

Driving Forces



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Key Findings

- Climate change, population growth and settlements, and consumption associated with economic growth are the overarching driving forces of environmental degradation.
- The Victorian community has a history of finding innovative solutions to environmental problems and is well placed to lead innovative solutions that may make a difference well beyond its borders.
- Climate change provides a defining context for this report because of the extent to which it is affecting and is projected to affect ecosystems. Significant environmental and economic policy changes are required to ensure the Victorian community lives well within a healthy environment.
- Trends in greenhouse gas emissions, insufficient and uncertain policy and uncertain technological development pathways highlight the current policy and technology gap between business as usual and emission reduction targets. Victoria, with its high energy and emissions intensive economy has a leading role to play.
- Continuing growth of Victoria's population will increase demand for land, energy and other resources, as well as housing and transport services, potentially leading to more waste and pollution. Extra demand for water is particularly pertinent given the predicted effects of climate change on already depleted water storages.
- Development in peri-urban regions is driving loss of natural habitat and biodiversity, as well as agricultural land. The challenge is to ensure development does not put undue stress on the environment; uses resources such as land, water, materials and energy efficiently; and allows replenishment of the natural resource base.
- As household sizes have declined and the number of rooms per house has increased there has also been a marked rise in floor area per house. The trend to larger and more luxurious housing is a driver of consumption. Further, as this trend is most evident on the urban fringes there are implications for biodiversity, food production and infrastructure as land use changes from rural to urban.
- Melbourne is an energy intensive city in international terms, and in common with other Australian cities, has a low-density urban form with high levels of car use.
- The cost of environmental degradation is not integrated into economic systems. Current measures of growth such as GDP or GSP do not adequately capture environmental degradation or social wellbeing.
- Victoria's economy has been growing at a faster rate than population, an indication of an affluent society. This affluence comes with increased consumption of goods and services that place pressure on the environment.
- The resource intensity of the economy is improving, however total (absolute) resource use and associated environmental pressures are increasing, with the exception of water which has decreased due to a combination of resource scarcity and demand management.
- The environment does not care how resource efficient the economy is if absolute environmental pressures continue to increase.
- Improvements in human wellbeing and economic development have been achieved at the expense of ecosystem services essential to life.
- It is currently cheaper to protect the environment than it is to attempt restoration, but it is even cheaper to degrade the environment, externalising the costs.

DF0 Introduction

An environmental driving force can be any natural or human-induced factor causing environmental change. Climate change is a direct driver, while population and settlements as well as consumption associated with economic growth are indirect drivers. A direct driver influences natural processes in an immediate way. For example rising temperatures, reduced rainfall and runoff are damaging the Murray-Darling basin. By contrast, the impacts of an indirect driver are mediated by other phenomena. For example rising population on the outskirts of Melbourne creates a demand for roads, and road-building in turn may damage vulnerable ecosystems. Similarly rapid economic growth fuels a demand for larger homes and new household furnishings, which in turn places demands on forests that provide materials for buildings and furniture. Environmental changes usually result from multiple, interacting drivers operating across a variety of scales¹.

It is often difficult to identify direct causal relationships between a driver and its impacts. Moreover the interactions between climate change, population growth and settlements, and economic growth and consumption are particularly complex. The complexities are increased with the increasing globalisation of economic, social and political landscapes. While there is growing recognition that human activity is causing environmental degradation, finding ways to prevent and/or reverse these impacts involves unpacking and resolving complex political and social as well as scientific issues.

It is necessary to decouple these drivers from relationships where they have a negative impact on the environment. For example Victoria's growing population consumes materials at an increasing rate, placing increasing pressure on limited resources. One solution is to invest in technologies that increase material use efficiency, or resource substitution, reducing overall consumption of raw materials. It may then be possible to decouple the impact of growing population from environmental degradation. Not all technological solutions achieve this, however.

Changes in factors *indirectly* affecting ecosystems, such as population, technology, and consumption, can lead to changes in factors *directly* affecting them. For example using fertilisers to increase food production may affect environmental health, causing environments to change and affecting human well-being. These interactions can take place at more than one scale and can cross scales. For example, the growth of a global market for timber may lead to regional loss of forest cover, which can increase the magnitude of floods. Similarly, the interactions can take place across different time scales. Human intervention can have positive or negative impacts at almost all points.

The Victorian community has a history of finding innovative solutions to environmental problems, such as the now internationally successful Landcare movement. This community based organisation has brought together individuals, scientists and governments to find solutions to local environmental problems. Now with increasing community awareness of a broad range of environmental issues, and the urgency required in finding solutions, Victoria is well placed to lead in finding innovative solutions that may make a difference well beyond its borders.

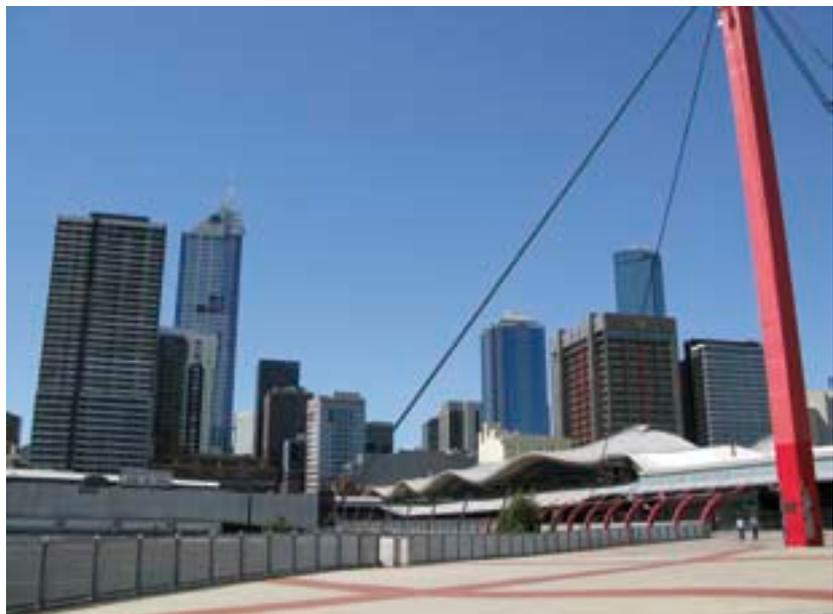


Photo: Jane Tovey

DF1 Climate Change

Climate change is one of the most complex and pressing issues facing the global community. It has become a direct driver of environmental change in every corner of the globe; at the same time environmental changes of many kinds also contribute to the global climate change dynamic.

Climate change can refer to any change in the climate, whether due to natural variability or human activity, but today the term is commonly applied to an urgent environmental, social and economic challenge. Human activity is causing global temperature increases through the accumulation of greenhouse gases in the atmosphere. This will have wide-ranging social and economic impacts on basic elements of life such as access to water, food production, health and the environment (for more information on Victoria's climate and projections see Part 4.1 Atmosphere, Climate Change).

Climate change is driving many environmental sustainability problems, and must be addressed at a variety of scales, from local energy initiatives to international agreements to cut emissions. Impacts cut across sectors and regions. For example, impacts on water resources affect not only agriculture, but also energy and manufacturing. Impacts on natural resources, forestry, biodiversity and tourism form a complex of issues confronting Victoria. Impacts will be felt in such diverse areas as health care, primary production, fire, and loss of snow cover in alpine resorts. Victoria is also likely to encounter impacts not yet foreseen.

At the same time, the workings of industrial society contribute to climate change by generating greenhouse gas from energy production, transport, manufacturing, agriculture and personal activities. The interaction of cause and effect is exceptionally complex, being determined by trends in key climate variables, climate changes already underway, mitigation efforts and natural climate variability. Climate change provides a defining context for this report because of the extent to which it is affecting the balance of the Earth's ecosystems. Significant economic and social policy changes are needed to address this, to ensure the Victorian community lives well within a healthy environment. It requires a strategic, coordinated and collaborative approach between the private and public sectors and all levels of jurisdictional governance.

There is now a strong policy momentum in Victoria, around Australia and in much of the world, to advance mitigation and adaptation. International bodies such as The UN's Intergovernmental Panel on Climate Change (IPCC) have established, at a high degree of scientific probability (greater than 90%), that anthropogenic greenhouse gas emissions have caused most of the observed increases in global average temperature since the mid-20th century. The financial cost of inaction on climate change (or following an adaptation-only policy approach) could rise to 20% of global GDP or more². Part 4.1 Atmosphere, Climate Change shows the IPCC's best estimates of temperature and sea level rise, depending on the level at which CO₂-e concentration is stabilised.

Both the Australian and Victorian Governments have committed to a 60% reduction in greenhouse gas emissions by 2050 (compared to 2000 levels)³. Figure DF1 shows current emissions and the current policy gap between business as usual and the 2050 target. The graph shows that Victoria's emissions intensity has significantly improved between 1990 and 2006. This improvement is associated with a slower rate of total emissions growth. However, it also highlights that total greenhouse gas emissions are increasing and that critical policy and technological measures to reduce greenhouse gases are not yet in place. Urgent action is required to prevent dangerous climate change and Victoria, with its high energy and emissions intensive economy has a leading role to play (see also Part 4.1 Atmosphere, Climate Change).

The Australian and Victorian policy environment is experiencing dynamic change, stimulated by the new Commonwealth Government, the Garnaut Climate Change Review and the Commonwealth Government's Carbon Pollution Reduction Scheme Green Paper and subsequent white paper, as well as the Victorian Government's proposed white papers on Climate Change and Land and Biodiversity, and the Victorian Coastal Strategy. These foreshadow the advent of new policy approaches and technologies, particularly carbon capture and storage from coal-based electricity generation – assuming that the technology works and can be delivered at a commercial scale to sufficiently reduce emissions in time.

Combustion of fossil fuels has combined with a massive intensification in livestock numbers to release unprecedented amounts of greenhouse gas into the atmosphere. Meanwhile, the capacity of the Earth to store carbon in terrestrial and ocean sinks is thought to be diminishing. IPCC modelling indicates a significant increase in global temperature with the potential for catastrophic risks to global economic, social and environmental well-being.

Climate change is likely to drive a shift in agricultural regions within the State, with broad-acre cropping forced to move south because of advancing aridity. This could intensify competition for water amongst different users resulting in migration of some primary production to other states (see Part 3.2 Water Resources, Part 4.2 Land and Biodiversity and Part 4.3 Inland Waters).

As a result of climate change, rising sea levels, floods and storm surges are likely to put coastal areas at risk of severe damage. Intrusion of saltwater into aquifers will compromise groundwater quality, impacting on consumptive use and natural systems (see Part 3.2 Water Resources and Part 4.4 Coasts, Estuaries and the Sea). Higher temperatures will lead to more frequent bushfires. Streams will reduce in flow, with much of the available water being captured for consumptive uses. This decrease in flow will seriously change streambed and bank conditions, and affect the animal and plant species that depend upon them (see Part 3.2 Water Resources and Part 4.3 Inland Waters).

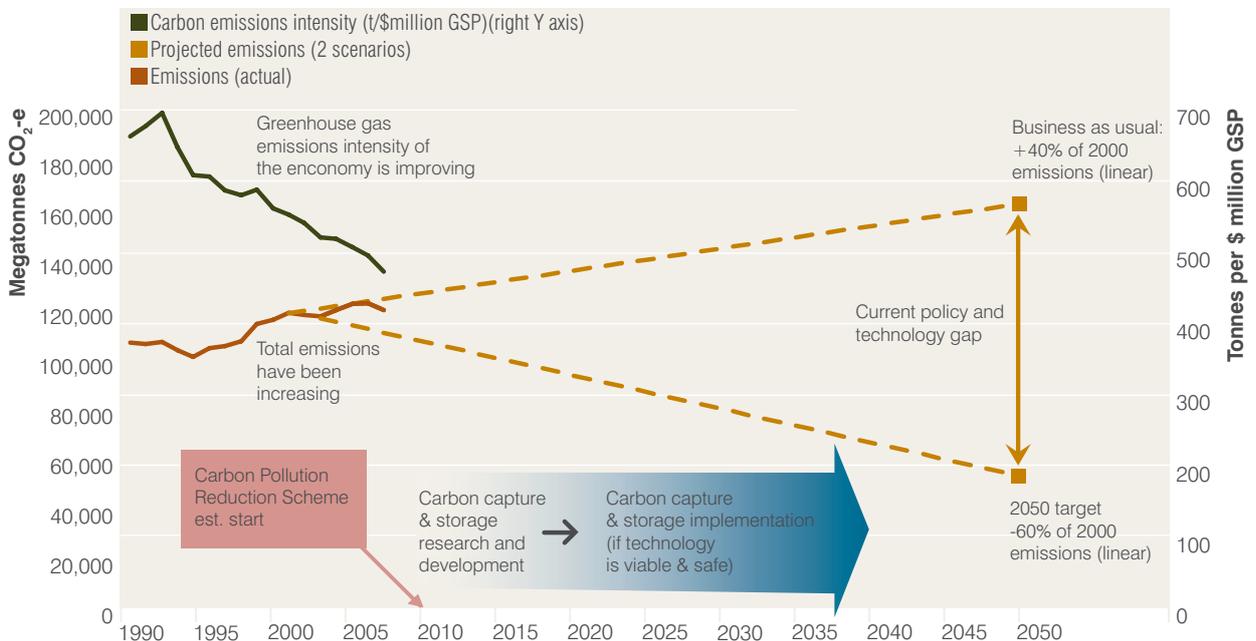
Climate change will force plants and animals to move or adapt. Alpine species will lose their habitat and be trapped on islands of high altitude. Cleared land will act as a barrier to the migration of plants and animals toward suitable habitats. The southern coastline will provide another barrier to migration, which may result in the further loss of plant and animal species (see Part 4.2 Land and Biodiversity). Evolutionary adaptive capacity is projected to be exceeded in many species.



Photo: OCES

Figure DF1 Current Victorian policy and technology gap between “business as usual” greenhouse gas emissions and the 2050 target

Sources: DPC 2007, Department of Climate Change 2008, ABS
 Note: Mitigated emissions to 2050 are very unlikely to track evenly (as shown) but rather will decline in steps and at varying rates, depending on deployment of policies and abatement technologies as their efficacy is proven.



DF2 Population Growth and Settlements

Population growth is causing fundamental environmental change. The demands of a burgeoning world population (6.8 billion in 2008⁴) along with urbanisation leads to a depletion of natural resources, for example through reduction of biodiversity and agricultural production, and reduced quality of waterways. The Millennium Ecosystem Assessment reports that “over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fibre and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth. In addition, 15 out of 24 ecosystem services examined in the Assessment are being degraded or used unsustainably, including fresh water, fisheries, air and water purification; as well as the regulation of regional and local climate, natural hazards, and pests.”⁵

While developed nations have low rates of population growth, their consumption rates are currently far higher than those of developing nations; approximately 86% of global private consumption expenditure is accounted for by 20% of the world's population⁶. Developing countries, with some of the largest populations, are currently experiencing rapid economic growth leading to significant further pressures on the natural environment. Continuing growth of Victoria's population will increase demand for land (see Part 4.2 Land and Biodiversity), energy and other resources (see Part 3 Production, Consumption and Waste), as well as housing and transport services; potentially leading to more waste and pollution. Extra demand for water is particularly pertinent given the predicted effects of climate change on already depleted water storages.

A Rapidly Growing Victoria

In September 2008 the Australian Bureau of Statistics published projections for population trends under three scenarios. Victoria's population was projected to reach totals ranging from 6.5 million to 6.9 million by 2026, and totals ranging from 7.8 million to 9.9 million by 2056. The totals for Melbourne were projected to range from 4.9 million to 5.3 million by 2026, and to range from 6.1 million to 8.0 million by 2056. The balance of the State was projected to reach totals around 1.6 million by 2026 and between 1.7 million and 1.9 million by 2056. Under all the scenarios the proportion living in Melbourne was projected to increase. While the ABS emphasized that these were not predictions or forecasts, they nevertheless show in striking fashion the urgent need to decouple the impacts of population growth and settlements from environmental degradation.⁷

The Melbourne metropolitan area has expanded beyond its initial semi-circular pattern around Port Phillip Bay to meet the hill country to the north and east. The Victorian Government's *Melbourne 2030* strategy outlines a framework for urban development in the coming decades. As a result of consensus about the strategy's effectiveness an expert audit identified key aspects requiring review and rectification as: “better management of growth (economy and employment, central and inner Melbourne, activity centres, established suburbs, growth area planning, managing the Urban Growth Boundary (the area that has been identified for future urban development) and developing networks with regional cities); transport; environmental sustainability; affordable housing; and monitoring”⁸. In responding to the audit the Government has emphasized four areas for action: planning for all of Melbourne; transport and managing congestion; environmental sustainability and climate change; and managing urban growth and change.⁹

Population Growth

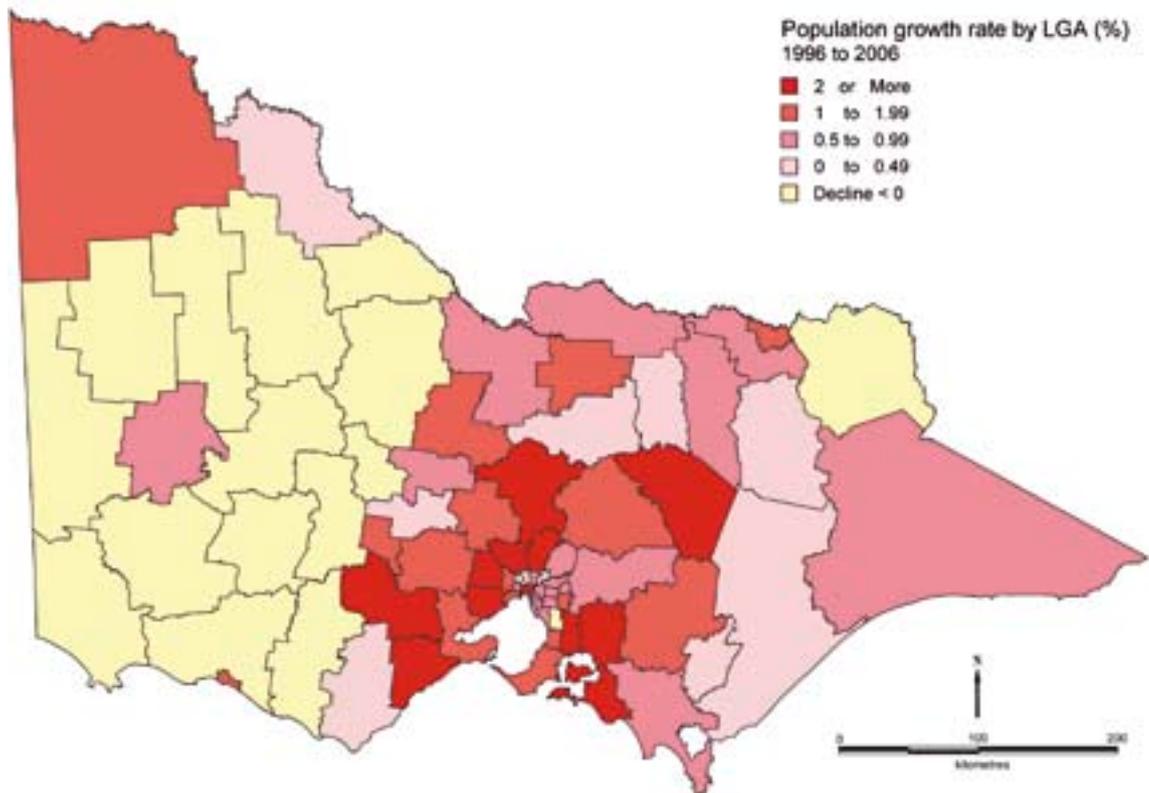
Victoria's population growth and the expansion of Melbourne, and associated affluence, has brought with it unsustainable levels of resource consumption and waste production, with direct environmental impacts through changes in land use from conservation and agriculture to built environment. The impacts include harvesting and diversion of water for residential and manufacturing purposes, altering river flows; discharge of human wastes to land and sea; loss of native vegetation; disposal of solid wastes to landfill; and discharge of liquid wastes from industrial processes to adjacent water bodies.

Immigration makes a major contribution to the growth of Victoria's population, and especially to Melbourne's. Between 1987 and 2004, net international migration contributed 71% of Melbourne's population growth, whilst natural increase contributed 61%. (The total exceeds 100%, but was offset by a 32% rate of internal migration away from Melbourne to other locations in Victoria and Australia.¹⁰)

As shown in Figure DF2 population growth in regional Victoria is uneven. Research for the Victorian Government published in 2005 stated that “most growth occurred in the metropolitan sphere of influence, the major provincial centres and hinterlands, coastal and major recreation areas, and the Murray River region”¹¹. The fastest growing Local Government Areas (LGAs) in Victoria from 2001 to 2006 were Melton (8.9%), Melbourne (8.6%) and Wyndham (5.9%). Melbourne had the largest population growth of all Australian capital cities during that period.

Population growth in regional Victoria can be partly attributed to government incentives, investment in infrastructure, education and health, and transport services. The fastest growth rate outside the metropolitan area was at Golden Plains (between Ballarat and Bendigo) with an average annual growth rate of 2.5% and Mitchell to the north of Melbourne which grew at 2.4%. Some LGAs, mostly in the West, experienced a population decline.¹²

Figure DF2 Average annual population growth for Victoria 1996 - 2006.
Data source: ABS



Victoria's coastal settlements are also growing. This 'sea-change' trend can be attributed to lifestyle choices, an extended commuter belt and retirement migration¹³ (see Part 4.4, Coasts, Estuaries and the Sea). Over 20% of Victoria's population live on the coast, with total coastal population forecast to reach 1,063,099 by 2011¹⁴. In the period from 2001 to 2006 LGAs leading this growth included the Surf Coast (1.8%) and Bass Coast (1.4%)¹⁵. These areas are already experiencing environmental pressures which further population growth will intensify, such as land use change, loss of biodiversity, increased water consumption, generation of waste, and the impacts of road construction and transport. In addition climate change is becoming a consideration in planning decisions on the coast with some areas predicted to be subject to inundation more frequently. This issue is discussed in Part 4.1 Atmosphere, Climate Change, Part 4.2 Land and Biodiversity, Contemporary Land Use Change, Part 4.4 Coasts, Estuaries and the Sea, and Part 5 Living Well Within Our Environment.

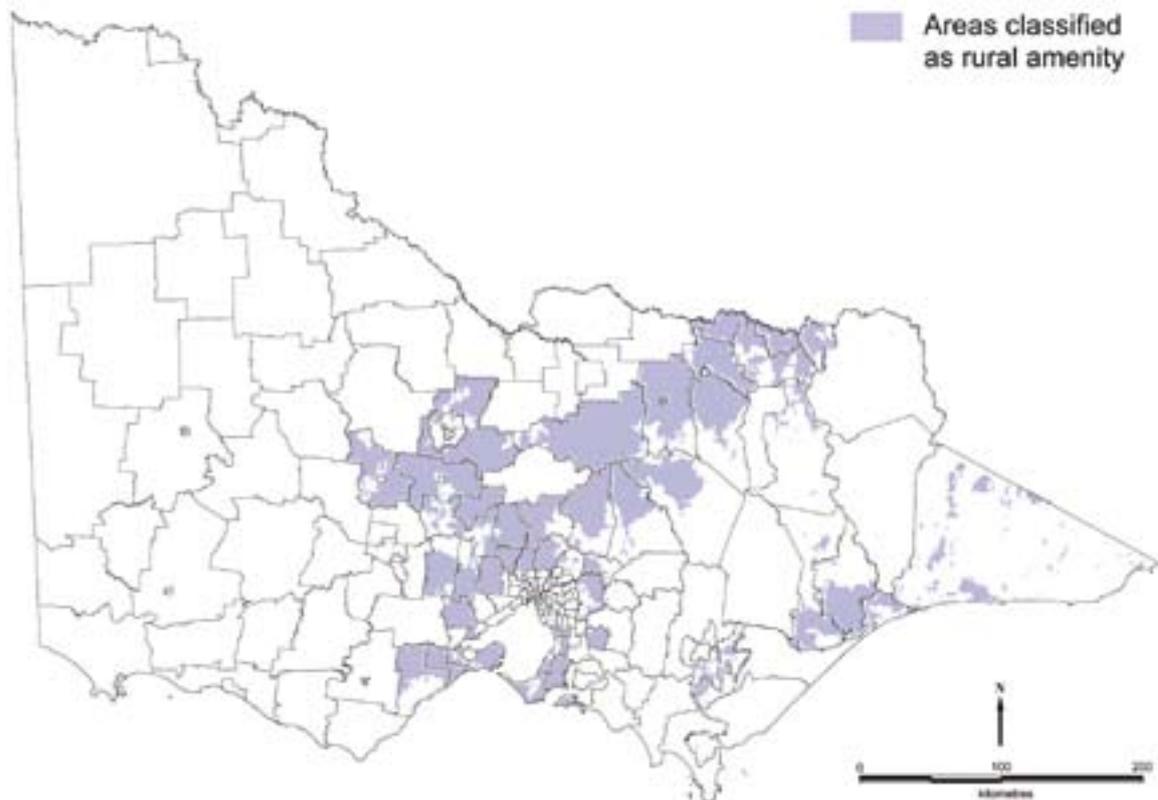
Peri-Urban Growth

The term peri-urban refers to belts of land on the periphery of urban centres, which are neither entirely metropolitan nor entirely rural, but rather mixed and in transition.¹⁶ The greatest population growth in Melbourne tends to occur in peri-urban areas. In the Melbourne Statistical Division the largest growth rate in the period from 2001 to 2006 occurred in the outer Local Government Areas of Casey, Wyndham and Melton.¹⁷ Life-style factors such as demand for more space and larger homes, as well as the rising cost of city living are driving the increased demand for peri-urban development. Consequently, peri-urban regions are expanding further into rural and coastal areas. The expansion has driven increased demand for transport infrastructure, such as freeways, ring-roads, and public transport. Construction of these facilities aligned to growth area planning along with public amenities, attracts new residents, further stimulating peri-urban development.¹⁸

Victoria's peri-urban areas have been defined on the basis of a number of factors including population density. It may be more useful to consider the rural amenity value of the land, being the relationship between the value of rural land and the agricultural production value. Figure DF3 shows areas of rural amenity land that are more likely to be purchased for lifestyle reasons than its agricultural potential.¹⁹

Development in peri-urban regions is driving loss of natural habitat and biodiversity, as well as agricultural land. In the Urban Melbourne reporting area of the Port Phillip and Westernport Catchment Management Authority, only 5% of original vegetation remains.²⁰ This is a significant concern in Wyndham and Melton where urbanisation is driving a reduction in the extent of native grasslands on Victoria's volcanic plains, the most depleted bioregion in the State (see Part 4.2 Land and Biodiversity, Vegetation loss and modification). The challenge is to ensure development does not put undue stress on the environment; uses resources such as land, water, materials and energy efficiently; and allows replenishment of the natural resource base (see Part 4.2 Land and Biodiversity).

Figure DF3 Areas of Victoria classified as rural amenity based on 2001 census data
Source: Victorian Government 2005



Peri-urban development also places pressure on infrastructure, including water and sewer provision. In Victoria, a number of major water storages are located in peri-urban regions, and urban sprawl creates additional demand for infrastructure development. Consequently, the water supply needs of Melbourne have significant impacts on the urban fringe and the rural areas beyond.²¹ Environmental impacts of peri-urban development include an increase in introduced species, a reduction in availability of productive agricultural land, conflicting fire management needs, an increase in aesthetic dams, and degradation of waterways.²² Increased tourism and recreation, transport and road construction all intensify these impacts. For example road building leads to an increase in impervious surfaces, and hence increased vulnerability to flooding and damage to waterways.

Housing and Density

With growing population there is increased demand for housing in both the inner and outer suburbs of Melbourne as well as in Victoria's regional towns. In Melbourne single person households tend to locate in the inner areas, where there is greater availability of amenities matching lifestyle choices²³. By contrast families with children tend to locate in outer suburbs, where more affordable housing and larger lots are available²⁴. Consequently for every person moving to the inner suburbs there are five moving to the outer suburbs. This drives land-releases in Melbourne's Urban Growth Zone.²⁵

Much of the housing demand in middle and outer urban areas comes from traditional patterns of household formation whereby young people start families and seek adequately sized and affordable housing. The development of the urban fringe also results from established family households trading up into larger and newer dwellings²⁶. This is accompanied by the 'McMansion' phenomenon, with poor climate-sensitive design and a large floor area per occupant placing heavy stress on artificial climate control. Managing expectations about what is appropriate housing design will be critical in sustaining liveability whilst retaining affordability.

The inner city also is becoming more densely populated. In 2001 Melbourne had 50,673 inner city residents, while by 2006 the number had grown to 76,678²⁷, (though this may be indicative in part of a boundary change). Two key groups are contributing to this trend: young adults seeking proximity to work, education, and social and recreational venues; and financially secure families and middle-aged people, looking for established housing in wealthier areas close to the core business district and amenities. Increased demand for inner city housing has come about as "people put place (i.e. a convenient location) ahead of space"²⁸.

Victoria has a large proportion of detached dwellings (88%), compared to higher density housing²⁹. Detached dwellings are considered to have a greater environmental impact than high density housing, which is why the Victorian Government is promoting urban consolidation and higher density housing through implementation of Melbourne 2030. The average density of dwellings per square kilometre in Victoria in 2006 was 7.7 whilst the highest density was for the City of Melbourne with 817.1 dwellings per square kilometre. In the outer urban LGAs with a fast rate of population growth the density was 47.8 for Melton, 67.7 for Wyndham and 84.7 for Casey. The fastest

growing coastal LGAs, Surf Coast and Bass Coast showed a much lower density of housing with 4.9 and 12.2 respectively. The regional LGAs with the fastest rates of population growth, Golden Plains and Mitchell, had housing density of 2.0 and 3.62 dwellings per square kilometre.³⁰

Several factors are interacting to change the structure of household formation. Changing attitudes towards partnering and marriage, aging populations, and increasing divorce rates are leading to a decline in the size of households. As is shown in Figure DF4 the number of persons per household has been declining for many years. The average household size in Australia is projected to decline from 2.6 people per household in 2001 to between 2.2 and 2.3 people per household in 2026³¹. This decline, combined with an increase in the number of dwellings, has important social and environmental implications, such as increased housing and land demand. Greater demand for household furniture and appliances, as well as space heating and cooling has led to an increased requirement for ecosystem services which provide the raw materials.

Social conditions also influence the way housing space is occupied. For instance, children are now less likely to share bedrooms than they were in the past, leading to an increased number of bedrooms per house; there is also greater demand for additional rooms, such as games rooms. Accordingly Victorians tend to occupy more space per person.

Figure DF4 shows that as household sizes have declined, the number of rooms per house has increased. Recently there has also been a marked rise in floor area per house. The trend to larger and more luxurious housing is a driver of consumption as each of these large homes will require more furniture, fittings and appliances than the smaller homes that were more common decades ago (see Part 3.3 Materials). Further, as this trend is most evident on the urban fringes there are implications for biodiversity, food production and infrastructure as land use changes from rural to urban (see Part 4.2 Land and Biodiversity, Contemporary Land Use Change).

Urban Form and Transport

Melbourne is an energy intensive city in international terms, and in common with other Australian cities, has a low-density urban form with high levels of car use. Historically, changes in urban form have interacted dynamically with changes in transport. Post Gold Rush Victorians created a world-class rail-based public transport system, which in turn helped create a spacious and accessible city. In the twentieth century, motor vehicles emerged as a major form of transport as the city spread and cross-suburban travel became more important and oil availability and affordability encouraged motor vehicle use. After the Second World War the relative importance of public transport declined. The oil shocks of the seventies heralded a new interest in public transport, but Melbourne’s “car culture” persisted as shown by extensive freeway construction.³⁵

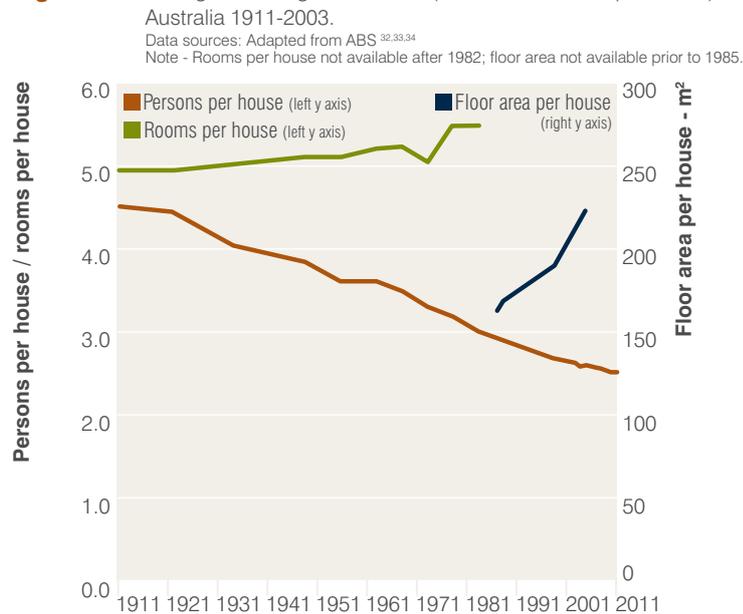
Only in recent years has interest in public transport assumed a sense of urgency, as a consequence of continuing

traffic congestion, high and increasing petrol prices and to a minor extent, environmental concerns. There has been increased interest in the principles of Transit Oriented Development, which creates compact, walkable communities centred on high quality public transport systems.³⁶

However transport in Victoria is still dominated by motor vehicles, both for travel and freight. Only in the inner city does a sizeable majority travel to work by means other than car. In 2006 transport accounted for 16.7% of Victoria’s total greenhouse gas emissions.³⁷ Motor vehicles are a primary source of urban air pollution, with exhaust emissions accounting for 77% of carbon monoxide and 72% of oxides of nitrogen in the Port Phillip region (see Part 4.1 Atmosphere, Air Quality). Other impacts include increased noise and safety issues. Being resource intensive, car use leads to greater environmental consequences than alternatives such as public transport, cycling or walking. While more greenhouse gas efficient than cars, public transport is nevertheless itself responsible for significant emissions through the brown coal-sourced electricity used to power trains and trams, and the diesel used for buses.

Land use patterns, the location of residences, employment services and facilities respond to the available modes of transport. In Victoria a focus on road-building has enabled people to live in locations once deemed too isolated from employment opportunities and the inner city in general. A direct consequence of this increased access to, and mobility around, the outer suburbs is increased development.

Figure DF4 Change in average house size (rooms & floor area per house) compared to average household size (persons per house)



Transport featured prominently in the recent independent audit report of Melbourne 2030, which noted that providing a greater range of transport options and reducing car dependency both encourages physical activity and enhances liveability. It recommended that 'transport should be the servant of land uses, not the dictator'³⁸.

Peri-urban development has increased the average distance travelled to work. Longer journeys mean higher emissions per trip and increasingly complex road navigation. This may lead to less family time, more sedentary lifestyles resulting in health problems such as obesity, increased traffic congestion and air pollution. The distribution of mobility choices is uneven across the metropolitan area; people living in inner Melbourne have a wider range of transport options, whereas people living in outer suburbs are more car dependent.³⁹

There has been a dramatic rise in car trips taken to work over the last 30 years, with Melbourne experiencing the largest increase of any capital city, from 56.1% in 1976 to 72.6% in 2006. Only 43% of this increase is attributable to a growing workforce, the remaining 57% resulted from a shift away from more environmentally friendly modes of transport⁴⁰. Between 1985 and 2006 metropolitan Melbourne's demand for urban mobility increased by 45%, as measured by person-kilometres. The vast majority (93% in 2006) of this demand was met by the private passenger car (see Figure DF5). In terms of vehicle-kilometres travelled (VKT), travel demand in metropolitan Melbourne increased from 28.08 to 31.8 billion kilometres between 2001 and 2006⁴¹. (Note this data does not capture more recent shifts to public transport use in response to rising petrol prices.)

A social concern over increased car dependency away from the centre of Melbourne has been illustrated through the VAMPIRE index⁴² (see Figure DF6) which demonstrates that the social and economic impacts increase with distance away from the CBD. It indicates that car dependency in the outer suburbs of Melbourne will lead to increased vulnerability to future rises in oil prices for those residents because a higher percentage of the household budget is spent on transport, pushing up the total cost of living. Victoria's public transport issues are discussed further in the Commissioner's separate reports, *Creating a City That Works*⁴³ and *Public Transport's Role in Reducing Greenhouse Emissions*⁴⁴. Reports are available from www.ces.vic.gov.au.

The legacy of past urban transport planning in Victoria is car dependency as a result of policies that favoured road building at a higher rate than development of public transport. This reflected a model where demand for roads drove policy. There is now a shift in policy direction represented by the government's Meeting Our Transport Challenges plan (MOTC) indicating emphasis on funding public transport with a commitment to spend \$10.5 billion on Victoria's transport network from 2006 to 2016. The 2008 budget delivered more than \$429 million in projects in addition to the Government's MOTC commitments. The Victorian Government is also expected to release an updated transport strategy by the end of 2008.

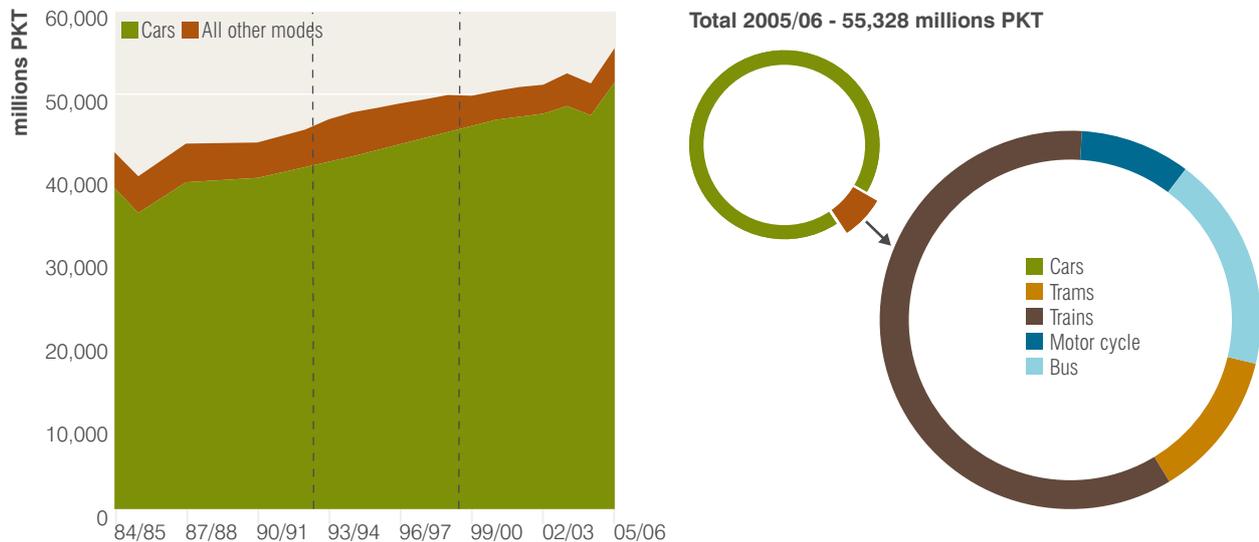
The *Melbourne 2030* strategy seeks to achieve urban efficiencies in areas such as infrastructure and energy use, reducing social and environmental costs in areas such as water, congestion, travel patterns and urban sprawl. While this initiative demonstrates government commitment to improving sustainability, there are recognised gaps and shortfalls in the implementation. Greater investment in rail and bus services and the provision of more walking and cycling paths, would achieve greater urban efficiency.

Transport pricing which made those responsible for social and environmental pressures associated with car use bear a commensurate proportion of the total cost would remove current incentives to depend on passenger cars. Regulation is needed to induce individual consumers and businesses to buy vehicles with greater fuel efficiency, and to adapt existing fleets where possible. Budgetary allocations should avoid funding the continued expansion of urban road networks to the detriment of public transport. Independent auditing and improved institutional coordination are also important.⁴⁶ See also Part 3.3 Energy for further information on transport in Victoria.

Figure DF5 Metropolitan Melbourne travel demand as measured by person-kilometres travelled (PKT)

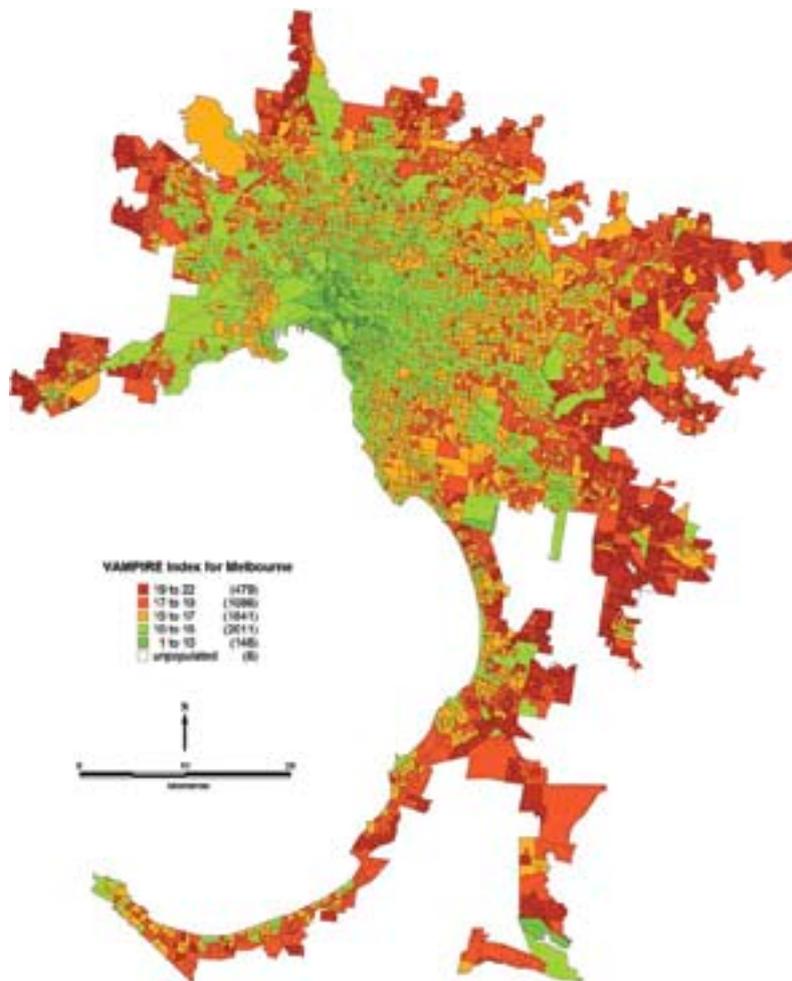
Source: ACG & RMIT

Note: The period 1992/93 - 1998/99 (dotted lines) includes cycling & walking in Melbourne as estimated by the Victorian Activity and Travel Survey, 1993 - 1999 (VATS).



DF3 Economic Growth and Consumption

Figure DF6 Vulnerability assessment for mortgage, petrol and inflation risks and expenditure (VAMPIRE) assessment for Melbourne. High values indicate higher levels of vulnerability.
Source: Dodson and Sipe (2004)⁴⁵



To achieve sustainable development Victorians must, in the words of the 1987 Brundtland Report, “meet the needs of the present without compromising the ability of future generations to meet their own needs”⁴⁷. Whilst there was some recognition at the time that economic growth was impacting on the environment, there was considerable discussion in the 1990s about the prospect that economic growth and rising incomes could lead to better environmental quality⁴⁸. However it is now more widely accepted that current patterns of economic development represent a primary driver in the depletion of global natural resources. The *Millennium Ecosystem Assessment Report* (2005) stated that substantial net gains in human well-being and economic development have been achieved at the expense of ecosystem services essential to life⁴⁹.

According to the *Limits to Growth Report: The 30-Year Update*, humanity’s demands are exceeding the Earth’s carrying capacity⁵⁰. This is also shown by the Ecological Footprint which shows that humanity is using resources at a greater rate than that at which they are being replenished. The Footprint tracks the capacity of the planet to provide ecosystem services in terms of biocapacity – the amount of land required to provide for the needs of humanity. Since the late 1980s the planet has been in overshoot, that is, the Ecological Footprint exceeds the biocapacity of the Earth. This means that people are turning natural resources into waste at a faster rate than nature can turn waste back into resources. This pressure drives habitat destruction or degradation, threatening natural systems and human well-being.⁵¹ (See Part 3 Production, Consumption and Waste for information on Victoria’s Ecological Footprint.)

The conversion of natural materials into producer and consumer goods places increasing pressure on the environment because per capita and total consumption continues to increase. Economic growth is not achieved in ways that take full account of the environmental impacts (rather it involves unsustainable levels of resource consumption and waste production), and the environment is not properly valued in market exchanges and decision-making (see Part 3.3 Materials.)

While increased consumption is a global trend, the highest rates of consumption occur in wealthier, developed nations; there is a clear correlation between a nation's standard of living, its per capita consumption and its ecological footprint. As developing nations expand, their consumption can be expected to increase, which is likely to place even greater pressure on the Earth's non-renewable resources. Industrialisation of developing nations is also increasing global consumption of fossil fuels, thus contributing to climate change.

The 2004 CSIRO report *Environmental Sustainability Issues Analysis for Victoria* addressed the link between GDP growth and its environmental impacts. The authors used energy use to illustrate the challenge facing policy makers:

"Despite major changes to the structure of the economy, primary energy use (predominantly fossil fuels) and GDP have been growing together at an average rate of 3.6 % per year throughout the 20th century. There may be no necessary connection between energy use and GDP, but the close correlation suggests a structural constant of the Australian economy. Breaking this correlation would require changes to the current development path."⁵²

One aspect of our development path that needs review is how we assess the costs and benefits of actions that impact on the environment (see Part 5 Living Well Within Our Environment for more information on decoupling).

Valuing the Environment

The economy tends to operate on the principle that companies and individuals choose cost-effective alternatives, which historically has led to a prioritisation of fiscal gains over environmental benefits. Governing frameworks, legislation and policies within contemporary approaches to economic management seek to be market-friendly. It is only in cases of market failure that the government has a strong policy imperative to intervene. Such interventions may themselves take market forms, as with Australia's proposed emissions trading scheme.

Economic growth is generally measured by statistics such as the growth in gross domestic product (GDP), or gross state product (GSP), which show the value of goods and services produced by the nation or the state per year. Reflecting the market environment discussed above, GDP is confined to values registered by monetary transactions. This misses some important contributions to well-being. Moreover it registers some negative phenomena as if they were positive. As Dowrick and Quiggin put it:

"No allowance is made for environmental differences, non-market household production or production and consumption externalities. For example, if polluting industries cause illnesses that require expensive medical treatment, both the output of the polluting industry and the expenditure on medical services will be counted as part of GDP. Thus, aggregate output may increase whilst well-being declines."⁵³

Conventional growth measures may fail to alert us to serious problems because these problems are 'externalities' – i.e. they lie outside conventional economic and market frameworks. Consequently GDP is an unsatisfactory measure of human well being.⁵⁴

This statistical issue reflects a serious market failure, in that the market does not adequately value environmental services and assets. If the environment is not 'paid' for its services, they appear to be without cost to those using them. For example, an industrial plant may release effluent into a river. If the plant were not charged for this activity, use of the river to dispose of effluent would appear 'free' – and free (or underpriced) goods and services tend to be overused. Ultimately, of course, the cost would register when someone had to pay to clean up the river.⁵⁵

The cost of water, energy and waste disposal in Victoria does not currently account for the full environmental cost benefits ratio⁵⁶. Electricity costs in Victoria, which are low because environmental costs are not fully captured, offer little incentive for consumers to cut their energy use, or switch to alternatives such as slightly more expensive renewable sources.

Likewise, it is relatively cheap to send waste to landfill, so there is little incentive to seek alternative ways to dispose of waste or better still, reduce waste production at the design stage. Thus there is a danger that it appears cheaper to degrade the environment than to conserve it. This has been graphically illustrated at contaminated sites such as the Metropolitan Fire Brigade complex in Burnley and the former Cranbourne landfill; both examples of contamination from former land use (see Part 3.3 Materials). These incidents clearly demonstrate that polluters effectively defer substantial risks and costs to later generations.

The challenge of fully capturing environmental costs and benefits appears in a number of guises. In costing long-term projects, such as wind farms or coal-based power generation, a discount rate is applied to future costs and benefits to measure them against present values. There has been much controversy over how to discount environmental costs and benefits in such contexts.⁵⁷ Another related issue is 'opportunity cost', which involves the costs associated with alternative courses of action. When contention arises over these issues, it is commonly about differing assumptions underlying economic models, which may reflect different community interests. Part 5 of this report explores alternative measures of growth and well-being.

To identify environmental externalities, accurately value them, and regulate the market to ensure this value is reflected in human behaviour represents a major policy challenge. Part 5 Living Well Within Our Environment considers a range of economic instruments which may assist.

Economic trends

Australia has enjoyed the benefits of a global resources boom, driven to a large extent by rapid growth in developing countries such as China. Consequently it has experienced relatively strong growth over recent years. From 1997 to 2006, Australia experienced an average annual growth rate of 3.5% for GDP in real terms, higher than any 'G7' country⁵⁸. Commensurately, in the decade to 2005-06, Victoria experienced an average annual GSP growth rate of 3.6%⁵⁹.

As shown in Figure DF7 Victoria's economy has been growing at a faster rate than population, an indication of an increasingly affluent society. Since 1990 Gross State Product has grown by more than 60%. However, more recently the global economic environment has become much more challenging, causing GDP growth to slow.⁶² Slower growth would not

necessarily reduce overall environmental impacts; indeed it could conceivably intensify them or at the very least increase pressure not to adequately treat current and emerging environmental degradation. Whilst the growth in total consumption would be likely to slow, industry and the community might face new economic pressures (such as reduced profitability and concerns about unemployment) which compete for attention with environmental concerns. Also, there may be increasing pressure to not harm economic growth during periods of worldwide financial volatility. This may delay or influence the effectiveness of the implementation of emissions trading as the principal measure to reduce levels of greenhouse gas emissions.

The overall structure of the economy contrasts with the structure of exports. The economy as a whole is increasingly

dominated by the service sector (see Figure DF8), with manufacturing retaining a certain importance. Victoria's service sector has grown since 1990 in its contribution to the State's economy from 47% to 60% in 2006. Manufacturing and primary industries are also significant contributors to the Victorian economy, providing close to 20% of Victoria's total factor income (see Figure DF8). However, primary industry's contribution to the economy has declined from 7.5% in 1990 to 5% in 2006. The manufacturing, electricity, gas, water and construction sectors have also experienced some decline in their relative contribution to the economy.

Victoria's exports comprised 18.8% of Australia's total exports in 2000-01. In 2004, Victoria exported almost \$26 billion of goods and services with food and manufacturing the key drivers of export growth. Dairy is the largest component of Victoria's food industry providing \$2.3 billion in exports in 2000⁶⁴.

In 2007-08 Victoria's merchandise exports were valued at \$20.5 billion, making up 11.4% of Australia's merchandise exports. Manufactured products contributed 86.5% of the total Victorian value of exports, with the Food, Beverages & Tobacco Industry exports valued at \$5.4 billion and Metal Products Industry exports valued at \$5.3 billion. The biggest contributing industry groups were motor vehicle & parts manufacturing valued at \$2.8 billion and Dairy product manufacturing valued at \$2.4 billion. Direct exports from Agriculture, Forestry and Fishing contributed 5.9% of the total Victorian value in 2007-08. Mining Industries exports were valued at \$327 million or 1.6% of the total.⁶⁵

Figure DF7 Victorian GSP compared to population

Source: ABS^{60,61}

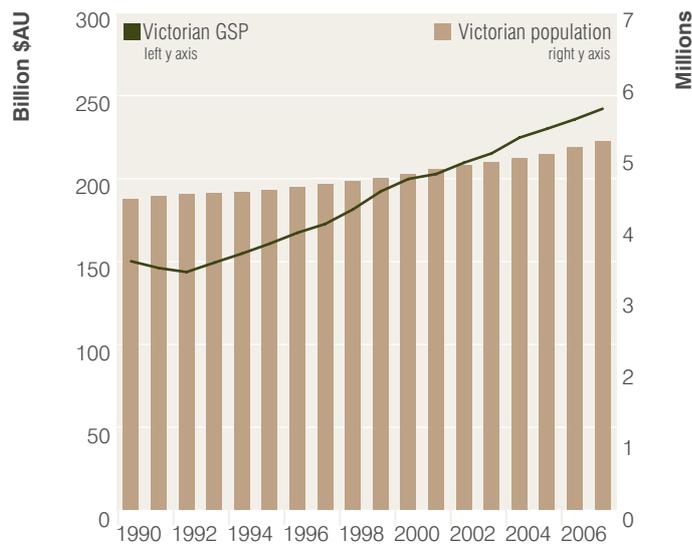
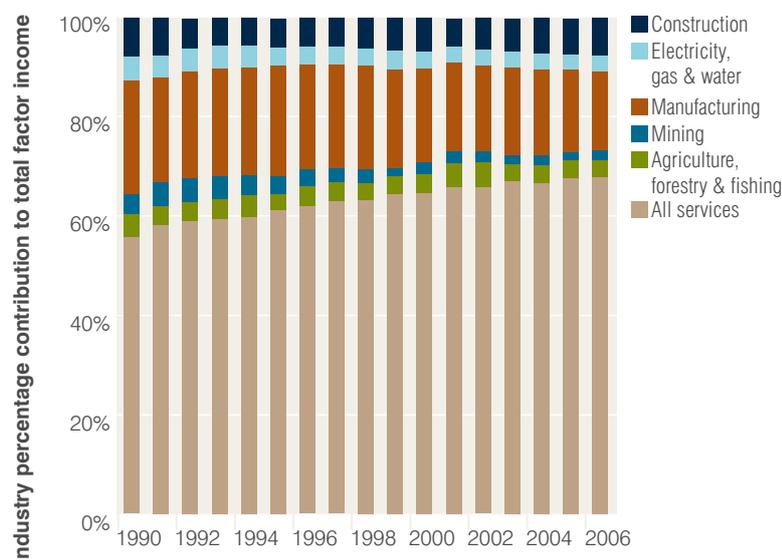


Figure DF8 Victorian Industries 1990 – 2006 as a contribution to Total Factor Income

Source: ABS 2006⁶³

NOTE: Total factor income is a measure of industry's contribution to the economy



Resource Intensity in Victoria

Victoria's economy exhibits increases in the efficiency of a number of key indicators of resource use (pressure per million dollars worth of GSP). However, increased efficiency does not necessarily equate to a reduction in absolute pressure. In fact increasing efficiency, by reducing prices, can induce greater consumption, which may lead to increased pressure and potentially to increased environmental degradation. This phenomenon is sometimes called the rebound effect.

Box DF1 Defining the rebound effect:

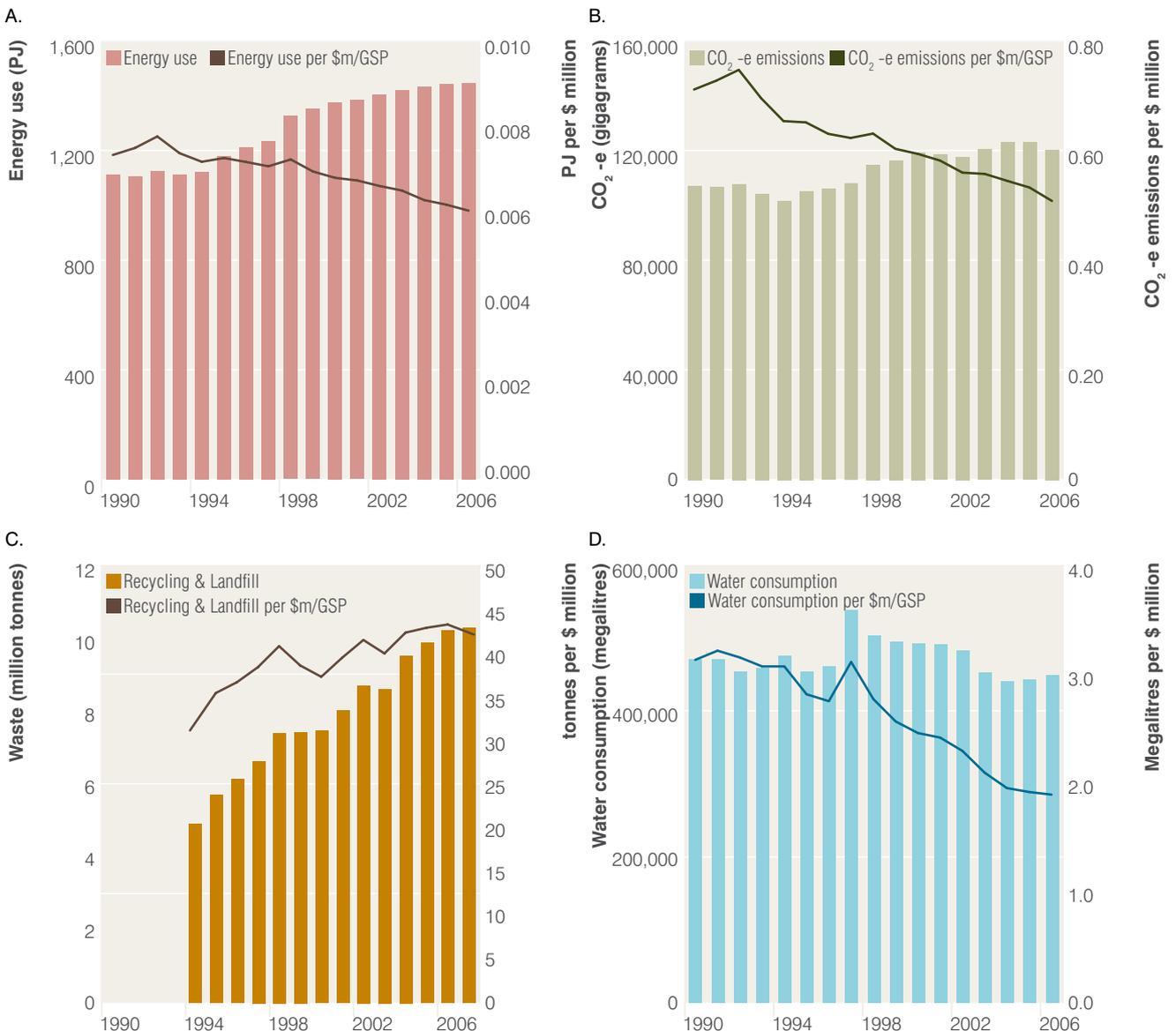
Direct: Many energy efficiency improvements do not reduce energy consumption by the amount predicted by simple engineering models. This is because, as rising efficiency makes energy services cheaper, the lower costs encourage consumption. For example, since fuel-efficient vehicles make travel cheaper, consumers may choose to drive further and or more often, thereby offsetting some of the energy savings achieved. Similarly, if a factory uses energy more efficiently it becomes more profitable, thereby encouraging further investment and greater levels of output. This is termed the direct rebound effect.

Indirect: Even if consumption of energy services remains unchanged, there are reasons why energy savings across the economy may be less than simple calculations suggest. For example, drivers of fuel-efficient cars may spend the money saved buying petrol on other energy-intensive goods and services, such as an overseas flight. Similarly, any reductions in energy demand will translate into lower energy prices which encourage increased energy consumption. These mechanisms are collectively known as indirect rebound effects. The sum of direct and indirect rebound effects represents the economy-wide rebound effect. Rebound effects are normally expressed as a percentage of the expected energy savings from an energy efficiency

improvement, so a rebound effect of 20% means that only 80% of the expected energy savings are achieved.

Disputes over the magnitude of rebound effects arise in part from a lack of clarity about definitions. Energy efficiency can be measured in a variety of ways, for example using physical indicators (tonnes of coal to produce a tonne of steel) or economic ones (energy per unit of output measured in dollars). Energy efficiency can also be measured at different levels, for example for an individual manufacturing process, a factory, a company, a sector or even the economy as a whole. Estimates of the rebound effect therefore depend upon the indicators chosen and the level of analysis⁶⁶.

Figure DF9 The estimated environmental intensity of the Victorian economy: Energy use (A), CO₂-e emissions (B), waste (C) and water use (D) per \$million GSP
Source: ABS, ABARE, DSE and Sustainability Victoria ^{67,68,69,70,71}.



DF4 Summary

For example, the Victorian economy is becoming more efficient in its use of energy. In 1990 0.0077 petajoules were consumed for every million dollars worth of GSP generated, while by 2006, this had been reduced by 22% to 0.0063 petajoules. Over the same period however, total energy use increased 30% (see Figure DF9). While efficiency has increased, absolute pressure has also increased. The same pattern is observable for CO₂ emissions. For material flows there is no significant decoupling of waste from the economy and in terms of absolutes waste production more than doubled from 1994 to 2007 (see Part 3.3 Materials). The combined effect of efficiency improvements and demand management measures (restrictions) created as a result of scarcity has resulted in a decrease in water consumption. Efficiency gains are more likely to translate into decreased consumption if they are accompanied by other factors such as scarcities, economic incentives and/ or government regulation.

This section has identified and discussed the key drivers of environmental degradation: climate change; population growth and settlements; and consumption associated with economic growth. Their wide-ranging impacts are explored throughout this report. Most immediately they inform the analysis of energy, water and materials in Part 3 Production, Consumption and Waste. Then in Part 4: State of the Environment, the drivers are reflected in the discussions of atmosphere, land and biodiversity, inland waters; and coasts, estuaries and the sea.

A challenge for the Victorian community is to find solutions to break the cycle and put the State on track to truly become a sustainable State. Options for new directions are explored in Part 5: Living Well Within Our Environment, which re-examines the drivers in light of the findings, and suggests solutions.



Photo: Jane Tovey