

# Human Settlements



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## National Library of Australia Cataloguing-in-Publication Data:

Human settlements.

Bibliography.

Includes index.

ISBN 0 643 06747 7.

ISBN 0 643 06754 X (8 v.)

ISBN 0 643 06755 8 (7 v.)

1. Human ecology – Australia. 2. Human settlements – Australia.  
3. Environmental monitoring – Australia I. Newton, P. W. (Peter Wesley), 1948– . II. Davies, Alexander. III. Australia. Environment Australia. (Series : Australia state of the environment 2001).

304.20994

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The book is printed on Regent Recycled paper made in Australia.

Published by **CSIRO PUBLISHING** on behalf of the Department of the Environment and Heritage.

150 Oxford Street (PO Box 1139)  
Collingwood VIC 3066  
Australia

Telephone: +61 3 9662 7666  
Freecall: 1800 645 051 (Australia only)  
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Email: publishing.sales@csiro.au  
Web site: www.publish.csiro.au

Cover photo: Pink Lake near Meningie, South Australia © John P Baker

For bibliographic purposes, this report may be cited as:

Newton, P.W., Baum, S., Bhatia, K., Brown, S.K., Cameron, A.S., Foran, B., Grant, T., Mak, S.L., Memmott, P.C., Mitchell, V.G., Neate, K.L., Pears, A., Smith, N., Stimson, R.J., Tucker, S.N. and Yencken, D., 2001. ***Human Settlements***, Australia State of the Environment Report 2001 (Theme Report), CSIRO Publishing on behalf of the Department of the Environment and Heritage, Canberra.

The 2001 *Human Settlements* theme report is one of seven produced for the Australian State of the Environment Committee which form the basis of the report *Australia State of the Environment 2001*. Theme reports for the remaining themes: *Biodiversity*, *Atmosphere*, *Land*, *Inland Waters*, *Coasts and Oceans*, and *Natural and Cultural Heritage* are available in print from **CSIRO PUBLISHING** and on the web at: <http://www.ea.gov.au/soe/>

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Cover and text design by James Kelly.  
Typeset by Desktop Concepts P/L, Melbourne.  
Printed in Australia by Brown Prior Anderson.

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## Acknowledgments

State of Environment Reporting on Human Settlements is evolving its unique conceptual framework and approach for examining the environmental, social and economic implications of the manner in which the Australian human settlement system operates. I am indebted to my colleagues on the 1996 SoE report, Professor Peter Newman (Murdoch University) and Dr Bob Birrell (Monash University), who were part of the intellectual environment where the Extended Urban Metabolism Model was conceived as a guiding conceptual framework for SoE reporting on human settlements.

More recently, discussions with Barney Foran (CSIRO Sustainable Ecosystems) have led to greater focus on urban stocks than heretofore; Professor David Yencken (University of Melbourne) suggested separation of urban liveability into its human well-being and environmental quality components; and Professor Peter Cullen (University of Canberra) encouraged the view of stormwater, wastewater and solid wastes as key urban resources. The structure of this report reflect these insights.

The content and substance of this report are due in large part to the specialist knowledge contributed by the co-authors: Scott Baum and Bob Stimson (population, housing and settlement), Kuldeep Bhatia (environmental health; with Andrew Phillips), Stephen Brown (indoor air quality), Scott Cameron (food), Barney Foran (stocks and scenarios; with Franzi Poldy), Tim Grant (materials; with Dominique Hess), Swee Mak (solid and hazardous waste; with Kwesi Sagoe-Crentsil), Paul Memmott (Indigenous population and settlement; with Mark Moran), Grace Mitchell (water), Alan Pears (energy), Nariida Smith (transport and noise), Selwyn Tucker (energy and housing), and David Yencken (urban design). Significant research and editing assistance was provided by Kirsty Neate and Cathy Bowditch.

In addition, important contributions have been made by: Professor Russell Blong (Macquarie University) and John Schneider (AGSO) on geohazards; Professor Peter McDonald (ANU) and Professor Graeme Hugo (University of Adelaide) on demographics; Associate Professor Maryann Wulff (Monash University) on housing; and Phil McKenzie (ACER) on human capital.

This report has also benefitted substantially from the constructive comments of two review panels:

- the expert reference panel—Professor Valerie Brown (University of Western Sydney), Professor Richard Eckersley (ANU), Bob Harrison (ABS), Professor Stuart Hill (University of Western Sydney), Professor Graeme Hugo (University of Adelaide), Andrew Speers (CSIRO Urban Water Technologies), and Victoria Henry (Air Toxics Branch, Environment Australia), and
- the peer review panel—Professor Ian Lowe (Griffith University), Professor Janis Birkland (University of Canberra), and Professor Peter Droege (University of Sydney).

I bear full responsibility, however, for what appears in the final version of this report.

There are two substantive areas that remain to be successfully addressed by SoE reporting. The first is to move the document from an SoE report to an 'ESD report'. From one which is less of a scorecard on 'what is', including implications of pursuing a 'business as usual' path, to an alternative document which addresses what could be done or what needs to be done in presenting alternative futures, preferred visions of sustainable development. The second is to produce a spatial information system, underpinned by the emerging discipline of *sustainability science*, where the complex web of causal linkages and connections characteristic of urban systems are capable of being explored in order to better understand future rates and paths of change. The technology platform of Internet and GIS capable of delivering some of the objectives listed above is rapidly developing (refer to Data Gaps section of this report) and should be available for the 2006 report. The creation of a network of researchers linked to Federal and State Environment Departments within the framework of a *Cooperative Research Centre for SoE/ESD Reporting* is, perhaps, the only means by which the growing expectations surrounding sustainable development can be realised.

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April 2001



## Executive summary

Australia's transition to the 21st century has been marked by an extended period of economic prosperity unmatched for several decades, but one in which a series of question marks are being raised in three principal areas: in relation to the environment, the social well-being of the population, and the future path of economic development.

The first concern, which is of primary interest in this report, relates to the physical environment of cities and their surrounding regions, and the range of pressures exerted by population and human activity. The report begins by noting the increasing divergence of the prime indicator of national economic performance—gross domestic product (GDP)—from the Genuine Progress Indicator (GPI). GPI is a new experimental measure of sustainable development that accommodates factors currently unaccounted for in GDP, such as income distribution, value of household work, cost of unemployment, and various other social and environmental costs. The divergence of these two indicators in recent decades suggests that Australia's growth has been heavily dependent on the draw-down of the nation's stocks of capital assets (its infrastructure), its human and social capital, and its natural capital (Hamilton 1997). The pressures of Australia's consumption are becoming increasingly obvious.

The 1996 SoE Report on Human Settlements highlighted several issues of concern. Australia's major cities and coastal towns were absorbing most of the nation's population growth, placing pressure on natural environments, productive agricultural land, water resources, urban airsheds, and sewage and waste disposal systems. At the same time, many inland towns were declining in population and economic well-being, thereby compromising their capacity to manage or rehabilitate their immediate environment. Remote Indigenous communities were found to be suffering from critically low levels of social amenity, inadequate housing, and poor waste treatment and water supply systems, and presented severe health problems.

In 2001, the situation can be summarised as follows:

### **Future population**

Australia's population is forecast to increase to a likely 23 million by 2021, equivalent to creating one extra city the size of Sydney, with its attendant demands on resources, infrastructure and services. A national 1.2% annual population growth rate is high compared with the OECD. This, coupled with high and increasing levels of per capita consumption, has significant implications for the environment.

### **Coastal belt**

Between 1991 and 1996, one-quarter of Australia's total increase in population was accommodated within three kilometres of the coast—predominantly concentrated in 'sun-belt' locations on the New South Wales and Queensland coasts and selected regions in the south-west of Western Australia. Development to accommodate this population is exerting pressure on natural environments and will intensify.

### **Cities versus country**

On existing trends Australia's cities and regional centres will continue to grow at more than twice the rate of smaller centres, providing challenges for environmental management in areas of growth as well as in areas of decline. Mega-metro region growth will be a feature of the nation's settlement system this century, stimulated by high-speed transport and communications and the locational requirements of industry.

### **Re-urbanisation versus suburbanisation**

Re-urbanisation processes have resulted in the growth of population and residential densities in the inner suburbs of Australia's major cities, reversing a pattern of consistent decline since the early post-war years. However, the overwhelming trend is still suburbanisation with centrifugal pressures causing the loss of open space, natural environments and rural use at the urban fringe (for example, over 40% of nationally listed threatened ecological communities occur in urban fringe areas such as the Swan Plains near Perth; Schedule 2, *Endangered Species Protection Act 1992*). Centripetal pressures from sprawl contribute to increased congestion and gridlock in inner and middle ring suburbs due to a mismatch of jobs and services, with housing in the outer suburbs resulting in inwards commuting for work.

## Density of development

Residential densities, while low by international standards, are increasing in Australia's largest cities, reflecting influences of government urban consolidation policies (and planning codes), a change in the locational preferences of information industries and information workers towards the CBD, and a responsive property development sector which is increasing the supply of medium-density housing. Overall, the benefits are positive for the environment in relation to lower water and energy use, although there are concerns over changes to neighbourhood character caused by unsympathetic urban design and fine-particle air pollution in congested inner city precincts.

## Resident versus visitor populations

Short-term overseas arrivals to Australia have increased from 40% to 56% of all arrivals between 1981 and 1999 (ABS 2000a). International tourism is forecast to grow at several times the rate of resident population growth, channelling visitors and their impacts into a relatively narrow set of locations: capital CBDs, holiday resort coasts, and key natural and cultural heritage locations. Tourism now rates as Australia's fourth-largest industry in attracting foreign income. Yet it is one whose environmental impacts are largely hidden because they are 'transferred' to other sectors: for example, transport, energy and greenhouse; generation and disposal of solid waste; and expansion of consumption spaces (hotels, restaurants, shopping centres).

## Indigenous settlement

Indigenous communities are represented in all types of settlements, but proportionately are concentrated more heavily in remote locations which are poorly serviced—compounding health, employment and housing problems. Withdrawal of Indigenous traditional land management has, and is, altering broad-scale biodiversity (see the Biodiversity Theme Report).

## Per capita consumption

Most indicators of resource consumption and their precursors continue to outpace population growth, for example:

- The annual rate of household formation (2.0%) exceeds that of population growth (1.2%), stimulating demand for housing and related consumption expenditures.
- Consumption of dwelling space continues to grow as reflected in increasing floor space of new dwellings constructed (3% per annum increase 1992–1999 linked to reduction in cost per square metre of new construction). This is despite a decline in the average size of households (2.6 persons per household in 1999 versus 3.3 in 1976). Tax benefits associated with the family home and negative gearing of investment property is an additional stimulus.
- In Australia, 3.2% of households own a holiday house, representing approximately one-quarter of a million dwellings—equivalent to two cities the size of the Gold Coast.
- Australia generates total material flows of almost 180 tonnes per person per year (Foran and Poldy 2000). This flow is several times that of other OECD countries as is the rate of growth of these flows. (Total material flows per person reflect the combined effect of materials for export and domestic consumption, and the fact that the Australian economy continues to rely heavily on its mineral and agricultural commodities.)
- End-use consumption of energy by the residential sector has increased by 60% since 1975 (versus a 35% increase in population). Forecasts are for more rapid increase in consumption of energy for transport, industry and commercial uses (e.g. AGO forecast almost a doubling in commercial energy consumption between 1990 and 2010 in a business-as-usual scenario).
- With per capita consumption of 1540 kL/year, Australia leads all other countries in water use (1510 kL/year per capita in North America; 665 kL/year Europe; 650 kL/year Asia; 670 kL/year world (Shiklomanov 2000)). Growth in demand for water for domestic use continues, but at a slightly slower rate than growth in population. During the 1990s, average per capita water use in major urban areas decreased slightly (by 7% between 1993–94 and 1998–99). Only 8% of water use in Australia is due to domestic consumption; 70% is for agricultural use.

- The rate of car ownership in Australia (484 passenger vehicles per thousand people) is high by international standards. And for those with access to cars, personal mobility, as measured by vehicle kilometres travelled (VKT), is increasing at a faster rate than other transport indicators would suggest. For example, in Sydney between 1981 and 1997, the population increased by 20%, car trips for all purposes increased by 34%, the number of registered cars increased by 47%, and VKT increased by 58%.
- Australians currently dispose of 620 kg of domestic waste per person per year, second only to the USA. When commercial and industrial as well as construction and demolition wastes are added, Australia has a per capita solid waste disposal stream of 1.15 tonnes per year. Over 95% of solid waste is currently disposed to landfill, adding to the nation's consumption of space and demand for virgin materials for commodity production. Landfill also poses major environmental problems for groundwater quality.

The challenge for Australia is to stabilise its total consumption. Both population and consumption per person need to be controlled to achieve what Herman Daly, in his book *Beyond Growth: The Economics of Sustainable Development*, termed the 'steady-state economy'.

### **Greenhouse**

Australia is one of the largest per capita emitters of greenhouse gas in the world (27 tonnes per capita—double the average for developed countries), although most of the growth in emissions per capita is coming from sectors other than household energy use. The 1998 National Greenhouse Gas Inventory, using the current accounting system, reveals that Australia's greenhouse gas emissions (excluding land use change) were 16.9% above 1990 levels (the Kyoto target for Australia is 8% above 1990 levels by 2008–2012).

### **Material consumption**

At a time when there is much talk about the growing importance of services, information and dematerialisation (the reduction of material inputs), our profile of material flows reinforces the image of 'Quarry Australia'—of the seemingly irreducible physical basis of our economy. 'Hidden flows' (overburden, wastes from mineral processing operations, soil loss from agricultural cultivation) represent 70% of total material flows in Australia, yet provide no direct economic benefit while incurring environmental cost. While the USA has rich natural endowment like Australia, it has also developed a sophisticated manufacturing and services base to a level as yet unmatched by Australia.

### **Energy consumption**

Australia is well endowed with both renewable and non-renewable energy resources. Australia is capitalising on the latter endowment to drive its economic growth, but future use of fossil fuels will be constrained to a greater extent than in the past by the environmental impacts of their extraction and consumption. In this era of transition to a renewable energy base, which has only just begun, considerable reliance will be placed on increasing energy efficiency of a wide spectrum of built environment products and processes, ranging from household appliances, automobiles, housing and office buildings, to industrial processes etc. Government standards and regulations working in tandem with market mechanisms will prove to be critical to this process. Other key areas for attention include optimising the efficiency and environmental effectiveness of the national electricity market in respect to optimising fuel mix and improving the efficiency of electricity generation (currently about two-thirds of the energy is lost in conversion); as well as encouraging growth in activities that are low in energy intensity via structural change to the economy. A fundamental question for 21st century Australia is what spectrum of industries should it have by 2050? Intimately connected to this is the reshaping of technology, industry, settlement and culture that must, of necessity, accompany the social transition from a fossil fuels-based economy to an economy based on renewables; from a waste-producing society to a waste-utilising society; from an economy based on material extraction to one based on knowledge production and utilisation.

### **Water availability and use**

There is great geographic variability in rainfall, runoff and consequently divertible water resources available to Australia's human settlements. The proportion of divertible freshwater

resources used varies from 1% in the Northern Territory and the Kimberley to 38% on the Queensland coast to 2500% in the South Australian part of the Murray–Darling Basin. The decline in per capita domestic water use in most large urban centres during the 1990s has been due to a combination of water pricing, consumer education, use of water-saving appliances and higher residential densities (linked to lower outdoor water use for gardens etc.). With increasing resident and visitor populations, and industrial and agricultural activity, however, a key challenge for water authorities involves the speed with which they move to re-engineer water systems for human settlements. This will involve the reuse of stormwater and wastewater currently removed from human settlements in order to reduce the large volumes of water currently imported to them. As an example, Sydney Water Corporation supplies approximately 640 GL of water to Sydney and collects 550 GL of wastewater, while on average some 420 GL of stormwater runoff is discharged. Therefore, the output of stormwater and wastewater represents 150% of water supplied. Scalable treatment technologies and networks now exist to effectively service settlements of different size in relation to stormwater and wastewater reuse. However, a range of instruments (standards, economic pricing, community acceptance) are not yet in place to encourage stormwater and wastewater reuse. The challenge is a significant one, as currently less than 1% of Australia's water use is supplied from the reuse of wastewater.

### **Land, water, food, air and noise quality**

An overall trend across Australia since the 1990s has been an increase in the level of environmental complaints (covering water, air, land, noise and waste issues), as recorded by state and local environmental protection agencies. Significant shortcomings have been identified against this class of (subjective) indicator, with the consequence that greater reliance should be paid to the scientific assessments of the state of each domain:

- *Land.* There are an estimated 80 000 contaminated sites in Australia. There are no overall estimates of remediation costs available, but in New South Wales 7000 sites have been identified for remediation at a projected cost of more than \$2 billion.
- *Water.* Ninety-eight per cent of the population is connected to reticulated water supply and nearly 95% to reticulated sewerage networks, although Perth and its surrounding regions are lagging behind (AWA 2000). Rural and remote communities are less likely to have reliable reticulated supplies; Indigenous communities even less so. The salinity of drinking water is an issue for some cities and towns, especially Adelaide, but biological contamination of water is not judged to be an issue. Food quality is considered to be of greater concern than water quality in diarrhoeal diseases.
- *Food.* Australian food is judged to be of high quality from the perspective of agricultural and other chemical residues. An estimated four million cases of food-borne illness occur each year, caused primarily by inadequate preparation and storage of processed food prior to consumption. Very few deaths are attributable to food-borne disease, and those that occur are almost universally linked to the very young, old or immuno-compromised (similar to those susceptible to poor indoor air quality).
- *Indoor air.* Indoor air quality is often inferior to outdoor air—especially in urban transit, new homes and refitted offices—because of the entry of traffic pollution or because of pollution emitted indoors from manufactured materials and other sources. This is looming as a key issue for human health and productivity, since on average 96% of each 24 hours is spent 'indoors' by the Australian population.
- *Passive smoke.* While there has been a significant reduction in tobacco smoking over recent decades, there are still substantial numbers (39%) of young children exposed to tobacco smoke, with a consequent burden of respiratory illness.
- *Noise.* Environmental noise and its impacts on residents is increasing, due to trends such as increased residential density, traffic volumes and the 24-hour city. One in 10 dwellings in Australia's cities experience levels of road traffic noise over an 18-hour period which exceed recommended levels (68 dB(A) L10 18-hour). Noise-related standards within the Building Code of Australia have not kept pace with urban development. Air traffic noise is also increasing—especially for Sydney residents.

### **Effectiveness of urban infrastructure networks**

The performance of Australia's urban infrastructure networks fundamentally affects the competitiveness of the economy and the quality of life of its citizens. In this context,

Australia's level of infrastructure spending has fallen dramatically over the past few decades and has been accompanied by increased participation by the private sector in infrastructure construction, operation and ownership (Evatt Foundation 1996). Privatisation in the electricity sector has resulted in lower costs, increased consumption and increased CO<sub>2</sub> generation. In the water sector, increased fragmentation and privatisation raises questions over the ability to plan for and finance the re-engineering of entire metropolitan water and sewerage networks to integrate wastewater and stormwater reuse. The possibility for full privatisation of telecommunications may bring into question the prospect of universal access to a full range of services to all levels of settlement in Australia. This constitutes an increasing concern to rural and regional Australia where there has been a significant reduction in services during the 1990s, as well as a growing disparity—compared to the cities—in human capital, employment opportunities and new economy industries. Privatisation of different modes (trains, trams, buses) and zones of public transport in a number of the capital cities means that each zoned franchise maximises its profitability at the expense of metropolitan-wide connectivity. This further impedes the ability of public transport in its competition with the private car.

### **Human health and well-being**

The health of Australians is good by international standards. We rank second to the Japanese in terms of healthy life expectancy (73 years). There are several key disparities among the Australian population in relation to health, however. For example, a man can expect to die six to seven years younger than a woman. Also, the health status of Indigenous Australians significantly lags that of the non-Indigenous population. The life expectancy of Indigenous Australians born in the 21st century is similar to that for non-Indigenous Australians born at the beginning of the 20th century.

The major causes of death in Australia are cardiovascular diseases, cancers, respiratory diseases and injuries (particularly motor vehicle accidents and suicide). Some of the risk factors for these causes of death are:

- Lifestyle and environmental factors:
  - smoking, including passive smoking
  - poor diet
  - physical inactivity
  - exposure to pollutants.
- Where people work:
  - blue-collar versus white-collar occupations
  - workplace-related injuries.
- How much they earn:
  - affecting access to timely and quality health care, medications and therapies.
- Where they live:
  - quality of local environments and amenity
  - proximity to health care services is a key factor affecting health outcomes in urban versus rural and remote settings.

### **Waste recycling and reuse**

The era of significant and widespread waste recycling and reuse, like that of renewable energy, is in its infancy. In some states and territories, and for particular waste streams, recycling rates are approaching disposal rates. However, there are uneven rates of recycling for different types of wastes, and in different states and territories. For example, in the ACT and Queensland the rate of recycling and recovery of plastics ranges between 2 and 3 kg/capita/year, while in Victoria the figure is closer to 9 kg/capita/year.

The principal barriers to reuse of waste in new product development are the absence of performance criteria for new (composite) materials, existing building regulations and standards and conservatism within the building industry, continuity of waste streams, and price competitiveness relative to virgin materials.

### **Urban planning and design**

Reshaping and recycling Australia's human settlements must become a priority for all stakeholders in the built environment of the 21st century. This report has outlined the key challenges to sustainable urban development, but there are clear choices (responses) available

which lead to more sustainable outcomes than those suggested by the current state of play in this report. These exist at the individual level and involve change in human behaviour. They exist at government level and involve change in policy settings, regulation, pricing and investment in key urban infrastructures that significantly affect the economies and environments of urban communities. They also exist at industry level, and involve investment in new technologies and management practices to create new industries that meet the charter of increased resource productivity, which underpins increased well-being and reduced resource consumption (Weizsacker et al. 1997).

The second question mark concerns the appropriate path for Australia's future economic development, involving choices between levels of investment in the 'new' versus 'old' economy industries, and between what Marceau et al. (1997) have termed a 'high' versus a 'low' road for national industrial development. From an environmental perspective, the new economy is based to a greater degree than previously on deriving wealth from knowledge, and human and natural capital and services—cumulative and renewable resources—rather than on non-renewable resources and the energy-intensive activities necessary for their conversion to commodities (in 2000, commodities still comprised the bulk of Australia's exports at 55%; Wyatt 2000). While much of the focus on the transition to the new economy has to date centred on information technology, communications and biotechnology industries (Brotchie et al. 1985, 1987, 1991), the shift is likely to be much more comprehensive. Indeed a new industrial revolution is being advanced (Hawken et al. 1999) whereby new materials, products and services are generated from new industries based on radical resource productivity, which includes the recycling and reprocessing of waste streams presently discarded. How these latter trends will manifest spatially is as yet unclear. What is becoming evident is that the fossil fuel-powered base of Australia's industrial era is being challenged technologically and environmentally. The earlier agricultural era is in its final stages of transformation from a settlement perspective (e.g. rural depopulation and town closures). The transitions from industrial-era manufacturing to an information-based economy has seen a revitalisation of previously dormant and declining inner city areas. Meanwhile the geography of 21st century manufacturing, based around industrial ecology principles, is yet to be mapped onto the nation's settlement landscape, but is likely to act as a new engine for development within Australia's mega-metro regions. Higher productivity associated with the penetration of new economy technologies and work practices into old economy industries and workplaces, if sustained, can also weaken the traditional neoclassical linkage between economic growth and population growth.

The third and final question mark concerns the increasingly unequal manner in which Australians are sharing in the benefits of growth in national wealth. Significant gaps are emerging in areas such as:

- *Income*—where average gross incomes for the most affluent 10% of Australians has increased three to six times that of the middle and bottom income distribution between 1982 and 1997 (National Centre for Social and Economic Modelling (NATSEM)), and where between 1994–1995 and 1999–2000 ABS income survey data shows the ratio of the 90th percentile to the 10th percentile among income units in Australia for the gross income measure has increased by just over 5% to a ratio of 8. However, as ABS data shows, when the gross income measure is adjusted to a disposable income measure, the Gini coefficient of income distribution in Australia reduced from 0.448 to 0.396 in 1999–2000, and when the Henderson equivalent measure of income is used, the Gini coefficient is further reduced to 0.317, thus showing that interventions through the tax and social security systems are having a redistributive outcome as such policy measures are intended to do. But, by 2000 more than one in four Australian children lived in families that relied on social security payments for a substantial part of their income, whereas ten years before, fewer than one in six children lived in a family on income support, and 30 years ago it was about one in 25 (Gray 2000a). Of course unemployment was much lower 30 years ago. When space is introduced as a variable, marked differences in income distribution differential certainly are evident across the settlement system. This is shown by NATSEM's modelling (Lloyd et al. 2000), where substantial differences exist between the big cities and regional Australia. The actual average incomes in 1996 were \$44 700 in the capital cities, \$34 600 in the regional towns, and \$36 100 in the rural areas.

- *Health*—where the health gap between the poorest 40% of Australians and the rest of the population has increased significantly. In 1983, people in the bottom two income quintiles had nearly 30% more serious illnesses per person than people in the top three quintiles; by 1995 this gap had increased to 45% (NATSEM 2000). This gap widens further for Indigenous Australians. In 2000, for example, they experienced life expectancies equivalent to all Australians at the turn of last century (Australian Institute of Health and Welfare (AIHW) 2000a).
- *Housing*—where the Australian dream of home ownership is declining from 72.4% of households in 1988 to 68.9% in 1998; and it remains but a faint hope for 70% of the Indigenous population.
- *Human capital*—where average levels of educational attainment, the most commonly used proxy for human capital, place Australia 15th among 21 OECD countries. This is further exacerbated by the ‘digital divide’ (access to and use of the Internet) currently evident in Australian society.

### **The patchiness of prosperity**

As a generalisation, life seems reasonable for around two-thirds of Australians based on this broad set of quantitative social indicators. Concomitantly one-third of Australians *believe* ‘life is getting worse’ (Eckersley 1999; see also Bone 2001). The trend towards a widening social divide is also reflected in a significant increase in the geographic polarisation of households within Australia’s settlement systems. According to Gregory and Hunter’s (1995) study: ‘The poor are increasingly living together in one set of neighbourhoods and the rich in another set. The economic gap is widening’. The role that geographic space and settlement processes (primarily through the operation of labour markets and to a lesser extent through housing markets) play is significant and continuing, as data from the more recent work of Baum et al. (1999) and Lloyd et al. (2000) documented in this report reveals.

These issues—vulnerable people and vulnerable localities—strike at the liveability and sustainability of our cities and urban regions, which, in the 21st century, constitute the engines of national economies and the location in which an increasing proportion of the nation’s population will live.

# Introduction

Human settlements are where all Australians live, where 95% work and where over 90% of the nation's GDP is generated. Their design, planning, construction and operation are fundamental to the productivity and competitiveness of the economy, the quality of life of all citizens, and the ecological sustainability of the continent.

Human settlement in Australia dates back at least 50 000 years (State of the Environment Advisory Council 1996 p.ES-11) to an Indigenous population engaged in hunting and gathering. With the arrival of Europeans a little over 200 years ago, the first in a series of major global social, economic and technological processes were unleashed which continue to shape and reshape human settlements in this country through the manner in which people live and work (Figure 1).

The early permanent settlements in Australia were linked to agricultural production, with primary production occurring in the hinterland regions of the colonial capitals. Each colonial capital developed largely independently before Federation in 1901, laying the foundation for metropolitan primacy that continues for the most part to the present. Movement was powered by human or animal energy, and the spatial scale of human settlement development was determined by the distance and time taken to walk within the town or to travel the fields. What manufacturing and service activities there were, were conducted within the settlements, often as cottage industries. Urban form was essentially contained in a residential sense, but dispersed in terms of the bulk of employment activity. Infrastructure networks were minimal. Over time, further coastal settlements evolved as ports and as focuses for transport linkages with their hinterlands. But the colonial capitals became the dominant hubs as a truly core-periphery form of settlement evolved.

The Industrial Revolution caused a major change in urban scale, form, activities, lifestyle and consequent settlement patterns. The substitution of mechanical force and fossil energies for human labour and craftsmanship led to mass production of goods, a centralised concentration of production activities, and the need for mass transport of the increased labour concentrations that developed. There were changes in employment conditions to more formal employment practices. As Ryan (1980 p.202) described it in the context of the USA's industrialisation and urbanisation:

'The concentrated nature of fossil fuels had the effect of organizing American life in a more concentrated physical and social structure ... Larger production units necessitated gathering larger quantities of the factors of production—labour, materials, machinery, and services—into a relatively small area around factories. This resulted in the growth of urban centers, and people left the site of the former energy source, rural America for the economic advantages of the centers where the new fuel was used, the city. Social concentration grew out of physical concentration in the form of crowding in cities, the accumulation of wealth in large organizations, and the greater political power these organizations exercised in national affairs.'

Rail transport enabled the growth of larger cities and their suburbs. In cities with railways, employment was concentrated in the city core, and residential areas were more dispersed. The city was essentially single-centred, with radial, fixed rail transport reinforcing the concentration of employment in the core.

Automation and associated labour productivity have continued to occur since World War II, with a shift to a service-based economy initially centred around personal and community services, but increasingly around information and transactional services. At its height, the 'services' era saw major suburbanisation of retail and other personal and social services in association with the increased personal mobility offered by the automobile.

Since the early 1970s, rapid development of telecommunications, information technologies and fast transport, and the shift to an information economy, is producing further changes in scale and form, including the reversal of several previous trends.

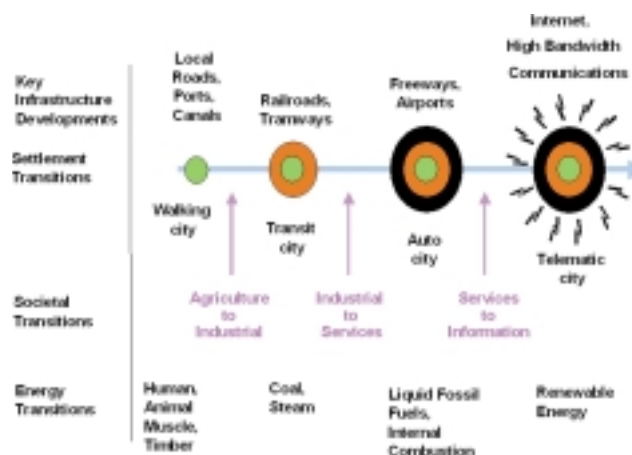


Figure 1: Settlement transitions.

Source: Newton (2000).

A significant feature, however, is that the time people are prepared to spend travelling to and from work has remained remarkably invariant throughout settlement history (Marchetti 1992). With this essentially constant travel time budget (on average, 30 minutes commuting either way between residence and workplace), the size of the city has been influenced by the distance which can be travelled within that time budget. Thus, with each transition, an increase in travel speed has been provided by new technology, and this has facilitated an increase in urban scale, with transition from walking city to transit city to automobile city to (in the future) telematic city. With continued growth in telework and e-commerce, prospects for a new space-economy begin to emerge, especially for those sectors of business activity where the constraints of 'being there', distance and conventional travel are significantly weaker.

The increased importance of information to urban and regional economies is evident from the continued growth of the information sector in the Australian economy (Table 1). In this transition, cities assume even greater significance than previously, as reflected in increasing rates of urbanisation on a global scale. Their transformation has been one from the centres of production and distribution of material goods, to centres of information exchange, service production and consumption as well as manufacturing.

**Table 1:** Structural change in the Australian economy—percentage contribution of major sectors to total employment,<sup>A</sup> 1947–1996. [HS Indicator 0.4]

Year	Rural	Mining	Manufacturing	Tertiary services <sup>B</sup>	Information services <sup>C</sup>
1947	16.8	1.8	27.0	38.5	15.9
1954	13.4	1.7	28.2	39.7	17.0
1961	11.1	1.3	27.5	40.4	19.7
1966	9.6	1.2	27.5	39.8	21.9
1971	7.7	1.5	24.2	40.4	26.2
1976	7.5	1.4	21.1	39.8	30.2
1981	6.5	1.4	19.2	39.2	33.6
1986	5.8	1.5	15.2	42.6	35.0
1991	4.9	1.4	13.8	43.2	36.8
1996	4.4	1.2	13.1	42.9	38.4

<sup>A</sup> Based on 1968 Australian Standard Industrial Classification; employees whose industry is unknown or unclassified are excluded from percentage calculations.

<sup>B</sup> ASIC divisions D, E, F, G and L.

<sup>C</sup> ASIC divisions H, I, J and K.

Source: Rich (1987 p.42), updated using ABS Census of Population and Housing.

In other words, a transition from an economic landscape dominated by 'old economy' industries to one where 'new economy' information and knowledge-based industries and occupations will increasingly feature as the key engines of 21st century economies.

Following a sharp recession that began at the end of the 1980s and lasted into the early 1990s, the remainder of the 1990s saw the real rate of growth of gross domestic product (GDP) average 4% per year—rates not sustained since the 1960s (INDECS 1995 p.26, Dowrick 1999, Macfarlane 2000). Consumption increased at a similar rate. GDP growth in per capita and absolute terms provides a measure of the strength of Australia's market economy. However, there are concerns about the representativeness of GDP as an indicator of national well-being, as it fails to embrace all three dimensions of triple bottom line (sustainability) reporting: economic, environment and equity. Despite the current period of sustained growth, significant progress has not been made towards addressing the unemployment rate, inequality in the distribution of income continues, and Indigenous Australians continue to lag almost a century behind non-Indigenous Australians in a range of health and welfare indicators. In addition, significant urban environmental problems continue to emerge (indoor air quality, drinking water quality, interruptions to energy supply, transport safety etc.) and there is a failure of metropolitan, non-metropolitan, rural and remote settlement to equally capture the benefits of national economic growth (Lloyd et al. 2000, Garnaut et al. 2001). Perhaps it is not surprising then that, when Australians were asked how they thought people and conditions (social, economic, environmental) in general fared during

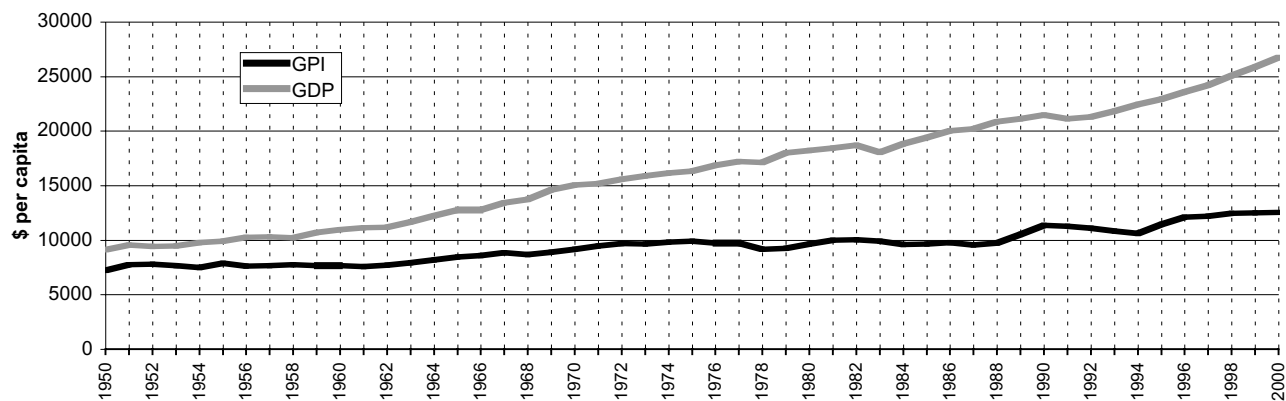


Figure 2: GDP and GPI per capita, 1950–2000 (constant 1989–1990 prices). [HS Indicator 0.2]

Source: Australia Institute (<http://www.gpionline.net>).

the 1990s, between one-third and one-half of those surveyed responded that they believed 'life is getting worse' (Eckerley 1999, 2000).

The genuine progress indicator (GPI) has been advanced by Hamilton (1998) as providing a new experimental measure of sustainable national well-being via its accommodation of factors currently unaccounted for in the GDP such as: income distribution; value of household work; costs of unemployment; and various other social and environmental costs. Figure 2 shows the change in GPI as compared with GDP. The significant divergence over the past 20 years indicates, according to Hamilton (1997 p.47), that 'continued growth in Australia is relying ever more heavily on the run-down of stocks of built, social and natural capital'. The GPI approach represents an innovative way of linking an aggregate performance measure of national well-being to sustainability principles that are relevant for SoE reporting.

## Conceptual approaches to modelling the state of the environment in human settlements

There are two contexts in which human settlements may be considered for the purpose of SoE reporting: through their direct and indirect impacts on the physical environment, and through the fact that human settlements constitute a significant 'environment' in their own right. Monitoring of human settlements must consider both the internal environment of the settlement itself and its success in delivering desirable outcomes to its inhabitants while minimising problems and undesirable effects, as well as the effect that the settlement has on the wider physical environment through resource use and waste outputs (Newton et al. 1998 p.3).

State of the environment reporting, as originally defined (OECD 1994) and as applied in several countries (e.g. Canada), tends to marginalise the human dimension, with key issues such as energy consumption, transportation, waste generation, population growth and lifestyle patterns relegated to 'pervasive influencing factors'.

In seeking a conceptual framework within which SoE reporting on Australian human settlements could be based, the State of the Environment Advisory Council (1996) developed the Extended Urban Metabolism Model (EUMM). It is a useful composite model: it accommodates the key sustainability concepts (triple bottom line dimensions), it is goal-based (viz. reduce resource inputs and draw-down on endowments, increase liveability, reduce waste and emissions, improve urban processes), it is capable of accommodating performance indicators and targets (e.g. standards, benchmarks), it is representative of the key urban sectors (e.g. housing, health, transport), and it is systems based, enabling the representation of causal linkages (driving forces – pressures – condition – implications – response) as well as dynamic processes related to sustainability, viz. endowments → processes → outputs (see US Inter-agency Working Group on Sustainable Development Indicators at <http://venus.hq.nasa.gov/iwgsdi>). This model is represented diagrammatically in Figure 3, and forms the framework for this report.

Following an introductory section which reports on the key dimensions of Australia's settlement hierarchy, the first substantive section of the report focuses upon urban stocks and

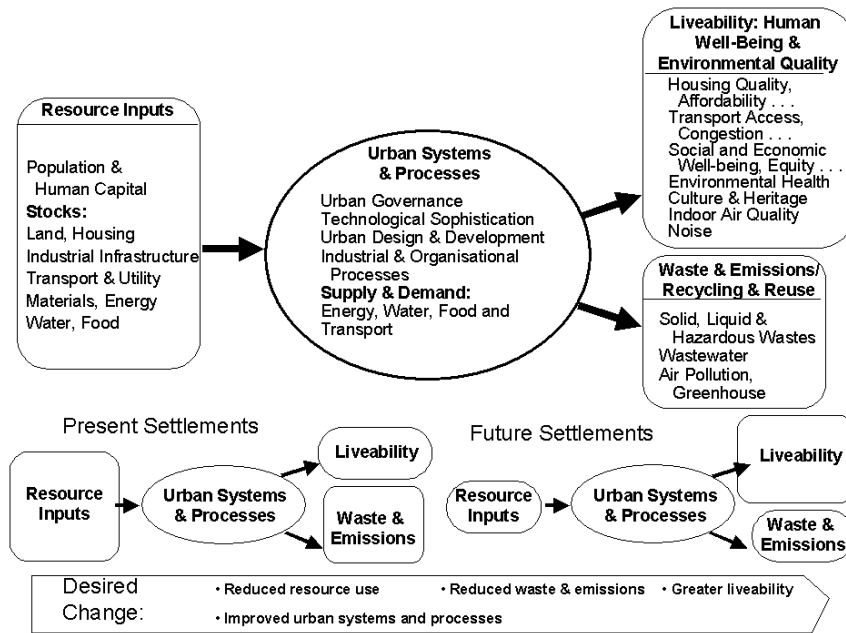


Figure 3: Extended urban metabolism model for SoE reporting on human settlements.

Source: Adapted from State of the Environment Advisory Council (1996) and Alberti (1996).

processes. It reports on the nation's principal stocks—population, materials, energy etc.—and the manner in which processes of supply and demand affect the draw-down on these endowments. The unique mix of production, consumption and governance characterising each urban centre will dictate the signature of outputs for that settlement on three levels. Firstly, *liveability: human well-being* captures several key human 'environments'—the home environment, the work environment, and the activity space (accessibility, mobility) of individuals and households. The section clearly illustrates how geographic or settlement processes distribute population on the basis of affordability and access—two key factors affecting the health and well-being of populations. Secondly, *liveability: environmental quality* recognises that urban populations are also directly affected by the quality of their immediate physical environment, in this report measured primarily via indoor air quality, noise, water quality and food quality. Thirdly, *waste, recycling and reuse* captures the ecological impact that urban activity has on the immediate and hinterland regions of human settlements. In this report there is no assessment of the wider ecological footprints of particular Australian settlements. These can be found in Simpson et al. (1998, 2000) and Close and Foran (1998). Wastewater, stormwater and solid waste streams are examined in the context of the extent to which each are being harnessed as a resource, as opposed to being considered as waste.

Within each section, the pressure – state – response – implications model of environmental assessments is followed to the extent possible for human settlements. The complexity of the urban–environmental linkages are such that they become more or less evident from different 'views': a *settlement view* will reveal variability from a national 'average' on the basis of scale, access, remoteness, climate, political jurisdiction; a *sectoral view* will reveal differences from one sector of the economy to another (e.g. domestic versus commercial versus industrial) as well as from one industry class to another; and a *population view* will reveal divergences from a national norm due to socio-economic factors, ethnicity, age, workforce status etc. As an example, and in relation to attitudes of Australians to the environment, most recent surveys indicate that over 70% of the population show some level of concern about the environment (see Table 2), but the levels of concern can change over time.

Key trends to emerge are a general decline in concern for the environment during the 1990s, with more metropolitan residents being concerned about environmental issues than were non-metropolitan residents across all issues, except for some that are primarily rural in nature, such as soil erosion/salinity, use of pesticides, and disposal of hazardous wastes.

Many of the leading environmental concerns listed constitute the key theme reports in 2001 State of Environment Australian reporting, namely air pollution (Atmosphere Report), freshwater pollution (Inland Waters Report), ocean/sea pollution (Coasts and Oceans Report), destruction of trees/ecosystems/animals (Biodiversity Report), ozone layer,

greenhouse (Atmosphere Report), soil erosion/salinity (Land Report), and can be linked to the pressures exerted by population, industry and urban settlement on the natural environment.

**Table 2: Environmental concerns of Australians, 1992–1999. (Percentage of respondents.)**

Environmental concern	1992	1996	1999	1999 metro	1999 non-metro
Air pollution	40.2	30.9	29.1	33.9	20.0
Freshwater pollution	29.9	23.7	24.6	24.4	24.8
Ocean/sea pollution	32.3	23.8	22.4	23.2	21.0
Destruction of trees/ecosystems	32.8	23.6	21.1	22.0	19.6
Garbage/rubbish disposal	22.9	14.0	14.1	15.1	12.1
Ozone layer	28.6	10.9	12.3	13.4	10.1
Toxic chemicals/hazardous waste	21.3	8.6	11.0	10.7	11.5
Soil erosion/salinity	15.3	7.7	10.2	8.5	13.5
Greenhouse effect	17.2	6.3	8.7	9.6	7.2
Destruction of animals/wildlife	19.3	9.1	7.8	8.0	7.4
Conservation/preservation of resources	15	6.5	7.1	7.2	7.1
Irresponsible urban development <sup>A</sup>	12.6	5.9	6.1	6.6	5.2
Use of pesticides	13.7	4.2	5.6	4.9	6.9
Uranium mining/radioactive materials	8.5	5.1	5.6	5.9	5.0
Nuclear testing/weapons	14.6	7.6	5.1	5.2	4.9
Overpopulation <sup>A</sup>	12.6	5.9	4.1	4.5	3.2
Other pollution <sup>B</sup>		8.8	3.9	4.2	3.3
Other	5.8	5.5	3.5	3.4	3.7
Don't know <sup>B</sup>		1.8	2.3	2.2	2.5
No concern	25.2	29.8	29.6	28.2	32.2

<sup>A</sup> In 1992 and 1996 these categories were combined under the heading 'urban development/overpopulation'.

<sup>B</sup> Not recorded in 1992.

Sources: ABS (1994a, 1999a).