SUSTAINABILITY AND THE BUILT ENVIRONMENT

A Submission to the State Sustainability Strategy

April 2002

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1 Executive Summary

1. Introduction

The scope of this analysis of the built environment is limited to buildings and construction projects and does not extend to planning and other built environment sustainability factors.

2. Sustainability

Sustainability centres on meeting three objectives simultaneously, commonly known as the triple bottom line – social, economic, and environmental.

3. The Built Environment

- Buildings define how resources flow from the environment and how people feel and perform, and therefore deliver a significant impact on their surrounding environments.
- Sustainable buildings can be defined as those buildings that have minimum adverse impacts on the built and natural environment and the humans who occupy them.
- Buildings have a large impact on the environment and are responsible for approximately 30% of raw material use, 42% of energy use and 40% of air emissions. Therefore, the industry has a huge contribution to make to improving the quality of life.
- Sustainable construction may be defined as building practices that strive for integral quality, including economic, social and environmental performance and issues.

4. Relationship with Other Themes

Built environment sustainability can clearly be linked with other significant State Government themes:

- State Strategic Plan
  - Sense of place
  - Community building
  - Resilience
  - Wealth creation
- Building WA Strategy
  - Quality built environment
  - Vibrant industry
  - Regulatory protection and enablement
  - Best practice works procurement

5. Targeting Effort

- Components that make up the built environment:
  1. Residential Housing
  2. Non-residential/Commercial Buildings
  3. Infrastructure
- Built environment sectors and influence mechanisms:
  1. Built Form – All Public and Private Assets: Legislation, Incentives, Regulation
  2. Built Form – All Public Assets: Mandated Government Policy/Legislation
  3. Built Form – State Government Public Assets: Control and Processes applied through the relevant State Government Departments.

- Issues for the non-residential/commercial works industry fall under five different areas, which represent the life of a built asset:
    1. Pre-design/Planning/Land Development
    2. Design
    3. Construction
    4. Operating/Maintaining
    5. Disposal/Renewal
- Future development in a sustainable manner represents new ways of thinking in planning, designing, building, operating and maintaining the built environment.

6. Specific Priorities

There is a need to develop built environment priorities in consultation with all parties involved in the WA built environment. Some suggestions of suitable priorities include:

1. Environmental:
- Improved energy efficiency and use of renewable energy resources
- Reduced overall environmental impact
- Increased resource conservation
- Enhanced indoor air quality

2. Economic:
- Increased efficiency/productivity of the construction process
- Better working conditions for employees and contractors
- Improved business relations

3. Social:
- Increased consideration of community issues
- Contribution to safe, viable and cohesive communities
- Increased responsiveness to customers, end users and other stakeholders.

7. Barriers

It is possible to identify several broad areas that may present barriers to a more proactive approach to sustainability in the built environment:

1. Industry Culture
2. Economic
3. Educational/Awareness
4. Institutional/Process

8. Mainstreaming Sustainability: Facilitating Change

It is possible to identify a number of key areas that represent the key to bringing about change and facilitating a more sustainable built environment:

1. Market Demand: Community, clients and investors creating market demand for sustainable practices.
2. Affordability/Delivery: Building and Construction Industry achieving and delivering affordable sustainable practices.
3. Regulation/Facilitation: Government providing a regulatory environment and acting as the driver and facilitator of sustainable practices.

9. Research and Development Requirements

- Improvements in environmental quality – providing convincing evidence of business benefits.

- Sustainable building and construction industry – transform the market to one receptive to sustainable buildings.
- Delivering a sustainable built environment and contributing to sustainable communities.
- Specifics in relation to building performance and construction.

10. Options for Action

- Sustainable Asset Management Lifecycle Strategies: A framework for achieving sustainable outcomes in the asset management process should be developed by linking Strategic Asset Management principles with sustainability principles.
- Capital Works Project Approval and Funding Process: An approach based around a new capital works project approval and funding process. The sustainability star rating system would be linked to funding incentives for Government agencies to encourage sustainability initiatives in works projects.
- Fiscal Incentive Schemes:
  - Incentive Schemes for Business/Private Sector: price preferences in Government tendering processes for those organisations that incorporate built environment sustainability principles.
  - Incentive Schemes for Government Agencies/Public Sector: higher funding incentives for those agencies who incorporate sustainability objectives in their capital works project planning.
- Educational and Awareness Programs:
  - Education Centre for the Built Environment: an education centre for the built environment could be established to promote sustainability concerns and initiatives.
  - Promote Sustainable Buildings and Infrastructure
  - Promote the Business Benefits of Sustainable Construction
- Rebuild Public Service Expertise: Rebuilding of expertise in the relevant public sector departments to oversee the works design and construction processes to ensure sustainability principles are implemented.
- Built Environment Sustainability Research and Policy Unit: Creating a research unit consisting of representatives from all Departments operating within the built environment to enable the coordination of policy efforts.
- Improve Existing Built Facilities: Renewal programs and the improvement of renovation and repair methods and practices.
- Forming Alliances and Partnerships: Partnerships with business, Government organisations/agencies, and non-government organisations.
- Implementing Legislation: To achieve maximum sustainability benefits with a minimum of regulation.

11. Case Studies – Sustainability in Action

- Five case studies are included in this paper:

  1. Rat Island Research Camp – Abrolhos Islands
  2. Shenton College
  3. Energy Efficient Design of Schools in WA
  4. Fremantle Prison and Heritage Precinct
  5. Percent for Art Scheme

2 Introduction

2.1 State Sustainability Strategy

The Western Australian Government has placed sustainability as a top priority to re-examine its future vision, making a strong commitment to sustainability and the development of a State Sustainability Strategy when coming into office in February 2001. Professor Peter Newman, seconded from the Institute for Sustainability and Technology Policy at Murdoch University, has been driving sustainable thinking in Western Australia as the Director of the Sustainability Policy Unit in the Department of The Premier and Cabinet.

Consequently, the Western Australian Government recently released a consultation paper for the development of a State Sustainability Strategy, inviting widespread participation in this development process via written submissions to the Sustainability Policy Unit.

The Department of Housing and Works welcomes this opportunity for State Government Departments, Industry and the general community to come together to translate the vision of sustainability into a reality. We commend the Gallop Government and Professor Newman's Sustainability Policy Unit for their concern and efforts to end the current trend of borrowing heavily from the future.

Accordingly, what follows is the Department of Housing and Works, non-residential works component, response to the Western Australian Governments consultation paper "Focus on the Future: Opportunities for Sustainability in Western Australia".

2.2 Department of Housing and Works (DHW)

The Department of Housing and Works (DHW) is the State Government Department responsible for the public sector's buildings component of the built environment (i.e. housing and non-residential buildings), and the Government's assets and project management. The Department builds homes, develops land, undertakes joint venture projects with other housing providers, and delivers and manages non-residential buildings and some infrastructure assets across the State.

With the recent merger of Ministry of Housing and the Asset Management Services section of Department of Contract and Management Services (CAMS), DHW is effectively split into two sections. The main bulk of the Department is concerned with the residential housing and rental market (referred to as DHW Housing). In these works the Department is its own client and does not provide services to other Government agencies in relation to housing.

The other side of the departmental split focuses only on non-residential public works (referred to as DHW Works). These works are carried out on behalf of other Government agencies as a "client" of DHW Works, and the role of the Department here is more of a project management / contract management one. Whilst the client agency ultimately has the final decision on project matters, and therefore greatest control over implementing sustainability initiatives, DHW Works could play a significant role in assisting clients to recognise and pursue sustainability in their built assets.

2.3 Scope of Submission

The scope of this analysis of the built environment is limited to buildings and construction projects and does not extend to planning and other factors affecting the sustainability of the built environment. While concentrating on issues under the direct control of the building industry, the narrow focus in most cases precludes consideration of the broader impacts of construction on sustainability and sustainable development. In this way several key issues are excluded which need to be addressed in partnership with other actors for the industry to optimise its contribution to sustainability. These include land use and land development, transport, community safety and health, and access to employment and local services.

Given the fundamental differences in the operation of the two sections of the Department of Housing and Works (Residential Housing / Non-Residential; Commercial), this paper primarily attempts to focus on non-residential/commercial public works (particularly so with respect to the options for action in Section 10), although there are many sustainability issues that permeate all areas of the built environment. The general residential housing market is covered under a separate paper prepared by DHW Housing.

3 Sustainability

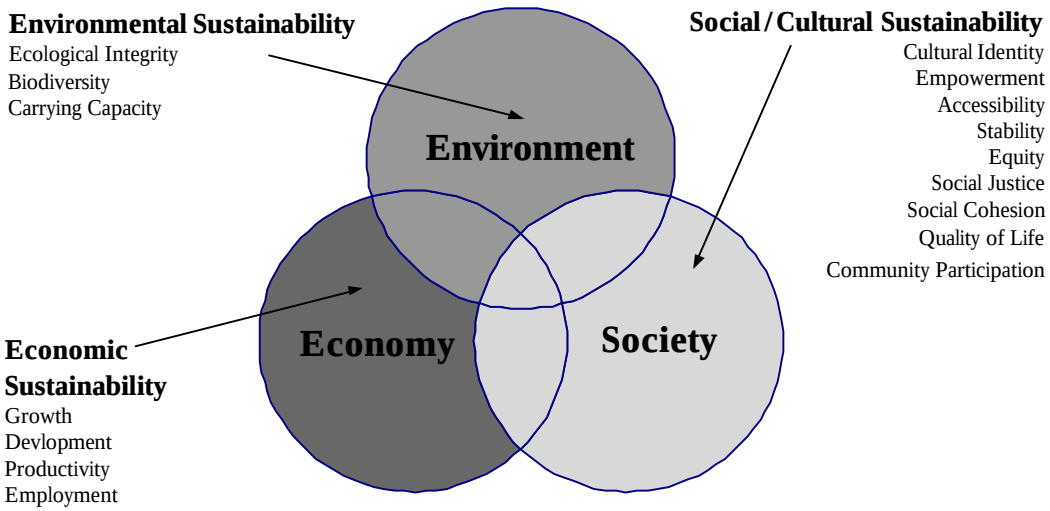
For many years the pursuit of economic, environmental and social goals have been in isolation from each other. The realisation has emerged that our long-term well-being depends as much on the promotion of a strong, vibrant society and the conservation of our environment, as it does on economic development.

At the heart of sustainability is the simple idea of providing a better life for everyone, now and for future generations. Although the idea appears simple, the task is far more substantial. It centres on meeting three objectives simultaneously, both in Western Australia and indeed around the world. These dimensions of sustainability are now commonly known as the triple bottom line – social, economic, and environmental – and the objectives are as follows:

1. **Social** progress that recognises and incorporates the needs of all, especially indigenous people and other disadvantaged groups – building a sustainable society and communities.
2. Effective protection, and where possible enhancement, of the **environment** to limit global environmental threats and prudent use of our natural resources to ensure they are not depleted, including the development of alternatives – building a sustainable environment with sustainable natural resources.
3. Maintenance of high and stable levels of **economic** growth and employment – building a sustainable economy.

Future development must consider these three dimensions and their objectives. In order to achieve sustainable development there is a need to integrate social, environmental and economic objectives in all policy-making and decision taking. A sustainable approach is a balanced approach.

Three Dimensions of Sustainability



4 The Built Environment

The built environment is that part of the natural environment that has been altered by humans with the introduction of man made structures. It is everything humanly created, modified, or constructed, arranged, or maintained that is developed to fulfil human purpose (to satisfy human needs, wants and values). It is developed to protect us from the overall environment, to mediate or change this environment for our comfort and well-being, with results that affect the environmental context.

"The built environment refers to the totality of all that humans have changed or rearranged within the natural environment." (Bartuska & Young, 1994, p. 7.)

The increased desire for people to achieve a more harmonious relationship between the built and natural environment is stimulating communities and local governments to explore new patterns for human settlement and to utilise the skills of artists and designers innovatively in this process. These issues have also pressured industry to aim for ecologically sustainable development and to deal with polluting waste products.

The characteristics of a sustainable built environment, along with the benefits that would ultimately accrue, are as follows:

- Cities/suburbs would be planned with input from the community and would be built around liveable centres linked by quality public transport, ultimately reducing reliance on motor vehicles (and hence reducing pollution/noise etc), and producing more opportunities for socialisation, greater social justice, less crime, improved quality of life, increased community participation, all leading to a strengthened sense of community and social cohesion, and
- Houses/commercial dwellings would be planned with community input and built on sustainability principles – analysis of location, analysis of actual need for the asset, alternative delivery strategies such as co-housing, and environmentally friendly principles such as solar based, ecological in design and interior health – all leading to the greater protection of the environment and reduced resource depletion, to ensure a workable, healthy future for generations to come.

Some key sustainability issues for the built environment are set out in the table[1] below:

Sustainability objective	**Theme**	**Specific Issue**
Economic	Competitiveness	• Efficiency, productivity and profitability of the industry • Employment
Environmental / Resource Use	Energy	• Energy efficiency • Use of renewables vs non-renewables
	Materials	• Efficiency of use • Use of renewables vs non-renewables • Embodied energy
	Water	• Efficiency of use

[1] Table borrowed from the following source: CRISP Sustainable Construction Theme Group, 1999 http://www.crisp-uk.org.uk/reports/isrt_fr.pdf

		• Pollution of surface and groundwater
	Land	• Use of brown-field vs green-field sites • Degradation / pollution
	Air	• Local air pollution
	Nature conservation	• Protection of wildlife habitats
Social	Building occupants	• Quality of built environment • Equity of access
	Employees	• Health and safety • Training and development
	Community	• Construction impacts (nuisance, noise etc) • Contribution to viable, safe and cohesive communities
	Wider Society	• Industry accountability

4.1 Buildings[2]

As society becomes more complex and technologically sophisticated, the concept of buildings seems relatively simple. Yet the environmental and social impacts of buildings are only partly realised and understood. Buildings define how resources flow from the environment and how people feel and perform, and therefore deliver a significant impact on their surrounding environments.

Buildings shape the lives of individuals. In Australia people spend a large amount of their life inside a building. Consequently, building design has a large impact on our lives and how we feel. Poor building design incurs high operating costs, including lower occupant productivity. Yet in Australia, design costs are seen as a burden on capital budgets. This is due to the fact that life cycle costs of buildings are not generally considered – the industry is based around short term cost decisions rather than long-term costs and affects. Design costs are minimal compared to life cycle costs, and operating costs are quite significant and should therefore be a major consideration of building design. Built asset life cycle issues are raised further throughout this paper.

Buildings are also an integral part of the wider general community. Planning and infrastructure impact on the life cycle, and economic and environmental performance of individual buildings. In Australia, large cities are spreading because of car use, causing high social, environmental and economical costs for new development.

Buildings mark a change in the relationship between humans and the environment. Unlike nomadic communities, which respond to the capacity of the surrounding environment, a settled community draws resources from beyond its immediate area. Consequently, nature does not impose an immediate limit on the resource use of settled communities. When presented with local environmental degradation, the settled community searches further afield for its resources. Modern production systems now extend throughout the world. The search for resources barely

[2] Please note this Section has borrowed from the following source: Environmental and Energy Services of the NSW DPWS, 1998, Page 4-7 http://www.industry.gov.au/industry/building/LCReport.pdf

enters the consciousness of building dwellers - resources are consumed unaware of the distant location and impact they carry.

4.1.1 The environmental impact of buildings

Not only are building products and activities a large part of the Australian economy, they also have a large impact on the environment. Over their life, from construction through to disposal, they consume large amounts of natural resources and energy and produce significant quantities of pollution. Therefore, the design and environmental performance of our buildings is a key factor in the health of our environment.

Buildings are a collection of products and services, which consequently contribute to problems such as habitat destruction, global warming, depletion of natural resources, ozone depletion, soil erosion and so on. The impacts extend beyond the local area of the building to the source of all the products and services provided to a building over its life-time. Therefore, we can clearly see that contemplation of the life cycle of a building is integral when considering sustainability of the built environment.

4.1.2 Sustainable Buildings

Sustainable buildings can be defined as those buildings that have minimum adverse impacts on the:

- built and natural environment, in terms of the buildings themselves, their immediate surroundings and the broader regional and global setting; and
- the humans who occupy them, in terms of comfort of the building, health and safety, accessibility, and other broader social issues.

Ideal sustainable buildings:

- Harvest all their own water and energy needs on site.
- Are adapted specifically to site and climate and evolve as conditions change.
- Operate pollution-free and generate no wastes that aren't useful for some other process in the building or immediate environment.
- Promote the health and well-being of all inhabitants, as a healthy ecosystem does.
- Are comprised of integrated systems that maximize efficiency and comfort.
- Improve the health and diversity of the local ecosystem rather than degrade it.
- Are beautiful and inspire us to dream.

4.2 Building and Construction Industry[3]

The building and construction industry provides the built environment within which the nation undertakes social and economic activities. The industry is defined as all who produce, develop, plan, design, build, alter, or maintain the built environment, and includes building materials manufacturers and suppliers as well as clients and end use occupiers.

The building industry is a major component of the Australian economy. Buildings also have a large impact on the environment and are responsible for approximately 30% of raw material use, 42% of energy use and 40% of air emissions (Environmental and Energy Services of the NSW DPWS, 1998, page 1, http://www.industry.gov.au/industry/building/LCReport.pdf). Therefore, the industry has a huge contribution to make to improving the quality of life; both directly by providing safe, secure buildings for people to live and work in, and by ensuring that the industry

[3] Please note this Section borrowed from the following sources: Environmental and Energy Services of the NSW DPWS, 1998, http://www.industry.gov.au/industry/building/LCReport.pdf; and Construction Best Practice Program, Sustainable Construction, http://www.cbpp.org.uk/cbpp/themes/suscon/intro_1.jsp

itself works in a sustainable way, husbanding resources, reducing pollution and waste and valuing its workforce.

The industry is central to the delivery of any Government sustainability policy or initiatives, in areas such as:

- Regeneration of housing, particularly to revitalize town centres (social/economic)
- Planning communities to reduce car use (social/environmental)
- Using energy and water more efficiently (economic/environmental)
- Minimising mineral extraction (economic/environmental)
- Protection of the countryside (environmental)
- Provision of training (social)

Through its activities, whether it is the provision of buildings, infrastructure development or contaminated land reclamation, the construction industry has a major role to play in the delivery of sustainability of the built environment. The industry must play an integral part in providing a better quality of life through its activities, whilst minimising impacts on the environment and local communities. By shifting its culture to embrace sustainable thinking at every level, the industry can save energy, reduce waste and pollution and cut the lifetime costs of property ownership.

The challenge facing the industry is to provide affordable, safe, functional buildings and communities whilst minimising the impact of their design, construction, renovation, re-use and demolition on the natural environment. Through more efficient use of limited resources, costs can be reduced while delivering better outcomes for builders and consumers. Therefore, there must be a concerted effort to work toward advancing more sustainable building design, construction and demolition/re-use.

4.3 Sustainable Construction[4]

The creation and responsible management of a healthy built environment must be based on sustainable construction principles. Sustainable construction is generally used to describe the application of sustainability or sustainable development to the construction industry.

Sustainable construction may be defined as building practices that strive for integral quality, including economic, social and environmental performance and issues. It is the set of processes by which a profitable and competitive industry delivers built assets (buildings, structures, supporting infrastructure and their immediate surroundings) which:

- enhance the quality of life and offer customer satisfaction;
- offer flexibility and the potential to cater for user changes in the future;
- provide and support desirable natural and social environments; and
- maximise the efficient use of resources,

leading to a healthy built environment. Clients and end use occupiers also have key roles to play in delivering sustainable construction.

Sustainable Construction = Minimising the negative and maximising the positive to achieve a balanced triple bottom line in terms of environmental performance, economic performance, and social performance.

[4] Please note this Section borrowed from the following source: Sustainability Action Group of the UK Government Construction Clients' Panel, 2000 http://www.property.gov.uk/services/construction/gccp/100700.pdf

A sustainable approach towards the construction process requires continual improvement in how environmental, financial and social issues are dealt with. As previously discussed, sustainability is increasingly being recognised as embracing not just long-term environmental viability but also economic and social issues. Issues of sustainability will therefore increasingly be 'market-driven' and a concerted effort will be required to change the embedded culture of building industry thinking to one which embraces sustainable thinking as an integral part of how the construction process is procured, designed, supplied, and maintained. Inherent within this change will be the need for sustainability to be more clearly 'valued' and supported by the financial community, clients and the public alike.

5 Relationship With Other Themes

The issue of built environment sustainability, and the State Sustainability Strategy emerging from Peter Newman's Sustainability Policy Unit, can clearly be linked with other significant State Government themes. There are clear synergies with themes such as the State Strategic Plan and the developing Building WA Strategy, which are outlined briefly below.

5.1 State Strategic Plan

Four key principles are emerging as Government Priorities in the State Strategic Plan, currently being developed by Department of the Premier and Cabinet. These priorities are briefly outlined below; their inherent relationship to sustainability can be clearly inferred.

5.1.1 Sense of Place

Promoting a sense of place, centred on environmental and regional sensitivity.

5.1.2 Community Building

Community building in WA, concerned primarily with social justice and inclusiveness.

5.1.3 Resilience

Concerned with the resilience of the State of WA with a focus on sustainability and long term synergistic planning.

5.1.4 Wealth Creation

Creating wealth in the State of WA, concentrating on innovation and economic diversity.

5.2 Building WA Strategy

More specifically related to the built environment is the Building WA Strategy currently being developed by DHW Works. The strategy will establish a framework for the Government's works and construction policies and initiatives. The framework identifies four key objectives for the WA built environment, based around a number of themes.

5.2.1 Quality Built Environment

Provision of a quality built environment in WA, both aesthetically and functionally, while focusing on environmental, social and economic sustainability.

5.2.2 Vibrant Industry

Focus on developing and sustaining a vibrant and healthy building and construction industry.

5.2.3 Regulatory Protection and Enablement

Providing a regulatory environment consisting of both regulatory protection (for environment, industry, consumers) and enabling regulation.

5.2.4 Best Practice Works Procurement

Ensuring the delivery of Government works procurement in line with best practice through the provision of frameworks, standards, systems and guidelines.

6 Targeting Effort

6.1 Sectors / Components of the Built Environment

The WA built environment incorporates a number of individual sectors and components in which Industry and Government operate. For the purposes of this paper the following sectors have been identified:

9. Built Form – All Public and Private Assets: the holistic view of the built environment incorporates all public and private sector built assets. Within this complete built environment picture are the following sectors;
10. Built Form – All Public Assets: this segment of the built environment consists of all public sector built assets, incorporating Commonwealth and Local. Contained within this sector of the built environment is the following;
11. Built Form – State Government Public Assets: this segment incorporates all State Government built assets.

Cutting across these public and private sectors are a number of differing components that make up the built environment. For the purpose of this paper, the built environment is considered as comprising three separate components:

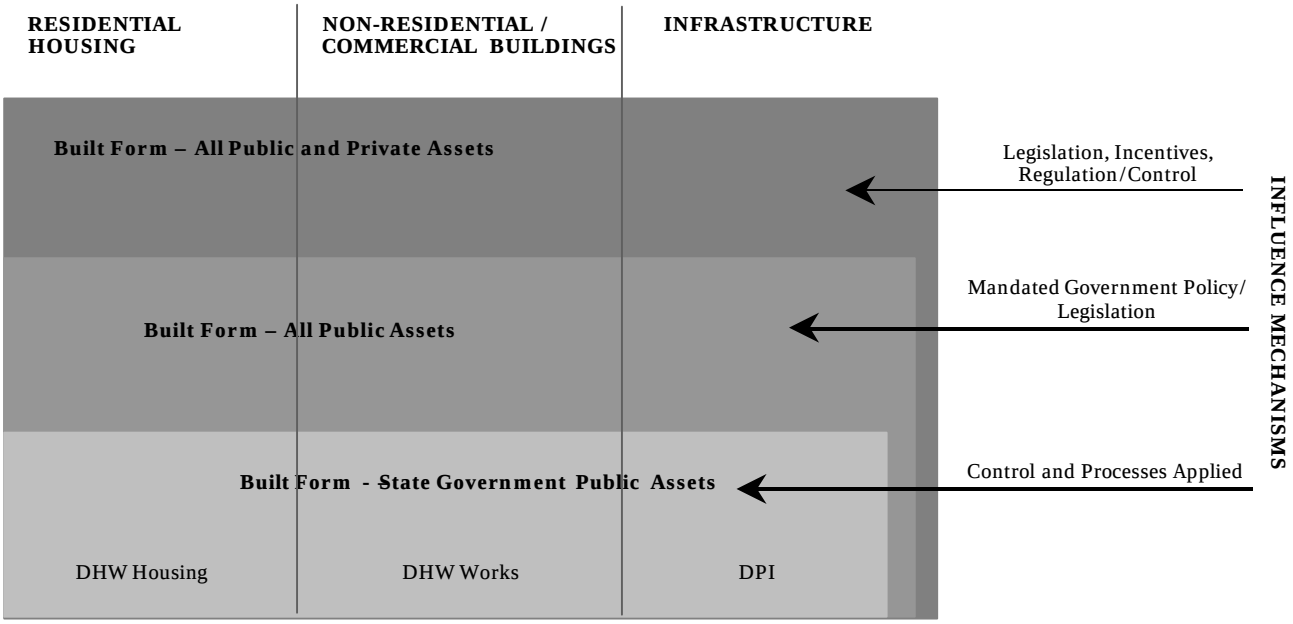
1. Residential Housing
2. Non-Residential/Commercial Buildings
3. Infrastructure

There are a number of mechanisms that may be utilised to influence and encourage sustainability within the various sectors of the built environment:

1. Built Form – All Public and Private Assets: Legislation, Incentives, Regulation
2. Built Form – All Public Assets: Mandated Government Policy/Legislation
3. Built Form – State Government Public Assets: Control and Processes applied through the relevant State Government Departments.

These sectors, components and influence mechanisms are illustrated in the diagram below. DHW Works fits within the State Government public assets sector, in the non-residential/commercial buildings component of the built environment, with DHW Housing residing in the residential housing component. Departments such as the Department of Planning and Infrastructure (DPI) reside within the infrastructure component of the State Government public assets sector of the built environment.

The WA Built Environment



Effective change in the built environment is best achieved by targeting the appropriate mechanisms at the particular sector where change is required. Any single change objective may require use of a number of the mechanisms to achieve across the board success.

6.2 Built Asset Life Cycle[5]

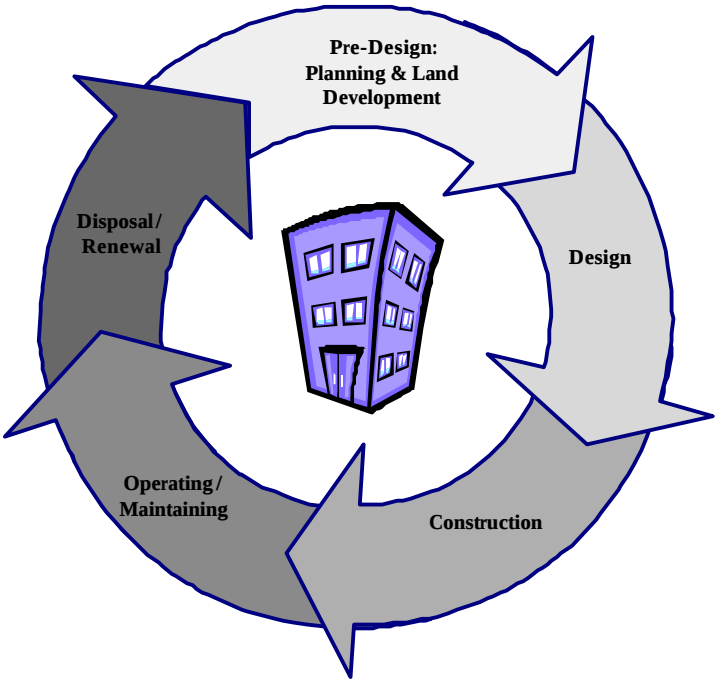
Sustainable building involves considering the entire life cycle of buildings, taking environmental quality, functional quality and future values into account. In the past, quality issues have hardly played a significant role. However, in strict quantity terms, the building and housing market is now saturated in most countries, and the demand for quality is growing in importance. Whole life thinking needs to prevail from design and throughout manufacture, to build, operation, maintenance and disposal of facilities.

Efforts to achieve sustainability should be focused on the various stages of the built asset life cylce. The environmental, social, and economic impact of an activity is fully realized when the life cycle is considered. Each part of the building process, or the built asset life cycle, has different impacts on the environment and therefore provides different opportunities to develop appropriate sustainability responses. Using a life cycle perspective, these impacts can be measured and used to design individual buildings.

The built asset life cycle is from "cradle to grave". Issues for the non-residential/commercial works industry fall under five different areas, which represent the life of a built asset. These include the pre-design aspects of planning and land development, design aspects such as raw material extraction and building product manufacturing, the actual construction of the building, operation and maintenance, and renewal or disposal at the end of the buildings life.

[5] Please note this Section has borrowed from the following source: Building Energy Efficiency Research (BEER), Sustainable Construction, 2002 http://www1.arch.hku.hk/research/BEER/sustain.htm#2.1

Built Asset Lifecycle



6.2.1 Pre-design / Planning / Land development

Issues:

- Appropriate uses of land,
- Alternative uses of land,
- Sharing of land,
- Reducing environmental impact – on surrounding areas, and in choice of location,
- Increase community involvement,
- Plan for social cohesion and equity,
- Cultural aspects – aboriginal heritage etc.

6.2.2 Design

Issues:

- Green design principles,
- Decrease energy consumption – passive solar designs etc.,
- Accessibility,
- Quality of life aspects,
- Decrease environmental impact of materials used.

6.2.3 Construction

Issues:

- Decrease environmental impact of construction materials and machinery used,
- Control of annoyance to surrounding community (noise, pollution etc),
- Site clean up,
- Waste management and control of site waste.

6.2.4 Operating / Maintaining

Issues:

- Improve renovation and repair methods and practices,
- Data concerning operation and maintenance costs, and better asset management, will play an important part in ensuring the sustainability of existing facilities,
- Invest more in repair, maintenance, renovation and refurbishment of existing facilities to extend the life of the built asset, and therefore produce notable overall savings by reducing the need for building new assets.

6.2.5 Disposal / Renewal (including cultural heritage value)

Issues:

- Consider all available options for disposal
- Recycle materials upon demolition of asset,
- Consider all deconstruction issues,
- Re-use of asset,
- Renewal of facilities,
- Consider any heritage and cultural issues and act accordingly

Future development undertaken in a sustainable manner represents new ways of thinking in planning, designing, building, operating, and maintaining the built environment. It should be noted that many of the issues that may arise later in the life cycle of a built asset are best-considered and catered for during the initial development and planning phases. These early phases offer the most effective opportunity to influence the overall sustainability of future built assets. Although some of our existing built assets may not have been designed with sustainability in mind, significant benefits can still be achieved by applying sustainable practices during each remaining phase of the assets life.

7 Specific Priorities

This paper has so far identified the dimensions and objectives of sustainability in general and the characteristics of a sustainable built environment, setting out the key sustainability issues and exploring the elements of an ideal sustainable building and the theory of sustainable construction. The sectors and components of the WA built environment have been recognised along with the appropriate mechanisms for influencing sustainability through the various sectors. The importance of considering the life cycle of a built asset has also been explored, with future development and sustainability progress seen as representing new ways of thinking throughout the stages of a built assets life.

It is recognised that the identification of specific key priorities is required to focus our efforts in the pursuit of a sustainable built environment. As DHW Works is only one player within the built environment, this paper does not attempt to set priorities for a sustainable built environment. It is necessary to obtain assimilation of thoughts, research efforts and knowledge from all stakeholders in the built environment to be able to set these specific priorities. At the State Government level, this would involve the integration of all State Government Departments operating within the built environment.

However, the Building WA Strategy discussed in Section 3 has identified four high level key objectives for the WA built environment, based on the emerging priorities of the State Strategic Plan. Whilst these are not all directly focussed on sustainability, elements of sustainability arise under each. These four priorities are:

1. Quality Built Environment
2. Vibrant Industry
3. Regulatory Protection and Enablement
4. Best Practice Works Procurement

These four broad objectives could be integrated with more specific sustainability priorities for the built environment. It must be stressed that DHW Works has not yet given exceptionally deep consideration to these issues and are only providing preliminary thoughts at this stage of the State Sustainability Strategy process.

Again, there is a need to develop these priorities in consultation with all involved in the WA built environment, but some suggestions of suitable priorities (in no particular order of importance) are provided below under each of the three sustainability objectives.

7.1 Environmental

7.1.1 Priority 1: Improved Energy Efficiency and Use of Renewable Energy Resources

- Orientation – properly sited buildings will benefit from solar heat, natural shading, and natural lighting and thus reduce energy requirements.
- Building Envelope – houses/buildings that are airtight and well-insulated consume less energy.
- Building Systems – select the most energy efficient equipment possible. The energy cost savings will more than outweigh the possible higher initial cost.

7.1.2 Priority 2: Reduced Overall Environmental Impact

- Preserving Integrity of Site – evaluate the site and determine how the building could best blend in with the natural environment.
- Landscaping – incorporate green landscaping for low water and maintenance requirements. Proper landscaping can also help reduce heating and air-conditioning energy consumption and water consumption.
- Materials Selection – consider each material with respect to its impact on the environment by selecting local materials and materials that have less impact on the environment.

7.1.3 Priority 3: Increased Resource Conservation

- Recycled Content Materials – selecting materials that have at least some recycled content
- Minimisation of Construction Waste – recycling construction related waste where possible. Waste can also be reduced by salvaging rather than landfilling.
- Use of Alternative Building Materials – utilising technologies that allow for more efficient use of resources.
- Materials Re-use – salvaging certain products when buildings are demolished or rehabilitated.
- Water Conservation – installing energy efficient appliances and fixtures and changing irrigation practices and behaviour can reduce water consumption.

7.1.4 Priority 4: Enhanced Indoor Air Quality

- Reduced Chemical Content of Products – reduce risk of indoor air pollution by buying natural products wherever possible, or those that are low in chemicals.
- Adequate Fresh Air Supply – mechanical ventilation systems for providing fresh air.

7.2 Economic

7.2.1 Priority 5: Increased Efficiency / Productivity of Construction Process

- Process and Team Integration – improving links between planning, design and construction to reduce waste and facilitating use of sustainable materials through a sharing of knowledge and skills.
- Product Development – new technologies etc.
- Improved Customer Focus
- Quality Management Systems
- Training – increase job knowledge and efficiency.

7.2.2 Priority 6: Better Working Conditions for Employees and Contractors

- On-site facilities,
- Health and Safety Measures,
- Use of Local Employment, and
- Training,

to ultimately retain workers through increased safety, job satisfaction and social interaction.

7.2.3 Priority 7: Improved Business Relations

- Long-term Partnerships
- Non-confrontational Contracting
- Codes of Conduct
- Quality Assurance / Environmental Standards

7.3 Social

7.3.1 Priority 8: Increased Consideration of Community Issues

- Siting Buildings – situating buildings, where possible, near public transportation and other amenities such as shopping centres, medical centres and recreational facilities.
- Pedestrian Friendly – sites that are pedestrian friendly encourage walking and cycling, reducing the need for automobiles.
- Historical and Cultural Preservation – preserve the historical and cultural aspects of the community with designs that blend in to the natural feeling and aesthetics of a community.

7.3.2 Priority 9: Contribution to Safe, Viable and Cohesive Communities

- Co-housing – encourage co-housing facilities as a resource efficient housing option with a strong sense of community offering social, economic and environmental benefits.
- Providing for community diversity through a mix of housing
- Accessibility – ensuring ease of access to public buildings i.e. disability access
- Measures to improve quality of built environment, both functionally (healthy and safe buildings) and aesthetically (public art and renewal programs).

7.3.3 Priority 10: Increased Responsiveness to Customers, End Users and Other Stakeholders

- Involvement of communities and end users in project planning design.
- Consultation with other stakeholders affected by development / construction
- Environmental reporting

8 Barriers

It is possible to identify several broad areas of the non-residential/commercial building sector that may present barriers to a more proactive approach to sustainability in the built environment:

8.1 Industry Culture

- **Historical divisions** between the trades involved in the construction process and the wide range of actors involved in the realisation of both development and public construction projects;
- **Historical characteristics** of the industry (e.g. conservatism), which mitigate innovation of sustainable practices.
- **Industry drivers** provide an effective barrier to more sustainable practices in the built environment. The building industry (both government and private) is driven by short-term economic goals, which prevents life cycle economic, social and environmental savings and benefits. Currently capital costs dominate building economic costing, but represent approximately two percent of the building costs over a 30 year time period. Operations and maintenance costs equal six percent and personnel costs equal 92 percent.
- **Financial pressures and professional attitudes** toward sustainable building are the root cause of barriers to life cycle initiatives and sustainable practices in the building industry. All sectors of the building industry are affected including development, design, building products, construction, use and maintenance, retrofitting and waste management in both the government and private sector.

8.2 Economic

- **Underdeveloped market** for sustainable products and initiatives prevents the wider use of these products in non-residential/commercial construction projects.
- **Perceived investment risks:** Sustainable buildings are often branded alongside 'Green' buildings by investors. The image is of natural materials, green roofs, radical passive design, and technological gizmos. They are seen as a potentially short-term fashion trend with a narrow market place appeal that runs counter to longer-term investment strategies. Such buildings clearly do not appeal to long-term investment planners.
- **Perceived capital costs:** It is a commonly held belief that more sustainable buildings cost significantly more in terms of their capital cost. This belief is not well founded and is based on experience with 'bolt-on' sustainable design solutions. It does also reflect a wariness of the unknown amongst building and construction professionals in general and Quantity Surveyors in particular.
- **Building cost decisions** are based on short-term capital expenditure rather than life cycle costs, which tends to give the impression that the inclusion of sustainable initiatives is more costly.
- The **tenant/owner financial relationship** inhibits the reduction of recurring costs: building capital is an investment by the owner but the burden of recurring expenses is shifted to the tenant. For existing buildings, the owner is unlikely to invest money for capital that gives returns to the tenant. Similarly, the tenant is unlikely to invest in reducing recurring expenses if the investment becomes part of the owner's capital.

8.3 Educational / Awareness

- A **general lack of awareness of all the issues** surrounding sustainability and a sustainable built environment: There exists a marked lack of understanding and awareness amongst industry, government and the general community in relation to sustainability – if all stakeholders had attained full awareness of the issues, there would be a much speedier transition to a more sustainable built environment with the uptake of new technologies and design processes.
- The **architect's attitude** and the **client's commitment** to sustainable design: the commitment of clients to sustainability depends upon the financial viability and occupant comfort of buildings. This relates to the level of awareness among clients and Architects/designers of the benefits of sustainable practices. Although the Australian public has a high level of environmental concern generally, it appears unlikely that these concerns will translate into sustainable buildings without market incentives and the promotion of sustainable practices through education and awareness campaigns.
- **Lack of information** resources and design assistance for environmental and economic life cycle information: There is a lack of environmental and economic life cycle design tools and information in Australia. It is critical that architects and designers can demonstrate to clients that sustainable design is cost effective.

8.4 Institutional / Process

- Relatively **short occupation periods** for which developers/contractors occupy a site, making management of local environmental impacts a lower priority;
- **Design teams are traditionally segmented** according to their skills: the design process rarely has an interdisciplinary team or thorough input from all the stakeholders. One or two architects make the key design decisions that form the framework for the work by other designers.
- **Separate capital and recurrent budgets**: Separate budgets for capital and recurrent costs are reflected in the design and construction process of government buildings. The **types of contracts** used illustrate the emphasis on reducing capital costs without regard for life costs.
- The **approach to asset management** restricts life cycle concepts: Total Asset Management (TAM) is supported by all levels of government in Australia and potentially restricts the full consideration of life cycle costs.
- **Procurement of materials** does not advocate environmental life cycle issues: the Australian government spends billions of dollars annually on the procurement of goods and services. However, the evaluation process for government tenders does not include a system for assessing life cycle economic, social or environmental issues.

9 Mainstreaming Sustainability: Facilitating Change

It is possible to identify a number of areas that represent the key to bringing about change and facilitating a more sustainable built environment. Issues of sustainability and whole life cycle principles will increasingly be 'market-driven'. A concerted effort will be required to change the embedded culture of all stakeholders involved in building and construction projects to one which embraces sustainability at every level. Sustainability must be more clearly 'valued' and supported by the industry, community, and clients alike.

9.1 Market Demand: Client / Investors / Community

Community, clients and investors – creating market demand for sustainable practices:

- Generate a change in client mindset – deeply ingrained attitudes and social conscience working against sustainable practices. Well-informed and clearly motivated clients are required, who place emphasis on community development and the expression of cultural identity.
- Generate a change in mindset of investors and industry players – deeply ingrained attitudes and lack of awareness of sustainable practices and initiatives is working against sustainability in the built environment. Investors and industry players who are fully informed and aware of the opportunities that exist, and the practicalities surrounding them, are a necessity.
- Generate general community desire to attain a sustainable built environment to generate demand for appropriate technologies etc, and further encourage Government (through political pressure) to take a leading role in these initiatives. An active community is required, with a concerned commitment to improving the quality of their built environment.

9.2 Affordability / Delivery: Industry

Industry (Building and Construction Industry) – achieving and delivering affordable sustainable practices:

- Advancing new sustainable technologies – the lack of advancement of new sustainable technologies is hindering the widespread implementation of sustainable initiatives. The advancement of sustainable technologies will in turn lead to the achievement of affordability. Professionals promoting and advancing sustainable technologies are a necessity within industry.
- Adopting new initiatives and technologies in sustainability – lack of demand has led to a lack of adoption of new initiatives and technologies. Generation of demand (the first key area of change) will encourage the widespread adoption of sustainability initiatives and technologies, which in turn will lead to more affordable sustainable practices. Industry players are required to adopt new initiatives and technologies.
- Adopting Best Practice procedures with a focus on the triple bottom line of sustainability – economic, social, environmental impacts. The development of new forms of design practice is required involving collaboration amongst design, arts, environmental, landscape, planning and other such professionals, and consultation with the community, for the advancement of the quality of the built environment while recognising the increasing importance of ecological sustainability.
- Adoption of more environmentally responsible construction processes– waste, clean up, pollution etc. During the construction process the adoption of more environmentally sound

practices are required to reduce the impact of construction on the surrounding natural environment, construction workers, and the inhabitants of the general community.

9.3 Regulation/Facilitation: Government

Government – providing a regulatory environment and acting as the driver and facilitator of sustainable practices:

- Promote general awareness of importance of sustainability – Government must take the lead in raising awareness of the general public and the community at large to generate demand, leading to affordable sustainable practices and widespread adoption.
- Offer incentives to business and community for adopting sustainable practices and technolgies – Government is in a position to offer incentives to business and the general community through programs and initiatives. This again will generate a higher level of demand, reducing costs and increasing delivery of sustainable practices.
- Legislation, regulation and policy implementation – Government is in the position to regulate industry and implement mandatory legislation and policy to encourage more sustainable practices in the built environment. Accordingly, policies that contribute to the sustainability of building practices should be implemented, with recognition of the importance of existing market conditions. Both the environmental initiatives of the construction sector and the demands of users are key factors in the market. Governments will be able to give a considerable impulse to sustainable buildings by encouraging these developments.
- Best Practice promotion – the promotion of best practice techniques in procurement of building services for a sustainable outcome is an important function of Government in working toward a sustainable built environment.
- Lead by example – Government is in prime position to lead by example in sustainability initiatives through pilot projects, showcase studies, further research and development, and adoption of sustainable principles and thinking throughout its planning and procurement of building services. Agencies need to adopt sustainability as part of their mindset when planning for new assets or disposal/renewal of assets.
- Education – education plays an integral part in facilitating change toward more sustainable building practices. Many areas of education already include sustainable ideals and it is important for these to continue so tomorrow's generation will hold sustainable principles in high priority.

10 Research and Development Requirements

Research and development efforts should centre on identifying ways of overcoming the recognised barriers to a sustainable built environment, through coordinated research and development programs. Research and development efforts should be coordinated and linked between all parties working within the built environment to ensure no double up of research efforts, whilst enabling the sharing of vital information and developments.

Currently a substantial amount of research is being undertaken all around the nation and globe relating to sustainability and the built environment, and more specifically, sustainable construction. For some examples of existing research efforts see Appendix 1.

These research efforts represent only a small portion of the research activities currently underway in Australia and overseas. A method of integrating these research efforts and widely disseminating results and findings, would ultimately be for the benefit of all. In order to overcome identified barriers and drive sustainability in the built environment a mixture of new research, and more effective dissemination of existing research, is required. Research efforts need to be interdisciplinary and collaborative with end users.

In addition to coordinating and integrating existing research efforts, Western Australia should be conducting its own research and development programs focused on sustainability in the built environment. Research and development requirements in WA should concentrate on:

- **Improvements in environmental quality:** there is a need to provide convincing evidence of the business benefits of environmental good practice and to disseminate this, and the tools to implement it, throughout the industry and the wider community. This could include such things as:
  - an explanation of 'What is' sustainable construction/built environment,
  - information on who is taking effective action,
  - information on all technologies and initiatives currently available for sustainable design, management, buildings and construction practices,
  - information to convince those who doubt the benefits (business or other) of sustainable buildings and construction,
  - effective communication of best practice and research outputs,
  - how to assist small to medium businesses in the move towards sustainable construction.
- **Sustainable building and construction industry:** there is a need to transform the market into one which is receptive to sustainable buildings, where sustainable materials are appropriately certified, and where the right price signals exist. This involves:
  - the provision of information and tools for the practical application of whole life cycle costing,
  - information on available technologies and initiatives for sustainable design and construction practices.
- **Delivering a sustainable built environment, contributing towards sustainable communities:** research is required to examine the interaction between the construction side of the industry and other industry players and stakeholders (e.g. those involved in planning, land development, transport, safety, health) and regulatory structures (e.g. planning and building control regulations, Government).

- To ultimately decide how the building and construction industry will change methods of external and internal communication to improve sustainable performance throughout the whole built environment.

In relation to **building performance and construction** in particular, research should be undertaken into the following:

- the environmental performance of buildings and other permanent structures;
- factors relevant to the health, safety and comfort of human occupants and users of buildings and other permanent structures;
- the efficiency of energy use of buildings and other permanent structures;
- the performance and durability of materials used in construction;
- the efficiency and methodology of the construction process;
- the application of information technology to aspects and techniques of building.

Again, it should be noted that these are preliminary thoughts only and DHW Works require more time and resources to provide a more thorough and well thought out list of R&D requirements for a sustainable built environment. Critically though, more sufficient attention must be paid to the communication of research or innovation findings. This is to allow construction practitioners to make pragmatic business decisions that reflect the current best practice understanding of how the industry can contribute to sustainable development.

11 Options for Action

In Australia the rate of adoption of environmental building design and other sustainability initiatives has been relatively slow. Government programs can reverse this trend by addressing the various barriers and acting accordingly.

DHW Works is the "best practice" centre of expertise for capital works procurement and issues surrounding the non-residential/commercial sector of the built environment, and are a facilitator between Government and the Building and Construction Industry. This places DHW in an ideal position to ultimately play a regulator or facilitator role for encouraging sustainability in the Western Australian non-residential/commercial sector of the built environment.

Options for Government to encourage and promote a more sustainable approach to the built environment should centre on overcoming the identified barriers through focussing on the key areas for facilitating change (Regulation/Facilitation – Government; Affordability/Delivery – industry; Market Demand – client/community/investors). This section identifies options for sustainability action that will help address identified barriers and facilitate the mainstreaming of sustainability initiatives in the built environment. Again it must be stressed that these initiatives and suggestions are only the preliminary thinking of DHW Works and require more contemplation and development.

These options for action could include:

1. **Regulation/Facilitation – Government**:

Mandatory minimum sustainability requirements for Government projects, including incentives for a higher sustainable performance.

2. **Affordability/Delivery – Industry**:

Fiscal incentive schemes for sustainable performance – e.g. tax deductions, government fees reductions, consumer rebates, tender price preferences, and funding incentives for Government Agencies.

3. **Market Demand – Client/Community/Investors**:

Educational and Awareness Programs.

4. **Other General Strategies**:

Programs to improve existing built facilities; forming alliances and partnerships; the development of a built environment research unit for further research and development.

11.1 Sustainable Asset Management Lifecycle Strategies

A more sustainable methodology for asset management involves taking an integrated approach to develop projects and policies that will facilitate beneficial social, economic and environmental outcomes in both the short and longer term. A framework for achieving sustainable outcomes in the asset management process should be developed by linking Strategic Asset Management (Treasury's SAM process currently in place in WA Government agencies) principles with sustainability principles.

Strategies for sustainable asset management can include:

- consult stakeholders effectively in the planning phase to consider sustainable approaches;
- provide equitable access across communities, cultures and regions;

- protect and enhance heritage features, as well as key flora and fauna habitats and movement corridors;
- integrate service delivery and infrastructure to increase reliance on public transport;
- plan, procure, and provide for sustainable materials and objectives throughout the life cycle of a built asset

Implementing Sustainable Asset Management could be undertaken along the same lines of Queensland Department of Public Works Ecologically Sustainable Asset Management (ESAM) framework. This framework should encourage asset planners and managers to adopt strategies at the most appropriate phase of the asset life cycle to ensure best return for effort.

Key goals to plan and aim for in each phase can be assessed and planned for objectively, transparently and systematically, using the approach shown in the tables at Appendix 2.

11.2 Capital Works Project Approval and Funding Process

To support the framework of ecologically sustainable asset management, the Queensland Department of Public Works' Building Division has also developed a decision-making and planning tool called the ESAM five-star rating system that measures whether organisations, building projects/facilities and suppliers plan and operate in an economically, socially and environmentally responsible way (Queensland Department of Public Works, http://www.publicworks.qld.gov.au/07_showcase/content_showcase_essam.htm). DHW suggests a similar approach for Western Australia based around a new capital works project approval and funding process, incorporating a works project sustainability rating system.

A rating system could be used to guide and encourage agencies toward achieving sustainability performance (incorporating sustainability principles) for their works projects. Funding and approval would be linked to obtaining a sustainability "tick" in the project approval process for meeting economic, social and environmental sustainability objectives. An agency would obtain a "star" for each sustainability initiative incorporated within the works project, and a certain number of stars would be required to obtain the sustainability "tick" for the particular project. Treasury could then extend incentives, such as further funding or some other financial incentive, for the project if an agency takes sustainability initiatives a step further (i.e. obtains **over** a certain number of sustainability "stars").

Funding incentives would certainly prove to have the most affect in relation to encouraging sustainability initiatives in works projects, as most agencies struggle to obtain the level of funding required for some capital works projects (considering a chunk of that funding must go toward DHW Works project management fees etc).

A diagrammatic example of the proposed star rating project and funding approval system can be seen at Appendix 3. Social, economic and environmental sustainability objectives would be listed, with agencies obtaining a star for each objective considered within their particular project.

This initiative is currently in conceptual stage and would require further research and development if it were to be adopted.

11.3 Fiscal Incentive Schemes

Fiscal incentive schemes are a major key to overcoming cost barriers and delivering affordable sustainability initiatives in the built environment. Incentives will always work best if they are of a financial nature – in business, whether public or private, financial concerns are paramount.

11.3.1 Incentive Schemes for Business / Private Sector

Price preferences could be offered to private sector practices that incorporate or consider sustainability. Price preferences along the same lines as Buy Local Policy preferences, could be incorporated in government tendering processes to encourage contractors / consultants to incorporate built environment sustainability principles in their tender submissions and subsequent design and construction work on behalf of Government.

Price preferences could be extended to those organisations that offer environmental, social, and economic sustainability principles in their tender for the particular project. This will ultimately encourage those wishing to win tenders for Government public works to think seriously about, and to start implementing, sustainability principles into their every day work practices.

11.3.2 Incentive Schemes for Government Agencies / Public Sector

Financial incentives could be offered to those agencies with major capital works programs (such as DHW Works major clients – Education, Health, and Justice). Treasury could offer higher funding incentives for those agencies who incorporate sustainability objectives in their capital works project planning, to further encourage the push toward a more sustainable built environment. This initiative is linked to the Capital Works Projects Approval and Funding Process option discussed previously.

11.4 Educational and Awareness Programs

Education and awareness programs are integral to educating the youth (as tomorrows decision makers), investors, and the general public on the importance of sustainability, to mainstream sustainable thinking into the community and create market demand. Education and awareness programs should include Architecture and Design principles that support sustainability to ensure tomorrows decision makers are fully aware of sustainability principles, and requirements in design, for built assets and infrastructure.

11.4.1 Education Centre for the Built Environment

An education centre for the built environment could be established to promote built environment initiatives and sustainability concerns.

In 1988 Europe introduced CUBE – Centre for the Urban Built Environment. CUBE is committed to the investigation, discussion and advancement of design quality within the built environment. The centre is aligned with Government and is cited as an integral player in the delivery of high quality urban design. CUBE is dedicated to broadcasting the ideas and issues that lie behind the buildings, spaces and environments that make up the built environment. The centre also provides education on the built environment, aiming to enrich the learning process of children as tomorrows decision makers for the built environment, and undertakes a program of challenging exhibitions, educational activities, publications and events. (http://www.cube.org.uk/)

11.4.2 Promote Sustainable Buildings and Infrastructure

If sustainability is to be integrated in every level of business and community within the built environment, Government must take the lead in promoting sustainable buildings and infrastructure to act as a leader / facilitator of sustainable initiatives. Promotion would involve Government taking the lead in non-residential building projects by undertaking showcase projects to promote sustainability initiatives in the built environment. This would ultimately accelerate the widespread introduction of new technologies, “intelligent” products, standardised pre-assembled components and advanced materials into every level

of the built environment. This in turn will create new business opportunities, improve living and working environments and enable information feedback to improve overall construction quality.

11.4.3 Promote the Business Benefits of Sustainable Construction

Environmental design provides economic returns that need to be widely conveyed to increase general awareness. The business benefits of sustainability must be highlighted and brought to the attention of the building and construction industry and the community at large. The economic returns of sustainable design and construction must be conveyed to provide greater likelihood of widespread adoption of such practices.

Many research papers have been prepared on the business benefits of sustainable construction, the conclusions of which need to be communicated to all players in the building and construction industry. Examples of such research papers are examined at Appendix 4.

Reports such as these should be widely distributed to ensure awareness of all benefits relating to the incorporation of sustainable initiatives in building projects. This will help increase demand for sustainable initiatives, drive costs down and lead to a far more sustainable built environment.

11.5 Rebuild Public Service Expertise

Traditionally the public sector was responsible for setting and maintaining standards for design quality, training and apprenticeships, guidance and long-term strategic directions for the building and construction industry. With the push toward outsourcing and contracting practices, the public service lost control of many of these once core functions. The current WA State Government has recognised that a major core function of Government in general is to provide where the market fails. Throughout this paper we have seen that currently the market is failing to provide for sustainability in the built environment – it does not currently provide for future generations and intergenerational equity.

If the WA State Government is serious in driving sustainability initiatives in the built environment, a rebuilding of public sector expertise could facilitate this process. Currently DHW operate with no professional design staff (Architects, Engineers etc) to ensure sustainability is of a high priority in public works design and construction. Therefore, working directly toward sustainability in the built environment is difficult without a policy or legislative directive aimed at the consultants and contractors we engage, or the Government agencies that make up our client base.

DHW Works recommends the rebuilding of expertise in the relevant public sector departments to oversee the works design and construction processes to ensure sustainability principles are adhered to and implemented in all public works projects. Employing State Architects, Designers, Engineers etc. to oversee and coordinate design would ensure alignment with sustainability principles – professionals such as these already exist in our organisation and could be further developed and educated to be utilised for such a role.

11.6 Built Environment Sustainability Research and Policy Unit

As part of rebuilding public service expertise, DHW Works recommends the development of a Built Environment Sustainability Research and Policy Unit, consisting of representatives from all State Government Departments operating within the built environment. These departments would include all those under the Minister for Works portfolio to enable the coordination and

integration of policy efforts in respect of the built environment and to ensure no double up of efforts in the area and a sharing of knowledge and sustainability initiatives.

Alternatively, individual research units could be established for each State Government department operating within the built environment. However with so much overlapping of issues between the different expert agencies and areas that comprise the built environment, some cohesion is required to formulate workable policy and initiatives embracing all areas.

Such a research and policy unit would undertake extensive research and scanning of the built environment to investigate initiatives that will facilitate the most improvements for economic, environmental and social/cultural sustainability in Western Australia. Extensive research is required to determine the type of initiatives required to achieve a higher level of sustainability through the built environment. Policy, legislation, government incentive schemes, or the most appropriate delivery strategies for increasing sustainability in the built environment could be researched and assessed, along with initiatives being utilised in other States and countries (including their results).

Research papers on available initiatives, new technologies, business benefits of sustainability, government offered incentives for sustainable practice, etc. could be published through this unit to enable widespread dissemination of sustainability information. This would help facilitate the mainstreaming of sustainability thinking into the wider community and every day business and working environments, ultimately increasing demand, driving costs down and developing a more sustainable built environment.

The unit could also be utilised to demonstrate new building technologies, products and practices through showcasing specific government sustainability building projects. Demonstration and evaluation of sustainable products in government building projects will eventually lead to greater adoption of these initiatives throughout the built environment.

A sustainability policy and research unit could certainly be utilised within DHW Works to “sell” or promote sustainability initiatives to the Government agencies that make up our client base. As a centre of excellence in capital works procurement DHW Works could implement a sustainability area whose function is to research and encourage the implementation of sustainability initiatives in capital works projects. This may involve canvassing our main clients (Justice, Education, Health) and providing advice on appropriate sustainability initiatives for their capital works projects.

Various similar research units developed in other states and nations support the establishment of such a built environment sustainability unit in Western Australia and are examined at Appendix 5.

11.7 Improve Existing Built Facilities

The improvement of existing built facilities will aid the progress toward a more sustainable built environment. Improvement of existing built facilities could be undertaken in two ways:

1. Renewal programs aimed at refurbishing and repairing existing facilities in the built environment; and
2. Improvement of renovation and repair methods and practices.

Programs aimed at renewing the existing built environment could be initiated to increase sustainability. Investing more in repair, maintenance and refurbishment extends the overall life of a built asset, substantially diminishing the requirement for building new assets. A large degree of the existing built environment was not designed to be inclusive, so there are somewhat limited

facilities for the elderly and disabled. This obsolescence in existing buildings and structures could be overcome by technical fixes or re-use. The majority of existing built assets were also not designed with sustainable principles in mind but, as we have seen from the built asset life cycle analysis, significant benefits can be achieved by applying sustainable practices during each remaining phase of the assets life.

DHW Housing has been actively involved in north of Perth urban renewal programs to increase the aesthetic aspects of residential property in certain northern suburbs to increase the ultimate value of those suburbs in general. Similar programs as this, aimed at the non-residential/commercial sector of built environment, could also be undertaken for improvements to hospitals, schools, and other public buildings and assets.

With a large amount of construction output consisting of repairs and maintenance to existing built facilities there is a need to find new ways to exploit its potential and value through lateral thinking about alternative uses and the application of innovative technology. The improvement of renovation and repair methods and practices, with better refurbishment 'processes' and improved standards for their supply, will enhance living conditions and add value and appeal to existing built facilities. Data concerning their operation and maintenance costs, and better asset management, will play an important part in ensuring the sustainability of existing facilities.

11.8 Forming Alliances and Partnerships

Developing and maintaining productive partnerships with businesses, government organisations/agencies, and non-government organisations is an integral key to successfully achieving sustainability objectives. DHW Works has identified massive quantities of completed and continuing research and information surrounding sustainability in the built environment, as indeed most agencies producing similar submissions to this would agree. Forming alliances and partnerships enables the sharing of this vital information, research, findings, and new technologies, with minimal double up of research and development efforts. To achieve a more sustainable built environment, unification is required of all bodies researching different aspects of the same issue.

Alliances and partnerships could be pursued in the following manner:

- Consultation and collaboration with key industry representative bodies such as the Master Builders Association, Property Council of Australia, Royal Australian Institute of Architects, Australian Building Energy Council etc.
- Co-operation and co-ordination of efforts with other WA Government agencies operating within the built environment;
- Co-ordination of research efforts with Universities;
- Implementation of programs and coordination of research efforts in collaboration with similar organisations/departments operating within the built environment in other jurisdictions or nations;
- Indirect partnerships with other stakeholders and consumers within the broader community.

11.9 Implementing Legislation

Legislation is a possible tool for improvement to achieve maximum sustainability benefits with a minimum of regulation. Legislation in areas such as management of asbestos, safe on-site practices, construction waste management, and other such detrimental environmental impacts is recommended.

12 Case Studies – Sustainability in Action

The public works component of Department of Housing and Works (DHW Works) can demonstrate an existing commitment to sustainability through a number of past projects and existing initiatives. Each case study provides an overview of the project or initiative, followed by a number of points to demonstrate how the project works toward economic, environmental or social sustainability through the built environment.

Five case studies are included in this paper:

1. Rat Island Research Camp – Abrolhos Islands
2. Shenton College
3. Energy Efficient Design of Schools in WA
4. Fremantle Prison and Heritage Precinct
5. Percent for Art Scheme

CASE STUDY 1: RAT ISLAND RESEARCH CAMP – ABROLHOS ISLANDS

DHW Works in Geraldton, on behalf of Department of Fisheries, is currently documenting designs for a new Research facility on Rat Island, part of the Abrolhos Group, approximately 50km west of Geraldton. These islands are used as a live-in base for Western Rock Lobster fishermen between March and June of each year. There is no infrastructure on the islands and, due to their remoteness and difficulty in access - traditionally fishermen have used diesel-powered generators for all their power requirements.

This project at Rat Island comprises construction of a new jetty, dinghy landings and storage sheds, administration and research building, accommodation for 10-12 visitors (visiting researchers, fisheries inspectors etc, mess hall, kitchen and ablutions

Consultants have been engaged to research environmentally sustainable options for supplying power to these facilities. This includes both solar and wind powered generators feeding into battery bank for AC power supply for lighting, fridge/freezers, pumps and a range of other services. Power supply also needs to be maintained during off-season where camp usage is very ad hoc. Further research is proceeding

Sustainability Characteristics

This research has the potential to contribute to increased sustainability in the built environment through delivering the following benefits:

- Promotion of an ecologically viable alternative power supply
- Solar/wind orientation and design
- Incentive for other solar or wind powered features
- Decreased environmental impact
- Utilising the benefits of the natural environment

CASE STUDY 2: SHENTON COLLEGE

Shenton College[6]

A north facade of the upper school showing highlight windows with shades[6]

DHW Works arranged for the procurement and construction of Shenton College. Shenton College was designed to combine two former state schools in Perth's Western suburbs, an area that has become a desirable place to live over the last decade. A lengthy consultation process was undertaken with tenderers, students, parents, and local community to define the brief. This was the largest consultation process ever undertaken for a new school, involving more than 300 stakeholders over 16 weeks.

There were a number of key objectives of this project, of which one of the most significant was to design the school to minimise operating energy costs. Shenton was to achieve energy efficiency for heating, cooling, and ventilation. Surrounding bushland was also retained and landscaping for the school centred on complementing the existing bushland.

Environmental Consultants were engaged to identify passive design opportunities, including enhancement of natural ventilation, analysis and assessment of options for sun shading, building envelope, glazing, thermal insulation and daylighting.

The school contains the following energy efficient features:

- Buildings thermal mass is managed to regulate summer temperatures, facilitate night cooling, and in winter, retain internally generated heat. Buildings are oriented so that most windows are facing north, with dedicated shade structures on north facades to help keep interior temperatures down in summer.
- Natural ventilation and summer cooling optimise comfort conditions – strategies include openable windows at body height for air inlet, ceiling sweep fans and operable high level ventilation.
- Daylighting – glazing down to floor level opening out to courtyards. Highlight windows are used throughout the school for daylighting. The more common use of skylights was not adopted as they can be a source of radiant heat.
- Artificial lighting has been based on energy conservation principles. Classrooms contain ceiling suspended luminaries with high performance low brightness reflectors. Lights are on a timing cycle.

[6] Photo's reproduced from Australian Building Energy Council, Building Case Studies http://www.abec.com.au/

Sustainability Characteristics

Despite political and administrative changes, a culture of designing for positive environmental outcomes has survived and is beginning to prosper in WA. This project has directly contributed to increased sustainability through the built environment by delivering the following benefits:

- Decreased environmental impact on development
- An ecologically viable alternative for clients
- Lower operating costs
- Utilises the benefits of the natural environment
- Strong community consultation and involvement
- Provides incentive for others to work toward energy efficiency in buildings
- Government providing leadership and setting an example for energy efficiency awareness

CASE STUDY 3: ENERGY EFFICIENT DESIGN OF SCHOOLS IN WA

DHW Works have engaged an Architectural firm to conduct a research project into the energy efficiency of existing primary schools in Western Australia. The project's primary focus is the current "standard pattern primary school". It will review the current energy efficient guidelines for new primary schools, identify deficiencies in these guidelines and prepare potential new or amended guidelines for consideration.

The firm will conduct an environmental modelling analysis demonstrating potential energy efficiency improvements and prepare capital and recurrent cost estimates for implementing potential guidelines.

Sustainability Characteristics

This research has the potential to contribute to increased sustainability through the built environment by delivering the following benefits:

- Decreased environmental impact on development
- An ecologically viable alternative for clients
- Lower operating costs
- Utilises the benefits of the natural environment
- Provides incentive for others to work toward energy efficiency in buildings
- Government providing leadership and setting an example for energy efficiency awareness

CASE STUDY 4: FREMANTLE PRISON & HERITAGE PRECINCT

Main Cell Block from South West

Prison Gatehouse

The Fremantle Prison is one of Western Australia's premier heritage sites, centrally located in the heart of the port city of Fremantle. The site is listed on the Australian Heritage Commission's Register of the National Estate, on the Heritage Council of Western Australia's Register of Heritage Places and in the Fremantle West End conservation area. Many of the buildings in the precinct are also listed with the National Trust of Australia (WA).

DHW Works has been promoting the Prison Precincts exceptional cultural heritage values, which has ensured the site is not only WA's premier heritage site, but is now an overall complex for government, community and commercial use. DHW is continuing work to conserve, interpret and promote the history, culture and use of the Prison Precinct to standards that acknowledge the precinct's exceptional cultural heritage values. This is done through:

- Conservation of the Prison precinct
- Interpretation of the Prison precinct
- Attracting visitors to the Prison precinct
- Using the Prison precinct as an educational resource
- Attracting compatible uses
- Integrating the Prison precinct into Fremantle
- Best practice in heritage management and financial planning
- Working actively to achieve world heritage listing

As part of the management policies for the long-term sustainability of the site as a heritage place, new uses have been developed for a number of buildings within the precinct. Leases include tourism, education, and community ventures. The *conservation and future use* approach to the management of the precinct has ensured the history and significance of the place are maintained while providing for continuing use of the site.

Sustainability Characteristics

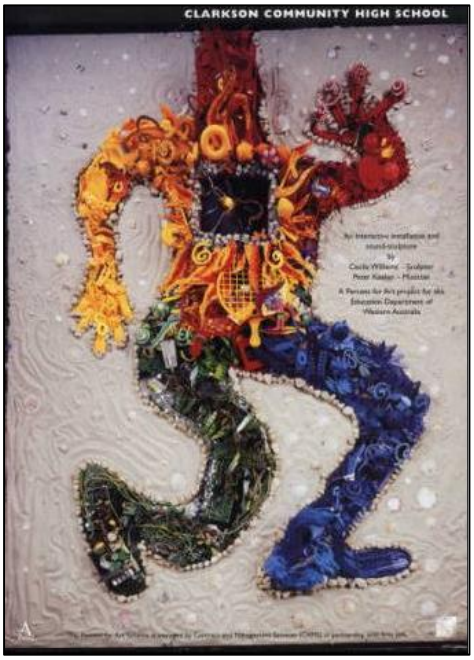
The City of Fremantle demonstrates that retaining built heritage and a walkable city centre, contributes significantly to sustainability. Fremantle's built environment provides a strong foundation on which to support diverse communities and business and to reduce the impact of its populations on the environment. The vibrancy and history of the community attracts tourists

from interstate and overseas, providing a valuable economic resource for the state, and employment for local people in their local area, all of which are essential for social sustainability.

The Fremantle Prison Precinct is an integral historical part of the City as a premier heritage site and tourist attraction. By preserving and enhancing the prison, a remarkable part of Fremantle's history is passed on to future generations. DHW is helping create a culture of sustainability in which practices that preserve our cultural and heritage values, and enhance individuals' quality of life become part of every day living. The Prison Precinct contributes to increased sustainability in a number of ways:

- Rich in cultural history – facilitates cultural identity through our heritage
- A tourist attraction
- Enhances the local economy
- Contributes to the creation of a local identity
- Creates a sense of belonging and pride in the community
- Contributes to a stimulating, vibrant built environment

CASE STUDY 5: PERCENT FOR ART SCHEME



The Percent for Art Scheme is a Western Australian State Government program, forming part of the broader Minister for the Arts "Public Art Initiative", designed to foster the creation of art in public places. The objectives of the scheme are to improve the quality of the built environment and the value of public facilities, and to create opportunities for Western Australian artists. The Scheme seeks to achieve this through public art projects carried out as part of the Western Australian State Capital Works Program.

The Scheme applies to most new State Government buildings and major additions over $2 million, and is managed through a strategic alliance between DHW Works and ArtsWA. The Percent for Art Scheme is allocated a percentage of the construction cost of State capital works projects, usually one percent, to commission artists to work as part of the project team. The artist's role is to create works that are conceptually integrated with the building or its landscape.

DHW Works manages the implementation of the West Australian Government's Percent for Art Scheme, maintains a consultant panel for public art co-ordination, and provides advice on public art procurement.

The Percent for Art Scheme in WA is currently generating more public art activity than anywhere else in Australia with most state government building projects over 2 million dollars having art projects built into their budgets. Local government authorities such as Melville and Fremantle, and redevelopment authorities such as East Perth and Subiaco are also implementing public art projects.

Sustainability Characteristics

The Arts make a significant contribution to quality of life, regeneration, and bringing communities together, and should therefore be accessible to everyone. The Percent for Art initiative is helping work toward social and cultural sustainability by instigating a sense of

community and pride in Western Australia, while supporting local and indigenous Artists. Percent for Art has the prospect of reducing crime in society and graffiti in public places such as schools, hospitals, police stations and the like.

The benefits of incorporating public art within the built environment align with the fundamentals of social and cultural sustainability, and incude:

- Enhancing quality of life
- Improve the quality of our built environment
- Contribute to the creation of a local identity
- Enhance the local economy – provide employment for artists and local businesses
- Express aspects of local history or heritage
- Contribute to the safety of a place and reduce vandalism
- Develop community pride
- Create new landmarks
- Become a tourist attraction
- Contribute to the Reconciliation process with Aboriginal peoples
- Make the world a more interesting place
- Contribute to a stimulating, vibrant environment

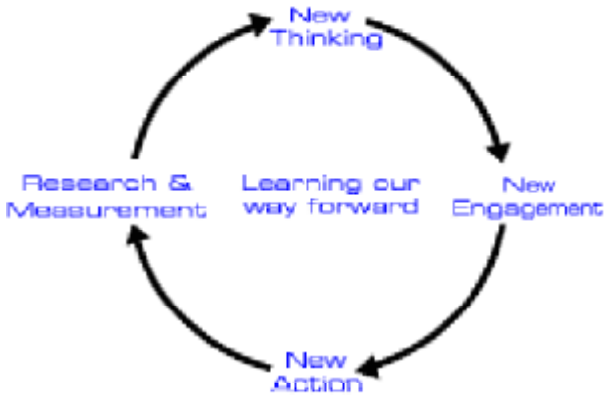
13 Conclusion

This paper identified the dimensions and objectives of sustainability and the characteristics of a sustainable built environment, setting out the key sustainability issues and exploring the elements of an ideal sustainable building and the theory of sustainable construction. The sectors and components of the WA built environment have been recognised along with the appropriate mechanisms for influencing sustainability through the various sectors. The importance of considering the life cycle of a built asset has also been explored, with future development and sustainability progress seen as representing new ways of thinking throughout the stages of a built assets life.

Suitable priorities for the built environment were established, whilst highlighting that these priorities need to be developed in consultation with all involved in the WA built environment. Barriers to a more proactive approach to sustainability were explored, along with identification of a number of areas that represent the key to bringing about change and facilitating a more sustainable future. Research and development requirements were observed, along with a group of case studies. A number of suggestions were also provided for action toward a sustainable built environment, from the viewpoint of DHW's non-residential/commercial component.

Progress toward sustainability can be perceived as a continuous loop of new ways of thinking, new engagement of technologies and initiatives, new actions in the way we do business and impact on the environment, and further research and measurement.

Sustainability progress loop



The scale of the building and construction industry, the sustainability impacts of its operations, and the influence of its products on the nation's quality of life make it a key player in delivering sustainability in the built environment. However, the full impacts on the built environment are not under the direct control of the industry, or DHW Works, as decision on patterns of development are shaped by the broader policy context of planning, housing, regional development and others. Integration of all these aspects will enable full appreciation and control of the effects of the built environment, to lead the way to a more sustainable future for Western Australia.

14 Appendices

14.1 Appendix 1: Existing Research Efforts

Currently a substantial amount of research is being undertaken all around the nation and globe relating to sustainability and the built environment, and more specifically, sustainable construction. Existing research efforts include:

- The Natural Step, a U.S based organisation, has been conducting research to strengthen the theory and practice of sustainability, drawing on the experiences of nine international offices. TNS conducts both applied and conceptual research related to sustainability issues and key barriers to sustainability. (http://www.naturalstep.org/about/about_tns-us_research.html)
- A U.K based organisation, CRISP (Construction Research and Innovation Strategy Panel) brings together Government, clients, industry and the research community to consider research priorities for sustainable construction. CRISP has a wide research remit encompassing all aspects of generating and refining the knowledge that industry and its clients need to improve the performance of U.K construction. (http://www.crisp-uk.org.uk)
- AnewNZ, a New Zealand based organisation, has been conducting ongoing sustainability research and awareness campaigns to ensure all New Zealanders hold a clear understanding of the issues and can effectively contribute toward a sustainable future. (http://www.anewnz.org.nz)
- Foundation for the Built Environment, a U.K based organisation, conducts extensive sustainability research programmes to achieve a higher quality built environment; built facilities that offer improved functionality and value for money; and a more efficient and sustainable construction sector, with a higher level of innovative practice. (http://www.fbe.co.uk/research/)
- BRE Centre for Sustainable Construction, another U.K based organisation, is currently conducting a two year intensive case study based research into the underlying benefits of more sustainable building design and management options. This research incorporates the new build, refurbishment and existing building sectors. (http://projects.bre.co.uk/suscon_casestudy/)
- CSIRO (Commonwealth Scientific and Industrial Research Organisation) Built Environment, and Australian based organisation, conducts continuing research into issues surrounding the built environment. Many of these research efforts are based on sustainability. (http://www.dbce.csiro.au/res-proj/)
- Western Australia's Murdoch University Institute for Sustainability and Technology Policy also conducts research into key sustainability issues for the built environment, such as sustainable cities and regions. (http://wwwistp.murdoch.edu.au/)

These research efforts represent only a small portion of the research activities currently underway in Australia and overseas. A method of integrating these research efforts and widely disseminating results and findings, would ultimately be for the benefit of all.

14.2 Appendix 2: Sustainable Asset Management Lifecycle Strategy Tables

Key goals to plan and aim for in each phase of an assets life can be assessed and planned for objectively, transparently and systematically, using the approach shown in the tables[7] below.

Table 1: Whole of Government Strategies for Sustainable Asset Management

Whole of Government Context	Economic, Social, Environmental Sustainability Principles
Community Expectations and Service Demand	**Conserve resources and materials, water, fresh air, energy, soil, minerals and scarce resources.**
	Enhance habitat elements of biodiversity, natural reserves and landscape.
	Reduce emissions to water, air and natural reserves.
	Protect values of heritage, security, recreation & equity.
	Enhance the quality of the built environment with aesthetically pleasing structures (including public art incorporation)
	Community participation in built environment projects
	Enhance environmental health by "green" buying, healthy building and ensuring work-place health.
Corporate Directions	**Develop clear statements of vision, mission & purpose with respect to resource conservation.**
	Develop, maintain & implement policy to enable resource conservation, social and economic objectives to be met.
	Invest in research on resource conservation.
	Develop clear statements of vision, mission & purpose with respect to maintenance of environmental qualities.
	Develop, maintain & implement policy to enable environmental health quality, social and economic objectives to be met.
	Invest in research on environment health protection.
	Consider an Environmental Management System (EMS)

[7] Tables have been borrowed from the following source: Queensland Department of Public Works, http://www.build.qld.gov.au/sam/sam_web/content/esd_cont.htm

Table 2: Built Asset Lifecycle Sustainability Strategies

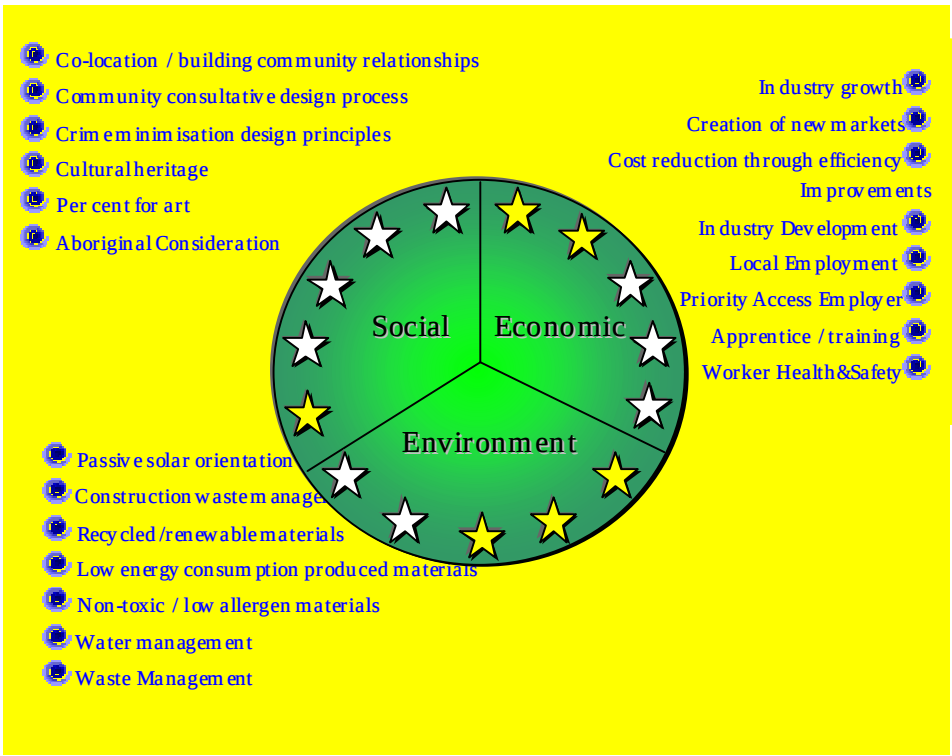
Asset Lifecycle Phase	Economic, Social, Environmental Sustainability Principles
Planning	Seek non-asset solutions/demand.
	Management solutions.
	Plan for capital investments to specifically adopt innovative, sustainable technology.
	Plan disposal to recover scarce resources.
	Ensure consistency with heritage and cultural values.
	Ensure equity of access, safety and security.
	Enhance environmental health, key heritage elements and adoption of low-pollution products or services.
	Consult stakeholders and community & integrate planning with local & State Government service delivery initiatives.
	Implement an Environmental Management Plan (EMP) as outlined in AS/NZ ISO 14000.
Design	Reflect cultural, heritage & social context.
	Enable present & future conservation of energy, water & materials.
	Maximise individual control of natural ventilation.
	Design for disassembly of components.
	Minimise harmful emissions via intakes from & to the external environment.
	Ensure equitable access for public transport & service delivery to disadvantaged groups and disabled persons.
	Incorporate natural landscapes & visual amenity.
Procurement	Evaluate tenders on:
	enhanced renewable energy usage
	increase recycled content & reduce waste
	avoidance of scarce resource usage
	use of local resources in labour and materials.
	Ensure new built assets reflect existing urban form & are integrated with public transport.
	Ensure habitat-sensitive development methods.
	Pre-qualify suppliers in terms of pollution abatement.
	Minimise hazardous, volatile and reactive compounds.
Construction	Ensure:
	reduced wastage, on site recycling
	conservation of scarce resources, water and soil
	protection of cultural & heritage features.
	Minimise noise and dust emissions.
	Implement pre-qualification of contractors & suppliers in terms of Occupational Health and Safety & EMP.

	Minimise disruption of natural and human habitat.
Refurbishment	**Facilitate:**
	increasingly efficient use of energy and materials
	reliance on renewable energy and resources.
	Conduct pre-& post occupancy air quality audits.
	Pre-qualify contractors and suppliers in Occupational Health and Safety & EMS.
	Facilitate improved pollution abatement.
Operating	**Pursue practices that:**
	maximise total system energy efficiency
	minimise finite energy/scarce resource usage
	avoid material waste & increase total resource efficiency
	facilitate purchase of increased renewable energy.
	Facilitate quality improvement via Occupational Health and Safety & EMS.
	Ensure Sustainability training & Human Resources key performance criteria.
	Ensure avoidance of hazardous materials & procedures.
	Reduce emissions to air, land and water.
	Enhance preservation of habitat/regional biota.
Maintenance	**Pursue practices that:**
	increase efficiency & renewable energy use
	ensure soil conservation; less materials wastage; healthy site biota; and avoid scarce resource use.
	Conduct pre/post-occupancy audits to ensure reduced emissions to air, land & water; and reliance on hazardous materials.
	Enhance biodiversity in natural and human habitat.
Disposal	**Pursue practices that:**
	minimise demolition waste
	facilitate re-use of materials
	ensure the safe recovery of hazardous materials such as contaminated air, soil and effluent.
	Ensure allocation is based on evaluation of all significant social, environmental and economic factors.
	Pre-quality contractors for Occupational Health and Safety & EMP in best site restorations; and minimize emissions to air, land & water.

14.3 Appendix 3: Capital Works Project Approval and Funding Process – Star Rating Diagram

A diagrammatic example of the proposed star rating project and funding approval system can be seen below. Social, economic and environmental sustainability objectives would be listed, with agencies obtaining a star for each objective considered within their particular project.

This initiative is currently in conceptual stage and would require further research and development if it were to be adopted.



14.4 Appendix 4: Research Papers – Business Benefits of Sustainable Construction

Many research papers have been prepared on the business benefits of sustainable construction, the conclusions of which need to be communicated to all players in the building and construction industry. Examples of such research papers are examined below:

- A report prepared by the NSW Department of Public Works and Services, "Economic and Environmental Lifecycle Costs of Buildings", found that over 35 Australian case studies demonstrated economic savings from environmental design. NSW SEDA has achieved an average internal rate of return of approximately 40% for energy retrofits of buildings. This relationship is supported by a multitude of international case studies.
  (DPWS, 1998 http://www.industry.gov.au/industry/building/LCReport.pdf).

- Alan Yates from the UK Centre for Sustainable Construction has also prepared a report on the business benefits of sustainable buildings in which he identifies a number of economic, environmental and social benefits to businesses (http://projects.bre.co.uk/suscon_casestudy/report1290301.pdf).

- Donald Reed from the World Resources Institute Sustainable Enterprise Program prepared a report in December 2001 titled "Stalking the Elusive Business Case for Corporate Sustainability". This paper explored the conventional mind-set that sustainability initiatives adversely affect corporate profits, while making note that many companies have found prudent environmental investments can lower costs or improve efficiency sufficiently to be a net economic gain. Using an analytical approach focusing on estimating the expected financial results of specific strategies, this paper examines the business case for corporate sustainability strategies and the attempts to quantify it financially.
  (http://www.getf.org/file/toolmanager/O16F24459.pdf)

- Also in existence are a various self-help tools such as NSW Environment Protection Authority's "Profits from Cleaner Production – A Self Help Tool for Small to Medium Sized Businesses" which aim to assist and alert businesses to the potential for reducing costs and boosting productivity by integrating environmentally sustainable practices and processes into the everyday running of their businesses.
  (http://www.getf.org/file/toolmanager/O16F24527.pdf)

14.5 Appendix 5: Built Environment Sustainability Research Units

Various similar research units developed in other states and nations support the establishment of such a built environment sustainability unit in Western Australia. Queensland have set up a number of different research units aimed at promoting sustainability in the built environment. These include:

- Cooperative Research Centre (CRC) for Construction Innovation: which is a consortium headed by the Queensland University of Technology with Department of Public Works as a venture partner to undertake extensive research in a number of areas, including sustainability. (http://www.publicworks.qld.gov.au/07_showcase/content_showcase_crc.htm);
- Built Environment Research Unit (BERU): a branch of the Department of Public Works aimed at supporting the research, development and demonstration of new sustainable building technologies, products and practices. (http://www.publicworks.qld.gov.au/07_showcase/content_showcase_research.htm)

Examples of similar research units around the globe include:

- Foundation for the Built Environment (FBE): a UK non-profit organisation developed to achieve a higher quality built environment, with a more efficient and sustainable construction sector, through a higher level of innovative practice. (http://www.fbe.co.uk/)
- Centre of Excellence for Sustainable Development: a unit of the US Department of Energy developed to provide information and services on how communities can adopt sustainability in the built environment as a strategy for long term well-being. The centre conducts research and development programs, promotes sustainable technologies, provides educational materials and produces articles and publications. (http://www.sustainable.doe.gov/index.shtml)
- Anew NZ: An independent non-partisan cross section of motivated and concerned New Zealanders contributing their collective talent, skills, experience and time to facilitate a process of national awakening and change. They aim to promote a vibrant and sustainable society with the highest quality of life through conducting research, surveys and awards. (http://www.anewnz.org.nz/index.html)
- The Natural Step: A United States based international organisation established to help organisations and communities understand and move toward sustainability. The organisation conducts research, holds events, develops programs, and showcases sustainability initiatives. (http://www.naturalstep.org/index.html)

15 Resource List

Primary Resources

Anew NZ
http://www.anewnz.org.nz/index.html

Bartuska, T & G Young, *The Built Environment, Creative Inquiry into Design and Planning,* CRISP Publications, 1994

Building Energy Efficiency Research (BEER), Sustainable Architecture, 2002
http://www1.arch.hku.hk/research/BEER/sustain.htm

Building Research Establishment (BRE) Centre for Sustainable Construction
http://www.bre.co.uk/sustainable/index.html

Built Environment Research Unit (BERU)
http://www.publicworks.qld.gov.au/07_showcase/content_showcase_research.htm

Centre of Excellence for Sustainable Development, U.S Department of Energy, *Green Buildings*
http://www.sustainable.doe.gov/buildings/gbintro.shtml

Construction Best Practice Program, Sustainable Construction, UK
http://www.cbpp.org.uk/cbpp/index.jsp

Cooperative Research Centre (CRC) for Construction Innovation
http://www.publicworks.qld.gov.au/07_showcase/content_showcase_crc.htm

CRISP Sustainable Construction Theme Group, *Integrating Sustainability and Rethinking Construction,* Environmental Resources Management, UK, May 1999 http://www.crisp-uk.org.uk/reports/isrt_fr.pdf

CRISP Sustainable Construction Theme Group, *Theme Group Report,* UK
http://www.crisp-uk.org.uk/REPORTS/sctg_r.pdf

CRISP *Construction for Sustainable Development - Research and Innovation Needs,* UK
http://www.crisp-uk.org.uk/REPORTS/9915_sum.htm

Environmental and Energy Services of the NSW Department of Public Works and Services (DPWS), *Economic and Environmental Life Cylce Costs of Buildings* Discussion Paper, 1998
http://www.industry.gov.au/industry/building/LCReport.pdf

Foresight, *Constructing the Future,* Department of Trade and Industry, UK, June 2001

Foundation for the Built Environment (FBE)
http://www.fbe.co.uk/

Queensland Department of Public Works (Building Division), *Ecologically Sustainable Office Fitout Guideline,* June 2000
http://www.build.qld.gov.au/aps/apsdocs/ESDMasterDocument.pdf

Queensland Department of Public Works, Ecologically Sustainable Asset Management (ESAM) (http://www.build.qld.gov.au/sam/sam_web/content/esd_cont.htm)

Queensland Department of Public Works, Ecologically Sustainable Strategic Asset Management (ESSAM)
http://www.publicworks.qld.gov.au/07_showcase/content_showcase_essam.htm

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http://www.getf.org/file/toolmanager/O16F24459.pdf

Royal Australian Institute of Architects (RAIA), *Environment Policy*
http://www.architecture.com.au/i-cms_file?page=/1/17/32/218/RAIA_Env_Policy_SDS_for_Arch.pdf

Sustainability Action Group of the UK Government Construction Clients' Panel, *Achieving Sustainability in Construction Procurement*, Office of Government Commerce, June 2000
http://www.property.gov.uk/services/construction/gccp/100700.pdf

The Natural Step
http://www.naturalstep.org/index.html

Yates, Alan (Centre for Sustainable Construction), *Quantifying the Business Benefits of Sustainable Buildings*, Building Research Establishment Ltd, February 2001
http://projects.bre.co.uk/suscon_casestudy/report1290301.pdf

Secondary Resources

Australian Building Energy Council, Building Case Studies
http://www.abec.com.au/

Centre for the Understanding of the Built Environment (CUBE)
http://www.cube.org.uk/

Centre of Excellence for Sustainable Development
http://www.sustainable.doe.gov/index.shtml

Community Environment Art and Design (CEAD), Murdoch University of Western Australia
http://wwwistp.murdoch.edu.au/su/site.html

EPA Cleaner Industries Unit, *Profits from Cleaner Production – A Self Help Tool for Small to Medium Sized Businesses*, NSW Department of State and Regional Development and NSW Environment Protection Authority, August 2000
http://www.getf.org/file/toolmanager/O16F24527.pdf

Sustainable Energy Development Authority (SEDA), *Corporate Plan 2000 – 2002*
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DELIVERING AFFORDABLE LAND AND SOCIAL HOUSING FOR SUSTAINABLE COMMUNITIES

A Submission to the State Sustainability Strategy

April 2002

Department of Housing and Works

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EXECUTIVE SUMMARY

Introduction

The State Government through the Department of Housing and Works has significant land holdings and a large portfolio of public housing. It makes considerable annual investment in land development and social housing across Western Australia.

The Department has embraced a number of sustainability initiatives in its land development, housing procurement and asset management roles of its portfolio. DHW, through its various functions is the only agency in WA that manages the entire property life cycle from "cradle to grave".

However, the nature of the current housing stock, the geographical extent of the Department's operating area, including significant climatic diversity, declining real funding for public housing and major societal shifts, present a number of challenges to the delivery of affordable housing to meet a growing demand.

This submission outlines current initiatives within the functional areas supported by several case studies looking at the integration of technology into housing through land development, urban renewal, aged housing and improving health in indigenous communities.

OPPORTUNITIES AND CHALLENGES FOR SUSTAINABILITY

Opportunities
In addition to the initiatives already in place, there are further opportunities for the delivery and procurement of social housing to provide more sustainable outcomes for tenants, the community and environment.

- *Surplus Government land to deliver affordable housing*

  Surplus government land provides scope to deliver affordable housing into areas of generally high locational advantage with access to services.

- *Environmental Rating and Management System*

  Review and implement one of the current national environmental rating systems appropriate to WA's climatic diverstiy. Audit current designs and existing asset portfolio against rating system

- *PATHE (Partnership Advancing the Housing Environment)*

  Advancing more sustainable construction practices through tender specifications

- *Whole of Life Housing – Universal Design Principles*

  Making universal design mandatory for all new construction would deliver whole of life housing benefits to tenants but it does so at a cost. In the majority of cases it would provide tenants without special needs little or no benefit.

- *Better Matching Supply and Demand – Management of the Existing Portfolio*

  A mix of housing stock within major demand areas provides scope to manage the portfolio to better meet clients' needs as they move through their housing careers, and minimise social dislocation when matching supply and demand.

Challenges

Equally there are many challenges to the delivery of more sustainable outcomes, not the least of which is the cost, particularly where the pay back cannot be achieved over the economic life of assets.

- *Community acceptance of affordable housing*

  Negative reaction from a section of the community in 2001 to a proposal for social housing units in the Subiaco Redevelopment Area on public owned land highlighted perceptions that social housing and its tenants have a negative impact on the community and property values.

- *Cost of retro-fitting sustainability initiatives - insulation*

  Insulation has been integral to all new housing since the early 1980s. Retrofitting insulation to the current portfolio constructed before the 1980s (approximately 17,000 dwellings) potentially has a significant cost ($8.5 million @$5,000 / dwelling) and will need to consider the remaining economic life of the asset.

- *Universal Design*

  Dwellings built to universal design principles require more space estimated at an average of 14m^2, adding up to $11,575 per dwelling in construction costs.

- *Alternate Construction Technologies*

  Consideration of whole of life costs through future maintenance plus imperatives of achieving value for money for diversity of location and climate across the State are major considerations and need to be balanced against the benefits flowing to tenants.

CONCLUDING COMMENTARY

The Department of Housing and Works has embraced a number of sustainability initiatives in its delivery of affordable land and social housing and will continue to explore opportunities, particularly in the context of Government showing leadership in new initiatives.

However this approach needs to be balanced with its role as the provider of much of the housing for those in the community in greatest need, the need to deliver socially sustainable communities and to maximise the number of dwelling units within its funding constraints.

1 INTRODUCTION

The State Government through the Department of Housing and Works has significant land holdings and a large portfolio of public housing. It makes considerable annual investment in land development and social housing across Western Australia.

This investment extends across all regions of the State and includes:

- major land development including joint ventures that provide serviced lots for the Department's housing program with the balance marketed to low and middle income households for owner occupation
- the production and procurement of new housing under public, community and indigenous housing programs
- refurbishment and disposal of existing housing stock under the urban renewal New Living program
- upgrading and maintenance of existing housing stock.

The Department has embraced a number of sustainability initiatives in its land development, housing procurement and asset management roles of its portfolio. DHW, through its various functions is the only agency in WA that manages the entire property life cycle from "cradle to grave".

However, the nature of the current housing stock, the geographical extent of the Department's operating area, including significant climatic diversity, declining real funding for public housing and major societal shifts, present a number of challenges to the delivery of affordable housing to meet a growing demand.

This submission is presented under discrete headings reflecting agency programs and the is supported by several appendices and case studies that detail a number of the current sustainability initiatives:

- *Affordable Land Development and Urban Renewal*

- *Delivery of Social Housing* – provides a context to understand the social and economic environment in which the public housing sector presently operates and a number of the challenges confronting it

- *The Existing Housing Portfolio* – provides an appreciation of the diverse nature of the existing social housing portfolio and a number of sustainability initiatives in place

- *Housing Procurement* – an overview of recent investment and sustainability initiatives that are integral to the procurement program

- *Indigenous Community* – outlines current programs in place to achieve sustainable communities by enhancing the physical environment to improve living conditions, health outcomes and provide training and employment opportunities

- *Opportunities and Challenges for Sustainability Initiatives in Social Housing*

2 AFFORDABLE LAND DEVELOPMENT and URBAN RENEWAL

2.1 Overview

Landstart, the Department of Housing and Works fulfills a major role in the development and redevelopment of land for housing across the State. Landstart's overall objective is to create safe, attractive communities that are affordable. Landstart has been at the forefront of the housing industry through broadhectare developments such as Ellenbrook and its 'New Living' initiatives in established suburbs.

Landstart has increasingly embraced the principles of 'sustainability' in its approach to land development. The following outlines examples of this and points to elements that could be incorporated into the State Sustainability Strategy.

2.2 Sustainable Development

In the context of its land development and redevelopment operations, Landstart views 'sustainability' as including a range of land use planning and development considerations, which in collaboration with key stakeholder interests produce an integrated environmental, social and economic outcome for the proponent and the community.

Typically 'sustainable development' may give consideration to the following :

- Walkable mixed use/mixed density neighbourhoods;
- Transit orientated development, particularly around public transport nodes;
- Small lots;
- Solar orientated design;
- Multi-functional open space planning and design;
- Selective retention of native bushland;
- Water sensitive urban design;
- Traffic calming;
- Streetscape landscaping promoting water conservation treatments;
- Use of recycled materials in civil works;
- Soil conservation measures and vegetation mulching in construction phase;
- Communications technology incorporated in design;
- Community infrastructure provided early ;
- Infill housing to achieve efficiency of land use and community infrastructure.

Landstart recognises that the application of these elements begins at the structure planning stage or when setting the development objectives for a project. In this respect Landstart seeks to have suitable regard for the principles contained in the Liveable Neighbourhoods Design Code prepared by the Western Australian Planning Commission. Application of these elements is typically considered on project specific basis and with a view to promoting housing affordability.

2.3 Stakeholder Collaboration

Landstart has increasingly recognised the importance of forming partnerships with the private sector and working collaboratively with other state agencies, local government agencies and local

communities in its development operations. Landstart has typically engaged with such interests at the outset of the planning process and maintained an ongoing dialogue with the changing or emerging community.

Typical of this is its participation in Enquiry-by-Design Workshops such as for projects at Butler, Clarkson and the Mirrabooka Regional Centre. In the case of various 'New Living' projects such as at Lockridge, Coolbellup and more recently Queens Park, Landstart has convened a series of public discussion forums. At Ellenbrook a Community Plan was formulated as the basis for the progressive implementation of community infrastructure. Landstart can claim to be at the forefront of community development in its current operations with the early establishment of facilities such as shopping, public transport, schools, developed open space and the facilitation of social interaction and events.

Landstart has links with the Housing Industry Association and is supportive of its Partnership Advancing The Housing Environment (PATHE) strategy. The strategy is concerned with improving the environmental performance of housing and land development with particular attention to waste management, drainage management and energy efficiency. Landstart proposes to apply the PATHE principles to the development of its Albion Town (Henley Brook) project given that the site is conducive to the undertaking innovative techniques in stormwater / groundwater management.

Collaboration with local aboriginal groups to produce a culturally responsive design which also applies 'Liveable Neighbourhood' principles and water sensitive design techniques has been undertaken by Landstart at Broome.

Clearly a collaborative approach underpins the ability to implement housing initiatives including social change, as well as enhancements or modifications to the physical environment.

2.4 Application of Sustainability Principles

2.4.1 Large Scale Development Projects

Ellenbrook has incorporated many elements of the 'Liveable Neighbourhoods' design code with the more recent stage known as Coolamon being developed as an environmentally friendly village. This is already featured as case study on the www.sustainability.dpc.wa.gov.au website. Elements of the village theme include emphasis on solar design technology, retention of natural vegetation in public open space, hydrozoning of plantings for water efficiency, lightweight construction materials, iron roofs, use of native species in front yard landscaping and a fibre optic cabling system. An Energy Reward System is available to home buyers who adopt a specified number of design and building components. The project also seeks to promote local employment generating activities.

New projects at Butler and Clarkson in partnership with the private sector have served to advance the application of sustainability principles given the association of the land with the future Northern rail link. These projects are planned to incorporate main street shopping / commercial, mixed land use and higher housing densities within walking distance of rail stations. Planning will also provide for the installation of communication technology such as high speed internet services. For Clarkson an employment strategy is to be applied with the aim of fostering a higher level of local employment.

Similarly Landstart will be aiming to optimise the form of development around future rail stations at Leda and Bertram on the proposed South West Metro rail line. Expressions of interest have recently

been sought from the private sector in respect to the development of Leda with the tenderers being requested to address planning for sustainable development.

Landstart, in conjunction with its joint venture partners is also implementing various sustainability measures and initiatives in regional WA. These include:

- Dalyellup estate south of Bunbury, which integrates water sensitive urban design and the preservation of native vegetation of the coastal dune environment into a new urban village. The estate also includes the early provision of community infrastructure such as 'school in shop' pioneered elsewhere at Secret Harbour and more recently at Ellenbrook

- installation of optic fibre communications technology in subdivisions at Dalyellup and Wandina in Geraldton. See *Case Study One.*

2.4.2 Development Works

Landstart typically requires its contractors to implement a range of measures aimed at lessening the impact of development works on the physical and social environment. These include the stockpiling of topsoil, mulching of vegetation, dust and noise mitigation and the planting of native plant species. Increasingly as Landstart develops on land which is constrained by drainage characteristics, water sensitive design techniques are applied.

It is acknowledged that there is scope to pursue other measures such as recycling of construction materials for use in road pavements as well as water harvesting techniques including grey-water recycling and roof water collection. These will require further investigation to determine their cost effectiveness, particularly in the context of maintaining housing affordability.

2.4.3 Urban Renewal and Redevelopment

Since 1995, Landstart's 'New Living' program has provided a significant impetus to the redevelopment of many inner and middle suburbs resulting in more efficient use of land and community infrastructure while dispersing concentrations of public housing. New Living is targeted at larger public housing estates, at times covering several suburbs such as New Kwinana (Calista, Medina, Parmelia and Orelia) and the New North (Balga, Koondoola, Girrawheen and Westminster). The program has also been extended to regional WA with the Carey Park-Withers renewal underway in Bunbury. Various aspects of New Living are presented as *Case Study Two.*

The Redevelopment Program has similar objectives to the New Living program but operates on a smaller scale and without the same level of social dislocation for tenants. The program is also targeted at a greater number of areas in regional WA which include: Albany (Lockyer & Spencer Park), Esperance, Geraldton (Beachlands & Rangeway), Carnarvon, Kalgoorlie and South Hedland.

2.4.4 Infill Housing

In a complementary manner, Landstart seeks to acquire properties for infill housing with opportunities typically arising on surplus Government land or land which has higher density codings given its locational advantages relative to public transport and community facilities.

The ability to provide affordable housing through infill development is significantly constrained by the attitudes of local government. This demonstrated in the down coding of localities and the

interpretation of development standards through additional policies such as to restrict or deny redevelopment. It is also apparent in terms of onerous requirements in respect to the retention and reuse of buildings with perceived heritage values.

3 DELIVERY OF SOCIAL HOUSING

The social and economic environment in which social housing operates in the early years of the 21st century is dramatically different from the post World War II period when the sector was established and primarily provided workers' rental accommodation. The community and the social housing sector are still coming to terms with the pressures and societal shifts that have occurred since the 1980s as a result of globalisation and government fiscal and economic rationalist policies. These have resulted in:

- the collapse of work and employment security due to workplace reform, productivity gains and the shift to a service-based economy, resulting in the casualisation of employment
- changing socio-economics, resulting in a shift from an "egg-shaped" society with a large middle class to a polarised "peanut-shaped" society with a larger lower income strata that has limited wealth accumulation capacity

3.1 Changing Role of Public Housing

The role and emphasis of social housing, which comprises the public and community housing sectors, have undergone a number of transitions over the past 50 years with each subsequent re-negotiation of the Commonwealth State Housing Agreement (CSHA).

In 1989, reduced State debt raising capacity, due to high interest rates and financial deregulation, restricted the growth of public housing and saw the emergence of alternative community housing providers (1989 CSHA). COAG reforms, in response to the 1993 Industry Commission Inquiry into Public Housing, re-targeted assistance to those in greatest need, including the disabled and de-institutionalised. However this was combined with a reduction in public housing funds (1996 and1999 CSHAs)

3.2 Declining Real Funding

Since 1954, the CSHA has required States to match Commonwealth funding. However a lack of indexation, annual efficiency dividends and inadequate GST compensation has severely curtailed CSHA funds available for new housing procurement since 1989. WA's loss of funding, estimated at $89 million would provide a least 900 additional dwellings.

Federal Governments since the 1980s, have increased funding for rent assistance in place of public housing funds to allow eligible recipients to access the private rental market. However research has indicated that a loss of low cost rental housing stock between 1986 and 1996 is placing further pressure on social housing providers. The decline in funds has constrained capacity to deliver additional housing and further reduced the funds available to support the maintenance of the existing housing stock.

The emergence of the working poor as a result of economic reform, the loss of low cost rental housing, reduced public housing funds and the changing role on the social housing sector to support those in greatest need calls into question the long term sustainability of current social housing settings.

4 THE EXISTING HOUSING PORTFOLIO

4.1 Overview

The social housing sector's portfolio of dwellings (38,700 at June 2001) represents approximately *5 percent* of the total housing stock in WA:

- Public housing 35,100 dwellings
- Indigenous communities 1,000
- Community housing 2,600

Of the public housing component, 71% is located in the Perth and Peel Regions which is broadly in line with the State's population and housing distribution. The balance is distributed according to Table 1. In the Mid-West, Pilbara and Kimberley, public housing represents approximately 10 to 15% of the total housing stock, well above their respective proportions (1.5-3.0%) of the State's housing stock.

Parts of regional WA have a greater reliance on public housing to meet the community's needs due to lower levels of home ownership, private rental investment and higher housing costs. The December 2000 Regional Price Index indicates housing costs significantly higher than Perth in the Goldfields (11%), Pilbara (29%) & Kimberley (35%).

Table 1: Rental Stock x Region (30/6/01)

	No.	%
North Metro	11,052	31.5%
SE Metro	7,022	20.0%
South Metro	6,771	19.3%
South West	2,280	6.5%
Southern	1,338	3.8%
Central	1,788	5.1%
Mid West	1,812	5.2%
Pilbara	1,519	4.3%
Kimberley	1,529	4.4%
Total	= 35.111	

Table 2 : Rental Stock x Bedrooms (30/6/01)

	No.	%
Bedsitters	486	1.4%
1 bedroom	7,163	20.4%
2 bedroom	9,635	27.4%
3 bedroom	15,018	42.8%
4 bedroom	2,459	7.0%
5 or > brms	350	1.0%
Total units	= 35,111	

Table 2 summarises the public housing stock by bedroom numbers and indicates the diversity of the stock available to meet the needs of a broad client base comprising of singles, single parents, families and the aged.

Social transfer payments represent the major tenant income and highlight the role of public housing to support those in need in the community with only 17% paying full rent under current rent criteria:

- Aged pension 23%
- Disability Support Pension 18%
- Single Parent Payment 18%
- Other incl. veterans & low waged 25%

Public housing supports a diverse and shifting client base spread across the entire life cycle; i.e. singles, single parents, families and the aged. Maintaining and adjusting the portfolio to meet locational demands and demographic shifts is both time-consuming and costly. This impacts on the capacity of the portfolio to deliver social, economic and environmental objectives.

The make-up of the public housing stock by dwelling type is significantly different from the State's overall housing stock as follows:

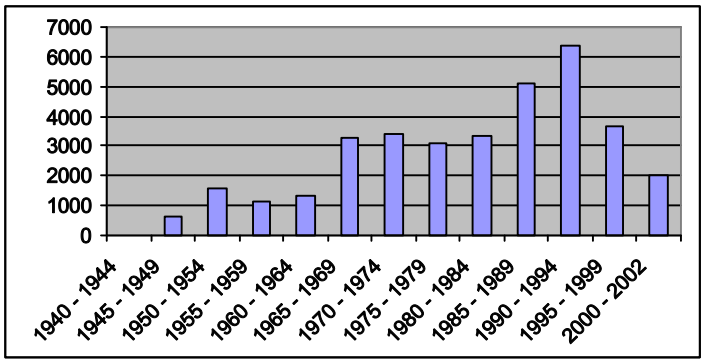
- Single detached houses 38.3% (76.5% State)
- Semi-detached duplexes 13.1% (11.9%)
- Medium & high density 47.3% (7.2%)

The public housing stock is dominated by the type of dwelling which is being actively pursued by State and local government through various town planning instruments such as Liveable Neighbourhoods and local housing strategies.

The type of construction of the existing portfolio varies from the State figures recorded in the 1999 Australian Housing Survey. Much of the variance can be attributed to the age and location of the stock:

- Double Brick 67 % (76 % State)
- Brick Veneer 19 % (7 %)
- Fibro / Asbestos Cement 11 % (10 %)
- Weatherboard & Other 3 % (7%)

The average age of the current housing stock is around 20 years old as indicated on the accompanying year of construction profile.



The age, condition and type of construction of the existing portfolio present a number of challenges to keeping the stock relevant in the face of rising expectations of tenants.

4.2 Current Sustainability Initiatives

Despite the dispersal and physical profile of the existing portfolio presenting a number of challenges, it also provides the opportunities to implement sustainability initiatives that are being delivered through a number of programs, broadly grouped as follows:

4.2.1 Refurbishment – Improving assets and the quality of life

Refurbishment - An ongoing major refurbishment program targets approximately 200 properties p.a. at a cost of $4.5 million. The program aims to modernise the older stock through major internal refits and external makeovers that include re-cladding and wet area upgrades. Benefits of the program flow to:

- the tenant through improved amenity
- the agency by extending the life of the asset
- the community through aesthetic benefits of improved housing stock

Gas conversions – In the past three years, 1500 properties in Kalgoorlie, Albany and Busselton have been converted from bottled gas to cheaper LPG at a cost of $700 per property

Lever Action Taps - retrofit for the aged and arthritis sufferers

4.2.2 Conservation and Environment – Reducing costs & enhancing the environment

Solar Hot Water Replacement Program – a proposal to install solar hot water heating for all new and replacement units for public housing in the Gascoyne, Pilbara and Kimberley is being implemented. It will incur substantial more up-front unit costs with the trade-off being lower recurrent household expenditure through lower energy use. Hard water quality may limit the life of the units and therefore may require ongoing assessment of the program

Smartpower metering – is saving $75,000 p.a. for security lighting in larger multi-residential complexes

Water Conservation Program – Individual property metering in multi-residential complexes has seen a reduction in use as tenants are now accountable for use. Installation of automatic reticulation in multi-residential complexes underway.

Sewer Connection Program – on-going program of connecting all properties where sewerage services are provided as part of Infill Sewerage Program. The current $2.8 million investment will provide environmental benefits and eliminate septic pump out and replacements.

4.2.3 Safety and Security – Protecting people and property

Smoke Detectors – a five-year program commenced in 1997 to retrofit at least one detector to all properties at a cost of $5.5 million

Gas Room Heaters – replacement of radiant heaters with more expensive but safer, more efficient and cheaper operating convection heaters

Anti Tilt Devices – fitting of devices to gas and electric ranges

Installation of Residual Current Devices (RCD) – although compulsory in all new dwellings, retrofitting reduces risks of electrocution

Safety taps over baths – standard in new construction with retrofitting as required to reduce the incidence of infant scolds and drownings

Barrier Screen Doors and Windows – an ongoing program initially targeted at seniors and those considered vulnerable such as single parent families.

5 HOUSING PROCUREMENT

5.1 New Housing Investment and Spot Purchase

Despite the decline in real funding, prudent management has allowed WA to consistently outperform most other States in the production of new public housing over the past five years. WA has provided 24% of the new stock nationally through the construction of an average 1,100 dwellings at a cost $95 million p.a. Note these figures exclude Indigenous and Community Housing programs that account for a further 150 -250 dwelling units p.a. to meet the needs of specific groups.

New dwelling investment in social housing, despite the small size of the sector provides important economic stimulus, particularly in regional and remote centres.

5.2 Climatic Diversity and Construction Practices

A number of sustainable design and construction practices that have a range of environmental and economic benefits have been incorporated into housing procurement. The Department addresses local climatic conditions through appropriate construction methods such as those required for cyclone areas.

Consideration is given to whole of life cost in the choice of materials thereby reducing maintenance requirements, given the remoteness of some of the housing stock.

5.3 Supporting those most in need; the aged, disabled and de-institutionalised - Universal Design and Carer Accommodation

A number of universal design features have been made mainstream in the production of purpose built dwelling units for the aged and disabled. *Case study three* outlines a number of these features.

Approximately 30% of recent procurement programs have been dedicated to aged persons units (APUs) and constructed on a 40/60 split as one and two bedroom units. Additional bedroom allows for carer accommodation to allow “ageing in place”, thus reducing demand for institutional care.

5.4 Locational Aspects of Procurement – Fringe vs Redevelopment

Some trade-offs are necessary in public housing procurement to achieve the best outcome. Near-city land with good access to transport and services is a desirable outcome for sustainable communities. However high prices for near-city land, which now exceed average housing construction costs, restrict the capacity to construct affordable, family dwellings. These sites, many in ex-public housing estates are preferred as group housing sites for singles or APUs to yield the greatest benefit.

Therefore construction of larger accommodation units is undertaken on the urban fringe which tends to suffer from a short-term lack of adequate service provision. Although a large proportion of tenants are beyond working age, access to employment, training and services remains an issue, especially in terms of the welfare reform agenda of the Commonwealth. Current initiatives include programs to employ tenants in construction and landscaping of estates in order to address these issues.

5.5 Current Sustainability Initiatives

A number of sustainability initiatives with benefits across the entire triple bottom line have been integrated into the Department of Housing and Works Capital Works Program for housing procurement. Design briefs for new housing contain the following requirements that are detailed in full at Appendix A. Some experimental housing initiatives have also been undertaken and are listed at Appendix B.

5.5.1 Solar Passive Design

- Building orientation and sun control
- Protection of windows
- Internal zoning
- Appropriate use of building materials
- Insulation
- Ventilation
- Landscaping

5.5.2 Water Sensitive Design

- Dual flush toilets.
- Spring loaded taps to baths
- External tap at 1500mm above ground level for selected accommodation
- Appropriate plant selection and reticulation installation and control

5.5.3 Energy

- Smart Power meters for common services in group-sites.
- Fluorescent light fittings to kitchens and laundry.

5.5.4 Standardised Designs

- Cost and material efficiencies by using mass production to achieve economies of scale.

5.5.5 Universal Design

- Integral to aged persons and disabled accommodation

5.6 Benefits of Current Sustainability Initiatives

- Increased level of personal comfort and wellbeing with reduced living costs allowing for increased disposable income
- Improved community standards including access to and equitable allocation of appropriate housing for those with greatest needs, including the disabled and de-institutionalised
- Improved environmental outcomes through reduced energy and water consumption and material use
- Lower construction costs through efficiency of standard designs with minimal material waste reducing landfill disposal

6 INDIGENOUS COMMUNITIES

6.1 Overview

The Department of Housing and Works runs a number of programs through its Aboriginal Housing and Infrastructure Unit to support both indigenous urban housing and remote community development. These programs aim to achieve sustainable communities by enhancing the physical environment to improve living conditions, health outcomes and provide training and employment opportunities.

The urban housing program is an integral part of the existing portfolio and procurement program and seeks to meet the specific needs of the indigenous community particularly where there is limited access to private rental accommodation.

The remote community programs have been developed in response to various strategic assessments of the needs to improve outcomes for indigenous communities which include: *The Environmental Health Needs of Aboriginal Communities in Western Australia* (The 1997 Survey and its findings) and *Report of the Chief Executive Working Party on Essential Services to Aboriginal Communities* (Hames Report)

The 1997 Environmental Health Needs Survey found deficiencies in essential services (power, water, sanitation, solid waste disposal), housing, dust and dog control across 213 of 259 respondent aboriginal communities surveyed that support some 16,000 people.

Remote community programs are undertaken in consultation with the Aboriginal and Torres Strait Islander Commission (ATSIC) on jointly funded projects and the Department of Indigenous Affairs where cross government coordination is required.

6.2 Current Programs

The balance of this section of the submission will focus on the relevant programs and major sustainability initiatives

6.2.1 Community Construction Program

Provides for the design and construction of new housing and selective maintenance. The program encourages community input into the design and siting of housing and provides training and employment opportunities in building construction and maintenance.

The program has a number of eligibility criteria including secure land tenure, a town plan and adequate essential service infrastructure capacity to support new development.

6.2.2 Remote Area Essential Services Program

Provides a 6-8 week cyclical and emergency breakdown maintenance service for essential service systems (power, water and wastewater). In 2001 the program supported 67 communities at a cost of $6.5 million p.a.. The program also seeks to increase community participation and provide training opportunities in the ongoing maintenance and responsibility for essential services.

6.2.3 Management Support Program

Focuses on the management, repair and maintenance of community housing. The program aims to achieve community self management of its housing stock through the development of housing management plans and training of community members in building maintenance.

Similar to the Community Construction Program, there are a number of eligibility criteria including demonstration of financial and tenure management.

6.2.4 Aboriginal Communities Strategic Investment Program (ACSIP)

This aim of this program is to ensure that larger remote Aboriginal communities (greater than 200) have access to essential, municipal and administrative services of a standard comparable to that of other similarly sized mainstream towns in WA. This also includes the normalisation of services for delivery by local government.

The program provides for both infrastructure and administrative services to compliment the work of other agencies and contribute to an improvement in health and living standards.

6.3 Current and Recent Sustainability Measures

6.3.1 Preparation of Town Plans

The gazettal of the WA Planning Commission's Statement of Planning Policy No.13 – Planning for Aboriginal Communities in August 2000 provided an important step for the sustainable development of larger communities. Preparation of development plans and inclusion of settlement zones in town planning schemes provides a coordinating mechanism for infrastructure development and housing construction. The also ensure adequate buffers are provided to noxious services such as wastewater and solid waste facilities.

6.3.2 Improved access, management and living conditions

The ASCIP provides the catalyst to leverage funding and improve access and overall health and living conditions for communities through investment in a broad array of infrastructure projects that include airstrips and roads, waste management including tip fencing and dust management to community infrastructure such as swimming pools. *See Case Study Four*

6.3.3 Training and employment opportunities

The various programs provide vital training and employment opportunities for community members with skills development contributing to the capacity of the community to achieve self management

7 OPPORTUNITIES AND CHALLENGES FOR SUSTAINABLE LAND DEVELOPMENT AND SOCIAL HOUSING

7.1 Opportunities

In addition to the initiatives already in place or under review, there are further opportunities for the delivery and procurement of social housing to provide more sustainable outcomes for tenants, the community and environment.

7.1.1 Surplus Government land to deliver affordable housing

Surplus government land such as rail reserves and institutional sites that are being rationalised as part of broader government service delivery strategies provide opportunities to deliver affordable housing into areas of high locational advantage with access to services.

7.1.2 Environmental Rating and Management System

- Review and implement one of the current national environmental rating systems appropriate to WA's climatic diverstiy
- Audit and assess current designs and existing asset portfolio against rating system

7.1.3 PATHE (Partnership Advancing the Housing Environment)

Advancing more sustainable construction practices through tender specifications

7.1.4 Whole of Life Housing – Universal Design Principles

Making universal design mandatory for all new construction would deliver whole of life housing benefits to tenants. However it would do so at a cost, particularly for larger family homes that in the majority of cases would provide tenants without special needs little or no benefit.

Retrofitting and purpose built dwellings to meet specific needs, whilst incurring possible minor time delays may provide a more cost effective outcome.

7.1.5 Better Matching Supply and Demand – Management of the Existing Portfolio

Construction of a mix of housing stock within major demand areas provides scope to manage the portfolio to better meet clients' needs as they move through their housing careers, and to minimise social dislocation when matching supply and demand.

7.2 Challenges

Equally there are many challenges to the delivery of more sustainable outcomes, not the least of which is the cost, particularly where the pay back cannot be achieved over the economic life of assets.

7.2.1 Community acceptance of affordable housing

The NIMBY (not in my backyard) syndrome to public housing surfaced in 2001 as a negative reaction from a section of the community to a proposal for social housing units in the Subiaco Redevelopment Area on public owned land. The incident highlighted perceptions that social housing and its tenants have a negative impact on the community and property

values. With an increasing demand for appropriately located low cost rental accommodation due to socio-economic shifts in society, there is a need to educate the community about the role and delivery of affordable housing.

7.2.2 Cost of retro-fitting sustainability initiatives - insulation

Energy efficiency initiatives such as those proposed in a current Building Code of Australia amendment have not been assessed and will not come into force until January 2003.

The Office of Housing in Victoria has costed retrofitting wall and ceiling insulation to a 3 bedroom dwelling to meet a minimum 2 star rating under the First Rate energy assessment software. While the Victorian climate and housing construction is different to WA, indicative costs of retrofitting were:

- Cavity Construction (double brick) $7,000
- Veneer (brick or clad) $4,000

Annual energy savings for a family of four were costed at $200-$400 with 16-35 percent reduction in greenhouse emissions depending upon the insulation.

In relation to DHW's portfolio, insulation has been integral to all new housing procurement since the early 1980s; ie ceiling insulation to double brick construction and wall and ceiling insulation to brick veneer and framed construction. Retrofitting insulation to the current portfolio constructed before the 1980s (17,000 dwellings) potentially has a significant cost ($8.5 million @$5,000 / dwelling) and will need to consider the remaining economic life of the asset.

7.2.3 Universal Design

Dwellings built to universal design principles require more space than ordinary dwellings particularly in the bathrooms and bedrooms. It has been estimated that this can increase the floor space of a standard design by an average of 14m^2, adding up to $11,575 per dwelling in construction costs.

In WA, additional budget for the construction of dwelling units to support those with special needs have been costed as follows for various dwelling types and locations:

Units	$15K (metro)	$20K (country)	$22-29K (North West)
Houses	$30K	$40K	$44-58K

7.2.4 Alternate Construction Technologies

The emergence of new construction materials and techniques may provide sustainability opportunities. However the cost imperative of achieving value for money and the diversity of location and climate across the State where the agency operates are major considerations.

Consideration of whole of life costs to the agency through future maintenance need to be balanced against the benefits flowing to tenants.

APPENDIX A - ENVIRONMENTAL INITIATIVES IN MAINSTREAM PUBLIC HOUSING CONSTRUCTION

1. Building Orientation and Sun Control

- Direct sun control – Glazing to habitable rooms to take advantage of northern orientation.
- Optimum building proportion where ever possible – the north and south facing walls 1.5 to 2.0 times the length of east and west facing walls.
- Non habitable rooms should be used as thermal buffer, where possible, to the east and west facing walls.

2. Protection of Windows

South West Region

- Windows and openings facing west or east are to be protected by a verandah, or hood in conjunction with aesthetics of the street elevation.

North West Region

- Provide year round shading of at least 3 sides of external walls to minimise solar heat gain. This is a minimum of 1.5m wide verandah, or a pergola, carport or storage room.
- External living spaces shall be shaded and protected from solar radiation and hot dusty winds by the use of verandah and pergolas.

3. Internal Zoning

- The north face of the house is the warmest all year round and the south face the coolest. Provide daytime living areas to the north side, utility areas to the west or south and bedrooms to the south or east where possible.
- Daytime living zones should be able to be shut off from sleeping zones. Zones that require heating or cooling should be able to be shut off from utility areas to conserve the desired temperature.

4. Appropriate Use of Building Materials

South West Region

- Use high thermal mass building materials such as bricks, concrete blocks and concrete. These materials are effective at storing heat in winter and are cool in summer.
- Cavity brick and brick veneer construction provide good thermal mass for solar gain in winter and remain cool in summer if protected from direct sunlight.
- Windows that allow the winter sun onto concrete floors will assist in absorption of heat for re-radiation throughout the evening

North East Region

- Low thermal mass lightweight building materials such as fiber cement, weatherboard or metal cladding on a timber or steel stud frame. These materials absorb heat quickly in the sun, but cool quickly after sunset.
- Framed construction, brick veneer and reverse brick veneer constructions are commonly used in this region. This is dependent on the location.
- Use light colour (off white) colorbond roofing.
- High ceiling or roof space is desirable for ventilation, fan extractions, etc.

5. Insulation

There are two main types of insulating materials:

- Bulk insulation such as fibreglass batts, treated paper fibre and mineral wool, all of which rely on the poor conductivity of air trapped in the insides to reduce the rate of heat transfer.
- Reflective surface (sisalation) under steel roof sheeting and R2.0 insulation at ceiling level for metal roof cover. R2.0 insulation at ceiling only for tile roofing.
- Wall insulation for frame construction.

6. Ventilation

Generally:

- Housing planned to allow the penetration of cooling breezes.
- Locate openings to maximise the through ventilation from prevailing breezes summer or winter.
- Maximise exposure of internal spaces to cooling breezes by placement of doors.
- Ventilate the roof spaces to reduce heat radiating below the ceiling.

North East and North West Region:

- Breezeway steel fencing allows prevailing breezes to the building.
- Provide ceiling fans to improve air movement.
- Cross ventilation within the building, ie. extra high windows within the room.

7. Landscaping

- Provide appropriate trees on the north side of the house; evergreens on the east and west side of the house. Plant grass, groundcover and low shrubs to cover bare ground.

North West Region

- Use vegetation to assist in the reduction of airborne dust around building. Trees may be used to reduce dust infiltration into the building. Plant canopy trees for shade.

8. Rooflights

- Rooflights are used in internal non-habitable rooms or in areas where it is considered necessary to improve the level of natural light.

APPENDIX B - EXAMPLES OF SPECIAL INITIATIVES

1. Murdoch University Low Allergen Home Project - Ellenbrook

This project was initiated to design and construct a low-allergen home by incorporating materials into the home that reduce the level of allergen exposure or lessen the potential for allergens to develop. A four-bedroom 'select and construct' home was built in 1996 with a number of similar homes monitored as controls. The study was over a two-year period and looked at the following:

1. Design for efficient ventilation
2. A reduction of emissions by selecting materials and products with reduced volatile organic compounds.
3. Preventative measures to reduce dust and the growth of bio-allergens.

The overall performance of the low allergen home has fulfilled many of the objectives of the project. The primary conclusion was that effective ventilation is the key to lowering allergens within the home.

A detailed report was prepared in August 2001 for the Allergy Research Foundation by Kelvin Maybury and Associate Professor Frank Murray, School of Environmental Sciences, Murdoch University.

2. Grey Water Reuse Trial

In 1995 Homeswest obtained 'Better Cities' funding to investigate the recycling of 'grey water' for toilet flushing and garden watering. The benefits were to reduce the demand for scheme water and reduce the amount of household waste discharged into the sewer system. A project of six seniors units in Moody Glen, Palmyra was selected for the trial. After a four year trial the following conclusions were drawn:

Positive aspects:

- Experience was gained and documented in the collection, treatment and reuse of domestic grey water;
- Treatment unit effluent was satisfactory with regard to colour, turbidity and pH;
- Disinfected effluent sample results have consistently met Health Department requirements.
- Disinfection of effluent with chlorine tables has operated well and without maintenance problems.
- The project gained only positive media exposure.

Negative aspects:

- The treatment unit was found to be oversized for the grey water from around ten persons, resulting in difficulties in the operation of the biological unit of the plant;
- Overall, costs of operation exceeded savings in water purchased from the Water corporation;
- On occasions residents were unhappy with the maintenance service relating to their in-home use of grey water.

A detailed report on the trial and the results was prepared in August 2000 by CCD Australia, Consulting Engineers.

3. Energy Efficient House (Stratton)

In conjunction with the building industry, the Renewable Energy Advisory Council and numerous suppliers, Homeswest built an energy efficient display home in Wade Square, Stratton in 1991.

The home was built to demonstrate Homeswest's standard design features such as orientation, location of rooms, construction materials, insulation, landscaping and the like.

The main feature of the display home was an active solar energy system. This system used roof-mounted, photovoltaic cells to collect the sun's energy and store it in a series of batteries for the supply of electricity to the home. In addition to this, a gas boosted solar hot water system was used as well as a specifically designed solar pergola.

4. Curtin University Centre for Cleaner Production Waste Study

In 2001,the Centre of Excellence in Cleaner Production joined with the Department of Housing and Works, interested builders and the Waste Management and Recycling Fund to develop guidelines for reducing waste in the housing industry.

Eight projects were selected to document the waste generated from current construction practices and to determine the source, volume and the costs, if possible.

In summary the study found that waste was generated by complexity of designs, and not recognising standard product sizes, traditional on-site construction practices, labour only contracts that did not encourage material efficiency, product packaging and suppliers' packaging and delivery systems.

Based on the information obtained, guidelines have been prepared which may assist designers, builders and all trades involved in the building process with minimizing site waste.

The guidelines, as well as the 'waste notes' which formed the basis of the recommendations, will be available to the building industry on the Internet to encourage awareness of waste management issues.

5. Curtin University PhD research study of Energy Efficiency in Seniors Public Housing by Elizabeth Karol

In this study seven public housing developments were studied over a twelve month period to address the following six questions:

1. Is the indoor temperature in public housing for older people likely to provide comfortable thermal conditions?
2. How does the attitude towards energy consumption of older people affect the indoor temperature?
3. Are the general rules of thumb of energy efficient design appropriate in public housing designed for older people?
4. Are there design features that can be incorporated into public housing for the aged that may overcome some of the behavioural patterns that reduce the effectiveness of energy efficient design?
5. How would particular design features affect indoor temperature?

6. If public housing for the aged was designed to achieve improved energy effectiveness, what additional capital costs would be incurred; how much operating energy cost would be reduced and how much primary energy would be saved?

This thesis is due for completion in 2003.

CASE STUDY 1: URBAN DEVELOPMENT – INTEGRATING TECHNOLOGY FOR SMART HOUSING

Broadband Technology and New Development

The installation of broadband optic fibre communications technology has become a standard feature of the subdivision stage for major new land developments in the Perth Metropolitan Region. These include a number of DHW joint ventures including Ellenbrook and Brighton. More recently, DHW joint ventures at Dalyellup near Bunbury and Wandina in Geraldton has seen the initiative extend to regional WA.

Installation and access to the communication technology has allowed new homeowners the potential to access the information super highway and hardwire their properties during construction to take advantage of emerging Smart House technology. Currently most 'wired' developments offer high speed internet access and cable TV to connected home owners.

The Seacrest Estate joint venture in Geraldton has a mandatory requirement for the installation of a Communications Cabinet and Panel similar to the power and gas services during construction. This ensures properties are technology ready rather than incur the cost and inconvenience of retrofitting.

Existing Development

Unfortunately most existing homeowners across WA have limited capacity to access the new technology other than over their existing household telephone service, dedicated line or roof mounted communications facilities.

The retrofitting of broadband technology to existing suburbs by way of cable roll out has only extended to a limited number of areas within Perth. The State Government has not supported the installation of large unsightly overhead cabling on power poles that became a community battleground in the Eastern States. Technology providers have reviewed the market potential of Perth and have not proceeded.

Contribution to Sustainability

Installation of optic fibre cabling during subdivision and housing construction allows new communities to take advantage of existing communications technology and emerging Smart House technologies to enhance the quality of life.

Installation during subdivision and housing construction eliminates the need for costly and disruptive retrofitting

CASE STUDY 2: URBAN RENEWAL – REVITALISING COMMUNITIES THROUGH THE NEW LIVING PROGRAM

The New Living urban renewal program is a major initiative started in 1995 that is targeted at ageing public housing estates across the State. It aims to reduce the proportion of public housing down to 12 percent in project areas through the refurbishment, demolition and re-subdivision of existing public housing assets, some of which have reached the end of their economic life.

Refurbished properties are either sold to existing tenants under the Right to Buy scheme or on the open market. Past tenants as new owners take on maintenance responsibilities of refurbished properties whilst accumulating wealth through property investment and providing for their own long term housing needs.

New Living is also providing a valuable stock of affordable housing that is encouraging home ownership particularly to first home buyers at a time when there has been emerging evidence of a national decline in home ownership.

Many of the suburbs included in New Living are experiencing significant property sales and increasing values with five included in the top 10 growth suburbs during 2000/01.

Highlights of several projects underway or completed to date include:

- *Lockridge* undertaken between 1995 and 2000
    - 823 or 53 % DHW property ownership has reduced to 16 percent
    - property prices increased by 30% over the period
    - crime rates fell by 43 % and now considered a low crime area
    - 1999/2000 UDIA Award for Excellence in Urban Renewal

- *New Kwinana* ongoing since 1995 spread over four suburbs
    - 600 out of 1,300 dwellings have been refurbished and sold
    - Finalist in the International Real Estate Federation awards

- *New North* commenced in 1998 and expected to take 10 years
    - Involves 3,060 dwellings in four suburbs, with 1,550 refurbished and sold, 1,130 refurbished and retained for public housing & 380 demolished
    - Upgrading and beautification of major arterial roads

- *Coolbellup* commenced in 1999 and due for completion in 2004
    - Targeted reduction of 32 % of public housing stock including several larger (up to 48 units) apartment complexes down to 11 %
    - Works also include road network improvements and parkland enhancments
    - Awarded 2000 UDIA Award for Excellence & RAPI Urban Design Prize

New Living has also received the international World Habitat Award in 2000. Details of other New Living projects are available on www.dhw.wa.gov.au/landsales

There has been some criticism leveled at New Living, focussing only on asset management issues and with only limited regard for community building. The criticism primarily revolve around the loss of public housing stock and social dislocation that occurs for some public housing as they are relocated out of the suburb either temporarily or permanently as part of the program.

Community participation is an integral part of the New Living program with specialist consultants engaged as part of the project.

Contribution to Sustainability

New Living is seeking to enhance the social and economic of targeted areas through the selective removal or refurbishment and / or sale of existing public housing estates. In undertaking this activity it aims to achieve a greater social mix through a community less reliant on public housing and provide improved social and economic outcomes through redevelopment utilising existing infrastructure in areas with locational advantage.

CASE STUDY 3: HOUSING PROCUREMENT – SUPPORTING THE AGED

The Department of Housing and Works constructed three purpose built aged persons complexes in 1999 as part of its contribution to the International Year of the Older Person, the State's 1998-2003 five year plan on ageing "Time On Our Side" and the Health Department's "Stay On Your Feet" campaign.

Features of these projects which reflected best practice in affordable low income rental housing for over 55 year olds have become standard specifications for DHW's aged persons unit (APU) construction program. These included:

Trip Hazard Removal

Removal of "trip" hazards that cause falls and injury to people, especially those who are ageing, normally found in standard housing. Trip hazards included such items as the front door step, hob in the shower recess which have now been changed to a gradient floor slope and sliding door frames have been recessed to enable the floor frame to be flush with the floor.

Spacial Area

Open plan internal design with passage widths increased to 1 metre and internal door widths to 820mm instead of 720mm and external entry door widths to 870mm widths to allow room for a manual wheelchair mobility.

Other Features

Hazard removal in kitchens with rounded benchtops, higher cupboard kickboards for wheel chair access.

Security includes providing barrier screens to open windows, sliding doors and front and rear entries.

Weather protection to entries and wider carports to improve access

The Tuart Hill, Bentley and Mandurah complexes yielded 21 units and were constructed at a cost of $1.3 million on DHW land. The units were also open for display period and attracted strong public interest.

Contribution to Sustainability

The proportion of the population in Western Australia over 65 is anticipated to increase from 12% in 1996 to 25% by 2031. Therefore strategies to support ageing in place rather than costly institutional solutions will become paramount as demand for aged care increases.

CASE STUDY 4: ENHANCING THE HEALTH OF INDIGENOUS COMMUNITIES

As reported in both *The West Australian* and *The Australian* on 22nd February 2002, the construction of 25m half-size Olympic swimming pools at remote indigenous communities in the Pilbara and Gascoyne over the past two years has had a major health and education benefits for community members.

The pools have been constructed at Burringurrah, Jigalong and Mugarinya at a cost of $1.25 million each as part of the State's Aboriginal Communities Strategic Investment Program

Investigations by the Telethon Institute for Child Health Research has found that the facilities have provided the following health outcomes:

- Ear infections have decreased from 90 percent to 54 percent over 12 months with the incidence of perforated eardrums dropping from 32 to 12 percent

- Skin sores which can lead to heart and kidney problems now only affect 3 percent of the children , down from 28 percent.

In addition to teaching community members to swim, the no-school, no-pool policy has seen school truancy reduce markedly with attendance figures doubling.

Contribution to Sustainability

Improved health outcomes are expected to deliver increased life expectancy for indigenous communities over the longer term.

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May 7, 2002

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Department of Housing and Works

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The residential housing sector is a key component in the development of a sustainable urban form that minimises its use of resources and waste output, as well as promoting sustainable communities in terms of employment, equity of access, affordability and social interactions.

In considering sustainable housing, the following factors have been identified as being the most influential and have guided the preparation of this paper:

- Urban form
- Housing design
- Housing Construction
- Housing Consumption
- Household perceptions and expectations

Of these factors, urban form is considered to be by far the most important. Without sustainable urban form, sustainable housing is problematic. For example, lot orientation and street layout affect the degree to which a dwelling takes advantage of solar passive design principles. Urban form also determines factors such as the availability of transport options and proximity to services and employment.

The issue of sustainability in urban form is a topic in itself and has been well covered in other reports and publications. For that reason, this paper will not be addressing urban form in any detail and will instead be concentrating on the other four areas of influence. Nevertheless, it is strongly acknowledged that urban form is critical to a sustainable housing sector and this paper should be read in conjunction with these other publications.

Sustainability has emerged in the past decade as a key principle guiding human interaction with the natural environment. It is acknowledged as a major theme, influencing all aspects of the housing sector, ensuring the integration of environmental, social and economic goals.

Much of the focus nationally has been on environmental sustainability with very limited consideration of the social or economic sustainability of housing or the urban form. This is reflected in the fact that there are no discrete portfolios at national level dealing with housing or with fundamental aspects of how we live[1].

[1] National responsibility for housing sits within the broader portfolio of Commonwealth Department of Family and Community Services. DFACS has responsibility for administering the CSHA and Commonwealth Rent Assistance.

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This paper is a submission to the State Sustainability Strategy on the residential housing sector of Western Australia.

The submission is based on work currently being undertaken by the Office of Policy and Planning, Department of Housing and Works in the preparation of the State Housing Strategy. This work will result in the publication of a Sustainability Issues Paper; one of a series of issues papers covering the five themes adopted by the Strategy – Sustainability, Affordability, Access and Equity, Tenure and Location.

To assist in the development of the Sustainability Issues Paper, a reference group was established comprising representatives of organisations with a broad interest across the housing continuum and sustainability. A list of the membership of this group is at Attachment 1.

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Housing has consequences for sustainability in the following ways:

- Because the way we construct our homes has a major bearing on the use of resources such as energy and water, housing form is important.
- Building homes, and living in them, result in significant emissions of greenhouse gases.
- The residential construction industry is a large consumer of natural resources.
- Construction and demolition waste is the largest contributor to the waste stream going to landfill.
- Housing design and the materials used in construction have a major influence on the liveability, thermal comfort, safety, health and quality of life of its occupants.
- The location of housing has impacts on transport and employment opportunities.
- Housing has an important psychological and cultural importance in terms of concepts such as ‘home’, ‘shelter’ and as a store of wealth.
- Housing is a long term investment and once built, can influence the sustainability or otherwise of the urban form for many years.

The 1997 State Planning Strategy projected that 52 percent of the housing stock constructed before 1996 would still be in use in 2029. This highlights the long-term nature of housing investment and the need to focus on both the established and new housing sectors in discussing housing sustainability. This approach will assist in identifying unsustainable aspects of the current housing system that can provide important lessons for the future.

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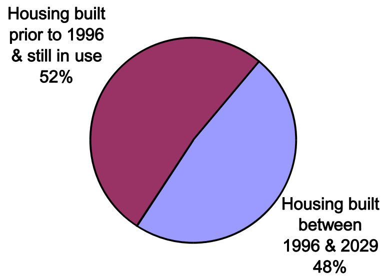
Source: State Planning Strategy



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The Western Australian Government has adopted the following definition of sustainability:

"Sustainability is the simultaneous achievement of environmental, economic and social goals."

Sustainable housing aims to balance these simultaneous goals, in order to meet the needs of present and future generations. It is housing that:

- Minimises the use of energy and resources, throughout the life cycle of the building
- Minimises waste products and maximises recycling and reuse of materials
- Has easy access to services and amenities
- Provides reasonable levels of privacy and security
- Is accessible to people from a diversity of backgrounds and abilities
- Is affordable
- Assists the financial viability and competitiveness of the industry
- Assists in the strengthening of communities

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It is important to put the delivery of housing in Western Australia in a context as it potentially has a major influence on sustainability. Housing provision has been very much a product of market demands and a number of statutory requirements across a range of Government portfolios including local government.

Housing sits at the end of a fragmented supply chain that is heavily influenced by the:
- planning system,
- land development and building industries
- finance and marketing sectors

Therefore housing provision remains predominantly one of individual choice, location and cost.

In addition to consumer preference, the nature and form of housing is controlled by a range of statutory instruments of State and local government with various taxes and charges levied on transactions for both new and established housing.

The State provides public housing (5% of the State's housing stock) for those in greatest need in the community and provides funding support for the development of the community housing sector

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- As at June 1996, there were 698,000 dwellings in WA of which 534,000 (76.5%) were single detached houses, 83,400 (11.9%) were semi-detached and 50,400 (7.2%) were flats.
- 60% of the existing housing stock was constructed in the last 30 years.
- Double brick and tile is the dominant form of construction (76%), compared with the national average of 30%.
- 70% of households either fully own their home (38%) or are purchasing (32%). 22% of households are in private rental with the remainder in public (5%) or other tenures.

- 48% of total households consist of singles or couple without dependants.
- In 1999, 45% or 320,000 homes in WA had two or more spare bedrooms, while 3% (approximately 20,000) of households had an unmet need for 1 or more bedrooms.
- The Perth Metropolitan Area has 72% of the State's population and housing stock.
- Of the remainder, 75% live in urban centres (>1000) and localities (>250)
- More than half of new dwellings in Perth are built in the outer suburbs.
- 45% of the dwellings approved in the Perth Metro area in recent years were in the inner and middle ring suburbs.
- In 1999, there were 43,000 sales of established dwellings in WA with a turnover value exceeding $10 billion.
- Transfer payments on property transactions in WA represent more than 25% of State taxation revenue.

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Urban form is the main factor influencing the sustainability of housing. A house may meet all environmental criteria in terms of solar orientation, energy efficiency, and waste and water recycling. However it is unlikely to be truly sustainable if its location and placement does not provide appropriate access to employment opportunities, services and transport options, or provide for opportunities for social and cultural interaction within the community.

The urban form is affected by factors such as the regulatory planning framework, government policy, market forces and cultural values and expectations. These factors can act as barriers to increased sustainability. For example, the range of planning policies at state and local government level has resulted in significant differences in the application of codes and regulations. This can make it difficult for a developer or builder attempting to incorporate sustainable features into a development.

Urban form in Western Australia is predominantly characterised by low density, dispersed suburbs. This is particularly the case in Perth where urban development has spread largely north and south along the coastline. A number of problems have been identified with this type of urban form including:

- A high dependency of the populace on car travel with its attendant costs to the community due to pollution, health impacts, high fossil fuel use and destruction of environment (eg. to build roads).
- Loss of quality agricultural and bush land to development.
- The increasing costs to the community of providing infrastructure to development on the urban fringes.
- The loss of opportunities for improved efficiency in the provision of services such as water, energy and public transport through more compact urban development.
- The development of a separation between the location of dwellings and employment opportunities.
- Social isolation, particularly for those who do not have access to a car.

The legacy of planning policies and land development practices over the past decades has contributed to this unsustainable urban form. Many of Perth's suburbs for example are based on a curvilinear system of streets that do not support the solar orientation of lots or ease of pedestrian movement. Suburbs are also not well integrated with transport options and services and do not lend themselves to redevelopment in the same way as grid pattern neighbourhoods with rectangular blocks.

A number of reviews of planning policies are currently underway, in part as a response to the sustainability agenda. This includes reviews of the Western Australian Residential Planning Codes and METROPLAN (known as Future Perth). There is also encouraging evidence that sustainability principles are beginning to influence both infill redevelopment and the development of greenfield sites. For example, the *Liveable Neighbourhoods Community Design Code* is influential in the design of the Brighton subdivision in the City of Wanneroo, Mont Clair Rise in Dianella and Coolamon Village in Ellenbrook. The principles of *Liveable Neighbourhoods* are also being applied in the revitalisation of Gosnells, Midland and Armadale.[2] GreenSmart principles will guide the new development at Atwell South, 25km south of Perth.

The State Infill Sewerage Program, commenced in 1994, is also providing the impetus for significant infill and redevelopment across urban centres in Western Australia.

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Design is a very important influence on the sustainability of housing. The incorporation of solar passive principles into housing design can minimise the need for energy for space heating and cooling, leading to savings in both operational energy costs and greenhouse gas emissions. Other design features can enhance the capacity of the disabled to live independently in their homes, or increase the security of the home for its occupants.

Initiatives in sustainable design have been slow to be adopted in Western Australia. The predominance of project home builders constructing standard 'off the plan' project homes constrains opportunities to take account of climate or solar orientation, energy/water efficiency or the environmental impact of housing. Climate-sensitive design has been mainly offered through a limited number of individual architects. Some demonstration projects have also been undertaken by agencies such as the Department of Housing and Works in partnership with universities and industry[3].

The drive to incorporate sustainability in housing design in WA is supported by programs run by government (eg. Australian Greenhouse Office's 'Your Home' design manual and the Sustainable Energy Development Office's Community Program) and industry (the Housing Industry Association's GreenSmart program and the MBA's Housing for Life).

One aspect that is not addressed by these housing design initiatives is consideration of cultural diversity and the appropriateness of housing. This is nevertheless an important facet in the sustainability of indigenous communities, particularly in rural and remote areas of the State. Design in this context needs to go beyond the obvious requirements to address differences in climate, to also incorporate the cultural requirements of these communities and to support healthy living practices. This should also be considered in relation to indigenous people and large migrant families living in urban centres across WA.

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Housing construction impacts on environmental sustainability in terms of its use of energy, water and raw materials. There are also associated impacts on the environment in terms of land clearance, loss of biodiversity and greenhouse gas emissions.

The choice of building materials can have an influence on the thermal properties of a dwelling, determine the level of its embodied energy, and affect the health of its occupants.

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[2] Rebecca Armstrong & Glen Head, 'Liveable Neighbourhoods, Guiding New Developments for a More Sustainable Urban Future', Sustainability Case Study

[3] Low Allergen Homes Project (Ellenbrook), Grey Water reuse trial (Palmyra), Energy Efficient House (Stratton).

It can also affect the affordability of a dwelling, an important aspect when considering the capacity for people within the community to access sustainable housing.

The housing construction industry is also a significant contributor to the State economy.

- Average investment in new housing over the past 10 years was approximately $1.8 billion per annum, representing an average of 18,500 new dwellings each year.
- In Perth, 35-40 new dwellings commence every day with, at any one time, as many as 6-7,000 dwellings under construction[4].
- This supports approximately 120,000 housing related jobs in Western Australia.
- An unpublished statement from the HIA suggests for every $1 spent directly on housing there is a further $1.40 spent elsewhere in the economy[5].

Housing is an important component of regional economies. The stability of a regional housing industry provides both continuity of local employment and affordability as local contractors do not incur the same set up costs as remote builders.

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The physical and psychological consumption of housing affects the sustainability of the housing sector.

Since the 1970s, there has been a progressive decline in the proportion of first home buyers constructing first homes, with the majority (80%) preferring to purchase in the established housing market. The motivations are unclear, however affordability, accessibility and location are all indicated as influencing factors[6].

New construction is therefore heavily dependent on 'trade up buyers' who generally have more capital than first home buyers and can therefore afford to build better quality, larger homes.

In the 15 years from 1985 to 2000, the average floor area of new houses in WA increased by 22% from 188m^2 to 230m^2. The industry standard for single detached dwellings is now also the 4X2' (four bedroom, two bathroom dwelling) to the extent that it now represents 32% of the total dwelling stock in Western Australia, or 40% of all single residential dwellings. This compares with a national average of 23%.[7]

The increase in dwelling size and number of bedrooms is despite a decrease in the average household size. Between 1971-1996, average persons per dwelling fell from 3.68 to 2.8. This suggests the influence of changing lifestyles as additional bedrooms become used for study and hobby rooms, and home offices.

Smaller lot sizes and changes in building regulations such as zero boundary set backs have resulted in a preference for European style housing such as Tuscan and Mediterranean design in recent years. This form of housing is devoid of eaves, overhangs and verandahs, features that are considered desirable in climate sensible design. Such housing is also often two-storey, making them less accessible to a proportion of the population.

[4] Housing Strategy, Housing Sector Paper, November 2000, p11
[5] Housing Strategy, Housing Sector Paper, November 2000, p14
[6] Housing Strategy, Housing Sector Paper
[7] Housing Strategy, Existing Housing Stock Paper

These factors have contributed to an increase in energy demand for space heating and cooling. On average, an Australian home now consumes four times more energy than homes built a few decades ago[8].

Planning and development practices imposed by local governments or developers, such as the use of restrictive covenants specifying minimum house size or material selection influences consumption and therefore sustainability. This can effectively exclude parts of the population as it dictates a minimum level of investment at the expense of affordability.

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One influence that should not be overlooked is that of perceptions and expectations about housing. An appreciation of this factor can assist in an understanding of why certain types of housing form predominate, and can also inform strategies and education campaigns to increase the market preference for 'sustainable' housing.

In October 1998, the Australian Bureau of Statistics conducted the *Survey of Housing Motivations and Intentions*. The survey found in relation to Western Australia that:

- At the time of the survey, 79.8% of all households in private dwellings were living in a 'separate house' while 13% were in 'semi-detached/terrace houses'.
- Despite the recent trend towards smaller lot developments in Perth in recent years, the survey revealed that when selecting their next dwelling, the majority of people still expressed a preference for a 'separate house', 'larger residence' and 'larger block'[9]
- 81.6% of households intending to move within the next three years would prefer to live in a 'separate house' while 8.6% would prefer a 'semi-detached or terrace house' and 6.8% a 'flat, unit or apartment'.

These findings indicate that there is still a strong preference for single detached dwellings despite the move to increased housing density in Perth[10].

Encouragingly, there is an increasing awareness of energy efficiency. Of households intending to move to a new dwelling, 51.1% claimed that energy efficiency features will be factors affecting their choice of dwelling. This is in contrast with the choice of current dwellings where energy efficiency features were sought by only 14.3% of households. The most common energy efficiency features sought in future dwellings are 'natural gas access' (27.4%), 'solar hot water system' (26.0%), 'insulation' (5.3%) and a 'northern aspect' (4.4%).

As noted, one factor contributing to an increase in the average floor area of new housing is the predominance of the '4X2'. Interestingly, it is claimed to be an industry standard based on the belief that this is the 'preferred' housing type by buyers and consumers. It can be conjectured whether this is the case or to what degree the promotion of this type of housing by the industry, over other forms of housing, is influencing the market.

Another factor of note is the degree to which expectation and 'wants' can influence the housing industry. Rising aspirations combined with successful marketing of 'lifestyle' have resulted in households wanting to buy the best they can afford, rather than gradually upgrading as circumstances and incomes improved.

This has consequences for sustainability. The price of housing may be affected as people are prepared to pay for 'bigger and better housing' as a reflection of what is considered

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[8] 'Energy Efficient housing design' www.abc.net.au/7.30/stories/s115196.htm
[9] (Future Perth, p46).
[10] For example, a survey of building approvals by the ABS found that nearly one quarter of new dwellings approved were medium density developments. Refer 1367.5 Western Australian Statistical Indicators, December Quarter 2001

desirable and socially acceptable housing. In turn, this can impact on the affordability of housing, thereby affecting those on low incomes[11]. To what degree rising aspirations and expectations may be contributing to debt over-commitment, housing stress and family breakdown also bears further understanding.

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- Growth in property values particularly in Perth and falls in real incomes particularly for those in the lower two income quintiles has presented barriers to entry into home ownership.
- The Department for Planning and Infrastructure believes that the rapidly increasing price of land is the main cause of increases in housing costs. Between 1990 and 1998, land costs in Perth rose faster than established house prices, rising at 48.3% compared to 37.8% for the latter. Building material prices increased by 12% over the same period.
- The December 2001, median property prices across various centres in WA were:
    - Perth $171,800 (house) $128,300 (unit)
    - Mandurah $142,000
    - Bunbury $137,000
    - Albany $151,600
    - Kalgoorlie $141,000
    - Geraldton $119,000
    - Port Hedland $175,800
- A household on the median income of $972 per week (Dec. 2001) could borrow around $140,000 on a 25-year loan at a nominal 8.0% interest rate.
- A person on the award wage would only qualify for a loan of around $65,000
- Some 35% of households in the lowest 40% of the income distribution pay more than 25% of income to meet their housing costs.
- Low cost rental stock fell by 20% in Perth and 67% in the rest of the State between 1986 and 1996. Overall rental stock increased by 32.5% (Perth 44%).
- Real weekly rents in the lowest quartile rose by 10.7% compared with a 2.1% increase for the highest quartile. In non-metropolitan areas of Western Australia, the respective increases were 151.3% and 30.4%.
- Public housing has been increasingly targeted at people with high housing needs, needs that cannot be met by the private rental market. This has meant that households with a simple affordability problem have had to access housing in the private rental market.
- Funding for public housing has declined by 20% in real terms in the past decade.

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- Emerging evidence of a decline in home purchase rates among younger cohorts of the population.
- If the ownership rate declined progressively to 60% over the next 30 years, by 2030 the majority of housing being built will be for the rental sector.

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- Some 19% of the WA population has a disability – this figure is expected to increase to 30% by 2021 as the population ages.
- 13% of indigenous households in WA live in overcrowded accommodation.

[11] Andrew Burbidge, 'Housing and Families: Towards an Alternative View', presentation to a seminar at the Australian Institute of Family Studies, 19 October 2000

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The Western Australian housing stock at June 2000 was estimated to be around 780,000. Sixty percent of this stock was constructed in the past 30 years, coinciding with the emergence of the project home market promoting a range of standard designs. As previously noted, these designs have taken little account of environmental or social sustainability issues.

On average, 18,000 new dwellings are added to WA's housing stock per annum. This represents an annual addition of only 2.25%. Most homebuyers will only ever buy an established property in their lifetime. The existing housing market has a far greater influence on the sustainability of the sector than new housing.

Therefore, it is very important that strategies aimed at increasing sustainability do not concentrate on new housing only. Strategies that encourage the retrofitting of existing homes are needed. The promotion of renewable energy technologies such as solar hot water and photovoltaic systems would also assist in lessening the demand for energy from the power grid.

Such strategies can also assist the sustainability of the industry. Official figures indicate that the alterations, additions and renovations market represents 10% of the value of the new housing sector although it is known to be substantially higher. Encouraging the retrofitting of existing homes to make them more sustainable would ensure ongoing work, thereby assisting to soften the effects of economic cyclical swings on the industry.

Questions

- How can government and industry encourage the implementation of environmental sustainability into existing homes?
- What are the potential economic gains from encouraging increased sustainability in housing?
- Is it desirable for government to implement strategies that address the under-utilisation of housing capacity?
- What are the future implications for sustainability of the under-utilisation of housing space

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Sustainable housing is reliant on a sustainable urban form. Large parts of urban areas in Western Australia are unsustainable in terms of solar orientation, ease of movement for residents, access to local employment and services, and the efficient provision of transport links and infrastructure.

Changing the existing urban form will be very difficult. Apart from the enormous expense involved in terms of amending infrastructure, street design, and resumption and rezoning of land use, it is also socially and economically disruptive for communities and businesses.

A recent example from Perth's northern suburbs illustrates this point. The suburbs of Woodvale, Kingsley, Greenwood and Warwick are typical of the type of unsustainable urban form of recent decades, characterised by low density, single dwellings, and a street layout

based on a hierarchical, curvilinear system ending in cul de sacs. However, a development proposal by the City of Joondalup that would have introduced more sustainable urban features into these suburbs (such as mixed density and better connection between streets) was met with fierce local resistance, based on a fear that this would destroy the character of these suburbs. This resulted in the backdown of the City of Joondalup and the abandonment of the development proposal.

Such responses present a major challenge to State and local government. The sheer scale and ecological impact of the existing unsustainable urban form represents a burden on current and future generations. Modification of the urban form will have numerous environmental, social and economic benefits to the community. The lesson from Joondalup is that these benefits need to be clearly and comprehensively explained and promoted, and that the community needs to be closely involved in the process so that they have a sense of ownership and control.

It is also critical that new developments and redevelopment of existing suburbs not replicate the mistakes of the past and incorporate sustainable principles from the start. While there are many encouraging examples where such principles are being incorporated into greenfield and redevelopment projects, this is not yet standard. The predominant type of development continues to be greenfield subdivisions on the urban fringe that are often not well integrated with transport, services or employment.

Consideration may need to be given to strategies to address the apparent mismatch or distribution of housing capacity demonstrated by the high level of excess bedrooms given the demographic changes occurring in the community.

<u>Questions</u>

- What is the role of local government in promoting the principles of sustainability in urban form within their communities and encouraging ownership of the process of change?
- What can the state government do to assist this process?
- What can the state government, local government and industry do to ensure greenfield development and redevelopment of suburbs incorporate sustainability principles?

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Anecdotal evidence from developers and sales agents indicate a lack of understanding by homebuyers of the benefits of sustainable features in housing. This discourages the industry from embracing sustainability for fear that such housing will not sell well.

This is in part the consequence of rising living standards. People expect thermal comfort and are conditioned to believe this can only be achieved with the assistance of air-conditioning and heaters. A house with these features is also favourably viewed when reselling, further enhancing the desirability for the implementation of these features.

These perceptions even influence the promotion of energy efficiency. For example, reverse cycle air conditioners are promoted to homeowners as being more energy efficient for heating in winter. While this may be the case, it shows how strategies have had to be targeted towards moderating people’s use of energy for thermal comfort, rather than alternatives such as home modifications that would minimise the need for heating and cooling.

This lack of understanding of the benefits of sustainability extends to developers, builders and real estate agents. To some degree, this is being addressed through the HIA's GreenSmart environmental training program aimed at professionals in the building and construction industry. Such a program could be supported and extended to include all professionals (eg. real estate agents) and businesses working within the housing sector.

The challenge is to change these perceptions around and make sustainability a 'desirable' feature of housing, and therefore more marketable; e.g. by encouraging strategies that increases awareness and understanding of how these features assist thermal comfort, and provide substantial energy savings to the householder.

<u>Questions</u>

- How can sustainability be made 'desirable' to homebuyers?
- How can sustainability be incorporated as a key consideration for developers, builders and real estate agents when designing, developing and selling houses and land?

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There is a perception that incorporating sustainability into housing involves higher costs in terms of construction and materials, which in turn impacts on affordability. Because of intense competition in the housing industry to minimise costs, this can act as a barrier to a more general acceptance of sustainability in the industry.

There has in fact been very little research done in terms of the real costs of more sustainable housing. Such research may well help to explode the 'myth' of much higher initial capital costs. There is little reason to assume for example, that ensuring a dwelling is correctly solar orientated on a block should add substantially to building costs yet doing so can have major sustainability benefits in terms of energy efficiency and reduced greenhouse gas emissions.

At present, homebuyers rarely specify 'environmentally friendly' or 'sustainable' features when buying or building, largely it is suspected due to a lack of knowledge about the potential benefits and contrary to the findings of the 1998 Survey of Motivations and Intentions. This can be overcome through the use of educational and marketing campaigns, especially in conjunction with the implementation of a voluntary or compulsory ratings system. Ironically, making sustainability desirable to homebuyers is potentially more likely to impact on affordability, particularly in the short to medium term, as the interaction of supply and demand could lead to these homes commanding higher prices.

<u>Questions</u>

- What are the real costs of incorporating sustainability into homes?
- How will these impact on affordability?
- What strategies can be implemented to address either the perception or the reality of higher costs?

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There is an increasing trend for mandatory standards relating to energy efficiency and sustainability to be legislated. Examples include:

- The incorporation of mandatory national minimum energy efficiency standards into the Building Code of Australia
- The mandatory requirement for new dwellings in Victoria, the ACT and South Australia to have a minimum star rating before receiving planning approval.
- The inclusion of generic guidelines regarding solar access and stormwater retention in the review of the R Codes.

Considerable thought needs to be given as to which approach better supports the move to sustainability in the housing sector. There are arguments for both positions. Experience has shown in the past that implementing legislation that enforces compliance with a set of mandatory requirements can help to overcome market inertia and precipitate cultural change. For example, the introduction of a mandatory requirement for all car occupants to wear seat belts in 1971, resulted in industry compliance (the fitting of seat belts in all cars) and behavioural acceptance (most people now do not question the benefit of wearing seat belts).

An approach based on voluntary regulations supported by educational campaigns, incentives and recognition (eg. through sponsorship of a major award) can also be effective as in the case of the ratings system in Victoria when it was first introduced.

A danger of the current moves to mandatory regulations is the piecemeal development of a framework of legislation at national, state and local level. Potentially, these pieces of legislation could be contradictory to each other. It also adds a further layer to an already complex planning regulatory environment.

The Housing Industry Association is concerned that compliance with these multiple acts could result in additional costs being imposed on the industry, thereby affecting affordability. As a consequence, they are advocating the development of nationally consistent guidelines, preferably through an instrument such as the Building Code of Australia.

Care should also be exercised to ensure that legislation is not so prescriptive as to prevent flexibility and innovation in the implementation of sustainability. It is not possible to entirely predict the type of technologies or building materials that may become available in the future that would assist sustainability in the housing sector. Further, industry requires the flexibility to implement the most cost effective option.

Key Questions

- Should sustainability in housing be a mandatory or voluntary requirement? Which approach is more likely to achieve industry and cultural change and acceptance?

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Current rating systems are limited in their application to sustainability in housing by their emphasis on energy efficiency. There are however difficulties in developing a more comprehensive system, that is still simple, practical and unambiguous to use. Further, such systems are only concerned with the physical building itself. They do not rate elements such as affordability, accessibility, location or safety. Nevertheless, they can have a real impact on sustainability by making a star rating a desirable feature for those building or buying a house.

To date, no rating system for housing has been officially adopted in Western Australia, although a number of accredited house energy assessors use the FirstRate House Energy

Rating Software to assess housing designs. This software is also being promoted to industry by the Sustainable Energy Development Office.

The adoption of any ratings system must ensure it takes account of the range of climatic conditions in Western Australia, from temperate in the south to tropical in the north. While rating systems such as FirstRate and the Nationwide House Energy Rating Scheme (natHERS) incorporate a number of climate zones in their assessment, they do not as yet include zones for the tropical/north west zones.

Key Questions

- How can a rating system be best used to promote sustainable housing?
- Should it be a mandatory or voluntary requirement to have a house rated?
- Should a national rating system (eg. NABERS) be used or should a WA specific system be developed?
- Without a rating system, can new stock be truly sustainable?

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Government

- The appropriate inclusion of sustainability principles in the Government's decision-making processes for urban development and housing.
- Ensure triple bottom line accounting is a standard reporting requirement for all government agencies involved in urban development and housing.
- Support the implementation of an approved rating system, appropriate to WA conditions, for all new construction and existing homes being sold. Preferably, this should not initially be mandatory but promoted via agencies such as SEDO and the HIA's GreenSmart program. The starting point could be the requirement to have all project home standard designs rated to a minimum standard (eg. 4 star rating). The rating system could be supported with a recognition program (eg. state sponsored award).
- Investigate and implement financial and taxation measures that can help to offset the additional 'sustainability' costs
- Government agencies (Department of Housing and Works, LandCorp) could be used to demonstrate best practice in the implementation of sustainability within the housing sector. For example, a Keystart loan product with a lower interest rate should be developed that encourages sustainability features such as energy efficiency.
- Well-located surplus government sites should be used as demonstration projects for sustainable housing.
- Sustainability should be given more focus in all land development, redevelopment and construction programs carried out by government agencies.

Industry

Significant progress in sustainability within the housing sector cannot occur without the support of industry. Governments can set the framework, however industry must take the lead.

- Government should work closely with industry to raise levels of awareness about sustainability issues (through joint sponsorship of seminars, awards, competitions, programs).
- Support education and training programs aimed at all stakeholders, such as builders, developers, architects, real estate agents, contractors, small business owners, government employees, to assist a cultural shift to sustainability.
- Industry should liaise with financial institutions to ensure more widespread availability of 'sustainability' housing loan products. These loans can be modelled on the HIA's GreenSmart Home Loan and Bendigo Bank's discounted personal 'Green Loans'.[12]
- Support the development of a rating system suitable to WA and assist in its promotion through voluntary rating of all project home plans.

[12] Bendigo Bank's Green Loans assist customers to purchase "environmentally friendly products" such as solar hot water systems, insulation, water tanks, greywater treatment systems and renewable energy systems. It is also in the process of developing a green home loan product.

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- State and local government needs to instigate community consultation strategies to promote and raise awareness of the benefits of retrofitting the urban form to make it more sustainable.
- Instruments should be developed that encourage the retrofitting of existing houses to make them more sustainable. For example, the application of a rating system to existing houses being placed on the market can help to promote sustainability as a selling point. In conjunction with educational/promotional campaigns, this can help to make these features more desirable. A rating system or some other assessment measure of sustainability also needs to be applied to all approvals for additions or alterations.
- Financial incentives are important. Government grants or low interest loans for householders to implement environmentally sustainable features such as renewable energy technology or insulation can be effective and should be more widely promoted and supported.
- Government can assist by sponsoring design competitions and major housing awards to promote the 'sustainable' renovation of houses.

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- All building and planning codes should be reviewed to ensure that they support sustainability:
  - Where possible, these codes should be performance based in order to permit innovation in design and materials, and to allow for any technological advances not anticipated by these codes.
  - The codes need to go beyond environmental issues to consider social and economic sustainability.
  - The codes need to consider the full life cycle impact of housing, for example embodied energy.
- The planning framework needs to be rationalised to remove excessive layers of regulation and areas of duplication.
- More effective use of existing instruments such as the Metropolitan Development Program (MDP). The MDP could be used to ensure land releases are coordinated with the efficient provision of infrastructure.
- It is important that there not be a single approach only to the design, maintenance or refit of housing. Principles such as Liveable Neighbourhoods and Universal Housing Design should be considered as tools only, not the solution to the issue of sustainability.

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Research is required to investigate and better inform both government and industry about the implementation and promotion of sustainability within the housing sector:

- Research and development in sustainable building materials, and sustainable practices in construction and waste disposal.
- Research into the role of perceptions and expectations in the housing sector and strategies to address those that present a barrier to sustainability.
- Research into the effectiveness and cost of various design elements (for example universal design or climate sensible design) on the basic price of a house. This information can then be used by government and industry in education or marketing promotions that 'sell' the benefits of sustainability.
- Research to measure and quantify the embodied energy in residential housing in WA, identify financial measures to reduce the level of embodied energy.

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The concept of sustainability was put forward in the late 1980's in response to the perceived dichotomy between protecting the environment and economic development. In 1987, 'sustainable development' was proposed by the United Nation's World Commission on Environment and Development as the means to ensure "the fulfilment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future."[13]

Agenda 21 was adopted at the United Nations 'Earth Summit' at Rio in 1992 as the official global strategy for the implementation of sustainability at the global, national and local level. It is principally promoted via Local Agenda 21 (LA21). LA21 recognises that local government and communities are lead agencies in the promotion and implementation of sustainability through the integration of environmental, social and economic goals at the local level.

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The term 'ecologically sustainable development' was adopted by the Commonwealth Government as part of the development of a national strategy for the implementation of sustainability in Australia. In 1992, the Government endorsed the *National Strategy for Ecologically Sustainable Development*, subject to budgetary priorities and constraints in individual jurisdictions.

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Over the past decade, evidence has been mounting that human actions are increasing the concentration of greenhouse gases in the atmosphere, potentially resulting in devastating global climate change. The largest source of human created greenhouse gases is carbon dioxide released from the burning of fossil fuels.

The National Greenhouse Strategy, which was endorsed by the Commonwealth and all State and Territory governments in 1998, provides a national framework for action on climate change. The Australian Greenhouse Office (AGO) has been established with responsibility for cutting Australia's greenhouse gas emissions.

Because of the link between energy and the emission of carbon dioxide, the majority of initiatives to date have been directed towards improving energy efficiency with a lesser emphasis on the move to alternative, renewable energy sources.

Examples of such initiatives include the AGO's Greenhouse Challenge and Cool Communities (to encourage action by industry and the community), Cities for Climate Protection (a program for local government), the development of rating systems such as natHERS, and the establishment of sustainable energy development agencies in several states.

[13] Preamble, Agenda 21, United Nations Environment Programme

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The Sustainability Issues paper is part of the third stage trends and issues phase of the State Housing Strategy process and one of a series of issues papers covering the five themes adopted by the Strategy as indicated on Figure 1.

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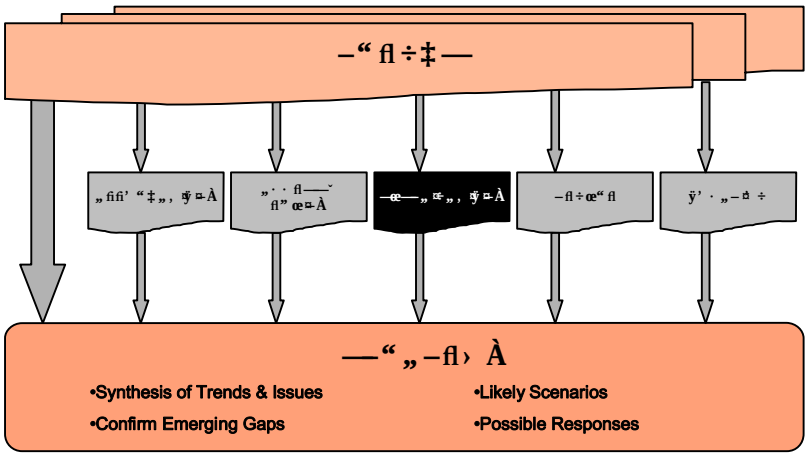

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The *State Planning Strategy*, released in 1997, was formulated to provide a vision and a strategic guide for land use planning for Western Australia and its regions to the year 2029. It is aimed at assisting the State to achieve a number of key goals, including generating wealth, conserving and enhancing the environment, and building vibrant and safe communities. The Strategy acknowledges the need to achieve a balance between environmental, social and economic goals in order to ensure the sustainable development of the State for the benefit of current and future generations[14].

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The Future Perth project is proposed to provide a new strategic plan for the development of Perth within the next 30 years. It will replace METROPLAN, the strategic land use vision for the Perth Metropolitan region released a decade ago. Sustainable cities, in terms of environmental and resource protection, employment, transport, land requirements and quality of life, are a strong focus of the preparation of Future Perth.

Future Perth complements the *State Planning Strategy*. It is specific to the Perth Metropolitan Region and all adjacent local government areas, the Peel Region and Greater Bunbury. These areas have been identified as facing major issues of growth management and planning[15].

[14] State Planning Strategy, Final Report, December 1997, Western Australian Planning Commission
[15] Future Perth Indicators, June 1999, Western Australian Planning Commission

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The WAste 2020 strategy was released by the State Government in August 2000. The strategy advocates a broad-scale shift from waste disposal to resource recovery in order to achieve zero waste to landfill by the year 2020. This is expected to be achieved by reducing waste production in Western Australia and greatly increasing re-use and recycling initiatives.

Construction and demolition waste is the main source for the waste stream going to landfill. Consequently, waste reduction and recycling within the housing construction industry is a key component of this strategy.

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A Greenhouse Management Taskforce has been established with the task of developing a State Greenhouse Strategy. The Taskforce is chaired by Fran Logan, member for Cockburn and comprises representatives from the Departments of Environmental Protection, Conservation and Land Management, Housing and Works, Planning and Infrastructure, Agriculture, and Industry and Technology, WA Office of Energy, Forest Products Commission and Murdoch University.

Three subgroups are being established to deal with the following areas:

- Stationery energy
- Agriculture
- Housing, planning and transport

The intent is for each subgroup to engage with key groups within the community who are involved in these areas. The housing sector will have an important role in providing comments and feedback via the subgroup to the Taskforce, thereby assisting the development of the Strategy.

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The preparation of a State Industry Policy was foreshadowed by the Minister for State Development in his *Building WA: A Strategic Partnership* statement. The Industry Policy will identify a number of high level outcomes that express the Government's economic development goals for the whole economy and, by extension, the whole-of-Government and the wider needs and aspirations of the Western Australian community. A key outcome is the promotion of sustainable development to ensure that economic development is achieved in a way that does not compromise the Government's commitment to sustainability and the triple-bottom line.

It is intended that the Policy will be supported by a series of sub-strategies specific to particular industry sectors or economic development issues. One of these may relate to the housing industry sector.

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The *Liveable Neighbourhoods* Community Design Code was developed by the Western Australian Planning Commission and released in 1997. It was prepared as a tool to assist the implementation of the sustainability objectives of the State Planning Strategy that aims to guide development in Western Australia to 2029.

The principles underlying *Liveable Neighbourhoods* are those of New Urbanism. New Urbanism promotes the creation and restoration of diverse, walkable, compact, mixed-use urban environments that encourage sustainable communities in terms of employment, services, community safety and social interaction.

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The Metropolitan Development Program (MDP) is prepared annually by the Department for Planning and Infrastructure to assist in the orderly planning for the provision of physical and community infrastructure. The MDP covers the Perth Metropolitan Region and Peel Sector (Mandurah and Murray local government areas).

The MDP was intended to be an urban management tool to provide a “more effective co-ordination of public investment and urban land release in the metropolitan region”[16]. It is therefore potentially a powerful tool for government to influence urban form and sustainable policy objectives. However, the MDP has not reached its full potential and is currently limited to providing information on current residential activity and identified trends in likely residential type land release over a five-year period. This has meant that infrastructure has tended to ‘follow’ land releases rather than direct where they occur, resulting in inefficiencies in service provision that affect the economic and social sustainability of communities.

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The Building Code of Australia (BCA) is intended to provide a framework for nationally consistent building regulatory systems that are efficient, cost-effective and meet community, industry and national needs.

In its current form, the BCA is performance-based, rather than prescriptive in its approach to building regulation. This has an advantage from a sustainability point of view as it allows for flexibility in the use of materials and forms of construction or design, provided that the intent of the BCA is met. This can assist not only the incorporation of environmental criteria into housing design and construction but can also result in cost savings in building construction, thereby assisting affordability.

The BCA is currently being amended to incorporate mandatory national minimum energy efficiency standards in all new homes from 1 January 2003.

[16] Planning for the future of the Perth Metropolitan Region, Report of the Review Group to the State Planning Commission of Western Australia, November 1987, p147

The BCA does not however have any legislative pre-eminence over State or Local Government planning legislation[17]. Rather, States and Territories have been implementing their own planning regulations across a range of urban and housing planning issues. This has resulted in a complex network of planning regulations, frustrating to designers and developers, and allowing local authorities to circumvent the application of the BCA.[18]

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The Residential Planning Codes 1991 (R Codes) control residential development in Western Australia in terms of built form and housing density. These codes are largely given effect through their incorporation into town planning schemes.

It is intended to replace these codes with the Residential Design Codes. In contrast to the prescriptive approach of the 1991 Codes, the new codes have a performance orientation and "deemed to comply" standards. This approach encourages "innovative design solutions" and "the widest possible range of dwelling types, to meet community desires"[19].

The revised Codes have also introduced several additional generic elements, including design for climate. This provides guidelines principally in relation to solar access but also to the containment of stormwater on site.

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It is intended that housing based on universal design is to be accessible to all users, regardless of physical ability, and is able to meet the changing needs of users over time, without the need for adaptation or specialised design. Examples of the features of a universally designed home include:

- undercover car parking that provides easy access into the house;
- step free entry, door handles that are easy to operate;
- an internal layout to assist easy access and circulation; and
- bathrooms and kitchens that can be used by a wide range of people.

An important principle underlying universal design is that it assists equity of access to housing for people with disabilities and the aged. In addition, because its design allows for the future incorporation of assistance aids, existing occupants can remain in their home despite increasing frailty or the onset of a physical disability. Universal design can be applied in multi storey dwellings.

Because dwellings built to universal design require more space than ordinary dwellings, this can add to costs. It has been estimated that the floor space of a standard design can be increased by an average of 14m^2, adding up to $11,575 per dwelling in construction costs. In response, proponents argue that this additional cost is recouped over time due to the reduced need for future modifications to the dwelling. There is also an indirect benefit to government and the community due to the reduced need for people to move into institutional care.[20]

Universal housing design is currently being applied by the Western Australian Department of Housing and Works, Queensland Department of Housing, and Housing Tasmania in their public housing programs. Its principles are also evident in publications such as the ACT Master Builder's Association's (ACT) guide 'Housing for Life'.

[17] With the exception of Tasmania
[18] Better Living Environments, Housing Industry Association, www.hia.asn.au
[19] Residential Design Codes of Western Australia, draft for public comment, Western Australian Planning Commission, Oct 2000
[20] 'Universal Housing Design', Queensland Department of Housing, Occasional Paper 5

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Climate Sensible Design (CSD) takes account of local climatic conditions in housing design to create dwellings that are thermally comfortable all year round. CSD is associated with passive solar design principles.

By using natural forces, such as the sun and wind, to maintain internal comfortable thermal conditions CSD homes require little additional heating or cooling. They are therefore also energy efficient, resulting in minimal energy running costs for the occupant, and reduced fossil fuel use and greenhouse gas emissions.

Key features associated with CSD are solar orientation, zoning of living and sleeping areas, the use of thermal mass to regulate internal temperatures, insulation, natural ventilation, window placement, and the use of landscaping for shade and cooling.

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Housing and urban design can both have an important influence on the potential for an individual dwelling to be at risk from crime. Burglary patterns for example, have been found to be affected by street layout, height of boundary walls and the inter-visibility of buildings[21].

In terms of housing, security can be improved by increasing the level of 'natural surveillance'. For example, it is recommended that houses face the street, and that fences, walls and vegetation not hinder surveillance of the street or the front of the house.

These design principles are a key element of the City of Gosnells *SafeCity* Urban Design Strategy and are a feature of planning documents such as *Liveable Neighbourhoods*.

A challenge for designers is to minimise the potential conflict between design principles. For example, facing a house to the street may not assist its solar orientation, or using vegetation to shade and cool a house could compromise its level of security by providing hiding places for burglars.

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A number of building rating systems have been developed and implemented nationally and at state level in order to measure the environmental performance of a building. Dwellings get a star rating (0 – 5) according to their potential for low energy use to maintain comfort. Star ratings compare houses' modelled annual heating and cooling loads per square metre of floor area under standard operating conditions.

As the impetus for the development of these systems has largely been in response to the concerns about global warming, they are mainly concerned with rating the energy efficiency of a dwelling[22]. Examples of such systems currently in use include the National Home Energy Rating System (natHERS), and First-Rate[23].

These systems are being used in the ACT, Victoria, NSW and South Australia to rate the energy efficiency of new and existing homes. New homes are required to achieve a 3.5 to 4 star energy rating in order to receive building approval. In the ACT, existing home-owners wishing to sell their properties are also required to have their home rated, and to include this rating in any advertisement for its sale.

[21] Safe City Urban Design Strategy, City of Gosnells, 2001
[22] David Beyers, Building and Construction Policy Initiatives and Rating Systems, February 2002
[23] natHERS was developed by the CSIRO, and First-Rate by the Sustainable Energy Authority Victoria.

A new rating tool, the National Building Environmental Rating Scheme (NABERS) is currently being developed by Environment Australia. NABERS aims to go beyond the current systems and intends to rate the overall environmental impact of a building including its energy and water efficiency, site conservation and biodiversity, indoor air quality, and efficiency of resource use.

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The GreenSmart program is the practical implementation of the Housing Industry Association's Partnership Advancing the Housing Environment (PATHE) national environment strategy. PATHE and GreenSmart have been developed in conjunction with the Commonwealth Government. It has been operating since 1998.

The GreenSmart program aims to instil sustainability principles into the culture of the housing industry via a range of actions:

- Environmental training and accreditation for building and construction industry professionals. The course incorporates training in regard to waste management, stormwater management, energy management and insulation. It is based on the 'Your Home' design guide, published by the Australian Greenhouse Office.
- Demonstration of sustainable principles and practices via showcase GreenSmart Villages.
- The provision of the GreenSmart Home Loan for consumers who build with accredited GreenSmart professionals. The GreenSmart Home Loan has a rate 0.25% less than the standard variable home loan rate offered by HIA Home Loans. The lower rate assists to offset the higher up front costs involved in incorporating sustainable features in a dwelling.
- The development of partnerships with companies, State and Local governments to advance the goals of GreenSmart.
- Recognising initiatives in environmental design and construction through GreenSmart Awards.

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Smart Houses are designed to incorporate current and emerging technologies that can either function automatically or be remotely controlled by a mobile user. Also marketed as home automation systems, it involves the house being 'smart wired' using copper pair wiring, cabling and Internet connectivity to allow home-owners to control a totally linked home network using keypad codes, phones, televisions or the computer.

The market for these systems is expected to be strong. In Australia, about 135,000 new homes built this year will incorporate smart wiring for telecommunications and lighting.[24]

Smart House technologies can assist energy efficiency, for example by allowing appliances such as washing machine and dishwashers to turn themselves on when electricity is at off-peak rates. Potentially, they could also assist sustainable houses to monitor and operate waste treatment and renewable energy systems.

Home automation can also help people with disabilities or the frail aged to live independently by permitting them to control devices in any part of the house from a central point. The degree of automation is however determined by cost. Incorporation of smart wiring is most cost effective at construction (representing approximately 0.5% of the cost of the dwelling),

[24] 'Wired for house of the future', The Real Estate Report, South Australia, 2002

while retrofitting an existing dwelling is currently prohibitively expensive[25]. This raises an issue of equity of access to these technologies for those on a low income if the house is not pre-wired.

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The residential housing industry is a significant producer of large volumes of waste, mostly solid waste left over from the construction of housing. Much of this finds its way to landfill. In Victoria for example, construction industry waste accounts for 44% of total landfill[26].

One approach to the issue of construction waste is that of Cleaner Production. Cleaner Production refers to the application of an "integrated preventative environmental strategy" to increase eco-efficiency in the use of materials and reduce waste[27]. Strategies to achieve this in the building construction industry include input substitution of less polluting materials, changes in operational procedures and management to eliminate waste, and on-site recycling and reuse of building materials.

Cleaner production directly addresses the triple bottom line by linking environmental measures with economic strategies aimed at the more efficient use of resources.

For industry, the reuse and recycling of building materials can result in large cost savings in waste disposal and the transportation of materials to site. However, a number of barriers have been identified including the cost of reusing/recycling waste relative to disposal in landfill, attitudes to using recycled materials, and lack of information about potential markets and customers for recycled goods. It also requires local government to be flexible in regard to regulations on the use, or reuse, of building materials within an area.

The potential benefits to consumers come from reduced building costs due to savings made by industry. This could aid affordability or at least offset some of the potential additional costs from the incorporation of sustainable features into a dwelling.

A national Cleaner Production strategy was launched in December 1998 and is promoted via Environment Australia. This strategy mandates that states and territories implement Cleaner Production policies and strategies, and report on progress annually. In Western Australia, Cleaner Production has been adopted as part of the Government's waste policy for industrial waste[28]. A Centre of Excellence in Cleaner Production has also been established at the Curtin University of Technology in Perth.

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WasteWise is a program coordinated by Environment Australia with the aim of reducing the amount of construction waste going to landfill.

In the first phase of the WasteWise program, five leading Australian construction companies volunteered to work with the Australian and New Zealand Environment and Conservation Council (ANZECC) to develop waste reduction best practice. The companies had to find the best way to reuse, recycle and reduce the waste resulting from their day to day operations.

[25] 'Securing a Home's Future', Building Product News, www.hometoys.com/htinews/feb01/articles/hpm/hpm.htm
[26] 'Waste Minimisation in the Construction Industry – Fletcher Construction Australia', Cleaner Production Case Study
[27] Cleaner Production Opportunities for Small to Medium sized Enterprises, Prof Rene Van Berkel, Waste & Recycle Convention, 5-6 August 1999
[28] Cleaner Production Opportunities for Small to Medium sized Enterprises, Prof Rene Van Berkel, Waste & Recycle Convention, 5-6 August 1999

Their experience demonstrated the capacity for significant reduction and reuse opportunities for construction waste. As a consequence, broader industry participation was attracted in the second phase of the program commenced in 1998.

The HIA is pursuing its WasteWise commitment through the PATHE program and has released a Waste Management Guide for Residential Building. The Guide seeks to create an awareness of the waste problem and to identify cost-effective waste minimisation solutions for the normal range of circumstances found on most building sites. The HIA is incorporating waste management training in its training and education seminars to help facilitate the shift towards effective waste management in the housing industry.

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Embodied energy is the energy used by all the processes associated with building a house including the extraction of the natural resources, manufacturing of materials and equipment, transport and administrative functions.

The question of embodied energy is often overlooked when considering the energy consumed by the residential housing sector. However, the amount of energy involved is significant. It is estimated that the energy embodied in existing building stock in Australia is equivalent to ten years of the total energy consumption for the nation[29].

The choice of building materials can have a major influence on the embodied energy of a building. Wood and concrete typically have low embodied energy while stainless steel and aluminium have quite high energy content. The amount of embodied energy in building materials can however be recaptured to a large extent through reuse and recycling. The reuse of building materials can save about 95% of embodied energy, while recycling can save between 20-95% dependent on the material[30]. As noted above under Cleaner Production, construction waste reuse/recycling can result in significant cost savings.

Because of the connection between energy and greenhouse gas emissions, it is inevitable that embodied energy will become a higher profile issue. However, the question of how to address the issue of embodied energy in housing is not necessarily straightforward. For example, building dwellings that are more energy efficient usually means (at present) increasing the embodied energy content. This may be acceptable if the life of the building is extended to offset the increase in energy. Another consideration is the amount of materials used (for example, wood and concrete are generally used in larger quantities in a dwelling than steel).

With the development of, and increasing use of rating systems, another matter to consider is whether, or how, embodied energy can be incorporated into considerations of the 'energy efficiency' rating given to a building.

Further work is clearly required into the issue of embodied energy and housing as follows:

- to measure and quantify the embodied energy in terms of residential housing. This has implications for greenhouse gas emissions measurement.
- explore financial or other incentives to encourage home owners and builders to consider reducing the amount of embodied energy in the houses.
- encourage policy makers and private industry to consider total life cycle energy use (operational and embodied energy) in the construction of residential buildings.

[29] 'Embodied energy' CSIRO Built Environment Online Brochure, www.dbce.csiro.au/ind-serv/brochures/embodied/embodied.htm
[30] Tracey Mumma, 'Reducing the Embodied Energy of Buildings', Home Energy Magazine Online, January/February 1995, www.homeenergy.org/archive/hem.dis.anl.gov/eehem/95/950109.htm

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The Sustainable Energy Development Office (SEDO) was established in November 2001, as part of the Office of Energy, in order to deliver the State Government's sustainable energy policy.

SEDO's interim strategic plan lists as its objectives the increased uptake of energy efficient products, practices and renewable energy by WA households, the encouragement of best practice energy management in the business sector, and the support of an efficient and sustainable energy supply industry.

Initiatives undertaken by SEDO in support of its objectives are:

- Funding initiatives such as the solar hot water subsidy and the Photovoltaic Rebate Program (PVRP) and the Renewable Remote Power Generation Program (RRPGP).
- Provides information to the public on energy efficiency measures via the Home Energy Line, the SEDO website, brochures and promotional campaigns.
- Implementation of the nationally developed *Reach for the Stars* program to promote the sale of high efficiency household appliances.
- The establishment of the FirstRate training course in conjunction with Central TAFE.
- Development of policies to promote and encourage growth in the sustainable energy industry.

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The housing construction market is dominated by project home companies that produce the majority of new single residential and small multi-residential group housing projects. Project home companies operate on small margins and rely on sales volume to generate economies of scale through bulk purchase of materials from suppliers and continuity of sub-contractor labour.

This makes the industry vulnerable to economic fluctuations and cyclical investment in the housing sector. The volatility of housing activity has significant flow-on effects to the economy and society. For example, a downturn in housing construction can affect the supply of local labour, in terms of unemployment and the loss of skilled tradesman from the industry. This in turn can result in a shortage of labour during an upturn leading to increased labour costs, which can impact on the affordability of housing for those on low incomes.

The raw materials used in housing construction are sand, limestone, lime sand, clay, hard rock and gravel. The market value of the basic raw materials industry in Perth was assessed at $768 million in 1994 and was directly responsible for 4127 jobs[31].

The extraction and transport of these materials contribute significantly to the ecological footprint of the housing industry. The sources for these materials are drawn from sites close to Perth and throughout the southwest from Geraldton to Albany.

WA has traditionally met all its housing timber needs through native forest hardwoods, and more recently plantation softwoods. With pressure on local natural resources, particularly for the preservation of hardwood, imported timber from South East Asia has been flowing into the local industry primarily for roofing timber[32].

There are no figures available for the amount of embodied energy used in the WA residential sector. However, it is worth noting that manufacturing utilised the largest share of the state's final energy use (36%). Most of this was used in the processing of alumina, nickel and iron. Transport represents a further 32% of final energy use[33].

The proximity of the sources of raw materials close to point of use assists affordability in the housing industry. However, depletion of these resources will have a significant impact on the cost of housing and construction. For example, an increase of 25 kilometres in haulage of hardrock would add approximately $550 to an average residence and associated infrastructure[34].

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People living in dwellings use energy and water, and produce solid and liquid waste. The level of consumption is affected by a number of factors. These include the design and building materials used in construction, attitudes towards the use of resources, government policies regarding waste disposal or its reuse/recycling, the existence and effectiveness of public campaigns and financial incentives to improve energy efficiency and water conservation, and behavioural patterns of consumption.

[31] WA Regional Forest Agreements, South West Forest Region, www.rfa.gov.au/rfa/wa/raa/cra1, p95
[32] Housing Strategy Housing Sector paper, November 2000, p19
[33] Energy 2001, Office of Energy Western Australia
[34] WA Regional Forest Agreements, South West Forest Region, www.rfa.gov.au/rfa/wa/raa/cra1, p95

Energy

Households account for 8% of the state's final energy use. Since 1974/75, residential energy use has almost doubled from 19 petajoules (PJ) in to 33 PJ in 1999/2000. In 1974/75, wood was the main source of energy. It has now been replaced by electricity as the largest source of energy (38%), while gas provides a further 26%. This is a reflection of the increasing use of electrical appliances within the home, and changing lifestyles. As virtually all electricity is produced in fossil fuel fired plants, this has significant implications for the state's greenhouse gas emissions.

There has been considerable focus on the promotion of energy efficiency in the residential housing sector. As previously noted, the Sustainable Energy Development Office has recently been established in Western Australia to assist the adoption of energy efficient practices by individuals and business. Another initiative is the Australian Greenhouse Office sponsored initiative "Cool Communities", which aims to highlight and moderate energy use behaviour in the home in order to reduce greenhouse gas emissions.

Greenhouse gas emissions

On average, households in Western Australia produce 6 tonnes of greenhouse gas emissions per year, excluding transport and wastes (landfill) emissions. In Western Australia, the residential sector is responsible for 10% of the state's total greenhouse gas emissions[35].

A report commissioned by the Australian Greenhouse Office into greenhouse gas emissions by the residential building sector has found that 15% of emissions can be attributed to the need by residents to heat and cool their homes. They report that the amount of energy used for this purpose is affected by factors such as design, housing materials and other factors determined at the time of construction, and modification in the behaviour of energy users[36].

Hot water heating contributed a further 28% to greenhouse emissions from this sector. The largest contribution of 52% was from electrical appliances.

Not included in the above calculations are greenhouse gases emitted from the extraction of raw materials, manufacture and transport of building materials, or construction on site (embodied energy). This is a significant omission in understanding the full impact of the housing sector on greenhouse gas emissions.

Water

Residential water consumption constitutes over 50% of the overall demand for water in urban centres. The overall water consumption per residential customer largely depends on climate, household size and outdoor consumption requirements (eg. gardens). The South West of the state has the lowest water consumption levels while per capita consumption increases towards the North and inland.

The average Perth household consumes about 920 litres of water per day. Virtually, all of this water is supplied from surface dams and underground aquifers and delivered to households via an extensive network of infrastructure pipes.

[35] Information provided by SEDO, 15 March 2002
[36] Australian Residential Building Sector Greenhouse Gas Emissions 1990-2010, Australian Greenhouse Office, Executive Summary report 1999

It is estimated that by the year 2031, due to population growth, Perth will require an extra 150 gigalitres of water per annum. At the same time, there has been a significant reduction in winter rainfall in the past 25 years, a trend expected to be exacerbated by global warming[37].

Pressure on water supplies can be significantly reduced through the development of water efficiency programs and the recycling of wastewater. The average person in Perth produces 200 litres of wastewater per day[38]. Housing design can be influential in this area in terms of incorporating water efficient appliances, the capacity to capture and use rainwater and the reuse of wastewater onsite.

There appear however to be several obstacles at present to the widespread implementation of recycling/reuse water management initiatives. Council and public health regulations can be a barrier to the greater application of water efficiency measures in housing design. For example, greywater recycling is prohibited at present by the Health Department, on public health grounds, unless specific approval is granted (although using washing machine water on gardens is a common practice). The Water Corporation has indicated that it is keen to develop wastewater options, however states that the relatively cheap scheme water and local groundwater alternatives present obstacles to a greater takeup of this option. A significant decrease in greywater moving through the sewerage system could also affect its efficiency[39].

Waste

The largest single source of landfilled waste in WA is materials and soils from construction and demolition (C & D) activity. For the Perth metropolitan area in the year 2000, it has been estimated that 1,500,000 tonnes of C & D waste was generated accounting for almost 55% of the waste stream by weight.

The largest contribution to C & D waste is soil that has to be removed from a site for health reasons or to facilitate construction. Other sources include waste materials from interim and post-construction cleanups, and waste materials from the demolition of old buildings.

There is little information available about the level of recycling in the C & D industry although some high value materials such as timber beams, steel, aluminium, baths, toilets and copper piping are reused or recycled. The value of these salvaged materials is estimated at $10 million per annum.

The implementation of a resource exchange for soil removed from construction sites could assist in creating a market for it, and divert this material from landfill.

A large amount of C & D waste is illegally tipped every year and has been identified as a substantial environmental problem. Illegal tipping has severely compromised some areas of bushland and forest, requiring clean-ups that could cost millions of dollars and would lead unavoidably to further destruction of bushland[40].

The second highest proportion to the waste stream is municipal solid waste. In 2000, the municipal waste stream in Perth was 800,000 tonnes. Typically, the major component of the domestic waste stream is organic, with green and food wastes accounting for 60-70% of a household's total solid waste. This organic waste could be composted or shredded for mulch. Another 20% is recyclable materials (paper, cardboard, mixed plastics, metals and

[37] Planning for Perth's water needs, Water Corporation, November 2001
[38] http://www.watercorporation.com.au/environment/content-wastewater.asp
[39] Water Corporation of Western Australia, Submission to the Senate Inquiry into Australia's Urban Water Management, July 2001
[40] 'Construction and Demolition Waste Sector Actions', WAste 2020 TaskForce Report and Recommendations, 1 Jan 2001

glass). Therefore, potentially over 80% of the waste generated by residential housing could be diverted from landfill through reuse and recycling[41].

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Smart Housing and GETSmart Housing are programs run by the State Housing departments in Queensland and Tasmania respectively. Both programs have the objective of promoting sustainable housing that is "flexible, efficient, safe and affordable over time"[42]. The principles underlying both programs are universal housing design and climate sensible design.

In support of its program, the Queensland Department of Housing has produced a residential design manual for designers and builders providing public housing, co-sponsored a Smart Housing Design Award with the HIA and have built demonstration Smart Houses in Brisbane, Townsville and Cairns that "showcase environmentally and economically sustainable design principles."

As in Queensland, Housing Tasmania has incorporated GETSmart principles into the construction of public housing. It has also initiated a number of partnerships with designers and builders in order to make GETSmart Homes the normal standard for construction and renovation of houses throughout Tasmania.

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The Olympic Athletes Village and the wider suburb of Newington were designed as a demonstration of the commitment to 'green' principles by the 2000 Olympic Games in Sydney. Key features include:

- Permanent houses designed to achieve a 50% reduction in energy requirements and greenhouse gas emissions compared to conventional dwellings.
- 665 permanent dwellings fitted with rooftop photvoltaic cells sufficient to generate household energy demands, making it the largest solar powered suburb in the world.
- 50% reduction in potable water usage as compared to conventional dwellings through water saving devices and use of reclaimed waters.
- PVC use reduced by at least 40%.
- The recycling of 92% of construction waste.
- Housing in Newington has been designed to incorporate passive solar design while responding to the need for street frontage and privacy.

The successful tenderer, the Mirvac Lend Lease Village Consortium, was awarded the project as a consequence of their commitment to Ecologically Sustainable Development. A challenge for the developers was to balance the incorporation of innovative and green design ideas with mainstream marketing needs. There was in recognition that the market was more open to environmental design if it promotes the thermal comforts, lifestyle improvements and energy cost savings it can bring.

Important design lessons from Newington put forward by the developer are:

[41] 'Municipal Solid Waste', WAste 2020 TaskForce Report and Recommendations, 1 Jan 2001
[42] 'What is Smart Housing', Smart Housing brochure, Queensland Department of Housing, www.housing.qld.gov.au/org/smart_hsing.htm

- Passive energy efficient aspects of the design are the easiest and most cost effective to employ. However, active energy efficient aspects such as PV cells, while more expensive, are more visible to purchasers.
- Apart from solar hot water, the general public do not have a good understanding of the benefit of active energy efficient aspects. There is a need for greater branding of these products together with education campaigns.
- Government grants should be more progressive. Providing subsidies to owner-occupiers only, limits the incorporation of energy efficient technology (eg PV cells) into building design. Without a similar incentive, developers are reticent to include energy efficient technologies into large projects for fear that they may not be understood by future purchasers, thereby affecting sales[43].

While Newington has been praised for its innovation and demonstration of environmentally sustainable housing features, there are also concerns that it does not provide for low cost housing. In Stage 1 of the project, house prices for three bedroom houses started at $355,000, while a two-bedroom apartment was selling for $265,000. Indications are that properties in Stage 2 are exceeding these amounts.

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The First Rate House Energy Rating System has been available in Victoria since 1994. Active promotion by the Sustainable Energy Authority Victoria and Insulation Solutions (formerly ACI Insulation) in conjunction with the State’s major housing awards have helped to raise awareness of the benefits of a house energy rating. This resulted in hundreds of new house designs from leading builders being rated voluntarily.

Research in 1998 found a 14% increase in the average energy efficiency of new homes since the inception of the ratings system. As a consequence, 38% of new homes had a rating of four or five stars[44].

Victoria has now legislated to ensure that planning permits for multiple dwellings on a lot are subject to each dwelling achieving a four star rating. Interestingly, this legislation does not apply to single dwellings or residential buildings (such as hostels, backpacker accommodations, motels).

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The Victorian government is supporting sustainability principles in social housing through a number of initiatives.

- The development of social housing projects in Windsor, Kensington, Port Melbourne, Richmond and Carlton that will be energy efficient. The Windsor project, awarded last year via a competition for the best environmentally sustainable design, will feature the use of renewable energy only, a 50% reduction in water use and be built to last 200 years.
- Funding for 600 solar hot water systems to social housing projects over a three-year period.
- The voluntary introduction of a minimum 4 star rating for all new social housing construction.
- Energy efficiency training of Office of Housing staff by the Sustainable Energy Authority.
- The provision of rainwater tanks in homes in regional Victoria.

43 ‘Newington Master Plan’, www.netspeed.com.au/abeccs/newington/newington%20design.htm
44 ‘‘New Homes Go Green In Victoria’, November 1998, www.aie.org.au/pubs/greenvic.htm

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In the United Kingdom, all new housing is assessed against the Environmental Standard Award. This sets out a range of criteria covering aspects such as carbon dioxide emissions, use of environmentally friendly materials, use of recycled materials, water conservation and minimisation of ecological damage to the site. Those housing developments meeting a necessary number of criteria are awarded the Environmental Standard Award.

A number of organisations, such as Sustainable Homes and the Somerset Trust for Sustainable Development, have been established to promote sustainability in housing. They promote awareness of sustainable development issues and good practices through seminars, conferences, newsletters, funding assistance, and the development of partnerships with organisations such as housing associations.

One example is Millenium Homes, Tewkesbury. Fifteen two and three bedroom rental houses were developed by the Gloucestershire Housing Association for low-income families. The properties feature a number of sustainable features including solar passive design, low embodied energy, environmentally friendly materials, solar hot water, and water conservation measures. They also incorporate universal housing design principles to ensure the flexibility, adaptability and accessibility of the houses to meet the changing needs of families over their lifetimes[45].

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The building of a new quarter in the City of Amersfoort in the Netherlands provided an opportunity for innovative policy in the incorporation of photovoltaics into the urban form. The Utrecht Electricity Corporation (REMU) has, in partnership with developers, the Amersfoort Housing Corporation and owner occupiers, installed an average of twenty square meters of solar panels on the roofs of about 500 houses amounting to 1 MW of capacity. This is fed into the grid with residents receiving a credit equivalent to the normal domestic consumer tariff. In addition, a further 1150 houses were equipped with solar collectors.

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The reurbanisation of the inner city suburbs of East Perth and Subiaco has to a large degree successfully demonstrated the principles of New Urbanism that underpin documents such as Liveable Neighbourhoods. Both developments feature a compact, walkable urban form, mixed use development, public transport links, and natural surveillance of streets and parks for increased safety.

These developments have been very popular with housing selling strongly and recording solid and consistent price growth. They demonstrate that well designed, higher density developments can be marketed successfully. The December 2001 median price for a dwelling in East Perth was $289,000 while Subiaco was $395,800, while the overall median for Perth was $171,800.

Since the establishment of both redevelopment authorities in the early 1990s, a number of sustainable housing issues have gained prominence such as: solar orientation, access and affordability and adaptability.

[45] Sustainable Homes Case Study, Gloucestershire Housing Association, www.sustainablehomes.co.uk/case_studies/gloucs.htm

Planning policy made provision for passive solar design but were 'desirable' only and encouraged "so long as it is consistent with good design and market acceptability"[46]. There were possibly missed opportunities for the use of renewable energy such as solar hot water heating or photovoltaic panels.

High density small lot development whilst efficient in terms of land and infrastructure requires multi-storey construction which may have a long term downside in terms of meeting the whole of life housing requirements of current occupants as they age.

A criticism that has been leveled at both developments is the low proportion of affordable housing. However, affordability was not a key driver in the original charter of these estates. Indications are that the new Northbridge and Eastern Gateway project areas of EPRA will incorporate affordable housing projects.

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The Department of Housing and Works has a significant role in the housing sector. The agency has responsibility for the provision of public rental and community housing, aboriginal housing and infrastructure, land development and home ownership finance.

The Department has implemented a number of sustainability initiatives:

- The Department is an inaugural partner in the HIA PATHE program
- The principles of Liveable Neighbourhoods have been adopted as an underlying principle in its land development and redevelopment programs.
- The 'mainstreaming' of universal housing design in the construction of seniors and special purpose housing.
- Where appropriate, the incorporation of solar passive and water sensitive design in mainstream construction of public housing.
- The Department has been a partner in demonstration projects:
  - The trial of greywater recycling for toilet flushing and garden watering at six seniors units in Palmyra.
  - The construction of an energy efficient house in Stratton featuring solar passive design and active solar technologies such as roof mounted photovoltaic cells and gas boosted solar hot water system.
  - The Department has assisted the preparation of guidelines for minimisation of construction waste, in conjunction with the Centre of Excellence in Cleaner Production, interested builders, and the Waste Management and Recycling Fund.
- The Department's range of programs to assist Aboriginal people with their housing and infrastructure needs, promotes sustainability within Indigenous communities in several ways. Programs such as the Management Support Program and Remote Area Essential Services Program aim to develop skills within communities in management, repairs and maintenance of housing and infrastructure through training and employment opportunities. Communities are also encouraged to have a major input into the design and siting of housing to ensure they are culturally and climatically appropriate.
- The New Living program, Western Australia's largest urban renewal project, aims to rejuvenate older public housing estates to create more functional and attractive living environments, reduce the Department's presence and encourage home ownership. This ensures a greater mix of household and tenure types, and the availability of affordable housing close to services, employment and amenities.

[46] General Planning Policies, East Perth Redevelopment Authority, http://www.epra.wa.gov.au/_extranet/planpol2.pdf

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The Coolamon Village, a subdivision of Ellenbrook, has been designed to encourage the construction of solar efficient housing. The subdivision has been designed incorporating the principles of Liveable Neighbourhoods and has a permeable grid system with two thirds of the roads having a north/south axis permitting solar passive housing to be constructed. Housing Packages have also been designed to encourage energy efficiency. If homebuyers meet six of ten environmental criteria, they are eligible to receive free ceiling insulation.

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This new neighbourhood will be developed by LandCorp in close consultation with the community and in co-operation with the City of Cockburn and environmental agencies. The Minister for Planning and Infrastructure has indicated that LandCorp was working closely with the Housing Industry Association on the GreenSmart Village concept and 12 builders had already committed to a display centre of 14 houses built to environmentally sustainable guidelines.

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Ian Macrae	Department for Planning and Infrastructure
Ray Haeron	City of Gosnells
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