SUSTAINABLE BUILDING and CONSTRUCTION.

Initiatives and Regulatory Options towards a Sustainable Planning, Building, Design and Construction Sector in Western Australia.

Background Paper
For the
State Sustainability Strategy
(Western Australia)

By David Beyer.
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ISTP Murdoch University.
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Abstract.

This discussion paper concerns the processes and essential elements of the built environment and suggests that they can operate in a supportive and synergistic manner to achieve a sustainable living environment. In recognition that there are already moves within various parts of the building and construction sector to create a sustainable built form, and that there is strong community interest in sustainable living, the main focus is on the role of the Western Australian State Government in supporting these moves.

There are two main parts to this paper. The first part states the case for a sustainable building and construction sector in W.A. with a specific focus on the role of State Government in supporting, stimulating, and guiding a more rapid and comprehensive change. The second part gives strategies, recommendations, and a framework to begin the process for achieving sustainability. Whilst there are broad suggestions for all stakeholders, there are more specific recommendations that pertain directly to State Government, particularly about how to implement greater sustainability in planning, local government and building materials.

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Part A.

Introduction.

Building and Sustainability.

Building and construction, land development, local, urban and regional planning, provision of services; all these are inextricably linked in the web of urban form. By considering all components sequentially, each facilitates and supports the successful implementation of the other. For example, planning policy and guidelines define and support land development and sub-divisions which define the individual blocks for building design which in turn defines the construction itself. The result is the built environment in which we all live. All of these aspects are key components in considering, formulating, and implementing a more sustainable building, design and construction sector in Western Australia.

The Building and Construction Sector (BCS) holds significance in Western Australia for many reasons and has real importance for sustainability because of the life of the built product, often 50-100 years or more, as well as the implications for our environment, our social life and our economy.

The BCS is a large producer and consumer of resources, including materials, labour, finance, and energy, both during and post construction. It is often a key indicator of economic stability and investment and is a target of government monetary policy to manipulate a volatile economy. It is a large direct employer, and indirectly supports all other sectors including, mining, manufacture, agriculture, transport, and commerce. It also results in the alteration, destruction, or redefining of the natural environment, and has significant impacts on the land, water and air.

How our built environment is planned, designed, and constructed can largely determine our quality of life. A well-planned and designed built environment will consider the natural environment and validate it as intrinsically important and also necessary to our own wellbeing. The human built environment can and must be one that supports ongoing wellness and integrity of the natural environment as well as the individual and society, whilst maintaining social and economic prosperity. The sustainability of our built environment, and our physical health and emotional wellbeing is intrinsically linked to the quality of the environment.

This paper will assert that the three elements of sustainability can co-exist in the BCS and that this co-existence is strongly and directly influenced by planning, building and construction regulation. Furthermore, the paper will contend that the steps to creating a framework for and ultimately implementing a sustainable built environment are achievable, particularly with government support.

Many federal and state government agencies are openly supportive and, where possible proactive in promoting more sustainable practice. Industry associations and private companies are well advanced in their initiatives. At the community level there are many NGO, educational centres, and individuals, which are canvassing for and creating a more sustainable urban environment.

The BCS as a whole is capable of stepping beyond the early adopter stage into mainstream implementation for sustainability. It is at a government level that support is required in the form of appropriate regulation, incentives and also mentoring or role modelling. The key ministers and their attendant agencies will have to be committed to taking a stand in implementing real and long term change.

Two key levels to the sustainability debate are the ideological and the evidential. If an individual or a society holds the ideological belief in sustainability forming the overarching framework for human existence then there is no need for argument that the BCS needs to change. All that is required is defining and deciding on the most appropriately viable course of action. The evidential aspect is more complex because the starting point is about need, importance, and degree. For many there is a denial of any need for action, whilst others differ on the importance of change[1]. On the critical issue about the degree of change, there is awareness of ecological issues and general agreement that sustainability is required but differ on the level and depth of change and how quickly it should happen. The challenge for Government is to translate the general awareness of ecological issues to commitment to change both at an organisational and individual level.

In our own local context, many would argue that life in Western Australia is fine. Relative to the global average we have strong environmental protection, lots of bush and public open space, clean water and air, high paid jobs and a high standard of living, including good education and health care. Where then is the convincing evidence for change?

There is ample evidence that there is a need to do things differently. The almost universal acceptance of global warming has direct linkage to cities and urban form, auto use, energy use and levels of consumption and waste. Within the realm of design and construction, appropriate climate sensitive and environmentally managed buildings can drastically reduce energy use and resource use. Socially, the urban form of Perth, being low-density sprawl [2]contributes to social isolation, dislocation, and inequity. Both the 'Housing Strategy W.A.'[3] and 'Future Perth'[4] state that the outer ring suburbs are consistently more costly in terms of transport, services and infrastructure. The environmental impacts of continued development at the urban fringe and periphery with their high levels of energy

[1] Lomborg, (2001). *The Sceptical Environmentalist: measuring the real state of the world.* Cambridge University Press, New York.
[2] Newman and Kenworthy 1999, *Sustainability and Cities: Overcoming Automobile Dependence*
[3] Office of Planning and Policy 2000. *Housing Strategy W.A. Background Paper Housing Sector* Published by the Department of Housing and Works. http://www.ohp.dhw.wa.gov.au/
[4] WAPC (Western Australian Planning Commission) 2001, *Future Perth (Draft Woking Paper No. 2), Costs of Urban Form.* Published by WAPC, wwww.planning.wa.gov.au

use and resource consumption are the loss of biodiversity, reduced air quality, loss of valuable arable land, and surface and ground water pollution. The critical water issue alone in Perth provides ample evidence that we cannot continue to build suburbs and continue the levels of consumption the way we have. Added to this are many health issues associated with buildings, in terms of design and materials, particularly indoor air quality. Thus sustainability is on the agenda for the BCS from the perspectives of public good as well as the ecological good. This paper will suggest some strategies to guide the BCS towards a more sustainable future.

Sustainability Issues.

From an economic perspective the contribution of the housing sector to the Gross State Product was 8%, (4-6% nationally) or $4.6 billion during 1998-99[5]. The BCS industry invests in new housing at an average of $1.8 billion per annum, and alterations and additions equalling $248 million per annum. There is also a multiplier effect from investment in housing since the industry generates investment and employment in other industry sectors. "The Housing Industry Association (HIA) suggests that for every $1 spent on new housing there is $1.40 spent elsewhere[6]. Employment is also significant.

> *"In 1994 there were around 20,000 persons employed directly in the housing sector in WA", which multiplied by the average annual investment of $1.8 billion equates to 120,000 housing related jobs in Western Australia."* [7]

Thus from an environment perspective it is important to ensure that the sustainability strategy does not damage the BCS but indeed will strengthen it.

From an environmental perspective, human settlements account for the vast majority of environmental pollution and for the consumption of recourses.[8] [9] Large urban areas often destroy the original ecosystems and can affect the local climate. Specific to the BCS many direct impacts are generated by land development, usually meaning site works, land clearing and landscaping. Other direct impacts are due to construction methods, and demolition including waste disposal. Indirect or discreet impacts result from associated mining, manufacture, supply, including transportation, and also post construction occupant behaviour. Table 1 below lists the direct and indirect environmental impacts from building and construction.

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[5] Office of Planning and Policy 2000. *Housing Strategy W.A.Background Paper Housing Sector* Published by the Department of Housing and Works. http://www.dhw.wa.gov.au
[6] Ibid.
[7] Ibid.
[8] WAPC (Western Australian Planning Commission) 2001, *Future Perth (Draft Woking Paper No. 2), Costs of Urban Form*. Published by WAPC, wwww.planning.wa.gov.au
[9] O'Meara 1999. *Exploring a New Vision fro Cities*. In Lester R. Brown et al, 1999, State of the World, W W Norton & Co., New York

Table 1: The direct and indirect environmental impacts from building and construction.

Sector Component	**Component Element.**	**Environmental Impact.**
Planning and Development.	Planning Policy, Subdivision and Development and Approvals.	• Continued green field development. i.e. Urban Sprawl. • Lack of integrated planning. • Small influence over infill. • Inefficient. • BAU.
Design.	Architectural form. Materials selection.	• High embodied energy. • High operational energy. • High resource use. • Toxic or non benign materials. • Poor recyclability.
Materials. Directly from Manufacturer Or from suppliers.	Mining operations and timber logging. and Manufacture, fabrication and distribution.	• Habitat or eco-system destruction. • Air, water and land pollution. • Associated resource use and energy intensity.
Construction Methods. Include materials selection and method of construction.	Materials. Construction.	• High embodied energy and poor recyclability. • Poor thermal qualities. • High labour cost. • Large material use and waste. • Poor workmanship. • High resource use and waste, i.e. Energy and water. • Destruction of vegetation and habitat. • Land, air and water pollution.
Occupant Behaviour. Influenced by • Urban form and local potential. • Type of building constructed. • Its internal fit out. • Occupant use patterns.	Levels of consumption. and Levels of waste. (Associated with levels of consumption.)	• Energy use of fixed and transferable appliances. • Water use. • Material Goods including Furnishings, fittings. • Food.

Clearly many of these impacts are a consequence of development but the 'ecological footprint' of development can be reduced by incorporating the principles of sustainability

Thus the sustainability strategy needs to find out how an integrated and comprehensive approach to the BCS can reduce its various environmental and resource impacts.

The third key aspect of sustainability is the social. In many ways urban form and buildings are subject to the planners, developers, and designers preferred options. If the dominant, or only bottom line is financial gain, then the urban and built form will not always, possibly rarely, satisfy the optimal criteria for society. Preferred subdivision style to date favours the sub-urban form, private housing lots with single stand alone dwellings resulting in an ever spreading outer ring of suburbs which contain little or poor infrastructure and services. Whilst many residents enjoy the life style offered by the individualised urban house with land, others are often burdened by a large mortgage, are isolated in a monoculture housing development and are forced to travel long distances to work, or for education, health services or shops. The dominant home construction style, particularly project homes for the first or second homebuyer is capital and energy intensive to construct and requires high cost inputs to maintain. These issues of on-going costs related directly to affordability, social equity and disposable income.

Thus the sustainability strategy needs to set out how good housing can be provided that achieves the above goals and at the same time is better able to provide for those on the margins of society in terms of housing.

Existing Action.

There is a very clear commitment to sustainability from elements of all stakeholder groups including government agencies. Many industry and community associations have strategies and plans that specifically suggest government support for initiatives to promote change for sustainability in their sector. Although many of the programs and initiatives are targeting energy efficiency and consumption as a response to global warming, nonetheless they contain many of the broad principles of sustainability as well. This section will highlight the key initiatives and programs from key stakeholder groups that are currently in operation.

Government (Federal).

There are many programs that have resulted from the work of the federally funded Australian Greenhouse Office [10] and Environment Australia[11], which are aimed at achieving attitudinal, behavioural and operational change in government, industry and the community.

In recognition that more than 30% of the contribution to greenhouse gas emissions comes from the construction industry, the AGO is driving reform within the Building and Construction Sector (BCS), including the Home Residential Sector (HRS). The primary focus of this reform is to reduce carbon emissions by creating more energy efficient buildings as well as improving occupant behaviour within the home.

Although many of their initiatives are greenhouse related, they link directly into the principles of ecological sustainable development (ESD). Relevant information in regards to BCS includes

[10] Australian Greenhouse Office. http://www.greenhouse.gov.au
[11] Environment Australia., http://www.ea.gov.au

Building Efficiency, (www.greenhouse.gov.au/energyefficiency/building) and Appliances and Equipment. (www.greenhouse.gov.au/energyefficiency/appliances)

Environment Australia (EA) is closely aligned to the work of the AGO in the context of building and construction. Their Sustainable Industries Branch[12] has a strong focus on the construction industry as a key way of introducing sustainability principles into mainstream society. To date some of its programs include:

- Waste Wise Construction Program. www.ea.gov.au/industry/waste/construction/wastewise
- HIA PATHE Program, (see below) http://www.hia.asn.au
- LCA Project with RMIT, (see below) http://buildlca.rmit.edu.au/
- National Australian Building Environmental Rating System (NABERS). (see below) www.ea.gov.au/industry/waste/construction/abers
- Recycled Concrete and Masonry. www.ea.gov.au/industry/waste/construction/concrete
- Your Home - The Good Residential Design Guide. (see below) www.yourhome.gov.au/

Its also has numerous publications which promote sustainable practice including

- Environmental Management System (EMS) model guide for Commonwealth Agencies, www.ea.gov.au/industry/sustainable/greening-govt/ems.html
- Environmental Management System for private sector businesses. www.ea.gov.au/industry/eecp/tools/tools2.html
- Green Procurement Guide. www.ea.gov.au/industry/sustainable/greening-govt
- Eco-efficiency. www.ea.gov.au/industry/eecp/tools/tools12.html
- Environmental Labeling. www.ea.gov.au/industry/eecp/tools/tools8.html
- Framework for Public Environmental Reporting to suit Australian organisations and local requirements. www.ea.gov.au/industry/eecp/publications/per.html
- A Green Office Guide to assist in the purchasing of energy efficient office equipment. www.ea.gov.au/industry/sustainable/greening-govt/green-office-guide.html

Both the Department of Industry, Tourism and Resources[13] and CSIRO Building Construction & Engineering [14]also have initiatives for sustainable building and construction.

Three key programs that link all areas of the BCS are Your Home, GreenSmart, and Cool Communities.

- The Your Home technical manual developed and produced by Environment Australia (EA) and Australian Greenhouse Office (AGO) in 2001 is a definitive design and construction kit that gives comprehensive

[12] Environment Australia, Sustainable Industries Branch. http://www.environet.ea.gov.au
[13] Department of Industry, Tourism and Resources. http://www.industry.gov.au
[14] CSIRO Building Construction & Engineering. www.dbce.csiro.au/index.cfm

information on all aspects of sustainable housing and is appropriate for use by both professionals and the public. (http://www.yourhome.com.au)

- GreenSmart is an industry based initiative that resulted from a partnership involving the Housing Industry Association (HIA)[15], the AGO and EA. Its aims are to promote increased energy efficiency, minimise waste and encourage better environmental management at each stage of manufacture, design, and construction process. GreenSmart includes professional training and accreditation, which requires a code of conduct and compliance with an annual update, industry networking through forums, and newsletters, and best practice awards and case studies. (See Landcorp below.). GreenSmart is an example of appropriate implementation achieving recognisable change.(http://www.greensmart.com.au)
- Cool Communities, an AGO sponsored program, is a public focused greenhouse initiative that aims to bring greater awareness and behavioural change into the residential home. It highlights issues of sustainability in terms of consumption and resources, waste management, water efficiency and transportation to name a few. (www.greenhouse.gov.au/coolcommunities)

Government. (State)...Western Australia.

The Department for Planning and Infrastructure (DPI)[16], has developed the Liveable Neighbourhoods community design code. Recognised internationally as a model of best practice in planning and subdivision development, this performance based code can be used as a more sustainable alternative to the existing 'development control policies' in that it has the potential to create a structural urban framework that should help to reduce car dependence, increase lot and housing variety, and facilitate access to Perth's public transport system. A trial Liveable Neighbourhoods policy will be evaluated in late 2002. Statement of Planning Policy No.8 (SPP8) draws together existing state and regional planning policies in a guidance framework that aims "to provide for the fair, orderly, economic and sustainable use and development of land."[17] . To further define this primary aim, five key principles are identified being; Environment, Community, Economy, Infrastructure, and Regional Development. Statements that elaborate on these principles often refer to sustainability and ecologically and environmentally sustainable development although within the context of sustainability their level of implementation is not explicit enough.

Residential Design Codes or R-codes are used to guide and plan residential development are incorporated in local government town planning schemes. The R-Codes have been under review since 1999. Draft changes include; greater reliance on performance criteria, moderate density increases and distinctions for inner and outer urban living, restrictions on overshadowing, limits on building heights. The Future Perth project aims to give a strategic planning direction for the metropolitan region for the next 10-20 years.

[15] Housing Industry Association (HIA). http;//www.hia.asn.au
[16] Department for Planning and Infrastructure (DPI). http://www.planning.wa.gov.au/
[17] WAPC, 2000 *Statement of Planning Policy No.8 : State Planning Framework Policy (variation No.1)* Prepared under section 5AA of the Town Planning and Development Act 1928 (as amended) by the WAPC and Issued with approval of the Minister for Planning and His Excellency the Governor.

The DPI is a critical player in facilitating a more sustainable urban and built form and can play a more dynamic role in defining both green field and infill development in a more sustainable way.

The Department of Housing and Works (DHW)[18], through its Office of Policy and Planning (OPP)[19], is currently writing the Housing Strategy WA. This document has yet to address specific sustainability criteria though it states that "the Housing Strategy has embraced the three areas of the triple bottom line approach i.e. social, economic, and environment."[20] Landstart is charged with the development of surplus government land predominately for first homebuyers who often take advantage of the government sponsored Keystart home loan scheme. (See financing below.)

These agencies within DHW have great potential to influence sustainable housing for the socially disadvantaged in terms of location and housing product.

Landcorp[21] is creating a more sustainable approach to housing development. The main interest of Landcorp is the development of surplus government land whilst attaining social and financial returns to the state. A current Landcorp project, located at Atwell South in the City of Cockburn is being developed with many sustainability principles. Atwell South has been designed to Liveable Neighbourhoods and GreenSmart principles.

Accordingly Landcorp, being an agency similar to DHW, is well positioned to become a market leader in setting higher standards of sustainability for land development and building.

The Department of Environment, Water and Catchment Protection (DEWCP)[22], has attempted to influence waste management through WAste 2020 which outlines a programme to eliminate waste to landfill by 2020.

Sustainability covenants that cover the entire production and user life cycle stages from mining to post consumer are recent developments that DEWCP should develop for implementation.

DEWCP is most appropriate State Government agency for applying influence over the materials component of the BCS. One possible mechanism is a sustainability covenant.

The Office of Energy[23] focuses on initiatives and promotes projects associated with greenhouse gas reduction. Within this agency the Sustainable Energy Development Office (SEDO)[24] provides technical, financial and educational support for a variety of programs, including those associated with and similar to the AGO and EA. SEDO is also aiming to implement First Rate which is a Victorian based home energy rating system. (See below.)

In terms of the energy component of sustainability SEDO can promote initiatives for change in this state within other government agencies, and in industry and the community.

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[18] Department of Housing and Works (DHW). www.dhw.wa.gov.au
[19] Office of Policy and Planning (OPP). www.ohp.dhw.wa.gov.au
[20] Office of Policy and Planning 2001 *Housing Strategy WA: Conceptual Framework and Methodology*, published by the Department of Housing and Work.
[21] Landcorp. http://www.landcorp.wa.gov.au
[22] Department of Environment, Water and Catchment Protection (DEWCP). http://www.environ.wa.gov.au
[23] Office of Energy. http://www.landcorp.wa.gov.au
[24] Sustainable Energy Development Office (SEDO). http://www.sedo.energy.wa.gov.au

The Department of Local Government has the Building Control Section, which is mainly responsible for issues in building regulation and for implementing and monitoring compliance of the Building Codes of Australia (BCA) within this state. In light of current and proposed reviews within the BCA (see below), this agency may take on a more influential role in supporting the sustainable building and construction transition.

The Western Australian Local Government Association (WALGA)[25] is the representative voice in W.A. and exerts influence on how policy decisions are made that affect Local Government. It has a number of policies relating to building and land use (planning) and a Sustainability and Environment policy. It also has a document which set out Proposals for a Building Act for Western Australia that proposes the concept of private certification of building surveyors for housing approvals.

WALGA, like many associations, can play both a representative and an influential role by clearly enunciating policies and initiatives for change.

Government. (State) Eastern.

Similar to SEDO in W.A, other state government agencies offer a number of energy related programs and initiatives. Specific to the HCS are various information packages that detail the process for designing, constructing and occupying a dwelling. As yet no government based initiative such as these exists in W.A. The key programs include;

- Energy Smart Building (Sustainable Development Authority of Victoria)
  - http://www.seav.vic.gov.au/building/index.html
- GetSmart Homes.(Housing Tasmania.)
  - http://www.dhhs.tas.gov.au/housing/partners/builderscontractors/
- Smart Housing.(Dept of Housing) Queensland)
  - http://www.smarthousing.qld.gov.au/
- ESD Fit-out Guide for Office Accommodation.(Dept of Public Works, Queensland)
  - http://www.build.qld.gov.au/aps/aps.htm
- Environmental Performance Guide for Buildings (Dept of Public Works and Services, NSW)
  - http://asset.gov.com.au/environmentguide/ehp/frameset.htm

Industry.

Industry based initiatives are usually resultant from either government support or a more individual ethical response to ecological issues as well as an attempt to stimulate best practice. Many programs or initiatives are produced by representative associations for members, but are often made freely available in the hope of generating

[25] Western Australian Local Government Association (WALGA). http://www.walga.asn.au

greater and more rapid change. Some of these initiatives fall into the category of action based, whilst others are position papers or vision and mission statements.

The Housing Industry Association (HIA)[26] is a national body that is actively involved in sustainable housing through programs and recommendations. Amongst its recent position statements and documents are its National Housing Plan (2001) and the Better Living Environments (2002). Both these papers propose a national housing approach to deal with economic and social impacts of housing. Better Living Environments sets out a reform agenda for the planning approval systems for residential development. The HIA has an action orientated initiative in GreenSmart. Although voluntary, this program requires a commitment from accredited participants but has no mechanism to enforce compliance other than non-renewal of accreditation. The HIA also offers a reduced interest rate home loan in conjunction with the Macquarie bank for new and existing homes. The GreenSmart Home Loan offers clients a reduced home loan interest rate, up to 0.4%less than major banks, plus other incentives if the home has proven energy efficiency features, such as those included in the GreenSmart and Your Home guidelines. (See financing below.)

The Royal Australian Institute of Architects (RAIA)[27] is committed to sustainability and has a number of policy and educational initiatives to support its position. Its Code of Professional Conduct, Environmental Policy, and Sustainability Policy reaffirm the responsibility of the architectural profession to contribute to the quality and sustainability of the natural and built environments. They also publish a quarterly Environment Design Guide, which is produced by the Australian Council of Building Design Professions (BDP). This publication aims to increase awareness on environmental design for a wide-ranging audience including architects, engineers, landscape architects, planners and quantity surveyors, in addition to local government and educational bodies.

The local Western Australian chapter recently published a 'Proposed Policy on the Built Environment for Adoption by the W.A. State Government" and calls on the government to "become a leader in policy toward the built environment."[28]

Similar positions, aims, visions and policy statements as these are held for the following associations. All support ESD principles and practices, including improvements in planning, sub-division development, and design.

- Australian Council of Building Design Professionals (BDP) http://www.bdp.asn.au
- Building Designers Association of Australia (BDAA) http://www.bdaa.com.au
- Australian Building Energy Council (ABEC) http://www.abec.com.au
- Royal Australian Planning Institute (RAPI). http://www.rapi.com.au
- Australian Housing and Urban Research Institute Limited (AHURI) http://www.ahuri.edu.au

This is not intended to be a definitive list of organisations that are involved in sustainability.

[26] Housing Industry Association (HIA). http://www.hia.asn.au/
[27] Royal Australian Institute of Architects. http://www.raia.com.au/
[28] (Royal Australian Institute of Architects, W.A Chapter, 2002. *Proposed Policy on the Built Environment for Adoption by the W.A. State Government.*

Similarly, there are numerous educational and community groups that are active in sustainable housing in W.A including;

- UNEP-IETC Environmental Technology Centre, Murdoch University.
  - http://wwwies.murdoch.edu.au/etc/
- Centre for Organic Waste Management, Murdoch University.
  - http://cowm.murdoch.edu.au/
- Institute for Sustainability & Technology Policy, Murdoch University.
  - http://wwwistp.murdoch.edu.au/
- Centre for Cleaner Production, Curtin University.
  - http://cleanerproduction.curtin.edu.au/
- School of Architecture, Construction and Planning, Curtin University.
  - http://www.humanities.curtin.edu.au
- School of Architecture and Fine Arts. University of Western Australia.
  - http://www.safa.uwa.edu.au/
- Conservation Council of WA. http://www.conservationwa.asn.au/
- Permaculture Association of W A. http://www.eepo.com.au/perma/pawa/

RATINGS AND PERFORMANCE CRITERIA.

The move toward achieving more sustainable design and construction has been stimulated significantly by the response to global warming, both internationally and here in Australia. Although no 'all of government' approach exists as yet to the BCS, there have been attempts to ensure a better product by requiring certain performance levels which to date relate solely to energy efficiency. There are two main approaches to the performance requirements: regulatory codes, and rating systems.

Building Codes.

Australian Building Codes Board (ABCB)[29] is reviewing the Building Codes of Australia (BCA)[30] to include nationally consistent minimum energy performance requirements. The BCA is a performance based code, which outlines minimum standards with the aim of eliminating worst practice. Even so, in regards to broader sustainability issues of concern in this paper "the ABCB is also considering introducing environment sustainability as a goal of the BCA when the next major review takes place."[31]

[29] Australian Building Codes Board (ABCB). http://www.abcb.gov.au/
[30] Building Codes of Australia (BCA). http://www.abcb.gov.au/content/codes/
[31] Australian Building Codes Board (ABCB). http://www.abcb.gov.au/. *Energy Efficiency Measures BCA Volume 2 (Housing Provisions). Part A. Regulatory Proposal.* March 2002.

The reforms will include series of measures aimed to improve the thermal performance of homes thereby reducing or even eliminating heating and cooling costs, which account to approximately 25% of energy consumption within the home.

In term of equity and financial outlay to the consumer "the proposals will add to the capital cost of a house for a first-home-buyer, possibly up to $800 per house." Even so this initial capital outlay, as in all energy efficiency measures "is offset to the extent that energy savings reduce the running cost of houses and release financial resources for loan repayment."[32] The revised BCA will need to be carefully assessed, as regulation is a powerful mechanism to be breaking the nexus between affordability dominating over energy efficiency. The proposed changes are currently available via the ABCB website for public comment.

Rating and Assessment Schemes.

With the purpose of the BCA being to eliminate worst practice, the role of Rating Systems is to stimulate best practice. To date there are numerous rating systems in operation throughout the world, many of which have been developed in Australia

NatHERS[33] is a national building envelope energy rating software tool developed by CSIRO to provide a comparative assessment of building envelope design. Star values, from one to five, determine the energy efficiency of the design. A low rating indicates the home will have either high-energy bills or relatively uncomfortable internal temperatures. A four or five-star design is a sign of a thermally comfortable house that will minimise the need for heating and cooling.

The rating tool being considered by SEDO for use in W.A. is First-Rate.[34] The First-Rate house energy rating instantly evaluates the energy performance of each part of the house. The computer-based software allocates a point score for various features of the building envelope and then provides an overall rating based on a five star rating scale similar to NatHERS.

The National Building Environmental Rating System (NABERS)[35] is of greater and more specific interest to this paper. This system goes further than energy rating tools in that it rates the overall environmental impact of buildings and provides performance targets for designers to aim at. Because it is designed to report the reality of the situation (as opposed to a simulation tool like First-Rate) of a building as it exists, it is based wherever possible on measurable performance rather than prescription. As such NABERS is not generally concerned with trying to prescribe the particular techniques used to achieve a particular performance; rather it aims to highlight deficiencies so design improvements can be made.

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[32] Australian Building Codes Board (ABCB), Regulatory Impact Statement 2001-1, *Energy efficiency measures for services & interim roof insulation for houses*. http://www.abcb.gov.au/content/publications/Energy_RIS2001-1.pdf
[33] NatHERS, National Home Energy Rating Scheme. http://www.dbce.csiro.au/ind-serv/brochures/nathers/nathers.htm
[34] First-Rate. http://www.seav.vic.gov.au/building/housing/firstrate/index.html
[35] National Building Environmental Rating System (NABERS). http://www.ea.gov.au/industry/waste/construction/index.html

Whilst the BCA is being reviewed in an attempt to make it more nationally consistent, "states and territories have the power to vary or add to the technical provisions of the BCA and may do so if they disagree with the common approach…"[36] Various states and local governments have implemented energy ratings into the home design approvals process as an attempt to improve both new and existing housing stock. There already exist mandatory energy rating requirements in three jurisdictions in Australia being the ACT, Victoria, and South Australia.

Rating systems and assessments are also applied to single components, systems and products.

- Minimum Energy performance standards (MEPS) are mandatory measures, which apply to electric motors, lighting, and appliances. (www.greenhouse.gov.au/energyefficiency/appliances/meps)
- Plumbing and electrical systems, which are included under plumbing law, are also regulated.
- Energy Rating gives a star rating based on energy efficiency of white goods appliances including, refrigerators, freezer, clothes washers, clothes dryers, dishwashers and air-conditioners. (http://www.energyrating.gov.au/)
- The Energy Star rating applies to energy-efficient office equipment like computers, printers, photocopiers, and home electronics like TVs, VCRs, audio products or DVD players. (http://www.energystar.gov.au/)
- The gas energy efficiency rating system uses stars to show the energy efficiency level of a gas appliance.
- The Windows Energy Rating System (WERS), an initiative by the Australasian Window Council Inc ranks residential windows for their energy performance in typical housing anywhere in Australia. It is also compatible with ratings tools like NatHERS. (http://www.wers.net/)
- The Australian Environmental Labelling Association has recently launched (Sept 2001) a full product life cycle environment label or Ecolabel, which conforms to ISO 14 024 standards. The Ecolabel program is designed to give independent credibility for the products environmental load from a full product life perspective. Products included to date that are of interest to the BCS are recycled plastic and rudder products, paints, adhesives, wool carpets, and gypsum plasterboard. (http://www.aela.org.au/)
- The National Packaging Covenant was developed in 1999 "to minimise the environmental impacts of consumer packaging waste throughout the entire life cycle of the packaging product by closing the recycling loop, developing economically viable and sustainable recycling collection systems and ensuring that the voluntary process continues." (NPC. 2000) It is based on the principles of 'shared responsibility' through 'product stewardship' and is applied throughout the packaging chain from raw material suppliers to retailers, and the final disposal of waste packaging. Signatories to the Covenant recognise that a co-operative approach between industry and government is the best method of achieving consistency in the management of packaging and paper. (http://www.packcoun.com.au/)

[36] Australian Building Codes Board (ABCB). http://www.abcb.gov.au/. *Energy Efficiency Measures BCA Volume 2 (Housing Provisions). Part A. Regulatory Proposal.* March 2002.

Part B, Strategies, Recommendations, and Framework.

Introduction.

The first part of this section will provide a rationale for strategies and recommendations of the key component sections of the BCS. These include:

- Planning and Development.
- Materials, including the mining, manufacture/production, and supply; and also the design use of selected materials
- Design, including materials specification.
- Building and Construction.
- Householder attitudes and behaviour.

Also included will be a component on financing.

Following this will be a description of specific recommendations for Western Australia.

General Strategies for Change.

Overview.

The two key components of 'Planning and Development', and 'Materials manufacture and production' have a critical role to play in achieving sustainability. If these two components are sustainable then there is strong down-line support to the other key components and therefore for the implementation and continuation of sustainability throughout the BCS. It is critical that the building designer is supported both in terms of land development and appropriate building materials. There are currently some moves toward sustainability in the design and construction stages by government and industry players. There is also significant interest and support for sustainable homes and buildings throughout the public sector. These moves need to be extended into and supported by all other component parts of the building and construction process.

Planning and Development.

There are many sustainability issues that relate to urban form and how the regional structure of neighbourhoods needs to be defined to influence liveability, transport, employment, and economic and ecological health.[37] [38] As defined by Liveable Neighbourhoods, community neighbourhoods should be interconnected and clustered to form viable town centres.

[37] WAPC (Western Australian Planning Commission) 2001, *Future Perth (Draft Woking Paper No.10), The Sustainable City*. Published by WAPC, http://www.planning.wa.gov.au

[38] UNEP (United Nations Environment Programme) 2002, *Cities as Sustainable Ecosystems (CASE)*, http://www.unep.or.jp/ietc/New Approach/CASE/CASEcontent1.asp

In terms of building and construction a well-planned development will lay the building blocks for a more sustainable built environment. The key relevant parts of this are the development form and block placement, orientation, and shape.

Form and placement relate to the larger planning issues of liveability such as those covered in planning design codes like Liveable Neighbourhoods. **Issues that are specific to design and construction relate directly to solar access and overshadowing, cross-flow ventilation, and also access, security, and privacy**. If the designer, specifically the project home designer is guaranteed that a maximum of residential blocks in any given sub-division or development will meet the criteria for favourable solar access and cross flow ventilation then their homes can be designed to meet this layout with no or minimal individual variations required, and consequently no or minimal capital cost increases. **By bringing the project home companies into sustainability, much of the residential home market will be guaranteed a better product**. Further planning for sustainability issues to consider are:

- Urban density and infill.
- Environmental integrity and intrinsic worth, including
  - Retention of natural land form,
  - Retention of native vegetation,
  - Retention and protection of wetlands or other significant areas.

The key issues of placement and orientation can be adequately addressed if they are tackled at the right time and place but "land use planning through planning schemes and development control has considerable limitation"[39]. Regional and town planning guidelines are shared between the DPI, the WAPC and local governments All three bodies working collaboratively can have a beneficial influence on promoting better land development. **It is at the point of application and approval that a potential building sub-division can be assessed and influenced for its sustainability characteristics. The city and town council planners are at the coalface of the approvals process. It is they, if given the right authority and resources that can direct and influence an application based on its level of sustainability characteristics.** By empowering the local planners to better direct and influence the approvals process within a set of specific and regionally (or even nationally) consistent sustainable design guidelines, the built environment would soon be moving toward being more energy efficient and arguably more liveable. This adapted approvals process can be applied to both new sub-divisions on the urban periphery and also and equally importantly for smaller infill developments.

A program that has the explicit purpose to investigate and recommend appropriate changes at both the state and local government levels that would result in the improvement of the planning development and approvals process interface would go a long way to resolving planning criteria to support sustainable building and construction.

[39] Royal Australian Planning Institute (RAPI), 2000. *Liveable Communities – A National Agenda'.* ACT, Australia.

Materials.

The manufacture and supply of the materials completes the basic elements of construction that a sustainable building needs. Sustainable materials include those from new and recycled products. Currently most homes and buildings that are deemed sustainable are limited by the amount and extent of sustainable materials that are available. A comprehensive supply of sustainably produced materials is lacking within the sector. Even so, a designer, builder or occupant of a truly sustainable home must consider the materials to be used.

Materials that include a high-recycled content are of highest priority because the capturing and reuse of waste materials reduces resource consumption, lowers the materials embodied energy and lessens landfill and associated impacts including potential ground water pollution.

Green Procurement and life cycle assessment (LCA), or cradle to grave assessment of materials are terms that relate to sustainable materials and must therefore be of prime importance in sustainable building and construction. Green procurement and LCA relates to environmental management, the environmental impact on habitats and eco-systems, air, land and water pollution, level of resource consumption, and reusability including recyclability.

A full material or product LCA as well as a company wide Environmental Management System (EMS) to ISO or similar accreditation and a Public Environmental Reporting (PER) structure would need to be considered by a manufacturer, a producer, or fabricator of building materials if they were to be assessed as sustainable. There are many resources currently available to any company that wants to take advantage of them. These include the Environment Australia initiatives such as; Environmental Management System, Framework for Public Environmental Reporting, and Green Procurement Guide. The Australian Environmental Labelling Association has a national ISO accreditation for manufactured goods, many of which are building materials. RMIT has Eco Specifier as a comprehensive rating for materials. Government agencies in the Eastern States have numerous Internet sites for accessing building materials and products that are classified as Green. Also, there are numerous publications, including the Environment Design Guide that promotes Green Products.

Many of the larger manufactures/producers and suppliers in Western Australia could be influenced by a 'sustainable building association' to gain ISO accreditation (See below). If these industries were to see themselves as key stakeholders in the building and construction chain and they were to recognise their own involvement as being crucial to creating a more sustainable sector then their voluntary compliance would take on a critical role. With government, industry and community pressure these companies could close the loop to create a more sustainable sector. With this vital element in the chain Western Australia would become a world best in full cycle sustainable building and construction.

All of these themes would be included in a sustainability covenant that should be developed for all materials processes.

Design.

The design of sustainable buildings at an industry wide scale, with the important inclusion of project home companies is feasible if the above two criteria of planning and development and materials are met. The building

design industry is currently making steps toward an improved product with numerous initiatives that promote better design and materials use.

Although current building practice has the builders choosing where to buy materials and products, the designer can specify particular materials, even extending to a full materials specification list. Project homes companies and the larger building companies have a more integrated design and materials specification, with many of the materials sourced from preferred manufacturers and suppliers. **If a national and state based comprehensive catalogue of sustainable building materials and products were to be established, much of the industry could easily access them.** If the large manufacturers were to be EMS/ISO accredited this would cover, by volume and cost, the majority of building products: - cement/concrete, clay bricks and tiles, steel and aluminium, and timber. This is not to say that all other manufacturers are not also crucial to a sustainable BCS, rather that the larger players will have a greater and more rapid relative effect on the sector in terms of sustainability and also public perceptions.

Building and Construction.

The building and construction stage of the product is mostly determined by the design process; even so it is critical to creating a sustainable built form. This stage of the building chain would require mainly education and training for both building supervisors and contractors to achieve better practice in terms of environmental management and materials use. An important component of this would be waste management and recycling, including the waste bin contractors as the key process is separating construction waste so it can be recycled. Specific education and training might not need to be as comprehensive as the GreenSmart training program, although it does have all the necessary elements included. The dissemination of adequate training material would have to be carefully considered in regards to the target group, either builders or supervisors, as well as consideration of costs. If education does not work then regulation may be required.

Householder Attitudes and Behaviour.

A building that has been planned, designed, and constructed to be sustainable requires appropriate usage to remain sustainable.

> *"Whether theoretically feasible savings from increased thermal insulation are actually achieved depends upon qualified and disciplined user behaviour, i.e. upon the disposition of all household members to strictly follow certain behaviour patterns on a daily basis."* [40]

Much consideration has been given to the sustainable use of a sustainably designed and constructed building. Many energy and water efficiency, and waste reduction programs directly target occupant attitudes and behaviour. Reducing resource consumption is a key sustainability issue that is well supported by programs such as the AGO sponsored Cool Communities, and government agency initiatives such as SEDO, Western Power, Alinta Gas, and the WAWA. As valuable a first step as these programs are, they require stronger strategies to confront increased energy and water use, as well as post consumer waste. Water usage, particularly in W.A. is of critical

[40] Gestring et al (1997), p59.

concern and requires Government support for the reuse of grey and black water, and the capturing of rainwater. This is not an issue of technology; there are many local water systems available; rather it is an issue of government regulations. Government and their agencies need to be open to change on this issue. The key departments of Health, Water, and DEWCP must work with local experts to prepare a meaningful response

Partnership programs to enable householders to be given better information on what is a sustainable product and how to live more sustainably are a very obvious part of the BCS sustainability agenda.

Financing.

The linking of favourable financing packages in terms of reduced interest rates on home loans to energy efficient and sustainably built homes has great potential to stimulate interest and uptake for industry and importantly the consumer.

Currently a number of financial institutions are offering various packages which reward customers for including sustainable design and energy efficient appliances within the new or renovated home. The HIA in conjunction with the Macquarie bank offers a reduced interest rate home loan. (See above). Recently the Bendigo Bank announced a reduced home loan that is tied to environmental incentives. The bank is currently finalising a list of design features for homes to be eligible for special loans.

These loans are of interest to first home buyers, particularly those who qualify for the state supported Keystart home loans. These loans already offer favourable conditions to those on low incomes and who often are forced into a marginal housing product in terms of location and efficiency. **By linking sustainability incentives to the Keystart loans these first homebuyers will have a more efficient and less costly home in terms of operating cost. This has the potential to free up the amount of disposable income and is therefore beneficial to their ability to repay the loan and their longer term well-being.**

Recommended Strategies for Western Australia.

All of the suggestions and programs relate to and require the support of state government. This is because any long term and organized change requires the regulatory provisions and support that Government can deliver. The current trend is for the voluntary implementation by Industry, a policy that is supported at federal government level. The strongest mechanism that Government has is to create a more functional, consistent, and understandable planning regimen by bringing closer together the role of DPI and the Local Government TPS. Following this, the other key element of sustainable building is the manufacture and supply of materials. Although the regulatory levers that Government has at its disposal are limited, none the less they can still exert considerable pressure on industry to improve their products. This can best be done in partnership with industry and community. Specific W.A. State Government initiatives would be as follows.

Planning and Development.

- Planning for building development, especially residential requires a rethinking of the existing approvals process to explicitly support sustainable building guidelines in terms of placement, shape and orientation. This would give the building designers a huge boost in delivering a passive solar, energy efficient, and more liveable environment. Arguably appropriate improvements in the approvals process that support passive solar design could deliver a built product with no or minimal capital cost increases. Recommendations are;
    - § DPI to use their influence over both subdivision and infill development by creating stronger support for road layout that supports solar orientation.
    - § DPI to review the policies and guidelines, including Residential Design Codes (R-codes) and Development Control to include fundamental and explicit sustainability provisions.
    - § Stronger liaising between Local Government Planners and the DPI that would have the aim of unifying and simplifying planning regulations and development guidelines.
    - § Case studying international and national best practice for planning to ascertain the best course of action for WA, in the development of an Integrated Planning Act. Many of these are identified by the HIA in their Better Living Environments publication including the Integrated Planning Act, Queensland, Victoria Planning Provisions, and ACT Code.[41]
    - § Investigating the workability and benefits and possible pitfalls of localising TPS amendments such as in the City of Cockburn which allowed the progression of the Atwell South development.
    - § Investigating the possibility for a closer more synergistic integration of the development process and the building process. This is in terms of appropriate planning development supporting and facilitating sustainable building design.
    - § Investigating urban infill development potential that would allow for a more integrated form of housing development. This would include provisions for new housing stock that better reflects future average household numbers that is predicted to continue declining from 2.5 persons in 2001 to 2.27 by 2031 (Future Perth: Population, 2001, Section 6).
    - § Consult with Curtin School of Planning to review training for planners on these issues.

Materials.

- Materials that are manufactured, produced and supplied within the framework of sustainability, that is within EMS/ISO guidelines, or a sustainability covenant is an issue that would require ongoing and broad and comprehensive research. A key issue for government in creating a comprehensive sustainable building materials catalogue would be in enlisting and supporting private industries to develop their own EMS. This could be achieved in partnership with industry peak bodies such as RAIA, HIA and MBA.

  Recommendations are:

[41] Housing Industry Association (HIA). 2001. *Better Living Environments.*

- For a State Government policy or statement on the benefits of voluntary industry EMS[s]. These benefits include eco efficiency and cleaner production, both central tenets of sustainable industry, which have direct positive impact on resource consumption, air, land and water pollution including global warming, and general ecological and social health.
- To enlist appropriate government agencies, industry associations and community/NGO support that would promote and facilitate broad industry uptake of sustainable practice. Specific to this would be the role of the DEWCP with support from related agencies including AGO, EA, DPI, DHW.
- To create an 'Association of Sustainable Building' that contains a comprehensive register of green products and accredited industries. (See below)
- To investigate the application and broadening of a green materials register to incorporate existing initiatives such as, Eco-specifier and Ecolabel to match the Western Australian market.
- To develop a sustainability covenant for all materials processes.

Design.

- Design of sustainable homes requires a guaranteed market. Dispelling any myths or scepticism that industry or the public may have would require the efforts of government in partnership with key stakeholders to achieve a smooth and comprehensive transition.

  Recommendations are;

  - Continued support and broader application of industry based training programmes such as GreenSmart.
  - Broader application and distribution of educational literature such as the EDG to assist industry professionals.
  - Surveying industry professionals to ascertain the key concerns in designing a more sustainable building and the impediments to change. This would include questions on simple cost effective design and materials changes.
  - Greater education for all aspects of sustainable design in schools of architecture and architectural design.
  - Specific focus and project home companies that would result in a clear understanding of their requirements in terms of design and client responsibility to be part of the transition to a sustainable BCS.
  - Initiate strong public relations to communicate the process of the government /industry partnership program.

Building and Construction.

- Building and construction of sustainable homes requires an understanding of the impacts of construction methods and resource use by the builder and contractor.

Recommendations are:

- Specific training and short courses for builders at TAFE colleges and industry based training programmes in site and construction impacts and environmental management, including waste minimisation and recycling.

Occupancy.

- Education for the public on all aspects of sustainability is essential to successful implementation. The residential home is a near prefect vehicle for understanding what sustainable living is and how to change behaviour and eventually attitudes.

Recommendations are:

- For all appropriate government agencies to support a unified ‘sustainable home living package’ that gives a comprehensive guide to all key elements of sustainability that the individual may undertake.
    - This sustainable home living package should build on and support the Cool Communities initiative.

Association of Sustainable Building.

Purpose: To bring together all stakeholders of the BCS supply and consumer chain under a unified umbrella that has the explicit task of acknowledging that the built form of human settlement is inextricably linked to us all, and that because of this all stakeholders have the implicit duty to support the delivery of the best possible product that will give a positive result for all.

Member Stakeholders.

- Complete broad spectrum supply and consumer chain including:
    - Mining, manufacture, and supply;
    - Planning, development, and design;
    - Building, construction, and contractors;
    - Householder occupancy and post use deconstruction.

Stakeholder requirements.

- All must have compliance assessment and be committed signatories to the full implementation of the BCS sustainability program. Specific requirements include:

    Government: including ministers, legislators, policy makers, consultants, inter-agency units.

        - Require; vision and commitment to implement initiatives.
        - Require code of conduct and annual audit.
        - Willingness to hold leadership role and to interact with stakeholders.

    Industry: including peak bodies and representatives.

        - Require vision and commitment to implement.
        - Require code of conduct and annual audit.
        - Willingness to interact with stakeholders.
        - EMS/ISO standard or compliance record, including a sustainability covenant.

    Manufactures/ Producers.

        - Require Code of conduct and annual audit.
        - EMS/ISO standard or compliance record, including a sustainability covenant.

    Planners, developers, designers, builders/ contractors.

        - Require Code of conduct and annual audit.
        - EMS/ISO standard or compliance record, including a sustainability covenant.

    Householder.

        - Require total building chain rating showing certification record of compliance; i.e. each project is supplied with certificates of sustainability that show the overall and individual ratings. This could be a measure of value for the property.

Measuring Progress

The great concern that has led to the writing of this paper is to see and realise that the principles of sustainability are being implemented. Measurement of progress must reflect the strategies for a sustainable building and construction sector as those suggested above and also include the many similar positions issued by industry and community. Each key component of the building chain has its own requirements that would be linked to form a sustainable sector.

Overall sectorial change can be measured over time by;

- Reduced environmental impacts due to cleaner more efficient materials production by industry and reduced consumption by the consumer.
- Reduced home energy use due to more people occupying and living in sustainable and energy efficient buildings.
- Reduced resource consumption due to improved manufacturing, specifying, and use of materials (i.e. reduced waste).

Planning and development improvement can be measured by;

- Statutory reform to planning requirements for mandatory provision of sustainable development characteristics in terms of
  - Greater urban infill/ higher density allowances.
  - Block placement, shape and orientation.
  - Liveable neighbourhoods or similar criteria.
- Reform to planning and development approvals process measured in terms of;
  1. Greater consistency and clarity of development design requirements.
  2. Streamlining of approvals.
  3. Reduced complaints and appeals.

  Real quantifiable measurement can be in terms of
  - Increased of sub-division developments that contain favourable block placement.
  - Increased of small development urban infill.

Materials improvement can be measured by;

- Joint government and industry policy statement on eco efficiency and sustainable production.
- Actualisation of a sustainable green materials catalogue.

  Real quantifiable measurement can be in terms of;
  - Number of companies that undertake a company wide environmental audit and seek ISO accreditation.
  - Number of designers and builders that use green materials.

Design improvement can be measured by;

- Number of designers and project home companies that are influenced and change their practice by government and industry initiatives such as GreenSmart and EDG.
- Percentage of homes that are designed (and built) to passive solar and energy efficient principles.
- Home size floor area that better reflects occupancy numbers.
- Percentage of home that achieve significant energy efficiency and environmental rating through First Rate or NABERS.

Building Process improvement can be measured by;

- Number of builders who undertake environmental education training and awareness to improve building practice.
- Reduction of onsite excess materials and waste.

Occupancy improvement can be measured by;

- Demand for urban infill, passive solar, energy efficient, sustainable homes.
- Increased urban density resulting in less car use.
- Reduced operational energy use, particularly for heating and cooling, and water heating.
- Reduced water consumption.
- Reduced materials consumption.
- Increased use of sustainable technology, eg Grey Water, P.V^{s}, Water Tanks.

References.

Australian Building Codes Board (ABCB) & Australian Greenhouse Office (AGO) (2001), *Energy Efficiency in Buildings, Directions Report.* ABCB, Canberra. http://wwww.abcb.gov.au.

Australian Building Codes Board (ABCB) (August 2002). Regulatory Impact Statement. *Energy efficiency measures for services & interim roof insulation for houses.* ABCB, Canberra. http://wwww.abcb.gov.au

Australian Building Codes Board & Australian Greenhouse Office (2000), *Feasibility Study – a National Approach to Energy Efficiency Measures in Houses.* Presented by CSIRO, Building Construction and Engineering and the Office of the ABCB. http://wwww.abcb.gov.au

Australian Building Codes Board & Australian Greenhouse Office (2000), *International Survey of Building Energy Codes.* Report produced by the Office of the ABCB.

Australia Greenhouse Office. (1998). *National Greenhouse Strategy.*
AGO, Canberra. http://www.greenhouse.gov.au/ngs

Office of Housing Policy, Department of Housing and Works (2001). *Housing Strategy Western Australia, Background Paper, Housing Sector.* . DHW, Perth W.A. www.ohp.dhw.wa.gov.au

Office of Housing Policy, Department of Housing and Works (2001). *Housing Strategy Western Australia, Scoping Paper, Sustainability.* DHW, Perth Western Australia. www.ohp.dhw.wa.gov.au

Greenhouse News, Newsletter of the Australia Greenhouse Office
Summer 2001, Vol 4, Issue No 4. AGO, Canberra. Australia.

Gestring et al 1997, p59
From Schurer. J (2001). *Urban Ecology, Innovations in Housing Policy and the Future of Cities: Towards Sustainability in Neighbourhood Communities.*
PhD Thesis, ISTP, Murdoch University, Perth Western Australia.

Housing Industry Association (HIA), 2001. National Housing Plan (August 2001)
Canberra, Australia.

Lomborg, (2001). *The Sceptical Environmentalist: measuring the real state of the world.*
Cambridge University Press, New York.

Newman, P and Kenworthy, J (1999). *Sustainability and Cities: Overcoming Automobile Dependence.*
Island Press, Washington D.C.

Office of Planning and Policy 2000. *Housing Strategy W.A. Background Paper Housing Sector*
Published by the Department of Housing and Works. http://www.ohp.dhw.wa.gov.au

Office of Policy and Planning 2001 *Housing Strategy WA: Conceptual Framework and Methodology.*
Published by the Department of Housing and Work. http://www.ohp.dhw.wa.gov.au

O'Meara, M (1999). *Exploring a New Vision fro Cities*. In Lester R. Brown et al, 1999, State of the Worl.,
W W Norton & Co., New York

Royal Australian Institute of Architects, Environment Policy, 2000.

Royal Australian Institute of Architects, (W.A Chapter), *Proposed Policy on the built Environment for Adoption by the W.A. State Government.* 2002.

Royal Australian Planning Institute (RAPI), 2000. *Liveable Communities: A National Agenda.* Produced by RAPI Canberra available online at: http://www.rapi.com.au

UNEP (United Nations Environment Programme) 2002, *Cities as Sustainable Ecosystems (CASE),* http://www.unep.or.jp/ietc/New Approach/CASE/CASEcontent1.asp

Western Australian Planning Commission (WAPC). September 2001, Future Perth Draft Working Paper No.1.*Planning Context.* Published by the Western Australian Planning Commission. www.planning.wa.gov.au

Western Australian Planning Commission (WAPC), September 2001 Future Perth Draft Working Paper No.2. *Costs of Urban: Form Perth Metropolitan Region.* Published by the Western Australian Planning Commission. www.planning.wa.gov.au

Western Australian Planning Commission (WAPC), September 2001 Future Perth Draft Working Paper No.5. *Population: Perth Metropolitan Region.* Published by the Western Australian Planning Commission. www.planning.wa.gov.au

Western Australian Planning Commission (WAPC), September 2001 Future Perth Draft Working Paper No.10. *The Sustainable City: Perth Metropolitan Region.* Published by the Western Australian Planning Commission. www.planning.wa.gov.au

Western Australian Planning Commission (WAPC), September 2001 Future Perth Draft Working Paper No.12. *Can Perth be more Creative.* Published by the Western Australian Planning Commission. www.planning.wa.gov.au

Western Australian Planning Commission (WAPC), 2000: *Statement of Planning Policy No.8 : State Planning Framework Policy (variation No.1)* Prepared under section 5AA of the Town Planning and Development Act 1928 (as amended) by the WAPC and Issued with approval of the Minister for Planning and His Excellency the Governor. www.planning.wa.gov.au