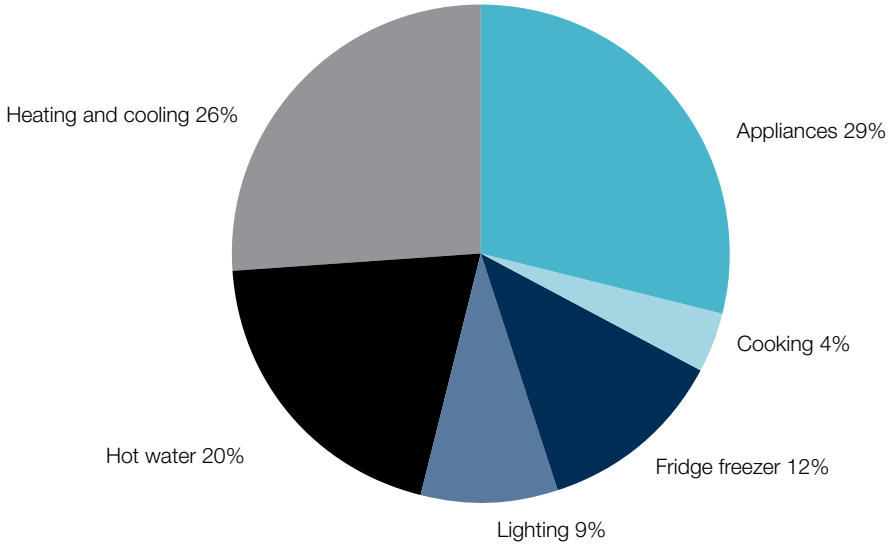


Figure 10: Victorian domestic emissions by end use[17]

5.4.1 Target

An emission-reduction target of approximately 149 kt CO_2-e on 2020 business-as-usual emissions has been set across the residential sector. This represents an increase of six per cent on 2005–06 levels and a 20 per cent decrease on 2020 business-as-usual emissions as highlighted in Figure 11.

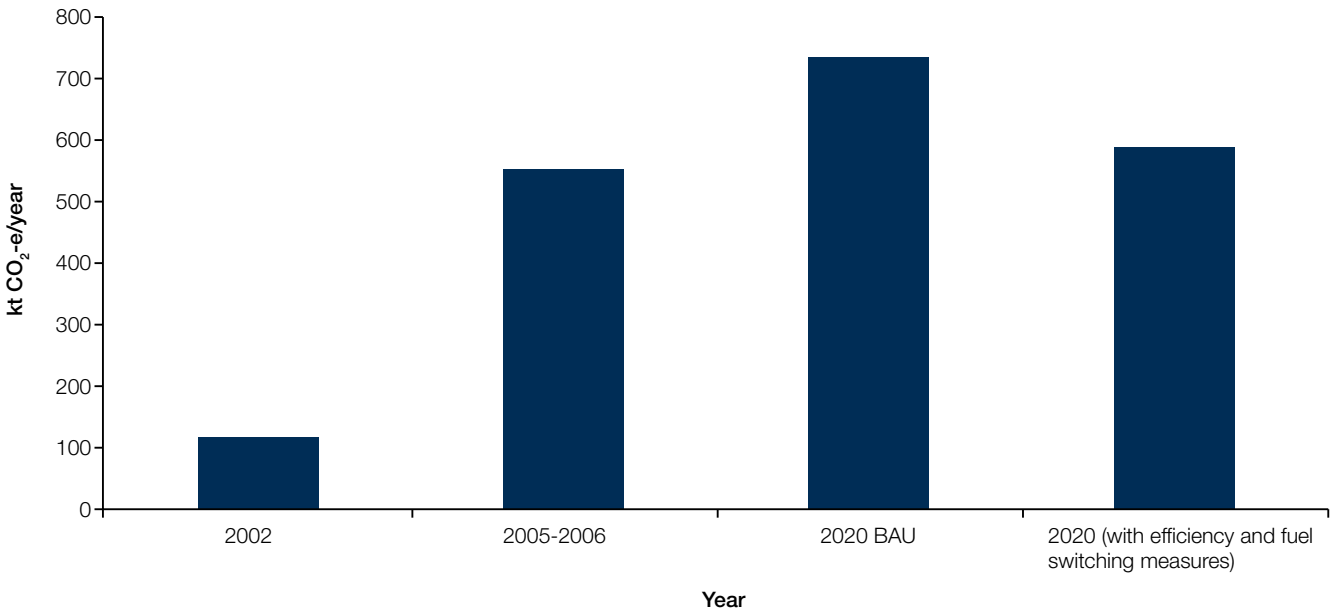


Figure 11: Residential sector greenhouse gas emissions from 2002, 2005–06 to 2020 (under a business-as-usual and *Zero Net Update 2008* scenario)

17 Sustainability Victoria, 2007

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

The 2020 target for each dwelling's carbon footprint is set at 9 t CO_2-e.

The 2020 target for each resident is set at 11.5 MWhr of energy consumption per year with a carbon footprint of 5.1 t CO_2-e per year, a 34.5 per cent decrease on 2005–06.

This will be achieved by targeting the largest proportional sources of emissions that can be reduced for the least cost, specifically:

Space and water heating (approximately 12,000 households)

- space heating – upgrading from electric to gas in existing dwellings (all dwellings where gas is able to be reticulated, or to high-efficiency electric where gas is not available)
- water heating – upgrading from electric to gas (instant or gas-boosted solar) in single and low-rise dwellings or to electric heat-pump in high-rise dwellings.

Common areas in high-rise developments (in 75 per cent of all high-rise developments or a total of 24,507 dwellings)

- reductions in common area energy demand or fuel switching via on-site renewables (high-rise buildings).

Lighting and other measures

Other measures including the impact of Smart Meters (if introduced) and the Victorian Energy Efficiency Target (VEET) Scheme on appliances and lighting:

- appliances – moving to higher efficiency models and removing standby options (all dwellings)
- reductions in lighting demand, particularly in new dwellings (all dwellings).

The combined impact of the possible introduction of Smart Meters,[18] the VEET Scheme[19] and a behaviour change campaign from the City of Melbourne should reach those households not affected by a house audit program.

This impact is estimated to result in an average one per cent reduction in emissions in relation to the use of appliances (all households) on the basis that growth in emissions from appliances is predicted to grow by 10 per cent by 2020 if no action is taken.[20]

New residential developments

The challenge of improving the thermal performance of new residential buildings (above the current 5 Star standard) rests with the Victorian Government.

Research undertaken on behalf of the Victorian Government suggests that while some improvements could be made by raising the minimum requirement to six or seven stars (around eight per cent), this is not where the largest gains could be made in the short to medium term (the most significant gains being in appliances, lighting, heating and cooling, and water heating).[21]

For this *Zero Net Update 2008*, the contribution of thermal performance has been modelled in expectation that the Victorian Government will consider increasing minimum thermal performance standards in the near future. Table 5 provides a summary of the total emissions reductions in existing dwellings and potential savings in new dwellings.

18 COAG has agreed to a mandatory roll-out of Smart Meters where benefits outweigh costs. COAG is make determinations on this issue in 2008 (MCE 2007)
19 DPI, 2007
20 GWA, 2008
21 GWA, 2007

Reduction measure	Emission reduction (kt CO_2-e)
Space heating	60.5
Hot water	40.7
Common areas	21.8
Lighting	9.5
Impact of other measures (1%)	2.0
New residential 7 Star rating	14.8
Total	**149.3**

Table 5: Total emissions reductions in existing residential buildings

5.4.2 Pathway to reductions

The City of Melbourne will enable emission reductions in the residential sector through three strategies:

- house-to-house audit program targeting space, water heating and insulation in approximately 12,000 households
- commissioning retrofits on common areas in 75 per cent of all high-rise residential developments and communal hot water and space heating where feasible and appropriate
- a behaviour change program to support and encourage resident involvement in the audit program, and providing broader energy efficiency advice and information to residents.

These measures have been designed to complement existing measures of the City of Melbourne, the Victorian Government and the Australian Government, such as the VEET Scheme, the forthcoming National Emissions Trading Scheme, existing residential energy performance building standards, and appliance standards under the Mandatory Energy Performance Scheme.

5.4.3 Next steps for implementation

In order to implement these proposals in 2009, the City of Melbourne will develop and cost a business case for each strategy over the next six months. Issues for consideration in the development of the business case are outlined below.

Home auditing scheme targeting space and hot water heating and insulation

The City of Melbourne will develop a business case to establish a house-by-house audit program in consultation with the Victorian Government and energy retailers. The program will operate in conjunction with a behaviour change scheme to target space and water heating and insulation, as well as provide information on other energy saving measures.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

The business case will consider how to provide a single conduit for householders to access information and make informed decisions about a range of energy performance issues in their homes. The business case will also consider how the program can link to existing and appropriate subsidies, grants and other new measures to minimise high up-front costs, offering householders an affordable way to reduce energy use and save money in the longer term.

Specifically the business case will:

- Consider the best options for funding management and administration of the program. This will include liaison with other government partners such as the Victorian Government and other local authorities.
- Consider the most viable potential market and other mechanisms to fund the technologies applied in the program, including:
  - green loans and green mortgages to meet up-front costs of technology
  - institutional investment in the program as a whole in exchange for energy trading certificates and other carbon tradeable receipts (could be negotiated or the opportunity tendered out)
  - sign-up of dwelling owners via energy performance contracts (to be provided via tender through individual contractors, or as a business unit within the City of Melbourne or a special purpose vehicle)
  - potential provision of a tax credit from the City of Melbourne via a rates rebate for accredited installation of specific technologies
  - forming an agreement with the energy retailer to extend the VEET Scheme to ensure active coverage of all target households in exchange for in-kind opportunities (for example the right to develop air-space and roof-space on City of Melbourne properties for renewable and other low-carbon energy installations)
  - potential for the City of Melbourne's existing grants program (currently providing about $20 million in grants) to target a portion of these grants towards organisations that assist the roll-out of energy efficiency schemes in the residential sector, or other mechanisms for reducing emissions associated with the residential sector.

Common area improvements in high-rise developments

The City of Melbourne will develop a business case supporting the establishment of a retrofit program for the common areas of high-rise developments using private energy performance contractors considering, where appropriate, communal gas heating and hot water. As part of the business case, the City will consider:

- how it can contribute to, or fully fund, the management and administration component of the program
- how it can provide leverage for the program to ensure sign-up from building owners/management companies/ strata companies.

Sustainable Living in the City

'Because we can actually measure the reduction in our energy use. I can take this to other buildings and convince them to make the same changes.' Body Corporate Manager, Southbank Towers

The Sustainability Victoria and Australina Greenhouse Office funded Sustainable Living in the City (SLIC) pilot project focuses on four high rise apartment buildings to find ways to reduce water, waste and energy use.

Focussing on common areas and individual apartments, savings have been achieved through a combination of low cost retrofits and behaiour change workshops.

For more information please visit

www.melbourne.vic.gov.au/sustainableliving

Behaviour change program

In developing a business case for the behaviour change program, the City of Melbourne will consider:

- how the program can link strategically to other public relations and behaviour change campaigns
- what role residents also play as workers and how Smart Meter messaging could influence energy consumption behaviour during the day and evening
- what incentives are required for residents to sign up to the auditing program and to make broader changes (for example competitions, rates holidays, awards and recognition mechanisms)
- what communication methods could be used, such as rates notices, forums and community meetings, letters to the editor and opinion pieces, festivals, 'energy days' and direct approaches
- the duration of the program and the level of intensity of the program throughout its duration.

5.4.4 Supporting information

Victoria recently introduced higher energy standards for all new dwellings (5 Star); including a requirement for all new stand-alone dwellings to have solar-gas boosted hot water systems installed.

Despite substantial increases in energy efficiency, analysis undertaken for the Victorian Government suggests the projected carbon emissions from new homes is expected to slightly exceed the average carbon emissions from existing homes due to increases in dwelling size and lighting demand.[22]

This same research suggests the largest future gains in energy efficiency could be made through focusing on energy consuming activities in homes (as opposed to higher building energy performance standards in the residential sector).

While the decision to increase minimum thermal performance standards rests with the Victorian Government, the City of Melbourne's planning scheme will continue to play an important role in encouraging high-density development and facilitating low-carbon approaches, particularly in the case of mixed residential and commercial development.

22 GWA (2007)

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

The Victorian Government has announced its intention to introduce a new scheme to cut emissions from the residential sector by 10 per cent. The VEET Scheme will require energy retailers to offer greenhouse friendly space heating, hot water and appliance options to customers at discounted prices. Due to start in 2009, the details of how the scheme will operate are still being resolved.

It is expected VEET will complement the possible introduction of Smart Meters in Victoria which, if implemented, could provide half hourly updates to householders on energy use and energy pricing.

At this stage there is no date set for introduction. Smart Meters would encourage householders to make active choices about when to use certain high-energy consuming appliances and for how long.

Modelling undertaken on behalf of the Victorian Government in relation to the impact of Smart Meters has suggested greenhouse savings overall will be extremely modest (less than one per cent), but that energy savings at peak times will occur.[23]

Overseas studies suggest Smart Meters can achieve typical savings in energy of about 10 per cent.[24] It may be the difference in these findings is due to with the nature of the Victorian modelling, which has focused on the financial benefit to consumers of altering behaviour according to pricing signals.

If consumers are motivated and encouraged to use Smart Meters to help them reduce greenhouse costly consumption across the board (not just at times of peak demand), then Smart Meters could play a powerful role in reducing energy consumption relating to appliances and installed consumption such as lighting.

Heating and cooling

In Victoria most households rely on gas for heating their homes. About 14 per cent of households across Victoria rely on electric heating or have no heating at all (less than two per cent).[25]

In total, approximately 10,000 dwellings in the City of Melbourne are estimated to be using high greenhouse gas emitting space-heating systems, or are without heating systems.

An analysis completed for the Victorian Government suggests that while there are a range of efficiencies in gas and electric space heating, the potential greenhouse differential between low-efficiency electric and gas space heating or high-efficiency electric systems is in the order of six to eight tonnes per dwelling, representing about 50 per cent of the total carbon burden.[26]

Water heating

The biggest contributors to emissions in water heating are in multi-unit developments where there is a higher proportional reliance on low-efficiency electric heating.

In total, just under 9,000 dwellings in the City of Melbourne are estimated to be using high greenhouse gas emitting hot-water systems. As with space heating, natural gas is the predominant energy source for water heating as shown in Table 6.

23 NERA, 2008
24 Koeppel, Urge-Vorsatz, 2007
25 ABS, 2005
26 GWA, 2007

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

Energy Source	Percentage
Natural gas	76.90%
Electric – off-peak	11.60%
Electric – peak	7.60%
Solar	0.60%

Table 6: Main source of water heating in Melbourne[27]

Central services in high-rise buildings

In an analysis undertaken for the Victorian Government, central services in high-rise developments are assumed to account for up to 38 per cent of total emissions for high-rise buildings and include common lighting, lifts, car parks and other ventilation and services such as pools, saunas and spas.[28]

However, the relative greenhouse impact of central services varies considerably depending on the number of services offered in a building and whether the technology to support these optimises energy and greenhouse gas efficiency.

While central services appear to add to the carbon burden of residential developments, providing central services for a number of households in a high-rise development is arguably more efficient than for a less dense development where these are provided externally to the dwelling and therefore not counted as part of the dwelling's emissions burden (eg. street lighting, road-laying and public baths).

Potential savings in central services have been estimated at 0.89 tonnes per high-rise dwelling, in line with modelling by George Wilkenfeld and Associates.[29]

Lighting

Lighting is a growing source of carbon emissions and is not currently covered by building rating schemes. This means it is difficult to rely on potential carbon savings from lighting as this usually depends on householders deciding on low-carbon lighting options, and cannot be guaranteed for the life of the building.

An analysis undertaken for the Victorian Government suggests carbon savings in lighting schemes for residential developments can be achieved in the order of 0.5–1.5 tonnes, depending on occupancy behaviour.[30]

Appliances

There has been a consistent trend across Australia for householders to have more appliances, and of those, more high-energy consumption appliances such as plasma television screens and other home entertainment systems.

Some evidence suggests the number of high-energy consuming appliances in each household correlates with relative wealth – with wealthier households having a greater number of appliances.[31]

While the efficiency of whitegoods such as fridges and freezers is now regulated nationally under the Mandatory Energy Performance Scheme, so-called 'black goods' or electronic equipment is not currently covered by a mandatory scheme. This is reflected in the large proportion of average household greenhouse gas emissions deriving from appliances.

Appliances on average accounted for 27.7 per cent of household emissions, or approximately 4.2 tonnes per household in 2005. This contribution is expected to grow to 37.7 per cent of total household emissions by 2020. The potential for savings is theoretically considerable but in practice this depends on a combination of household behaviour and purchasing choices.

27 ABS, 2005
28 GWA, 2007
29 GWA, 2007
30 GWA, 2007
31 Independent Pricing and Regulatory Tribunal, 2004

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

A confounding factor is the disproportionate impact of individual appliances. For example, a household could effectively nullify the impact of in-home energy efficient behaviour by purchasing and using a single plasma screen television.

Barriers

There are a number of barriers to householders taking up more energy efficient appliances, and making the change to more efficient fuel sources such as natural gas and renewable energy.

These include:

- level of awareness about energy and its effect on the environment and the impact of energy efficiency on household bills
- high up-front costs involved in making changes
- decision-making by third parties such as plumbers and electricians
- split incentives for tenants and landlords
- complexity and the limitations of markets
- personal choices being influenced by time-constraints, lack of information and point-in-time priorities (for example accessing the benefits of a particular appliance over its relative energy efficiency).[33]

These barriers are common to household energy efficiency programs around the world and are mirrored by a common set of solutions and strategies to resolve them.

5.5 Passenger transport

Transport emissions associated with the City of Melbourne accounted for 20 per cent of all emissions in 2005–06 and this is predicted to grow by 61 per cent by 2020. Passenger transport (road and rail) accounts for 12 per cent of total emissions, with freight at eight per cent. The focus of transport solutions in this *Zero Net Update 2008* is on passenger transport.

The primary source of passenger transport emission reduction in the short- to medium-term (and which the City of Melbourne can reasonably influence) are policies and actions to facilitate a mode shift away from cars to public transport, cycling and pedestrian options.

5.5.1 Target for emissions reductions

An emission-reduction target of approximately 188 kt CO_2-e on 2020 business-as-usual emissions has been set across the passenger transport sector. This represents an increase of 23 per cent on 2006 levels and a nine per cent decrease on 2020 business-as-usual emissions as per Figure 12.

The emission-reduction targets associated with the three key initiatives are as follows:

- reducing the carbon intensity of the public transport system with a 20 per cent reduction in public transport emissions by 2020
- a 15 per cent reduction in car emissions by 2012 and maintained to 2020
- a 100 per cent increase in bicycle use by 2015 to be maintained to 2020.

32 DPI, 2007

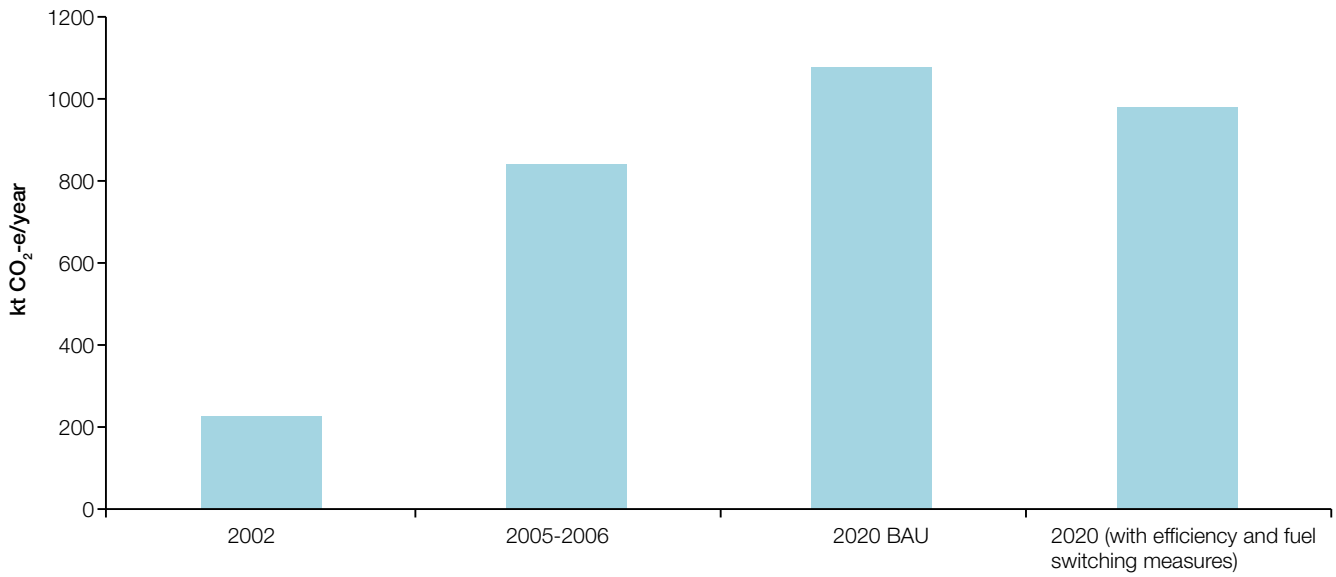


Figure 12: Passenger transport sector greenhouse gas emissions from 2002, 2005–06 to 2020 (under a business-as-usual and *Zero Net Update 2008* scenario)

5.5.2 Pathway to reductions

Expanding the train and tram network would greatly increase access to relatively low-emission transport options for the population of greater Melbourne.

The City of Melbourne will seek to influence this outcome in the longer term but this strategy focuses on short to medium term measures to affect modal shift and decrease the carbon intensity of the existing transport system by:

- decarbonisation of the public transport system through the introduction of low-carbon or clean source energy, thereby reducing reliance on emission-intensive sources
- implementation of a range of measures to achieve a 15 per cent reduction in car emissions by 2012 and maintained to 2020
- introduction of an integrated Cycle Melbourne scheme combining bicycle hire, expanded end-of-trip facilities and a cycling network throughout the city.

Decarbonising the public transport system is distinct from the last two measures, which are predicated on an underlying mode shift away from cars to public transport and cycling.

5.5.3 Next steps for implementation

Decarbonising the transport system

Existing fuel sources for road and rail include energy intensive electricity and petroleum based fuels. The City of Melbourne will develop a business case to assess carbon reduction options for public transport such as:

- establishing a gas-fired power plant specifically for public transport energy supply. The plant could be used exclusively by the tram and train network, and depending on whether suitable uses for waste heat can be found, the plant could be a combined cooling heat and power plant, thereby greatly increasing efficiency (see further discussion in Section 5.6)

- requiring all public buses entering the City of Melbourne to use low-carbon or clean fuel sources by 2012.

Specifically, the City of Melbourne will consider:

- siting options for large-scale gas-fired power plant(s) and the potential to link this with broader decarbonising options
- the potential for heat and cooling demand in the residential, commercial and manufacturing sectors to be met through the gas-fired plant(s)
- finance, build, own and operate options for the gas-fired power plant(s) including private-public partnerships
- spatial and regulatory conditions required to support the establishment of refuelling centres for CNG and clean-sourced hydrogen to be used by public buses
- potential partnership arrangements with neighbouring councils to initiate an investment strategy for base-load solar power in wider Victoria.

Private vehicle emission reduction

This strategy has modelled the result of achieving a 15 per cent reduction in emissions from private cars. It is expected that these savings will be achieved through a mode shift toward public transport usage, behaviour change that leads to fewer kilometres travelled, and an increase in the overall efficiency of the private vehicle fleet.

The City of Melbourne will develop a business case to deliver a 15 per cent reduction in emissions from private cars. The business case will:

- identify a range of options to achieve this target
- establish, with the Department of Transport, the necessary improvement in public transport required to accommodate the projected mode shift away from private cars
- determine the parameters for an economic analysis of the impact of achieving this target.

Cycle Melbourne

As demonstrated in the Melbourne Transport Strategy, the City of Melbourne has a series of planned cycling-specific initiatives under consideration. By combining the key elements of the existing cycling strategy, into a Cycle Melbourne strategy, emissions will be further reduced. In particular the program will include the:

- introduction of technology to provide an integrated bicycle hire scheme for the City of Melbourne making bicycles available at strategic locations around the municipality. Users would hire bicycles using their credit cards or a Transport Smart Card.
- extension and improvement of the existing bicycle network and, where possible, new Copenhagen-style routes established on key east-west/north-south routes to the edge of the municipality, enabling cyclists to move around the inner city and suburbs with ease.
- creation of a statutory requirement for end-of-trip facilities within city buildings, and the creation of city ‘super bicycle stations’. Both concepts would provide appropriate changing facilities and secure parking for bicycles and personal items.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

The realisation of the primary elements of a Cycle Melbourne strategy would enable an increase of 100 per cent of trips made by cycling.

By 2009 the City of Melbourne, in conjunction with the Department of Transport and private providers will:

- identify the up-front costs and implementation issues of similar schemes in Barcelona and Paris
- scope the siting options for infrastructure to support the scheme
- scope the potential for the scheme to be linked via a City of Melbourne Transport Smart Card.

5.5.4 Supporting information

Emissions from transport are growing in cities around the world. Achieving fundamental cuts in emissions from transport requires deep and structural measures that create modal shift and which reduce the carbon intensity of public transport.

Few cities have been able to achieve these goals, but those that have made progress have been at the cutting edge. In Barcelona and Paris, new bike hire schemes are already in place, drawing on the benefits of 'smart' technology to enable bikes to be electronically tagged, booked and paid for.

5.6 Decarbonising the energy supply

Most stationary energy consumed within the City of Melbourne is in the form of electricity from coal and natural gas in the residential and commercial sectors. In addition to electricity and gas, the manufacturing sector also uses a range of petrochemical fuels such as diesel.[33]

Not only does electricity generated from coal release considerable emissions, a significant component of the energy contained in coal is lost during the generation process and the transmission of electricity via the national grid. This means the amount of energy used in a home or business is only a fraction of the energy that has been used to deliver the electricity to the consumer.

A particular benefit of locally sited renewable infrastructure and low-carbon forms of energy generation is that heat and transmission losses are eradicated. In meeting a local electricity demand, for example, a locally sited wind turbine is removing the need for almost twice as much energy to be turned into electricity at the coal-fired power station.

Decarbonising the energy supply through decentralised low-carbon energy infrastructure in urban areas is now a leading strategy for many city governments around the world.

Most notably, London has recently adopted a target of meeting 25 per cent of its energy supply by 2025 and the majority by 2050 using locally sited infrastructure.
It has established a special purpose company, the London Climate Change Agency, to implement the proposal.[34]

The City of Sydney recently announced plans to provide for 70 per cent of the city's energy needs from a combined demand reduction and decentralised energy strategy.[35]

33 Due to the nature of the data available, it is not possible to determine the fuel mix for the manufacturing sector for this report.

34 Mayor of London, 2007
35 City of Sydney, 2008

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

The Victorian Government recently announced plans to introduce a new feed-in tariff for small producers of renewable energy (domestic and other micro applications).

If implemented, this will help make on-site renewable energy more cost effective for individual householders and building owners, by providing a cost-neutral basis for feeding electricity generated back to the grid. Depending on the design of the scheme, the tariff may even enable renewable producers to receive a cost-positive benefit for the energy they generate.[36]

Locally sourced and/or sited renewable and low-carbon energy generation can include:

- residential, commercial and manufacturing buildings (roof-tops and walls) to site micro wind turbines and solar photovoltaics
- structures such as bridge pylons to site wind turbines and photovoltaics (PV)
- dense built structures such as city blocks where there are 24-hour heating/cooling demands (eg. in mixed-use developments or in hospitals and manufacturing activities (combined heat and power systems)
- any business or activity that has a high electricity demand (clean source hydrogen fuel cells) or a high physical energy demand (Stirling engines)
- in open space corridors and in low-density manufacturing lands, or in offshore locations such as Port Phillip Bay (wind turbines).

5.6.1 Target for emissions reductions

A target of 1,455 kt of emission reductions has been set, which represents approximately 18 per cent of total emissions from stationary energy in 2020. The major contributors to this reduction target are expected to be derived from combined heat and power or combined cycle cooling, heat and power systems. It is anticipated that a small proportion of emissions reductions will derive from proven renewable technologies such as large- and small-scale wind and from solar power (photovoltaics). A summary of the reduction potential is provided in Table 7.

36 DPI, 2007

Potential technology to decarbonise the energy supply	Installed capacity (MW)	Number of generators	Estimated abatement (kt CO_2-e)	Sectors for abatement
Wind (based on abating 5% residential emissions)	11	6–10	27.6	All grid connected
Combined heat and power (CHP) at an abatement factor of 3.5 tonnes CO_2 /MW	400	1-400+ *	1400	Commercial and Transport (grid-connected)
PV (based on abating 5% of residential emissions	15	9375 1.6 kW systems **	27.6	Residential
Total			**1,455.2**	

Table 7: Carbon emission reduction potential energy supply initiatives

This target is based on an assessment of targets set by other cities and against the technologies available to meet the target.

It is highly likely that new market conditions created by the National Emissions Trading Scheme and new Mandatory Renewable Energy Target will lead to investment that supports the most economically viable, locally sourced, renewable and low-carbon technologies within the City of Melbourne.

Analysis undertaken for the Victorian Government is in line with these assumptions (proposing that cogeneration will contribute to a 20 per cent reduction in base-load electricity demand by 2030, and that renewable energy will account for a 20 per cent reduction in coal and gas electricity generation by 2035).[37]

5.6.2 Pathway to reductions

The timescale of this strategy is fairly limited in terms of investigating and commissioning new energy infrastructure, so weight has been given to strategies already proven internationally and domestically (wind, gas-fired combined heat and power, and photovoltaics).

Within the City of Melbourne there is a large industrial area that could be better used to support energy infrastructure and this would match well against medium- to large-scale infrastructure investment. A summary of the relative merits of strategies available in priority order is outlined in Appendix F.

37 Nous Group & SKM, 2007

The key technologies that could contribute to emission reductions in the City of Melbourne and which will be scoped include:

- large-scale wind (in industrial areas and potentially in Port Phillip Bay)
- district combined heat and power (sited in a new development and feeding new and existing developments)
- localised combined heat and power (sited as part of a precinct energy approach)
- micro wind (sited on suitable high-rise buildings)
- waste to energy (subject to discussions with other councils and the Victorian Government)
- solar photovoltaic (on residential developments and other suitable sites).

To assist in the implementation of the decarbonising the energy supply stream of this strategy, the City of Melbourne will investigate and consider establishing an arms-length agency with appropriate legal and financial powers to:

- act as a development proponent, where appropriate, and commission energy infrastructure
- manage interaction with energy retailers and distributors
- own energy infrastructure as appropriate
- attract investment to support the implementation of specific technologies as appropriate.

The agency could also undertake the administrative functions to support other streams of this strategy in the residential, commercial sectors and passenger transport.

5.6.3 Next steps for implementation

To complete the steps necessary for implementation, the City of Melbourne will work with the CCI and State Government to:

- fund/carry out the necessary range of capacity, scoping and feasibility studies
- develop a detailed strategic spatial plan for decentralised energy systems in the City of Melbourne.
- consider the most appropriate mechanism for delivery and operation of feasible technologies.

Supporting information

Decentralising the City of Melbourne's energy supply inherently requires multiple strategies to be pursued, as no single decentralised energy supply will on its own make sufficient inroads into the energy mix used across the municipality.

For action to occur, it will be important to address each decentralisation strategy in order of priority, according to the speed with which they can be implemented, the relative carbon impact of each strategy and their capacity to attract market investment. Key actions to pursue these strategies are detailed in Appendix F and outlined below.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

Large-scale wind

There is potential for some contribution from wind turbines within the City of Melbourne, and possibly even in Port Phillip Bay. In order to progress this strategy, the following would need to occur:

- a wind map/capacity study focusing on industrial lands, Port Phillip Bay, the Yarra River and other under-used land in inner Melbourne to identify suitable sites
- ensure appropriate zoning arrangements for land with high potential
- agree with neighbouring councils and the Victorian Government on sites to be prioritised for wind resource.

District combined heat and power

It is feasible to plan for a large gas-fired combined CHP plant that could provide enough heat and power to offset about half of the commercial sector's emissions (after other demand reduction measures have been taken into account).

A system of this nature could be designed to run initially on natural gas, but in the future using biomass feedstock. In order to progress this strategy, the following would need to occur:

- a study to identify potential sites for a large-scale (over 100MW) CHP system in Melbourne's industrial lands and liaison with energy distributors over grid constraints and opportunities to bolster grid resilience against dips in supply
- as part of the study, identify current and proposed developments that have day/night heating, cooling and power loads which could match to a CHP system, and the relative build times for the CHP infrastructure relative to developments
- an economic analysis identifying capital and recurrent costs, risks, net present value and investment potential.

Localised combined heat and power

Alternatively, a more localised approach to CHP could be adopted, where smaller systems designed to meet heat and power loads in individual buildings or blocks could be investigated. In order to progress this strategy, the following would need to occur:

- a study to identify suitable locations where several heating and cooling loads could be matched to a precinct supply (for example commercial/rental/residential or university/hospital)
- establish a Smart Energy Zone over priority sites and work with building owners on a collective investment strategy
- review building regulations to identify barriers to building owners installing localised CHP
- as part of a siting study, identify critical city infrastructure that could be made more resilient by being linked to a private wire network for electricity supply from CHP.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

Micro wind

Micro wind turbine generators do not in themselves significantly reduce the carbon emissions of a business or building (typically less than one per cent). But if a strategy was adopted of installing micro wind turbines on all of Melbourne's tall buildings, this would collectively contribute considerably to carbon reductions. In order to progress this strategy, the following would need to occur:

- a study to identify which buildings would be suitable for micro wind applications
- require all new developments to include a proportion of on-site renewable or low-carbon energy supply (so-called Merton Rule)
- establish Smart Energy Zones within the central business district and target building owners within this zone to reduce energy use and displace a percentage of energy use with local supply
- encourage building owners to participate through incentives such as recognition events
- an economic analysis to determine net present value of micro wind generation.

Waste to energy[38]

Waste to energy technology includes pyrolysis, anaerobic digestion and biomass boiling. While the treatment of waste currently occurs outside of the City of Melbourne's boundaries, responsibility for emissions arising from waste lies with the City of Melbourne under international greenhouse reporting protocols.

It is logical, however, for this strategy to be carried out in conjunction with other councils to optimise the benefit of investment. A trial CHP system is planned for installation in an outer Melbourne municipality, which will provide valuable information on technology performance and process issues including working with the local energy distributor.

Ways of optimising the energy content of waste while reducing harmful emissions will be explored, including:

- a study to track commercial and industrial waste to determine the percentage of the carbon/methane resource being under-used, including scoping the potential biomass load from parks and from combined waste, which could be used in biomass boilers or pyrolysis (and available feedstock from elsewhere)
- an options analysis of the best approach to optimise the carbon/methane value of commercial, industrial and municipal waste in greater Melbourne
- identification of suitable locations for a pyrolysis/anaerobic digestion plant within greater Melbourne
- regulatory powers to require commercial and industrial waste collection and treatment processes to optimise the carbon/methane value of waste.

Solar photovoltaic

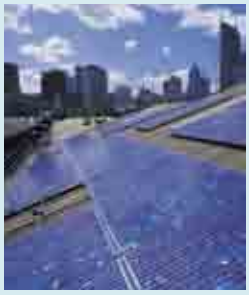
The City of Melbourne already has a record of supporting photovoltaics, having installed the southern hemisphere's largest array of photovoltaic cells at Queen Victoria Market. While photovoltaics are comparatively low efficiency, they are an effective visual signal to consumers that energy is being generated through clean sources. In order to progress this strategy, the following would need to occur:

- carry out a net present value assessment to determine whether a commercial or a break-even approach to installing PV on residential developments is viable over the life of *Zero Net Update 2008* (for example through an energy performance contracting mechanism operated by City of Melbourne or commercially)
- encourage the Victorian Government to honour its commitment to the introduction of net-metering to support local generators to reap the full financial benefit of electricity generation.

38 WMAA, 2003

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

Queen Victoria Market



Solar Energy

Launched in April 2003, the Queen Victoria Market Solar Energy system is the largest grid-connected solar photovoltaic in the southern hemisphere.

It has the capacity to generate 252,000 kilowatt-hours of electricity each year - enough to power 46 average sized homes for a year!

Real time information on how the solar installation is performing is displayed on an information board outside the food court on Queen Street.

To view real-time data on the web please visit

www.melbourne.vic.gov.au/qvm

Governance structure

This *Zero Net Update 2008* has included a review of climate change strategies in cities around the world, revealing that most city governments, regional and local authorities have established a range of institutional mechanisms to drive the implementation of specific measures.

Institutional mechanisms enable governments to ensure their climate change plans are fit-for-purpose and are often required because existing institutional mechanisms were not designed to tackle climate change which requires a range of specific actions and strategies.

Implementation of this decarbonising strategy will require the City of Melbourne to consider an appropriate legal and financial structure that is fit-for-purpose. It will also require detailed negotiations with a range of potential partners: the Victorian Government, neighbouring councils, landowners, developers and potential investors. Substantial investment will be needed.

Economic analysis

Much of the work proposed as part of decarbonising the City of Melbourne's energy supply requires an economic analysis to determine whether particular technologies can be implemented via market mechanisms. It is beyond the scope of this *Zero Net Update 2008* to undertake such an analysis, and indeed much of the economic landscape will change within the next 12 to 24 months as the National Emissions Trading Scheme is established and the new Mandatory Renewable Energy Target starts to impact on the supply chain for renewables.

The principle of least-cost measures becoming cost-effective first will apply and this is illustrated in Figure 13.

The relative price of carbon and energy will largely be determined by where the cap is set by government in relation to total emissions, and therefore the extent to which carbon certificates deriving from different abatement measures come on to the market. In other words, high-cost measures may never become price competitive, whereas low-cost measures are likely to always be price competitive.

A basic economic assessment has been developed to provide an indicative guide for how measures will be assessed in economic terms over the next 12 months. This is detailed in Appendix E.

5. A ROADMAP FOR EMISSIONS REDUCTIONS TO 2020

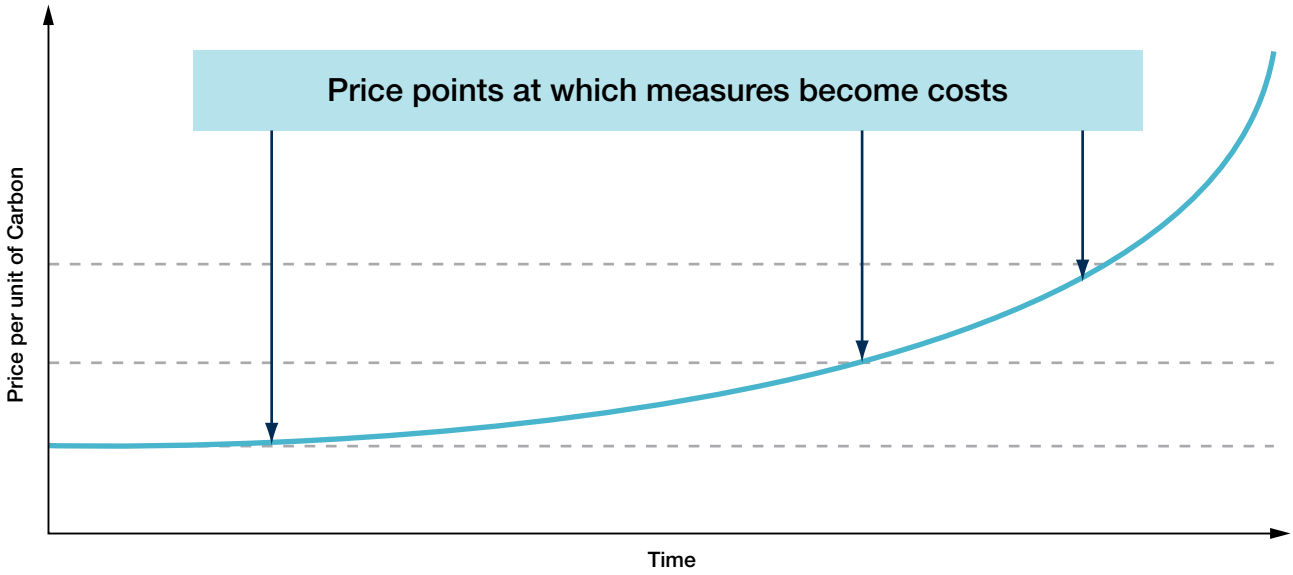


Figure 13: Principle of least-cost measures

Barriers

The City of Melbourne faces a range of barriers to tackling energy at the source. These include:

- lack of an obvious institutional mechanism to complete the steps necessary to decarbonise the energy supply (from negotiating with energy distributors through to packaging up proposals to attract investment)
- the historical reluctance of energy retailers and distributors to make allowances for a more distributed energy network as opposed to a centralised one
- the lack of industry experience in Australia to explore CHP on a large scale
- uncertainty of outcomes and the difficulty this will pose for investors should these options be considered as commercial propositions.

6. CONCLUSION

Zero Net Update 2008 repositions the City of Melbourne as a national and international leader in carbon strategy. However, the council cannot achieve this vision alone.

Residents, employees, businesses, institutions and other levels of government all have a part to play in creating Melbourne's low-carbon future. The need to act fast is not a matter of choice but one of necessity. Expert analysis is now pointing to a very narrow timeframe for global action if climate change is to be contained.

Globally the rate of carbon emissions continues to increase and this trend is reflected in the growth of community emissions within the City of Melbourne.

In this context, the City would be failing in its duty to the community if it did not try to exploit every opportunity to reduce emissions from activities that occur within its boundaries.

Zero Net Update 2008 ensures that implementation strategies remain appropriate for the task at hand. It sets out a vision for achieving zero net emissions by 2020 and clearly defines how the vision will be reached by incorporating several approaches that have been committed to by other leading international cities.

Many of the challenges set out in *Zero Net 2003* have already been addressed, giving the City of Melbourne renewed confidence it can also meet its new goals and achieve the overarching aim of deep carbon reductions.

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APPENDIX A. ZERO NET EMISSIONS BY 2020 ACTIONS IMPLEMENTATION

a) Leading edge design

	Action	Implementation status	Comment
1	Create a showcase out of the City of Melbourne's administration building current procedures by 2005.	Achieved	CH2 opened in August 2006 and has a 6 Star Green Star rating from the Green Building Council of Australia (GBCA). It cost $51 million and the estimated payback period of the sustainable design features will be 10 years.
2	Facilitate tenants/developers into consortia to invest in landmark green building developments.	Partially achieved	No consortium was formed, but the Melbourne Forum has helped encourage many of the recent green building developments.
3	Commit to best practice for the Commonwealth Games Village.	Achieved	The Athlete's Village achieved a 6 Star energy rating, games venues used Green Power, free public transport reduced the use of cars and solar PV panels were installed at the Athletes Village and the MCG.
4	5 Star energy regulation for residential housing by 2003.	Achieved	7 Star is the current international best practice level and it is suggested that the City of Melbourne look to adopt this in the future.
5	New energy regulations for commercial property by 2004.	Achieved	Achieved through the City of Melbourne's C60 Planning Scheme, introduced in December 2005
6	Encourage the Property Council of Australia (PCA) to revise its rating code to include energy efficiency.	Achieved	Guide to Office Building Quality was released by the PCA in May 2006. These criteria grade buildings against Green Star and the Australian Building Greenhouse Rating Scheme (ABGRS).
7	Accelerate approvals for green buildings and environmentally sustainable development (ESD) features.	Partially achieved	Used in the approval of the QV and Southern Cross developments but used little since.
8	Introduce mandatory energy modelling for buildings greater than 5,000 sq m.	Achieved	Achieved through the City of Melbourne's C60 Planning Scheme, introduced in December 2005.
9	Introduce a procurement scheme for green offices.	Not achieved	A commercial opportunity exists for a service such as this. The Your Building website and the GBCA offer some information on this topic but many companies still experience difficulties in sourcing green products in Australia.
10	Establish a green building 'learning hub' as part of a Global Centre of Greenhouse Expertise and Technology.	Not achieved	No formal centre has been established. The City of Melbourne could add value to its reputation by holding a roundtable information-sharing exercise with some of the universities that have been showing leadership in this area.
11	Fund design charettes for new buildings.	Achieved	Sustainability Victoria's Commercial Office Building Environment Initiative and Resource Smart Commercial Buildings programs both helped to achieve this objective.
12	Develop an energy assurance scheme for buildings greater than 5,000 sq m.	Achieved	Achieved through the City of Melbourne's C60 Planning Scheme, introduced in December 2005.

APPENDIX A. ZERO NET EMISSIONS BY 2020 ACTIONS IMPLEMENTATION

b) Greening the supply

	Action	Implementation status	Comment
13	Progressively increase the City of Melbourne's use of renewable energy.	Partially achieved	Australian Government renewable energy targets will be greater than those set by the City of Melbourne. The council should continue to increase use of renewable energy.
14	Pass on innovative energy-efficient technologies to the City of Melbourne's Sustainable Investment Fund Independent Board of Trustees.	Partially achieved	The Sustainable Melbourne Fund facilitates this action.
15	Participate in a fuel cell demonstration project.	Not achieved	A fuel cell has been included at 40 Albert Rd but it is recommended that the City of Melbourne incorporate a fuel cell demonstration into its CH1 development.
16	Establish a green supply chain by 2004, using the Green Tick and Greenhouse Challenge standards.	Not achieved	The City of Melbourne's supply chain remains a potent instrument for influencing behaviour within the municipality. Opportunities exist for the council in this area.
17	Participation in a Green Power buying consortium to access green power at the lowest possible price.	Achieved	Strategic Purchasing included Green Power into its tendering process.
18	Better coordination of expertise.	Not achieved	Will be pursued under this strategy.
19	Promote Melbourne's expertise and technologies abroad and assist local firms to attract international investment in sustainable energy technologies.	Not achieved	Will be pursued under this strategy.
20	Support the Victorian Government in encouraging the use of embedded energy, solar hot water and co-generation.	Not achieved	Difficult consumer purchasing decisions are the key barrier to solar hot water. The City of Melbourne could address this as part of the strategy to leverage Australian Government support programs, such as the low-income loans for retrofits. Co-generation is currently being explored by the council in an upcoming study.
21	Support energy retailers and contractors to move to value-added services: examine solar hot water financing as a first step	Not achieved	Will be pursued under this strategy.

APPENDIX A. ZERO NET EMISSIONS BY 2020 ACTIONS IMPLEMENTATION

c) Sequestration

	Action	Implementation status	Comment
22	Establish a city-rural partnering arrangement to invest in a carbon sink.	Not achieved	Will be pursued under this strategy.
23	Invest in blue-Mallee eucalypt plantations as feedstock for renewable power generation, with eucalyptus oil as a by-product.	Not achieved	The Australian Government's commitment to a carbon-trading scheme has made these policies redundant.
24	Establish an investment vehicle for City of Melbourne businesses and residents for commercial offsetting projects.	Not achieved	The Australian Government's commitment to a carbon-trading scheme has made these policies redundant.
25	Link this investment vehicle and a carbon-credit purchasing scheme for tenants as part of the pilot municipal emission trading market.	Not achieved	The Australian Government's commitment to a carbon-trading scheme has made these policies redundant.

APPENDIX B. EMISSION REDUCTION MODELLING AND BENCHMARKING

The emission and energy reductions were modelled under the following key categories:

- residential
- commercial
- decarbonising the energy supply

The general methodology adopted was to determine the total emission reductions achievable, the energy demand reductions achievable and the change in energy demand from electricity sourced from the grid for each strategy within the residential and commercial sector.

Once all the strategies were modelled, the decarbonisation of the energy supply was applied to the residual emissions associated with grid electricity proportionally across all the sectors where the decarbonisation technology is to be applied.

Residential

The residential strategies for existing houses are more prescriptive than for other sectors making detailed modelling of the emission reduction strategies possible.

Strategy	Emission Reduction	Reduction type	Electricity Reduction from Energy Efficiency	Electricity Reduction from fuel switching	Total Electricity Reduction
	kt CO_2-e /year		MWhr/year	MWhr/year	MWhr/year
Space heating	60.5	Electricity to Gas / Electrical Energy Efficiency	9,130	43,345	52,475
Hot water	40.7	Electricity to Gas / Electrical Energy Efficiency	6,150	29,180	35,330
Common areas	21.8	Electrical Energy Efficiency	16,460	-	16,460
Lighting	9.5	Electrical Energy Efficiency	7,170	-	7,170
Appliances	2.0	Electrical Energy Efficiency	1,525	-	1,525
Total	**134.6**	**Various**	**40,435**	**72,525**	**112,970**

For new residential homes constructed to a 7 star standard and an eight per cent emission reduction was assumed. This factor was applied uniformly across all fuel types resulting in an eight per cent reduction in electricity use for new homes compared to existing homes. The final emission and energy targets for residential before applying decarbonisation strategies are presented below.

APPENDIX B. EMISSION REDUCTION MODELLING AND BENCHMARKING

Residences	Emissions	Energy	Electrical Energy (from grid)
	kt CO_2-e /year	MWhr/year	MWhr/year
Existing Residences	552	1,040,210	300,240
Existing Residences (with measures)	418	1,015,053	187,272
New Residences (with measures)	168	251,272	103,342
Total (with Measures)	**585**	**1,266,326**	**290,614**

Commercial

The strategies adopted for commercial buildings require the retrofitting of existing commercial buildings to achieve ABGR targets or percentage reductions and do not prescribe any specific reduction measures. For modelling purposes it was assumed that all these reductions are a result of energy efficiency measures which reduce the amount of electricity sourced from the grid. The resulting emission and energy reductions were then subtracted from the projected commercial total to produce the commercial target

Strategy	Emission Reductions	Electrical Energy Reduction
	kt CO_2-e /year	GWhr/year
Commercial office buildings retrofit	383	289.1
Commercial office buildings new build	163	123.0
Education, health and community	57	43.0
Hotels retrofit	83	62.7
Hotels new build	103	77.9
Retail and wholesale retrofit	78	58.9
Retail and wholesale new build	137	103.4
Total	**1,004**	**757.9**

The final emission and energy targets for the commercial sector before applying decarbonisation or offsetting strategies are presented below.

Strategy	Emissions	Energy	Electrical Energy (from grid)
	kt CO2-e/year	GWhr/year	GWhr/year
Total 2020 (with Measures)	2,975	3,446.5	1,233.1

APPENDIX B. EMISSION REDUCTION MODELLING AND BENCHMARKING

Industrial

The industrial sector has not been modelled in detail. This is mainly due to the lack of detailed fuel use data available form ABARE to determine the emission intensity of the energy use across these sectors.

A 10 per cent reduction in emissions has been assumed to occur to 2020 based on energy efficiency initiatives or fuel switching to reduce emission intensity.

The reductions achieved in this sector will likely be addressed under other programs of the Victorian and Commonwealth Governments targeting energy efficiency in industry.

Decarbonising the energy supply

Three potential technologies are proposed for decarbonising of the energy supply. However, a number of alternatives may become viable in the future which are able to replace grid-based electricity and achieve similar emission reduction targets.

For the purposes of this strategy, the abatement able to be supplied by the technologies of wind, solar PV and combined heat and power has been modelled.

It was assumed that all solar PV would be installed on residences and would replace grid sourced electricity in the residential sector only. It was further assumed that either district or localised CHP plants would be installed to supply the needs of the commercial sector and transportation systems (heavy and light rail) drawing from the grid.

Finally, it was assumed that large scale wind would supply the grid and would therefore abate emissions across all sectors in proportion to the residual electricity drawn from the grid once all other energy efficiency, fuel switching and decentralised energy supply options had been adopted.

Sector	Wind		Solar PV		CHP	
	Energy Supplied	Emissions Abated	Energy Supplied	Emissions Abated	Energy Supplied	Emissions Abated1
	GWhr/year	kt CO_2-e/year	GWhr/year	kt CO_2-e/year	GWhr/year	kt CO_2-e/year
Residential	4.9	6.6	20.8	27.6	0	0
Commercial	3.8	5.1	0	0	1,025	1,357
Industrial	11.9	15.8	0	0	0	0.0
Transport	0.1	0.2	0	0	32.2	42.7
Total	**20.8**	**27.6**	**20.8**	**27.6**	**1,057.2**	**1400**

Targets

From the modelled emission reductions, targets were set for both energy and greenhouse reductions based on percentage reductions from 2005–06 levels prior to offsetting.

For stationary energy use across all sectors, the strategy sets an absolute target of 3,180 kt CO_2-e per year by 2020 which represents a 35 per cent reduction on 2006 levels. For residential and commercial stationary energy, these were able to be further broken down by emissions and energy use per person and per sector. The targets for energy reductions are shown below for emissions per resident, per dwelling and per commercial employee.

APPENDIX B. EMISSION REDUCTION MODELLING AND BENCHMARKING

Energy Demand					
Baseline/Target	Residential Stationary Energy			Commercial Stationary Energy	
	Total	Per resident	Per dwelling	Total	Per commercial employee
	GWhr/year	MWhr/year	MWhr/year	GWhr/year	MWhr/year
2005-2006 Baseline	1,040	14.6	22.5	3,746	11.3
2020 Target	1,251	11.5	20.3	3,447	8.4
%change	**20.3%**	**-21.5%**	**-9.9%**	**-8.0%**	**-25.2%**

The energy demand is therefore anticipated to decrease on a per resident and per dwelling and per employee basis due to the energy efficiency measures. However, the absolute energy demand for the residential sector is predicted to increase due to the growth in this sector over the period.

GHG Emissions					
Baseline/Target	Residential Stationary Energy			Commercial Stationary Energy	
	Total	Per resident	Per dwelling	Total	Per commercial employee
	kt CO_2-e/year	t CO_2-e/year	t CO_2-e/year	kt CO_2-e/year	t CO_2-e/year
2005-2006 Baseline	552	7.8	11.9	3,235	9.9
2020 Target	554	5.1	9.0	1,659	4.1
% change	**0.4%**	**-34.5%**	**-24.8%**	**-47.7%**	**-58.2%**

The emissions per resident, per dwelling and per employee are anticipated to decrease to a greater extent than energy due to the effects of fuel switching in heating and decarbonising the electricity supply. The total emissions in the residential sector are predicted to slightly increase.

The above baseline calculations imply that a person living and working in the commercial sector in the City of Melbourne currently has a carbon footprint of 17.7 t CO2-e/year and an energy demand of 25.9 MWhr/year for energy use in buildings (non transport). This is comparable with the energy demand reported for London for 1997 of approximately 30 MWhr/year per person (which includes transport originating and terminating in London).

APPENDIX B. EMISSION REDUCTION MODELLING AND BENCHMARKING

Note on 2002 levels

The 2002 levels published in *Zero Net 2003* have been broken down for the commercial and residential sectors based on 2001 census data for comparison with the above.

Baseline/Target	Residential Stationary Energy			Commercial Stationary Energy	
	Total	Per resident	Per dwelling	Total	Per commercial employee
	kt CO_2-e/year	t CO_2-e/year	t CO_2-e/year	kt CO_2-e/year	t CO_2-e/year
2002	112	2.1	3.8	2,212.5	9.8
2005-2006	552	7.8	11.9	3,235	9.9
% change	**393%**	**271%**	**213%**	**46%**	**1%**

Due to the large discrepancies, an analysis of the Victorian data for residential emissions in 2002 was undertaken based on 2001–02 ABARE fuel use data and 2001 census data for Victoria. The per dwelling data for Victoria was then expanded to give the total City of Melbourne residential emissions

Baseline/Target	Residential Stationary Energy		
	Total (CoM)	Per resident	Per dwelling
	kt CO_2-e/year	t CO_2-e/year	t CO_2-e/year
2002 (Zero Net 2003)	112	2.1	3.8
2002 (Victorian average)	≈ 350	4.1	10.47
2005-2006	552	7.8	11.9

This shows the methodology used to estimate the 2002 residential levels may have underestimated the total emissions attributable to residents. When the data sourced from the 2002 Victorian averages is compared to the 2005–06 levels the following conclusions can be drawn:

- The emissions per dwelling for City of Melbourne in 2005–06 is slightly greater than the Victorian averages for 2002 and is likely associated with the greater emission intensity of high rise apartments which are concentrated in the City of Melbourne. It is not clear whether there has been an actual rise in emissions per dwelling since 2002.
- The emissions per resident in the City of Melbourne in 2005–06 is much greater than the Victorian average for 2002. This is likely associated with lower household size in City of Melbourne compared to rest of Victoria.

APPENDIX C. LEADING ACTIONS OF OTHER GLOBAL CITIES

C1.1 Strategies reviewed

The carbon-reduction strategies and commitments from the following major cities were reviewed.

City strategies

- New York City*: *A Greener, Greater New York Plan NYC*
- City of Melbourne*: *City of Melbourne Zero Net Emissions by 2020 Strategy,* 2002
- Greater London Area*: *Action Today to Protect Tomorrow, The Mayor's Climate Change Action Plan*, 2007
- Tokyo*: *Tokyo Climate Change Strategy – A 10 Year Project for a Carbon-minus Tokyo,* 2007
- Manchester City Council: No formal strategy released, but announcement of key elements in February 2008
- Seattle: *Seattle, a Climate of Change: Meeting the Kyoto Challenge*, 2006
- San Francisco: *Sustainability Plan for the City of San Francisco,* 1996
- Wellington: No formal strategy released, but announcement of commitment to carbon neutrality
- City of Vancouver: *Sustainability: The Climate Friendly City, A Corporate Climate Change Action Plan for the City of Vancouver*, 2004
- Vancouver, BC: *Climate Change Strategy*, 1999
- Toronto: *Change is in the Air: Climate Change, Clean Air and Sustainable Energy Action Plan: Moving from Framework to Action Phase 1*, June 2007
- *Cities that are part of the C40 group of cities committed to reducing carbon emissions.

Local government area strategies

- City of Camden (London): *Climate Change in Camden – a Joint Effort, Camden's Climate Change Action Plan 2006-2009*
- Borough of Woking (UK): *Think Globally Act Locally, Climate Change Strategy,* Woking Borough Council

C1.2 Best practice review

Cities and regions around the world are committing to and implementing a range of measures to reduce emissions and which address the barriers that exist. A summary of leading measures categorised in accordance with the Zero Net Update 2008 is outlined on the next page.

APPENDIX C. LEADING ACTIONS OF OTHER GLOBAL CITIES

Mechanism	Residential	Commercial	Energy supply
Planning and building guidelines	**London** Mayor's Supplementary Planning Guide for Sustainable Design and Construction and the London Plan requires comprehensive standards on energy use, lighting, water use, proximity to transport, on-site renewable energy, noise, ecology, materials and other environmental considerations. http://www.london.gov.uk/mayor/strategies/sds/sustainable_design.jsp **San Francisco** building code is to be changed to require at least 80 per cent of all permanent light fixtures in new construction have an efficiency of 20 lumens per watt or greater. **Toronto** has committed to develop new standards that require and regulate green roofs.	**Germany** has introduced a law which requires renovations to meet energy performance standards where the renovation is 20 per cent of the gross floor area. **London** Mayor's Supplementary Planning Guide for Sustainable Design and Construction and the London Plan requires comprehensive standards on energy use, lighting, water use, proximity to transport, on-site renewable energy, noise, ecology, materials and other environmental considerations. http://www.london.gov.uk/mayor/strategies/sds/sustainable_design.jsp **San Francisco** building code is to be changed to require at least 80 per cent of all permanent light fixtures in new construction have an efficiency of 20 lumens per watt or greater. **New York City** is requiring new construction to exceed the energy performance requirements in the building code by 20 per cent and for major renovations to exceed the code by 15 per cent. The City will pursue an aggressive program of upgrades and enforcement of the state energy code. It will also require lighting systems in existing buildings to meet the building code at the point of renovation/retrofit or at change of tenancy. **Woking UK** to include a new 80 per cent reduction target for new development in its next review of its development plan. **Vancouver** has set a 25 per cent target for improvement in energy efficiency in new construction by 2012 on a 2000 baseline.	**London** has put mechanisms in place to promote the uptake of on-site renewable energy (20 per cent target with all new development). Aims to decentralise the energy supply by 25 per cent by 2025 and the majority by 2050. **San Francisco** has committed to develop a plan to obtain 25 per cent of the city's electricity needs from green energy sources over a four-year phase-in period starting in 2008. **Camden** has committed to investigating a focus on decentralised energy solutions to achieve 60 per cent cuts in carbon emissions, supported by a range of infrastructural and administrative measures.
Zoning and planning requirements	**London** has established Energy Action Areas to act as spatial catalysts for renewable energy and low-carbon technologies. **Victoria** has launched Smart Energy Zones as a similar program.	**London** has established Energy Action Areas to act as spatial catalysts for renewable energy and low-carbon technologies. **Victoria** has launched Smart Energy Zones as a similar program. **San Francisco** has committed to establish Solar Enterprise Zones in two districts within the city	**London** has established Energy Action Areas to act as spatial catalysts for renewable energy and low-carbon technologies. **San Francisco** has committed to establish a simplified permit process for renewable energy systems, such as solar photovoltaics; to establish Solar Enterprise Zones in two districts within the city; and to develop a solar access ordinance. **Toronto** has committed to create permissive regulations for district-based energy distribution between multiple properties.

APPENDIX C. LEADING ACTIONS OF OTHER GLOBAL CITIES

Mechanism	Residential	Commercial	Energy supply
Onsite and locally sourced renewables	The Mayor of **London** has set a new target for all new development to include a 20 per cent contribution to energy use from on-site renewables. **San Francisco** has committed to every residential building becoming a 'renewable energy provider'. **Manchester City Council** is to introduce district heating schemes for 20,000 households using heat and fuel derived from biomass material (30,000 tonnes). **Manchester City Council** has set a requirement for 20 per cent of final energy demand in new development and major refurbishments to be met from renewables, saving the City 50,000 tonnes in emissions. **Tokyo** has committed to roll-out a photovoltaic program for its residents	The Mayor of **London** has set a new target for all new development to include a 20 per cent contribution to energy use from on-site renewables. **San Francisco** is committed to decrease energy use in municipal and commercial buildings by 50 per cent through conservation and use of on-site renewable resources. **Manchester City Council** is committed to 10 per cent of businesses introducing combined heat and power units and micro generation schemes, reducing emissions by a total of 30,000 tonnes. **Manchester City Council** has set a requirement for 20 per cent of final energy demand in new development and major refurbishments to be met from renewables, saving the City 50,000 tonnes in emissions. **Toronto** has committed to establish an Eco-Roofs program to make a minimum of 10 per cent of the total industrial, commercial and institutional roof spaces more environmentally friendly by 2020.	**London** has established a Climate Change Agency to enhance the roll-out of combined cooling, heat and power through new development and existing development; is committed to rapid development and delivery of waste-to-energy mechanisms (not including mass burn); and to pursuing large-scale renewable power generation in London e.g. wind turbines sufficient to power 47,000 households. **New York** has committed to pilot one or more technologies for producing energy from waste and end methane emissions from sewage treatment plants and expand the use of digester gas, and consider expansion of gas capture and energy production from landfill gas. **San Francisco** has committed to initiate demonstration projects that use solar, wind, ocean and/or biogas as energy sources. **Manchester** has committed to the creation of 20 large wind turbines in or around Manchester (abating 150,000 tonnes CO2). **Toronto** has committed to including 1500 city buildings and landfill sites to be included in an Expression of Interest for on-site renewable energy systems. **Woking UK** has established a 200 kW fuel cell project. **Camden UK** has committed to investigate establishing an energy services company to manage the approach to decentralised energy.

APPENDIX C. LEADING ACTIONS OF OTHER GLOBAL CITIES

Mechanism	Residential	Commercial	Energy supply
Mandatory energy and reporting labelling	The **UK** Code for Sustainable Homes sets mandatory rating standards for all new homes at point-of-sale, with rating criteria including energy and CO_2, water, materials, surface water run-off, waste, pollution, health and wellbeing, management and ecology. http://www.communities.gov.uk/publications/planningandbuilding/codesustainabilitystandards. **San Francisco** has committed to introducing mandatory point-of-sale information on energy performance of residential development.	**San Francisco** has committed to revive, strengthen and enforce mandatory point-of-sale information on energy performance of commercial development under its Commercial Energy Conservation Ordinance for existing buildings.	
Mandatory auditing	The **UK** has a requirement for all social housing dwellings to meet minimum 'decent homes' standards. A key component to meeting the standard is an audit of all building stock and the application of an energy performance rating.	**New York** has committed to make mandatory by 2015 benchmarking and retro commissioning or audit/retrofit (where payback measures are guaranteed within five years). San Francisco has committed to conduct a baseline survey of CFC-based cooling and refrigeration equipment in the city.	

APPENDIX C. LEADING ACTIONS OF OTHER GLOBAL CITIES

Mechanism	Residential	Commercial	Energy supply
Utility demand-side management and voluntary auditing	**London** Green Concierge Service offers households a bespoke auditing and retrofit service to reduce energy use (can be linked to mandatory reduction programs on utilities). **Camden UK** is considering establishing a proactive on-site/door-to-door energy audit and advice service. **NSW** 'Big Switch'[39] is a recent a house-by-house auditing approach to individual householders in the Wollongong area to provide bespoke solutions. The scheme, which was presented to householders as a household emissions saving competition, was subsidised by the NSW Government. **Victoria** the Victorian Government carried out audits on over 3000 low-income households in 2006 and found that savings could be made of 15 per cent on average household energy use.[40]	**London** has committed to establish the Green Organisations Program which includes a Better Buildings Partnership to upgrade commercial buildings through routine refurbishment in partnership with building owners. **Manchester** has committed to establish a Building Engagement in Energy Demand Reduction program with a target to reduced emissions by 100,000 tonnes. **Toronto** has committed to establish an Enviro-Business Working Group to create a comprehensive efficiency and improvement program.	
Large-scale retro com-missioning and Energy Performance Contracting	**New York City** has established a program for energy efficiency upgrades of large residential buildings using energy performance contracts that enable a guarantee of energy savings over a period of time in exchange for the implementation of energy efficiency and other improvements.	**New York City** has established a program for energy efficiency upgrades for large commercial and industrial buildings greater than 100,000 square feet with a target of 30 per cent reduction in emissions from buildings and operations by 2017. **Vancouver** has set a 20 per cent improvement in energy efficiency target for 25 per cent of medium to large commercial buildings through retrofits, equipment replacement and operator training, and a 15 per cent improvement in the energy efficiency of 20 per cent of smaller commercial buildings.	

39 Big Switch http://www.bigswitch.com.au/home.html
40 DPI 2007

APPENDIX C. LEADING ACTIONS OF OTHER GLOBAL CITIES

Mechanism	Residential	Commercial	Energy supply
Smart meters	**New York** and **San Francisco** introduced smart meters to provide a two-way flow of information in real time on energy pricing and consumption to enable the consumer to tailor their behaviour to least-cost outcomes.	**New York** and **San Francisco** introduced a requirement for smart meters in all new buildings to provide a two-way flow of information in real time on energy pricing and consumption to enable the consumer to tailor their behaviour to least-cost outcomes.	
Capital subsidies, grants and subsidised loans	**Seattle** has established a Neighbourhood Climate Protection Matching Fund to promote and help finance neighbourhood-based climate protection projects. **Tokyo** has committed to revitalise the solar thermal market. **Vancouver** has committed to connect householders to the resources required to facilitate behavioural change. **Camden** is to explore options to create incentives for energy efficiency measures in households. **Manchester** is to offer incentives for the uptake of solar hot-water heating and micro-generation to all existing homes. **San Francisco** is to subsidise a number of programs assisting low-income households including weatherisation and lighting. **New York City** has committed to a range of financial incentives for residents to reduce energy use. **London** has offered subsidies on the installation of insulation.	**San Francisco** has committed to facilitate small-business access to loan and rebate programs for energy efficiency services. **New York City** has committed to a system of graduated incentives for higher energy savings and environmental performance for Gold or Platinum LEED equivalent with superior energy and water savings.	**New York** has committed to foster the market for renewable energy and increase the use of solar energy in buildings through creative financing via long-term contracts let by the City. **San Francisco** has committed to establish incentives for projects that increase energy resources with solar, wind, ocean, and/or biogas energy; to remove disincentives for utility buy-back of renewable energy; and to dedicate 50 per cent of the utility franchise fee to the promotion of energy efficiency and renewables. **Camden UK** has committed to investigating the establishment of a 250,000 pounds sterling fund as a revolving energy fund.

APPENDIX C. LEADING ACTIONS OF OTHER GLOBAL CITIES

Mechanism	Residential	Commercial	Energy supply
Taxation	**San Francisco** has committed to establishing a revenue-neutral property transfer tax to provide matching funds for energy-efficiency improvements.	**Tokyo** is considering establishing an energy efficiency tax promotion system. San Francisco has also committed to lobby for state tax laws to discourage waste and encourage efficiency, such as a revenue-neutral carbon tax, and to investigate the opportunities for a regional carbon tax.	**New York** has committed to create a property tax abatement for solar panel installations.
Cooperative procurement	**San Francisco** is to set up groups of residents to bulk-buy energy efficiency measures. **Clinton Climate Institute in cooperation with C40 Cities** has committed to develop buyers' groups globally to increase economic efficiencies for low-carbon technologies.	**Toronto** is to organise a Green Vendors Fair for providers of products and services that improve the energy performance of buildings in all major building sectors. **Clinton Climate Institute in cooperation with C40 Cities** has committed to develop buyers' groups globally to increase economic efficiencies for low-carbon technologies. **San Francisco** is to create pools with other local governments for the purchase of energy efficient and renewable technology products and services.	**Tokyo** has committed to establish a green energy purchasing network.
Training for energy technology installers, plumbers, electricians and builders	**San Francisco, New York City and London** are establishing training programs for industry players.	**San Francisco, New York City and London** are establishing training programs for industry players.	
Appliance standards	**Tokyo** has committed to ban incandescent globes.	**Tokyo** has committed to ban incandescent globes. **New York** is to establish a system of incentives to encourage the purchase of highly efficient models of appliances, electronics and air conditioners, as well as incentives for retailers and wholesalers to stock more efficient products.	

APPENDIX C. LEADING ACTIONS OF OTHER GLOBAL CITIES

Mechanism	Residential	Commercial	Energy supply
Awareness raising, education, information and campaigns	**London** has established London Leaders, to provide leadership on making London a sustainable world city through the actions of everyday Londoners. **New York City** has committed to a series of targeted campaigns aimed at schools, buildings and trades and press campaigns. **San Francisco** has committed to develop outreach programs that use multiple media such as telephone books (an energy page), print and broadcast advertisements and websites. **Vancouver** has created a comprehensive community engagement plan to empower, connect and engage the community and partner in reducing greenhouse emissions.	**London** has committed to establish a green organisations' badging scheme to work with private and public tenants to reduce emissions through behaviour change and improved building operations with targets linked to badging. London will also establish a lobbying campaign to focus on key barriers to the uptake of energy savings and clean energy. **San Francisco** has committed to conduct a global campaign about the city's energy successes. As well, the city plans to target tourists by highlighting businesses that practise sustainable energy. **Seattle** is to run a campaign to encourage all 10,000 city employees to reduce climate pollution on the job and at home. **Camden UK** has established a Better Climate for Camden Scheme that provides detailed advice to businesses and has developed 'Green Office Surgeries'. **Woking UK** has introduced a local awards scheme for sustainable developments.	
Infrastructure			**New York** has committed to facilitate the re-powering and construction of power plants and dedicated transmission lines, expand clean distributed generation, and modernise grid infrastructure. **Woking UK** has established a private wire network for heating and cooling.

APPENDIX D. DATA METHODOLOGY

Overview

The general approach adopted in the preparation of the City of Melbourne's Community Greenhouse Gas Inventory groups emissions under the standard categories specified by the International Panel on Climate Change (IPCC), which are adopted for reporting of the national and state level inventories.

However, the City of Melbourne requires data further disaggregated by the end-use sector to understand the emissions associated with specific activities and to facilitate a greenhouse gas emission reduction policy.

Due to lack of data at the local scale, the community inventory generally takes a top-down approach, firstly determining emissions at a wider geographical scale (Australia, Victoria, or Melbourne Statistical Division) and then assigning a percentage to City of Melbourne based on the most appropriate indicator.

Where sufficiently local data was available, this was used as the preferred method to develop a bottom-up approach.

Stationary energy

D1.1 End-use emissions on Victorian scale

Emissions associated with the stationary energy sector were calculated by end-use within each economic sector on an all-of-Victoria level due to a greater degree of data availability aggregated at the state level.

ABARE publishes state-based energy use by fuel type for each sector (under ANZSIC, 1993). The most recent year of data was 2005–06 which then set the inventory year for all subsequent calculations.

The ABARE data was used to calculate emissions attributable to energy by each fuel type within each sector. This approach is similar to that adopted for the preparation of the Victorian Greenhouse Gas Inventory (VGGI) by the Department of Climate Change. However, for the purposes of this study, it was important to only include emissions associated with end-use within Victoria.

Sustainability Victoria commissioned George Wilkenfeld & Associates to produce a comprehensive report on end-use allocation of emissions in Victoria for the 2005 inventory (GWA 2008). This report was used to cross check the end-use emissions on the Victorian scale and source the most accurate full fuel cycle emission factors for Victoria for the inventory year.

These account for emissions associated with extraction production, transmission and distribution. This approach allows energy use reported for the sectors involved in fuel extraction, fuel production, transmission and distribution to be omitted from the emission calculations.

Therefore energy associated with fuel extraction, power generation and fuel production for energy forms that were ultimately exported from Victoria was not included. It is for this reason that the VGGI data by ANZSIC category could not be directly used for the stationary energy sector for the purposes of this study.

For some sub-sectors, ABARE fuel-use data is not reported separately and is aggregated at either the sector level, total Victorian or Australian level. This particularly impacts on the calculations for end-use by the manufacturing sector to the extent that for these categories, the ABARE data could not be used. In these instances the data reported by GWA for these sectors was used.

Furthermore, the GWA report reallocates the emissions between the commercial and residential sectors, resulting in an increase in the commercial sector and decrease in the residential sector compared with the ABARE data. This is explained as below:

"Detailed bottom-up modelling by Energy Efficient Strategies (EES 2008) estimates significantly lower consumption of electricity than was reported by ABARE for the period 2002–05. The EES and ABARE trends for residential electricity use are very close from 1990 to 2002, but diverge sharply in 2003, and in 2005 the EES estimate was 14 per cent lower than the ABARE trend). Residential electricity sales forecasts by Victoria's electricity distributors compiled by the Essential Services Commission (ESC) are very close to EES's projections.

As the residential sector end-use breakdown in the present report is based on the EES study, the EES electricity estimates are used in preference to the ABARE estimates. However, it is likely that the ABARE estimates of total Victorian electricity consumed are correct, because they can be checked against NEMMCO and ESAA data.

Therefore the electricity removed from the residential sector must be reallocated elsewhere. The most likely sector is the commercial sector, where the ABARE data show a complete cessation of growth after 2002. There is no obvious reason why this should have been so – the economic output of the commercial sector continued to increase at a roughly constant rate from 2000 to 2005.

The conclusion is that there is a high probability that ABARE misallocated some of the electricity use in the commercial sector to the residential sector in the period 2003–05, and this has been adjusted for the present study."

D1.2 Determine end-use emissions on City of Melbourne scale

Once the estimate of end-use allocation of Victoria's 2005-06 emissions had been produced, the percentage of Victoria's emissions for which the City of Melbourne community was responsible was determined for each sector.

This was achieved using an appropriate indicator depending on sector characteristics. The indicators were chosen based on their correlation to emissions and more importantly the availability of indicator data on both the Victorian and City of Melbourne scale. The indicator selection process for each sector is further detailed under the relevant sector headings below.

D1.3 Residential

For the residential sector, the total emissions for Victoria could be calculated from the ABARE energy used data for this sector and full fuel cycle emission factors.

The indicator used for this sector was based on the number of each type of dwelling (Class 1, Class 2 Low Rise, Class 2 High Rise) weighted by the average emission intensity of each of these dwelling types.

APPENDIX D. DATA METHODOLOGY

Building Class	Vic Dwellings (a)	Emission Intensity Factor [41] (b)	Vic Emissions (a) x (b)	City of Melbourne Dwellings as a % of Vic Dwelling by Dwelling Type (c)	City of Melbourne Emissions as a % of Vic Residential Emissions (a) x (b) x (c)
Class 1	89.50%	0.99	88.4%	0.40%	0.35%
Class 2 LR (<3 storey)	2.80%	0.74	2.1%	11.72%	0.25%
Class 2 HR (>3 storey)	7.70%	1.23	9.5%	21.48%	2.04%

This assumes that the energy-use profile in the average City of Melbourne dwelling is the same as for the whole of Victoria. In reality, gas may constitute a higher proportion of energy use within City of Melbourne dwellings, which may have resulted in a slight overestimation of the emissions associated with the City of Melbourne's residential sector.

D1.4 Commercial

For the combined commercial sector, the total emissions for Victoria could be calculated from the ABARE 2005-06 energy use data and full fuel cycle emission factors. The commercial sector ABARE data includes the combined fuel use for the following ANZSIC 1993 divisions:

- wholesale trade
- retail trade
- accommodation, cafés and restaurants
- communication services
- finance and insurance
- property and business services
- government administration and defence
- education
- health and community services
- cultural and recreational services
- personal and other services.

To further disaggregate the 2005 Victorian end-use emissions by commercial division, the 1999 end-use allocation breakdown (GWA, 2002) was then used to distribute the Victorian 2005–06 commercial emissions total amongst sub-sectors as shown below.

Wholesale and Retail Trade	37.7%
Finance, Insurance, Property and Business Services	16.5%
Communication	3.5%
Government Administration and Defence	13.6%
Education, Health and Community Services	14.9%
Accommodation, Cultural and Personal Services	13.8%
Total Commercial	100%

The GWA report for the 2005 end-use allocation does not provide this breakdown of emissions by subdivision. This is because the ABARE data has been further aggregated since the previous report was done, making such analysis impossible.

This methodology assumes that:

- the growth in each commercial sector in Victoria between 1999 and 2005–06 was the same; and
- the relative emission intensity of these sectors within Victoria has not changed over this time.

41 GWA, 2007

APPENDIX D. DATA METHODOLOGY

For each commercial sub-sector, an indicator was developed to assign a proportional quantity of Victoria's emissions to the City of Melbourne. A number of indicators were considered including floor area, contribution to GRP and number of facilities.

However, due to data availability, the number of employees for each sector was selected to be the most appropriate indicator.

The study therefore assumes that the emissions in each sub-sector are directly attributable to the number of persons employed in that sub-sector. This would result in inaccuracies if there were gross operational differences between facilities operating in each sub-sector affecting employment numbers.

However, Victoria is considered an adequately refined boundary and the sectors adequately disaggregated to avoid such gross differences.

	Vic Commercial Emissions (a)	City of Melbourne Employment as a % Vic Employment by Sector (b)	City of Melbourne Emissions as a % of Vic Total Commercial Emissions (a) x (b)
Wholesale and Retail Trade	37.7%	7.21%	2.72%
Finance, Insurance, Property and Business Services	16.5%	9.74%	1.61%
Communication	3.5%	31.56%	1.10%
Government Administration and Defence	13.6%	36.23%	4.93%
Education, Health and Community Services	14.9%	13.34%	1.99%
Accommodation, Cultural and Personal Services	13.8%	33.08%	4.57%
Total Commercial	**100%**	**12.79%**	**16.9%**

A further data challenge in determining employment-based indicators is the way in which employment numbers are categorised on the City of Melbourne scale and Victoria scale.

For the City of Melbourne, the new ANZSIC 2006 categories are used, whereas the ABARE fuel-use data is only available under the ANZSIC 1993 categories. To enable comparison, the City of Melbourne CLUE employment data was re-categorised into 1993 sectors.

A complete re-categorisation exercise requires details of each business down to the four-digit ANZSIC sub-sector level. The complete CLUE employment data set can only be provided at the two-digit level due to confidentiality reasons. Therefore the re-categorisation may have resulted in some inaccuracies which are not likely to have significantly affected the results. In future years the ABARE data should be published according to ANZSIC 2006 categories, which will make this process easier.

APPENDIX D. DATA METHODOLOGY

D1.5 Industrial

Manufacturing

For the manufacturing sectors, the total emissions for Victoria were sourced from the GWA, 2008 report and further distributed amongst sub-sectors as shown below.

Food, beverages, tobacco	8.9%
Textiles, clothing, footwear	1.7%
Wood, paper and printing	8.3%
Chemicals	11.0%
Non-metal mineral products	4.3%
Iron and steel	7.4%
Non ferrous and other metal products	53.8%
Machinery, equipment and other	4.7%

For each manufacturing sub-sector, an indicator was developed to assign a proportional quantity of Victoria's emissions to the City of Melbourne. Due to data availability, the number of employees for each sector was selected to be the most appropriate indicator. The study therefore assumes that the emissions in each sub-sector are directly proportional to the number of persons employed in that sub-sector. This would result in inaccuracies if there were gross operational or level-of-automation differences between facilities operating within each sub-sector affecting employment numbers. However, Victoria is considered an adequately refined boundary and the sectors adequately disaggregated to avoid such gross differences.

	% Vic Manufacturing emissions (a)	City of Melbourne employment as a % Vic employment by sector (b)	City of Melbourne emissions as a % of Vic total manufacturing emissions (a) x (b)
Food, beverages, tobacco	8.9%	3.51%	0.31%
Textiles, clothing, footwear	1.7%	1.85%	0.03%
Wood, paper and printing	8.3%	2.82%	0.23%
Chemicals	11.0%	7.14%	0.79%
Non-metal mineral products	4.3%	4.55%	0.20%
Metal products	7.4%	1.20%	0.08%
Non ferrous and other metal products	53.8%	0%	0.00%
Machinery, equipment and other	4.7%	11.92%	0.56%

APPENDIX D. DATA METHODOLOGY

A further data challenge in determining employment-based indicators is the way in which employment numbers are categorised on the City of Melbourne scale and Victoria scale. For the City of Melbourne, the new ANZSIC 2006 categories are used, whereas the ABARE fuel-use data is only available under the ANZSIC 1993 categories.

The City of Melbourne employment data has been re-categorised to allow for the indicator to be developed. In future years the ABARE data should be published according to ANZSIC 2006 categories, which will make this process easier.

Non-energy mining

For the non-energy mining sector the total emissions for Victoria were sourced from the GWA 2008 report.

The non-energy mining sector emissions were then allocated to the City of Melbourne based on employment data. The City of Melbourne CLUE data set identifies an unexpectedly high number of employees in the non-energy mining sector.

This is likely due to the number of office-based services to mining based in the local government area (LGA) which are included in the non-energy mining 1993 ANZSIC category.

Emissions per employee in this sector are relatively high due to the emission intensity of on-site mining activity and therefore may represent an overestimation of the emissions attributable to the City of Melbourne. However, there is an argument that the support services located in the City of Melbourne do have some control over the on-site mining emissions and therefore should be reported in this way.

Agriculture

For the combined agricultural sector, the total emissions for Victoria could be calculated from the ABARE 2005–06 energy use data and full fuel cycle emission factors. These emissions were then attributed to the City of Melbourne based on employment numbers.

Employment in the agricultural industry within the City of Melbourne is largely limited to small-scale nurseries and horticulture as well as a number of agricultural, fishery and forestry support services. Emissions per employee in this sector as a whole are relatively high due to the emission intensity of large-scale forestry and livestock industries which are not typically located in the City of Melbourne.

Transport services and storage

For the combined transport services and storage sector, the total emissions for Victoria could be calculated from the ABARE 2005–06 energy use data and full fuel cycle emission factors. These emissions were then attributed to the City of Melbourne based on employment numbers in this industry.

APPENDIX D. DATA METHODOLOGY

Construction

For the construction sector, the total emissions for Victoria could be calculated from the ABARE 2005–06 energy use data and full fuel cycle emission factors. These emissions were then attributed to the City of Melbourne based on employment numbers.

The employment numbers reported in CLUE may not be representative of the construction occurring within the City of Melbourne's boundaries.

The CLUE data reports full-time, casual and part-time employees at facilities based in the City of Melbourne. Contractors may therefore not be picked up in this employment category, where their main place of employment is off-site and not within the City of Melbourne's boundaries. This may have ultimately resulted in an underestimation of construction-related emissions.

Transport

Passenger transport (road and rail)

Passenger transport data was taken from the *City of Melbourne Greenhouse Footprint for Transport Report June 2008.*

Freight transport (road and rail)

Freight emissions include emissions associated with freight generating industries that operate within City of Melbourne.

Freight emissions were firstly determined for the whole of Victoria for roads using the fuel-use data from SMVU and the whole of Australia for rail using the fuel-use data from the 2006 *Australian Rail Industry Report.* The full fuel cycle emissions were then determined and apportioned to the City of Melbourne according to the concentration of freight-generating industries located within the City of Melbourne boundaries.

A number of indicators were considered to determine the percentage of Victoria's or Australia's freight emissions which should be attributed to the City of Melbourne, including contribution to GSP/GDP.

However, such an indicator was ruled out as it would include the high contribution of financial and business service industries to GSP within the City of Melbourne, which are not high freight-generating industries.

Due to this consideration and data availability, the number of employees within freight-generating industries (manufacturing, mining, agriculture and wholesale and retail trade) was selected to be the most appropriate indicator.

It should be noted that this approach includes emissions which physically occur outside of City of Melbourne boundaries for the purpose of travelling to (or from) the City of Melbourne.

This is consistent with the City of Melbourne report for emissions from transport. This approach is not consistent with the Draft International Local Government GHG Emissions Analysis Protocol (ICLEI 2008), which requires only the emissions that occur within the geopolitical boundary to be included.

APPENDIX D. DATA METHODOLOGY

Waste

Emissions associated with waste were determined using both a top-down and bottom-up approach. Estimates of the total municipal waste to landfill were sourced from records for 2005–06 from City Wide waste management contractors responsible for collection of 100 per cent of the City of Melbourne's municipal waste.

The relative quantities of commercial and industrial, and construction and demolition waste compared with municipal waste for the City of Melbourne were then determined. The methodology applied involved using the data for the percentage breakdown of waste types for the whole of Victoria allocated to the City of Melbourne based on the relevant indicator as shown below.

	Victoria waste[42] (a)	Indicator	City of Melbourne indicator as % of Vic indicator (b)	City of Melbourne waste as a % of Vic waste (a) x (b)
Municipal	36%	# Residents	1.44%	0.52%
Commercial and industrial	24%	# Employees	16.94%	4.07%
Construction and demolition	40%	# Employees (ANZSIC 1993 construction sector)	1.66%	0.67%

Waste emission factors for the three waste types above were then applied to determine the emissions associated with each waste type.

Wastewater

Wastewater emissions were obtained directly from Melbourne Water, which operates the Western Treatment Plant and is responsible for 100 per cent of the treatment of City of Melbourne's sewerage. Melbourne Water calculates all emissions from its operations for the purposes of its own corporate inventory.

This includes both energy emissions and fugitive emissions of nitrogen dioxide and methane from the anaerobic treatment process. The fugitive emissions only are included within the City of Melbourne's community inventory, based on the volume of sewerage from the City of Melbourne sent to the plant as a percentage of the total sewerage treated at the plant.

The inclusion of fugitive emissions from wastewater in the inventory is consistent with the methodology on both the state and national greenhouse inventory preparation protocols.

Energy emissions associated with the operation of the plant, however, would not be included within the stationary energy sector above, as this plant operates outside the City of Melbourne's geopolitical boundaries.

Normalisations and projections

The emissions from all categories were normalised to an indicator and then projected based on the projection of the indicator.

42 DCC, 2007

APPENDIX D. DATA METHODOLOGY

Sector	Indicator
Residential	Dwellings
Commercial	Employees (by sub-sector)
Manufacturing	Employees (by sub-sector)
Agriculture	Employees
Non-energy mining	Employees
Construction	Employees
Water	Employees
Transport services	Employees
Passenger transport (road and rail)	Not required (projection sourced from *Greenhouse Footprint for Transport Report)*
Freight transport (road and rail)	Sum of residents and employees
Municipal waste	Residents
C&I waste	Employees
C&D waste	Employees
Wastewater	ML

Dwelling and population

Projections for residents and dwellings were obtained from the City of Melbourne population and household forecasts.

Employment

There is limited information projecting employment within the City of Melbourne to 2020. The projection data used was sourced from the Small Area Projections for Inner Core study produced for the Department of Infrastructure in March 2007 by SGS Economics and Planning. The Inner Core in this study represented the eight Statistical Local Areas representing the inner city, namely:

- Melbourne – Inner
- Melbourne – Southbank/Docklands
- Melbourne – Remainder
- Port Phillip – St Kilda
- Port Phillip – West
- Stonnington – Prahran
- Yarra – North
- Yarra – Richmond

The area is therefore larger than the City of Melbourne LGA.

The study projected growth in the Inner Core using the Labour Force Constrained Employment Forecasting Model which simulates the regional economy through a regional Input – Output (IO) Model and projects employment based on two key economic stimuli – growth in exports (international and inter-regional exports) and growth in resident population and the resultant consumer spending, constrained to take into account the growth in working age population.

The model did not take into account development capacities/ constraints and therefore may have resulted in an overestimation of growth in some industries where development is anticipated to be constrained within City of Melbourne.

The percentage growth rates determined for each sector to 2020 were applied to the CLUE employment data set.

APPENDIX D. DATA METHODOLOGY

Wastewater volumes

The increase in wastewater volumes was first determined by allocating a percentage of the wastewater to residents and a percentage to commercial/industrial/council.

Data provided by the Ecological Engineering Practice Area of the City of Melbourne in the preliminary draft report, City as a Catchment: A Strategy for Adaptation, suggests that in 2000, approximately 22 per cent of mains water supply was supplied for residential purposes.

For the purposes of this study it was assumed that this also represented the percentage of wastewater produced by residents in the City of Melbourne. Residential and employment projection data as above was therefore used to determine the total predicted increase in megalitres per year of wastewater generated by the community.

APPENDIX E. FINANCIAL MODELLING METHODOLOGY

E1.1 Introduction

The following is an outline of the methodology for the financial consideration of carbon management solutions identified as part of the *Zero Net Update 2008*.

The methodology incorporates the basic project approach of firstly identifying the carbon reduction solutions and quantifying the associated emissions, and then modelling the identified cost, regulatory and macroeconomic influences.

E1.2 Process

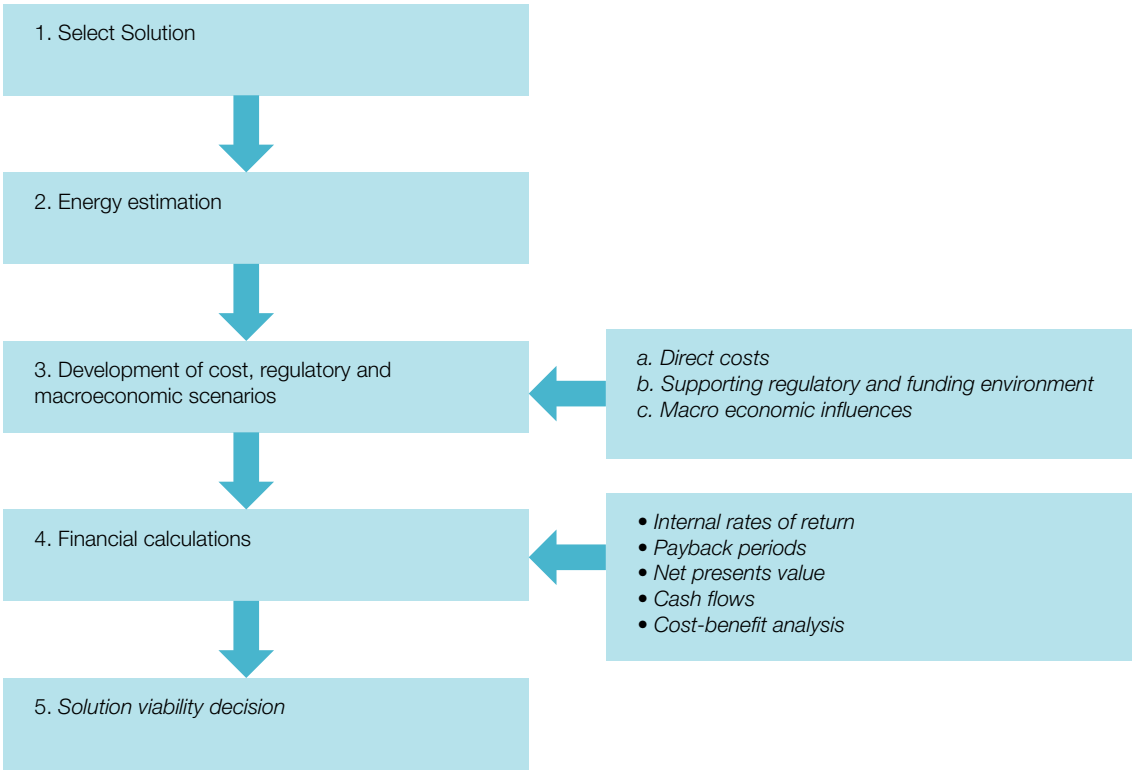


Figure E1: *Zero Net Emissions by 2020* strategy review solutions – financial

APPENDIX E. FINANCIAL MODELLING METHODOLOGY

1. Select solution

The potential carbon management solution is identified during the *Zero Net Emissions by 2020* strategy review.

2. Solution emission reduction contribution

As per the *Zero Net Emissions by 2020* strategy review scope, the emission reduction contribution of each solution will be calculated.

Although the project process may have identified many potential solutions at this initial stage, a review will be undertaken to assess which solutions should proceed through a process of financial assessment.

3. Development of cost, regulatory and macroeconomic scenarios

Once the solutions to undergo a financial review have been confirmed, the parameters and influences that will define the viability of each solution need to be identified.

This will involve the consideration of a series of associated cost, regulatory and macroeconomic influences as discussed below.

a. Direct costs

Consideration of the direct associated costs of a suggested solution will involve aspects such as:

- initial capital costs
- installation expenditure
- project implementation costs (e.g. project management and administration)
- maintenance costs
- operating costs.

Direct costs are a particularly important factor given the scale of the solutions, the nature of the associated technology, and the relative experience of the recipients.

b. Supporting regulatory and funding aspects

The identified solutions will be subject to a range of both government and non-government influences, particularly in the area of regulation, policy and funding.

Each solution will be affected differently, requiring a tailored financial assessment approach. In addition, the regulatory and funding influences will need to be considered in the long-term (up to 2020 and beyond), and will require a series of assumptions of increasing variability.

Regulatory and funding influences that will have to be considered include:

- tax incentives which may support the implementation of a solution such as investment tax breaks
- tax structures which support the implementation of a solution by making alternative, more emissions-intensive solutions less attractive
- state and federal government subsidies
- one-off government grants for specific initiatives
- supportive regulatory frameworks for initiatives such as renewable power generation
- fiscal incentives for local governments
- direct fiscal incentives for individual households and businesses
- the emergence of a more robust framework to trade carbon and environmental assets such as that being proposed as part of the Australian Emissions Trading Scheme
- red-tape reduction on climate change initiatives.

APPENDIX E. FINANCIAL MODELLING METHODOLOGY

c. Probable macroeconomic influences

In addition to the rapidly emerging regulatory and funding environment associated with government and non-government institutions, the financial assessment of identified solutions will also include the consideration of probable macroeconomic influences.

Such issues will include:

- the price of carbon which will need to be incorporated into investment decisions as price transparency improves
- the escalation of fuel prices due to scarcity issues such as peak oil.

4. Financial calculations

After determining the relevant cost, regulatory and macroeconomic influences, a financial model shall be built to undertake the assessment.

The model shall:

- use a series of financial parameters (discount rates, payback periods) agreed with the City of Melbourne to ensure alignment with the established financial assessment processes
- provide a set of financial outputs which shall have associated trigger points for decision making (internal rates of return, payback periods, net present value).

5. Solution viability decision

The set of financial outcomes will allow the City of Melbourne to make a decision regarding the viability of a solution on financial grounds.

APPENDIX F. DECARBONISING THE ENERGY SUPPLY

Infrastructure type	Scale	Application	Emissions efficiency	Potential for market investment	Barriers to implementation	Actions for City of Melbourne/ another appropriate vehicle to encourage implementation
Large-scale wind	State/ regional	Off-shore array or in industrial lands	High	Medium/ high	Lack of detailed information to identify wind resource and available sites. Energy retailer concerns. Resident concerns and potential environmental impact.	• Fund/carry out capacity study focusing on industrial lands, the bay area, the Yarra and other under-used land in inner Melbourne. • Make appropriate zoning arrangements for land with high potential. • Agree with neighbouring councils and Victorian Government on sites to be prioritised for wind resource.
Decentralised combined cooling, heat and power	Regional/ local	District systems that can match existing heating and cooling loads (for example hospital, retail, manu-facturing)	Medium	Medium/ high	No track record of implementation in Australia. Energy retailer concerns.	• Fund/carry out study to identify suitable locations where heating and cooling loads could be matched to a district supply (for example commercial/rental/ residential, or university/hospital). • Establish a Smart Energy Zone over priority sites and work with building owners on a collective investment strategy.
Solar photovoltaics	Regional/ local	On buildings and other structures	Low	Low	Cost. Lack of net-metering.	• Carry out net present value assessment to determine whether a commercial or a break-even approach to installing PV on residential development is viable over the life of the Strategy (for example, through an Energy Performance Contracting mechanism operated by City of Melbourne or commercially). • Encourage state governments to honour their commitment to the introduction of net-metering to support local generators in reaping the full financial benefit of electricity generation.

APPENDIX F. DECARBONISING THE ENERGY SUPPLY

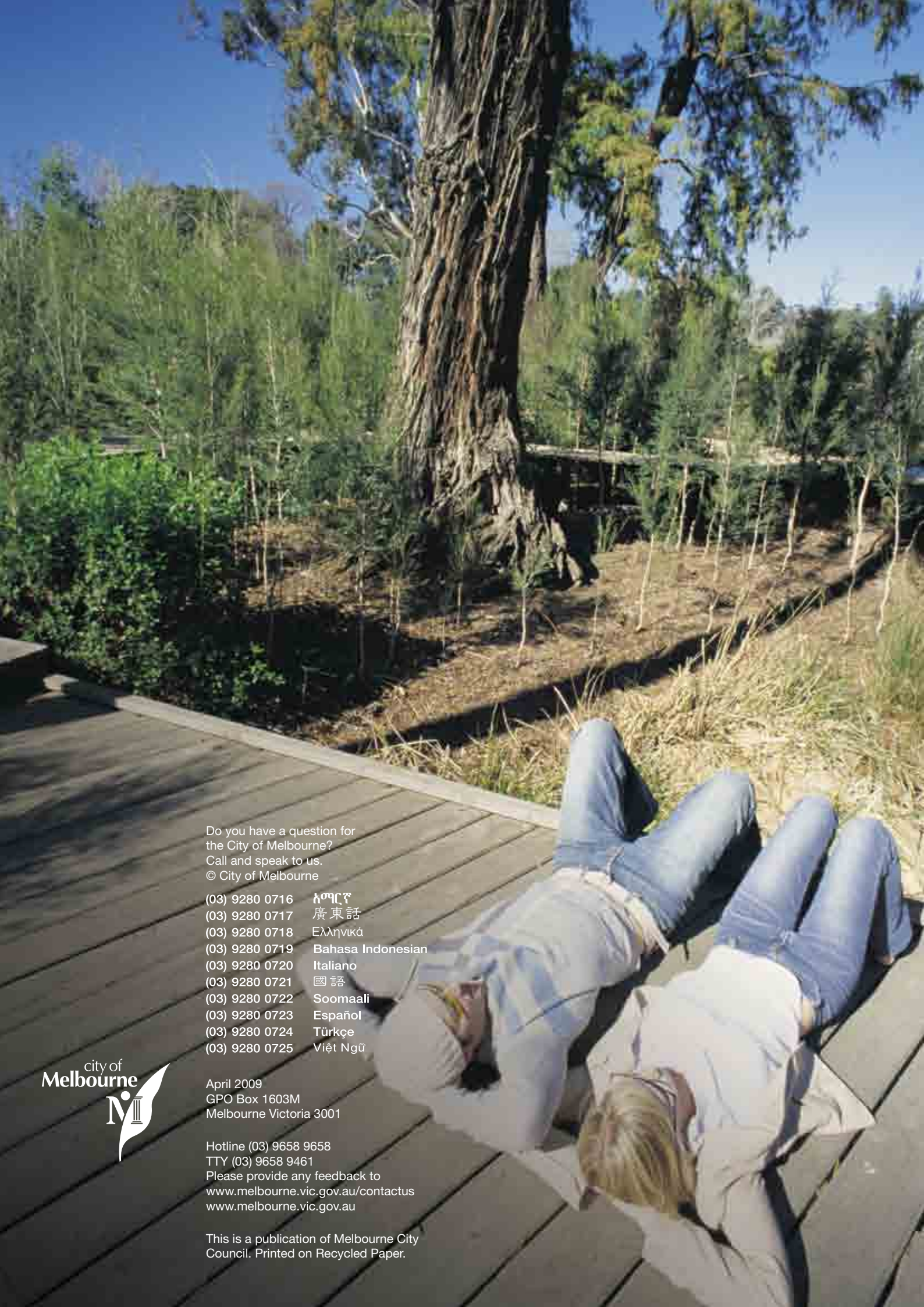
Infrastructure type	Scale	Application	Emissions efficiency	Potential for market investment	Barriers to implementation	Actions for City of Melbourne/ another appropriate vehicle to encourage implementation
Micro wind	Local	On buildings and other structures	High	Medium/ high	Lack of incentive for building owners and developers to install.	• Require all new developments to include a proportion of on-site renewable or low-carbon energy supply (so-called Merton rule). • Establish Smart Energy Zones within CBD and target building owners within this zone to reduce energy use and displace a percentage of energy use with local supply. • Encourage building owners to participate through incentives such as recognition events.
Pyrolysis of waste	Regional	Discrete electricity plant to feed into grid	High	Low/ medium	No track record of implementation in Australia.	• Carry out study to track commercial and industrial waste to determine the percentage of the carbon/methane resource being under-used. • Carry out options analysis of best approach to optimise carbon/ methane value of commercial, industrial and municipal waste in greater Melbourne. • As part of the study, identify suitable locations for a pyrolysis/AD plant within greater Melbourne. • Via regulatory powers require commercial and industrial waste collection and treatment processes to optimise carbon and methane value of waste.
Anaerobic digestion or green waste	Regional	Discrete electricity plant to feed into grid	High	Medium	Limited track record of implementation. Competition for feedstock from compost industry.	As above
Clean source hydrogen fuel cell	Local	In commercial and manufacturing operations	Medium	Low	No significant track record of implementation in Australia	• Encourage investment in local market by providing opportunities for local industry through appropriate zoning in manufacturing and industrial lands.

APPENDIX F. DECARBONISING THE ENERGY SUPPLY

Infrastructure type	Scale	Application	Emissions efficiency	Potential for market investment	Barriers to implementation	Actions for City of Melbourne/ another appropriate vehicle to encourage implementation
Stirling engine	Local	In commercial and manufacturing operations	Medium	Low	No track record of implementation in Australia	• Encourage investment in local market by providing opportunities for local industry through appropriate zoning in manufacturing and industrial lands.
Geothermal	State/ regional	As part of combined heating and cooling plant	Medium	Medium	Identifying suitable geothermal conditions within City of Melbourne boundary	• Lobby Victorian Government to fund study to determine location of further geothermal sites within greater Melbourne (other than Rye).

GLOSSARY

Abbreviation	Meaning
5 Star	5 Star standard as required in the *Building Code of Australia, Victoria Appendix Volume 2.* From 1 May 2008, this requirement will be extended to home renovations and relocations.
ABARE	Australian Bureau of Agriculture and Resource Economics
ABGR	Australian Building Greenhouse Rating Scheme
ABS	Australian Bureau of Statistics
ANZSIC	Australia and New Zealand Standard Industrial Classification
CCI	Clinton Climate Initiative
CEO	Chief Executive Officer
CH_4	methane
CHP	Combined heat and power
CLUE	City of Melbourne Census of Land Use and Employment
CNG	compressed natural gas
CO_2-e	carbon dioxide equivalents
CO_2	carbon dioxide
GDP	Gross Domestic Product
HFC	hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
kt	kilotonnes
LGA	Local government area
N_20	nitrous oxide
PFC	perfluorocarbons
ppm	parts per million
PV	photovoltaic cells
SF_6	sulfur hexafluoride
VGGI	Victorian Greenhouse Gas Inventory
VEET	Victorian Energy Efficiency Target



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