The House of Representatives Standing Committee on Environment and Heritage

Inquiry into Sustainable Cities 2025

CSIRO Response

Compiled by:
Peter Newton, CSIRO Manufacturing & Infrastructure Technology.[1]
Joslin Moore, CSIRO Entomology.

Contributors:
Guy Barnett; CSIRO Sustainable Ecosystems.
David Batten; CSIRO Manufacturing & Infrastructure Technology.
John Carras; CSIRO Energy Technology.
Helen Cleugh; CSIRO Atmospheric Research.
Lynne Cobiac; P-Health Flagship.
Peter Dillon; CSIRO Land & Water.
Greg Foliente; CSIRO Manufacturing & Infrastructure Technology.
Barney Foran; CSIRO Sustainable Ecosystems.
Tony Haymet; CSIRO Marine Research.
Carol Howe; CSIRO Manufacturing & Infrastructure Technology.
Allen Kearns, CSIRO Sustainable Ecosystems.
Geoff McAlpine; CSIRO Environment & Natural Resources Group.
Mike McLaughlin, CSIRO Land & Water
Grace Mitchell; CSIRO Manufacturing & Infrastructure Technology.
Steve Morton, CSIRO Environment & Natural Resources Group.
John Parslow; CSIRO Marine Research.
Bill Physick; CSIRO Atmospheric Research.
Kwesi Sagoe-Crentsil; CSIRO Manufacturing & Infrastructure Technology.
Seongwon Seo; CSIRO Manufacturing & Infrastructure Technology.
Ian Shepherd; CSIRO Manufacturing & Infrastructure Technology.
Nariida Smith; CSIRO Manufacturing & Infrastructure Technology.
Graham Turner; CSIRO Sustainable Ecosystems

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[1]Contact: CSIRO Manufacturing & Infrastructure Technology
GPO Box 56
Highett, VIC 3190
Ph: 61 03 9252 6126
Fax: 61 03 9252 6250
Email: Peter.Newton@csiro.au

Preamble

CSIRO welcomes the *Inquiry into Sustainable Cities 2025* as a mechanism by which it can provide input to the Inquiry in accordance with its general Terms of Reference, as well as consider possible new strategic directions for CSIRO's Research &Development in the urban systems arena. To this end, CSIRO convened a *Sustainable Cities 2025 Workshop* in Melbourne on 13 October of 21 senior scientists from 7 Divisions across CSIRO together with several experts external to the organisation. The outcomes of the workshop are embodied in the material summarised in this submission.

One of the major outcomes of the workshop was the recognition that urban systems are highly complex systems with many interrelated and interacting components. This complexity means that total system sustainability can only be achieved when we can conceptualise, plan and manage individual system components in the context of the total urban system. Because of our belief that progress towards sustainability may be hampered by the very human habit of wanting to break things down into units that subsequently never re-connect, we have made a conscious decision to emphasise the importance of complete system understanding through the structure of our submission. In what follows the terms of reference are addressed implicitly in an integrated vision of city sustainability in 2025. Nevertheless, we highlight some of the key outcomes in relation to the terms of reference below.

CSIRO undertakes a program of research, currently costed at $29.4 M p.a. which addresses key issues related to urban systems performance. This program was the subject of a presentation to the House of Representatives Standing Committee on Environment and Heritage on 26th June 2003 at Parliament House, Canberra (and which can be viewed here: http://develop.cmit.csiro.au/brochures/core/sbe/SC2025Appendix.ppt).

Terms of Reference

1. *The environmental and social impacts of sprawling urban development.*

   Based on a wide range of indicators (e.g. Newton, Baum et al. 2001; NSW EPA 2003) our cities, their current development patterns and their occupants consumption patterns are not sustainable and are unlikely to become sustainable without active effort from the community, industry and all levels of government (see overview section below).

2. *The major determinants of urban settlement patterns and desirable patterns of development for the growth of Australian cities.*

   The major cities, particularly the state capitals, will continue to grow as these are the key economic engines of the 21st century economy and are best placed to compete for capital investment, tourism, new industries, new residents etc. (Newton, Botchie et al. 1997).

   More sustainable patterns of urban development in Australia for 2025 and beyond have the potential for realization through a bundle of existing as well as emergent space transforming technologies. These urban forms are likely to more closely align to a future mosaic of cities within cities. Their underpinning infrastructures will also be radically different in a number of respects. This will result from:

   - A closer alignment of home and workplace (mediated by new information and communication technologies) resulting in a diminution of vehicle kilometers traveled (VKTs) and city congestion.

- Closed loop water and sewerage systems(supported by capture, treatment and re-use of stormwater and wastewater within the "urban catchments") significantly reducing demand for diverted water
- Sustaining appropriate environmental flows and improving quality of runoff to receiving waters.
- Distributed energy systems aligned to a hybrid solar- hydrogen economy which offers prospect for local self-sufficiency in green electricity generation.
- Hybrid transport and the contribution it will make to clean air in cities and associated human health.
- New eco-industry clusters based on a utilization rather than disposal of waste streams, creating a green economy for cities and a significant reduction in environmental damage to soil and groundwater.

Urban developments aligned to such a "blueprint" have the potential for a significantly reduced ecological footprint compared to the present.

3. *A 'blueprint' for ecologically sustainable patterns of settlement, with particular reference to eco-efficiency and equity in the provision of services and infrastructure.*

   Creating a sustainable city extends beyond a consideration of physical capital. Equally important is the development of social and economic capital. We need to integrate our knowledge of both physical and social and economic systems into an integrated systems framework that can be used to develop pathways to sustainable urban development.(see below definitions and sustainability matrix)

4. *Measures to reduce the environmental, social and economic costs of continuing urban expansion.*

   We need a framework for sustainability accounting for cities through which we can measure urban performance, understand linkages, identify components to target for change and monitor the impacts of such actions. We present one such possible framework below and articulate multiple pathways toward more sustainable cities.

5. *Mechanisms for the Commonwealth to bring about urban development reform and promote ecologically sustainable patterns of settlement.*

   There is considerable opportunity to evaluate current policy in a wide range of areas with reference to its impact on urban sustainability and subsequently adapt policy so that it is aligned to achieving the goal of sustainable urban systems. An urban audit would be a first step in achieving this goal. There needs to be a better understanding of 'what is' in order to track progress towards 'what should be'. Only government can provide such benchmarking information.

   Regulation in the urban environment often only identifies a minimum expected level of performance (e.g. Australian Buildings Code Board (ABCB) and the Building Code of Australia (BCA); and here there is currently an absence of reference to sustainability objectives).Government is best placed to investigate international best practice and encourage its take-up by Australian industry. This also requires government investing in the development of easy-to-apply-tools capable of assessing "performance" across the key dimensions of urban sustainability (best practice).

The remainder of the submission consists of a three page summary (pages 5 - 7) outlining the major issues and actions required to set Australian cities on the path to sustainability in 2025. This is followed by a more detailed account where sustainability indicators and goals for 11 key city system components (buildings and infrastructure; transport; energy; waste; water; air quality; soil and land quality; coastal and marine; biodiversity; population and human health) are organised into a *Sustainability Matrix* (page 8). The columns of this matrix constitute an accounting framework for urban sustainability. The submission concludes with a list of cited references and an Appendix (page 28).

Australia's Cities – an Overview

The most recent perspective on the performance of Australia's cities is found in the 2001 Australia State of the Environment Report on Human Settlements (Newton, Baum et al. 2001), summarised in Newton (2002).

Australia's population is forecast to increase to a likely 23 million by 2021, equivalent to creating one extra city the size of Sydney. If existing trends continue, 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. The annual rate of household formation (2.0%) exceeds that of population growth (1.2%), stimulating demand for housing and related consumption expenditures.

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. 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.

Australians are in danger of "loving our coasts to death". Between 1991 and 1996, one-quarter of Australia's total increase in population was accommodated within three kilometres of the coast. Coastal environments provide key ecosystem services for Australian cities, but Australia's coasts are threatened by rapid urban expansion in coastal corridors, catchment degradation and water diversion, and climate change.

Australia is one of the top five consuming nations in the world. Australia's ecological footprint of 8.1 hectares per capita indicates that its citizens are consuming between two and four times their 'fair share' of the world's resources. Areas of key concern are:

- 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).
- Australia generates the highest per capita CO_2 emissions globally (27 tonnes/person/year; Newton, Baum et al. 2001).
- Australia now ranks among the top 10 OECD countries with respect to solid waste generation with a per capita solid waste disposal rate of 1.1 tonnes/year.
- Vehicle kilometres travelled are increasing at a much faster rate than vehicle registrations or population, with significant implications for the urban economy (congestion costs) and environment (air pollution).
- Our biodiversity in cities and urban areas is rich but threatened by rapid urbanisation. More than 50% of threatened or rare plants, mammals, birds, reptiles and freshwater fish in Australia are found in cities and their surrounds. Over 40% of nationally listed threatened ecological communities occur in urban and peri-urban areas. The conservation of large amounts of natural open space presents a significant challenge to local government and private landholders.

- The urban-bushland interface is increasing in planning, design and management importance as more people live closer to the remaining bush, are threatened by bushfires, and interact with pest animals and endangered or vulnerable wildlife.

Australia's Cities – Towards Sustainability

Cities have become the economic focal points of national economies and are in global competition to attract capital investment, tourism, knowledge industries, and the most skilled and intelligent workforce. As one of the world's most highly urbanised countries, and where its five largest cities accommodate 6 out of every ten residents, cities are fundamental in determining the performance and sustainability of our economy, environment and society.

Critical to achieving sustainability in our urban landscapes is the ability to assess current conditions and identify targets which will achieve sustainability and allow the evaluation of policy and management strategies.

In addition, the performance of most city system components are likely to be strongly affected by climate change including; Buildings and Infrastructure, Energy, Water, Air Quality, Coastal and Marine, Biodiversity and Human Health. Achieving a transition to sustainable cities requires that all efforts are carried out in the context of climate change and its likely impacts on system components.

Sustainability objectives are now well represented in most federal, state and local government strategic plans as they relate to urban areas (e.g. Melbourne 2030); Sustainability units or advisory groups are attached to most state and territory governments, but the only substantive attempts to date to examine sustainability of urban development in Australia occur in the context of State of Environment Reporting. The current weaknesses of SoE Reporting are now well documented.

Recommendation: Address the paucity of data, analytical tools and resources available for urban sustainability reporting, management and monitoring by upgrading State of the Environment reporting across all levels of government.

Sustainable Cities: a Definition and Framework

Sustainable development of a city involves gaining maximum benefit from the investment made in the region's total capital. Total capital is deemed to include:

- **Physical capital**: built capital (e.g. buildings, infrastructure); natural capital (e.g. air, water, land, biodiversity) in relatively undisturbed ecosystems and modified ecosystems (e.g. agriculture, aquaculture).
- **Social and economic capital**: human capital (e.g. education, health, etc); social capital (e.g. community and institutional networks and interactions); financial and economic capital (e.g. macroeconomic planning, governance, etc).

Together they constitute the columns in an accounting framework for urban sustainability that also intersects with the *key components of an urban system* (e.g. biodiversity, water, built

environment, transport, energy etc – the 'rows'). The resultant cells are then capable of being populated – via an 'urban audit' – of *current performance.* A sustainability dimension is added via cells which seek to identify *future performance targets or goals* for each component of the urban system, resulting in a *Sustainability Matrix.*

Recommendation: That Australia's three tiers of government proceed towards development and use of a total capital accounting framework for budgeting and reporting.

A Challenging Reality: Cities are Complex Systems

Cities are highly complex and highly inter-connected systems as the urban audit table suggests. System complexity is one reason why both policy and research on cities has been sectorised and fragmented for much of the past 50 years. It is reflected in the structure of the Discussion Paper attached to the *Inquiry into Sustainable Cities 2025*, as well as most contemporary urban strategy documents (e.g. Department of Sustainability &Environment, Victoria).

To ensure *sustainable development* of cities in the 21st century requires that they be represented and modelled as interacting sub-systems, through which clearer understanding of system performance is possible. Recent CSIRO initiatives that are indicative of what is needed include:

- ***Re-Shaping Cities for a More Sustainable Future*** (Newton, 1997) – a report for the federal Inquiry into Urban Air Quality that modelled a range of alternative urban forms (ranging from compact to the low density sprawl) using integrated land use, transport, emissions and airshed models and concluded that more compact cities deliver superior energy, greenhouse and air quality outcomes compared to low density counterparts.
- ***Future Dilemmas*** (Foran and Poldy 2002) – a report for the federal Department of Immigration and Multicultural Affairs which modelled impacts of alternative population scenarios on future stocks of natural, built and human capital using a physical accounting framework.
- ***Healthy Country*** (www.healthycountry.com.au) – a CSIRO Flagship project that aims to model total urban water and physical ecosystem flows within Australia's mega-metropolitan regions in order that water use benefits for all sectors of the urban economy are optimised.

Recommendation: A government commitment to R&D focussed on assembling the appropriate capabilities and data to develop blueprints for sustainable cities.

Pathways to Sustainable Cities

"If you don't know where you're going, any road will take you there." Lewis Carroll (Alice in Wonderland)

For those urban domain components where sustainable targets can be specified, a further task identified in the Sustainability Matrix was to *describe a pathway* from the present state to the desired goal. The role of 2025 is problematic, however. As a number of charts in Future Dilemmas (Foran and Poldy 2002) illustrate (Appendix 1; 6 Policy Dilemmas) greatest divergence for many of the key urban issues (domains) is *after* 20 years from the present.

What follows are suggested sustainability pathways for specific urban domains towards 2025. The domains considered are: buildings and infrastructure; transport; energy; waste; water; air quality; soil and land quality; coastal and marine; biodiversity; population and human health.

The Sustainability Matrix

Buildings and Infrastructure

A number of key transitions need to be well underway in Australian Cities by 2025 if sustainability is to become reality. Many of these transitions will be enabled by new technologies, but can not be implemented without an engagement of industry (e.g. new product manufacture), government (e.g. new codes, standards, guidelines) and community (e.g. an understanding of why change in behaviour is required – viz, acceptance of recycled potable water). These are:

- Green buildings – that have a demonstrably smaller ecological fingerprint than existing stock (especially in relation to energy, water and material use). CSIRO's Life-Cycle Analysis (LCA) Design and Energy Express software can automate the process of green design direct from 3D computer aided design (CAD) models. This can be augmented by checklist systems such as Green Star and NABERS for auditing performance of *existing stock* (approximately 98% of total buildings).
- Integrated urban water systems (see Water section).
- Distributed energy systems (see Energy section).

These last two elements can deliver significant 'triple bottom line' benefits but required joint innovation at building level as well as neighbourhood and infrastructure level in order for maximum benefit.

A further paradigm shift will be for building and infrastructure procurement to be based on life cycle assessments and costings, rather than the capital cost basis which dominates at present and obviates selection of products which may have a higher initial cost but a lower complete *life cycle* cost (i.e. less maintenance, longer service life, etc). Governments can play a significant role here as they are frequently procurers, owners and landlords.

	Present	Possible 2025 Objective
Physical capital		
Built	The type and quantity of resource input and the volume and harmfulness of the output flow of a	Adoption of design and building practices that minimise resource use and waste and maximise

	Present	Possible 2025 Objective
	building development during its life time contributes to its impact on ecosystems and people. Thus damage to ecosystems and people as a result of a building's flows should be reduced.	utilisation of recycled material- energy efficient design, long service life, clean indoor air quality, zero emission for waste, no use of harmful building products-minimise the adverse impact on human health and safety as well as ecosystem, maximise the amenity for use of building and productivity.
	In Australia, energy consumption for building sectors (residential and commercial parts) is about 600 PJ/year (Bush, Dickson et al. 1999).	
Natural	In Australia, the contribution of greenhouse gases from the commercial building sector are expected to nearly double from the 1990 level of 32 Mt of CO_2 p.a. to 63 Mt p.a. by 2010 (Commonwealth of Australia 1999).	Development of more energy efficient buildings will ensure more sustainable use of non-renewable resources and will deliver economic, social and ecological benefits to the whole community.
	Greenhouse gas emission attributable to heating and cooling from Australian residential buildings are expected to increase by between approximately 14% and 30% in the periods of 1990 to 2010 (Commonwealth of Australia 1999).	Adoption of design and building practices that minimise resource use and waste and maximise utilisation of recycled material.
	Buildings typically consume 14 % of total water use in Australia (ABS 2000).	
Modified natural	Mechanical heating, ventilation and cooling (HVAC) is the norm.	High quality indoor air and natural ventilation are the norm.
	Building site impacts are frequently detrimental to local biodiversity, stormwater flow, groundwater recharge, etc.	Suitable building site or land with minimal footprint to minimise site disruption.
Social and economic capital		
Human and community	Reusing existing buildings can be less costly, take less time, can retain cultural heritage and be more community oriented, but design for deconstruction is almost totally lacking at present.	Research into the implications of building products substitution and recycling for energy and resource consumption over the life of the building and the impacts on maintenance, operational energy and refurbishment potential.
		Implementation of incentives and removal of impediments for incorporating environmentally sustainable features and minimising operating costs.
Institutional	Building regulations mainly focus on structural, fire safety and accessibility aspects of building. There are no sustainability themes within the current Building Code of Australia (BCA), although energy performance is the first to emerge in the context of minimum performance standard in 2003 (but not uniformly for all states).	Building regulations are extended to include sustainability performance requirements and raise minimum performance linked to guidelines that demonstrate routes to best practice.
	Incentives for environmental friendly buildings are uncoordinated and not comprehensive.	Existence of national and international benchmarks of performance for key aspects of building (e.g. energy, water, air quality).

Transport

Transport is one of the key components of any urban centre in that it is fundamental to providing inhabitants with access to goods and services and can have large negative impacts on liveability. The opportunity exists to minimise traffic stresses while providing better access to goods and services by:

- Undertaking integrated land use/transport planning of multi-centred cities to increase accessibility and limit travel demand.
- 'Right moding' public transport to centres and between centres, walking or cycling for short trips; efficient car travel outside centres.
- Reducing energy use and pollution using Intelligent Transport Systems (ITS) and low energy vehicles.
- Utilising ITS for logistics and for safety and security.
- Setting pricing regimes to improve the urban transport "Triple Bottom Line".

	Present	Possible 2025 Objective
Physical capital		
Built	Traffic congestion is growing with congestion in Melbourne and Brisbane likely to exceed Sydney levels by 2015. Limited transport connectivity and dispersed activity centres in cities increase the need for travel and discourage use of public transport. 80% of household trips occur outside urban centres. Land Prices discourage storage and freight traffic is growing with just-in time deliveries and "inventory in motion". "Open" transport systems are vulnerable to security threats (and natural disasters).	City structure planned around sub centres – a 'City of Cities' (Warren Centre 2002) to limit the need for travel. "Right moding" public transport to centres and between centres, walking or cycling for short trips. Intelligent Transport Systems (ITS) for efficient and safe passenger car travel for outside centres and for effective logistics to limit freight trips. Accessibility to required services, goods and activities leading to liveable cities for citizens, attractive cities for tourists and efficient cities for business & industry. A systems approach to risk assessment and control which balances costs, service and security.
Natural	Traffic contributes more than 75% of the carbon monoxide emissions, most emissions of oxides of nitrogen, and is a major contributor to emissions of organic compounds. Road Transport contributes 12.9% of Australian greenhouse gas (GHG) emissions (AGO 2002) most from travel within cities thus contributing to cumulative global warming. Congested driving condition increase pollutant emissions by up to 33%.	GHG impacts reduced in period to 2015 by Intelligent Transport Systems (ITS) reducing emissions and by 2025 70% of vehicles to be low emissions or zero emission hydrogen vehicles. Air pollutant emissions from traffic reduced to be no longer of concern.
Modified natural	Alienation of the natural environment for transport infrastructure. Increasing noise pollution in a 24 hour city as commercial vehicles move into residential areas.	Intelligent Transport Systems (ITS) providing efficient use of existing infrastructure and traffic calming to increase urban green space. ITS limiting noise with smoother driving and routing to avoid sensitive areas.
Social and economic capital		
Human and community	Urban car use is growing much faster than population. In Sydney while population rose by 20% between 1981 and 1997 household car use grew by 67%. Traffic congestion imposes economic stress on business (with costs expected to exceed $30billion p.a. by 2015) and is a growing community concern. (A survey in Sydney ranked congestion as the most important problem). While the number of on-road crashes is falling, the economic and social costs are still too high.	Intelligent Transport Systems (ITS) reducing economic and social impacts of congestion. ITS and infrastructure improvement limit crashes and fatalities rare. Safe & secure "walkable" neighbourhoods. Programs such as Travel Blending encouraging children to walk to school.

	Present	Possible 2025 Objective
	People are walking less due to both custom and concerns for safety and security. This is particularly significant for children where childhood obesity is growing. Adverse health effects especially to the young and elderly due to vehicle emissions.	
Institutional	Direct relationship between freight growth and GDP is being uncoupled as new business trends enabled by information technologies increase trips. Urban transport and transport planning usually separate. Insufficient funding for increasing road supply in line with travel growth. Taxing/charging regimes favouring large 4 wheel drives and company car use.	Integrated land-use transport environment planning framework Policies and practice such as City Logistics to encourage efficient freight movement. Appropriate road pricing to manage travel demand Taxing/charging regimes to encourage low emission vehicles and use of public transport.

Energy

There are considerable opportunities to drive more sustainable energy behaviours through:

- Wider implementation of existing and developing best practice to minimise energy consumption without prejudice to quality of life.
- Investment in new and developing technologies.
- Appropriate policy settings.

Opportunities include:

- Developing methods for simulation of complete systems (e.g. of buildings) to optimise total integrated performance.
- Policy settings that drive designs and behaviours towards energy thrift.
- Development of alternative and new technologies for heating and cooling e.g. solar hot water and air heaters, absorption chillers for air conditioning, solar cells, geothermal heat pumps.
- Development of technologies to increase the efficiency of fossil fuel use and fossil fuel decarbonisation.
- In parallel, implementation of alternatives to power generation in large fossil fuel plants should occur. This is anticipated to be a trend towards distributed energy systems, particularly in urban environments. Although production may still be fuelled from fossil sources, the location of the generation close to the point of use allows utilisation of waste heat for further electricity production, heating and cooling.
- Distributed generation may also be based on renewable sources such as wind, solar and biomass.
- In the longer term, it is envisioned that a global hydrogen energy economy will develop. This will comprise a system of technologies and infrastructure in which hydrogen is a major energy carrier, is generated in substantial proportions from renewable sources and is convertible from (and to) electricity at appropriate stages in the path through generation, storage, transport, distribution and use.
- A national strategy, involving Government, industry, academia and research institutions is required to engage in the development of an Australian hydrogen economy. Action now will secure benefits from opportunities in relation to

renewable resources, exploitation of Intellectual Property (IP) flowing from Research & Development and from manufacturing and export of technology and know-how.

	Present	Possible 2025 Objective
Physical capital		
Built	Most of the current stock of buildings were designed with a relatively low priority on energy efficiency because the price of energy was (and is still) very low. The price of electricity to Australian industry is one of the world's lowest rates (Australian Energy News, September 2001). In Australia, space heating and cooling account for 39% of the total residential energy consumption and 15% of residential sector greenhouse gas emissions (GHG) for the 1990 – 2010 period (AGO 1999).	Increased efficiencies and integrated (system) approaches to energy consumption. Complete cost energy accounting and pricing. Fully exploiting passive (non powered) means of achieving comfort in buildings e.g. improved thermal insulation, passive solar heating, natural and hybrid ventilation, utilising thermal storage capacity and optimum design. Improve adoption of distributed energy generation methodologies, where the generation of electricity is close to the point of use, enabling utilization of the waste heat for cooling and heating, thus increasing the overall efficiency. High quality electricity supply will be needed to service communications and other high-tech applications. With the increased uptake of distributed generation due consideration will need to be given to any local air pollution issues which may arise.
Natural	We have seen a 60% increase in energy use since 1975 with a corresponding population increase of 35%. Electricity generation contributed 33% of Australia's net national GHG emissions in 2001 (AGO 2001).	In terms of mitigating GHG emissions, one of the most immediately fruitful strategies will be to reduce energy demand by altered behaviours, increased efficiencies and integrated (system) approaches to its consumption.
Modified natural	Development of Australia's renewable energy resources is just beginning. Optimisation of end use efficiency and environmental effectiveness of Australia's potential energy future will require strategic planning by Federal, State and local governments.	Increase exploitation of renewable sources of energy to a substantial fraction of the total energy supply.
Social and economic capital		
Human and community	In a knowledge economy, city competition is based increasingly on quality of life and urban amenity issues. These attributes have a strong positive correlation with energy consumption on a per-capita basis. A growth of 2.5% p.a. in demand for energy is anticipated (ABARE (2001) Australian Energy: Projections to 2019-20).	Actively discouraging and/or penalising energy profligate behaviours to drive populations towards substantially less consumption without seriously impairing quality of life. Australian society needs to address the conflicting demands of increased energy supply to maintain and improve quality of life and reducing GHG emissions. Promote schemes similar to the ClimateCam project in Newcastle NSW which seek to monitor energy use at neighbourhood level and seek programs for community participation in demand reduction.
Institutional	Uptake of renewable energy has not been widespread due to relatively high cost.	Government action to develop and implement policies that reward desirable outcomes, such as energy efficient building design and exploitation of

	Present	Possible 2025 Objective
		low emission technologies.

Waste

The key pathways to sustainability for waste are:

- Integrating multi-sectoral policies and framework for waste with air and water management
- Promote environmentally responsible industries operating in partnership with local communities
- Encourage eco-efficiency consumption patterns to reduce domestic and industrial waste and proactive public information on environmental and health implications of ever increasing consumption habits.
- Investment in sustainability practices that link urban waste management to other input suppliers; e.g. agricultural sector.

	Present	Possible 2025 Objective
Physical capital		
Built	25-30% of landfills are consumed with waste from construction and demolition (Johnston 2003). Many industrial and urban wastes are needlessly disposed to landfill, when beneficial re-use and co-disposal could realise benefits to both urban communities and the environment.	Zero building and construction waste. Waste to landfill minimised, benefits from re-use maximised.
Natural	Natural systems are threatened by subsidised landfills (contamination of groundwater) and incineration of solid waste (air pollution).	Incentives for engaging in resource recovery technical assistance, tax credits, surcharges on land fills, sound environmental regulations.
Modified natural	Physical flows of natural resources (e.g. nutrients, wood) one way (regions to cities)?	Research and extension policies that embrace the concept of waste use in agriculture on land and support increasing potential and user awareness. Stricter economic and legislative instruments are mandatory for effective waste management in our urban centre.
Social and economic capital		
Human and community	Perception that urban wastes are all hazardous. Lack of knowledge of risks associated with wastes. Lack of knowledge about alternative waste re-use strategies. Voluntary waste recycling targets.	Mandatory link of business solutions to sustainable policy initiatives. Redefining reuse priorities and strategies to recognize need to protect human health and generate public acceptance. Implementation of promotional and support activities such as public education, voluntary or mandatory recycling targets, liaison with private sector
Institutional	Below-cost or no waste disposal charge. Weak or no regulations restricting processing, use, or transportation of waste, sludge, or compost; for example, odour restrictions. Weak or no legislative and regulatory policies on waste generation, management and disposal.	Incentives to stimulate marketing of recovered material such as information and tax credits and including incentives to use urban waste provided by cities to off-set dumping costs. Waste re-use schemes enabled that classify and rank wastes on basis of environmental hazard with high risk wastes treated before disposal and beneficial materials re-used for food production or

	Present	Possible 2025 Objective
		ornamental/revegetation uses. Move towards an information and knowledge based economy: information and knowledge do not create waste.

Water

Water provision in urban areas and treatment of wastewater and stormwater are both major issues in Australian urban systems. To address these issues we need:

- A nationally coordinated research program on water conservation and reuse to address the barriers to more efficient urban water use and reuse, reduce costs, increase supply security, increase environmental flows, reduce impacts on coastal water quality, broader range of technology options, improve regulation of human and environmental health, enhance community understanding of issues and risks (see Australian Water Conservation and Reuse Research Program: http://www.clw.csiro.au/priorities/urban/awcrrp).
- A Commonwealth investment package to initiate a national portfolio of innovative demonstration projects that conform to 2025 targets for water management. These would include projects in greenfield and urban retrofit settings that would demonstrate progress towards an integrated urban water system that incorporates treated stormwater and wastewater into metropolitan supplies – the major urban water challenge for the 21st century.
- Major policy and institutional changes in urban water management to avoid embedding current inefficiencies that we will have to live with for 50 to 100 years due to capital intensive nature of water infrastructure decisions.
- Investment at state and commonwealth scale to ensure sustainable water systems are established taking account of externalities, rather than lowest cost option for local communities.
- To spread the responsibility for a sustained supply of water and energy to all city dwellers and developers, through education, regulation, and differential pricing strategies.
- Scorecards for water efficiency of appliances, new houses and buildings, new subdivisions and whole cities could provide a useful tool for implementing policies, devolving responsibility and stimulating innovation.

	Present	Possible 2025 Objective
Physical capital		
Built	Most Australian cities have aging infrastructure, with approx $1.5B p.a. capital expenditure on water supply, wastewater and stormwater systems. National domestic water consumption exceeds 300l/p/d (2nd highest after USA ;Price 2002) and discharge of effluent and stormwater from cities exceeds this figure. In low-lying areas, significant saline ingress into sewers limits reuse. Sydney currently consumes 106% of its estimated safe Yield of water (NSW EPA 2003) presenting clear challenges for reduction in use and creation of 'new' sources from treated	Increase sustainability of urban water service provision through integrated water management practices tailored to local conditions, employing strategies including provision of water services at a variety of scales (urban, sub-urban, local and individual property levels), increased retention of rainfall runoff in the urban landscape, and source control of contamination. Halve Australian per capita urban water demand, increase stormwater and wastewater use to 50% of total urban water demand, reduce combined stormwater and wastewater contaminant (including nutrient) discharges to receiving water waters to

	Present	Possible 2025 Objective
	wastewater and stormwater. Pressures are building for supplemented sources of supply for cities such as Perth, Canberra and Adelaide. This will lead to difficult allocation issues and water based planning for regional development. In 2000, only 11% of Australian sewage treatment plant effluent was reused (Dillon 2000), most for new agriculture not substitutional reuse. Less than 3% of urban stormwater is reused and it is difficult to get information on this.	50%, reduce the extraction of potable water from urban supply sources to 80% of current levels. Develop levels of service and accountability for water utilities, local government, developers and industry that encourage conservative water use. Increase the level of knowledge of acceptable risk judgments and management of more localised water based infrastructure.
Natural	Natural rainfall-runoff processes are almost non-existent as urban areas have modified volume, timing and quality of runoff and groundwater recharge. Urban waterways and wetlands are highly stressed ecological systems.	Increase self sufficiency with respect to rainfall retention, water quality, vegetation, wildlife and recreational use For new urban areas, water quality protected and indicator species are conserved. Groundwater extraction and recharge in urban areas is regulated integrally with other urban water resources.
Modified natural	Reducing lot sizes and increasing house sizes are reducing garden area, increasing runoff and changing groundwater recharge. Streams are canalised, flood-plains are built on, flood protection measures need enhancing and urban stream water quality and biodiversity is impaired. Subsurface storage is in its infancy.	Increase source control and local service provision with respect to rainfall retention, water quality management, flood protection, sanitation, amenity and recreational use. Water storage within the urban landscape (built and natural) avoids the need for new dam construction, water quality in urban waterways and wetlands improved, indicator species return, flood protection enhanced, riparian zones adjacent natural streams is preserved in all new subdivisions.
Social and economic capital		
Human and community	Public places high value on supply security and water purity, much higher than current water charges reflect. Understanding of risk in relation to water quality from different sources (e.g. treated wastewater for potable use) is weak. There is an acceptance of moderate restrictions as an ongoing demand management tool.	Public continues to place high value on supply security and water purity, more consistent with water charges. Understanding of risk in relation to water quality from different sources is soundly based and widely appreciated. At present, consistent empirical evidence in research conducted over the past decade has shown that the major predictor of community satisfaction with drinking water quality is their level of trust in the authorities providing it (Syme and Williams 1993; ARCWIS 2000). Innovative methods for using restrictions as a demand management activity introduced with the public's support. Increased adoption of efficient garden watering combines with smaller lot size to decrease demand.
Institutional	Fragmentation of stormwater, water/wastewater, catchment and groundwater management leads to gross inefficiencies in water use and urban planning. Regulation of water reuse is poorly orchestrated, localised, and often based on inadequate information.	Coordination of water management through cross-institutional bodies or new institutions. National regulations on water conservation and reuse that are consistently applied by knowledgeable regulators. Increased public interest, involvement and influence in whole of water cycle institutions.

Air Quality

Motor vehicles are the most persistent threat to Australian urban air quality. There are four ways to tackle the problem:

- *Supply-side changes*: supply-side strategies might be based, for example, on improved engine efficiencies, provision of better road or public transport networks, and intelligent Transport Systems (ITS) to make road systems more efficient.
- *Demand-side changes*: demand-side strategies involve changes in the behaviour of those involved in the transport sector, either as users or suppliers of services.
- *Fuel switching*: fuel switching is the most straightforward means of air pollutant reduction in the transport sector. Hybrid cars, powered by petrol or diesel engines, are likely to become commonplace and will reduce local transport pollution by a factor of 10.
- *Pollutant capture*: The use of various forms of pollution control equipment (e.g. catalytic converters and particulate traps) need to be combined with an inspection and maintenance program to ensure that the pollution control equipment continues to work as intended.

The planned introduction of Euro3 (2005–2006) and Euro4 (2006–2007) controls will diminish air pollution episodes, although eventually the growth in vehicle numbers and vehicle kilometres travelled could again raise the total emission levels. Maintaining and improving urban air quality will require adherence to strict emission standards.

	Present	Possible 2025 Objective
Physical capital		
Built	Knowledge of the air quality indoors, at home, in the workplace, in cars and in other transport vehicles, is not as good as for outdoor air quality. Australians spend from 90 to 96% of their time indoors (ABS 1994; ABS 1996; ABS 1998). Nitrogen dioxide levels from unflued gas heaters are a particular problem (SoE 2001).	A reduction in indoor levels of emissions from building materials and heaters through developing a greater knowledge base. Increase air quality through increased green spaces, network of natural green spaces, for recreation surrounding urban centres, sub-centres, largely localising transport movements.
Natural	In Australia, space heating and cooling account for 39% of the total residential energy consumption and 15% of residential sector greenhouse gas emissions for the 1990–2010 period (AGO 1999). Australia has the highest per capita greenhouse gas emissions in the world (27 tonnes/person/yr). Urban greenspace can reduce the greenhouse gas emissions associated with residential space heating and cooling (see above) as well as providing a (shortish-term) store through carbon sequestration. Stratospheric ozone depletion, while still occurring, is becoming less of a problem each year due to remediative measures regarding anthropogenic CFC emissions.	Energy efficient housing can reduce the greenhouse gas emissions of the urban residential sector. Requires government and industry setting sufficiently challenging performance benchmarks. At present, introduction of insulation into a dwelling is sufficient to deliver an accepted star rating, obviating additional benefits that can accrue through adherence to now well known design principles. A recent case study of project home development in South-east Queensland (Tucker and Ambrose 2002 for AGO) revealed that designs were well below expected energy performance levels. The study revealed that this can be quickly remedied via use of energy design assessment tools such as NatHERS/AccuRATE. Intelligent use of urban design and use of vegetation may also assist in ameliorating urban space heating and cooling requirements through its impact on urban microclimates.
Modified natural		Increase air quality through increased local self sufficiency and hence containment of traffic flows,

	Present	Possible 2025 Objective
		reducing trip lengths, traffic congestion.
Social and economic capital		
Human and community	Motor vehicles (cars, trucks, buses and motorcycles) are the major emitter of air pollutants in urban Australia. (SoE 2001). Levels of ozone and particulate matter are of concern, but other pollutants are below the National Environment Protection Measure (NEPM) standards. Air toxics (primarily hydrocarbons) are an emerging issue. Airborne particles are also of concern (health and visibility) as a result of wood smoke in some cities and rural communities (Keywood, Ayers et al. 2000). Continued epidemiological evidence that links *particulate matter* and mortality (Simpson, Williams et al. 1997). Asthma is exacerbated (if not caused by) air pollution and asthma affects 30% of young Australians; its treatment costs $1 B pa.	Particle emissions are expected to decline as the new plans to reduce the sulphur in diesel fuel come to fruition — However, emissions also result from domestic wood burning, industry, controlled burning and other motor vehicles. Increasing epidemiological evidence that links fine particles and mortality means that there continues to be a need to reduce this class of pollutants. Similarly ozone levels should be reduced.
Institutional	Exceedences of the six criteria pollutants are regulated Australia-wide in the NEPM standards by the state Environment Protection Authorities (EPAs). Industrial licences to emit are also issued by the EPAs.	Continued evolution of environmental legislation in accordance with society's direction.

Soil and Land Quality

Key strategies for addressing soil quality in our cities, especially with respect to past contamination, include:

- Development of alternative and new technologies for assessing risk from degradation of urban and peri-urban land resources.
- Development of methods for low cost environmental and socially acceptable technologies for remediation of contaminated land.
- Development of a National "Superfund" Strategy to support risk assessment and remediation of contaminated urban and industrial land.

	Present	Possible 2025 Objective
Physical capital		
Built	It is estimated that over 80,000 contaminated sites are present in Australia, with most of these located in urban and peri-urban areas, mostly as a result of past industrial practices in a less stringent regulatory environment. Contaminants in soils affect both human and environmental health in situ, and may move off-site to threaten groundwater resources or marine ecosystems.	Contaminated areas identified, risks quantified, and soils remediated if risks prove unacceptable.
Natural	Urban development in Australia is located on the coastal fringe, in higher rainfall environments. These are usually the most productive soils for food production, yet loss of soil is rarely	Soil quality and potential for food production integrated into planning processes.

	Present	Possible 2025 Objective
	considered in planning decisions.	
Modified natural	Artificial soils generated for landscaping, rehabilitation, and urban gardens are often derived from industrial and urban waste streams. Contaminants in these may pose unacceptable risks to human or environmental health.	Rapid techniques to screen and characterise contaminants in materials used in artificial soils. Clean, safe soils for urban rehabilitation and landscaping.
Social and economic capital		
Human and community	The public places a high priority on purity of foods and freedom from soil and land contamination in recreational and home environments. Perceptions of environmental risk from soil contamination are often greater than real or measured risks.	A public that understands and accepts risk-based management of urban and peri-urban land resources.
Institutional	Soil and land contamination issues are often orphaned, with industries responsible for past poor practices no longer existing, or liable. In USA, Superfund legislation addressed the issue of orphan sites, and developed a framework to allow Research &Development, and remediation and risk assessment, to be undertaken on these sites.	A national system for proclaiming and dealing with orphaned contaminated land in urban and peri-urban areas.

Coastal and Marine

Coastal environments provide key ecosystem services for Australian cities, but Australia's coasts are threatened by rapid urban expansion in coastal corridors, catchment degradation and water diversion, and climate change. This can be addressed through:

- Improved understanding and predictive capability to link city structure and function to pressures and impacts on coastal environments and ecosystems.
- Better awareness and recognition in planning of the implications of long-term drivers such as population growth, urban sprawl and climate change for interactions between cities and coastal ecosystems.
- Frameworks and models to support design and evaluation of integrated, multiple-use, multiple-objective strategies for coupled urban-coastal systems.
- Integration of socioeconomic and biophysical research, to incorporate coastal ecosystem services and community aspirations and values into city design and planning.
- Institutional arrangements which avoid jurisdictional conflicts and allow appropriate focus on regional, long-term issues.

	Present	Possible 2025 Objective
Physical capital		
Built	More than 90% of Australia’s population and almost all our major cities are located on the coastal fringe. Rapid population growth is occurring in coastal urban belts spreading from major cities (Brisbane, Sydney, Melbourne, and Perth). Increased coastal settlement is recognised as a key issue for Australia's coasts (SoE 2001). Many Australian cities have seen expansion onto	Population growth in coastal areas is likely to continue, but coastal urban development must be planned to maintain the coastal ecosystem services which attract coastal settlement. Coastal urban planning provides adequate infrastructure security and allows for impacts of climate change and extreme events on both built

	Present	Possible 2025 Objective
	flood-plains and low-lying coastal plains, and are vulnerable to river flooding, stormsurge or wave erosion. Frequency of inundation or loss is likely to increase with climate change. (Church, Gregory et al. 2001; Walsh, H. Betts et al. 2003).	and natural capital.
Natural	The estuaries, embayments and adjacent coastlines associated with our major cities have historically borne the brunt of wastewater discharge, urban stormwater runoff, industrial pollution, litter, shipping spills and antifoulants. Increasing pressures are causing deteriorating conditions in some coastal waters (SoE 2001). More than 50% of estuaries from SE Queensland to Perth are modified or severely modified (NLWRA 2001). Urban development along coastal margins has led to loss of wetlands and other key habitats, which play a key role both as filters of catchment loads and as nursery habitat (SoE 2001). Sea level rise will interact with coastal development and infrastructure protection to produce further loss of wetlands. Introduced marine pests are recognised as an increasing threat for coastal marine ecosystems. Major ports located in cities are a focus for introductions. (SoE 2001).	Point source contaminant and waste discharges into urban coastal waters are removed through eliminating toxic compounds in products and processes, green design and by more effective treatment and recycling. Diffuse urban loads from stormwater and atmospheric deposition are reduced through improved design of stormwater systems, and reductions in distributed pollution sources. The ecosystem services provided by wetlands are fully recognised, and wetlands are rehabilitated and restored where feasible. Marine pest introductions are reduced through risk assessment and prevention; effective techniques for control of marine pests are developed and applied.
Modified natural	Impacts of local pollution on urban estuaries and embayments are exacerbated by changes in water allocation and land use in catchment hinterlands (SoE 2001). There is increasing competition for fresh water, with a need for inter-basin transfers to support mega-urban centres. In extreme cases, e.g. Sydney, almost all of the flow in local catchments is captured and diverted through urban water supplies. Many Australian fisheries are fully or overexploited (SoE 2001), and there are increasing conflicts over access to coastal resources near cities e.g. competition between recreational and commercial fishing and between recreation/tourism and aquaculture. (Hancock 1997; Pepperell Research & Consulting Pty Ltd 2001).	Improved catchment management and water allocation leads to reduced sediment and nutrient loads into urban estuaries. Coastal impacts of water allocation and diversion are recognised and accounted for in setting environmental flows. City requirements for water diversion are reduced through more efficient water use and recycling. Sustainable marine resource use is achieved through adoption of local and regional multiple-use planning and management strategies.
Social and economic capital		
Human and community	Australians place a very high priority on coastal beaches, waters and ecosystems for recreational, aesthetic and conservation value. Surveys show residents are prepared to pay to maintain and/or recover recreational amenity and value in estuaries, embayments and coastlines adjacent to cities (Zann 1995).	Identify what kinds of coastal ecosystems will best meet community aspirations for recreational, aesthetic and conservation values, while proving robust and resilient in the face of anthropogenic and natural pressures.
Institutional	Jurisdiction over coastal environments is notoriously complex and fragmented (Resource Assessment Commission 1993).	Institutional partnerships are developed to overcome jurisdictional conflicts, and provide integrated regional planning and management.

	Present	Possible 2025 Objective
	Coastal ecosystems are often treated as "receiving waters" and not incorporated into city planning.	Coastal environments and ecosystem services incorporated into city planning and management systems.

Biodiversity

Loss of biodiversity is often related to the implementation of development projects and changes in land use.

- The preservation, restoration and sound management of urban natural areas is crucial to the maintenance of biodiversity.
- The risk associated with deterioration and loss of urban greenspace on the quality of urban life needs to be assessed, and if high, addressed.
- Developers, local government and design professionals should be encouraged to help provide leadership in the identification and application of strategies for reducing the biodiversity impact of urban development.

	Present	Possible 2025 Objective
Physical capital		
Built	Australia's cities are biodiversity rich, but threatened. Over 40% of nationally listed threatened ecological communities occur in and around our major cities. More than 50% of the threatened or rare plants, mammals, birds, reptiles and freshwater fish in Australia also have habitats in these areas (Yencken and Wilkinson 2000). A more insidious threat to Australia's biodiversity is household dynamics. Changes in the size and number of households influence consumption and the ecological footprint of cities (Keilman 2003; Liu, Daily et al. 2003).	Incorporation of biodiversity in built form to provide natural recovery services, including water purification, atmospheric cleansing and the clean-up of contaminated land; environmental regulation services, including climate amelioration, noise reduction and flood mitigation; and 'quality of life' services that contribute to human health and the enhancement of wellbeing (Bolund and Hunhammar 1999; Savard, Clergeau et al. 2000; Barnett 2001).
Natural	Habitat destruction and fragmentation is the most direct threat to biodiversity. Habitats that have been particularly susceptible include rivers, estuaries and heathlands. Our understanding of the impacts on fauna is less well known. In a list of 277 environmental weeds considered to be in their early stages of naturalisation in Australia, 73% were garden ornamentals. Sixty-five percent of species and sub-species known to have become naturalised were intentionally introduced as ornamental species (WWF Australia 2003).	Routine use of local native species in parks and gardens. Potential pest species should not be used. Buffers around remnants should be used to mitigate edge effects. Identify and educate public about particularly weedy garden ornamentals and threat that garden ornamentals constitute to native biodiversity. Responsible pet ownership in areas in and around significant urban biodiversity. Ensure that microclimate-health-energy use role of urban greenspace is included as an ecosystem service. Water used to maintain this greenspace is thus contributing to this ecosystem service plus urban greenspace can provide an important buffer and storage capacity for urban runoff.
Modified natural	The peri-urban areas in and around our cities are increasingly under pressure for urban development. While many of these areas have degraded biological value, they often provide an important refuge within the highly fragmented urban matrix.	"Greenfields development" is undertaken in manner that enhances biodiversity values rather than degrades them. Include also natural drainage systems- creeks, lakes, wetlands, vegetation, and wildlife.

	Present	Possible 2025 Objective
Social and economic capital		
Human and community	Urban greenspace is the cornerstone of healthy urban communities. It plays a significant role in improving human health, reducing crime, increasing educational scores and boosting property values (Alberti 1999; Lyle 1999). Higher density urban development is reducing private open space (back/front yard) and it would not appear as though there is commensurate compensation of public open space in re-urbanised or greenfields areas. Managing the bushfire threat associated with urban vegetation systems has become an issue in some urban areas.	Understanding of urban biodiversity improves the quality of life of urban citizens. Urban policy makers and managers are designing and revitalise urban greenspace for preventative health benefits – mental health and physical health. Improved understanding of urban biodiversity can help improve the quality of life of many citizens and also provide a basis to enhance community education and biodiversity and its management (Williams, Read et al. 2001).
Institutional	In the face of increasing development pressures, the conservation of large amounts of natural open space and the biodiversity these areas contain, presents a significant challenge to local government (Fallding, Kelly et al. 2001). Newton et al. (2001) suggest that the planners and developers of today have deserted the traditional 'garden city' concept in favour of privatised greenspace – the detached house on a 'quarter-acre' block of land.	Actions that increase or sustain biodiversity are chosen over those that reduce it (Barnett 2002). Use of Internet to increase community participation in local area community planning decisions.

Population

Growth in per capita affluence and population number are two of the key drivers that promote increasing metabolism in Australian cities and the associated challenges. There are six population-related innovations that need to be considered whatever population trajectory is underway. Each of these issues becomes more critical for policy the higher the rate of population growth:

- Under current workforce dynamics in a fast evolving skills market many workers run out of skills in mid career or in the case of physical skills (e.g. building and construction) they are simply worn out. The 40-50 year old age cohort has to be actively enticed back into realistic training options to prepare them for 20+ years of engaging and rewarding employment for future, rather than past employment requirements. If implemented well this will also act as an employment buffer and make spaces for young people entering the workforce.
- Ageing is inevitable whatever the rate of population growth. All new houses should be built with aged compliant structural features that allow most people to live active safe and rewarding lives in their houses of choice.
- Linked to the ageing issue is the issue of suburban structure. Many new housing developments are built with only the young demographic in mind. Since most suburban areas will eventually house 27% of people who are over the age of 65 years, spatial patterning and infrastructure needs to fully address the issues of access, safety, liveability and also catalyse community spirit and self achievement. The biggest social problem in Tokyo is the large number of aged women who live alone.
- The burgeoning health issues of obesity and related problems are, in the bigger context, an ecological mismatch where city structure, time-poor lifestyles and affluence produce an abundance of dietary energy, but little physical opportunity or

obligation to work off that energy intake. Creative designs for new suburbs must make sedentary lifestyles more difficult and lure people out onto the streets into active healthy communities and rewarding lifestyles.

- The increasing number of single person dwellings, whether due to individualistic lifestyles, family breakdown, or ageing, maintains suburban growth at rates higher than the raw rates of population growth. New dwelling designs might aim to 'hub' major energy requirements such as hot water, space conditioning and transport while maintaining 'spokes' of individual living areas. Incentive mechanisms could be put in place to increase people per dwelling to 3 persons in 2020 and 4 persons in 2050.
- The distribution of much new population growth in suburban areas promotes large equity issues in terms of transport linkage to nearby CBD locations, where much employment activity and social life occurs. Population growth policies would benefit by integration with anticipatory and full investment into fast transit infrastructure, rather than fragmented responses that lag major urban development by 20 years or more. Energy standards and incentives could be implemented to ensure that most city transport happens at 1-2 MJ (10^6J) per passenger kilometre over the full transport life cycle versus the 5 MJ km^{-1} value for the domestic car fleet on which most people currently rely.

	Present	Possible 2025 Objective
Physical capital		
Built	In an international context, Australian cities have low population densities. Sydney, with an average metropolitan density of 690 persons km^{-2}, is well below Asian cities such as Shanghai (6600) or Seoul (17 500), and western cities such as Copenhagen (5300), London (4300) and New York (9300). Population densities of Australian cities are increasing (Newton, Baum et al. 2001).	Increased densities around urban and suburban centres to increase self-containment, reduce transport needs, travel distances, emissions, and allowing more pedestrian trips to these centres.
Natural	Australia's population is forecast to increase to a likely 23 million by 2021, equivalent to creating one extra city the size of Sydney. Between 1991 and 1996, one-quarter of Australia's total increase in population was accommodated within three kilometres of the coast.	Sufficient areas preserved along the east coast of Australia to maintain biodiversity. Dematerialisation of society that decouples the current strong link between economic growth and resource consumption.
Modified natural	Increasing population will increase domestic requirements and trade activities which will put increasing pressure on already stressed agricultural soils, marine fisheries, and domestic stocks of oil and gas. Domestic capture of fish and seafood has peaked in the 1990's and appears set to decline by as much as 10% in coming years, while per capita consumption has been increasing at about 0.15kg/yr.	Urban expansion constrained to maintain landscapes adjacent to cities and towns that provide high-value agricultural production, water amenities and recreational activities. Increased self-containment of urban systems with respect to rainwater retention, reduced transport needs an open-space green matrix of natural environment, natural creeks, ponds, walking and cycle tracks.
Social and economic capital		
Human and community	The population is ageing and birth rates seem destined to decline. High immigration can offset this to a limited degree, but absolute numbers of aged citizens continue to rise and the supporting and caring tasks may not decline.	Urban areas will need to be suitable for an increasing population of aged people with limited mobility and specialised service needs. Acknowledgement and utilisation of aged population as a resource. Improved health and

	Present	Possible 2025 Objective
		a desire to remain active and engaged in the community means that this portion of the population can offer much in relation to the provision of community services.
Institutional	While both skill and infrastructure issues can be reasonably anticipated using drivers such as demographic size and structure most current urban development is left to the vagaries of the market with a short term (5 year) view rather than addressing the reality that a suburb will persist for centuries. This results in sub-optimal design most importantly a lack of connection between developments of the key elements and infrastructure that could be integrated to form more sustainable cities.	Population policy explicitly established and implemented so that infrastructure requirements can be appropriately designed and scaled. Increased education and skills development to create a competitive workforce in the new global information and knowledge based economy. Information and knowledge are cumulative assets not depletable. The information and knowledge industry uses the least resources of a depletable nature. It also raises standards of living by paying higher incomes and generally enables longer working lives. (CIBW72 Reports, Sustainable Transport for Cities Reports, Warren Centre Report).

Human Health

As a society, we need to develop initiatives that use integrated approaches to both primary health prevention and the design and implementation of health services**.**

Considerable opportunity exists for intelligent urban planning and design to improve human health through:

- Planning, designing and constructing urban forms that provide access to urban greenspace, safe ways to encourage walking and bike-riding and access to safe places for exercise and relaxation in order to help society address the major new epidemics of obesity and mental depression.
- Reduction of negative environmental impacts such as air pollution, noise and transmission of disease caused by ineffective urban design and inadequately maintained infrastructure.
- Improving the spatial distribution of access to health and community services.
- Increasing liveability and encouraging healthy lifestyle choices.
- Facilitating community cohesion and a sense of belonging.

This potential is currently poorly exploited and a programme of Research & Development is recommended to provide detailed understanding of the links between urban design, patterns of infrastructure provision and social cohesion and their effects on both enhancing the health and well being of people as well as and identifying the environmental causes of ill-health.

	Present	Possible 2025 Objective
Physical capital		
Built	Evidence exists for increased obesity prevalence and lower exercise levels in urban areas with low "walkability" even when controlling for individual demographics (Saelens, Sallis et al. 2003). A comparison of Germany and Holland with the US has shown a much lower incidence of cycling accidents where cycle-tracks are pre-planned	Increased self-containment of urban systems with respect to reduced transport needs, an open-space green matrix of natural environment, walking and cycle tracks to provide opportunities for a healthier lifestyle.

	Present	Possible 2025 Objective
	(Pucher and Dijkstra 2003). Recent research in the US has confirmed increased mental health problems in urban areas (Leventhal and Brooks-Gunn 2003).	
Natural	Australia's population is forecast to increase to a likely 23 million by 2021, equivalent to creating one extra city the size of Sydney. Between 1991 and 1996, one-quarter of Australia's total increase in population was accommodated within three kilometres of the coast.	Intelligent urban design that optimises the use of building materials, urban form and use of greenspace to reduce the thermal load on city dwellers during the warm season and enhance warming in cooler seasons. Reduction of particulate and air toxic levels to be consistently below those required by the National Environment Protection Measure (NEPM) standards for ambient air quality. The NEPM standards are designed to protect human health and well being.
Modified natural	Greenfield and urban fringe developments are frequently poorly provided with social infrastructure and local access to services. This causes increases transport demand, reduces access and may result in a sense of personal alienation and consequent anti-social behaviour.	Multi centred cities providing lower maximum air pollution levels through greater local self containment and reduced travel (ATSE 1997). Co-location of housing, economic opportunities, social infrastructure and services combined with efficient long-distance transport links to other centres will encourage community cohesion and a sense of belonging.
Social and economic capital		
Human and community	There are significant spatial differences in access to health services in our cities (SoE 2001). Commonwealth health and aged care spending is projected to grow significantly from 4.7% in 2001-2002 to 6.2% in 2020-21, due to the increasing cost of new procedures and medicines, with the ageing of the population also increasing demand for health spending (Commonwealth of Australia 2002).	Cohesive communities that take an active interest in creating an urban environment that maximises health and wellbeing and minimises overt health risks.
Institutional	Inclusion of health impacts into development planning and decision processes is not routine.	Preparation of health impact statements to complement environmental impact statements for major projects.

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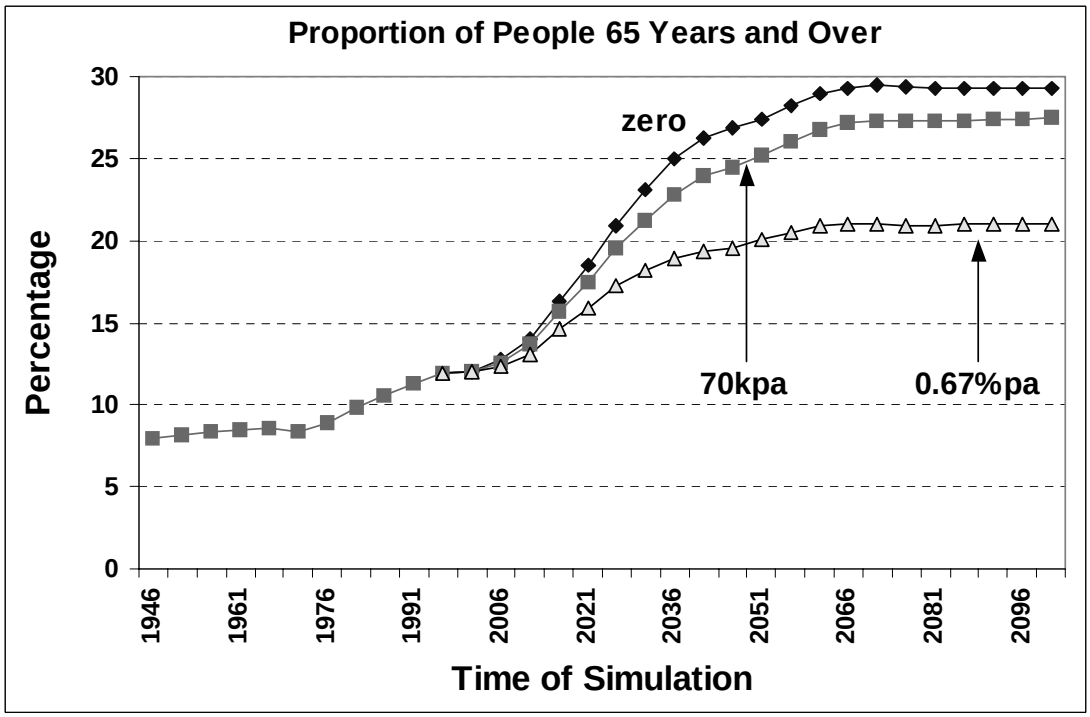
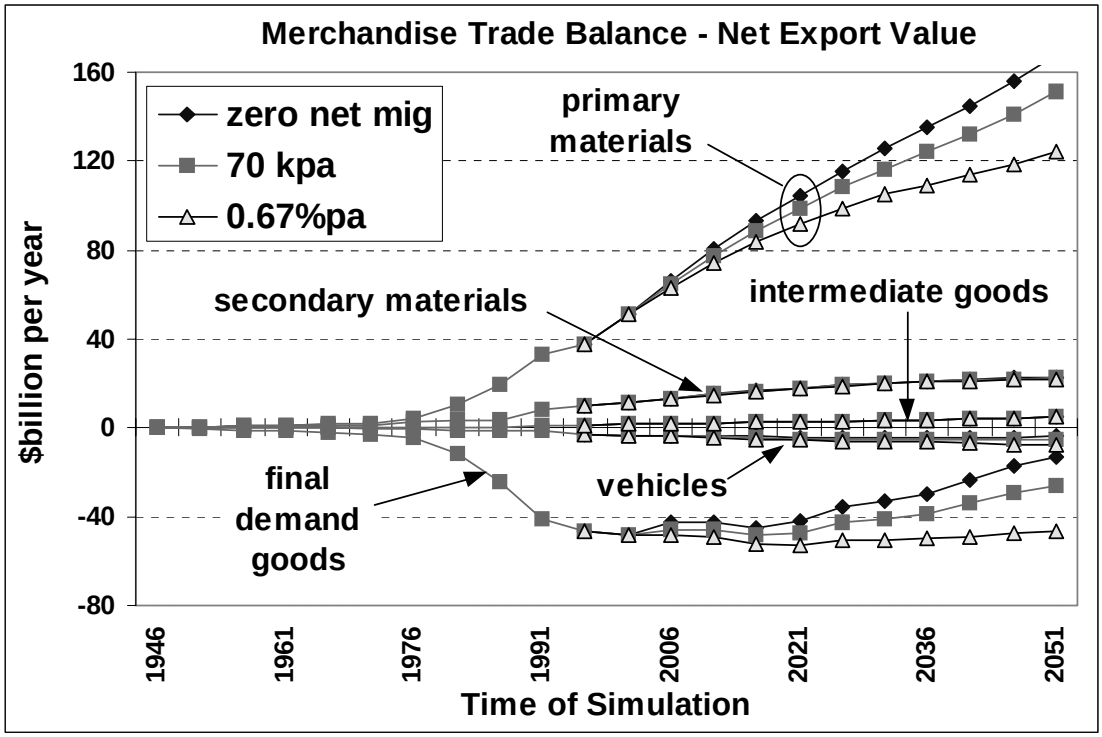
Appendix: Six Policy Dilemmas[2]

Population Ageing

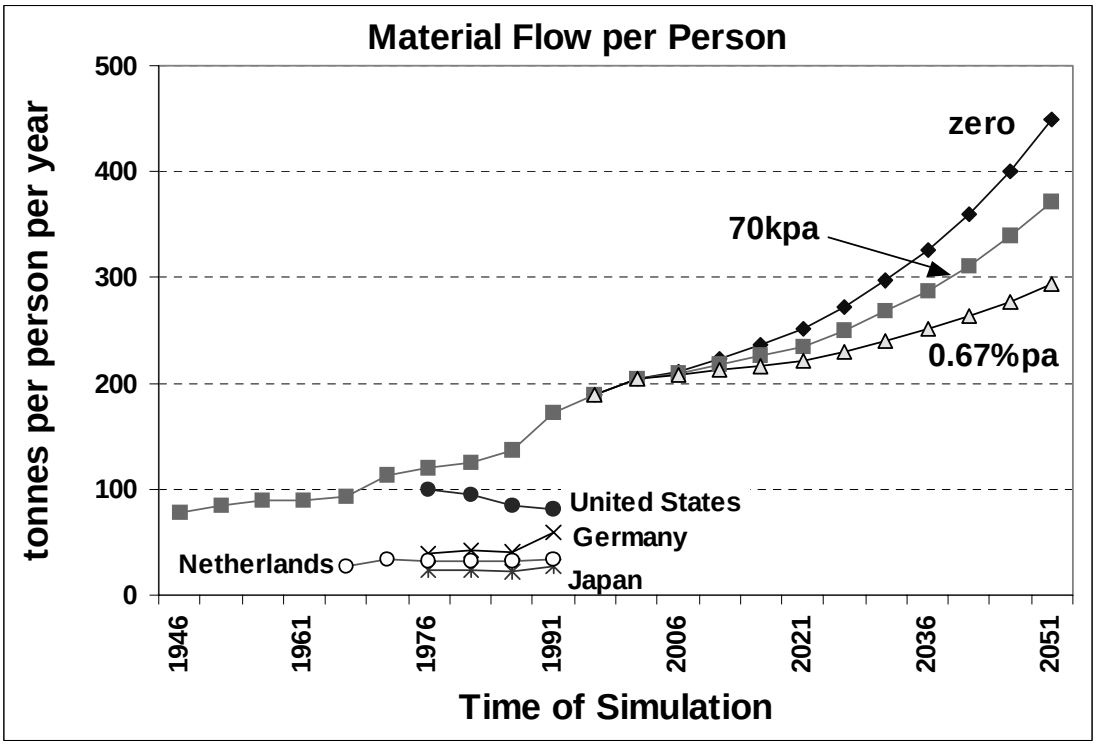


Physical Trade

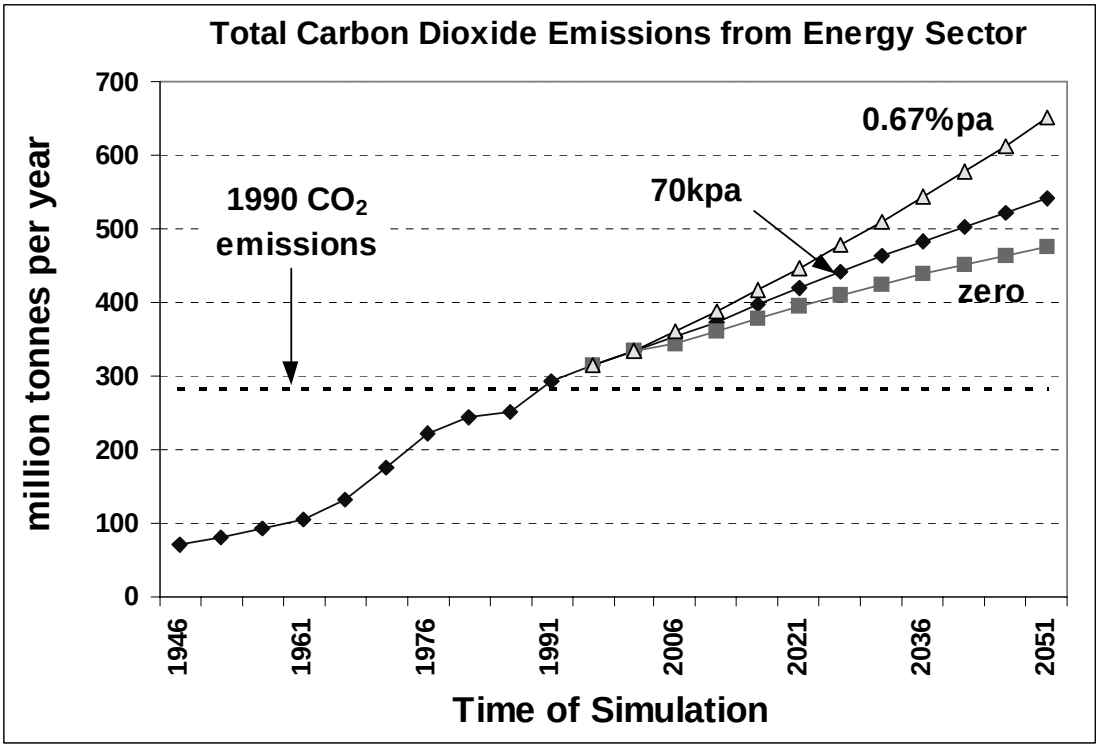


[2] Extracted from: Foran &. Poldy (2002).

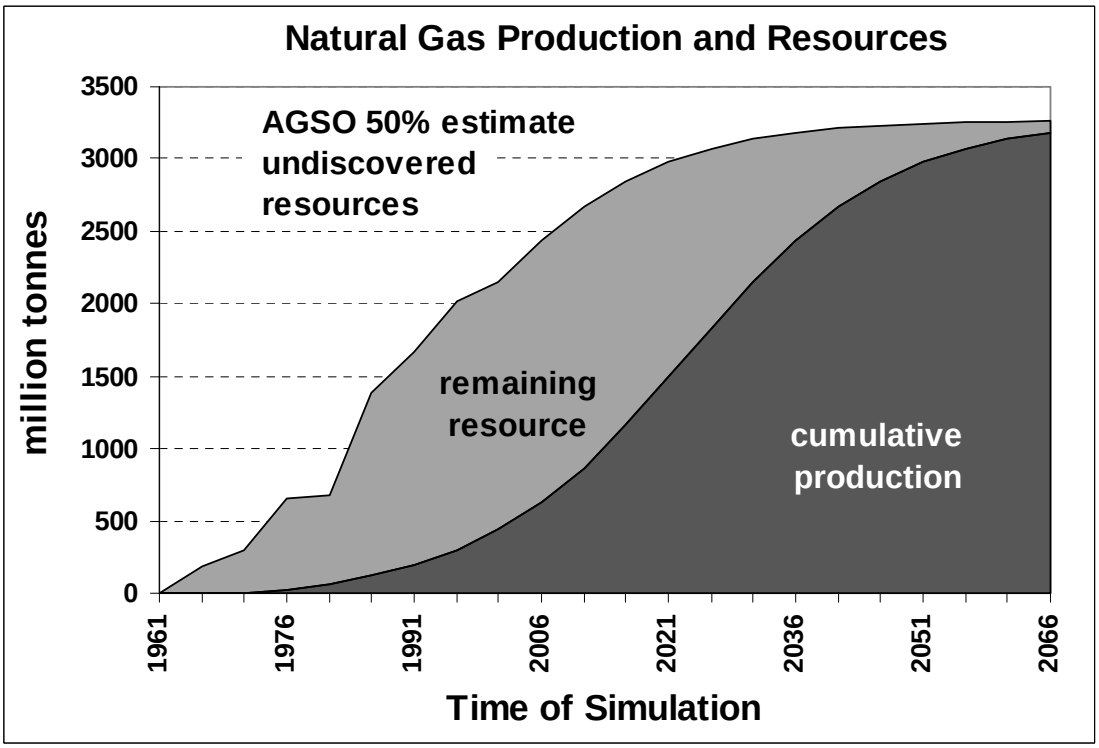
Physical Flows per Capita



Greenhouse Gas Emissions



Resource Use



Environmental Quality